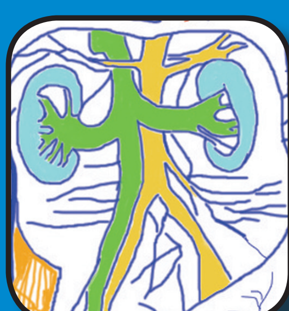
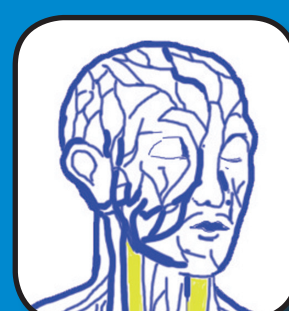
FOUNDATIONS OF NURSING

An Integrated Approach





Edited by
Cliff Evans & Emma Tippins

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Cliff Evans and Emma Tippins

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Brief Contents

Detailed Contents

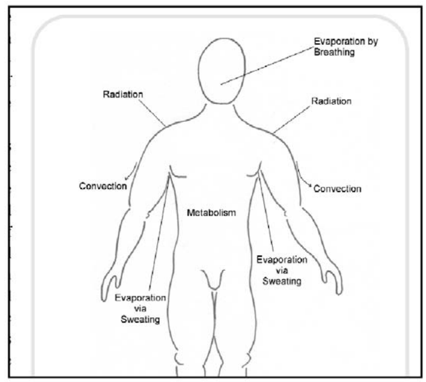
Guided tour

Chapter 3 Learning Objectives

- Gain knowledge and insight into the anatomy and physiology of the respiratory system
- Gain insight into several common conditions affecting these systems
- Apply theory to practice by understanding the physical manifestation of these illnesses in patients
- Gain understanding of commonly used medications to either prevent or treat respiratory conditions
- Learn essential practical skills that can be easily applied within clinical practice
- Learn to apply a solid structured approach to the patient assessment process
- Construct solid evidence of professional development for your growing portfolio

Learning Objectives
Each chapter opens with a set of learning objectives, summarising what knowledge, skills or understanding you should acquire from each chapter.

Figures and Tables
Each chapter provides a number of figures, illustrations and tables to help you to visualise the concepts and procedures explained.



speech, language comprehension, writing and analytical thought. The right dominates in perception, generalised thought, non-verbal and spatial perception; the more creative and insightful side. The dominance of activity between left and right sides is known as **cerebral dominance**.

The sensory and motor areas are located within the cerebral cortex, spanning the left and the right hemispheres, the motor area in the **precentral gyrus** and the sensory area in the **postcentral gyrus** (Figure 5.6). The sensory area's function is to perceive sensation and the motor area's function is to control movement. The fibres controlling sensation and movement cross over, or **decussate**, from left to right, thus, perception of sensation and control of movement occurs on the opposite side of the body; is contralateral. The whole body can be spatially represented in the sensory and motor cortex

Key Terms
These are highlighted throughout the chapter in bold and definitions are provided in a glossary of terms at the end of the book.

Applying Theory to Practice boxes
These boxes aim to show how a particular concept or idea works in practice to make you act on the theory you are learning.

Applying Theory to Practice: Exercise 2.1

Before commencing this chapter:

- Identify which organs or glands you already know that are involved in maintaining homeostasis
- Compose a list of diseases that you already know that affect the body's ability to maintain homeostatic function in relation to temperature, blood pressure, water balance, glucose control and acid base
- Add this list to your developing portfolio and on completion of this chapter expand your portfolio with the new disorders you have gained

Anatomy & Physiology in Action: Exercise 3.8

Compare the breathing of different individuals; there are many influencing or contributing factors to why an individual breathes in a certain way.

- Compare the rhythm and depth of breathing of a very obese patient with someone with a petite build

Remember what is considered normal for one person can be very abnormal for another.

- What is sleep apnoea?
- Which group of individuals are at particular risk of experiencing this?

Anatomy and Physiology in Action boxes

These demonstrate how the anatomy and physiology learned in the chapters relates to nursing practice.

Scenarios

Brief scenarios are included in each chapter to place concepts in a real-life context and to set the scene for further analysis.

Scenario 3.2

Chronic Obstructive Pulmonary Disease

Joan Middleton is a 63-year-old woman who is brought into the emergency department at 02.00 after experiencing shortness of breath and a purulent cough for three days. She is unable to complete a sentence; she appears alert although very anxious. Her respiratory rate is shallow, rapid and irregular at 38 breaths per minute. She appears to be nearing exhaustion, demonstrated by the heavy use of the accessory muscle of respiration, her neck veins are protruding and she adopts the tripod position (sitting, leaning forward with arms on thighs). Mrs Middleton has evidence of

Developing and Delivering Expert Care: Exercise 6.7

Obtaining a Mid-Stream Urine Sample (MSU)

A urinalysis provides a quick and simple overview of the urine. If a potential infection is identified a further specimen should be ascertained. This sample requires a mid-stream sample of the urine so that contaminates like bacteria that colonise around the end of the urethra are not included. The sample will be sent to a microbiology laboratory so that the bacteria can be grown and identified. The specimen is sent for micro-culture and sensitivity (MC&S, which means the identification of the bacteria (micro-culture) and what the specific bacterium is sensitive to, i.e. which antibiotic will

Delivering and Developing Expert Care boxes

These boxes indicate how and where you could develop and improve your knowledge and practice to become a better nurse.

Questioning Clinical Practice: Exercise 4.16

There are several important phrases used within clinical practice to describe both the act of resuscitation and the legal terminology surrounding care.

Using the correct terminology is paramount as misunderstandings can lead to distress and confusion in an area commonly described as one of the most sensitive that clinicians, patients and family members may have to face.

- Find out the clinical meaning of the terms below and locate a copy of the DNAR policy your trust employs
- What is the difference between a patient

Questioning Clinical Practice boxes

These boxes encourage critical thinking by inviting you to think in more detail about procedures and how they could be improved.

Chapter 6 Summary Quiz

1. The renal system is composed of:

A. Two kidneys, two ureters, and a bladder
B. Two kidneys, a common ureter, a bladder and the ure
C. Two kidneys, two ureters, a bladder and the urethra
D. Two kidneys, two ureters, two bladders and a urethra

2. Each nephron contains an extremely intricate pathway renal function. These include:

A. The collecting duct, the distal convoluted tubule, the Boatman's capsule and glomerulus
B. The distal convoluted tubule, the loop of Henle, the P glomerulus
C. The distal convoluted tubule, the loop of Henle, the

Summary Quizzes

The text includes brief summary quizzes at the end of chapters to enable you to test the knowledge you have gained from that chapter. Answers are found at the end of the book.

Technology to enhance learning and teaching

Online Learning Centre (OLC)

After completing each chapter, log on to the supporting Online Learning Centre website. Take advantage of the study tools offered to reinforce the material you have read in the text, and to develop your knowledge in a fun and effective way.

Resources include:
Testbank of Multiple Choice Questions
PowerPoints
Video interviews with Cliff Evans and a Patient Relations Manager

Visit www.openup.co.uk/foundationsofnursing today

Preface

Identifying a new philosophy

Welcome to a book designed specifically for nursing students. The focus of this book is to assist developing nurses to gain the essential knowledge and practical understanding necessary to excel as a newly qualified nurse. The initial knowledge and skill base required on qualification by a modern nurse can appear unachievable; when commencing your chosen course the university structure will be divided into many subsets or faculties, each one will consider itself the pinnacle of your development and show little regard for the workload and deadlines you will experience from the combination of them all.

I, Cliff Evans, have written and taught both pre- and post-registration nursing courses as an adult-branch lecturer specialising in both emergency care and acute cardiology. Emma Tippins has been employed predominately as a senior sister and practice educator within emergency care; this includes facilitating both advanced life support and advanced trauma courses. More recently Emma has developed the role of the modern matron within emergency care. Our combined theoretical and practice experience has enabled us to write this book with an underpinning philosophy centring on assisting student nurses to be fit for practice or fit for purpose by the end of their initial academic study and clinical placements.

When placed within clinical practice, many students can be bewildered by what may appear the total disparity between what is taught within the classroom and what is delivered in clinical practice. This theory/practice divide is not a new phenomenon and has had serious implications for students over many years. The Nursing and Midwifery Council (NMC 2005), Duffy (2003), and many providers of healthcare (healthcare trusts), have recognised this and as a direct result have had to introduce post-registration educational programmes for newly qualified nurses enabling them to develop the skills and knowledge to be fit for purpose. This can have a negative effect on the newly qualified nurse, who understandably may feel aggrieved after having spent three years in full-time education and having amassed considerable debt to be told they are unfit to practise safely.

Why are there inconsistencies between the Nursing and Midwifery Council's requirements, pre-registration courses and the skills and knowledge necessary to deliver quality care?

Although it may initially appear that a person or an organisation must be held accountable for this inconsistency, this may not be the case. Over recent years the role, knowledge base, and clinical skills required by nurses have expanded at an incredible rate. It is almost unbelievable to imagine that in 1969, the year in which I was born, it was common practice for only doctors to record blood pressures. Today nurses have taken on many tasks traditionally undertaken by other disciplines such as medical physicians and made them their own by developing research- and evidence-based initiatives surrounding these actions. Traditionally, doctors learnt following the see one, do one, teach one basis. Within the nursing profession you will find almost a contrary approach, with a study day, a competency document and a period of supervised practice mandatory for many 'advanced' or 'extended' tasks. Although this may appear unfair, this culture of education and underpinning rationales has had a dramatic effect on care delivery and the confidence and respect that nurses receive. To fully understand the development of nursing as a profession it is necessary to look back into the not so distant past and visualise how nursing education has developed and how it will continue to do so. On completion of this book I hope you will realise that nursing education was and remains mainly experiential, and that to become a dynamic and proactive practitioner your education will continue until you retire; this is termed lifelong learning and is at the centre of good clinical practice.

The team of contributors to this book all currently practise or deliver educational programmes. This inspiring mix of educators and healthcare providers has come together to produce a book that combines the best of both worlds by applying theory to clinical practice and, through the use of scenarios, demonstrating not only the physical skills associated with nursing, but also the considerable knowledge base a modern nurse requires.

Using the Book

This book is split into three distinct parts. Part 1 is an introduction to nursing which includes a reflective account of the many changes one nurse has experienced over her 40-year career.

Part 2 provides a 'systems'-based approach to understanding modern healthcare. By understanding the basic functioning of a physiological system of the body, a nurse can easily anticipate and recognise the associated clinical signs and symptoms when a particular system begins to fail. This foundation of anatomical and physiological knowledge is essential to practising nurses. The clinical application of this knowledge, in association with a structured assessment process, can result in both increasingly effective care and reduced morbidity and mortality rates (Evans & Tippins 2007). This section has been designed with particular components to assist the student with fundamental elements of their educational programme. These learning activities consist of individual exercises with common themes designed to facilitate this process. Activities include:

- Applying theory to practice
- Developing and delivering expert care
- Anatomy and physiology in action
- Questioning clinical practice.

Many of these activities have identified outcomes designed to facilitate the early development of a comprehensive personal and professional portfolio. The student can reflect on and visualise previous levels of understanding and practice and clearly demonstrate evidence of their progression from novice to expert (Benner 2001). Each chapter presents common patient scenarios clearly demonstrating how the student can apply a solid knowledge base to their clinical practice, thereby improving the care patients receive. This approach will aid the student in acquiring a holistic view of the needs of individuals and provide the clinical skills, theoretical knowledge base, and critical analysis techniques required to pass their chosen academic programme and become a competent and knowledgeable practitioner.

The importance of a research and evidence base to rationalise modern healthcare will be emphasised to familiarise students at an early stage of their training in a questioning approach to the care they deliver and to introduce students to 'best practice' initiatives geared to improving and standardising patient outcomes. These include government-driven initiatives such as the national service frameworks that currently underpin many areas of healthcare delivery, structuring local healthcare delivery strategies, through to internationally agreed guidelines delivered via the World Health Organization.

Part 3 details the separate but intrinsically linked branches of nursing. All nurses need to gain insight into all specialties, as they will encounter varying patients throughout their careers with a multitude of needs; in order to provide a quality of care, individuals must be seen as a whole (holism).

Part 3 is also designed to assist student nurses in gaining some of the associated skills required by nurses that are not always part of a university's curriculum (although this may be changing in the near future). These skills focus on a detailed understanding of medications and their administration, and the ability to provide effective first aid both within and outside the hospital setting.

Online resources designed to develop the facilitator–student relationship are also presented. This is achieved by the provision of a PowerPoint presentation for each chapter which can be used by lecturers within the academic setting or by the students for quick reference. A selection of other materials is also available to aid the learning process.

All chapters begin with identified learning outcomes; the student can then identify their own abilities and areas for development by completing the end of chapter quiz, the answers to which can be found at the back of the book. Each chapter shares common themes: these include in-depth patient scenarios detailing how complex patient management can be, activity boxes highlighting best practice initiatives, and the integration of anatomy and physiology and theory into clinical practice. The activity boxes are also designed to encourage students to question their practice, rationales, and the evidence base of care delivery. This enquiry-based approach treats students as adults and encourages individuals to seek further understanding for themselves. This requires discipline: by completing the exercises in this book at their own pace, individual students will gain the essential professional skills associated with lifelong learning and remain fit for practice.

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Paul Mills, University Campus Suffolk
Sean Roe, Queen's University Belfast
Jenny Temple, University of Plymouth
Anne Waugh, Napier University

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Cliff Evans is the Emergency Care Matron at Heatherwood & Wexham Park Hospitals. This role includes clinical, managerial and innovative components. Cliff has had a broad career encompassing mental health, acute medicine and cardiology, and is a qualified medical practitioner/specialist and Emergency Care/Acute Cardiology Lecturer. Cliff has had several publications including 'The Foundations of Emergency Care' (Open University Press/McGraw-Hill Education 2007) and has undertaken a consultancy role for the DoH.

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Emma Tippins has worked as an Emergency Care Sister, Practice Development Educator and recently as a Modern Matron within Emergency Care. Emma is also both an Advanced Life Support and Advanced Trauma Nursing Course instructor. Emma is an established writer with several publications including 'The Foundations of Emergency Care' (Open University Press/McGraw-Hill Education 2007). Emma's current role encompasses raising a 6-month-old baby boy!

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Lucy Tebbit is part of the Practice Development team at Heatherwood & Wexham Park Hospitals. Lucy is a registered Emergency Nurse Practitioner and has an extensive history within Emergency Care. Lucy leads on several in-house educational modules and is a pioneer of introducing evidence-based practice into the clinical setting. Lucy also has a keen interest in the local community and is Chair of Governors at a local Children's school.

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Nick Wrycraft is a Senior Lecturer at Anglia Ruskin University. Nick's current roles include Module Tutor for Module one of the Common Foundation Programme for pre-registration nursing, and admissions Tutor for Mental Health nursing. Nick has a keen interest in Mental Health nursing education and practice and the role of reflection, clinical supervision and other support mechanisms in developing capable practitioners. Other areas of interest include qualitative research methods, service design and development and new and generic roles including the Associate Practitioner.

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Alex McClimens, wannabe writer and aspiring literary giant, is senior research fellow with Sheffield Hallam University where he divides his time between writing research proposals, teaching and drinking coffee.

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Clare is an established pioneer within practice development, Clare's passion centers on working in partnership with patients and developing the team and organizational culture to support this. Clare has a keen interest in leadership and has led many leadership development programmes for nurses and midwives. Clare's current role of Assistant Director of Nursing includes practice and professional development, encompassing both pre and post registration nursing.

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Karen Chivers is employment at Heatherwood & Wexham Park Hospitals as a Clinical Practice Development Nurse. Karen is an Advanced Trauma Nursing Course instructor and a registered Emergency Nurse Practitioner. Karen's role includes formally and informally educating nursing students, nursing colleagues and other members of the multidisciplinary team. Karen leads on innovating clinical practice and delivers in-house programmes designed to empower and develop senior nurses.

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Part 1
The role of the nurse

1

The role of the nurse

Cliff Evans and Emma Tippins

Chapter 1 Learning Objectives

- Gain insight into how the historical role of the nurse has led to the creation of the modern reflective practitioner
- Understand the importance of questioning care practices and applying theory to decision making and clinical practice
- Provide qualitative care through gaining insight and understanding into the importance of 'rationales' to underpin practice
- Understand the role of the Nursing and Midwifery Council (NMC) and gain insight into principal publications
- Gain insight into the principles of research, thereby gaining skills associated with the true professions and lifelong learning
- Understand the rationale of having a reflective practice portfolio and begin constructing this essential tool to professional development
- Gain insight into modern educational techniques and the core nursing curriculums
- Gain insight into how politics affect healthcare delivery
- Gain understanding of the nursing career ladder

This introductory chapter includes a reflective account of nursing education and practice written by Penny Russell, a friend and colleague, who during her 40-year nursing career has lived through and partaken in many of the changes that have resulted in the modern nurse. Penny discusses how many external and internal influences have heralded dramatic transformation in both nursing education and the very act of nursing, thereby revolutionising modern healthcare delivery. This section provides the reader with insight into why a theory/practice divide exists and how, throughout recent times, many have tried to bridge this divide. Throughout the following chapters our contributors, all of whom are specialists in their fields, will introduce the reader to many methods of applying a theoretical underpinning to clinical practice, thereby delivering evidence-based clinical care.

This chapter identifies many aspects relevant to the everyday practice of the nurse including:

- The Nursing and Midwifery Council (NMC) and the Nursing Register
- Portfolio development and maintaining clinical knowledge and competence
- Educational techniques
- Clinical decision making
- The nursing process
- Government legislation and health policies (a modern approach to healthcare delivery)
- The importance of ethical decision making
- The introduction of research and an evidence base to nursing practice
- Nursing career potentials.

The Nursing and Midwifery Council and the Nursing Register

The Nursing and Midwifery Council (NMC) was established in April 2002, taking over from the United Kingdom Central Council and the four national boards (UKCC). The NMC published its new rules on registration in August 2004 entitled *Code of Professional Conduct: Standards for Conduct, Performance and Ethics* (NMC 2004a). This document identifies the basis of nursing practice thereby forming a crucial component of your professional development. The NMC is the UK regulator for nurses and midwives. Once you have fulfilled the learning outcomes of your chosen university course, you will need to be registered with the NMC before you can practise as a nurse. The NMC's key responsibilities are to protect the public by establishing standards of performance, nursing education and conduct (NMC 2004a). During training, student nurses also have standards of practice that they must abide by NMC (2005a): although they are not

cont. on page 10

The role of the nurse

Penny Russell, former Head of Nursing (Adult Branch) at Thames Valley University

This piece follows a personal reflective journey, through entry to nursing, the experiences of training in the 1960s, changes in clinical practice and nursing responsibilities, and nurse education. The influences of the changing health needs and expectations of society and how these have influenced and driven political and legal changes will be briefly explored, particularly where they have affected the role of the nurse.

Why do you want to become a nurse?

This question has been asked of every new nursing recruit since schools of nursing began in the United Kingdom in the middle of the 19th century. Individual answers would be slightly different but most would contain the wish to care for the sick and their families. I had never been a patient or visited a hospital before I entered nurse training. What I knew about the nurse's role was gleaned from watching *Emergency Ward 10* on television or reading Monica Dickens's book *Two Left Feet*. However, I had insight into illness and the needs of the chronically sick from my early years, particularly from visiting my grandparents. My grandfather was responsible for forming a great deal of my early values and feelings about life. He was a retired general practitioner who won the Military Cross for his medical services in the Great War. I never knew him without crutches and I often looked at his gnarled and deviated hand joints and wondered how they had got like that. I knew my grandmother had to help him wash and dress and that he took soluble aspirin for pain. He was a gentle and knowledgeable man who spent endless hours with his granddaughter explaining about cultures and peoples as we placed stamps in my stamp album. These experiences formed my early values and beliefs about peoples, places and, essentially, about sickness and health. Rheumatoid arthritis is indeed a cruel disease. Unfortunately, my grandmother and mother were similarly affected. My father died at the age of 46 from a heart attack. It was through these experiences that I was able to discuss how suffering, early death and bereavement had affected my family and myself at my interview, which contributed to my entry into nurse training.

Nurse training, 1966–1969

Twenty-five young women and I commenced nurse training at a London teaching hospital in March 1966. The preliminary training school was in the leafy suburbs of west London and was really very like my boarding school with a clearly defined timetable for classes and meals. Theory was largely anatomy, physiology and some public health. Psychology with some sociology was discreetly applied in the practical classes. We were only allowed out of the school grounds until 10.30pm at night. Afterwards we had to ring the doorbell, have our name taken and be reported to the Senior Tutor (or Matron) and given a suitable lecture on lateness and how such trends had to change and not transfer into our ward experiences. The practical sessions were challenging since a great deal of understanding was required to follow procedures accurately. A visual demonstration was followed by repeated practice: bandaging with hip spicas, reverse spirals, simple spirals, etc. Some of the learning was also experiential such as nursing observations, bed baths and feeding of each other. We all regarded these classes as 'real nursing' and seemed to absorb the theory that went with it, particularly as we were told 'lives depended on accuracy'. Our visits to the hospital were by coach once a week where we were introduced to 'real' patients. The ward sisters always seemed formidable with starched hats, cuffs, aprons and numerous badges. Several senior staff would prove to be quite eccentric with certain foibles that we needed to be aware of. However, the ward sister was mistress of all she surveyed; I can well remember new junior doctors and the ward orderly being put straight on several points with the consequence that patients, staff and the ward environment were all respected and kept in proper order. Students were set to work under close supervision and we busied ourselves with applying only what we had learnt, i.e. moving patients using the Australian lift (now banned), bed baths and

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patient observations. We learnt about the ward routine, religiously cleaning bedpans and sluices, also, essentially, the giving out of meals, on the instructions from the ward sister. We also helped patients to eat and drink. These were exciting times and we could not wait to get on the wards at the end of our three months in the training school. We felt confident, secure and supported.

Being a first-year student nurse was intermixed with trial and error, learning while doing, and a great deal of watching, listening and learning. There was also a subculture of trying to keep on the right side of sister and the senior staff nurses. Each placement was a new adventure. However, all nursing care followed the medical diagnosis and an unwritten protocol of patient care management. The ward sister managed nursing care with tasks being allocated according to experience via a workbook. Each student learnt from a more senior student, the 'sitting next to Nellie' method, and developed their skills and knowledge through the clinical placements with a stern test of each using a buff-coloured nursing schedule book which recorded observing, practising and proficiency of prescribed procedures and skills over the three-year training period. However, much unrecorded learning was gleaned from the context and the lived personal experience of being a young person endeavouring to care for sick and dying people in a regimented and 'professional' environment. There was little discussion on the traumatic issues that either patients or nurses had faced on a shift except informally with peers in the nurses home. Peers supported, comforted and saw to it that emotion gave way to common sense and a sense of perspective. In many cases fellow trainee nurses became lifelong friends through their shared experiences. A continuum of personal and professional growth was fostered throughout each year of the course through an advancement of knowledge of the disease processes, and the nursing response to symptoms, ever-increasing complexity of skills and increasing responsibility for patient care. There was security in this system as everyone knew their place and all students knew what they were supposed to be doing, although often patient care was seen as a set of tasks and applied to anatomical parts rather than as a whole person. Graduation to staff nurse was a natural process with the end of the third year spent on night duty in charge of the ward with a night sister on call. Teaching junior students, assigning and monitoring nursing care, reporting to the medical staff and ordering of medicines and essential equipment were expectations of a third year student to ensure that they were fit for purpose on completion of their course. Most of us were confident and had carefully chosen our first staff nurse post when our letter came through from the General Nursing Council.

Thus it was that nurse training in an apprenticeship model largely achieved its aim of producing a staff nurse who would carry on the old traditions and practise the skills using the medical diagnosis as the guide. The art and science of nursing itself was limited until challenges to the accepted nursing protocols began to ask serious questions of certain nursing practices.

Questioning clinical practice

Early nursing studies followed the quantitative research model almost exclusively favoured by the medical profession, based on large data gathering exercises; it took a further decade for the art of nursing to be acknowledged through the lived experience of the patient. The early qualitative research approach based on in-depth questioning, observation studies and empirical knowledge remained an area of scepticism outside nursing; within the profession they were well used to develop nursing care and patient well-being. The 'doctor's handmaiden' role of the nurse changed with greater professional confidence, almost alongside the introduction of more men into nursing and the changes to the role of women in society. Thus, postmodernism was to affect nursing with many challenges and moves for change through the 1970s.

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Changes in nursing care management

The introduction of the Nursing Process and Care Planning made attempts to consider patients as a whole rather than parts in the biological, psychological and social dimensions. This was later confused by the introduction of nursing models where new aspects of 'the person' could be viewed in different ways and a nursing response generated therefrom. Initially, the United Kingdom adopted the 'Activities of Daily Living' as a model and assessment tool (Roper et al. 1980). For those trying to assess the patient and plan care using the nursing process, adopting different formats to assess an individual patient's needs was sometimes confusing. It was often felt that 'the cart had come before the horse' since it would have been more fitting for the nursing model to be adopted first, with its specific assessment tools rather than the nursing process format.

Fundamentally, all nursing models assess patient need in a multidimensional fashion and the nursing response is generated from that assessment. Nursing care management moved from a series of tasks performed by selected individuals to being team orientated. The team was an eclectic mix of staff nurses, enrolled nurses, students and auxiliary nurses. Teams were secure and discharged their responsibilities for a group of patients in a corporate and responsible fashion. Although, it must be said, that sometimes the staff mix or staff numbers did not match the patient care requirements. Various tools were used to ensure that proactive staffing was achieved but none of these proved to be accurate enough for every situation. Thus, the anticipation of nursing needs was planned by those on the previous shift. Specific patient allocation in accident and emergency and intensive care units was, and still is, the patient care management pattern. However, individualised patient care was soon to become part of nursing care philosophy. This was followed by a flirtation with 'primary nursing'. This process required knowledgeable and experienced nursing practitioners to assess, plan and oversee care, and evaluate outcomes in a systematic and scientific fashion. Nurses needed time and education to be able to take on patient management from admission to discharge. However, the adoption of primary nursing care into busy surgical and medical wards was problematic since it was expensive and required a considerable number of top grade nurses. Visitors to the wards became confused as to who was in charge as the ward sister role became absorbed into that of ward coordinator.

The patient's named nurse (derived from the Patient's Charter which was abolished in 2000 – http://www.pfc.org.uk/node/633) was not 'on duty' 24 hours a day, although they were responsible for patient care for that time. Patient care became fragmented with the nursing handover not including all patients. The true success of primary nursing was seen in care of the elderly units where staffing was constant and access to outside agencies easy. But it was an exciting time to be a senior staff nurse with so many different ways to look at patient care, and with the sphere of responsibility for patient care increasing to allow for specialisation and the emergence of the specialist nurse role.

In the early 1990s the idea of having a more controlled and predictable patient care pathway was introduced through 'patient-focused' care and the arrival of patient care protocols. At this time my career moved into education and I was an educational manager in a school of nursing surrounded by a hospital introducing this type of patient management. The training of staff became crucial to its implementation, as the protocols were to be central to patient care, and I was involved in some of the staff assessments. It was expected that all the staff within a unit or ward, be they healthcare assistants, staff nurses or physiotherapists, would be able to address the patient's needs. This caused considerable debate and disharmony among professional groups, as they each had their own body of knowledge and professional boundaries. Some protocols proved successful and beneficial to patient care, particularly for patients such as those coming into hospital in sickle-cell crisis. The success of this particular philosophy was that it was generated by those working at the coalface and not from outside the unit. Patient focus as a form of patient care management, although inspirational, did not survive to be embraced

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across nursing. However, the idea of multi-professional patient protocols to guide staff and patients along the recovery pathway was adopted with great success in many areas. Today we see the emphasis in the management of patient care being that of 'the patient's journey'. The need for nurses to assume some of the junior doctors' role is not new but is legitimised through the reduction of junior doctor hours and the developing expertise of specialist nurses. In specialist units nurses' and junior doctors' roles have often merged for the good of the patient. Nurses have acquired knowledge and skills at the bedside with the expert tuition from lecturer practitioners and hospital consultants. To some extent the ward nurse has been left behind, possibly because of poor vision by educationalists and managers alike. Many find the interesting parts of their role being taken over by the nurse specialist, such as the diabetic nurse, the tissue viability and wound specialist nurse, or the cardiac rehabilitation nurse.

Contemporary teaching and learning

Being a clinical teacher was one of the roles that I enjoyed most. Teaching at the bedside and involving the patients and their relatives in the discussion and management of care was immensely satisfying. Not being responsible for the management of the ward provided essential time to demonstrate how procedures should be done. Afternoon tutorials during the patients' rest hour ensured that students applied and demonstrated their knowledge. They also allowed individual patient care to be critically discussed and for students to ask questions. Unfortunately, in the 1980s a clinical teacher was considered to be neither a tutor nor a clinician and, therefore, no career structure was developed and the role, like so many others created for a need at the time, fell away. It was supplanted by the lecturer practitioner, which added university support and development to the role while allowing knowledge and skills to be imparted at the bedside. This was particularly successful in units and distinct areas of clinical practice. Again, many lecturer practitioners enjoy their roles for the same reasons as the clinical teacher but they are an expensive resource and universities are short of money as are the National Health Service Trusts, making them an easy target in times of crisis.

Nursing and higher education

It is sometimes difficult to distinguish what has influenced nursing care and nurses most over the past 40 years. The training and education debate has almost gone full circle from the apprenticeship and learning on the job, through the introduction of the Project 2000 curriculum in 1989, following the Judge Report (1983). In this curriculum other academic disciplines were taught in their pure form and then applied to nursing, particularly sociology, law and ethics, physiology and psychology. At times, being a teacher of adult nursing was a juggling act to provide the essentials of nursing while applying the other disciplines. Patient Scenarios became the only way of bringing parts together to see the patient as whole through a multidimensional lens.

The Diploma of Nursing curriculum set out to mould nurses into 'knowledgeable and questioning doers' not just 'doers'. Thus, students were encouraged to enquire and develop their own knowledge base in the practice setting. This would have worked well had the existing workforce been prepared to diploma level, and indeed for the enquiring student. Many hours have since been spent by teachers, on their clinical visits, smoothing over areas of difficulty and situations where the assertive, enquiring student had asked the wrong question at the wrong time. Clinical staff have rightly felt threatened by the challenge to their knowledge and experience, especially as many had not had a basic training which reached diploma level. Post-basic education was slow to address the academic needs of the already qualified nurse other than by advancement of clinical skills.

There is no doubt that the closure of schools of nursing on the hospital sites in the mid-1990s had a profound effect on nursing students, teachers and indeed the way nursing education was perceived. Many hospital staff

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were glad that 'the school' was no longer omnipresent, since the demands on them with the close monitoring of the learning environment was, and still is, somewhat of a threat. Nurse teachers had to apply for the new university posts. Several schools of nursing had to merge and, therefore, downsize with inevitably job losses resulted. University life brought with it many changes of boundaries. Teachers were now lecturers, sharing large offices with colleagues they hardly knew, and had their workload redesigned into modules or units of learning. Joining a large establishment and feeling part of higher education depended on interactions with other lecturers in the university. Our faculty, as with many health science or nursing faculties, was run and kept largely separate, which meant that it took time for us to feel as though we belonged. Many lecturers of nursing found it hard to treat students differently and as independent learners, since we had always fostered learning and nurturing individuals through their difficulties. This simply was not possible in terms of the numbers of students and lecturer time. The political agenda and therefore university strategy to recruit as many students as possible meant that the student population changed markedly to include many nationalities, some fleeing oppressive regimes in Europe and Africa and others with complex family situations. Mastery of the English language and numeric skills soon became a huge problem in terms of examination success and patient safety. Although the education of nursing students was now within higher educational institutes, it could appear to the established nursing workforce that the abilities of the modern student nurse (other than to question) in basic skills such as written English and mathematics were diminishing. On qualification, nurses were now unable to perform many of the traditional basic nursing tasks, had a poor understanding of the human body and were seen to be fit only for essay writing and not the delivery of care.

A nurse that is both fit for purpose/practice and demonstrates a higher level of thinking

Fitness for practice and purpose is clearly the political agenda at the present time (NMC 2005a) but teaching and learning at the bedside are not necessarily consistent. This is due to the lack of clinical staff and sometimes the student's inability to observe and communicate effectively their learning needs to their mentor. Mentors have many students and they are not necessarily on duty at the same time. Mentors are also usually staff nurses; although they may be able to perform at an expected level, they may not be able to convey the theoretical components of many illnesses or situations to others, complicating the learning process. No matter what the fashion in nurse teaching, be it 'chalk and talk', lectures followed by seminars, experiential learning, enquiry- or problem-based learning, or structured reflection, the successful student manages their own time and learning agenda, making sure appropriate assessment takes place at the due time. They also then develop their own professional and personal schemata of what is optimum care and best practice. Learning to be a responsible professional should be a fundamental goal.

In the early years of my nursing training, patients were subservient, compliant and totally trusted their doctors and nurses to act in their best interests. Society regarded nursing as a respectable career, and indeed nursing in return tried to fulfil the criteria of a profession with its own body of knowledge and an active register of practitioners. It also had inculcated professional standards, which were monitored by the General Nursing Council. As a staff nurse on a busy 33-bed surgical ward, the nature of surgery was significant because often it was the only option in the treatment of tumours or gastrointestinal conditions. Coupled with the effects of anaesthesia, big procedures with large wounds and drains, patients spent considerable time in hospital.

The nurse's role in aiding recovery was specific, particularly in respect of observations, pain relief, wound care, fluid replacement, early mobility and acute reporting. Patients routinely could expect help from nurses with their personal hygiene, mouth care and toileting. Discharge planning was undertaken when the medical staff decided that a level of recovery had been sustained for the patient to manage at home. The hospital bed demand was not

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the issue that it is today and nurses were reassured that patients had reached their optimum recovery before discharge. They were also able to discuss fully with district nurses what ongoing care might be required. The introduction of non-invasive surgical procedures, advances in medicine, anaesthetics and wound closure and care have altered surgical nursing fundamentally. Today, most surgical procedures can be performed as a day case, the stay in hospital being minimal.

Discharge is planned simultaneously with admission and protocols are adhered to, ensuring patients move along the recovery pathway in a uniform and predicted fashion. General practitioner surgeries and 'walk-in clinics' now also perform surgical procedures, which means that the role of the surgical nurse is now extremely focused and the relationship with the patient is often transient and fleeting. Nursing care has needed to change to reflect the health needs of society. These have changed significantly with the speed and demands of everyday life. The concept of the family has moved from the traditional two parents with two children to now involve a broad spectrum of participants with partners, significant others, the community, and various agencies playing active parts to support parents and children. Patients are now often well informed and know that they are empowered to make choices. Successive governments have promoted patient empowerment and choice, which has meant that nurses have to be skilled at giving patients information and putting forward alternatives, ensuring that the patient's experience is one that they agree with and partake in. Many patients find this hard, preferring others to make choices for them: 'You're the nurse/doctor, you tell me what the best option is.'

The introduction of National Service Frameworks/National Strategies

The National Service Frameworks generated by the Department of Health have helped address the needs of various patient groups, including the elderly, the diabetic patient group, the cardiac patient, the mental health patient and those with cancer or chronic illness. The targets have proved invaluable in setting and monitoring a uniform agenda to prevent, treat and manage particular illnesses. Nurses were somewhat surprised to have a review of essential nursing care with dignity and privacy, record taking and nutrition being some of the central issues to be brought into focus with the Department of Health's *Essence of Care* (DH 2001, revised 2003). *The Essence of Care* was designed to support the measures to improve quality and contribute to the introduction of clinical governance at local level. The benchmarking process outlined in *The Essence of Care* assists practitioners to take a structured approach to sharing and comparing practice, enabling them to identify the best practice and to develop action plans to remedy poor practice. Hospitals systematically reviewed their procedures, setting up task groups and setting appropriate standards as a result of this exercise. Many nurses trained in times past were aghast at how poor essential care had become since it was so much part of our conditioning in the apprenticeship model. Nursing education and training have, to me, never lost the continuum explored in Patricia Benner's book *From Novice to Expert* (Benner 2001). It illustrates the acquisition of knowledge and skills through exemplars which demonstrate that there is no substitute for experience in nursing, but in my view this must be supported by the willingness of the individual nurse to learn through academic enquiry, and above all, from observation and critical reflection on and in action. The application of acquired knowledge and skills to each individual patient situation makes nursing the unique art and science that it is.

Conclusion

Being part of the nursing care environment working alongside patients, relatives and colleagues remains a privilege and has been central to my career as both a nurse and a teacher. Caring first about family, then patients, colleagues and students has never been far from my mind in all that I have endeavoured to do because it has given me such pleasure and enormous satisfaction. No other career could have given me more.

Penny Russell, 2007

not professionally accountable, students can be called to account by their university or by the law for the consequences of their actions or omissions. Nurses need to re-register with the NMC each year; absurdly the cost of this process is not met by the public, which the NMC serves to protect, but by nurses themselves. Over recent years the now annual cost has far exceeded inflation and is an area of much contention. The nurses' part of the register has marks to identify the branch of nursing practice in which the nurse has achieved the standards of proficiency.

The NMC and pre-registration

The NMC state that pre-registration nursing programmes should be designed to prepare students to apply knowledge, understanding and skills to provide the nursing care that patients require in a safe and effective manner, thereby assuming the responsibility and accountability necessary for the protection of the public. This is achieved by setting standards; these standards are considered the minimum expected level to enable the registrant to be competent to deliver safe and effective practice (NMC 2004a). The basic principles underpinning educational programmes are that:

- Evidence should inform practice through the integration of relevant knowledge
- Students should be actively involved in nursing care delivery under supervision
- Research should underpin practice
- The importance of lifelong learning and professional development is recognised.

The NMC monitors and approves the detailed programmes that demonstrate how the standards of education enable the NMC standards of proficiency to be achieved within the context of practice in each of the four branches or specialties of nursing. This quality assurance monitoring process is undertaken each year. The pre-registration nursing education programmes have to ensure that their individual programmes adhere to these guidelines, as their status is mandatory in accordance with statutory legislation.

Course design and the branches

All nursing students study together in the first year in a 'common foundation programme' (CFP). Many universities have made this not only a collaboration of nursing specialities but also multidisciplinary by including future doctors, physiotherapists and occupational therapists. On the completion of the first year, students must be seen to have met pre-designated outcomes or essential skill clusters (ESC) to enable progression into their chosen specialty or branch. The second set of outcomes or ESC are identified as the prerequisite level of knowledge to clinically practise. These are achieved in several ways during the educational programme and will include constructing a portfolio of professional development and practice (see next section). In addition, several clinical competencies must be achieved while on practice placements, making the educational programme 50% theoretical and 50% clinically based. These include ESC based on medication delivery, aspects of care and communication. The four branches of nursing are:

- **Adult nursing**: caring for those 18 and above, this includes various clinical settings and levels of patient dependency. Philosophically, care should be in partnership with the patient, be patient centred, and should acknowledge the individuality of patients. Nurses require skills to address the physical, psychological and social needs of patients; in addition, spiritual or religious requirements should be both respected and catered for when planning care. The nurse is seen as a pivotal member of the multidisciplinary team and supports patients through care pathways by working closely with other professions to maximise opportunities for recovery, and future avoidance of ill health through programmes of health education and promotion.
- **Mental health nursing**: centres on the provision of care for those experiencing mental distress through the application of therapeutic relationships directed at providing support and understanding for those afflicted. Mental health nurses work as part of a multi-agency/disciplinary team that seeks to involve service users and their carers in all aspects of their care and treatment.
- **Learning disabilities nursing**: aims to influence behaviours and lifestyles of a vulnerable client group to enable optimum health. This includes positive promotion of the cause and actively supporting the inclusion of those afflicted within society as equal and deserving citizens. The use of expert communication skills will engage the user group and establish

individual care packages. Learning disability nurses will work in various settings establishing support for clients and their families.

- **Children's nursing**: centres on the development of family-centred care and the belief that children should be cared for by people they know and, whenever possible, within their home environment. The empowerment of children and their families is a key element to promoting and providing safe, effective and informed care. Children's nurses play a fundamental role in the collaboration of key professionals to contribute to child protection. A central philosophy is respecting and promoting the rights of the child.

The NMC has published several pertinent documents that the student will be required to familiarise him- or herself with:

- *Code of Professional Conduct: Standards for Conduct, Performance and Ethics* (NMC 2004a)
- *Guidelines for the Administration of Medicines* (NMC 2004b)
- *Guidelines for Records and Record Keeping* (NMC 2004c)
- *An NMC Guide for Students of Nursing and Midwifery* (NMC 2006).

The identification of new learning opportunities and taking the onus to develop one's own knowledge and skill base are essential components of both modern adult education and nursing practice.

The NMC and mentorship

Your chosen course will be composed of 50% theory and 50% clinical practice. It is therefore imperative that the clinical provider, whether a healthcare trust, privately run concern or a primary care trust (PCT), provide you with a 'coach' or supervisor within that particular area. In 1993, the then statutory body for nursing (the UKCC) recommended the introduction of a formally recognised local support system for newly qualified nurses. This heralded the formal introduction of the preceptor, an experienced practitioner who would assist student nurses or newly qualified nurses in the transitional period between novice and capable practitioner.

Today an experienced nurse will be designated your mentor; the word mentor derives from Greek. In Greek mythology, Mentor was a famous figure whose name is proverbial for a faithful and wise adviser. Mentor was a man of integrity, an excellent friend to his friends, he did not deal in lies, and he could speak out if necessary. Mentor was a firm believer in acquiring knowledge from positive reflection, and was therefore in an ideal position to speak freely and unhindered about the actions of others. Mentor was a firm believer in addressing injustices, one of which was that he believed that to be aware of injustice and not act was also a crime. This could be directly applied to clinical practice today in that if a practitioner witnesses poor practice or abuse and does not act on it, they become part of the act itself (NMC 2004a).

The modern role of the mentor can be defined as a professional relationship that is dependent on joint, dynamic, sharing characteristics. The choice of mentor should be determined by the mentee as the mentoring philosophy is based on common ground (Morton-Cooper 2000). The initiation of this relationship is based on individuals who are brought together by common characteristics, abilities or recognition of shared values. Therefore the mentee will need to work for a period of time before they can identify their personal mentor. Although this process of identification is suited to the circumstance of the newly qualified nurse, it does not suit the requirements of students on short placements where a supervisor is identified for them. This individual was previously referred to as a clinical preceptor although in some areas the terminology will still exist.

The key to developing the mentor–student relationship

Respect is the key to both building a strong professional relationship and gaining the most from your placements. Some of your mentors will be keen to teach and facilitate your needs; others will see you as an unnecessary addition to their workload and may be unhelpful to your development. It is a mandatory requirement of the Code of Conduct (NMC 2004a) that all qualified nurses facilitate students; do not, therefore, tolerate individuals who demonstrate no interest in your learning outcomes for that placement, as this will be detrimental to your current needs and future learning. Give and take is the key to success; be seen as part of the team, seek every opportunity to show that you are both a hard worker and an inquisitive student. Use psychology and the understanding of others.

Your mentor will have a set of priorities to complete each shift; be seen to assist them with their workload and they will then be free to assist you in yours. The early implementation of action plans based on the clinical outcomes identified within your clinical placement or proficiency booklet is essential, as identifying them late within the placement can come back to haunt you. Action plans and fixed deadlines agreed by you and the mentor are easy to refer back to if either party is unreliable and they provide a solid structure for your placement.

Link lecturers can play a pivotal role in both the development of a unit's philosophy towards students and education and the student's acceptance in a particular placement. On commencement of a placement, identify the link lecturer's details, which should be on display on the education board, identify which days they are in clinical practice, and meet them early within the placement. They will be your first point of contact if you encounter any problems; they are also the first point of contact for the nurses if they encounter difficulties with you. Before commencing a placement, call to ascertain when you are off duty, make yourself known, and if possible identify your intended mentor. Be aware of both your presentation and your time keeping. Gain knowledge of the specialty of the placement by conducting a quick internet search and identify common medications used within that area; this will show you are not just another run of the mill student but a dynamic thinker. Nurses will treasure your keen interest and this will be rewarded by their placing a greater level of trust in you, so you will be entrusted to undertake roles and acts such as administering medications while others are undertaking more mundane tasks. Although this may appear unfair, remember that your mentor's actions and their delegation of tasks to you will be a direct result of how you present your current understanding. By demonstrating little understanding of that particular specialty or the needs of the patients, the student's abilities are limited and the mentor will identify this as they are professionally responsible for the delegation of tasks undertaken by you and will be held accountable if things go wrong.

The NMC and public protection

The NMC has a wide range of powers designed to protect the public. These include the ability to remove a registrant by the evoking of a 'striking off order'; they can impose a 'suspension order', or a 'conditions of practice order'; in addition, a caution of between one and five years can be imposed (NMC 2005b). Students and qualified nurses are allowed to view NMC disciplinary hearings held in London. By viewing this process one can gain insight into how things can go very wrong and the nurse can be held accountable for their practice and actions and failure to act.

The *NMC Advice for Delegation to Non-regulated Healthcare Staff* sets out ten principles for nurses and midwives to follow when delegating to non-regulated healthcare staff. The full set of principles can be viewed at http://www.nmc-uk.org/aArticle.aspx?ArticleID=2582.

Portfolio development and maintaining clinical knowledge and competence

Nurses and other healthcare professionals work in an area of constant change as a direct result of increasing technological and scientific advances, expanding roles and society's demands, in combination with political strategies. The ability and dedication to meeting these challenges by updating one's knowledge and skills base are therefore crucial to providing evidence-based care. The construction of a portfolio demonstrating the individual's professional knowledge and competence to cope with these demands is an essential part of professional development and an easy access point for regulation. Professional development is linked to the registration process through post-registration education practice (PREP) standards. These identify lifelong learning and the nurse's developing professional practice built upon the basic requirements for entry to the register. On qualification all newly registered nurses will have a comprehensive portfolio demonstrating their experience and evidence of competence in basic nursing skills, as this will be a requirement of their pre-registration course. This developing portfolio will be beneficial for career planning, assist in promoting you for career options and highlighting transferable skills. In addition, the portfolio will serve as direct evidence of locally agreed achievements for your future individual performance reviews.

The portfolio contains both personal and professional components. The personal portfolio is a private document and includes individual records of the development of the nurse's skills, knowledge, attitudes, understanding and achievements. It may also include structured written reflective accounts of individual case studies and critical reviews of practice (critical implies an open-minded, reflective appraisal that takes account of different experiences, perspectives and assumptions). The professional profile is seen as a public document, which may involve a combination of the above structured with the consideration that this document is open to scrutiny. It may include accounts of professional experience and direct observations of practice development. It can include evaluations of new working practices and critical incident reviews. Reflective pieces should focus on various topics and be seen to demonstrate positive aspects of practice as well as incidents that could be worth re-evaluation.

Recognising the limitations of one's knowledge or skills base is an essential element of professional development and self-recognition (NMC 2004d). The NMC refer to PREP as an essential component to providing best care for your future patients. The ability of an individual practitioner to reflect on both their clinical encounters and on new learning is a central component in applying theory to practice and improving one's practice.

Reflection in action

Learning and applying reflection to your daily practice will be a major component of your pre-registration course. Initially this key skill enables the individual to re-evaluate an encounter, their actions and the outcome of a situation, interaction or event. To actively reflect on your clinical practice creates the possibility of making sense of the past and present with the focus being the identification of an informed future; this 'higher level' of thinking is at the centre of professional development and an essential component of postgraduate higher educational courses. Smith (1995) identifies that by reviewing past events the individual can enhance good standards through the avoidance of actions that led to inferior outcomes in the past. Schön (1995) refers to reflection in action as the responses that skilful practitioners bring to their practice. This reflection consists of strategies of action, understanding of phenomena, and ways of framing the situations encountered in day-to-day experience.

This 'reflection-in-action' may take the form of problem solving, theory building, or re-appreciation of the situation (Schön 1995). Reflecting on practice therefore involves passing judgement on your own actions and reaching an understanding of your experiences, and then learning from them. It is an active process that should result in real outcomes in terms of changing your understanding of a situation and increasing your knowledge. It also involves developing action plans for future practice. In short, professional reflection involves the critical analysis of clinical practice (Johns & Freshwater 1998). In order to fulfil their professional development requirements, it is mandatory for all registered nurses to maintain a personal and professional portfolio. Within this personal and professional portfolio it is essential to provide demonstrable evidence of some structured and written reflective work (NMC 2004a).

Although this is a professional obligation, there are also many positive aspects to professional reflection, an example being that practitioners can gain insight into their own actions and beliefs in order to be able to build on existing strengths and take appropriate future action. Action should be the focal point, as analysis of past and present practice should be the driving force behind improved future practice. Reflection can be made easy and fluent by applying a structured approach to critical analysis (in this context the word critical refers to the ability to critique, not the seriousness of the situation). There are many models or structural frameworks the practitioner can use; your chosen university will discuss this with you. Taylor (2006) discusses these in detail; the reader is therefore directed to this source as a point of reference. Within the context of their chosen course the student will be asked to reflect on the application of new theory within their clinical practice. The aim of this is to make the student think of how important the application of evidenced-based information is to their expanding knowledge base, and to provide a rationale to their clinical practice. In addition, evidence of this learning opportunity will form the foundation for their developing portfolio. Having knowledge does not necessarily demonstrate understanding, as many practitioners have a solid knowledge base, but fail to apply this within the clinical arena, hence the importance of professional structured reflection (Evans & Tippins 2007).

Educational techniques – methods of learning

The enquiry-based approach

In recent years there have been several different approaches employed to educate student nurses. In the early 1990s, Burnard (1992) identified three types of knowledge:

- **Propositional**: relating to academic and scientific theory. Permits students to understand basic concepts, the 'what is' and 'why'
- **Practical**: relating to the acquisition of practical skills and the application of technology. Permits students to demonstrate 'how to'.
- **Experiential**: relating to the application of propositional and practical knowledge, which through time and experience allows the addition of reasoning which permits flexible application and considered practice.

Today these three basic principles are utilised in the delivery of enquiry-based learning (EBL). This approach to education refers to styles of learning motivated by a process of enquiry, where the learner is introduced pragmatically to a potentially complex problem or clinical case scenario. The learning ethos throughout this book centres on the enquiry-based approach to learning that provides the reader with certain cues or triggers which, through further reading and clinical experience, enable further exploration in order both to develop relevant knowledge and to gain the ability to research independently or in small groups. The EBL approach is composed of several supportive networks for the student; these can include workshops, chaired or facilitated presentations and simulations of real-life professional problems to stimulate students' learning. The facilitator's, or tutor's, role is purely to facilitate learning and provide guidance. Key sessions incorporate structures and forms of support to help students carry out enquiries. This can take several forms including analysis, problem solving and research. This approach enables students of nursing to obtain the ability to seek new knowledge, understanding and skills for themselves (an essential part of lifelong learning).

Clinical decision making

Nurses make multiple decisions rapidly in highly complex environments in order to deliver expert individualised care. A patient's condition can change rapidly and, therefore, demands intelligent and decisive decision making from nurses in short time frames. Despite this there remains minimal research on the clinical decision-making skills of nurses, and consequently much of the content and structure of nurses' decision making remains unclear (Fonteyn & Ritter 2000).

Clinical decision making can be defined as the process nurses use to gather patient information, evaluate that information and make a judgement that results in the provision of patient care (White et al. 1992). This process involves collecting information through the use of both scientific and intuitive assessment skills. This information is then interpreted by utilising knowledge and past experiences (Cioffi 2000, Tippins 2005).

There are many theories on how to teach these essential and dynamic skills; however, learning or the acquisition of new knowledge does not necessarily guarantee the clinical application of expert practice or critical thinking (Tippett 2004). Many theories on teaching and learning the art of critical thinking and expert clinical decision making are found; behaviourist, cognitive, and humanistic are the three commonly recognised (Sheehy & McCarthy 1998). The behaviourist theory relates to reactionary learning whereby the learning occurs when an unmet need causes the learner to embrace the learning process; unfortunately the inclination to learn is often stimulated by the learner feeling inadequate due to uncertainty and a lack of confidence. The cognitive theory relates to the interaction between the learner and their immediate environment, i.e. learning through experience and professional stimulation. The humanistic theory relates to adult-based learning where the focus is clearly on the learner ascertaining new knowledge through the process of self-discovery. A teacher who understands the present organised subject matter which is relevant to the learner's need will, therefore, encourage learning. The expert practitioner perceives the situation as a whole, uses past concrete situations as paradigms and moves to the accurate solution of the problem without wasteful consideration of a large number of irrelevant options.

The nursing process

The nursing process is a tool used by nurses to assist with decision making and to predict and evaluate the results of nursing actions (Reeves & Paul 2002). The deliberate intellectual activity of the nursing process guides the professional practice of nursing by providing care in a systematic manner. The nursing process has developed in recent years to incorporate five or six phases or stages (Lindberg et al. 1994, Oermann 1996, Wilkinson 2001, Reeves & Paul 2002).

Movement between these phases is unusually linear; there is free movement among the phases during clinical practice. Once an assessment begins, the nurse should begin to formulate some diagnoses and eliminate others.

Applying Theory to Practice: Box 1.1

Several key skills have been identified that facilitate the process of learning and empower the learner to independently further their own knowledge and understanding.

These key learning skills include:

- Information technology – literature searching skills, data retrieval, email, use of online resources and websites
- Communication – history taking and establishing a rapport, presentation of patient assessments and multidisciplinary team involvement
- Application of number – assessment of patient's clinical status using numerical data such as pain scoring, biochemistry results and the interpretation of individual's vital sign data
- Working with others – developing the ability to work within a small group, as part of a multidisciplinary team and to build short-term but mutually beneficial relationships with preceptors/mentors
- Improving own learning and performance – students need to reflect on new learning and evaluate their own performance within this area and simultaneously the amount of effort they used to achieve this
- Problem solving – developing the key skill of critical analysis and effective/decisive decision making.

The Nursing Process

1. Assessment – collection of subjective and objective clinical data to provide a rationale for care
2. Nursing/working diagnosis – analysis of physical presentation confirmed by scientific fact (data collection results)
3. Planning/outcome identification – plan of care and realistic goals discussed with patient
4. Implementation – performing interventions, reassess plan following each intervention to determine initial response
5. Evaluation – have expected outcomes been achieved? Determine patients level of clinical need and regularity of subsequent assessment

As more information is gathered, through physical and technological findings, the practitioner should begin to narrow the possibilities. The worst possible diagnosis should be paramount in the practitioner's hypotheses, as this must be addressed and eradicated before moving on. By using a systematic approach, patient problems can be identified and acted upon in the most effective way to ensure the best possible outcome for the patient. Examples of a systematic approach are those adopted by the Resuscitation Council (2006) on the Advanced Life Support (ALS) course with the ABC mnemonic: airway, breathing and circulation; and ABCDE: airway, breathing, circulation, disability and environment, taught on the Acute Life Threatening Events: Recognition and Treatment (ALERT) course, and by the American College of Surgeons (2005) in the Advanced Trauma Life Support (ATLS) course.

An obvious nursing diagnosis, such as difficulty in breathing with acute exacerbation of asthma, may be developed while data collection is still ongoing. In this situation implementation of life-saving actions (such as administration of oxygen therapy and bronchodilators) in which the desired outcome is obvious, may have begun before the assessment, diagnosis, outcome identification, and planning phases can be verbalised. Throughout the phases, reassessment can lead to immediate changes in any of the previous phases. Reassessment and the further collection and analysis of data are a continuous, ongoing dynamic process and should not be confused with evaluation, which measures outcomes. Reassessment may lead to a change in the working diagnosis, which in turn could lead to a change in outcome identification, planning, implementation and evaluation as the process continues. Although this process may appear complex, the novice can quickly begin to structure their patient assessment leading to early identification, action and evaluation.

Legislation and health policies

There have been massive improvements in health and life expectancy in recent years. A child born in Britain today on average will live nine years longer than one born when the NHS was first established in 1948 (Council for Science and Technology 2006). The current UK government have identified healthcare as an essential area of development, with healthcare being a focal point of their manifesto. In 2000, they published *The NHS Plan*, a White Paper identifying a 10-year plan for healthcare reform and development (DH 2000). *The NHS Plan* is available in a digestible format (executive summary) from the Department of Health's (DH) website dh.gov.uk. The government have also introduced several think tanks designed to introduce best practice and national standards based on the evaluation of both research and cost effectiveness; these include NICE (National Institute for Health and Clinical Excellence, formerly National Institute for Clinical Excellence). *The NHS Plan* identified:

- A lack of national standards
- Old-fashioned demarcations between staff and barriers between services
- A lack of clear incentives to improve performance
- The current approach to patient care delivery actually disempowered patients.

Of particular importance to nurses was the development of their role; this included the statement that in all areas of healthcare nurses would have the opportunity to extend their roles and that by 2004 over half of practising nurses would be able to supply medicines (under Patient Group Directions, Chapter 14).

The Government have recently established three core principles relating to public health:

- Informed choice
- Personalisation
- Working together (DH 2004).

The central focus is designed to assist individuals in making choices about their lifestyle that have a positive impact on their health. Providing healthcare within the community and assisting individuals in maintaining their independence are also contributory elements.

Do current government-driven health policies have an evidence base?

The improvement of the health of the entire population while simultaneously combating health inequalities should be central to any health philosophy. This requires well-informed and evidence-based policies, produced in combination with user groups and the professional organisations representing practitioners. In many areas where health policy has been dictated, it has demonstrated little clinical credibility by being unaudited and subsequently unevaluated. The setting of unrealistic goals has led to the development of unrealistic public expectations (DH 2001). The government's lack of clarity on many health topics and the failure of different government departments to act in unison have led to the Council for Science and Technology (2006) stating that both mechanisms for training government policy makers in the wider determinants of health and the use of evidence to assess them are needed.

In the modern era with evidence underpinning ever-increasing areas of healthcare it is unacceptable to think political parties can introduce both laws and local policies built upon obtaining short-term public accolade or demonstrating unfounded personal beliefs rather than introducing policies built upon a solid evidence base. This is reinforced by the Council for Science and Technology (2006) who state that the evidence base of government departments, not least the Department of Health, is at best patchy, at worst non-existent. Lord Darzi in his recently published interim review states that change should only be initiated when there is a clear and strong clinical basis for doing so. This may herald a new approach for ministers when examined in combination with the findings of the Council for Science and Technology (DH 2007).

The introduction of research and an evidence base to nursing practice

For many years healthcare delivery has been dependent on the particular skill base and subjective beliefs of individual practitioners (DH 2000). The modern approach to healthcare centres on each practitioner being able to work in unison with the patient to deliver a plan of care that envisages the patient as the central focus, and also involves an evidence base and cost effectiveness.

The argument surrounding the clinical application of theoretical knowledge has continued throughout nursing and healthcare education. *The NHS Plan* (DH 2000) identified the NHS as deficient in national evidence-based standards and, therefore, much of the practice was subject to individual interpretation. This initiated the current protocol-driven approach to care which aims to provide practitioners, and subsequently patients, with evidence-based objective treatment regimens, in contrast to individual subjective preferences. A prime example is demonstrated by the advanced life support algorithms, which have revolutionised multidisciplinary care delivery.

Changing practice within the vast institution of healthcare is a monumental task and to this end clinical governance was established. The clinical governance initiative is put into clinical practice by the National Institute for Health and Clinical Excellence (NICE). NICE, in conjunction with several specialist professional institutions, have released numerous national guidelines on specific patient presentations or illnesses. These are also supplemented by the DH's National Service Frameworks (NSF), which set clinical standards in relation to specific disorders, and specialist organisations such as the British Thoracic Society, which promote 'best practice'. These initiatives have combined to produce a constantly progressive clinical arena in which novice practitioners and students can easily become lost.

There is, therefore, a clear need to implement a tool or structure to the diagnostic process directly aimed at facilitating practitioners with the ability to base their clinical findings on objective rather than subjective data. This facilitation centres on two components: firstly, a solid understanding of the signs and symptoms associated with physical illness, and secondly, the application of critical thinking to practice. The first component is demonstrated throughout this book by experienced practitioners who discuss their own experiences in the form of patient scenarios which highlight both common clinical encounters and the frameworks and protocols they use to prioritise and manage patients quickly, appropriately and effectively. In addition, the clinicians discuss the associated anatomy and physiology, providing the reader with several key words or triggers. This enquiry-based learning approach promotes lifelong learning by encouraging the reader to seek key texts listed at the end of each chapter, thereby gaining further knowledge and understanding of the topics.

The importance of ethics in clinical decision making

'The ethics incorporated into good nursing practice are more important than knowledge of the law; practising ethically saves the effort of trying to know all the laws' (Hall 1996). Making decisions that are ethically sound can be extremely taxing for inexperienced nurses who seek to provide the best care for their patients. There are several tools a nurse can use to structure and re-evaluate their decisions (Tingle & Cribb 2007). Beauchamp and Childress (1994) provide a set of five basic principles to guide practitioners.

Non-maleficence

The first principle, non-maleficence, means to do no harm; this is directly linked to the nurse's duty to protect the patient's safety. Born out of the Hippocratic oath, this principle dictates that practitioners allow no harm to their patients.

Beneficence

The second principle, beneficence, is at the heart of everyday nursing practice. Beauchamp and Childress (1994) identify that beneficence requires taking action by 'helping or preventing harm, removing harm and promoting good'. A crucial component of beneficence centres on paternalism, which can be categorised as 'weak' or 'strong'. Weak paternalism implies protecting the patient when the patient is vulnerable and unable to make decisions. Strong paternalism involves interactions intended to benefit a person despite the fact that the person's risky choices and actions are informed, voluntary and autonomous (Beauchamp & Childress 1994).

Autonomy

The third ethical principle, autonomy, means that an individual has a right to self-determination, that is, to make decisions and choices about their health or life without interference from others.

Justice

The fourth ethical principle, justice, indicates giving each person, or group, what they are due. Justice is measured in terms of fairness and equality. In nursing, justice frequently focuses on impartial access to care and on the fair distribution of scarce resources. The postcode lottery and failure of clinical governance in many areas of care throughout the United Kingdom in recent times have made a mockery of 'just' decisions.

Privacy and confidentiality

The fifth ethical principle relates to privacy and confidentiality. Privacy is a fundamental right of each individual and, as such, it cannot be taken away from that person unless they choose to share it. Confidentiality, on the other hand, means that information shared with other persons regarding the patient will be used only for the purposes intended. A patient's sharing of private information imposes a duty of confidentiality on healthcare providers. That duty means providers will share information only on a need-to-know basis (NMC 2004a).

Nursing: career potentials

Nursing in the 21st century offers the student a diverse and rewarding career, second to none. Once qualified, and a consolidatory period of practice established, the nurse is ready to begin planning their future. Many specialist areas of practice will have a prerequisite that nurses have six months relevant experience prior to commencing with them. This is usually due to higher than normal patient dependency or the technical demands of the specialty. Teaching and educating others plays a major component of the nursing role; many nurses, therefore, undertake a coaching or mentoring course early in their career. There are many teaching pathways within nursing, with practice development or lecturing being two prime examples. These two roles offer the nurse great reward as they influence the knowledge and skills base of other practitioners and indirectly affect the care patients receive. The reintroduction of the matron role was seen by many as a paper exercise but this high-profile role does offer a focal point for professionals and patients. In addition, junior nurses have an easily identifiable role model and clear pathway of progression from staff nurse to senior staff nurse/junior sister/charge nurse to senior sister/charge nurse. Many areas also have a senior nurse supervising an area of practice and a matron overseeing several clinical areas. The roles of the nurse specialist, and the areas encompassed, have proliferated over recent years; most clinical areas will now have experienced nurses working at an advanced level. The grades of these specialists vary, with the role of the consultant nurse seen as the pinnacle position (DH 2000).

This chapter has discussed many key issues surrounding modern nursing including professional regulations, the importance of lifelong learning and maintaining an evidence-based approach established through the construction of a portfolio directly demonstrating professional development including clinical and ethical decision-making skills. Throughout the following chapters the reader can work at his or her own pace to gain extensive insight into the essential knowledge base required to deliver what can be called 'basic nursing care'. Undertaking the learning activity boxes and completing the end of chapter quizzes can assist in the development of this essential knowledge and skills base. As the reader progresses through their chosen educational programme, they will soon realise there is nothing basic about 'basic nursing care'. The ability to care for others in moments of their life when they have been affected by trauma, illness or psychological stress can provide the nurse with great satisfaction and self-fulfilment. Patients and their relatives are frequently vulnerable and require the demonstration of both professionalism and humanity from their nurse. The combination of these skills, which include information sharing and empathy, demonstrates a clinically knowledgeable nurse and a caring individual.

Work through the chapters at your own pace and return to the topics as you encounter them on your clinical placements, this will increase your understanding of clinical conditions and the potential care needs of the individual. Each chapter highlights methods of assessing and treating patients in an individual and dignified manner; in addition, each chapter provides several pertinent sources of further reading, including links to educational websites that convey best practice or relevant educational materials. I hope you enjoy this book and gain as much pleasure from it as we did writing it.

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Part 2
Body systems

2

Homeostasis

Andrea Blay

Chapter 2 Learning Objectives

- To gain knowledge and insight into the physiology related to the systems involved in maintaining homeostasis
- To gain insight into conditions related to dysfunction of these systems
- To apply theory to practice by understanding the clinical presentation when homeostatic failure occurs in patients
- To gain insight into pharmacological preparations to either prevent or treat relevant conditions
- To follow a structured approach to patient assessment thereby identifying homeostatic failure at a treatable stage
- To demonstrate evidence of professional development within your portfolio in relation to understanding homeostasis and homeostatic mechanisms
- To continue to develop the ability to question and critique the evidence base and effectiveness of plans of care for patients with a variety of problems affecting homeostatic problems

Introduction

Homeostasis refers to the state of functional equilibrium within the body's internal environment, namely the cells, tissues, organs and fluids (Clancy & McVicar 2002).

Maintenance of homeostasis depends primarily on providing an internal environment suitable for normal cellular function. Certain stimuli can result in alterations to the internal physical environment referred to as stressors, all of which have the ability to affect cellular function pathologically. Insults range from compromise to a specific cellular function, through to multi-organ failure and death. As a result, the internal environment is constantly changing or adapting; this is a direct result of physical, psychological and environmental stressors.

This chapter will define homeostasis and the homeostatic mechanisms essential to the normal functioning of healthy cells, which preserve the fundamental processes necessary to maintain cell, tissue and organ function i.e. life. One such example is the regulation of carbon dioxide, an acid and waste product of cellular metabolism which, if it accumulates, can lead to respiratory depression, hypoventilation or a low respiratory rate (<10 breaths/minute). Healthy lungs excrete carbon dioxide in water, which we exhale. Any diseases that affect the lung tissue or reduce the diffusion of gases across the alveolar–capillary membrane may affect the ability of the lungs to excrete carbon dioxide (Chapter 3).

The human body has many homeostatic mechanisms: thermal, chemical, neural and hormonal, which govern a multitude of cellular processes. Some processes are more familiar to us and more common than others, such as the production of insulin, the regulation of food intake, water and electrolyte balance, the hypothalamic control of body temperature, the maintenance of cardiac output, oxygen and carbon dioxide levels, and the balance between acidity and alkalinity as a consequence of metabolism. Others are less known but are of no less importance, such as calcium homeostasis for the remodelling and repair of bones (Chapter 8). A myriad of hormones released by the thyroid gland control growth, the sleep–wake cycle, and the body's response to stress and illness to maintain health.

Throughout the 24-hour cycle the body continuously adjusts all of these mechanisms, and many others, to maintain equilibrium and optimum cell function. During illness or excessive or prolonged exposure to stressors, the ability of the body to self-regulate and maintain an optimum internal environment by manipulating these finely tuned mechanisms is exceeded and cells and organs dysfunction; this can manifest as acute or chronic disease.

There are many different symptoms and clinical presentations associated with homeostatic failure; in fact most of the clinical conditions presented by patients are as a result of a failure on some level. This chapter will demonstrate how homeostatic failure is related to specific diseases, such as diabetes; case examples will illustrate the complexity of such clinical presentations and relevant investigations, and the clinical care required will be reviewed. The challenge for nurses is to be able to link the symptoms to the altered pathophysiology of the many diseases associated with homeostasis, and to understand the role of the nurse in supporting patients with a variety of clinical problems as a result of homeostatic failure. Questions should focus on understanding which assessments and investigations the patient may undergo. Which observations should be performed in the acute stages of homeostatic failure? How should treatment and management plans be constructed and evaluated? What information is required by the patient from healthcare professionals to adjust life styles such as those with newly diagnosed diabetes or renal failure?

Applying Theory to Practice: Exercise 2.1

Before commencing this chapter:

- Identify which organs or glands you already know that are involved in maintaining homeostasis
- Compose a list of diseases that you already know that affect the body's ability to maintain homeostatic function in relation to temperature, blood pressure, water balance, glucose control and acid base
- Add this list to your developing portfolio and on completion of this chapter expand your portfolio with the new disorders you have gained knowledge of and elaborate on how these disorders affect physiological function and how to recognise homeostatic failure
- This might include the patient's history, clinical presentation and tests such as blood analysis

Homeostatic feedback mechanisms: a matter of balance

As a nurse you need to understand how the different hormones and chemicals are 'switched' on and off, or how they are regulated up or down in response to a stimulus. These mechanisms operate on feedback systems that either result in a positive or negative response. For a system to operate, there must be detectors and effectors, which are ultimately coordinated by nerve centres, most often the hypothalamus in the brain. A feedback mechanism is one in which a positive effect is seen, with the release of chemicals or hormones which target specific cells or organs to achieve the desired effect.

Detectors are mostly nerve receptors that detect changes and monitor the variable that needs to be controlled. An example of a detector would be baroreceptors or stretch receptors that detect changes in blood volume by the amount of 'stretch' or volume of blood in the carotid sinus and arch of the aorta. When the circulating blood volume falls, as in haemorrhage, the baroreceptors send impulses back to the brain, or coordinating centre. In turn, via the autonomic nervous system, several mechanisms are stimulated, all aimed at increasing and redirecting the circulating volume and restoring blood pressure (Figure 2.1).

An effector is a gland, organ or muscle that will bring about or 'effect' the change (Figure 2.1). The release of catecholamines, such as noradrenaline and adrenaline, from sympathetic nerve endings causes an increase in heart rate in an attempt to raise cardiac output. When we review the mechanisms of hypotension, there are many effectors that come into play to try to raise the blood pressure; these will be discussed later in the chapter.

A negative feedback system is designed to respond in the opposite direction of the deviation so that the deviation is reduced in potency or shut off, causing the opposite effect to occur i.e. a drop in blood pressure. The deviation feeds back to the cardiovascular system, in this case via the brain, to reverse or alter the direction of the deviation or reduce its potency, in other words, to halt the hypotension. Equilibrium is achieved as the blood pressure is restored to normal, achieving homeostasis.

A positive feedback system responds in the same direction as the initial stimulus, enhancing the potency of and amplifying the stimulus rather than controlling, reducing or shutting off the deviation. An example would be the activation of the clotting cascade in response to haemorrhage. The up-regulation and production of clotting factors are amplified to control bleeding and achieve haemostasis.

Failures in homeostatic mechanisms can lead to life-threatening clinical emergencies such as severe hypotension, hypo- or hyperglycaemia, haemorrhage, and acid-base imbalances, which can cause patients to

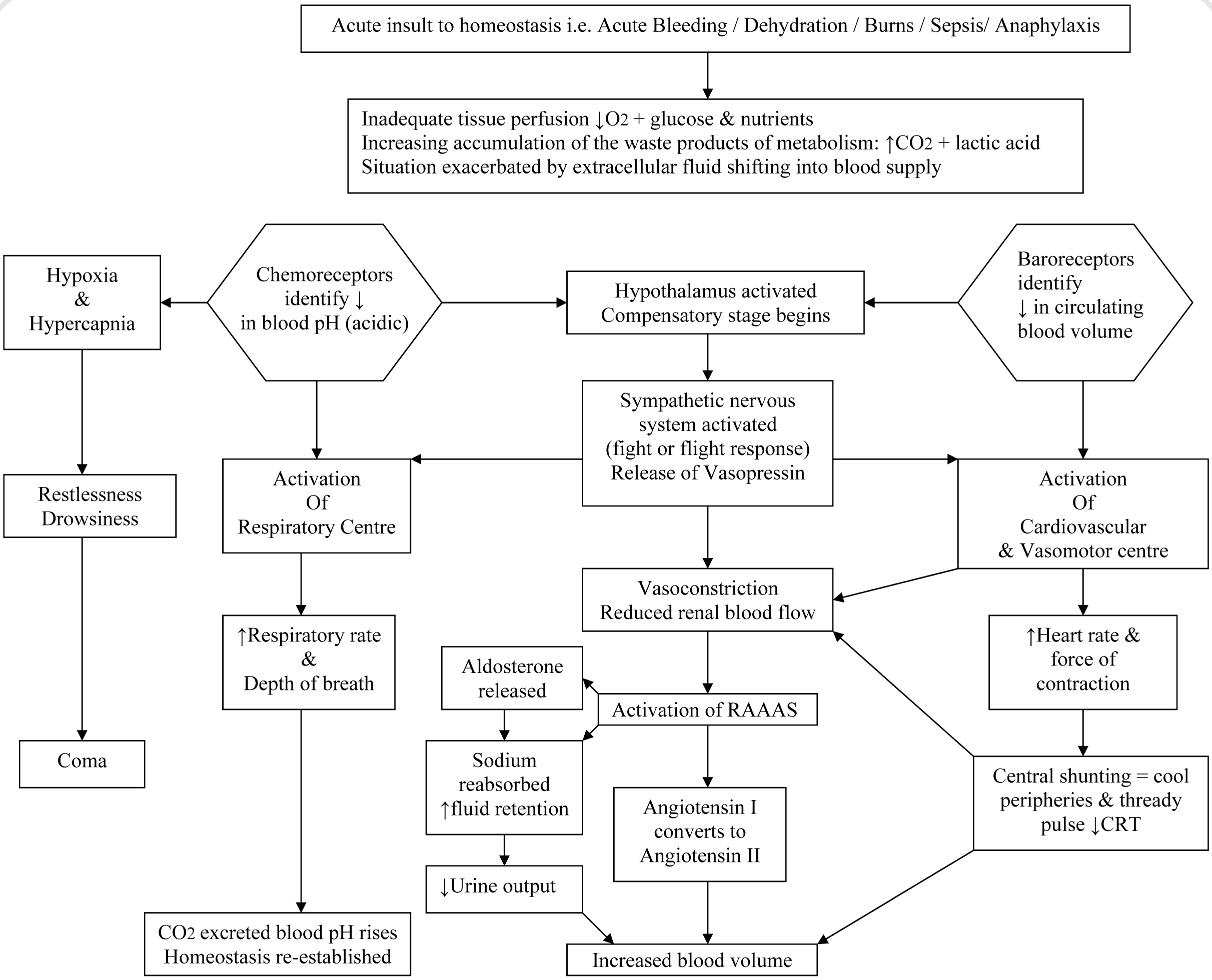

Figure 2.1 Maintaining homeostasis

develop renal failure and ultimately cardiac arrest or death. Extreme homeostatic failure can lead to the development of multi-organ dysfunction syndrome (MODS) necessitating admission to intensive care units.

The hypothalamus

One of the most important homeostatic regions of the body is the hypothalamus, situated below the thalamus on top of the brain stem and comprising the base of the third ventricle. It is the nerve control centre for many autonomic responses, which include respiratory rate and depth, heart rate and force of contraction, blood pressure and gut motility. Metabolic control includes body temperature regulation, water balance and thirst control, hunger and fullness mechanisms, which are linked to glucose and insulin levels, and regulation of the sleep–wake cycle or 'biological clock'. Emotional responses such as fear, rage and pleasure are also under hypothalamic control as the hypothalamus sits within the limbic centre, an area responsible for emotional responses, which are relayed via the autonomic nerve pathways of the hypothalamus (Figure 2.2).

The hypothalamus exerts its effects through two main mechanisms: the release of hormones and activation of nervous pathways to achieve the desired effect. The hypothalamus is in close contact with other important centres, the pituitary gland and the mammillary bodies or nuclei that are involved in the sense of smell (olfactory pathways).

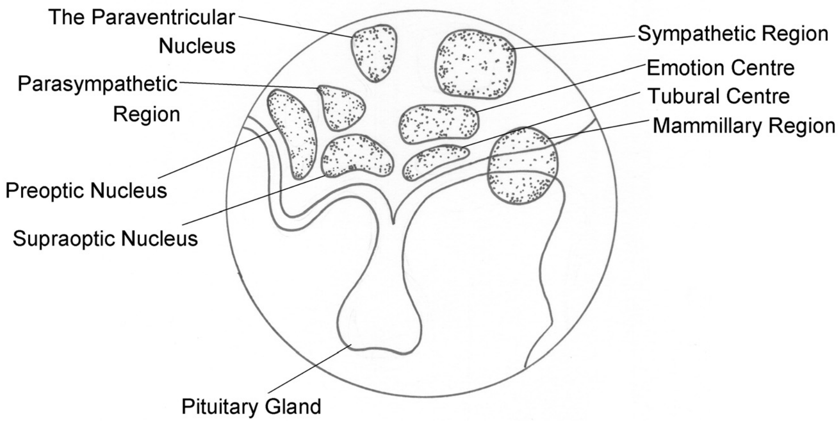

Figure 2.2 Structure of the hypothalamus

Regulation and control of temperature

The main thermoregulation centre in the hypothalamus is the preoptic region (Figure 2.2), which regulates temperature via the autonomic nervous system (ANS). This area comprises of a heat-loss and heat-promoting centre or the thermoregulatory centre. Humans maintain a constant core temperature about 37ºC which is independent of the surrounding environment. We are capable of living in extreme climates with the external temperature ranging from –52ºC to +49ºC (Hinchliffe et al. 1999).

The core temperature is shared between the organs within the skull, thoracic and abdominal cavities; these deep-seated organs have the highest temperature. The shell or periphery is the heat loss surface; the organs and deeper vessels are separated from the skin by a layer of fatty tissue, which acts as an insulating layer during cold weather. The skin has the lowest temperature and this can range from 27ºC on the toes to 34ºC on the forehead (Hinchliffe et al. 1999). A temperature gradient therefore exists between the core and the periphery. Sometimes patients who have severe infections can have a high core temperature of >39ºC but peripherally they can be cold demonstrating peripheral shutdown, often a sign of severe sepsis and circulatory collapse. Exercising skeletal muscles can generate 30–40 times more heat compared to the rest of the body (Marieb 1998). Heat or cold is detected by peripheral receptors (afferents) located in the skin and central thermoreceptors that detect blood temperature are located in the core.

The hypothalamus responds to input via autonomic efferent pathways. The nature of the stimulus will determine the character of the physiological response; whether to gain heat by shivering and vasoconstriction of the periphery or to promote heat loss by sweating and vasodilation of the periphery. (Figure 2.3).

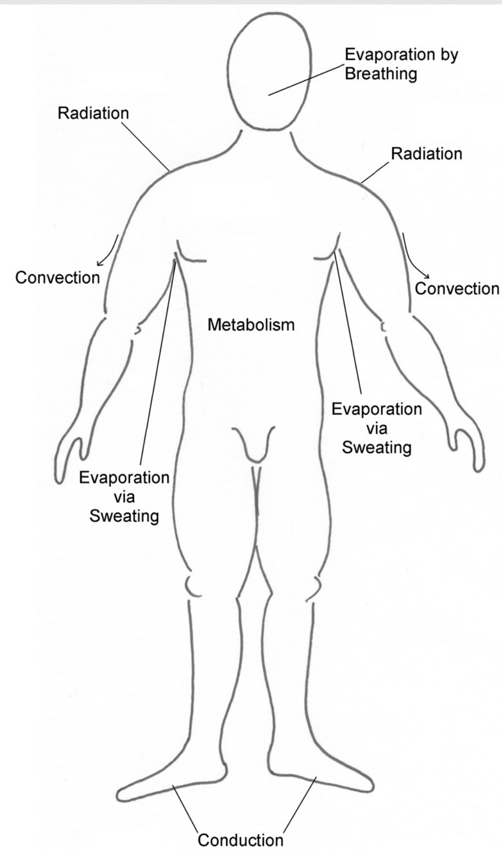

Figure 2.3 Heat loss and heat-generating mechanisms

Anatomy and Physiology in Action: Box 2.1

Maintaining Homeostatic Balance of Heat Loss and Heat Gain		
Radiation: heat is lost as infrared waves from the body to the air. A dense object like the body will transfer heat to the environment. Energy flow is always from warmer to cooler air/objects (Marieb 1998).	Conduction or convection: the transfer of heat between objects in contact with each other. It involves molecule-to-molecule contact. Thermal energy moves through a medium such as fluid. Convection is the transfer of heat to the air, causing warm air to expand and rise. The cooler air becomes denser and falls: the warmed air is continually replaced by cool air. This mechanism enhances the exchange of heat from the body surface to air – as the cooler air absorbs heat by conduction. That is how a summer breeze on a hot day cools the skin.	Evaporation: the conversion of water from a liquid into a gas or water vapour. Water molecules absorb heat from the environment – called the heat of vaporisation. The kinetic energy or temperature of the liquid will determine how much energy is generated and hence water vapour produced. An example is demonstrated by huskies in the Antarctic – as the huskies exhale, heat is lost as water vapour and because the surrounding air temperature is –28°C the water vapour is visible.
	Conduction and convection account for 15–20% of heat loss (Marieb 1998). Think about this statement – what might that mean for patients? Patients who experience fever are often fanned: this is called forced convection – fanning enhances the heat loss process. Patients should not be directly fanned as this can cause shivering and generate heat to inadvertently raise the temperature. Try the experiment on yourself or a colleague. Keep the fan on one part of the body for 10 minutes or more and see the effects.	Insensible water loss. Water vapour is lost via respiration, the mucosa of the mouth and skin. A patient with a chest infection on oxygen with a respiratory rate of 40 breaths/minute can lose water vapour due to the high respiratory rate and pulmonary secretions. This is exacerbated by the drying effects of oxygen and enhances the feeling of dehydration. During vigorous exercise the body can perspire and evaporate up to 2L of water just through sweat. In normal resting conditions and in environmental temperatures of 31°C–32°C the sweat glands produce 0.5L sweat/day. Sweat output increases up to 12L of body water/day depending on the external temperature and degree of humidity.

Heat-generating mechanisms

The peripheral receptors send impulses when the blood is cooler than the hypothalamic set point to the posterior heat-promoting centre.

Applying Theory to Practice: Exercise 2.2

- How does the body generate heat in response to cold external temperatures or following immersion in cold water or an infusion of cold fluids during a blood transfusion or prolonged resuscitation?

Administering cold intravenous fluids can quickly cause hypothermia in an already compromised patient.

- How can this be prevented?

Under the control of the sympathetic nervous system, vasoconstriction of the periphery is activated, diverting blood flow away from the skin surface to deeper tissues and vessels by closing precapillary sphincters and reducing blood flow to the skin. Patients who are very cold may have white, marble-like skin which may be cyanosed; this is caused by the trapping of blood in the periphery with loss of oxygen from the blood to the tissues, hence the blue tinge of the skin (Hinchliffe et al. 1999). The hairs or pili on our skin play a part in trapping heat; each hair follicle is attached to erector muscles which help to lift the hair follicle – the trapped heat acts as an insulting layer. This makes our hairs stand on end and also gives us goose pimples or bumps.

Another effective way of raising the core body temperature is shivering. Any muscle activity will increase the body temperature; shivering is activated by the hypothalamus when the shell temperature falls below 35ºC. Shivering is much more effective as a mechanism at higher temperatures as the muscles become weak and uncoordinated at lower temperatures. In the elderly, shivering is much reduced due to an ineffective response to sympathetic activity. The elderly can lose heat over a period of time and therefore may not take effective measures to raise the body temperature.

Thyroxine (T_4) is an important hormone secreted by the thyroid gland that stimulates metabolically active cells

Applying Theory to Practice: Exercise 2.3

Review the warming devices in your clinical areas that are available to warm patients and fluids

- Which mechanisms of heat production are employed?
- Which is the most effective?

to consume oxygen; this is called the calorigenic effect (Ganong 1995) and is effective in raising the basal metabolic rate (BMR). Chemicals such as adrenaline and noradrenaline also raise the body temperature by increasing the BMR and heat is gained. Another provider of heat is the powerhouse of the body, the liver. Through its enzymatic functions and processes it provides a constant source of heat.

Anatomy and Physiology in Action: Exercise 2.4

Thyroxine is an important hormone released by the thyroid gland. Identify the anatomical position of the thyroid gland and make a list of the functions of the different hormones released by the gland.

Removal of the thyroid is called a thyroidectomy

- For what reasons can this occur?

Heat loss mechanisms

During warmer weather the increased air temperature causes vasodilation of dermal blood vessels bringing the vessels close to the skin surface so that heat can be lost via conduction, radiation and convection. In addition, stimulation of the sweat glands via sympathetic fibres helps to cool the body by the process of evaporation. This negative feedback system is finely tuned to maintain the hypothalamic set point; during warmer weather the heat promoting centre is inhibited and the heat loss centre is activated.

Anatomy and Physiology in Action: Exercise 2.5

- Using Figure 2.1 apply the feedback pathway to the regulation of temperature. Draw the pathway and insert the mechanisms that are related to the homeostatic control of temperature.
- What and where would the receptors and effectors be located?
- What effectors are found within the skin that result in sweating and shivering?
- Make a list of the factors that affect heat gain and heat loss.

Developing and Delivering Expert Care: Box 2.2

Normal Body Temperature

The body can only function within a narrow temperature range between 35.6º–37.8°C despite changes in air temperature.

Body temperature fluctuates about 1 degree in 24 hrs. It is lowest in the early morning and highest in the early evening.

Temperature helps maintain optimal enzymatic function for effective cell metabolism.

Increases in the temperature will increase enzymatic activity or catalysis – therefore each rise of 1°C results in a 10% increase in chemical reactions (Marieb 1998).

Temperatures above 41°C can cause convulsions. The upper limit for life is 43°C although there are case reports of patients surviving beyond this upper limit. At this temperature proteins begin to denature and cell function is destroyed.

Hypothermia is a core temperature below 35°C. Heat-generating mechanisms are activated such as shivering and erector pili muscles.

At 34ºC intense shivering occurs, there is difficulty in the movement of digits, changes in skin colour – cyanosis and some confusion or behavioural changes may occur.

At 30ºC–32ºC shivering progressively ceases. There is increased sleepiness, bradycardia or slowed heartbeat, shallow respirations and moderate confusion.

At 28ºC the patient may appear dead. If uncorrected, coma, cardiac arrest from severe rhythm disturbances or respiratory arrest and death will occur when the body temperature approaches 21ºC.

Pathology of fever

Fever is also known as pyrexia or controlled hyperthermia. It is derived from the Latin word *febris* or febrile. Fever occurs when the body temporarily fails to maintain the temperature within normal limits. The set-point is elevated by 1–2º C and is a symptom of many medical conditions. White blood cells and macrophages release endogenous (internal) pyrogens (fire starters) or cytokines into the bloodstream. These chemicals act directly on the thermostat in the hypothalamus causing the release of prostaglandins and elevating or re-setting the set-point. Fever also increases the basal metabolic rate; it inhibits the growth of bacteria thus assisting the body's defence mechanisms to fight invading pathogens, eating is inhibited (anorexia) and proteins are denatured which can result in irreversible brain damage.

Figure 2.4 Mercury thermometer

Developing and Delivering Expert Care: Exercise 2.6

Classification of Fever

Pyrexia (fever) can be classed as

- Low-grade: 38–39°C (100.4–102.2°F)
- Moderate: 39–40°C (102.2–104°F)
- High-grade: >40°C (>104°F)
- Hyperpyrexia: >42°C (>107.6°F) (a medical emergency)

During clinical placements identify patients who have changes in temperature.

- Can you identify the causes?
- What treatments are required to manage patients with hypothermia and hyperpyrexia?

Applying Theory to Practice: Exercise 2.7

Causes of Fever

Under the following three headings identify some of the micro-organisms, diseases or therapies that might cause a fever:

- Infections: ....
- Inflammation: ....
- Allergic reactions: ....

Cancer and chemotherapy treatments can also induce a fever due to tumour necrosis. Brain injuries can cause fever that is unresponsive to cooling measures and anti-pyretics. Why might that be?

Review the location of the hypothalamus.

Immunological diseases like lupus erythematosus, sarcoidosis and inflammatory bowel diseases can also cause fever.

The destruction of tissues which can occur in **haemolysis**, surgery, myocardial infarction, crush syndrome, **rhabdomyolysis** and cerebral hemorrhage may induce fever.

- In clinical practice see if you can identify patients who have experienced some of the diseases or treatments mentioned.

Drugs can also cause a 'drug fever' either as a direct consequence of the drug or as an adverse reaction to the drug (e.g. antibiotics). Discontinuation of some drugs like heroin can induce a fever.

The homeostatic control of blood pressure

Before discussing the compensatory mechanisms deployed to control blood pressure we need to review some commonly used definitions. Blood pressure is defined as the force or pressure exerted on blood vessel walls by the circulating volume of blood in a closed system. Blood pressure is a hydrostatic pressure as the blood is confined within a closed system; confined liquids exert a pressure against the walls of the container and therefore any changes in flow, viscosity, resistance and structure will influence the pressure. See Chapter 4 for a more in-depth review of the cardiac cycle.

Applying Theory to Practice: Exercise 2.8

Thermometers

The first thermometers were used nearly 300 years ago based on the principles of a liquid (mercury) expanding in a sealed glass bulb (Figure 2.4). The temperature is recorded along a scale on the thermometer. There are two temperature scales in use today, Fahrenheit and Celsius. In the UK, Celsius is commonly used.

Mercury thermometers were used to take the temperature orally: from the axilla, mouth and rectum. There was also a low-grade thermometer, which had a blue-coloured bulb for easy identification. Today there are many alternatives to thermometry.

- Identify which thermometers are used within your practice areas.
- How are they cleaned? Does this affect their reliability?
- Why do they use this system? Are they research based?

Developing and Delivering Expert Care: Exercise 2.9

Recording the Temperature

Normal Temperature Readings:

Rectal temperature 0.5°C higher than the oral temperature

Otic temperature or tympanic (ear) is at, or higher than 38°C (100.4°F)

Oral temperature is at, or higher than 36.5°C–37.5°C (99.5°F)

Axillary temperature is at, or higher than 37.2°C (99°F)

- Identify in your clinical area which methods are utilised to measure the temperature (chemical, digital, tympanic or temporal).
- How is temperature monitored during surgery?
- Identify what alternatives may be used to monitor unconscious patients who cannot shiver or change their body temperature due to anaesthesia.

The 'gold standard' of temperature measurement is either the pulmonary artery catheter (PAC) or any device that can measure the blood temperature directly. The problem with these devices is that they are highly invasive and are only available in high dependency and intensive care settings.

Pulse pressure

The pulse pressure is the difference between the maximal systolic pressure and minimal diastolic pressure (Klabunde 2005). The pulse pressure is affected by the stroke volume and the elasticity of the arteries. If the 'normal' blood pressure in healthy adults is 120/80mmHg, then the 'normal' pulse pressure is roughly 40mmHg. Increases in heart rate and contractility can widen the pulse pressure as can head injuries associated with raised intracranial pressure. A narrowed pulse pressure is seen in hypovolaemia, septic shock, in patients on glycerine trinitrate (GTN) infusions (a potent vasodilator), or during major haemorrhage when the systolic pressure falls due to reduced arterial stretch; the diastolic pressure may drop slightly but often remains fairly constant. If you refer to the case study of Mark Bradbury on p. 32, his blood pressure has dropped to 85/45mmHg, he has a narrowed pulse pressure of 30mmHg. The clinical significance of severe blood loss resulting in a reduced or narrowed pulse pressure is that oxygen delivery to the tissues and subsequently the cell is compromised, resulting in cellular dysfunction.

Scenario 2.1

Major Haemorrhage

Mr Mark Bradbury, a 35-year-old Caucasian man is admitted to the emergency department following a road traffic accident. He sustained an open fractured right femur, ruptured spleen and a fractured pelvis, resulting in internal bleeding, and lacerations to his face and hands.

On examination he is pale, cold and clammy

His vital signs are:

Airway – Clear

Breathing – Respiratory rate 36, SpO2 95% on 12L/minute O_2 via non-rebreathe system

Circulation – Pulse 120, weak, regular. Blood pressure 85/45mmHg. Capillary refill time >4 seconds. Blood glucose 4.8mmols/L.

Disability – Patient responds only to voice on the AVPU scale = V. Pupils – Pupils equal and reactive to light (PEARL)

Exposure – Open/compound fracture right leg. Distended abdomen, tender with evidence of guarding in left upper quadrant. Lacerations to face and hands Temperature 35.6°C.

Past medical history (PMH): Nil of note

Social – Smokes 30/day. Alcohol: 20 units/week. Lives alone.

Mean arterial pressure (MAP)

Another important pressure recording is the mean or average arterial blood pressure (MAP). It is often recorded in brackets beside the blood pressure reading on monitors. The MAP reflects the perfusing pressure needed to maintain arterial blood flow and hence oxygen delivery to tissues and organs during each cardiac cycle. A MAP of 60mmHg is necessary to supply the coronary and cerebral arteries and the kidneys, which are more sensitive to pressure changes than other organs. The normal mean arterial pressure range is 70–110mmHg. At normal resting heart rates it can be calculated simply as the following equation in Anatomy and Physiology in Action: Box 2.3.

Anatomy and Physiology in Action: Box 2.3

MAP = systolic + (diastolic x 2)/3

Normal diastolic filling time is twice as long as the systolic time and is therefore measured twice. In patients who are unstable, this is a less accurate method but trends are helpful in assessing how the organs are being perfused guiding clinical judgement and interventions.

In Scenario 2.1 Mr Bradbury's current cardiovascular status is reduced; this is identified through the reduced capillary refill time and the MAP, which is calculated at 56mmHg. In a young and fit person this MAP is relatively normal and is well tolerated, but even the young and fit can experience renal compromise if the insult is sustained or the MAP is reduced even further over a number of hours causing renal impairment and failure of other organs.

Developing and Delivering Expert Care: Exercise 2.10

Calculate the pulse pressure and MAP from the following blood pressure recordings

120/80 mmHg =
90/50 mmHg =
160/90 mmHg =
70/40 mmHg =

Anatomy and Physiology in Action: Box 2.4

Mean Arterial Pressure (MAP) – Why is this so important?

Essentially there is no 'normal blood pressure' for many patients with cardiovascular disease. Healthcare professionals can get caught out if a 'normal' blood pressure is recorded which might not be 'normal' for that patient. Another way of defining 'normal' blood pressure is whatever pressure is required to maintain organ function. As we age, that will certainly rise as arteries lose their elasticity and resistance increases. If the BP drops more than 30mmHg below 'normal' or premorbid blood pressure, it should be considered as hypotension for that patient.

For example, if the BP is 180/90 –
MAP = 180 + (90 x 2) = 360/3 = 120mmHg

If the BP drops to 120/80 this would not be recognised as significant by healthcare professionals as it lies within the 'normal' range. Attempts to restore the BP are not undertaken and this can result in organ failure.

MAP = 120 + (80 x 2) = 280/3 = 89mmHg

As you can see, there is a difference of about 30mmHg between the two MAPs; for some patients this may be the difference between maintaining the fine balance between adequate blood flow to the tissues and ischaemia and MODS.

Many patients can maintain perfusion even if the blood pressure is lower than normal; the important determining factor is whether the patient can maintain sufficient cardiac output and oxygen delivery to the vital organs over a period of time. Cardiac output is very difficult to measure outside of critical care areas. A much cheaper and simpler method is urine output. The kidneys are a very good indicator of adequate perfusion; you can measure the volume hourly, observe the colour and concentration, analyse the blood urea and electrolytes in relation to the history, clinical information and diagnosis.

Renal blood flow

Why are the kidneys so sensitive to blood pressure changes? Despite their innate ability to auto-regulate blood flow over a wide and variable blood pressure range (80–180mmHg), during periods of hypotension they cannot maintain this state for too long without ischaemia occurring. It's because they receive approximately 20–25% of the cardiac output per minute, which they are dependent upon. Normal cardiac output is roughly 5L/minute or 5000ml/minute. Renal blood flow is approximately 400ml/min/100g at rest. The kidneys require a high blood flow, as the primary function of the kidney is to filter blood and produce urine. Most of the filtration of the blood occurs in the cortex region of the kidney.

The hydrostatic pressure within the glomerular capillaries is much higher than in normal capillaries; this is important in maintaining the glomerular filtration rate within the Bowman's capsule. The kidney is richly innervated by sympathetic noradrenergic nerve fibres, which maintain the glomerular filtration rate (GFR) by altering the diameter of the afferent arterioles if arterial pressure falls. The afferent arteriole dilates to maintain blood flow and pressure within the glomerular capillary. Prostaglandin E_2 (PGE_2) is synthesised in the renal medulla cells and is a potent vasodilator. The kidney is able to maintain function and GFR by a combination of autoregulatory mechanisms across a wide range of pressures from 80–180mmHg and renal vasodilation.

In acutely unwell patients the urine output should be calculated using the following formula: 0.5ml/kg/hr.

It is essential that an accurate weight assessment is made to guide the amount of urine expected per hour.

Calculate the following:

Weight is 80kg. How much urine should the patient pass/hour?

80 x 0.5 = ml/hr

Ageing, arterial wall changes and other factors can affect the MAP, especially in the elderly; this makes it more difficult for blood to flow through the arteries due to changes in the luminal wall of the artery. As the pressure is increased along the length of the arteriole, the MAP will also increase; over time a higher MAP is required to maintain arterial circulation to the organs. A sustained fall in MAP as a result of hypovolaemia, dehydration, sepsis or myocardial injury can lead to ischaemia resulting in organ failure.

Before discussing the homeostatic control of blood pressure it is important to include a brief overview of oxygen supply and demand. Outside of intensive care units it is difficult to monitor whether the oxygen supply to the tissues is adequate or not. When patients experience an inadequate oxygen supply to metabolically active cells an oxygen debt is accrued, which, if not corrected, can lead to chest pain and myocardial infarction, rhythm disturbances, confusion, gut ischaemia, organ failure and many other clinical manifestations associated with hypoxia and lactic acidosis. It is important as nurses that we appreciate and understand our role when recording observations, particularly the respiration rate and oxygen saturations which may be the first clinical warning signs that there is a problem; we need to act on these early warning signs by communicating this in a timely fashion to medical colleagues and to ensure that appropriate interventions are commenced to correct the problem and to restore homeostasis as quickly as possible.

Oxygen delivery

The primary function of the cardiovascular system is to maintain adequate blood supply, nutrients and oxygen essential for aerobic respiration and to remove the waste products of cellular functions. The delivery of oxygen to tissues is dependent on availability in the atmosphere, diffusion of the gas across the alveolar–capillary membrane, haemoglobin-carrying capacity and finally the diffusion of oxygen down its concentration gradient across the cell membrane to be utilised by the mitochondria for energy or adenosine tri-phosphate (ATP) production.

Oxygen delivery can be represented by the equation outlined in Exercise Anatomy and Physiology in Action: Box 2.5.

The amount of oxygen delivered to the tissues in a healthy adult is about 1000ml/minute or 550ml/min/m^2. Normal oxygen consumption (VO_2) is 250ml/minute or 140ml/min/m^2 (Hinds & Watson 1996).

Anatomy and Physiology in Action: Exercise 2.11

DO_2 = Q (Hb x 1.34 x SaO_2)

DO2 = delivery of oxygen, Q = cardiac output

- Why is this important to maintain particularly in patients with homeostatic failure?
- What simple blood test is performed to analyse oxygen content in the blood?

Controlling and maintaining acid base balance

Let us now look at the acid base balance of fluids which is essentially the regulation of hydrogen (H^+) ion concentration of extracellular fluid (ECF). All cells are very sensitive to changes in H^+ ion concentration. You may have heard of the pH scale which is used to denote the H^+ ion concentration in solution or alternatively the number of moles per litre of molarity. The scale ranges from 0–14. It is logarithmic, that is, each change of one pH unit equals a tenfold increase in H^+ concentration: this is an important point to remember that can have profound clinical implications. The pH of a solution is defined as the negative logarithm of the hydrogen ion concentration [H^+] in moles/litre or –log [H^+] (Marieb 1998).

Anatomy and Physiology in Action: Box 2.5

The normal or optimal pH range for arterial blood = 7.4
Venous and interstitial fluid pH = 7.35
Intracellular fluid pH = 7.0
Arterial blood gases actually measure the true plasma pH. Any reading below 7.40 is acidosis and above 7.40 is alkalosis.

Normal Arterial Blood Gas Values:
pH = 7.35–7.45
$PaCO_2$ = 4.5–6.0 kPa (kilopascals is the unit of measurement)
PaO_2 = 10.6–13.3 kPa
HCO_3 = 22–26mmols
Base excess or deficit (BE) = –2 to +2

Anatomy and Physiology in Action: Box 2.6

Understanding the Terminology: Acids and Bases

Acids are proton donors

Bases are proton acceptors

Strong acids e.g. hydrogen chloride (HCl) completely dissociate in H_2O which binds to H^+

Strong bases dissociate quickly

Weak acids e.g. carbonic acid (H_2CO_3) do not completely dissociate

Weak bases e.g. sodium bicarbonate ($NaHCO_3$) ionise incompletely

Bicarbonate is the most important inorganic buffer acting as an alkaline reserve

The equation below summarises the homeostatic balance between acid and base and the role of the main buffering systems of the body the lungs and kidneys. The arrows denote that the process is dynamic and bi-directional.

$CO_2 + H_2O \leftrightarrow H_2CO_3^- \leftrightarrow HCO_3^- + H^+$

Carbon dioxide production, transport and excretion

A by-product of respiration is carbon dioxide (CO_2) produced in large amounts by cellular processes; it is an important influence on the pH of the blood. We produce approximately 15,000 to 20,000 mmol of CO_2 each day or 200ml/minute (Marieb 1998). The body is constantly balancing the pH of the blood and ECF to maintain equilibrium.

CO_2 is transported by three mechanisms; 60% is converted into bicarbonate (HCO_3^-) ions formed by the reaction of CO_2 and H_2O at tissue level, this forms a weak acidic solution – carbonic acid (H_2CO_3). CO_2 is transported in solution in the blood, as carbonic acid rapidly dissociates into bicarbonate (HCO_3^-) and H^+ ions in the presence of an enzyme carbonic anhydrase found mainly in red blood cells. As the blood passes across the alveolar capillary membrane, CO_2 diffuses from the capillary into the alveolar sac and is excreted by the lungs.

The body is very sensitive to minute changes in pH, CO_2 and O_2 levels. Excretion of CO_2 via the respiratory system is regulated by peripheral chemoreceptors found in the carotid bodies and aortic arch and central receptors in the medulla which are sensitive to the pH of the cerebrospinal fluid (CSF). CO_2 diffuses easily across the blood–brain barrier whereas H^+ and HCO_3^- do not. The response is mediated by the medulla, increasing impulses to the phrenic nerve which innervates the diaphragm and the intercostal nerves which innervate the intercostal muscles to increase the rate and depth of respirations within 1–3 minutes to rebalance CO_2 concentration.

Carbonate–bicarbonate buffering system

The kidneys are the main regulators of acid base along with proteins, blood (Hb) and acids which act as buffers to control sudden changes in pH. When the pH rises, H^+ ions (act as acids) are released to mop up the excess base. When the pH drops (acidosis) H^+ ions bind to raise pH back to normal. This results in shifting the blood pH within normal limits as H^+ is removed or added to blood. Why is the H^+ ion concentration so important? Essentially cells can become denatured and destroyed within a few hours if the pH is <6.8 or >8.0 even for a few hours. The kidneys may take a few hours or even days to alter the pH. What might happen to the delicate balance between acid and base if the patient has renal failure?

The phosphate buffer system is present in low concentrations in the ECF. The buffering systems include sodium salts of dihydrogen phosphate ($H_2PO_4^-$) and monohydrogen phosphate (HPO_4^{2-}) which are effective intracellular fluid buffers when phosphate levels are high. Some 75 per cent of all buffering occurs within the cells and plasma proteins. Amino acids are also involved in buffering; groups of atoms carboxyl (-COOH) dissociate and release H^+ ions as the pH rises, amino acids act as bases and accept protons (H^+) to reduce the acidity of solutions. The kidneys have a number of functions maintaining acid-base homeostasis. They excrete other acids generated by cellular metabolism e.g. phosphoric, uric and lactic acid and ketone bodies. They regenerate new bicarbonate ions and replenish the stores as HCO_3^- is excreted from the lungs.

Developing and Delivering Expert Practice: Exercise 2.12

There are four main blood gas derangements:

- Respiratory acidosis
- Respiratory alkalosis
- Metabolic acidosis
- Metabolic alkalosis

Can you identify the causes of each of the above acid base disturbances and also determine whether the pH will be acidic or alkaline, and whether the CO_2 and HCO_3^- will be elevated or lowered? Interpreting blood gases is complicated and takes time, in your clinical areas collect some examples and see if you can work them out. Get a colleague to check your answers.

In summary

Acid base balance is a dynamic and constantly changing process. It is dependent on functioning lungs and kidneys, adequate haemoglobin and steady homeostatic states. When patients experience an insult such as Mark Bradbury has, this fine balance is disrupted and compensatory mechanisms are activated. If the insult is overwhelming despite the activation of the above mechanisms, decompensation will occur which may result in respiratory and/or cardiac arrest if uncorrected.

Control of insulin and glucose release

The pancreas is both an endocrine (consists of ductless glands that empty hormones directly into the bloodstream) and exocrine gland, releasing pancreatic juice into the small intestine for digestive purposes. Millions of pancreatic islets – the Islets of Langerhans – produce pancreatic hormones from the following cells:

- Alpha cells – Involved in glucagon synthesis
- Beta cells – Insulin production
- Delta cells – Growth hormone inhibiting factor (GHIF) somatostatin.

We are going to focus on the endocrine function of the pancreas; the release of insulin in response to raised blood glucose levels.

What is insulin?

Insulin is comprised of a 51 chain of amino acid synthesised by the beta cells. It is synthesised as a polypeptide chain proinsulin. Insulin has a very short half-life of 5 minutes. Eighty per cent of insulin is degraded by the liver and kidneys. Raised blood levels of glucose stimulate the release of insulin. The activation of insulin causes glucose to enter target cells. Insulin triggers enzyme activity which catalyses the oxidation of glucose for ATP production, enhances glycogenesis and converts glucose to fat (lipogenesis). Insulin stimulates amino acid uptake, protein synthesis and fat storage.

Developing and Delivering Expert Care: Box 2.7

Physiological effects of insulin

- Lowers blood sugar levels – (accelerates glycogenesis)
- Increases the membrane transport of glucose into cells
- Influences protein and fat metabolism

Insulin inhibits

- Glycogen breakdown to glucose (glycogenolysis)
- Amino acid and fatty acid conversion to glucose (gluconeogenesis)

Hyperglycaemia – defined as beta cells secreting insulin in response to

- Catecholamines (epinephrine)
- Growth hormone
- Glucagon
- Thyroxine

Gluconeogenesis 'new glucose'

Gluconeogenesis is the synthesis of glucose from lactic acid and non-carbohydrate molecules e.g. fatty acids, glycerol and amino acids. The release of glucose by liver cells into the blood causes the blood glucose level to rise.

The rise in blood glucose inhibits glucagon release and stimulates the secretion of insulin. Glucagon is released by alpha cells in response to a fall in blood glucose levels and is another example of a negative feedback system. Secretion is inhibited by GHIF (somatostatin). Glucose enters cells by facilitated diffusion. Normal venous glucose levels are 3.6–6.1mmol/L.

Figure 2.5 summarises the example of a negative feedback system. Patients who are experiencing high levels of stress may have a stress-induced hyperglycaemia

Developing and Delivering Expert Care: Box 2.8

Different Types of Shock

Hypovolaemic shock may result from a number of reasons, from haemorrhage as in the clinical case or from other factors as listed below:

- Exogenous – burns, trauma, sepsis
- Endogenous – interstitial loss or third space fluid shifts
- Increased capillary leakage

The main clinical characteristics are a reduction in circulating volume, reduced venous return, reduced stroke volume and cardiac output and ultimately blood pressure. The only simple bedside measurement available is blood pressure. However, as we will discover later on when we review the compensatory mechanisms for maintaining blood pressure, hypotension is often a late sign and can be misleading, as the body may have experienced a significant loss of circulating volume before the blood pressure changes.

Cardiogenic shock is defined as a systolic arterial pressure <90mmHg, and in a patient with known hypertension a fall of more than 30mmHg from their premorbid reading. Other features include reduced renal perfusion, urine output <20ml/hour, cold and peripherally vasoconstricted, changes to mental state – i.e. new onset confusion and signs of myocardial failure such as raised jugular venous pressure, pulmonary oedema and basal crepitations.

Causes:

- Acute myocardial infarction
- Cardiomyopathy
- Myocardial dysfunction post cardiac surgery
- Mitral and aortic regurgitation

Obstructive shock is defined as a fall in cardiac output due to mechanical obstruction to the circulation or by restriction of ventricular filling and ejection

- Cardiac tamponade – is the accumulation of fluid or blood in the pericardial sac. It acts like a tourniquet around the heart or myocardium reducing the force and contractility of the ventricular contraction and so less blood is ejected/beat.
- Pulmonary embolism – can completely occlude the pulmonary capillary circulation causing catastrophic circulatory collapse.

In both scenarios severe and refractory hypotension is the main clinical feature associated with distended neck veins, cyanosis, tachycardia, severe respiratory distress (in PE) and if untreated both situations can lead to cardio-respiratory arrest and death.

Distributive shock – is essentially related to the maldistribution of blood flow caused by severe and prolonged vasodilation and changes in vascular resistance as a result of anaphylactic reaction to antibiotics, blood transfusions or allergies. Other factors such as sepsis or spinal cord injury where there is a loss of vascular tone and capacitance.

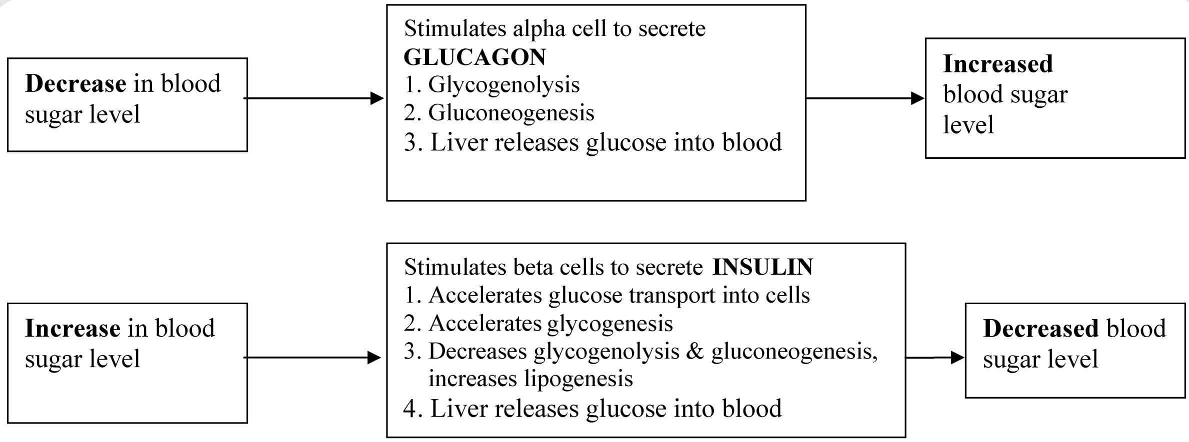

Figure 2.5 Negative feedback system: blood glucose and control

as a result of sepsis, catecholamines, glucagons, cortisol and growth hormone; this is due to excessive glucose release.

Defining shock/haemodynamic collapse

Patients may experience circulatory collapse for a variety of reasons: this is commonly known as shock. Physiological shock can be defined as an inadequate circulatory volume to facilitate the oxygenation and nutritional needs of the body's cells; this internal insult is intensified by the insufficient removal of the waste products of cellular metabolism (leading to metabolic acidosis). Initially this can result in compensatory homeostatic responses, which aim to counteract the internally identified deficit or surplus of waste products. If homeostasis is not restored, the internal environment will become increasingly hypoxic and acidotic. This acidotic environment is not compatible with cellular function, initially resulting in cellular injury. Depending on the insult this process can be instantaneous or have a gradual accumulative effect escalating from cell to tissue damage, and progressing into multi-organ failure.

In clinical practice all serious illnesses have the potential to result in reduced cellular perfusion producing physiological shock.

Now that you have gained insight into the different types of shock, the chapter will progress into discussing the protective and compensatory mechanisms the body can deploy to avert the problems associated with shock such as tissue necrosis and the initial patient assessment process will be discussed, providing the reader with a

Developing and Delivering Expert Care: Box 2.9

Stages of Shock

There are essentially four stages of shock:

- **Initial stage**: tissues are poorly perfused; there is a decreased cardiac output (CO), increased anaerobic metabolism and lactic acid formation
- **Compensatory stage**: is still reversible. Low CO activates sympathetic nervous system and compensatory mechanisms are deployed to improve tissue perfusion
- **Progressive stage**: compensatory mechanisms are inadequate and failing. There is profound vasoconstriction, with severe metabolic acidosis, CNS and myocardial depression
- **Irreversible or refractory stage**: cellular necrosis and multiple organ failure are evident and non-retractable.

As healthcare professionals it is important that we can recognise the different signs and stages of shock to prevent and anticipate further problems, to communicate effectively to other professional groups and to proactively intervene with appropriate and life-saving treatments.

structured approach to patient care that can be applied throughout their developing career.

Blood pressure

Blood pressure is normally regulated by several complex and inter-related neural, chemical and hormonal mechanisms. It is an example of a negative feedback system.

In cardiogenic shock the problem is not hypovolaemia-induced hypotension but the lack of response by the heart muscle to the stimulatory effects of adrenaline and noradrenaline. Compensatory mechanisms are activated but are ineffective. The same is seen in septic shock when the peripheral vasculature cannot vasoconstrict the arteries in response to sympathetic stimulation, compensation is ineffective resulting in a high cardiac output, tachycardia, hypotension and vasodilation or reduced systemic vascular resistance (SVR).

Hypovolaemia-induced hypotension

Changes in blood pressure are detected by baroreceptors found in the arch of the aorta, carotid sinus and all large arteries of the neck and thorax. The first part of the reflex to be activated is the baroreceptors or 'stretch' receptors, which are sensitive to changes in the stretch or pressure exerted by fluctuations in the volume of blood. When blood pressure falls, the receptors detect a change in the amount of 'stretch', there is an increased rate of impulses firing via afferent pathways back to the vasomotor or cardio-acceleratory centre within the medulla oblongata. Cardiac output, as discussed in Chapter 4, is the heart rate multiplied by the stroke volume, stroke volume being the amount of blood ejected per ventricle per beat. The stroke volume falls during haemorrhage as does the cardiac output, what is seen clinically is a fall in systolic blood pressure, and a narrowing of the pulse pressure. To compensate for the reduction in stroke volume, the heart rate is increased to distribute less blood faster around the body to the major organs to maintain oxygen delivery, perfusion and ultimately organ function.

How is the heart rate increased?

The heart rate is usually under the autonomic control of the parasympathetic or vagal nerve fibres (see Chapter 4 for more detail). The medulla receives information from baroreceptors and chemoreceptors via afferent nerve pathways on the volume and pressure status within the cardiovascular system. During times of emotional or physical stress and illness the sympathetic nervous system, via efferent vagal fibres, induces the 'fight or flight response' by releasing noradrenaline from nerve fibres which bind to beta one (β_1) adrenoreceptors within the heart muscle to increase the force of contraction (inotropy) and the heart rate (chronotropy). The adrenal medulla synthesises adrenaline and noradrenaline, which circulate in the blood stream. Adrenaline binds to β_1 adrenoreceptors also increasing heart rate and contractility. At higher concentrations of adrenaline it binds to alpha (α_1) adrenoreceptors causing peripheral smooth muscle vasoconstriction. As the rate of impulses from the SA node is increased, the conductivity of the impulse through the AV node also has to increase. In other words the gate (AV node) is opened to let more impulses pass through so that the ventricles can contract faster to raise the cardiac output.

Noradrenaline also exerts a vasoconstricting effect on the vasculature by binding to α_1 adrenoreceptors within the tunica media (middle arterial wall lumen) to bring about vasoconstriction of the vascular smooth muscle and increased systemic vascular resistance. Vasoconstriction shunts blood away from the peripheral circulation and the gut to the core organs; the clinical signs exhibited are cold, shutdown peripheries with an increased capillary refill time, as demonstrated by the clinical case in Scenario 2.1. The redirection of blood flow away from the mesenteric circulation of the gut is very difficult to measure and quantify, but the patient may exhibit signs such as nausea and vomiting.

Developing and Delivering Expert Practice: Exercise 2.13

In the elderly due to SA node disease and conduction problems, this may not be evident.

- Why might this be a problem if a patient is bleeding and the heart rate did not increase?

Patients on beta blockers will not be able to increase their heart rate as a natural response, why not?

What effects does beta blockade have on sympathetic stimulation?

Refer to the *British National Formulary* (BNF) for your answer.

Overall, the cardiovascular effects of noradrenaline on the blood pressure are increased blood pressure, MAP and pulse pressure. The collective term for noradrenaline and adrenaline is catecholamine; high catecholamine levels in the blood also stimulate the release of renin which is an important polypeptide released in low perfusion states by the kidney as part of the compensatory mechanisms for blood pressure control. While the body is attempting to maximise and increase available circulating blood volume, it also attempts to reduce urine output and water loss by stimulating other hormones such as aldosterone and anti-diuretic hormone to conserve water.

Renin-angiotensin-aldosterone mechanisms

In response to a significant drop in renal artery pressure below 80mmHg, such as in Scenario 2.1, the low blood pressure and MAP would stimulate the kidney's own tubuloglomerular feedback mechanism which is coordinated by the macula densa cells of the juxtamedullary apparatus (JMA). The reduced stretch on the juxtaglomerular cells is similar to the effects of baroreceptors. Other mechanisms such as increased β_1 adrenoreceptor stimulation brought about by sympathetic activity from the renal nerve triggered by shock and the kidney detect haemorrhage. The vasodilation of the afferent arteriole is also another indicator that something is wrong with blood flow. When the GFR, arterial blood pressure and circulating volume fall, as in our case scenario due to haemorrhage, there is a decrease in the delivery of sodium and chloride ions to the distal convoluted tubule which is detected by the macula densa cells. Remember they control and initiate the kidney's own feedback mechanism. A fall in the plasma concentrations of sodium and potassium ions also stimulates the secretion of renin. The combination of all these mechanisms causes renin to be released from the juxtaglomerular cells. Renin has a direct action on and causes afferent arteriole constriction.

Renin's main purpose is to bring about the release of the enzyme angiotensinogen from the liver, which undergoes a catalytic change to form angiotensin I. It circulates throughout the blood; certain endothelial membranes, particularly within the lining of the lung, produce an enzyme called the angiotensin-converting enzyme (ACE). When the angiotensin comes into contact with the enzyme, it converts angiotensin I to angiotensin II, a powerful vasoconstrictor. Further peripheral vasoconstriction occurs by increasing the systemic vascular resistance and raising the blood pressure. Angiotensin II also causes vasoconstriction of the efferent arterioles increasing the glomerular capillary pressure in the Bowman's capsule to maintain GFR. The glomerular filtration rate is the amount of filtrate produced per minute by the kidneys. Normal GFR is 120–125ml/minute or about 7.5L/hour. Ninety-nine per cent of filtrate is normally reabsorbed; normal urine production per day is 1–1.5L. The reason why maintaining the GFR is so crucial is that the GFR is directly proportional to the net filtration pressure, this means that even small changes in the hydrostatic pressure of the glomerular capillary or the large surface area available for filtration will affect the rate at which solutes are removed from the filtrate and the reabsorption of water and other substances. Filtration can cease completely with relatively small changes in blood pressure. It is also important to remember that the kidneys have a high demand for oxygen and are very sensitive to changes in oxygen delivery which can result in pre-renal failure, ischaemia or acute tubular necrosis (ATN).

Angiotensin II also acts on the adrenal cortex to release aldosterone, a mineralocorticoid. The function of aldosterone is to increase the reabsorption of sodium and water in the distal convoluted tubules in the kidney in response to low blood pressure and low circulating blood volume. As a result of this, the urine becomes dark and concentrated as water is removed.

Anti-diuretic hormone

Angiotensin II also stimulates the release of anti-diuretic hormone (ADH), or vasopressin, from the posterior pituitary. Anti-diuretic hormone inhibits or affects the production of urine. The hormone is released when water needs to be conserved. ADH exerts its effect on the lining of the distal convoluted tubule (DCT) and collecting ducts by increasing water permeability. Water moves out of the DCT and collecting ducts by osmosis and is reabsorbed by the peritubular capillaries and transported into the circulation to raise the circulating volume. The removal of water also causes sodium to move across and so both water and sodium are reabsorbed. ADH is also triggered by pain and emotional stress, hypoxia, severe exercise and surgery. In the absence of ADH, dilute urine is formed, this is called diabetes insipidus. Excessive ingestion of alcohol inhibits ADH production causing the loss of large volumes of urine, intense thirst and a dry mouth.

ADH is also released by the hypothalamus in response to signals from osmoreceptors located in the

Developing and Delivering Expert Practice: Box 2.9

Diabetes insipidus is a syndrome of ADH deficiency. It is characterised by the production of large amounts of dilute urine leading to dehydration and unrelieved thirst. It can be caused by damage to the hypothalamus or the posterior pituitary gland as a result of raised intracranial pressure from head injuries.

hypothalamus, which constantly detect the concentration of solutes in the blood. When the solute concentration is increased, the osmoreceptors send impulses to the hypothalamus to secrete ADH. The thirst mechanism is also stimulated so that more water is consumed to balance the concentration of the solutes.

Structured initial assessment

One of the principal skills required by all nurses is the ability to carry out a timely, but comprehensive, patient assessment. The focal point is to ascertain the individual care needs of the patient and prioritise subsequent treatment. To function effectively the practitioner requires excellent communication skills, and a thorough understanding of how pathology and trauma can affect the internal environment and its equilibrium leading to the clinically recognised state of physiological shock.

The initial assessment

There are numerous assessment models, or mnemonics, currently adapted to suit the needs of acutely ill patients and clinical practice. The Resuscitation Council in the United Kingdom (RCUK 2006) recommends the universal adoption of the ABCDE structure (Box 2.10), where each category addresses a separate, but intrinsically linked body component.

Vital signs

Vital signs directly demonstrate the current physiological state of the patient, yet research has clearly demonstrated the inability of healthcare professionals to correctly interpret or act on recorded data. The most common mistake nurses make is to underestimate the seriousness of the clinical data they have recorded; this is of particular importance in relation to the blood pressure due to an over-reliance on this one component. Many clinicians fail to recognise the subtle signs of deterioration associated with shock until there is a dramatic decrease in the blood pressure. The respiratory system is the first to demonstrate compensation therefore the application of the ABC approach will identify deficits early in the assessment process (the reader is referred to Evans & Tippins 2007 for

Developing and Delivering Expert Practice: Box 2.10

ABCDE Mnemonic

A = Airway and cervical spine immobilisation (Chapter 15)
When assessing a patient's potential to maintain their own airway, think about why they have been admitted or why they need assessment. This will provide vital clues as to what you might expect. For example, if the patient has been involved in an accident, they may have sustained a head injury thereby rendering them unconscious, they may have trauma to their mouth and bleeding. The mechanism of injury provides vital clues!

B = Breathing and ventilation (Chapter 3)
Refer to Chapter 3 which describes the full process

C = Circulation and haemorrhage control (Chapter 4)
A circulatory assessment should always focus on initially looking at the patient for signs of life and perfusion (Chapter 15). Always feel their pulse to ascertain the Rate, Rhythm and Depth.

D = Disability and neurological assessment (Chapter 5)
Chapter 5 provides in-depth detail on a neurological assessment. In the short term the AVPU tool can be applied.

E = Exposure and environment
No assessment is complete without recording the patient's temperature (an indicator of the internal environment); depending on the type of presentation, the nurse may need to see the front and back of the patient to look for signs of injury – remember dignity and respect, in addition, a chaperone may be required.

in-depth patient assessment techniques and scenario-based demonstrations).

Possible misleading data

Many factors can affect the reliability of vital signs data and clinicians need to take this into consideration when interpreting data. These include any other internal mechanisms that initiate the fight or flight response. These mechanisms mimic the instigation of the compensatory phase of shock, i.e. pain, fear, anxiety and stimulants. In contrast, several commonly prescribed medications can inhibit the compensatory response, these include beta blockers.

Developing and Delivering Expert Practice: Box 2.11

Level of Consciousness
A = Alert
V = Responds to a Verbal Stimulus
P = Responds to a Painful Stimulus
U = Unresponsive

Capillary refill time (CRT)

The recording of a CRT in addition to a radial pulse is an excellent indicator of peripheral perfusion. The patient's nail bed or the pulp of the finger is compressed for five seconds with sufficient pressure to cause blanching. Once pressure is released the nail bed should be engorged with blood and return to normal.

- In adults a CRT of two seconds or less will indicate good peripheral perfusion
- A prolonged CRT should be interpreted in conjunction with other circulatory parameters, such as pulse rate, blood pressure, and conscious level (RCUK 2006).

This figure can be prolonged in the elderly, in a cold environment, and in the presence of poor ambient lighting or circulation-based anomalies such as Raynaud's phenomenon.

Postural blood pressure

Under normal conditions autonomic reflexes stabilise an individual's blood pressure from the lying to sitting/standing positions. This can be seen as the initiation of quick response mediators that result in peripheral vasoconstriction and shunting of blood into the main circulation. When there is an established loss of circulating volume in the peripheries, this mechanism fails and a fall in blood pressure results, the recording of a postural blood pressure, therefore, is an excellent eliminative tool to the practitioner suspecting a patient to be in the early stages of shock.

Example of a patient experiencing reduced circulating volume:

- Lying B/P 105/70, H/R 90
- Sitting B/P 85/58, H/R 115

A positive result is achieved if the patient's blood pressure demonstrates a systolic drop of >20mmHg from lying to standing, or >15mmHg from lying to sitting, although the differential may be slightly less, this is offset by dangling the patient's legs over the trolley and the reduction in risk potential. Rises in heart rate exceeding 20 beats per minute (bpm), or a diastolic drop exceeding 10mmHg are also positive indicators.

If circumstances allow, lay the patient supine for five minutes, record a blood pressure and heart rate, then assist them to sit up, allow 1–3 minutes then record vital signs with the patient's legs dangling over the side of the trolley. Be aware of the possibility that your patient may become acutely unwell and document any changes to the initial assessment findings.

Defining the cause of shock

Defining the cause of shock will determine the focus of treatment, as the causative agent will need to be dealt with to combat the pathophysiological processes taking place. Shock is a progressive state and, therefore, early identification facilitates early intervention, which improves the patient's prognosis. A dramatic example is demonstrated in the management of meningitis. If left untreated until obvious signs like a haemorrhagic rash are evident, the long-term prognosis is poor.

Conclusion

Maintaining homeostasis is a dynamic process affecting all organs and cells of the body. It comprises complex, inter-related and interdependent systems that respond to the internal and external environment. As nurses, our role is to understand the complexities of the chemical, neural and hormonal interplay and how this can manifest as a single disease or as a result of multiple pathologies. Clinical treatments may range from simply correcting hypoxaemia or fluid deficits to the instigation of multi-organ support systems. Our role is to recognise, administer and constantly evaluate prescribed treatment until the fine balance of homeostasis is achieved.

The combined efforts of vasoconstriction of the smooth muscles, the redirection of blood flow, raising of the heart rate, and the complex interplay between the kidneys, adrenal glands and the hypothalamus, all assist in raising blood pressure and maintaining vital oxygen and nutrient supply in potential times of crisis. By applying the structured assessment process discussed, the nurse can identify varying degrees of illness at an early stage and initiate a plan of care based on a working diagnosis which is open to change as the assessment process broadens to encompass specialists and various members of the multidisciplinary team. Complete the following quiz to see direct evidence of your professional development and identify areas in need of further development.

Chapter 2 Summary Quiz

1. What is homeostasis?

A. The brain's ability to speed things up
B. The state of functional equilibrium within the body's internal environment
C. The state of gases within the body
D. The equilibrium of the venous and arterial blood supplies

2. Catecholamines describe hormones such as:

A. Noradrenaline and adrenaline
B. Glucose and oxygen
C. Blood and lymph
D. Vasopressin and methohaemoglobin

3. Normal body temperature ranges between:

A. 31.6ºC–36.8°C
B. 35.6ºC–37.8°C
C. 36.6ºC–39.8°C
D. 35.6ºC–36.9°C

4. Which of the following can result in a fever?

A. Infections
B. Inflammation
C. Allergic reactions
D. All of the above

5. A MAP of above what pressure is needed to supply the coronary and cerebral arteries and the kidneys?

A. 90mmHg
B. 10mmHg
C. 60mmHg
D. 120mmHg

6. Body fluids function optimally within a narrow range, at an arterial blood pH ranging between

A. 7.0 and 7.9
B. 0 and 14
C. 7.45 and 7.55
D. 7.35 and 7.45

7. Physiological shock can be defined as:

A. An inadequate circulatory volume to facilitate the oxygenation and nutritional needs of the body's cells
B. Not enough blood to produce urine
C. An inadequate circulatory volume to facilitate the process of haemofiltration
D. A severe fright causing stress

8. If a patient was demonstrating compensatory physiological shock, which of the following blood pressures would be expected?

A. 120/80
B. 50/30
C. 70/60
D. 84/59

9. How long should an area of skin be pressed on to identify the capillary refill time?

A. 1 minute
B. 10 seconds
C. 20 seconds
D. 5 seconds

10. What is an easy to remember tool for both respiratory and cardiovascular assessment?

A. Rate, rhythm and depth
B. Rate, listen and feel
C. Look listen and cross
D. Feel, count and write

Further reading

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3

The respiratory system

Cliff Evans and Emma Tippins

Part 3 Learning Objectives

- Gain knowledge and insight into the anatomy and physiology of the respiratory system
- Gain insight into several common conditions affecting these systems
- Apply theory to practice by understanding the physical manifestation of these illnesses in patients
- Gain understanding of commonly used medications to either prevent or treat respiratory conditions
- Learn essential practical skills that can be easily applied within clinical practice
- Learn to apply a solid structured approach to the patient assessment process
- Construct solid evidence of professional development for your growing portfolio
- Continue developing the ability to question and critique the evidence base and effectiveness of plans of care

Introduction

In the UK, respiratory diseases are responsible for more emergency hospital admissions than diseases of any other origin (LHO 2007). Many respiratory conditions are easy to assess and treat and despite a continual reduction in mortality rates over recent years in England and Wales, respiratory disease and infections still caused 11% of deaths among those aged 15–74 in 2000 (ONS 2007). Many problems can lead to respiratory distress, ranging from obstruction of the upper airway through to infection, emotional distress, hyperventilation and hypersensitivity reactions such as asthma. One of the most prevalent diseases affecting the respiratory system is chronic obstructive pulmonary disease (COPD): this disease alone affects around 900,000 individuals within the UK and accounts for in excess of 30,000 deaths per year, making it the fastest growing cause of death in the UK (British Lung Foundation 2005, GOLD 2006).

This chapter will initially guide the reader through both the form and function of the respiratory system; this will be aided by several exercises that the reader can undertake to consolidate new learning and provide evidence of professional development. The chapter progresses into discussing several disease processes that impact on respiratory function resulting in both acute hospital and primary care presentations and a chronically reduced ability to function. Many of the chronic conditions identified within the Government's National Service Framework (NSF) for long-term conditions and the NSF for older people have a respiratory component (DH 2001, 2005). The use of clinical scenarios will provide the reader with insight into how acute respiratory conditions are initially assessed and managed, and how their long-term management and treatment can be a complex multidimensional undertaking.

Form

The form of the respiratory system centres on several vital organs and their components, which work in unison with a range of muscles to produce the act of respiration. Figure 3.1 identifies the vital components that aid the passage of oxygen in and out of the body.

The initial structures of the respiratory system are the mouth, or oropharynx, and the nose. Although the nose, which is lined with special types of tissue cells and hair to filter and moisten air, is the primary route for the conveyance of air, the mouth can also relay air into the upper airway passages leading to the lungs.

Applying Theory to Practice: Exercise 3.1

- Why is it necessary to have two air entry points?
- If an individual breathes predominantly through the mouth rather than the nose, what might the long-term consequences be?

From Figure 3.1 identify where the two air entry points converge.

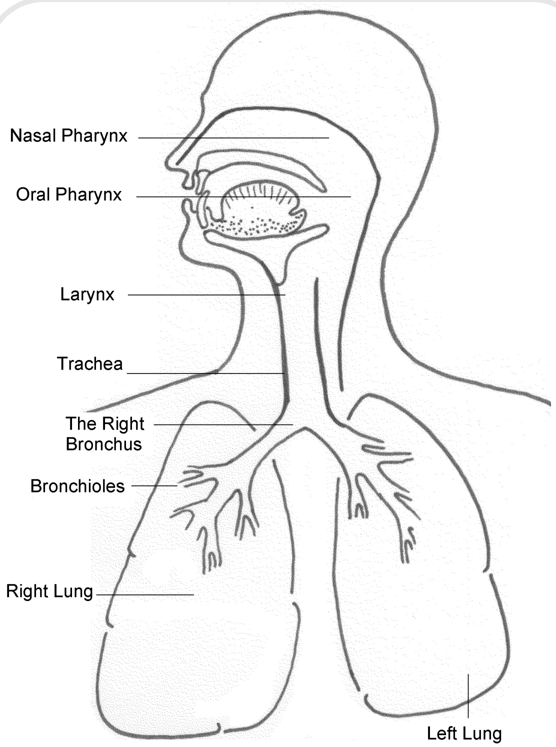

Figure 3.1 The main components of the respiratory system

The nose

The nose consists of two nasal bones and cartilage. The inside of the nostrils is lined with a **ciliated** mucous membrane (Figure 3.2). The nostrils are divided by the nasal septum composed of cartilage. This means the nose is soft on the outside and bony on the inside. The nostrils link with the paranasal sinuses, hollow air-filled spaces also lined with cilia.

The pharynx, larynx, trachea, bronchi and bronchioles

These structures are considered together as they form a continuous link between the air entry points and the beginning of the lungs. The 12.5cm passageway that forms the pharynx leads from the back of the mouth and nose, dividing into the oesophagus at the rear of the throat, and the larynx at the front. At the rear of the pharynx, at the base of the nose, sit small collections of **lymphoid** tissue known as the adenoids; in conjunction with similar structures called the palatine tonsils at the junction of the mouth and throat, they combine to filter invading bacteria.

Applying Theory to Practice: Exercise 3.2

Bacterial and viral infections of the airways are extremely common (BTS 2004), complete the following exercise before continuing:

- Make a list of at least three common infections that affect the upper airways
- What would be the clinical signs that someone was experiencing one of these infections?
- Do these infections need treating with drugs, if so, which ones?

The hyoid bone, which provides stability for the tongue and the epiglottis, is positioned at the top of the larynx. The epiglottis is the small movable flap that covers the airway to prevent the inhalation of particles of food and water into the airway. Some individuals can lose the

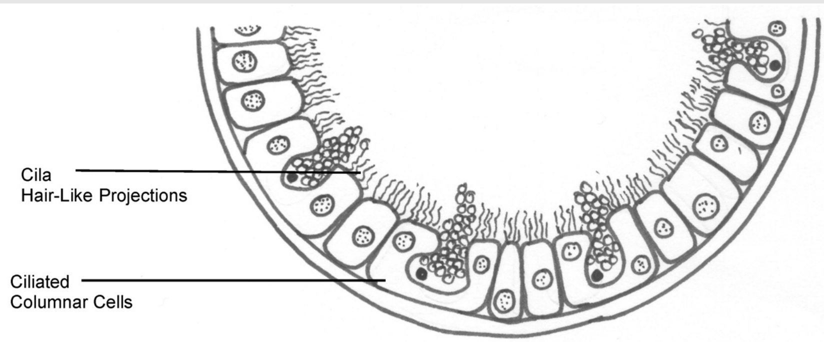

Figure 3.2 Ciliated tissues. Note that ciliated tissue opposes the flow of air resulting in foreign particles or bacteria/debris being swept away from the lower airways and lungs

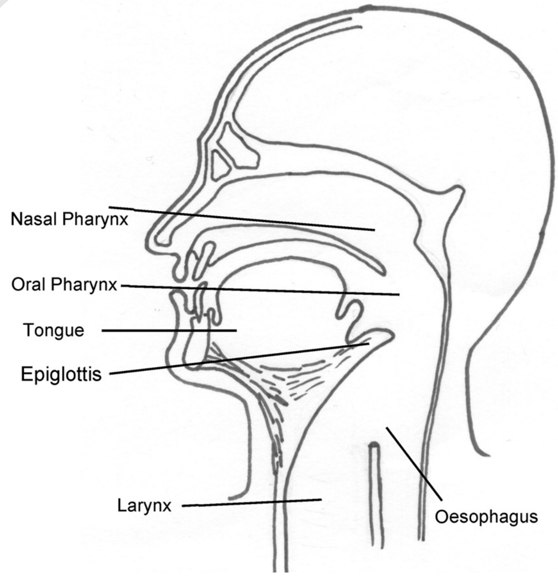

Figure 3.3a The upper airway tracts

ability to manage this involuntary function, which can potentially result in aspiration pneumonia.

The larynx, commonly referred to as the voice box, begins at the back of the mouth leading down the neck towards the trachea; both the larynx and trachea are composed of rings of cartilage attached by membranes and ligaments. The thyroid cartilage surrounding the larynx forms the Adam's apple, which is often visible in males where it is larger than in the female. The trachea is around 10cm long with incomplete hyaline cartilage rings running its outside length; involuntary muscle and connective tissues form the back or posterior aspect. The trachea is lined with a rich supply of mucus-secreting goblet cells.

The airway so far has consisted of a single pathway (excluding the mouth); the bronchi are where the single passageway splits in two, one leading to the right lung and one leading to the left. The bronchi are similar in composition to the trachea, consisting of hyaline cartilage, involuntary muscle and connective tissues. The inside of the bronchi are still lined with ciliated **epithelium**. The bronchioles should be envisaged as the last segment of a continuous passageway from the nose and mouth to the lungs. These increasingly fine tubes are composed of elastic, fibrous and muscular tissue.

The lungs

The lungs lie either side of the heart; the left lung consists of two lobes (superior and inferior), the right lung has an additional lobe (the middle lobe). Lung tissue is the combination of bronchioles, blood vessels, elastic and connective tissue, nerves and alveoli. A double-layered membrane, called the pleura, individually surrounds the lungs.

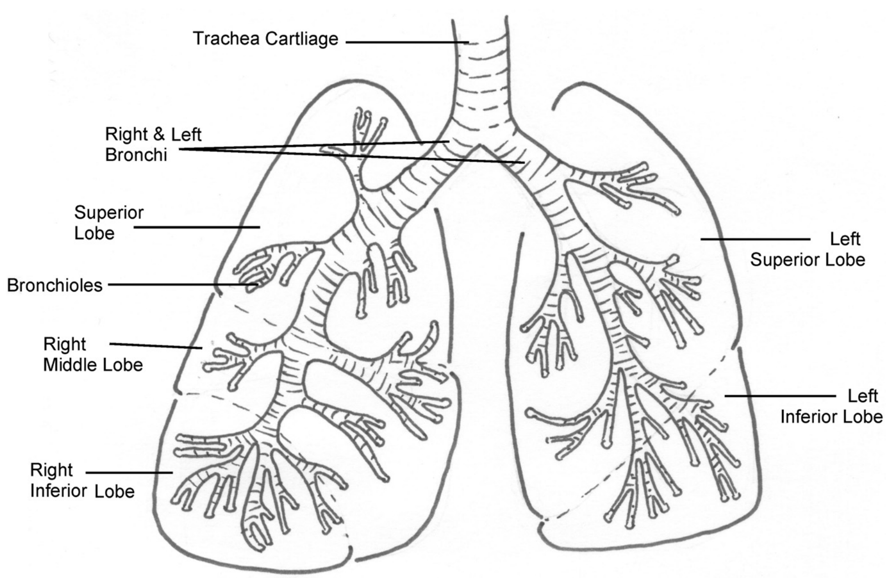

Figure 3.3b The lower airways

Anatomy and Physiology in Action: Exercise 3.3

A+P

Common disease processes can affect the amount of fibrous and elastic tissue as well the muscularity of the bronchioles:

- Identify one disease process that results in hypertrophy of the involuntary muscles within the bronchioles
- What are the physical consequences of a hypertrophic muscular layer within the bronchiole?

The pleurae

The two layers of the serous membrane that form the pleurae surround the lungs. The inner layer, or visceral layer, covers the surface and the outer layer, the parietal layer, adheres to the chest wall and to the diaphragm below. Between the two layers there exists a potential space containing serous fluid.

The acinus

The alveoli, of which there are an estimated 300 million within the lungs, are the point where air stops travelling and the action of respiration begins. The acinus is composed of the terminal portions of the bronchioles, which at this point are extremely fine, or one cell thick, and the alveolar ducts, which in turn open into two or three alveolar sacs, progress into several alveoli.

The muscles of respiration

Muscles that enable the act of respiration are as essential as the organs or structures that enable the passage of air to the alveoli. These muscles are so vital that if they begin to fail, the body has several reserve muscles that can also aid respiration; these are called the accessory muscles. Visualising the accessory muscles in a patient is a clear clinical indicator of respiratory distress, and individuals with chronic respiratory disease may have overdeveloped accessory muscles due to their continual use. The main muscle of respiration is the diaphragm, a large muscular sheet that separates the chest cavity from the abdominal contents. Lying beneath the lungs, the diaphragm resembles a dome and stretches across the base of the chest, attached at various points to bone for stabilisation. The sternocleidomastoid and intercostal muscles all assist in respiration.

Function

The act of respiration is a constant process that does not require conscious effort as it is driven by both voluntary and involuntary control mechanisms. In combination with the muscles of respiration, air is drawn in by active contraction of the thorax; during inhalation the diaphragm contracts downward and away from the lungs, creating more space in the chest cavity. This lowers the air pressure in the chest cavity relative to the pressure outside the body, subsequently air moves into the lungs. The diaphragm works in combination with the muscles of the neck which attach to the upper part of the sternum and clavicles; the sternocleidomastoid muscle, and the muscles between the ribs; the internal and external intercostal muscles; these increase the diameter of the chest wall, decreasing the pressure in the chest. The intercostal muscles then contract and minimise the size of the chest wall during forced exhalation.

The respiratory system is typically divided into two descriptive components: the acts of conduction and respiration; that is, a percentage of the respiratory system is dedicated to aiding the conduction of oxygen into the lungs; this function must also include warming of the air to achieve a level of heat conducive to homeostasis, the facilitation of diffusion, and the filtering of particles such as dust and contaminants. Once the air reaches the alveoli, the process of respiration can take place. The act of respiration can also be divided into two succinct parts:

- **External respiration** centres on the exchange of gases through diffusion between the alveoli and the bloodstream. A network of small blood capillaries surrounds the alveolar wall. The alveoli provide a large surface area for gaseous exchange, estimated at 70 to 80 square metres if stretched out (Shire et al. 2004). Venous or deoxygenated blood arrives at the lungs, via the right side of the heart and the pulmonary arteries, containing high levels of carbon dioxide (CO_2) and low levels of oxygen (O_2). The CO_2 diffuses into the alveoli until the point of equal pressure or equilibrium is realised. Simultaneously O_2 diffuses from the alveoli into the blood. This newly oxygenated blood is returned to the left side of the heart via the pulmonary veins. Once it reaches the heart, it is pumped to the systemic circulation to facilitate the process of internal respiration and the oxygenation of all cells. Blood flow through the capillaries is slow due to their relative

Form	Structure	Function
Nose	Composed of cartilage Lined with a ciliated mucous membrane The nasal cavity connects to the paranasal sinuses also lined with a mucous membrane	Sensual organ – smell Warms, moistens air Cilia – filter dust and foreign particles including bacteria Mucus secretion is part of the defensive inflammatory system which prevents particles entering the lungs
Pharynx	Around 12.5cm in length Composed of muscular and fibrous tissue Contains the lymphoid pharyngeal tonsils (adenoids)	Continues the process of warming, filtering and moistening air Lymphoid tissue filters and eradicates bacteria
Larynx	Tube-like structure Commonly referred to as the voice box Consisting of cartilage rings Contains the thyroid cartilage	Maintains voice production Continues the process of warming, filtering and moistening inspired air
Trachea	Continuation of the larynx Around 10cm in length Terminates to divide into the two bronchi Consists of hyaline cartilage (anteriorly) and involuntary muscle (posteriorly)	Continues the process of warming, filtering and moistening inspired air Secretes mucus from goblet cells
Bronchi	Connection points of trachea to lungs Consist of hyaline cartilage and involuntary muscle	Passageway for inspired air into the lungs
Bronchioles	Composed of muscular fibrous and elastic tissue Continually narrow until they meet the alveoli	Passageway for inspired air into the lungs
Alveoli	Composed of squamous epithelial cells Entwined with blood capillaries	Point of gaseous exchange Carbon dioxide is expelled back through the respiratory system and deoxygenated blood is circulated through the alveoli where it obtains oxygen through the process of diffusion
Lungs	The two lungs are divided into lobes, the right having superior, middle and inferior lobes, the left having just superior and inferior Lung tissue is composed of the alveoli, blood vessels, elastic connective tissue	The lungs facilitate the act of breathing In combination with the muscles of respiration the lungs inspire and expel air
Pleura	Serous membrane covering each lung Composed of an inner visceral layer and an outer parietal layer These layers are separated by a potential space lubricated with serous fluid	Prevents friction during the two layers as the lungs expand and contract. Provides structural points for the lungs

Table 3.1 Form and Function of the Respiratory System

Reproduced from Evans & Tippins (2007).

size; this allows the required time for diffusion to occur (refer to Table 3.3 for percentages of O_2 and CO_2).

- **Internal respiration** describes the process whereby gases diffuse between the blood capillaries and the cells of the body. The percentage of oxygen arriving at the tissue cells is constant with the concentration at the alveoli. This means the oxygen-rich blood creates a concentration gradient between the blood and the tissue cells, which, through the act of metabolism, are rich in CO_2 and low in O_2. O_2 diffuses from the bloodstream into the cells; simultaneously CO_2 diffuses into the extracellular fluid and into the venous capillaries and blood stream. Table 3.1 provides a quick review of both the form and functional components of the respiratory system.

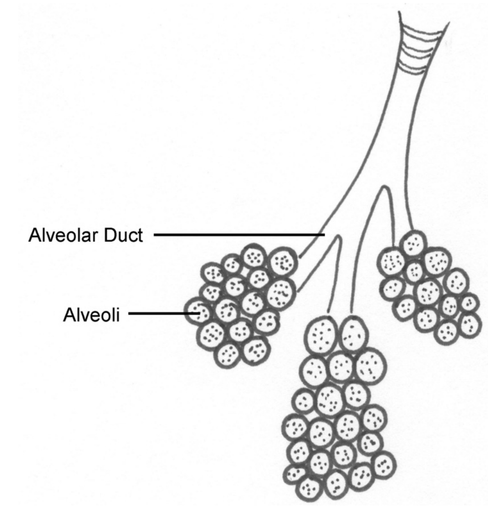

Figure 3.4a The alveoli

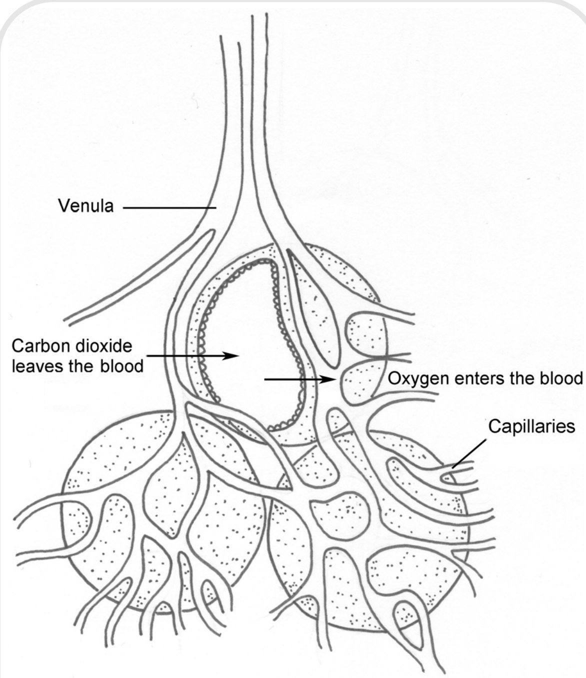

Figure 3.4b Close-up of the alveoli and the diffusion of oxygen and carbon dioxide

Transportation of oxygen and carbon dioxide within the blood

Oxygen transport

Most of the O_2 is transported in combination with haemoglobin (Chapter 4) to form oxyhaemoglobin. When the body is active, the tissues produce excessive CO_2 and heat, oxygen is released from its bound state with the haemoglobin. This intrinsic prioritisation process allows cells with the greatest need to receive O_2 first.

Carbon dioxide transport

This waste product of metabolism is mainly carried as bicarbonate ions in the plasma (70%). In addition, around 7% is carried in a dissolved state within the blood plasma and the remaining 23% loosely combined with haemoglobin as carbaminohaemoglobin (Waugh & Grant 2007).

Central control of respiration

The act of respiration is predominantly under involuntary control, otherwise when asleep an individual would lose the governing stimulus to breath. The rate and depth of inspiration are under the control of the respiratory centre situated within the medulla oblongata within the brain stem.

Chemoreceptors

Chemoreceptors monitor blood gas tensions and respond to **hypercapnia**, **hypoxia** and **acidosis**; there are two main types of chemoreceptors:

- Central chemoreceptors: it is estimated that 80% of the drive for ventilation is a result of stimulation of the central chemoreceptors (McGowan et al. 2003). These receptors, as the name implies, are located centrally although anatomically separate from the medullary

Anatomy and Physiology in Action: Box 3.1

There are many internal mechanisms within the human body that result in an equalisation of pressures or substances. Listed below are several basic principles that, once understood, would aid future learning.

- **Diffusion** occurs when a high concentration of a gas comes into contact with a weak concentration of the same gas (Figure 3.4). Molecules from the strong concentration will move across to the weaker area to create a balance or equilibrium; this process can only occur when the membrane lining of the lungs is moist as oxygen and carbon dioxide can only undergo the process of gaseous exchange in water-like material.
- Within the alveoli O_2 is under more pressure than the deoxygenated venous blood, therefore O_2 from the high pressure gradient moves or diffuses into the low pressure gradient until an equal balance is achieved.
- Within the venous blood the CO_2 is under higher pressure than the CO_2 level within the alveoli and therefore diffuses through the capillaries into the alveoli.
- At a cellular level the oxygenation/waste removal process continually repeats dependent on the current requirements of the body.

respiratory centre. They react to hydrogen ion levels whereby an increase results in a rise in the respiratory rate, and a decrease in hydrogen ions results in a lowering of the respiratory rate.

- Peripheral chemoreceptors: these receptors are located around the aortic arch and the carotid sinus. When stimulated, these receptors evoke both a respiratory and cardiovascular effect. They are directly affected by the blood pH, have a quick initial or compensatory effect, but have a limited systemic effect estimated at less than 10% of that of the central receptors (McGowan et al. 2003).

Now you have gained insight into both the form and functioning of the respiratory system, the chapter will broaden to discuss how the entry of air into the system can be hindered, thereby compromising oxygen delivery and the elimination of carbon dioxide. Common disease processes will then be discussed with the use of real-life clinical patient presentations to demonstrate the physical manifestations of illnesses affecting respiratory function.

Anatomy and Physiology in Action: Exercise 3.4

There are several other types of receptors aiding and contributing to effective ventilation. Complete the following exercise to gain further insight into the essence of respiratory function:

Identify what effect the following limited list of receptors have on ventilation/respiration; the first is completed for you:

- **Pain receptors** have an effect on respiration by initially causing apnoea which is closely followed by hyperventilation
- **Irritant receptors**
- **Stretch receptors**
- **Arterial baroreceptors**

Once you have completed the exercise, think about how you would identify the cause of hyperventilation in an acute clinical presentation.

Airway assessment and intervention (management)

Without an adequate constant and 'clean' supply of oxygen an individual will soon demonstrate the clinical signs of hypoxia. If a patient has an obstructed airway or fails to maintain airway patency, oxygen will not reach the lungs, leading to asphyxia. Prevention of hypoxaemia requires a protected, unobstructed flow of air into the lungs. Within the lungs it is also essential that a constant supply of blood reaches the alveoli. This balance between circulating oxygen levels and the presence of sufficient blood is referred to as the perfusion–ventilation ratio.

For a patient demonstrating an inability to maintain their own airway, prompt assessment, control of the airway, and provision of ventilation are essential. Airway compromise may be sudden and complete, insidious and partial, or progressive and/or recurrent (American College of Surgeons 2004). A compromise to air entry or flow can

Applying Theory to Practice: Exercise 3.5

Many disease processes can affect the perfusion–ventilation ratio resulting in minimal to profound hypoxaemia and cardiac arrest. Complete the following exercise to understand how common medical problems can impact on the respiratory system:

Identify at least three physiological problems that will affect the perfusion–ventilation ratio; the first is identified for you.

- If an individual has a reduced oxygen, carrying capacity within the blood due to a form of anaemia they will not be able to efficiently circulate the oxygen resulting in hypoxaemia. Interestingly their oxygen saturation level may read 100% because the red blood cells they have are fully saturated.

Once you have identified a further two abnormalities, add these to your portfolio.

occur at any level between the nose/mouth down to the bronchi. The site of obstruction varies dependent on the cause; in the unconscious patient the most common cause of airway obstruction is by the posterior displacement of the tongue at the level of the pharynx (RCUK 2006). Vomit, blood and foreign bodies commonly obstruct airflow at the site of the soft palate and epiglottis, resulting in aspiration of particles into the lungs. Obstruction can also occur at the larynx, resulting from the inflammation associated with burns and anaphylaxis. Obstruction below the larynx is also possible, but less common, and can be caused by excessive bronchial secretions, mucosal oedema, bronchospasm, pulmonary oedema, or the aspiration of gastric contents into the lungs.

Airway assessment

Assessment of the patient for signs of airway obstruction is also briefly covered in Chapter 15, as the ability to undertake a quick assessment and implement a manoeuvre can prove vital for a patient experiencing airway obstruction. The initial assessment can be achieved by applying the look, listen, and feel approach:

- **Look** for chest and abdominal movements.
- **Listen** and **feel** for airflow at the mouth and nose.

To assess effectively, put the side of your face, and ear, above the patient's nose and mouth, with your eyes facing the patient's feet for up to 10 seconds; this allows for rapid assessment of all three descriptors in one action.

Airway obstruction in an alert and conscious patient can be identified through their actions, such as grasping at their throat, clinical indicators such as central cyanosis, or obvious indicators such as the presence of vomit and blood within the oropharynx. There are also many localised noises that are synonymous with airway obstruction, which may alert the nurse when the patient is unable to communicate their compromise. These include stridor, wheeze, gurgling, snoring or crowing (Table 3.2).

Sign	Cause
Inspiratory stridor	Obstruction at laryngeal level or above
Expiratory wheeze	Obstruction of the lower airways, which can collapse and obstruct during expiration
Gurgling	Presence of liquid or semi-solid foreign material in the upper airways
Snoring	Partial occlusion of the pharynx by the tongue or palate
Crowing or stridor	Laryngeal spasm or obstruction

Table 3.2 Recognition of Airway Obstruction

Although most individuals breathe in a similar fashion, many patients present with chronically abnormal and inefficient breathing techniques.

Airway management

The administration of oxygen is pointless to a patient with an obstructed airway, as the oxygen will not enter the lower airways, irrespective of the delivered concentration.

If you identify possible airway obstruction immediate action must be taken. There are three basic manoeuvres that can be used to relieve upper airway obstruction:

head tilt, **chin lift** and **jaw thrust**. These simple repositional methods of expanding the airway are frequently successful when the cause of the obstruction is a loss of muscle tone within the pharynx; however, as with all interventions, it is crucial that following any manoeuvre the patient's ability to ventilate is reassessed by reapplying the look, listen and feel approach as described earlier.

The quick availability of suction is an absolute necessity for any patient with an actual or clear potential for airway obstruction. Suction can be used via a Yankaver tube if any visible debris is identified in the mouth. Suction should only be used in the areas of the oral cavity that can be visualised: pushing a suction catheter down an individual's throat can stimulate a conscious patient's gag reflex, and cause vomiting, further exacerbating the problem.

Anatomy and Physiology in Action: Exercise 3.6

Compare the breathing of different individuals; there are many influencing or contributing factors to why an individual breathes in a certain way.

- Compare the rhythm and depth of breathing of a very obese patient with someone with a petite build

Remember what is considered normal for one person can be very abnormal for another.

- What is sleep apnoea?
- Which group of individuals are at particular risk of experiencing this?

Questioning Clinical Practice: Exercise 3.7

Oxygen Therapy

There are many inconsistencies within clinical practice regarding the administration of supplementary oxygen therapy. In acutely unwell patients, regardless of any underlying aetiology such as COPD, the Resuscitation Council (UK) advocate delivering high flow oxygen at a rate of between 12–15L/min preferably via a mask attached to a reservoir bag.

- While on clinical placements identify if oxygen therapy needs to be prescribed by a practitioner with prescribing rights or if it can be administered via a patient group direction

This will prepare you for future discussions on this contentious topic.

Basic airway adjuncts

There are several easily applied airway adjuncts readily available in most clinical areas. The two most common are the oropharyngeal and nasopharyngeal airways. These types of airway adjunct are designed to correct soft palate obstruction and backward tongue displacement.

The oropharyngeal **Guedel** airway is inserted into the mouth behind the tongue. The Guedel airway must be sized before insertion; this can be achieved by holding the flange of the airway level with the patient's incisors and the other end of the airway at the angle of the patient's jaw. See Figure 3.5.

There are two techniques for insertion, the first is to insert the airway into the oral cavity in the 'upside down' position as far as the junction between the hard and soft palate, and then rotate it through 180 degrees. The other method is to use a tongue blade to depress the tongue and then insert the airway posteriorly. The advantage of the first method is that it minimises the chance of displacing the tongue backwards and downwards, thereby exacerbating the situation (RCUK 2006). The oropharyngeal airway must not be used in a conscious patient as this can result in gagging, vomiting and aspiration. Correct and effective placement is indicated by an improvement in the patient's breathing ability and/or the

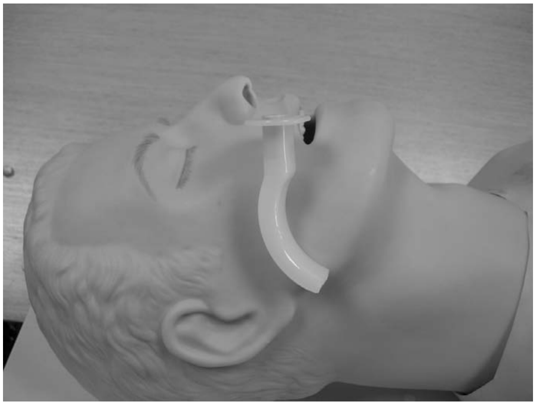

Figure 3.5 Measuring an oropharyngeal airway

eradication of the signs of obstruction identified in Table 3.2. Following any intervention always reassess and evaluate its effectiveness, in this case by applying the look, listen, feel approach as before. If an improvement is noted, supplementary oxygen should then be delivered via a facemask with reservoir bag.

The nasopharyngeal airway can be used in conscious patients, as it is not associated with initiating the gag reflex or vomiting. The RCUK (2006) recommends sizes 6–7mm as suitable for use in adults. Prior to inserting the nasopharyngeal airway the right nostril should be observed for obvious potential obstruction such as nasal polyps, blood or septal deviation; if any of these are present, the left nostril can be used. In some designs a safety pin should be inserted into the flanged end, prior to insertion, to prevent the adjunct disappearing into the airway. A water-soluble lubricant should be used to reduce localised trauma; insert the airway bevel end first, vertically along the floor of the nose, twisting gently as this is done. Once the airway is in place and the flange is sitting at the opening of the nostril, reassessment of the airway and breathing should occur with the look, listen and feel approach with supplementary oxygen applied as before. Insertion of the nasopharyngeal airway can cause damage to the mucosal lining of the nasal airway and will result in minor bleeding in 30% of patients (RCUK 2006). Extreme caution should be used when considering the use of the nasopharyngeal airway in patients with obvious facial fractures or suspected basal skull fractures, as passage of the airway through a fracture of the skull base and into the cranial vault is possible, although extremely rare.

If at any stage the patency of the airway cannot be maintained the patient will need urgent referral to an anaesthetist for assessment and possible intubation.

Before discussing the administration of supplementary oxygen it is worth reviewing your current understanding of how much oxygen and carbon dioxide we inspire and expire with each breath.

Gas	**Inspired air (%)**	**Expired air (%)**
Oxygen	21	16
Carbon dioxide	0.04	4

Oxygen delivery devices are produced in two formats: fixed flow and non-fixed flow

Type of mask	**Percentage of oxygen delivered**
Fixed flow devices	
Venturi adaptors (24–60%)	These devices deliver fixed flow oxygen dependent on which adaptor is used; concentrations range between 24–60%
Non-fixed flow devices	**Estimated percentage**
Nebulising mask	60% at 6–10 L/min
Ambu bag	85% at 12–15 L/min
Nasal cannula	24% at 2 L/min (higher rates not recommended)
Standard oxygen mask (Hudson)	60% at 6–10L/min
Oxygen mask with reservoir bag	85% at 10–15L/min

Table 3.3 Oxygen Delivery Devices

Scenario 3.1

Asthma

Gary Gibbs is a 24-year-old Caucasian man who attends the local walk-in centre near where he works as a labourer, suffering from shortness of breath, which he states commenced 20 minutes before while he was shovelling broken bricks on a building site. Mr Gibbs can complete a sentence without running short of breath.

His respiratory rate is shallow, rapid and regular at 28 breaths per minute. He has an audible wheeze on expiration and does not appear to be overusing the accessory muscles of respiration. There are no signs of central or peripheral cyanosis. His pulse oximetry reading is 94% on air. He is asked if he knows his normal peak expiratory flow rate (PEFR), which is documented as 550. A current PEFR is recorded as 200. His radial pulse is strong, regular and recorded as 129 bpm, CRT is within two seconds. The initial blood pressure is recorded as 132/87.

Mr Gibbs appears anxious, sweaty and clammy. He is orientated to time and place, with an AVPU score of A. His temperature is recorded as 36.5.

Relevant medical history includes eczema and asthma for which he takes a salbutamol inhaler as required.

Assessment and analysis of patient presentation

Mr Gibbs presents with several early warning signs of respiratory compromise that, if left untreated, may lead to respiratory failure. His respiratory rate of 28, PEFR of 200 (33–50% of his normal), in conjunction with a pulse rate above 110, demonstrates compensatory shock and is classified as an acute severe presentation.

The British Thoracic Society's clarification of the severity of asthma is an excellent predictor of the severity of presenting symptoms, and also provides the assessor with a quick reference to the appropriate treatment regimen (Figure 3.6).

In this scenario there are four indicators of severe compromise: the respiratory and pulse rates, the low oxygen saturation level and the reduced PEFR. He is also sweaty and clammy in appearance. Mr Gibbs has an atopic history, meaning he has a predisposition to various hypersensitivity reactions such as asthma, eczema and rhinitis. There is also a high correlation between atopic individuals and anaphylactic reactions to common antibiotics, namely penicillins and cephalosporins.

From the presenting history and primary data gathered. Mr Gibbs appears to be experiencing an asthma attack related to his exposure to allergens from the brick dust which he would have inhaled while at work. Mr Gibbs requires emergency treatment and should be transferred to an appropriate emergency centre. If available, treatment should commence at the walk-in centre: this will include the quick administration of high flow oxygen, combined with nursing the patient in a sitting position, allowing full lung expansion. Mr Gibbs has had a PEFR recorded: this test records the maximum flow of air that can be expelled in one single expiration, it provides a convenient indicator of the amount of bronchial

Recording Peak Expiratory Flow Rates Box 3.2

Many patients with a history of asthma will undertake regular peak flow recordings at home and will know their expected score; note this but be aware of their technique.

There are several meters on the market and patients are usually advised to keep their meter and to bring it with them if they attend hospital to reduce cross-infection rates. A disposable tube should be placed on the mouthpiece, the meter reset to zero and held by the patient horizontally. The patient should be standing and directed to take a deep breath in before placing the meter in their mouth. Their lips should be applied to the mouthpiece and the air expelled in one hard, fast breath. If the breath is continual and not short and sharp it may induce coughing. This test should be repeated three times and the highest score recorded. If possible, record their PEFR before and after any nebulised interventions; this will provide quantifiable data to the effectiveness of the treatment.

constriction, although readings can be affected by a poor user technique. Box 3.2 describes how to take a PEFR reading. Patients with an established history of asthma may know their usual or best PEFR; this will provide a baseline for evaluation of their current presentation. Current PEFR recordings will be expressed as a percentage of the patient's previous best. If this information is unavailable, the PEFR should be documented as a percentage of their predicted rate; this can be achieved by using the graph predictor in Figure 3.7. The continual monitoring of the patient's respiratory rate and oxygen saturation by pulse oximetry will determine the effectiveness of the supplementary oxygen therapy; an arterial blood gas is indicated if the SpO_2 falls below 92%.

Asthma – the facts

Asthma can be defined as a chronic condition with acute exacerbations resulting in a hypersensitivity reaction. Asthma is the result of a combination of complex interactions which culminate in the hypersecretion of mucus, constriction of smooth muscle within the bronchioles, and localised inflammation resulting in compromise of the affected individual's ability to breathe. The Global Initiative for Asthma (GINA 2004) estimate that 300 million people, of all ages and races, experience asthma. The annual incidence is increasing in all age groups. GINA estimate that asthma accounts for one in 250 deaths worldwide, many of which are preventable. Suboptimal long-term medical care and delay in seeking help are the main contributing factors. Industrialised countries top the list of worldwide prevalence with the USA experiencing a prevalence rate of 11% and England and Wales 15%, accounting for an estimated 4.7 million individuals, including 590,000 teenagers (Gina 2004, NICE 2006). The UK demonstrates the worst prevalence rate in Europe in comparison to Sweden's 6%; however, the UK has a mortality rate of around 3% which is extremely low in comparison to China's 36%. There are many theories related to the causes of asthma (Currie et al. 2005) although no one factor appears solely responsible.

Pathophysiology

The pathophysiology or **pathogenesis** of asthma can be seen as a multidimensional phenomenon in which a series of internal reactions combine or accumulate to produce increasing inflammation and hyper-responsiveness of the airways. This cascade effect results in varying levels of bronchoconstriction via smooth muscle contraction, mucus production and increased vascular permeability. Over repeated attacks the individual is exposed to the hypertrophy of several of the local tissues involved in this process, resulting in a cycle of deterioration and the potential for increasingly severe clinical symptoms (Figure 3.8).

Anatomy and Physiology in Action: Box 3.3

A+P

Pathology of Asthma

- Thickened basement membrane
- Hypertrophic goblet cells
- Hypertrophic smooth muscle
- Dilated local blood supply
- Increased eosinophils/immune/inflammatory response cells
- Increased mucus secretion resulting in mucus plugging

Theories related to the development of asthma

Environmental

The aetiology of asthma has for decades been considered to have a strong environmental link. This theory has been strengthened by studies concentrated on population migrations from areas of low prevalence to areas with an established high prevalence rate, whereby the migrating populace develop the same prevalence rate of asthma as the indigenous population (Bourke 2003).

Hand hygiene

This theory relates to the modern trend of creating of an artificially clean environment whereby children fail to develop immunologic responses to specific antigens, allergens and pathogens early in life. This failure to develop response mechanisms to common environmental factors results in an exaggerated or hypersensitive reaction later in life.

Genetic

It has been theorised that one of the components that contribute to both the development of asthma and the severity of the hypersensitivity response is genetic. The rationale is that the genes for most of the cytokines

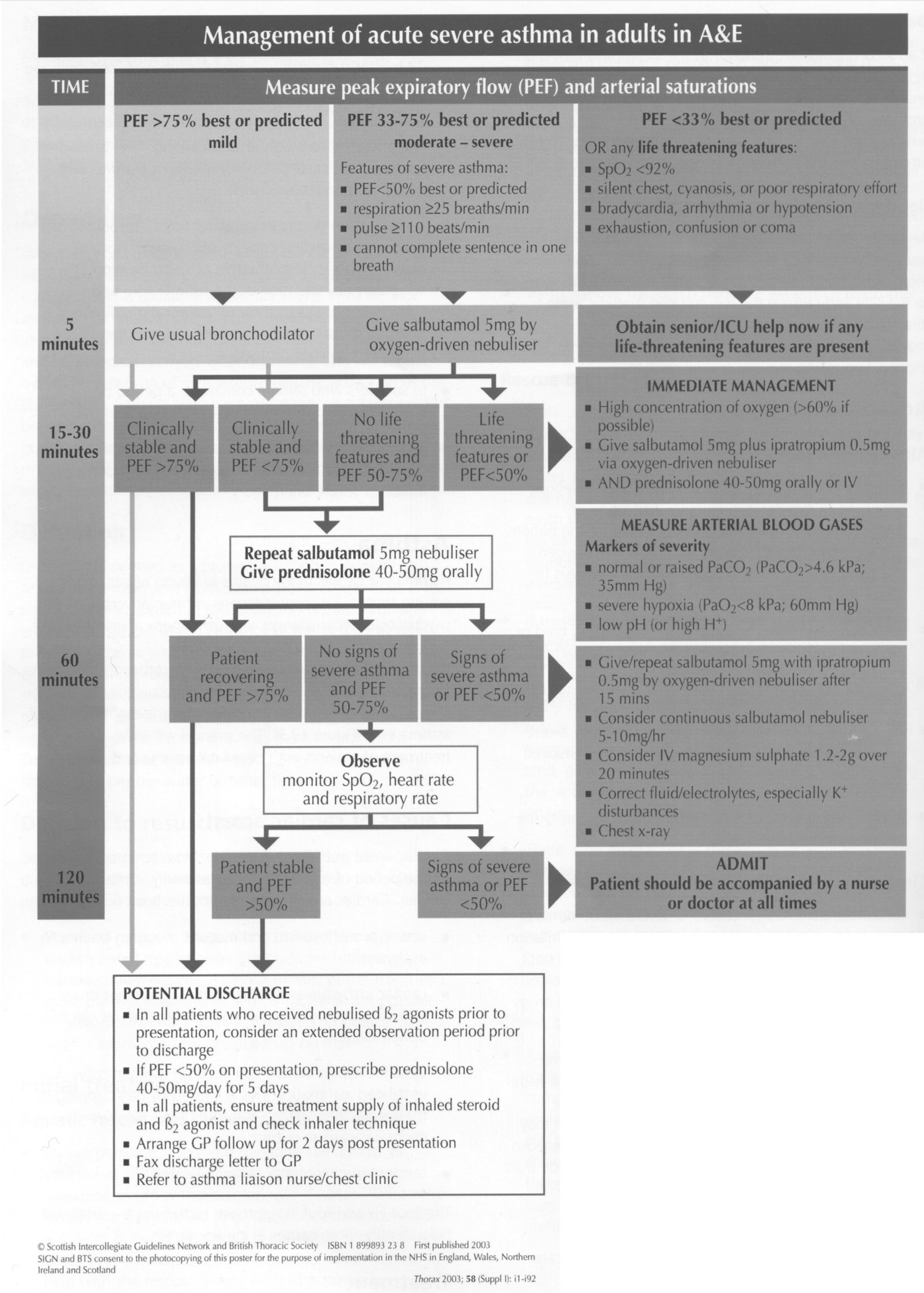

Figure 3.6 Management of acute severe asthma in adults in A&E. Source: British Thoracic Society and Scottish Intercollegiate Guidelines Network (2005)

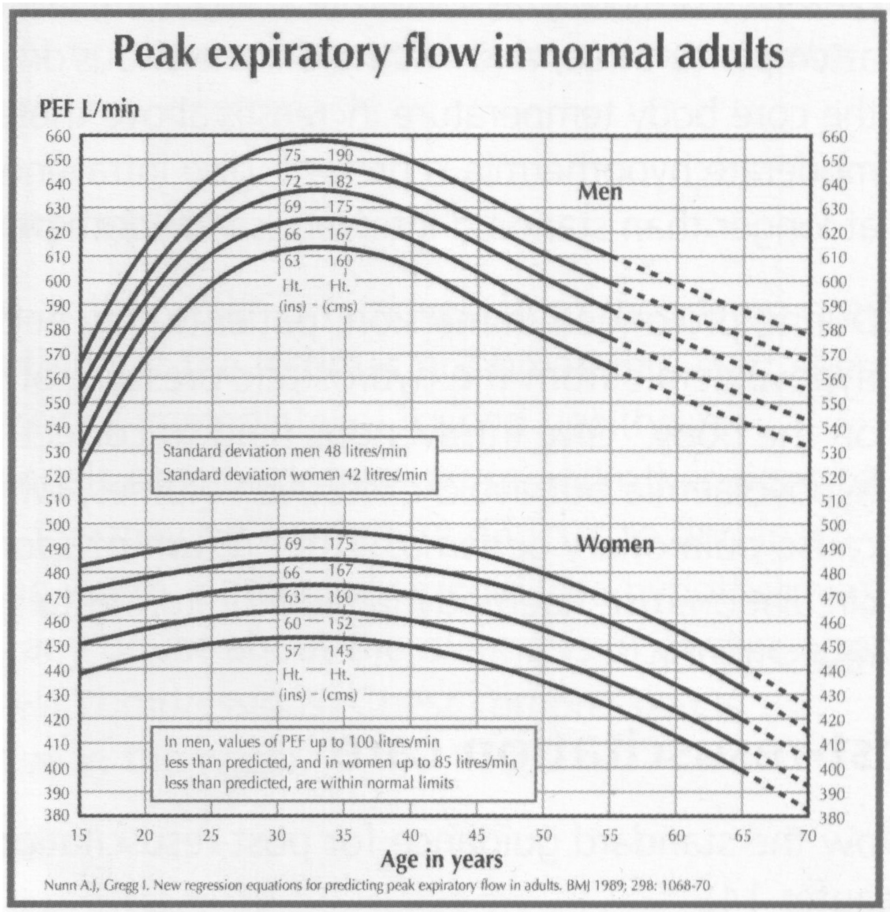

Figure 3.7 Predicted PEFR indicator. Source: British Thoracic Society and Scottish Intercollegiate Guidelines Network (2005)

involved in the development of asthma are found on chromosome 5, for which asthmatics have a predisposition (Lumb 2003). In addition, human lymphocyte antigens, which are involved in sensitisation of lymphocytes to specific antigens, play a major part in allowing immunological self-recognition and are inherited (Chapter 10).

Signs and symptoms

The indicative, and to an extent diagnostic, signs or symptoms of asthma are an expiratory wheeze, sometimes combined with wheezing on inspiration, shortness of breath, chest tightness and coughing.

When a patient presents in an alert and orientated condition, the assessment can begin by observing the patient's respiratory rate, depth, and the amount of effort they use to achieve effective respiration/ventilation. The

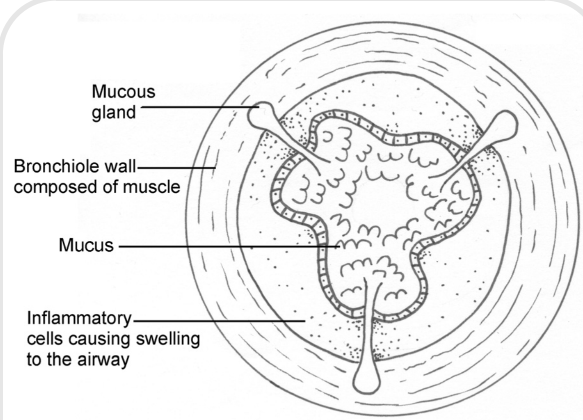

Figure 3.8 Bronchial hypertrophy and excessive mucus production

Applying Theory to Practice: Exercise 3.8

There are numerous outdoor and indoor environmental instigators implicated in the development of an acute attack of asthma, identify at least three from each category. The first is identified for you:

Indoor

1. **Dust mites** are commonly implicated in the development of asthma; there is now an entire industry providing bedding materials that are dust mite-free.
2.
3.

Outdoor

1. Nitrogen dioxide: the principal source of nitrogen dioxide and other oxides is motor vehicle emissions.
2.
3.

respiratory effort centres on the use of the shoulder girdle to assist breathing. Patients frequently present resting forward, with their arms outstretched in order to brace the shoulder girdle and enable the use of the accessory muscles of respiration, the sternocleidomastoid and trapezius muscles being the most evident. The ability of the patient to talk is a prime indicator of serious illness: if the patient cannot complete a sentence without stopping to draw breath, they are in a potentially life-threatening situation. In combination with the patient's level of consciousness their ability to complete a sentence is an extreme symptom. Chronic symptoms of asthma are variable, intermittent, can be worse at night, and can be provoked by certain catalysts, that is, allergens. These allergens include:

- Dust mites
- Pollen
- Chemical allergens such as paint fumes
- Exercise and cold weather.

In addition, psychological components have been extensively implicated in both provoking and exacerbating an acute asthma attack (BTS and SIGN 2005).

Psychosocial aspects

Physiological findings initially comprise the majority of the assessment process in a patient experiencing an acute asthma attack but there are other influencing and instigating factors. The BTS Guidelines (2005) state that in the assessment of asthma the assessor should note if the patient presents with one or more psychosocial factors such as a psychiatric illness (including depression), or drug and alcohol use, as these patients have a significantly increased mortality rate, making their identification paramount (BTS and SIGN 2005).

Analysis and treatment options

There is no universal approach to the prevention and management of asthma, with the UK and USA classifying the severity of asthma in different ways (Cates 2001). The UK philosophy focuses on prevention with the stepwise approach (BTS and SIGN 2005). This approach centres on increasing the use of medications titrated to the frequency and severity of symptoms and exacerbations, beginning with the use of inhaled short-acting beta 2 agonists for mild intermittent episodes, through to the daily use of oral and inhaled steroids. Recent pharmacological advances have led to the development of preventative medications that prevent, or antagonise, a major physiological instigator of asthma; these are the leukotriene antagonists.

The treatment of acute exacerbations, such as in the case of Mr Gibbs, should follow the BTS Guidelines (2005). These presentations frequently resolve with the administration of high flow oxygen and nebulised beta 2 agonists, which should be delivered within five minutes of the patient assessment; if the symptoms resolve and the PEFR returns to above 75% of the patient's predicted score, the patient can be discharged. If the patient's clinical condition slightly improves, but the PEFR remains below 75% of his best, a repeat beta 2 agonist should be administered and the patient commenced on oral steroid therapy; by strictly adhering to the guidelines, this reassessment will take place within 30 minutes and can be re-evaluated within the hour. If at any point the patient's clinical condition deteriorates, more intensive therapy should begin. This section of the algorithm includes the administration of ipratropium, an **anticholinergic** bronchodilator, recording and measuring arterial blood gases, possible administration of magnesium, and intubation if medication does not improve the patient's condition.

Scenario 3.2

Chronic Obstructive Pulmonary Disease (COPD)

Joan Middleton is a 63-year-old woman who is brought into the emergency department at 02.00 after experiencing shortness of breath and a purulent cough for three days. She is unable to complete a sentence; she appears alert although very anxious. Her respiratory rate is shallow, rapid and irregular at 38 breaths per minute. She appears to be nearing exhaustion, demonstrated by the heavy use of the accessory muscle of respiration, her neck veins are protruding and she adopts the tripod position (sitting, leaning forward with arms on thighs). Mrs Middleton has evidence of peripheral cyanosis. Her radial pulse is strong, regular and recorded as 118 bpm, CRT exceeds two seconds. Her initial blood pressure is recorded as 168/98. Mrs Middleton appears pale, sweaty and clammy. She is orientated to time and place, with an AVPU score of A. Mrs Middleton is a chronic smoker of around 30 cigarettes a day and has been an inpatient on several occasions with similar presentations related to what she describes as a chronic breathing problem. She commonly produces purulent green sputum.

Assessment and analysis of patient presentation

Mrs Middleton's presentation indicates a potentially life-threatening condition. This is demonstrated by her inability to complete a sentence, an ominous sign of impending respiratory failure. The dramatic rise in the patient's respiratory rate confirms the initial clinical findings. Her pulse and blood pressure are also raised and her CRT reduced. Her past medical history includes a chronic history of smoking and similar presentations, diagnosed as a chronic breathing problem or chronic obstructive pulmonary disease (COPD). If a patient presents with established damage to their lung function, it is essential to ascertain the current functioning ability of their heart as the two systems interlink to such an extent that it is very likely the lung compromise will also affect, at the very least, the functioning of the right side of the heart (Chapter 4).

Chronic obstructive pulmonary disease – the facts

Chronic obstructive pulmonary disease (COPD) can be defined as a chronic and debilitating disease continuum in which localised irritation of the bronchioles and lungs results in increasing airflow obstruction which is usually progressive (NCCCC 2004). COPD encompasses several lung conditions with varying causes (Table 3.4), although smoking is by far the most significant factor in its development (NICE 2004).

It is estimated that 900,000 individuals are diagnosed with COPD in the UK alone and it accounts for around 30,000 deaths each year (NICE 2004). In the USA there are an estimated 32 million affected individuals, with COPD being the fourth leading cause of death (Kleinschmidt 2005). Worldwide, COPD is the sixth leading cause of death.

Pathophysiology

COPD is a collective term for three separate disease processes: chronic bronchitis, emphysema and, to a smaller extent, chronic asthma. COPD is predominately caused by smoking, with each individual experiencing a unique mixture of these three instigators (NCCCC 2004). The two major components are identified in Table 3.4.

Symptoms are insidious and usually begin to appear in the mid-thirties proliferating with increasing age. The early warning signs or symptoms are the excessive production of phlegm and a chronic or persistent cough generally lasting in excess of three months. The diagnosis of COPD should be considered in all patients over 35 who have a chronic history of smoking, and who present with external breathlessness, a chronic cough and regular sputum production (NICE 2004). The formal diagnosis of COPD is confirmed by spirometry. Spirometry plays a pivotal role in the identification and modern management of COPD.

Due to the underpinning disease process, patients with COPD are susceptible to many illnesses that can result in a rapid deterioration of their already chronically compromised lung function. The NICE have produced specific guidelines for the treatment and management of this group of individuals (NICE 2004) (Figure 3.9).

Treatment plan

As with all serious presentations, high-flow oxygen should be administered, regardless of whether the patient may have a history of COPD. The application of high-flow

Chronic bronchitis	**Emphysema**
Chronic bronchial (inflammation bronchitis) leads to continuous stimulation of the immune system resulting in excessive production of mucus and hyperplasia of mucus-producing glands resulting in the obstructive component of chronic bronchitis. The internal response is to increase the cardiac output and decrease ventilation, thereby producing a ventilation–perfusion mismatch leading to hypoxaemia, hypercapnia and a mixture of respiratory and metabolic acidosis. Heart failure is a common pre-existing factor as the chronic respiratory failure causes pulmonary hypertension, and right heart enlargement (cor pulmonale). These patients have traditionally been described as 'blue bloaters' due to the clinical manifestation or picture that these internal disease processes create.	Emphysema is defined as a destruction of the distal airways. The alveoli and capillary beds that entwine them are gradually destroyed leading to the inability to oxygenate blood. There are several forms, each affecting either the distal bronchiole or different regions of the alveoli. The internal environment compensates by increasing ventilation and lowering the cardiac output, resulting in hypoxia. Due to the excessive respiratory function individuals experience chronic weight loss and muscle wasting. Traditionally described as 'pink puffers'.
Clinical presentation	
Chronic bronchitis	**Emphysema**
Patients may be obese Frequent cough and phlegm expectoration are typical Use of the accessory muscles of respiration is common The breath sounds are often normal but upon auscultation there may be inspiratory and expiratory crackles, rhonchi (coarse gurgling) and wheezes Patients may have signs of right heart failure (i.e. cor pulmonale), such as peripheral oedema and cyanosis Similar overall appearance to heart failure	Patients may be very thin with a barrel-shaped chest (hyper-inflated) They typically have little or no cough or expectorations Breathing may be assisted by pursed lips and use of accessory respiratory muscles; they may adopt the tripod sitting position The chest may be hyper-resonant, and wheezing may be heard Overall appearance is more like classic COPD exacerbation

Table 3.4 The Main Instigators of COPD

supplementary oxygen is essential until proven otherwise (RCUK 2006) (Table 3.4). The patient should be helped to sit upright to reduce the work of breathing; this may involve the use of several pillows on conventional beds. The effectiveness of treatments should be closely monitored and evaluated; this will involve continually monitoring the patient's oxygen saturation level via a pulse oximeter, counting their respiratory rate and assessing their level of consciousness.

Medication

The initial management of exacerbations of COPD centre on the use of nebulised bronchodilators, and antibiotics if the patient is producing purulent sputum. When tachypnoea is a prominent feature, steroids are added to the therapy; these are continued for one to two weeks and decreased gradually to prevent an acute adrenal insufficiency crisis.

Maintenance of the patient's oxygen saturation above 90% is essential; this will be achieved by supplementing oxygen and dilating the bronchioles. In addition, steroids will begin to reduce the inflammation, and anti-cholinergic

Managing exacerbations of COPD

Exacerbations of COPD can be associated with increased:

- dyspnoea
- sputum purulence
- sputum volume

Initial management

- Increase frequency of bronchodilator use – consider giving via a nebuliser
- Oral antibiotics if purulent sputum
- Prednisolone 30 mg daily for 7–14 days – for all patients with significant increase in breathlessness, and all patients admitted to hospital, unless contraindicated

Hospital — **Decide where to manage** (see table below right) — Home

Hospital

Investigations

- Chest X-ray
- Arterial blood gases (record inspired oxygen concentration)
- ECG
- Full blood count and urea and electrolytes
- Theophylline level if patient on theophylline at admission
- Sputum microscopy and culture if purulent

Further management

- Give oxygen to keep SaO_2 above 90%
- Assess need for non-invasive ventilation:
  - consider respiratory stimulant if NIV not available
  - assess need for intubation
- Consider intravenous theophyllines if poor response to nebulised bronchodilators

Consider hospital-at-home or assisted-discharge scheme

Before discharge

- Establish on optimal therapy
- Arrange multidisciplinary assessment if necessary

Home

Investigations

- Sputum culture not normally recommended
- Pulse oximetry if severe exacerbation

Further management

- Arrange appropriate review
- Establish on optimal therapy
- Arrange multidisciplinary assessment if necessary

Factors to consider when deciding where to manage patient

Factor	Favours treatment in hospital	Favours treatment at home
Able to cope at home	No	Yes
Breathlessness	Severe	Mild
General condition	Poor/ deteriorating	Good
Level of activity	Poor/confined to bed	Good
Cyanosis	Yes	No
Worsening peripheral oedema	Yes	No
Level of consciousness	Impaired	Normal
Already receiving LTOT	Yes	No
Social circumstances	Living alone/ not coping	Good
Acute confusion	Yes	No
Rapid rate of onset	Yes	No
Significant comorbidity (particularly cardiac disease and insulin-dependent diabetes)	Yes	No
$SaO_2 < 90\%$	Yes	No
Changes on the chest radiograph	Present	No
Arterial pH level	< 7.35	≥ 7.35
Arterial PaO_2	< 7 kPa	≥ 7 kPa

Figure 3.9 Managing exacerbations of COPD. Source: NICE (2004)

bronchodilators will reduce mucus secretion. If the patient fails to respond, there will be a need for more aggressive therapy such as non-invasive ventilation therapy or intubation; this will require expert advice and a senior anaesthetist should be sought. In the meantime a respiratory stimulant may be prescribed if the patient's level of consciousness begins to decrease. All patients presenting with sporadic bouts of coughing and purulent sputum production should be risk-assessed for tuberculosis, as this infection could be spread to other users of the emergency department or to healthcare professionals.

Non-invasive ventilation

Non-invasive ventilation (NIV) is a key component of treating severe presentations of COPD. This precise method of oxygen delivery is used to correct hypoventilation and reduce the workload of the accessory respiratory muscles; this is achieved by forcing open distal areas of lung space via a tightly fitted face mask (sometimes a nasal device may also be used) connected to either a continuous positive pressure airway (CPAP) or bi-level ventilation (BIPAP). The use of CPAP has been shown to be an effective frontline treatment (Vanpee et al. 2002). NIV assists in both the inspiratory and expiratory phases of breathing.

By providing additional assistance during the inspiratory phase of respiration alveolar ventilation is increased, thereby decreasing carbon dioxide accumulation and providing increased oxygen availability. This will also result in the patient having to work less (very beneficial when the accessory muscles are beginning to tire).

The provision of an expiratory positive airway pressure results in the alveoli being forced open at the end of expiration increasing the functional capacity of the lungs

The major drawback of this therapy is that many patients find it hard to tolerate due to the claustrophobic effect the mask can have, and as a result of the increased pressures the device delivers. Newer machines incorporate a pressure sensor to enable the machine to alter the CPAP pressure on a breath-by-breath basis, thereby making it more tolerable. If these NIV therapies fail to improve the patient's condition, the patient may need intubation (Poponick et al. 1999).

Psychosocial aspects

Smoking cessation is crucial to halting the progressive physiological lung deterioration associated with COPD; it is therefore fundamental to the management plan of all patients experiencing COPD, regardless of their age (NICE 2004). Nurses are placed in a variety of clinical settings providing the unique opportunity to interact with patients, and the public at large, in many formats other than through a formal consultation. This provides many occasions when health promotion and education can be utilised and a clear, concise message conveyed to the listener.

Oxygen Therapy Myths and Reality: Box 3.4

- Adequate oxygen should be given to relieve all cases of hypoxia

In COPD aim to maintain SpO_2 >90–93%

It is widely believed that supplementing too much oxygen can cause significant respiratory depression: multiple studies dispute this as administering high-flow oxygen causes PO_2 and PCO_2 to rise, but not in proportion to the very minor changes in respiratory drive (Kleinschmidt 2005).

Increased circulating PCO_2 can occasionally precipitate a decrease in the patient's level of consciousness; a subsequent reduction in supplementary oxygen only leads to profound hypoxia,

Patients exhibiting clinical deterioration should either receive a trial of non-invasive ventilation or be intubated.

Developing and Delivering Expert Care: Box 3.5

Orthopnoea

Patients presenting with severe respiratory compromise in the early hours of the morning are a common presentation to acute services. When a patient has a known cardiac history the obvious cause is that they have slipped down into a flatter sleeping position during the night, causing pulmonary oedema; this inability to breathe while lying flat is termed orthopnoea. Orthopnoea is most commonly associated with heart failure, but is also seen in asthma and chronic bronchitic conditions.

Applying Theory to Practice: Exercise 3.9

Work through the following questions to develop skills in relation to educational programmes:

- How could you encourage a patient or friend to stop smoking?
- Would your programme include trying to scare them by using statistics on mortality rates and the development of cancer?
- Do you think scare tactics work?
- Now think about government initiatives such as printing 'SMOKING KILLS' on the outside wrapper of every packet sold.
- On reflection, do these initiatives work or do participants become 'conditioned' to them?

Shared decision making

Educational programmes designed to help individuals to cease smoking cannot be forced on participants, there must be an initial desire on the behalf of the patient to want to stop smoking. This may be due to many reasons or to a combination of recent events such as ill health, external pressure from family members, or due to the deteriorating health of someone they know. Government-funded organisations such as NICE (2006) and Prodigy (2007) have published several documents providing plans of care to assist practitioners in delivering effective plans of care to smokers. Primary care programmes include referral of the individual to a NHS Stop Smoking Clinic. Prodigy identify several tips on aiding an individual to stop:

- Set a date to quit, and stop smoking completely from that day
- Get rid of cigarettes, ashtrays and lighters
- Anticipate problems such as social gatherings, withdrawal symptoms, cravings, and an increase in appetite
- If possible, give up with someone else for mutual support
- Nicotine substitutes are available in several forms such as gums and transdermal patches. It is estimated that by using a nicotine substitute the success rate for quitting smoking doubles (Prodigy 2007)

Remember that encouraging a person to continue when they have stopped smoking can be extremely beneficial:

- Congratulate the person on his or her success
- Reinforce the importance of permanent cessation

Developing and Delivering Expert Care: Exercise 3.10

Smoking Cessation

Once an addiction is established, whether physical or psychological, it can be extremely difficult to stop. Therefore the best policy is prevention. Recent legislation has been directed at stopping the promotion and use of tobacco and stopping exposure to secondary cigarette smoke.

- Do you feel this is a contradiction when cigarettes are legally available throughout the retail industry?

There are several help-lines that can provide in-depth information to both healthcare professionals and individuals wanting to cease smoking:

- gosmokefree.co.uk
- smokefreeengland.co.uk
- www.givingupsmoking.co.uk

Questioning Clinical Practice: Exercise 3.11

Professional Issues Debate

Many areas of healthcare involve controversial decisions or debates; these debates can become personal when they interfere or challenge the belief systems of participants. To hold an effective debate the process must therefore be structured and overseen by a chairperson or adjudicator; identify someone who has good 'crowd control' skills! For best effect your class should be split into two groups; if this isn't possible, the same exercise can be reproduced using a few of your classroom colleagues. Group A will argue for and Group B against.

- Can nurses who smoke engage in constructive relationships with patients wishing to 'kick the habit'?

Points for consideration:
A nurse informs a patient and their family that quitting smoking is paramount to the patient's long-term survival. On their next visit the family see the nurse having a quick 'fag' break outside the ward.

- Do you think the nurse would maintain her professional creditability or is this a conflict of interests?

Scenario 3.3

Pneumonia

Robert Bassett, an 81-year-old Caucasian man, has been an inpatient for several weeks. He has been awaiting a community care bed following a stroke that has left him unable to cope independently with the activities of everyday living. His family are insistent that the care home is of the highest quality as they have read newspaper articles that have revealed how bad care standards can be in some homes.

You are allocated to care for Mr Bassett today. As you begin talking to him you notice that he appears vague, short of breath and lethargic. He has had a cough for the past two days and is expectorating green phlegm. You record his vital signs: airway patent – patient talking, respiratory rate 21, shallow and irregular with sporadic episodes of coughing. Mr Bassett's pulse is 72, strong and regular, capillary refill within two seconds and his blood pressure is recorded as 154/93. His **tympanic** temperature is 35.

You are worried that he is suffering from a chest infection. High-flow oxygen is commenced and you ask a senior nurse to auscultate his chest. The senior nurse identifies that Mr Bassett has consolidation at the base of his right lung, orders a chest X-ray and asks you to collect a sputum sample as soon as possible for microculture and sensitivity. He prescribes broad-spectrum intravenous antibiotics under a local patient group direction, attaches Mr Bassett to an intravenous infusion to hydrate him, and takes blood samples including cultures before administering the antibiotics. The senior nurse also writes an urgent referral request for physiotherapy assistance to remove some of the deep secretions within the base of Mr Bassett's lung. He assists Mr Bassett to sit upright by placing several pillows behind him.

Assessment and analysis of patient presentation

Mr Bassett is demonstrating the early signs of a severe chest infection and lobular pneumonia. The recent history of increasing shortness of breath and lethargy can indicate ominous signs of respiratory failure. Knowledgeable clinicians will also recognise that elderly patients are less likely than younger individuals to exhibit a temperature in response to severe infection, and that Mr Bassett may be becoming septic (BTS 2006). The working diagnosis for Mr Bassett is hospital-acquired pneumonia (HAP), a serious consequence for all patients experiencing a prolonged stay in hospital. Mr Bassett has been prescribed the required treatments including intravenous fluids and blood tests, which need to include:

- Full blood count
- Urea and electrolytes
- Liver function test
- C reactive protein.

Blood has also been taken for microculture and sensitivity (MC&S) before broad-spectrum antibiotics are administered, as this would compromise the sensitivity of the blood result.

Pneumonia – the facts

Pneumonia can be defined as an acute inflammation of the lower respiratory tract most commonly due to bacterial and viral infection. Lobes of the lung become consolidated, resulting in an impairment of gaseous exchange (Figure 3.10). The British Thoracic Society Guidelines on the management of pneumonia include evidence of radiographic shadowing (BTS 2004).

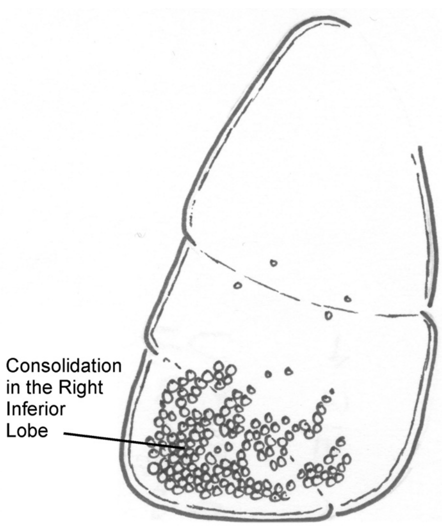

Figure 3.10 Right inferior lobe pneumonia

Classification of pneumonia

Pneumonia is classified into two distinct subgroups; the reason for this is that the two groups, despite having many common features, are treated very differently:

- **Community-acquired pneumonia.** Pneumonia that is contracted outside the hospital setting often following a viral respiratory infection; it affects nearly four million adults each year. Community-acquired pneumonia is caused by a small range of bacteria, namely *Streptococcus pneumoniae* (BTS 2004). Patients within the community are treated empirically: microbial investigations are not routinely requested and sputum should only be examined if the patient fails to respond to oral antibiotics.
- **Hospital-acquired pneumonia.** Pneumonia that is contracted within the hospital environment is known as nosocomial pneumonia. Hospitalised patients are particularly vulnerable to pneumonia, a complication of bed rest and a leading secondary infection. The main pathogens responsible for disease within the hospital environment are frequently resistant to standard antibiotics; they also prove to be increasingly virulent and associated morbidity and mortality are high. Hospital-acquired pneumonia is the leading cause of death in hospitalised patients. These infections require specific antibiotic therapy depending on the identified cause, making pathogen identification essential.

The mortality rate from pneumonia is estimated at around 10% and is the fifth leading cause of death in the UK with elderly patients experiencing the most serious effects (BTS 2004). Pneumonia is the sixth leading cause of death in the USA and the leading cause of death from infection; it is also the leading hospital-acquired infection and cause of death (Pellerano 2005).

The BTS Guidelines identify a 5-point scoring system based on individual clinical features these are summarised in Box 3.6.

Pathophysiology

Pneumonia can result from a variety of different causes:

- **Viruses** which invade cells in order to reproduce. Viruses reach the lungs when airborne droplets are inhaled through the mouth and nose (many them highly contagious). Once in the lungs, the virus

The CURB-65 Scoring System: Box 3.6
(Score 1 point for each feature present)

- Confusion
- Urea >7 mmol/L
- Respiratory rate >30/min
- Blood pressure: Systolic (<90mmHg) Diastolic (<60mmHg)
- Age >65 years

A CURB-65 score of 0 is associated with a mortality rate of 1.2%.
This figure rises to 18.2% for a score of 4 (BTS 2004).

0–1	Assess suitability for home treatment
2	Consider hospital treatment
3	Or more, manage as severe pneumonia
4–5	Assess need for ITU admission

invades the alveoli, and this can result in cell destruction. The immune system responds to the viral infection by proliferating the white blood cells. This immune or inflammatory response results in fluid leaking into the alveoli. The combination of cell destruction and fluid-filled and inflamed alveoli compromises the transportation of oxygen into the bloodstream, resulting in the clinical signs of shortness of breath, pain on inspiration and excessive mucus production. Viral infections make the body more susceptible to bacterial infections; for this reason, bacterial pneumonia often complicates viral pneumonia.

- **Bacteria** enter the lungs through inhaled airborne droplets; additionally they can also reach the lungs through the bloodstream from an infection in another part of the body. Once inside the alveoli, the immune response is triggered, and this leads to the release of several different types of cell (Chapter 10), and neutrophils engulf and kill the offending organisms. The combination of immune reactions leads to clinical signs such as fever, chills and fatigue. Again oxygenation can become compromised due to inflammatory processes associated with the immune response. In severe infections bacteria can migrate from the lung into the bloodstream causing sepsis and septic shock. Bacteria can also travel to the pleural cavity causing a complication called an empyema.

Fungi and parasites can also cause pneumonia; in addition, pneumonia may also occur from chemical or physical injury to the lungs. This can include aspirational pneumonia, a common complication of a stroke or compromise to the patency of the protective mechanisms of the airway, with altered level of consciousness, neuromuscular disease or seizures. Inhalation of infectious particles is probably the most important pathogenic mechanism in the development of community-acquired pneumonia. Various pathogens can colonise the lungs and cause disease, for example, tuberculosis. The clinical signs and features associated with acute pneumonia are insidious and develop over days to weeks.

In hospital-acquired pneumonia, invasive tubes or investigations compromise the anatomical defences and result in bacteria bypassing the defence network and directly compromising the tracheobronchial tree via colonisation, leading to a massive inflammatory reaction and an increase in mucus production. This escalating reaction results in bacteria entering the bloodstream causing involvement of the systemic circulation and the affected individual will demonstrate septicaemia. Hospital-acquired pneumonia is therefore far more virulent and destructive.

Treatment

Treatment focuses on administering appropriate antibiotics to terminate the colonisation of bacteria, sustaining optimum oxygenation through simultaneously supplementing oxygen and maintaining the patient's systolic blood pressure above 100mmHg. Providing **humidified oxygen** early in the treatment plan will reduce the incidence of damage to the airways and mucus membranes associated with high-flow oxygen administration. The early intervention of specialist care – ITU and physiotherapy to assist the movement of lung consolidation – will benefit the prognosis. Keeping the patient well hydrated and nourished has also been shown to benefit patient outcomes.

Professional issues

This preventable illness is one of the serious consequences of prolonged bed rest. Complete Exercise 3.12 to gain insight into these life-threatening complications and good nursing practice.

The Department of Health recognise that elderly patients are at increased risk of iatrogenic illness and inequality in healthcare provision. Statistics show that

Developing and Delivering Expert Care: Exercise 3.12

Complications of Bed Rest/Immobility

All healthcare workers need to be aware that all hospitalised patients are at varying degrees of risk from reduced mobility.

While on clinical placements you will see that many patients are prescribed medications to prophylactically prevent some of the possible complications of bed rest. Listed below are some extremely common pathologies associated with prolonged immobility. See if you can think of ways of preventing their development:

- Pneumonia
- Deep vein thrombosis/pulmonary embolism
- Pressure-related sores
- Thrombophlebitis
- Urine infections
- Constipation
- Malnutrition

The development of most of these pathologies are often associated with poor levels of nursing care, negligence on behalf of the carers and a failure in the nurse's duty of care (NMC 2004).

Questioning Clinical Practice: Exercise 3.13

Risk Assessment Tools

There are many risk assessment tools intended to provide a safeguard against poor hospital practices by identifying those at increased risk. Complete the following exercise to extend your developing knowledge:

- What risk assessment tools are used within the clinical areas you have practised in?
- Are tools such as the **Waterlow score** completed on a regular basis?
- What is a VIP score? How often should it be evaluated?

The following websites will provide additional information:

http://www.rcn.org.uk/publications/pdf/002179.pdf

nice.org.uk/download.aspx?o=57690

http://www.worcestershirehealth.nhs.uk/Intranet1_Library/foi_internet/foi_files/class_9/

Clinical_Policies/130405IV%20medication%20policy%202005.pdf

those over 65 occupy around two-thirds of hospital beds, their lengths of stay can be three times as long as younger patients, 80% of delayed transfers affect older patients, and figures based on London's '60 worst trolley waits' indicated that half of these patients were over 65 (DH 2005). As a nurse you need to be aware of this inequality and actively represent the best interests of those placed within your care by anticipating these complications.

Conclusion

Respiratory medicine covers an enormous catalogue of disease states and potential clinical presentations. Many of these are chronic and will lead to several patient presentations, for example, **cystic fibrosis** and COPD. Nurses do not need to specialise in respiratory medicine or one of its derivatives to encounter respiratory disease as these can be encountered in virtually all primary, secondary and tertiary environments. It is essential, therefore, that all nurses have a solid foundation of knowledge of respiratory care, particularly in assessing and maintaining a patent airway. Complete the summary quiz to reinforce your developing knowledge.

Chapter 3 Summary Quiz

1. What are the vital organs and components of the respiratory system?

A. Lungs, ciliated tissue, bronchioles
B. Lungs, epithelial tissue, alveoli
C. Lungs, villi, bronchioles
D. Lungs, adipose tissue, trachea

2. How much oxygen is in the air we breathe?

A. 19%
B. 21%
C. 60%
D. 100%

3. A patient stops breathing, which oxygen device is now essential?

A. 24% Venturi device
B. A Hudson mask
C. An Ambu bag
D. An oxygen mask with a reservoir bag

4. The muscles of respiration include:

A. The diaphragm, intercostal muscles, the hamstrings
B. Sternocleidomastoid muscles, quadriceps, triceps
C. The diaphragm, intercostal muscles, sternocleidomastoid muscles
D. Intercostal muscles, latissimus dorsi, gluteus medius

5. Non-invasive ventilation (NIV) is a key component to treating severe presentations of COPD because:

A. This precise method of oxygen delivery is used to correct hypoventilation and reduce the workload of the accessory respiratory muscles
B. This precise method of oxygen delivery means the patient will always receive 24% oxygen
C. This air delivery device will mean the patient only receives room air
D. It is the only way to deliver nebulisers to COPD patients

6. Orthopnoea can be defined as:

A. The inability to breathe due to coughing
B. The inability to breathe while lying flat
C. Shortness of breath on exertion
D. The inability to complete a sentence

7. The lungs are composed of:

A. Three lobes on the left and two on the right
B. Two lobes on the right and two on the left
C. Three lobes on the right and two on the left
D. Three lobes on both sides

8. External respiration centres on:

A. The exchange of gases through diffusion between the alveoli and the blood stream
B. The exchange of gases through diffusion between the trachea and the bronchioles
C. The passage of air into the larynx
D. The osmotic reaction within the alveoli circulation

9. Internal respiration describes the process whereby:

A. A person breathes in
B. Gases diffuse between the blood capillaries and the lymphatic circulation
C. Blood renews its supply of iron
D. Gases diffuse between the blood capillaries and the cells of the body

10. Which of the following are complications associated with prolonged bed rest/immobility?

A. Deep vein thrombosis, pulmonary embolism, euphoria
B. Constipation, pressure-related sores, pneumonia
C. Malnutrition, pressure-related sores, diarrhoea
D. Pressure-related sores, cystic fibrosis, deep vein thrombosis

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4

Blood and the cardiovascular system

Cliff Evans

Chapter 4 Learning Objectives

- Gain knowledge and insight into the anatomy and physiology related to these systems
- Gain insight into several predominant conditions related to these systems
- Apply theory to practice by understanding the physical manifestation of these illnesses in patients
- Gain insight into several commonly used medications to either prevent or treat relevant conditions
- Learn essential anatomical landmarks which can be applied in clinical practice
- Gain a solid structured approach to patient assessment
- Construct solid evidence of professional development for your growing portfolio
- Continue developing the ability to question and critique the evidence base and effectiveness of plans of care

Introduction

Disease of the cardiovascular system, or the essential fluids it carries, affects a vast percentage of the population at some time during their life (DH 2006). The physical signs are varied with many symptoms not clinically manifesting until irreversible damage has taken place.

This chapter focuses on two fundamentally important components to life: the heart and the fluid it circulates to provide nourishment, oxygenation and the removal of waste products throughout the body. For the system to be effective a transportation medium is necessary; this is the blood, which travels through a highly complex network of vessels. The lymphatic system, which complements the cardiovascular system, is also briefly discussed as the systems work in unison to maintain the internal state of homeostasis (Chapter 10 highlights the lymphatic system). Diseases related to the cardiovascular system, or one of its components, are so common that all nurses at some time during their career will deal with the consequences within their daily practice.

This chapter commences with an overview of basic cardiovascular function, identifying the main anatomy and physiological functions of this system. Common diseases that affect the ability of the system to function will be explored, illustrating how an individual's ability to perform the basic functions of life can be compromised; ultimately these diseases can result in the individual's lifespan being shortened.

Applying Theory to Practice: Exercise 4.1

Before reading on:

- Compose a list of diseases you already know that affect the heart, vessels or blood
- Add this list to your developing portfolio. On completion of this chapter expand your portfolio with the new disorders you have gained knowledge of and elaborate on how these disorders affect physiological function. This might include blood tests, electrocardiograms (ECG) and the patient's physical presentation.

Cardiovascular function

Optimum function requires several key components working in unison; despite this, the system itself can continue in the face of severe insult and the failure of many of its components.

The heart

The heart is the pump that ejects deoxygenated blood to the lungs for oxygenation, and simultaneously oxygenated blood to the systemic circulation for essential cellular function and waste removal. The heart weighs around 300g and is positioned in the thoracic cavity in the

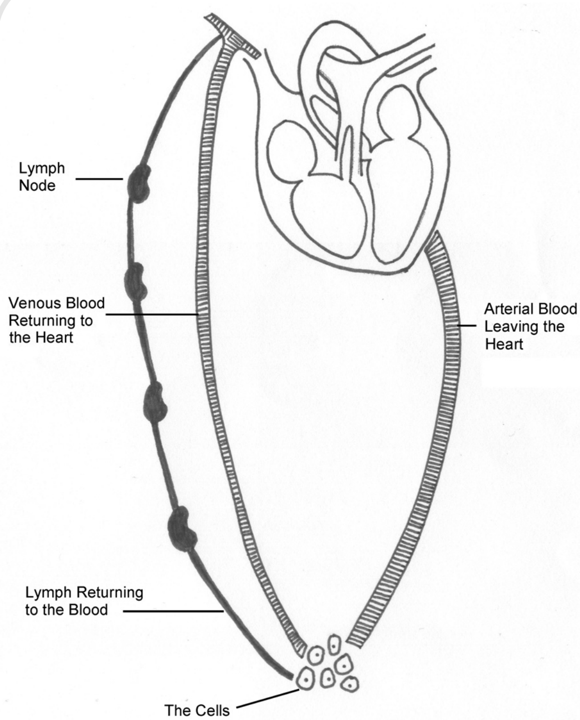


Figure 4.1 Relationship between the heart, blood and lymphatics

mediastinum, resting between the right and left lungs. The heart tilts towards the left where its main musculature sits just above the diaphragm. It is extremely muscular and compact, disproportionately powerful for an organ roughly the size of an adult fist – a necessity for its principal action of pumping a lifetime's supply of blood.

Form

The heart has three main layers:

- **The pericardium** – composed of two sacs surrounding the heart.
  The outer layer consists of strong fibrous inelastic tissue preventing over-distension. The inner layer consists of a double-layered serous membrane (secreting fluid which prevents friction as the heart pumps). The outer layer is called the parietal pericardium and the inner layer the visceral pericardium/epicardium which runs continuously with the parietal layer. These membranes are separated by a potential space in a similar fashion to the pleural space (Chapter 3).
- **The myocardium** – this specialised muscle is only found in the heart. It is mainly under involuntary control.
  Cardiac muscle resembles skeletal muscle although each cell has a nucleus and one or more branches. Cardiac muscle appears as a sheet of muscle rather than a large number of individual cells; this is important to its function, as when an electrical

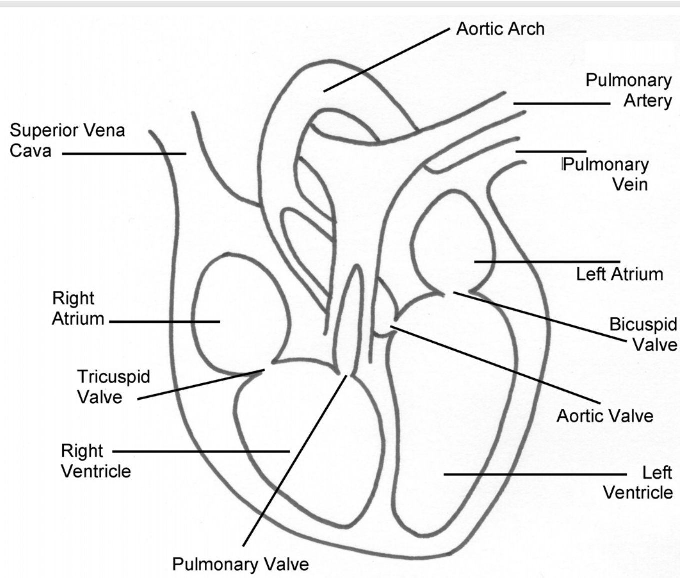


Figure 4.2 The heart chambers and major vessels

impulse initiates muscle contraction, the entire muscle sheet contracts simultaneously causing a huge force of contraction that can be increased or decreased depending on the body's needs.

- **The endocardium** – the inner layer of the myocardium, this layer is thin and covered with epithelial tissue in a similar way to the transport vessels, thereby preventing the adhesion of blood; this is essential otherwise the heart would be continuously firing off clotted blood into the circulation.

Figure 4.2 identifies the four hollow chambers of the heart:

- The atria (left and right)
- The ventricles (left and right).

The interatrial septum divides the two upper chambers, or atria; this partition continues downwards separating the ventricles where it becomes the interventricular septum. Each atrium is separated from the ventricles by an atrioventricular valve (the tricuspid on the right and bicuspid on the left) and horizontally between thin bands of non-conducting fibrous tissue, only allowing electrical conduction to follow one pre-designated route through to the ventricles. In comparison to the ventricles the atria are small receiving chambers for blood returning to the heart. The ventricles are large with a disproportionate amount of muscle on the left due to its increased workload. The top of the heart sits in the middle of the chest. The apex, which is mainly composed of the left ventricle, sits around the level of the left nipple.

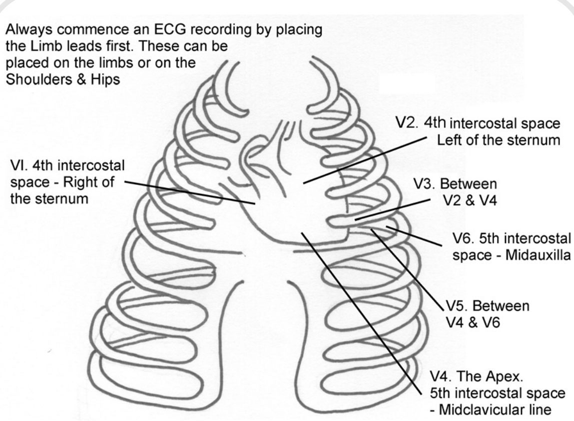


Figure 4.3 The chest and ribs with the anatomical landmarks identified for ECG recording

Anatomy and Physiology in Action: Exercise 4.2

Identification of the apex:
Located at the 5th intercostal space in the midclavicular line, left of the sternum.
Easily located by counting down the ribs from the collarbone otherwise known as the clavicle.

The clavicle counts as rib one because the first rib lies underneath it making it inaccessible. Once you have counted down and located the fifth rib, the fifth intercostal space will be between that rib and the sixth rib (Figure 4.3).
This landmark is important for the recording of electrocardiograms (ECG) and listening to heart sounds.

Practise finding and feeling this area. If you have a willing companion, ask them to undertake some aerobic exercise then locate the area again. When the heart contracts with increased power to meet the intensified cellular demands associated with physical exercise, the heart can be easily felt pounding against the chest wall.

Anatomy and Physiology in Action: Box 4.1

You can listen to the heart at the apex with a stethoscope; this process is referred to as **auscultation**.

The sounds to identify are those of particular actions within the cardiac cycle. This usually begins with:

- S1 – signifying the closure of the interventricular valves (sounds like lub)
- S2 – signifying the closure of the aortic and pulmonary valves (sounds like dub)

The first heart sound can be identified by concurrently feeling the carotid pulse and listening for the simultaneous closure of the interventricular valves (Figure 4.4 identifies the anatomical landmarks for auscultation).

There are several other heart sounds that you can learn once you have mastered the first two (Cox 2004).

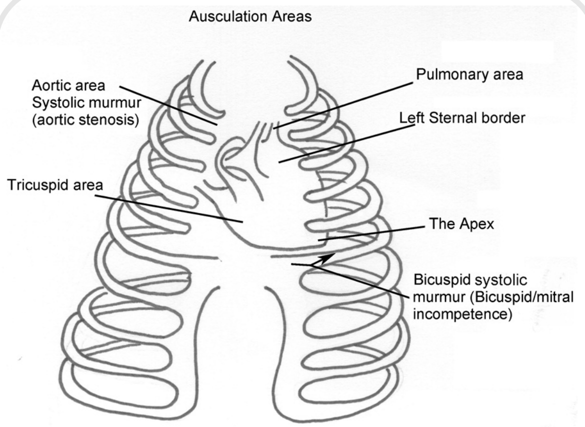


Figure 4.4 Anatomical landmarks for heart auscultation

The muscular ventricles form the main pumping component of the heart; each ventricle communicates with a large vessel via a semilunar valve to forward the blood flow. The pulmonary valve on the right leads to the pulmonary artery and ultimately the lungs. The aortic valve on the left leads to the aorta and the systemic circulation. At the base of the aorta there are two small openings, one to the left, one to the right; these are the coronary arteries, which branch off into smaller vessels encompassing the heart and supplying the heart muscle with a dedicated blood supply.

Applying Theory to Practice: Exercise 4.3

A+P

Disease of these arteries is referred to as coronary artery disease.

- Do you know which patient groups are particularly susceptible to this illness?
- List some ways of preventing this disease process

The DH's *National Service Framework for Coronary Heart Disease* is a good place to find further information (DH 2000).

Function

The cardiac cycle

The heart has electrophysiological, mechanical and neurological properties that combine and coordinate to produce effective myocardial contraction and pumping of the blood.

Mechanical

Each complete heartbeat, or cardiac cycle, consists of two phases in response to electrical stimulation.

The pumping phase of the atria is referred to as atrial systole and the pumping phase of the ventricles as ventricular systole.

Systole is triggered by depolarisation of cardiac muscle cells, which involves a transient change in sodium and potassium ion concentration inside and outside the cells (Chapter 2). Both the superior and inferior vena cava transport deoxygenated blood into the right atrium (venous return); simultaneously the pulmonary veins return oxygenated blood from the lungs to the left atrium. The blood travels into the respective atria then continues down into the ventricles through the open atrioventricular valves. The semilunar valves are closed. The atria are stimulated by a wave of electrical conduction from the sinoatrial node to force any remaining blood down into the filling ventricles. Once an adequate pressure is exerted by the ventricles, the atrioventricular valves close and the blood in the ventricles is simultaneously ejected through the semilunar valves towards the lungs from the right ventricle and the systemic circulation via the left ventricle.

The relaxation or filling phase of the atria takes place during the ventricular systole and the ventricular filling or relaxation phase takes place during atrial systole.

Immediately after depolarisation is completed, the process reverses itself, resulting in repolarisation and a return to the resting state, this relaxation phase is referred to as diastole.

These are the mechanics behind the cycle, which is also reliant on nervous stimulation and an electrical current to drive the conduction and depolarisation processes.

Neurologic (involuntary control over the heart)

Various neurologic factors regulate heart function; the most predominant is the **autonomic nervous system** (ANS). The heart is innervated via the cardiac centres in the brain by both sympathetic and parasympathetic fibres:

- The **sympathetic branch** of the ANS stimulates the heart via cardiac or accelerator nerve fibres and the release of **norepinephrine/epinephrine**. This results in both an increase to the heart rate and force of

Anatomy and Physiology in Action: Box 4.2

Summary of the Cardiac Cycle

The cardiac cycle reflects the flow of blood through the heart during one heartbeat:

- Depolarisation = discharging
- Repolarisation = recharging
- Systole = the contraction phase
- Diastole = the relaxation phase (filling) phase

The atria contract and force blood down into the ventricles; in contrast, the ventricles need to exert a pumping force to reach their targets.

The contraction of the atria can result in 20–30% more blood entering the ventricles; in disease states such as atrial fibrillation where the atria fail to adequately contract, the individual can lose this amount of their cardiac output resulting in haemodynamic collapse.

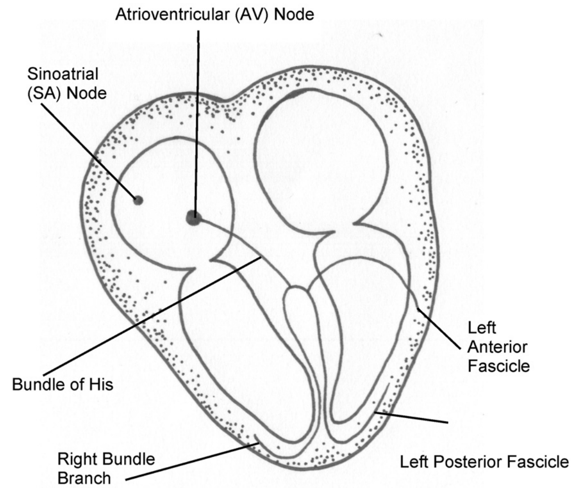


Figure 4.5 Electrical conduction within the heart

contraction (**positive inotropic effect**). This can have a profound effect with rates reaching in excess of 200 beats per minute (bpm). Sympathetic fibres also innervate the coronary arteries causing dilation and allowing increased amounts of oxygen and nutrients through.

- The **parasympathetic branch** of the ANS releases **acetylcholine** which blocks accelerator nerve fibres and causes an ionic change within the cells resulting in a slowing of the heart rate.

The levels of noradrenaline and acetylcholine are dependent on the requirements of the body at that particular moment, i.e. they either increase or decrease to maintain homeostasis. The principal force is the inhibitory effect of the parasympathetic nervous system, which slows the resting heart rate to between 60–80bpm. If the parasympathetic fibres were to totally dominate this tug of war, the heart rate might fall to a rate of between 20–30bpm. The term **vagal tone** is used to describe this slowing effect as the nerve stimulus originates in the vagus nerve. If the sympathetic nerve fibres dominate, the rate would exceed 100bpm (clearly demonstrated in exercise).

Electrophysiological (the conduction system)

The cardiac conduction system controls the route and pace, or timing, of electrical stimulation through the heart muscle. The four chambers are coordinated to work in concordance. Under normal conditions the electrical stimulation proceeds in the following sequence:

- **The sinoatrial (SA) node**: this collection of modified muscle cells (myocytes) found in the right atrium locally control or initiate each heartbeat and the rate at which the heart pumps. The SA node is commonly referred to as the heart's natural pacemaker. Under normal circumstances (at rest) the SA node will have an intrinsic rate of between 60 and 100 bpm. This intrinsic rate can be affected by exercise or intensified cellular demands: when asleep the rate will decrease. In individuals who are extremely fit the rate will be slower than normally expected due to an increase in the efficiency of the heart.
- **The atrioventricular (AV) node**: situated near the tricuspid valve acts as a bridge or gateway between the atria and ventricles. Under normal conditions this is the only entry route into the ventricles, as all other tissue between the atria and ventricles is fibrous and non-conducting.
- **The bundle of His**: this pathway, clearly identified in Figure 4.5, runs along the interventricular septum; it divides into two branches or fascicles on the left

(anterior and posterior) and one fascicle on the right travelling toward the apex of the heart.

- **The fascicles of the bundle of His/Purkinje fibres** become nerve-like processes that encompass the ventricular myocardium and form an elaborate network particularly on the disproportionately large left ventricle.

Although the SA node is the natural pacemaker of the heart, you will encounter many patients where this is not the case. Scenario 4.2 highlights a common clinical presentation where the conduction system becomes blocked.

Anatomy and Physiology in Action: Box 4.3

The Cardiac Conducting System

Under normal physiology the SA node is the heart's pacemaker, an electrical impulse instigates myocardial contraction.

The SA node determines the pace because it initiates a faster intrinsic rate of fire than any other area of the conduction system or the heart muscle; this rate ranges between 60–100bpm; the rate is affected by the body's needs via the autonomic nervous system.

If there is a failure of the SA node to conduct an impulse to the AV node, the AV node will itself instigate an impulse and become the pacemaker with an intrinsic rate of between 40–60bpm. If this back-up mechanism also fails, impulses can be generated further down the conduction system including in the bundle of His and Purkinje fibres where rates vary between 15–40bpm, but are notoriously unreliable, i.e. complete failure of the heart as a pump may ensue.

The electrical activity within the heart can be monitored via electrodes placed on the chest. Various views of the heart can be obtained depending on where the electrodes, otherwise known as leads, are positioned.

The two main formats used in clinical practice are a three-lead ECG where the viewer has three different views to choose from, and the **12-lead ECG** which uses 10 actual positions, but through combining some of these

Applying Theory to Practice: Exercise 4.4

What would the physiological consequences be for the patient if the heart fails? This may develop gradually.

Answer the following questions and add the answers to your portfolio.

- How would you expect the patient to look?
- Apart from the slow pulse rate, what effect would you expect on the other vital signs?

reveals 12 actual views of heart activity. Figure 4.3 identifies the positioning of these leads with which the nurse will need to become familiar. To begin to appreciate the ECG, the nurse needs to understand the correlation between heart function and the ECG waveforms (Table 4.1).

Heart Function	ECG Waveform
Atrial systole/depolarisation	P wave
Atrial systole to commencement of ventricular activity	PR interval
Ventricular systole/ depolarisation	QRS complex
Endpoint of ventricular systole pre-repolarisation	ST segment
Ventricular diastole/ repolarisation	T wave
Length between ventricular activity de/repolarisation	QT interval
Possible interventricular septal repolarisation	U wave

Table 4.1 The Correlation between Electrophysiology and ECG Waveforms

When continuously monitoring a patient on a cardiac monitor it is customary to select lead 2, which views the heart from the bottom up; therefore the electrical activity should be travelling toward this lead (think of sitting directly in the middle at the front of a cinema). When viewing the heart's electrical activity in this lead the

Anatomy and Physiology in Action: Exercise 4.5

The ECG enables the calculation of how long, in seconds, each part of the cardiac cycle lasts. Many tools exist to calculate and examine this event.

View some of the following online tools to gain insight and experience at understanding an ECG:

http://www.skillstat.com/6sECG_rdm.html

http://www.ecglibrary.com/

http://www.sadsuk.org/Medical_Information/Medical_ info_Storage/Equipment/BJCardN_ECG_Tool.pdf

electrics should be positive because under normal conditions the conduction will be coming directly toward lead II.

Cardiac output

The cardiac output can be defined as the amount of blood ejected from the heart by each ventricle in each minute (summarised in Box 4.4).

The cardiac output varies depending on the requirements of the body. Both the stroke volume and heart rate can be increased or decreased; these can work independently or they can combine, again depending on the current requirements.

Anatomy and Physiology in Action: Box 4.4

Cardiac Output (average under normal conditions)

- Stroke volume (SV) = 70ml
- Heart rate (HR) = 70bpm
- Cardiac output = SV x HR = 4900ml

The stroke volume can be defined as the amount of blood in the ventricles immediately before they contract (preload).

Cardiac output is the product of the heart rate multiplied by the stroke volume. It represents the efficiency with which the heart circulates the blood throughout the body. Each minute the entire blood supply is pumped through each side of the heart.

The effects of ageing

Chronic wear and tear affects the heart's ability to function in several ways. **Arteriosclerosis** is a degenerative process affecting the arteries whereby the walls of the vessel calcify and harden, resulting in a loss of elasticity, causing increased blood pressure and increased resistance and workload for the heart. As discussed, the main layer of the heart is composed of thick muscle; this muscle continually works harder to overcome the increased resistance of the arteries resulting in the insidious development of many illnesses:

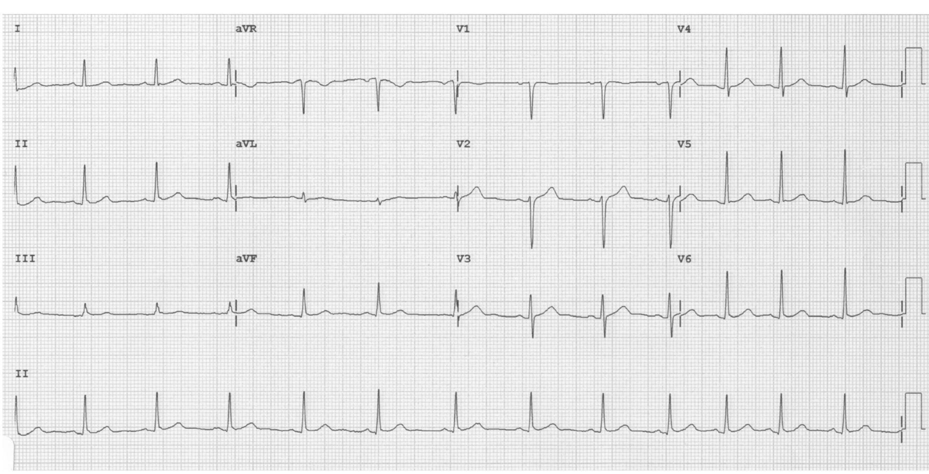


Figure 4.6 ECG revealing a sinus rhythm

Anatomy and Physiology in Action: Box 4.5

The Cardiac Reserve

The Frank–Starling law of the heart identifies that the crucial factor determining stroke volume is the degree of stretch on the myocardium just before it ejects. The greater the stretch of the myocardium, the greater the force of contraction.

During strenuous exercise the stroke volume can double; in contrast if an individual is losing blood or fluid resulting in less blood returning to the heart, the stroke volume and contraction are decreased.

- The ventricles, particularly the left, can enlarge and become **hypertrophic**, resulting in less space within the chambers; as the muscle grows larger it becomes sluggish.
- Due to **calcification** and degeneration the valves within the heart lose the ability to close properly, resulting in blood being forced in the wrong direction (regurgitation).
- The electrics begin to degenerate, leading to conditions such as **atrial fibrillation** and **heart block**.
- **Atheromatous deposits** adhere to the inner artery lining causing an increase in blood pressure and the potential for varying degrees of thrombus/clot formation with the potential of artery occlusion and starvation of the myocardium.
- **Aneurisms** within the vessels can develop, leading to weakness in the vessel wall and splitting of the vessel; common vessels include the aorta. A dissecting or leaking aneurysm is a life-threatening emergency (Evans & Tippins 2007).

Scenario 4.1 Part I

Acute Myocardial Infarction

James Collins, a 56-year-old Caucasian man, is admitted to the emergency department after suffering severe chest pain and shortness of breath for the past 25 minutes.

On arrival, he appears grey and clammy. He has vomited in the ambulance.

On arrival, his vital signs are:

Airway – clear, patient is talking, AVPU = A
Breathing – respiratory rate 24
Circulation – pulse 102, regular
Blood pressure – 149/94
PMH: **Hypertension**. Mr Collins smokes and is grossly obese.

Assessment and analysis of patient presentation

Mr Collins has presented with the typical clinical signs and symptoms of heart disease and more specifically acute coronary syndromes (ACS). He has vomited in the ambulance, a common cardiac-related symptom. He has several risk factors for the development of cardiovascular disease and his physical appearance suggests the possibility of a heart attack or acute myocardial infarction (AMI).

The structured initial assessment has identified several alterations to the patient's physical state before any vital signs are recorded. This approach is essential to identifying serious illness at an early stage. Clinical data reveal tachypnoea, borderline tachycardia and hypertension.

Developing and Delivering Expert Care: Box 4.6

Clinical Signs Associated with ACS/AMI

- Chest pain – commonly central and radiating into the neck, arms or jaw
- Sweaty, clammy or ashen grey appearance
- Nausea or vomiting
- Chest pain can be masked by diabetic neuropathy
- Sudden collapse of unknown cause
- Shortness of breath/dyspnoea
- Crushing sensation to central chest
- The early identification of these signs can prove life-saving.

Heart disease – the facts

Cardiovascular disease (CVD) is the collective name given to diseases affecting the heart and circulatory system. Cardiovascular disease was responsible for in excess of 216,000 deaths in the UK in 2004 with coronary heart disease (CHD) claiming the lives of 137,000 individuals. Cardiovascular disease is the leading cause of premature death, with more than one in three people dying from it (BHF 2006).

CVD can be split into two main types:

- Diseases affecting the heart and its circulation (coronary heart disease)
- Diseases affecting the circulation of blood to the brain (cerebral vascular accidents/stroke).

The blood distribution or supply to any area of the body can be disrupted; commonly affected areas include:

- The peripheral blood supply (arms and legs); this peripheral vascular disease is commonly precipitated by smoking
- The gut/intestines; the mesenteric artery supplies this region and can become blocked either locally by thrombus formation or by a blood clot travelling from elsewhere within the arterial system
- The deep veins of the lower and upper legs; clots can form in these areas and then travel throughout the venous system until they encounter a vessel of small diameter and become lodged; this area is commonly within the lungs resulting in a pulmonary embolism.

Pathophysiology

CHD and CVD relate to pathophysiological changes that take place within the circulatory system. In the case of CHD this process takes place within the coronary arteries directly affecting the delivery of blood to the heart. There are two closely related disease processes leading to CHD:

- **Arteriosclerosis** occurs as part of the ageing process in which arterial walls gradually become thickened, ridged and inelastic due to the deposition of fibrous tissue. The end effect of thickened and inelastic vessels is an increase in blood pressure and an inability to alter lumen size. This renders the vessel at an increased risk of rupture or occlusion, a prime example is demonstrated by aortic stenosis.
- **Atherosclerosis** is the term used to describe the deposition of lipid and cholesterol-rich atheromatous plaques within the arterial walls. Over time the inner lumen becomes increasingly clogged, resulting in a reduced **distal** blood flow. These atheromatous plaques have a serious risk of dislodgement, leading to thrombus formation and the complete occlusion of blood to an area of the heart.

Developing and Delivering Expert Care: Box 4.7

The Three Stages of Acute Myocardial Infarction Development

- Ischaemic – tissue damage caused by a lack of oxygen. Early administration of O_2 therapy can salvage the potential damage
- Injury – greater degree of damage, but still salvageable with the early instigation of treatment
- Infarction – necrotic/dead tissue, depending on timescale, damage can be limited

The early administration of oxygen saves lives!

Several theories exist as to why atheromatous plaques form or adhere to arterial walls. One theory centres on fat being the ultimate source of potential energy; it is stored throughout the body for times of need, but because of modern methods of farming and food production, with various foods being available all year round, and with increased wealth and access to food, this historically traditional period of starvation is never realised, resulting in the excessive accumulation of fatty deposits within the arteries (and elsewhere). It is accepted that if a surplus amount of fat is consumed within the diet and not utilised through energy requirements (exercise), then it is deposited not only in visible subcutaneous areas, but also within the walls of the arteries. This disease process does not occur overnight, in fact it can take decades before the

Applying Theory to Practice: Box 4.8

Risk Factors Associated with CHD

- Previous myocardial infarction
- Diabetes mellitus
- Obesity
- Genetic pre-disposition (Afro-Caribbean/Asian origination)
- Smoking
- Stimulant use (cocaine)
- Family history of CHD/CVD
- Sedentary lifestyle
- Hypertension
- Hypercholesterolaemia/lipidaemia

accumulation of atherosclerosis within the arteries actually leads to the patient experiencing chest pain due to ischaemia (cessation of blood flow). Recent studies have identified fatty deposits within the arteries as early as the teenage years (DH 2000). There are several prime predisposing factors for the development of coronary heart and vascular disease although obesity, a high fat diet, smoking, and a sedentary lifestyle, virtually guarantee its development.

The acute coronary syndromes

Figure 4.7 provides an overview of the acute coronary syndromes (ACS), an umbrella term used to describe the varying degrees of acute ischaemia that can result from this insidious disease process, disrupting blood flow to the heart, thereby compromising myocardial function.

The acute coronary syndromes reflect a disease continuum comprising three distinct but interchangeable stages of disease progression. Figure 4.7 identifies the potential outcomes when fat deposits within the coronary arteries dislodge.

The immediate treatment options depend on the extent of damage to the heart. If the episode fails to demonstrate changes on an ECG, and the patient's blood results fail to show a rise in the cardiac enzymes that are released into the bloodstream when the myocardium is damaged, the episode is referred to as unstable angina. The next stage, as identified in Figure 4.7, is non S-T elevated myocardial infarction (NSTEMI). The difference between NSTEMI and unstable angina centres on a specific blood result: if levels of **troponin** are raised in the blood, a myocardial infarction is indicated and the patient will require further treatment such as angioplasty. If the blood results reveal a raised troponin level and there is evidence of ECG changes associated with acute myocardial infarction (namely S-T segment elevation), then this is an S-T elevated myocardial infarction (STEMI).

Acute myocardial infarction – the facts

Thirty-three per cent of men and 25% of women who suffer an AMI die instantaneously. Post-myocardial infarction 50% of patients will go on to die within 30 days of the event (MINAP 2004). These alarming statistics are only the tip of the iceberg, as all of those that survive will still develop varying degrees of long-term heart failure.

In March 2000 the Department of Health published the *National Service Framework for Coronary Heart Disease*. Since its introduction the National Service Framework

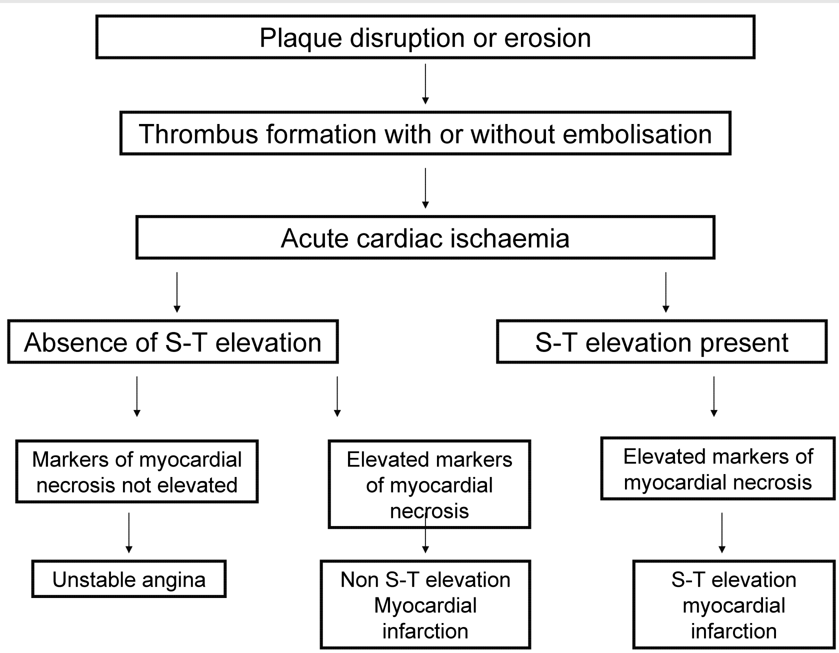


Figure 4.7 Acute coronary syndromes
(Adapted from Evans & Tippins 2007)

Applying Theory to Practice: Box 4.9

Summary of Pharmaceutical Treatments

- **Anticoagulants**: unfractionalised (UFH) and low molecular weight heparin (LMWH): true anticoagulants prolonging clotting time, reducing further clotting, enabling thrombus to disperse.
- **Anti-platelet agents**: aspirin and clopidogrel used together to reduce platelet aggregation in response to internal arterial damage (NICE 2004). Glycoprotein IIb/IIIa inhibitors are also used prior to percutaneous coronary interventions (PCI) and in the treatment of NSTEMI; their use is currently under review by NICE.
- **Thrombolytics**: directly decompose the thrombus. Time-dependent reduction in morbidity and mortality rates.
- **Morphine/diamorphine**: reduce pain, anxiety and pre-load thereby removing potential strain on the heart
- **Anti-emetics**: reduce nausea and vomiting thereby preventing further strain on the heart
- **Glyceryl trinitrate** (GTN): short-acting nitrate (vasodilators), which dilate coronary arteries, reduce myocardial oxygen demand and reduce both pre- and afterload
- **Percutaneous coronary interventions**: direct dilation of the affected artery and use of stents to maintain artery patency
- **Beta blockers**: reduce heart rate and lower blood pressure, prevention of further coronary events
- **Statins**: reduce cholesterol levels in the blood and possibility of further events

(NSF) has directly affected the care this group of patients receive. Specific guidelines dictate strict timescales within which patients must be seen and treated. The traditional treatment for AMI centres on delivering an intravenous drug to decompose the thrombus, referred to as a thrombolytic. In many hospitals a newer therapy involving directly accessing the occluded vessel and either removing or squashing the thrombus, or inserting a stent has proven to be increasingly effective (ESC 2005). These forms of treatment are called percutaneous coronary interventions or **angioplasty**.

In 2003, 75% of patients eligible for thrombolysis were treated within 20 minutes of arrival, more than double for the same period in 2000 (MINAP 2004).

The early treatment of AMI prevents and reduces the amount of death the myocardium experiences, thereby limiting the future development of heart failure (ESC 2005). The Resuscitation Council (UK) advocate the use of the acronym MONA as a quick and easy aide-mémoire for the effective initial treatment of cardiac chest pain.

Psychosocial aspects

Many patients have stated that the initial feelings they experience during an AMI centre on impending doom and a real feeling that they are going to die. Nurses throughout their career will encounter patients experiencing varying levels of anxiety and fear. It is paramount to listen to the patient's fears and communicate in a way they will understand; the minimal use of medical terminology is essential. By beginning to construct a good rapport with patients at an early stage of their presentation a relationship based on

Developing and Delivering Expert Care: Box 4.10

Excellent tools for curtailing AMI, are:

- Morphine
- Oxygen
- Nitrates
- Anti-platelet agents

Questioning Clinical Practice: Exercise 4.6

When Patients Benefit from Immediate PCI

In your clinical placements you will find many treatments on offer for particular diseases: however, this does not mean they are necessarily the most effective.

- Identify a treatment in your current placement, and research alternatives.
- NICE and NSFs provide national standards but what about international 'best practice'?

mutual respect can begin, this relationship will benefit both as the nurse will ascertain in-depth knowledge about the patient's needs and the patient will feel increasingly secure in the knowledge that the nurse is both interested in their case and is showing that they actually care about what the person is experiencing. Do not underestimate the profound effect this relationship-building phase can have on the entire patient journey!

Individuals respond very differently when faced with a potential serious illness: some will become hysterical, others will deny. It is the nurse's responsibility as the patient's main advocate to explain both the disease process (keep this brief and concise) and the immediate treatment options. Patients will frequently ask what treatment you would like to have in the same circumstance. This can be a particularly difficult question for the nurse to answer due to some serious ethical considerations that currently plague the National Health Service. Available treatments can be limited to certain regions; others may only be available privately, leaving the nurse in a compromising position in their ability to convey honest information.

Mr Collins's treatment will depend on which hospital he attends. Some will assess his needs and transfer him to another hospital where he could immediately undergo angioplasty; others may have angioplasty facilities; less-equipped areas will treat him with thrombolysis despite knowing this is not entirely in his best interest. Modern healthcare is littered with such clinical complexities and as the first line of contact for patients it is the nurse who will face most of the questions.

Professional issues

In emergency presentations the immediate priority is to assess and treat the patient's presenting problem, pain and vomiting caused by AMI in this case. Lifestyle choices are responsible for many of today's healthcare presentations. The worst culprits are smoking (Chapter 3) and obesity (DH 2006). The lifestyle choices of Mr Collins are literally killing him; his heart disease could have been completely preventable if he had adopted a healthier lifestyle. What influence can the healthcare professional have on individual choice? Does the government in a political democracy have the right to impinge on the social behaviours/habits of the public?

Recent healthcare initiates are directed at providing patients with an informed choice; if patients do not follow the guidance of the case managers (normally medical consultants/nurse specialists), they may limit their future choices. This is clearly demonstrated by local policies whereby a consultant cardiologist may refuse to undertake a second angioplasty on Mr Collins if he continues to smoke. This raises many ethical concerns for both the healthcare professional and the patient.

Scenario 4.1 Part II

Acute Myocardial Infarction (4 days post-presentation)

Mr Collins has received treatment for his acute presentation and is making a good recovery. He is now on the cardiac care ward, mobile and feeling well.

Family members who have brought him his favourite meal of steak and ale pie with chips are visiting. As his nurse walks past, Mr Collins is pouring salt onto his chips and talking with his family members.

The nurse knows that Mr Collins needs to rest and recuperate, but by continuing to eat a high fat diet with added salt he is putting himself at direct risk of a repeat episode of AMI.

The nurse begins discussing the issue with both the patient and his family. Mr Collins becomes upset and leaves the ward for some fresh air. On return the nurse can smell he has been smoking.

Questioning Clinical Practice: Exercise 4.7

What do you consider to be the role of nurses in promoting health?

- If nurses actively encourage healthier lifestyles, does this mean they need to abide by the same standards they are advocating?
- Do you smoke? Are you overweight? Do you binge drink alcohol or take recreational drugs? Does this compromise on your credibility as a nurse?

Analysis

Healthcare professionals are in an ideal position to provide essential information to patients for their long-term well-being. This health education or health promotion is vital, particularly for those with limited understanding of their conditions or limited resources (Rutter & Quine 2002). According to Rutter & Quine (2002), changing health behaviour is a complex process involving several stages:

- The patient needs to want the desired change to their lifestyle
- They must acknowledge the link between the identified high-risk behaviour and their predicament
- They need to visualise a clear pathway leading to the outcome whereby they have an action plan of avoidance and distraction when tempted to recommence the behaviour
- This includes identifying potential obstacles, resources and opportunities that will either assist or hinder their attempted change

Gollwitzer (1999) discusses how the construction of implementation intentions can further goal attainment. This can be a complex part of the patient's secondary phase of care, as confronting patients with news they would rather not hear can often be ignored or greeted with anger and denial.

In the case of Mr Collins, we know the disease process that brought him to hospital is related to the accumulation of fat within his coronary blood vessels; this could have killed him. By continuing to smoke, consuming a high-fat and calorie-rich diet, Mr Collins will be at increased risk of experiencing another heart attack or a cerebral vascular accident (stroke).

In the acute phase these matters are not usually addressed for two reasons: first, there may not be adequate time as medical and nursing staff are prioritising care; second, during this period of stress and anticipation, potentially blaming the patient for the illness would be viewed as unkind and inconsiderate. In addition, it is highly unlikely that Mr Collins would be in a fit mental state to comprehend such information. Regardless, the issue must be confronted during his time in hospital and should be a priority in his care plan during the secondary phase of his stay in hospital. Some hospitals will employ specialists (usually nurses) to address these issues and follow up patients either in the community or as outpatients.

All nurses have a moral and ethical obligation to confront actions by patients that may lead to direct harm; therefore, in this scenario the nurse should discuss the matter with both Mr Collins and his family, as these are the people he will be living with. If his current behaviour continues, they may well be living without him. Nurses must be professional and conscious of portraying themselves in a patronising manner. The point should be made that by encouraging Mr Collins to continue eating high-fat foods, his family are aiding the disease process that has led to his heart attack and that next time he may not be so lucky.

The family may view this presentation as a warning sign and take the matter seriously. It is important to educate patients about their illnesses and how they can prevent further exacerbations; this provides them with ownership of their fate. This patient empowerment is central to the modern philosophy of the Department of Health (2005). The DH has three main principles on promoting health in the NHS identified in *Shaping the Future of Public Health* (2005) which contributes to the delivery of the *Choosing Health* White Paper (DH 2004):

- Help people to make and maintain informed health choices
- Empower and mobilise local communities for health
- Develop health programmes and services, especially to reduce inequalities in health

By consulting with the patient and forming a mutually realistic plan of action, patient compliance can be improved; this process must include the patient understanding the plan and being satisfied with the affective aspects. These will include the support of his family, and counselling or belonging to a group with a common goal. Ogden (2004) centres the plan of care on information sharing and personalised information: when making statements about the benefits or risks of a particular action, it should be directly related to the patient's case so they can directly visualise the potential impact. Many patients will take the warning seriously and adopt healthier lifestyles, others will deny the cause and blame the condition on other less intrusive parts of their personality such as modern living and stress. It is important not to push the patient too far on these issues otherwise they may shun the health services completely and fail to seek help in the future.

The obesity epidemic and cardiovascular disease

Obesity and the associated long-term increase to both morbidity and mortality have led to this condition being the number one public health issue in the developing world. The clinical consequences primarily include heart disease and type 2 diabetes.

Obesity – the facts

The Department of Health have constructed a National Service Framework focusing on reducing clinical obesity, a phenomenon which is escalating at a prolific rate. In 2003, within the UK, 22% of men and 23% of women were clinically obese (DH 2006).

Questioning Clinical Practice: Exercise 4.8

You will need to ascertain which tools or systems are used to identify clinical and morbid obesity.

- Are these systems foolproof?
- Will certain user groups be given false information by the test components?

Scenario 4.2

Complete Heart Block

Ronald Mwete, a 72-year-old man of African origin, has been hospitalised for four days since collapsing at home where he lives with his wife.

Mr Mwete was found to have complete heart block; subsequently a pacemaker was inserted.

You are caring for him today and start your duties by undertaking a quick assessment of his current needs and by recording his vital signs.

On arrival his vital signs are recorded as:

Airway – clear, patient is talking, AVPU = A
Breathing – respiratory rate 16
Circulation – pulse 70, regular
Blood pressure – 149/94
Temperature – 37.9
PMH: hypertension and hypercholesteraemia

Assessment and analysis of patient presentation

Mr Mwete appears to be in a stable condition following the insertion of a mechanical pacemaker. His vital signs demonstrate that the pacemaker is functioning with an intrinsic rate set at 70. Mr Mwete has been found to have a slightly raised temperature; this could be due to an underlying infection. A source of infection should be sought. This will include observation of the pacemaker insertion sight and any indwelling invasive lines such as venous cannulae.

Applying Theory to Practice: Exercise 4.9

Venous cannulae and urinary catheters are common sites for infection (NICE 2003, NAO 2000). This is because they by-pass the body's natural defences and allow bacteria to proliferate and enter sterile sites. They should only be in place for as short a period as possible; this depends on the make and material type of the device.

- What is the life expectancy of the makes used within your clinical area?
- What cardinal signs are associated with infection?
- Identify which tests are regularly requested within your clinical placement areas and the laboratories they are sent to and for what kind of analysis.
- What is a VIP score?

Psychosocial aspects

There are two pertinent points for consideration in the care of Mr Mwete.

- First, it has been identified that many patients are frightened at the prospect of being hospitalised, sometimes due to adverse publicity, or to the real threat of developing a hospital-acquired infection (Washer & Joffe 2006). Healthcare professionals should rationally discuss patient fears about catching resistant bacteria while in hospital. Nurses must remain professional when questioned, with patient education the onus; simultaneously the nurse must be aware that hospital-acquired infections do pose a real and significant threat to both patient morbidity and mortality rates, with currently one in ten hospitalised patients affected (NICE 2003).

- Second, Mr Mwete must learn to come to terms with the device planted within his body. Most pacemakers will only be slightly noticeable to those unaware of their presence; despite this, the patient will initially be constantly aware of its presence.

Nurses are in an ideal position to discuss the psychosocial aspects of patient care, particularly when the patient is susceptible to the information. This is not necessarily within the initial period when the medical team may have conveyed relevant although technical data. Patients often take time to absorb information and frequently require the same explanation several times (Hollinworth & Hawkins 2002). Patients will commonly require reassurance about the potential alteration to body image, alterations to lifestyle and technical information.

The plan of care

Mr Mwete's plan of care will be based on the activities of living described by Roper et al. (2000: Chapter 1). Using a model provides the nurse with prompts to deliver a holistic approach to his care. Case management will include assisting Mr Mwete to return to his own home as soon and as safely as possible. This will be a multidisciplinary effort with several members of the team providing expert opinions on his potential needs via assessment processes. The initial plan of care centres on ensuring the pacemaker is providing an adequate level of stimulus to meet his physiological demands. This is demonstrated via vital sign analysis.

Mr Mwete was found to have a localised skin infection at the site of his pacemaker insertion. The area became red, inflamed and a purulent discharge was noted when the dressing was changed. A swab was taken of the discharge and sent to the microbiology laboratory for microculture and sensitivity examination (MC&S). Antibiotics were commenced and, depending on the results of the laboratory tests, the antibiotics might be replaced by a specific drug that would eradicate the infection. Mr Mwete was discharged home once his temperature had resolved. He was still taking oral antibiotics and was told to see his GP if the site became inflamed or if he felt unwell. An outpatient appointment was made to assess the effectiveness of his pacemaker.

Pacemakers – the facts

Pacemakers are common although most people are not aware of the crucial role they play in assisting an individual to lead a normal lifestyle. A permanent artificial pacemaker is a small, battery-operated device inserted below the skin on the patient's chest. There are a variety of different types of pacemakers available depending on the initial compromise. These include:

- Single-wire pacemakers, which sit inside one of the heart's chambers
- Two-chamber pacemakers are generally used when the individual requires additional support: one of those wires goes in the atrium; the other wire goes in the ventricle
- Three-lead pacemakers are used when the muscle of the heart fails to be powerful enough to maintain an adequate cardiac output.

The pulse generators can be set to a fixed-rate (asynchronous) or demand (synchronous) mode.

Although pacemakers are generally inserted when a patient has such a slow heart rate that they might collapse without warning due to insufficient blood flow to their brain (symptomatic bradycardia), they are also inserted for heart rates that can become dangerously fast (tachyarrhythmias). These devices can initiate an electrical charge designed to restart the heart in its normal sequence thereby curtailing the abnormal and potentially life-threatening rhythm (arrhythmia). These devices are referred to as indwelling defibrillators.

Applying Theory to Practice: Exercise 4.10

While on clinical placement identify how long the battery lasts in the types of pacemakers used in your area.

- How does one change the batteries?

Pathophysiology

The conduction sequence and its relationship to heart function are commonly affected by disease. These disease processes are synonymous with ageing and degeneration of areas of the conduction sequence, although several other predisposing factors have been identified

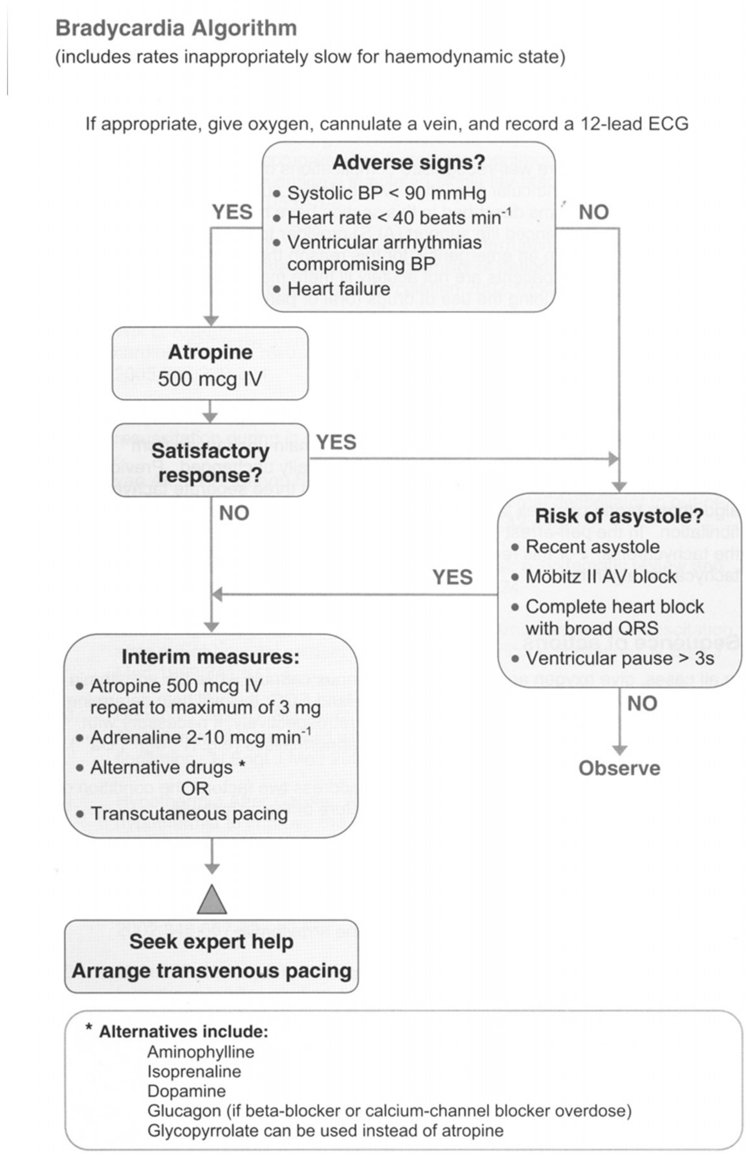


Figure 4.8 Bradycardia algorithm. Source: Resuscitation Council UK (2006). Reproduced with permission.

(Ariyarajah et al. 2005, Levine & Brown 2006). These disease processes manifest in several different ways depending on the origin of the anomaly and the current health status of the individual. There are two distinct types of arrhythmia: those that increase the heart rate (tachyarrhythmias) and those that slow the heart rate (bradyarrhythmias).

Bradyarrhythmias

There are several independent factors that can result in an excessively slow heart rate and for physically fit individuals (particularly runners) a very slow heart rate can be normal. Therefore, when assessing a patient's heart rate, take into consideration other relevant factors such as levels of fitness, medications such as beta blockers that will slow the heart rate, and hypothermia that may also have a pronounced effect. There is, therefore, a distinct need to separate the term bradycardia (purely meaning slow heart rate) into symptomatic or non-symptomatic bradycardia. Common causes of symptomatic bradycardia include:

- Drug toxicity – commonly digoxin and beta blockers
- Vagal over-stimulation
- Blocks within the electrical conduction pathway (referred to as heart block)
- Myocardial infarction.

The Resuscitation Council (UK) have identified an algorithm that identifies best practice when confronted by a patient demonstrating bradycardia (Figure 4.8).

Heart block – the facts

There are varying classifications of heart block referred to as degrees, with some simply being variants of normal and producing no physical effects. Others will result in profound effects including haemodynamic collapse and cardiac arrest. Heart block has a variety of causes. It can be a consequence of a congenital defect or **cardiomyopathy**, although it is commonly associated with myocardial infarction (Ghuran et al. 2003).

Tachyarrhythmias

Tachyarrhythmias encompass several pertinent abnormal cardiac rhythms. It does not include sinus tachycardia, as this is not an abnormal rhythm and therefore not an arrhythmia. The most prevalent tachyarrhythmia is atrial fibrillation, the most famous or infamous is ventricular tachycardia:

Atrial fibrillation (AF) is associated with an increased risk of embolus-related stroke due to clot formation within the atria, heart failure due to a reduced cardiac output and premature death (Bilal Iqbal et al. 2005). AF affects approximately 4% of over 65-year-olds in the USA; this figure increases to 15% by age 75 (Ezekowitz 1999). Majeed et al. (2001) suggest there are approximately 650,000 individuals diagnosed with AF in England and Wales. This is probably an underestimate as many people live with undiagnosed AF until a symptom manifests.

Stewart et al. (2004) state that the prevalence of AF is increasing and that 1% of the UK population experience AF; this increases to 10% in the elderly. Most patients with AF require long-term pharmacological treatment, often including anticoagulants, which require monitoring. The prevalence of AF-related hospitalisations has increased threefold over recent years (Stewart et al. 2004). Patients experiencing AF commonly present in one of three ways;

- Lethargic and weak; this is due to the reduction in cardiac output that the patient can experience
- In a collapsed state due to a combination of established heart disease and the impact of a reduced cardiac output
- Following a stroke or a cerebral event: due to insufficient contraction of the atria, blood stagnates resulting in clot formation; these clots are eventually fired around the circulation commonly resulting in a **stroke**.

Figure 4.9 demonstrates a **narrow complex tachyarrhythmia** with an irregular ventricular response. When a tachyarrhythmia is identified, there are two main points that need to be clarified:

- Does the patient exhibit signs of circulation? If not, the advanced life support algorithm should be commenced.

Questioning Clinical Practice: Exercise 4.11

- How might a symptom of AF manifest?
- Which is the most common illness directly associated with AF?

Applying Theory to Practice: Box 4.11

Causes of Atrial Fibrillation

- Coronary heart disease
- Alcohol
- Hyperthyroidism
- Cardiomyopathy
- Infection (sepsis)
- AF can be **idiopathic**

Atrial fibrillation can be easily felt at the patient's radial pulse. The pulse will feel irregular and possibly thready if the individual has a significantly reduced cardiac output. This vital datum will not be identified if you rely solely on machines to record vital signs.

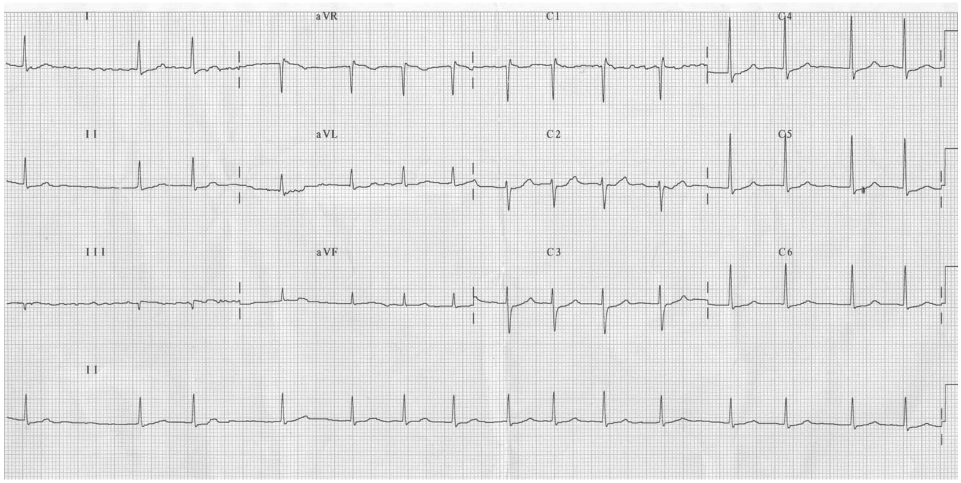


Figure 4.9 Atrial fibrillation (Evans & Tippins 2007)

- Is the patient haemodynamically compromised or incapacitated?

AF is a complex presentation to treat and its management is dependent on potential risk factors. NICE are currently reviewing AF guidelines published in 2007. The emergency management phase is covered within the Resuscitation Council (UK) tachycardia algorithm (Figure 4.10).

In chronic AF the prospect of cardioversion being successful is greatly reduced and drugs may be prescribed to reduce the ventricular response. Depending on the risk factors the patient may be prescribed long-term anti-coagulant therapy.

Cardiac arrest

Ventricular tachycardia (VT) implies that the ventricles, which form the major pumping force of the heart, are beating at an exaggerated rate exceeding 120–150bpm. Strictly speaking, only a limited number of beats originating from within the ventricles constitute ventricular tachycardia, but in reality the rhythm is continuous, with the individual commonly experiencing a sense of impending doom, or collapsing due to a reduction of their cardiac output, whereby the ventricles are pumping so fast that they do not have enough time to fill with sufficient blood.

Ventricular tachycardia, also known as **broad complex tachycardia**, can continue even after the individual has suffered such a haemodynamic insult that they lose their cardiac output and pulse. This is referred to as pulseless ventricular tachycardia; one of the four cardiac arrest rhythms.

Developing and Delivering Expert Care: Exercise 4.12

All healthcare staff need to be able to identify critical illness and deliver basic life support (DH 2001).

- You will need to develop expert skills within this area. The RC (UK) have a website with extensive information and easy to follow algorithms on serious emergencies such as choking and anaphylaxis through to cardiac arrest.
- Visit their site and download the algorithms guiding current practice.
- Practise drawing the electrical rhythms associated with cardiac arrest; add these to your portfolio.
- www.Resus.org.uk

Cardiac arrest synopsis

Cardiac arrest can be defined as the sudden cessation of cardiac function, resulting in the loss of effective circulation and therefore incompatible with life. The Resuscitation Council (UK) have published guidelines on advanced life support (RCUK 2006). These guidelines

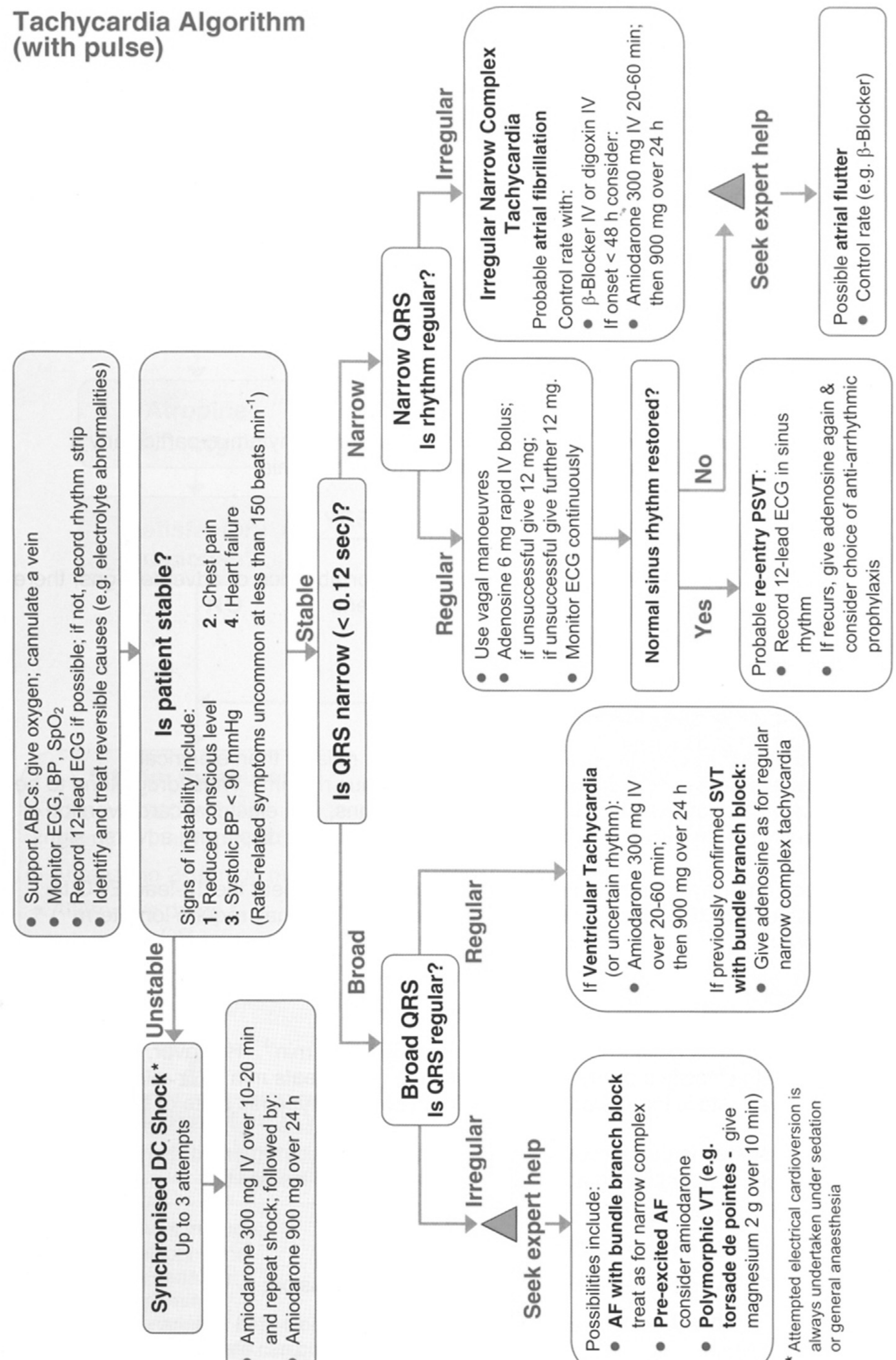


Figure 4.10 Tachycardia algorithm (with pulse). Source: Resuscitation Council UK (2006). Reproduced with permission.

provide healthcare practitioners with a structured approach to the emergency management of patients experiencing cardiac arrest (Figure 4.11). Most cardiac arrests within the hospital environment are predictable events, with many early warning signs and symptoms (RCUK 2006).

The ALS guidelines are initially based on the chain of survival outlined in Table 4.2.

Chapter 2 identified many of the early warning signs synonymous with physical deterioration and cardiac arrest; the following section describes the arrest rhythms and the associated ECG changes. The reader is referred to the RC (UK) guidelines for in-depth guidance.

Advanced life support

The treatment of cardiac arrest centres on achieving cerebral and vital organ perfusion until definitive treatment such as defibrillation can be delivered or an instigating cause identified and treated. Life support becomes 'advanced' once a defibrillator/cardiac monitor is available.

Shockable rhythms (defibrillation)

This requires a cardiac monitor to identify an underlying rhythm. If the rhythm is **pulseless ventricular tachycardia** (PVT) or **ventricular fibrillation** (VF), the application of an electrical current or **defibrillation** of the heart muscle may result in the chaotic rhythm and fibrillating muscle mass becoming organised again, with the patient regaining a cardiac output/pulse. VF and PVT are commonly associated with AMI and have the lowest mortality rate when early treatment is initiated. Therefore if the cause of the cardiac arrest is due to electrical faults such as ventricular fibrillation, defibrillation is the key to management (Figure 4.11).

Non-shockable rhythms

Two other rhythms are associated with the arrested patient. The first is **asystole**, which means without output, i.e. an absence of electromechanical activity throughout the heart. This, therefore, cannot be defibrillated and the management centres on basic life support. It is traditionally referred to as a 'flat line' and hence there is a need to check lead attachments are correct. This arrhythmia has the highest mortality rate. Causes include vagal over-stimulation. The second is **pulseless electrical activity** (PEA). PEA can be defined as an organised electrical rhythm without a cardiac output/pulse, i.e. the patient is pulseless despite a potentially normal electrical rhythm. Common causes include hypovolaemia and hypoxia. In PEA the cause must be identified and addressed in order to restore a spontaneous circulation. Exercise 4.13 lists the reversible causes of cardiac arrest.

Applying Theory to Practice: Exercise 4.13

Reversible Causes of Cardiac Arrest

4 Hs and 4 Ts

- **H**ypovolaemia
- **H**ypothermia
- **H**ypoxia
- **H**ypo/hyperkalaemia (electrolyte imbalances)
- **T**ension pneumothorax
- **T**amponade – cardiac
- **T**hromboembolic
- **T**oxins

Memorise this list and add it to your portfolio. By structuring your clinical decision making around these causes you may save lives!

Questioning Clinical Practice: Exercise 4.14

There are several important phrases used within clinical practice to describe both the act of resuscitation and the legal terminology surrounding care.

Using the correct terminology is paramount as misunderstandings can lead to distress and confusion in an area commonly described as one of the most sensitive that clinicians, patients and family members may have to face.

- Find out the clinical meaning of the terms and locate a copy of the DNAR policy your trust employs
- What is the difference between a patient receiving active treatment and a patient not being resuscitated in the event of a cardiac arrest?

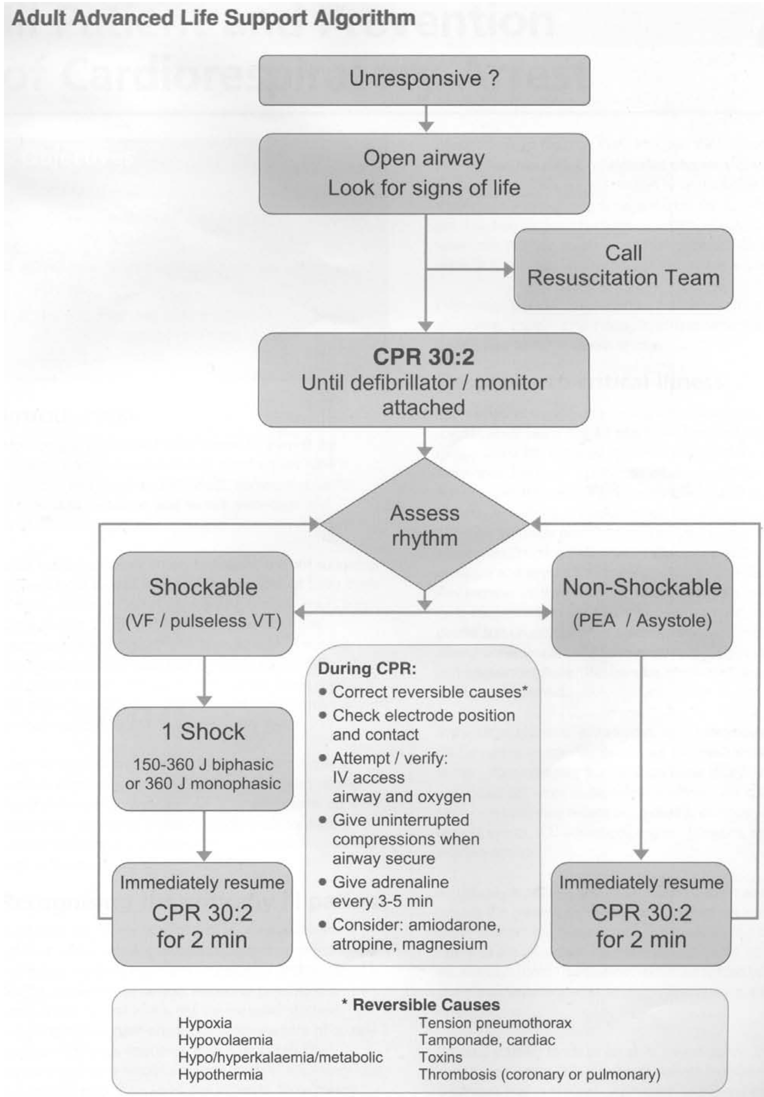
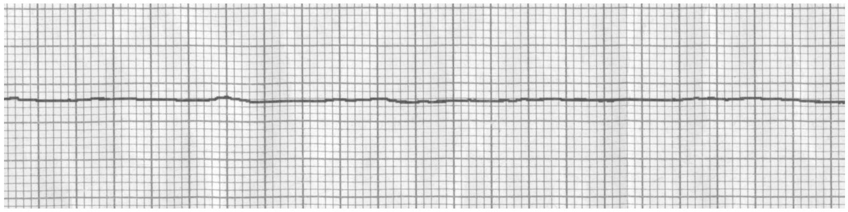


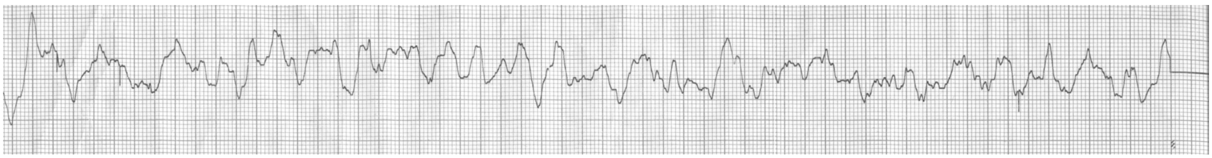
Figure 4.11 Adult advanced life support algorithm. Source: Resuscitation Council UK (2006). Reproduced with permission.

Action	Rationale
Early recognition of associated signs and call for help	Prevention is better than cure
Early **cardiopulmonary resuscitation** (CPR)	Cerebral oxygenation while buying time
Early defibrillation	To restart organised electrical activity and cardiac output
Post-resuscitation care	To maintain adequate circulation
	To prevent further arrests
	To restore quality of life

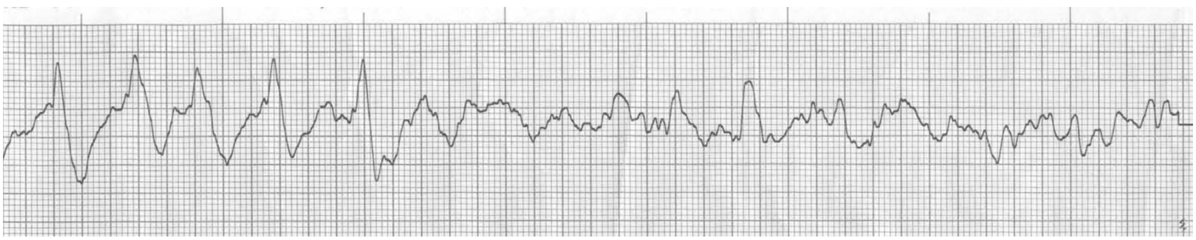
Table 4.2 The Chain of Survival



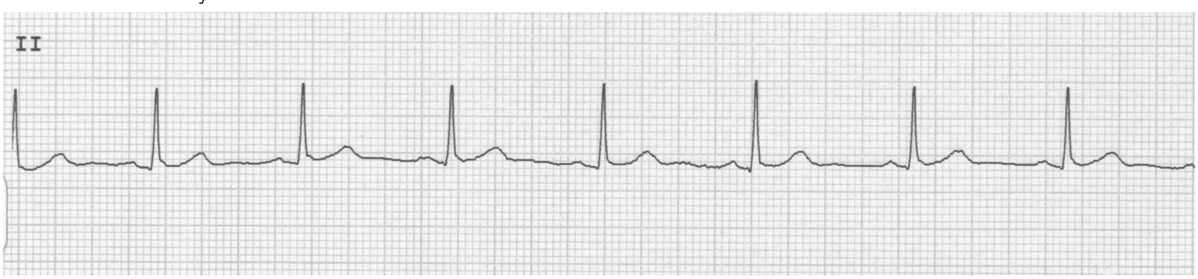
A. Asystole



B. Ventricula fibrillation



C. Ventricula Tachycardia into Ventricula fibrillation



D. Sinus Rhyth but no cardiac output

Figure 4.11 The four electrical rhythms synonymous with cardiac arrest

Professional issues

Cardiac arrest and Do Not Attempt Resuscitation Orders (DNAR)

Television programmes can portray an unrealistic view of cardiac arrest and the act of resuscitation: most patients survive after receiving defibrillation in response to the flat line seen on a cardiac monitor. As you will have already read, asystole is a non-shockable rhythm. In reality, even within an acute hospital environment fewer than 20% of patients who experience a cardiac arrest survive (RCUK 2006).

Every patient should be resuscitated following a diagnosis of cardiac arrest unless a patient has explicitly refused cardiopulmonary resuscitation (CPR), an example being the patient has a valid advanced directive/living will, or if their individual circumstances limit the potential benefits of CPR: this could include the patient being in the terminal stage of an illness, or having a chronic condition whereby the burdens of CPR outweigh the benefits.

Nurses need to be able to distinguish between the act of actively treating a patient, withdrawing active treatment and not resuscitating in the event of cardiac arrest. Patients and those close to them may misinterpret DNAR as a withdrawal of care. A DNAR order, which must be written by a consultant or the most senior doctor present, only relates to the act of administering CPR (it is assumed that senior nurses will also soon be decision makers). Many patients are admitted to hospital with complex needs; in younger patients these may be congenital defects. In the ageing population these may be due to a lifetime's wear and tear.

When a serious diagnosis is confirmed and cannot be cured, the patient's care management may change from cure to symptom control. Care is never withdrawn but the focus changes dependent on the individual's needs. In nursing terms this has been classically described as allowing the patient to die with both dignity and comfort. Pain control, symptom relief and psychological care become the central care focus. Withdrawing treatment centres on stopping treatments or investigations aimed purely at gaining a diagnosis or prolonging the quantity, rather than quality, of life. The patient's needs are still addressed and their plan of care may include surgery or radiotherapy for symptom control.

The Department of Health have issued guidelines on this sensitive issue. These include removing subjectivity from the decision-making process and involving the patient and those close to them as much as possible (BMA 2001). A DNAR decision should be considered when patients:

- Have previously stated they do not want to be resuscitated in the event of cardiac arrest
- Are unlikely to survive the cardiac arrest.

All UK hospitals should have an agreed DNAR policy, based on national guidelines (NHS Executive 2000). Healthcare workers need to attend regular mandatory updates on both the delivery of basic life support and on the clinical application of DNAR orders.

Analysis

DNAR orders can cause great distress to both patients and their families or loved ones. This can be exacerbated if they have not been involved or informed about the decision. It is considered best practice to involve the individual, next of kin or family in decisions affecting them, although legally the ultimate decision is a medical one (RCUK 2006).

The blood

The blood can be viewed as a fluid and mobile connective tissue. This tissue is composed of two prime components – cells and **plasma**.

Form

The components of blood are bathed and transported in the plasma. Plasma constitutes 55% of the blood volume. It is a thick and straw-coloured fluid; its main component is water (90–92%), the remaining volume being the transportation enzymes and the plasma proteins:

- Albumin
- Fibrinogen
- Prothrombin
- Globin.

Plasma transports several essential components to where they are required within the body, these include:

- Oxygen and carbon dioxide, dissolved within the plasma
- Hormones and enzymes – these chemical messengers and catalysts assist in the maintenance of homeostasis by influencing organs to return a state of internal equilibrium
- Antibodies and antitoxins – complex proteins programmed to attack specific antigens
- Waste – urea, carbon dioxide and lactic acid are transported to the liver to be broken down and to the kidneys for excretion
- Mineral salts or electrolytes – maintain nerve conduction and acid/water balance
- Nutrients – amino acids, essential fatty acids, glucose and vitamins are distributed to the cells for energy, cellular reproduction and repair.

The blood cells are composed of three distinct types of cell (Table 4.3).

Function

- Transports oxygen, hormones, enzymes and nutrients throughout the body
- Removes waste products from every region of the body and transports them to the organs of excretion
- Contains clotting factors, white blood cells and antibodies

Anaemia – the facts

Anaemia is a collective term used to describe the end result of many disease processes in which the blood cannot carry enough oxygen, either resulting from a decrease in the number of RBCs or because each RBC is unable to carry sufficient oxygen due to the depletion of

Erythrocytes (red blood cells/RBC)	**Leucocytes** (white blood cells/WBC)	**Thrombocytes** (platelets)
Biconcave cells that do not contain a nucleus Produced in the red bone marrow, containing haemoglobin which absorbs oxygen, providing blood with its distinctive red colour On average, circulate for 120 days when they are broken down by the spleen and iron recycled by the liver	Split into two groups: Granulocytes and non-granular leucocytes Irregularly shaped cells, largest of the blood cells Active role in preventing infection and repairing damage Can proliferate dramatically through mitosis when confronted by infection	Small, easily damaged cells with no nucleus The instigators to blood clotting Produced within the red bone marrow

Table 4.3 The Blood Cells

Pernicious anaemia	**Iron deficiency anaemia**	**Aplastic anaemia**
An insidious process in which a vital component for the absorption of vitamin B_{12} is lost This failure in the production of intrinsic factor in the stomach is associated with a reduction in hydrochloric acid production The end result is the circulation of large cells within the blood circulation that do not contain haemoglobin and cannot, therefore, carry oxygen The cause has been associated with an autoimmune response in the gastric mucosa Treatment centres on replacing vitamin B_{12} via slow-releasing intramuscular injections (cyanocobalamin)	A deficiency of dietary iron, the main component of haemoglobin, leads to the world's leading nutritional deficiency and the most common cause of anaemia (Clancy & McVicar 2002) A common cause is heavy periods (menorrhagia); 1% of women become anaemic at some time in their life due to this (Ramrakha & Moore 2004) Diseases related to a slow loss of blood e.g. peptic ulcers (often associated with the long-term use of NSAIDs) Some bowel conditions, e.g. coeliac disease or chronic diarrhoea, cause poor absorption of iron Low dietary iron can lead to anaemia, although there are many sources of iron, including meat, green vegetables, milk, flour and eggs Worldwide, hookworm infestation is the leading cause due to the worms feeding inside the intestines (Easton 1999); although mostly prevalent in tropical countries hookworm infestation can be seen in those who have recently been to tropical areas.	A failure in the production process of red blood cells in the bone marrow. Has been linked to certain classes of drugs i.e. sulphonamides, chloramphenicol, and the effects of radiation. Over a period of time the bone marrow becomes atrophied and ineffective Treatment ranges from discontinuing the identified cause to administering blood transfusions for the anaemia All the common forms of anaemia result in similar signs and symptoms

Table 4.4 Common Classifications of Anaemia

essential components, such as haemoglobin. The most prevalent forms of anaemia are summarised in Table 4.4.

Anaemia is associated with several common signs and symptoms:

- Breathlessness, increasing with activity
- Tiredness or lethargy
- Dizziness, particularly on standing
- Rapid pulse and palpitations (irregular heartbeats)
- Pallor (dependent on severity)
- Red, inflamed tongue
- Reduced CRT
- Jaundice.

Applying Theory to Practice: Exercise 4.15

- List what changes to a patient's lifestyle you would expect from this chronic or insidious disease process. Think about the symptoms previously discussed.
- Read the scenario 4.3 and compare your findings.

Scenario 4.3

Sickle Cell Disease

Chantal Ferguson, a 24-year-old woman, has been referred to the acute medical unit after experiencing increasing abdominal pain over the past two days. She has taken dihydrocodeine, which is prescribed by her GP for periodic acute attacks of sickle cell pain.

During the initial assessment Chantal appears pale, clammy and is crying with pain. Her respiratory rate is 29, regular and bilaterally shallow. There are no signs of central or peripheral cyanosis. Her radial pulse is weak, regular and recorded as 115 bpm; this is in conjunction with a CRT of three seconds. Her blood pressure is recorded as 148/79.

Miss Ferguson appears frightened. She adopts the fetal position and guards her abdomen, which is soft to touch. She is alert and orientated to time and place. Her pupils are equal and reactive to light. Temperature is 38.1.

She is allergic to penicillin, has lactose intolerance and a PMH of sickle cell anaemia.

Assessment and analysis of patient presentation

Miss Ferguson appears to be demonstrating the early stages of compensatory shock, identified by the rapid rise in her respiratory rate. Her radial pulse is weak and her CRT reduced. Her pale, sweaty appearance may be due to pain, or a severe ischaemic event making this presentation serious. A patient exhibiting severe pain is always a cause for concern due to the underpinning pathophysiology associated with pain development. Although sickle cell anaemia is a chronic disease process, the effects can result in acute exacerbations. She is at risk of vaso-occlusive, haematological and infectious processes, which can be extremely painful, leading to organ failure and ultimately an early death.

Applying Theory to Practice: Exercise 4.16

What would your initial plan of care involve for Chantal Ferguson?

- Identify her needs and prioritise your care delivery.
- Many healthcare trusts have a local policy on best practice – identify the one in your area.

As with all potentially critically ill patients, high-flow oxygen (12–15L/min) should be commenced via a reservoir bag and mask. Intravenous access will need to be established as sickle cell presentations commonly involve dehydration, with the associated decrease in peripheral circulation precipitating the red blood cells to sludge. The administration of analgesia should be a priority and all progressive units will have a set protocol to follow. Her pain will need to be assessed, analgesia administered and its effect evaluated.

Developing & Delivering Expert Care: Box 4.12

When administering intravenous **opiates** the drug should be given slowly to ascertain the desired effect and reduce the possibility of respiratory depression. This is called the titration of drugs, and is an essential component in the delivery of quality care.

Administering appropriate pain relief is an essential part of nursing practice. This assessment should be based on the World Health Organization's step approach to analgesics (WHO 1996). There are many pain assessment scales available, and it is recommended that acute areas use a minimalist approach to the assessment process due to the clinical symptoms, demonstrated in Table 4.5 (Evans & Tippins 2007).

Pain score	Appropriate analgesia
0 = No pain	None indicated
1 = Mild pain	Non-opioid analgesia
2 = Moderate pain	Weak opioid combinations
3 = Severe pain	Stronger opioid combination
4 = Very severe pain	Opioids titrated to pain

Table 4.5 Categorical Rating Scale for Acute Pain

Questioning Clinical Practice: Exercise 4.17

Explore your own experiences of pain.

- List some of the alternatives to drugs for pain relief.
- While on clinical placement identify local methods of pain relief.
- What tools or scales do nurses use to prevent subjective opinion and initiate appropriate treatment?
- Are these tools relevant to all users? What if the individual does not speak English?
- What other ways are there to justify your choice of treatment?

Many studies have identified that analgesia administration to patients in pain is inadequate, mainly due to the subjective opinions of practitioners (Davies & McVicar 2000, Nurmikko et al. 1999). The categorical rating scale directly links theory to practice through the correlation between the identified pain score and the choice of analgesia. As with the assessment of all patients in pain, objective findings, such as those associated with the sympathetic response, should be included in your assessment. There are many theories related to how patients interpret pain, and how their interpretation can be based on childhood experiences and learnt behaviour through to cultural beliefs and ethnicity (Edwards et al. 2001).

Sickle cell disease – definition and prevalence

Sickle cell disease is a genetically inherited disorder. Sufferers inherit two variant haemoglobin genes, one from each parent. It mainly affects individuals of Afro-Caribbean heritage, although similar genetic pathologies exist within Mediterranean countries and the Middle East. The high incidence of the sickle cell gene in these regions of the world is due to the sickle cell's ability to make RBCs resistant to the malaria parasite (Clancy & McVicar 2002). Thirty years ago the life expectancy of a sufferer was around 14 years; today with modern treatments it exceeds 50 years of age (Claster & Vichinsky 2003). There are in excess of 15,000 individuals living with sickle cell or haemoglobinopathies within the UK (Anionwu & Atkin).

Pathophysiology

Sickle cell disease results from genetic abnormalities in haemoglobin construction where a single amino acid substitution creates a cascade of events leading to the deformity of an essential component of RBCs. RBCs become misshapen, rigid and sticky, resembling a sickle. This sickling leads to an increase in blood viscosity; RBCs can adhere to the inner layer of arterial walls and literally get stuck while travelling through the capillaries, resulting in distal ischaemia and severe pain referred to as the sickle cell crisis.

The abnormal shape of the sickled cells results in dehydration due to water and potassium loss. Sickle cells also have a shorter life span (10 to 20 days) compared to that of normal RBCs. Although the body compensates for the decrease in viable RBCs, the overall count decreases resulting in anaemia, hence the term sickle cell anaemia. Common triggers include hypoxia, infection and dehydration.

With repeated attacks a chronic and progressive destruction to the internal tissues and organs occurs. Commonly affected areas include the spleen, lungs and liver.

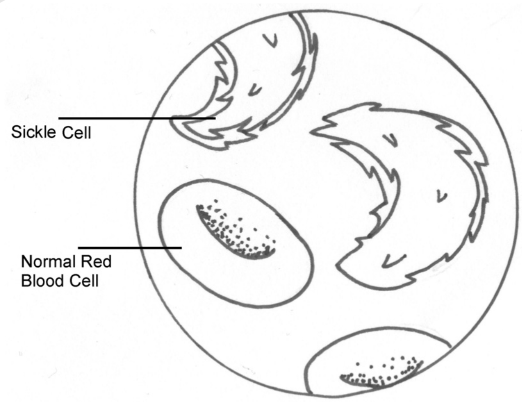


Figure 4.13 Sickle-cell disease (illustrating normal blood cells and sickle cells)

Treatment

Treatment initially centres on pain control, supplementary oxygenation and rehydration. An infective or ischaemic process needs to be reversed. The National Institutes of Health, National Heart, Lung, and Blood Institute (2002) have published a collaborative document focusing on developing a standard of excellence for this user group.

Analysis

Any patient with a history of pallor, lethargy, weakness and shortness of breath should have a full blood count; this simple blood test measures the number of RBCs and haemoglobin. Miss Ferguson was found to have a temporary ischaemic episode affecting her spleen. Her care involved the administration of NSAIDs to reduce inflammation and potential spasm, prophylactic administration of antibiotics in case of localised infection of the ischaemic site, and rehydration to correct any underlying dehydration or electrolyte imbalance. Miss Ferguson was referred to a sickle cell specialist nurse with the aim of preventing further episodes.

Blood group	Antigen	Antibody
O	None	Anti A Anti B
A	A	Anti B
B	B	Anti A
AB	AB	None
Rhesus positive	D	None
Rhesus negative	D	None

Table 4.6 Blood groups and their compatibility

Applying Theory to Practice: Exercise 4.18

Over time you need to become familiar with the normal values of test results.

- Find out the normal range for haemoglobin in the blood
- Is there a difference between men and women?

Learn the normal ranges for many of the common tests performed in clinical practice and add these to your portfolio.

Transfusing blood and blood products

Patients require a blood transfusion for a multitude of clinical conditions ranging from chronic anaemia to acute trauma and massive blood loss. The consequences of transfusing a patient with the wrong blood type can be devastating. Despite continued improvements in the processes involved, there continue to be serious errors (McClelland 2007). Good practice centres on following a few basic principles:

- Right blood
- Right patient
- Right time
- Right place.

Applying Theory to Practice: Exercise 4.19

Identify both the blood transfusion guidelines within your placement areas and the tool used to structure the physical observations you will need to record on those that are receiving a transfusion.

There are several different blood types, with many being incompatible with each other. Table 4.6 identifies both the blood groups and their compatibility.

The early identification of incompatibility is essential. Administering incompatible blood to a patient can result in an anaphylactic type reaction (Chapter 2). Patients with reduced renal ability or ineffective heart function may not be able to physically cope with the increased blood volume and may start to exhibit signs of cardiac failure and pulmonary oedema. It is essential to learn and follow local guidelines on blood administration. For further reading, McClelland (2007) is highly recommended.

Conclusion

With the current trend towards obesity escalating, heart disease and its prevention will play a prominent role in the foreseeable future of healthcare; therefore, the theoretical knowledge and clinical skills gained in this chapter will assist in developing a solid and dynamic approach to patient care. Gaining a solid understanding of the cardiovascular system, the fluid it carries, and its supporting system is essential to delivering expert care. Regardless of the setting or specialty in which a nurse works, they will encounter patients with both chronic and acute problems related to these systems. By anticipating both the physical and psychosocial needs of a patient, care delivery and the patient's journey can be enhanced, with potential and actual needs realised and acted upon in a partnership between the individual and the health service.

Chapter 4 Summary Quiz

1. Where can the heart's apex be easily auscultated?

A. In the fifth intercostal space in the midclavicular line to the right of the sternum
B. In the fifth intercostal space in the midclavicular line to the left of the sternum
C. In the fourth intercostal to the left of the sternum
D. Between the second and third ribs on the left side

2. The normal electrical conduction sequence of the heart can be summarised as:

A. Commencing at the atrioventricular node, travelling through the bundle of His and terminating in the atria
B. Initiating in the sinoatrial node, continuing down the bundle of His and terminating in the atrioventricular node
C. Initiating in the sinoatrial node, continuing through the bundle of His and terminating in the Perkinje fibres
D. Initiating in the sinoatrial node, continuing through the atrioventricular node, down the bundle of His and terminating in the Perkinje fibres

3. The QRS complex signifies which element of the cardiac cycle?

A. Atrial relaxation
B. Ventricular relaxation
C. Ventricular contraction
D. Atrial contraction

4. Which of the following electrical rhythms is associated with cardiac arrest?

A. Sinus tachycardia
B. First degree heart block
C. Atrial fibrillation
D. Ventricular fibrillation

5. The blood is composed of:

A. Red cells, white cells and lymphocytes
B. White cells, red cells and plasma
C. Red cells, white cells, platelets and plasma
D. Platelets, thrombocytes, white cells and plasma

6. Pernicious anaemia is caused when:

A. There is an excess of white blood cells
B. There is an inadequate number of platelets
C. There is a failure in the production of intrinsic factor in the stomach
D. Red blood cells become misshapen

7. S1 signifies which mechanical aspect of the cardiac cycle?

A. The closure of the interventricular valves
B. Opening of the interventricular valves
C. Opening of the aortic valves
D. Closure of the pulmonary and aortic valves

8. Acute myocardial infarction can be defined as:

A. The heart stops beating
B. When a clot causes occlusion of a coronary artery
C. The patient experiences chest pain
D. The patient's blood sugar being above 11

9. Which of the following is not a symptom of heart failure?

A. Shortness of breath on exertion
B. Swollen ankles
C. Pulmonary oedema
D. Pyrexia

10. Pain assessment and treatment should be focused on:

A. Both subjective and objective data in combination with a structural tool
B. The nurse's previous experience of a particular illness
C. Which medications are easily available
D. Listening solely to the patient and correlating their expression of their pain with a suitable analgesic

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5

The nervous system

Susie Scott

Chapter 5 Learning Objectives

- Build foundation knowledge and understanding of the anatomy and physiology of the nervous system
- Develop knowledge and understanding of several common conditions affecting the nervous system
- Develop the ability to apply theory to practice; understanding and recognising the physical manifestations of conditions in patients
- Gain an understanding of neurological assessment using a structured approach
- Gain insight into commonly used medications to prevent or treat disorders
- Broaden understanding and appreciation of the psychosocial impact of illnesses of the nervous system
- Rehearse a questioning approach to nursing, enabling evidence-based practice
- Construct solid evidence of professional development for your portfolio

Introduction

The nervous system is truly remarkable. It seems to effortlessly exert the most profound control and regulation over every aspect of life. Every thought, feeling or action reveals its fascinating activity; consequently, malfunction of the nervous system can have a devastating effect on life.

This chapter addresses the core of the nervous system, specifically the brain, the structures and systems within it, and the spinal cord. It begins with an overview of the structure and function of the brain itself, revealing anatomical features and physiological activity. The relationship between the brain and spinal cord is examined, by exploring the form and function of the cord and the integrated activity that allows the nervous system to function so eloquently. Patient scenarios are used to illustrate common disorders and diseases that affect the nervous system and confront patients with disability and failure of a system they depend on.

Applying Theory to Practice: Exercise 5.1

Compose a list of the conditions that you already know that affect the nervous system, add this to your portfolio.

At the end of this chapter, reflect back on the conditions that you knew about, recognising where your knowledge and understanding has been enhanced.

Include these conditions in your portfolio. Include

Nervous system function

The nervous system is divided into the **central nervous system** (CNS), comprising the brain itself and the spinal cord, and the **peripheral nervous system** (PNS), encompassing the cranial and spinal nerves. The CNS is an integrated command centre interpreting and responding to sensory impulses. The PNS is divided into sensory (afferent, carrying towards) and motor (efferent, carrying away) divisions. The **sensory division** allows the relay of information from receptors in skin, muscles, joints and visceral organs of the body, such as the heart, so that the CNS is constantly informed of activity inside and outside the body. The **motor division** brings about a motor response; this may be for a muscle to contract or for a gland to secrete. The motor division has two main parts:

- **Somatic (voluntary) nervous system** conducting impulses to skeletal muscles only
- **Autonomic nervous system** (ANS) regulating activity of smooth muscles, cardiac muscles and glands. Its activity is involuntary, outside of our control. The ANS is functionally divided into the parasympathetic and the sympathetic branches.

The brain

Form

Isolated from the rest of the body, the brain is hidden and protected by its own bony framework, the **skull**, or cranium. The brain has the consistency of a soft-boiled egg, the wrinkled appearance of a walnut and no moving parts. This pinkish-grey structure weighs approximately 1500g and contains more than 100 billion **neurons**, the fundamental functional unit of the nervous system. The **meninges** cover, surround and protect the brain and the spinal cord. They have three layers:

- **Dura mater** is the outermost layer of the meninges. It is a tough double-layered membrane attached to the bones of the cranium, housing the veins and arteries supplying the skull.
- **Arachnoid membrane** is a thin, delicate layer loosely covering the brain. Between the dura and arachnoid membranes is the **subdural space**, below the arachnoid membrane is the much bigger **subarachnoid space**, which is filled with cerebrospinal fluid.
- **Pia mater** is the innermost layer that clings to the brain and spinal cord. It contains many blood vessels, which are important as they extend into the brain tissue.

Applying Theory to Practice: Exercise 5.2

Answer the following questions to gain insight into how theory can be applied to clinical practice:

- What conditions have you heard of that are characterised by bleeding into the spaces between the meninges of the brain?
- What are the most likely causes of such bleeding?

Cerebrospinal fluid (CSF), a clear, colourless, odourless liquid, surrounds the brain and the spinal cord. It acts as a shock absorber, floating and cushioning the brain and spinal cord from trauma. CSF is secreted from each of the four **ventricles** within the brain (Figure 5.1), specifically the **choroid plexuses**, and also provides a source of nutrients. The choroid plexuses are projections that hang from the roofs of the ventricles, and are composed of capillaries that are permeable enabling them to constantly leak CSF from their surfaces. CSF moves freely through the ventricles, a closed system continuous with the subarachnoid space of the brain and spinal cord. Most CSF is reabsorbed via the **arachnoid villi**, projections in the subarachnoid space, and then emptied into the venous sinuses.

Applying Theory to Practice: Exercise 5.3

Meningitis is inflammation of the meninges, most often caused by infection. It affects the meninges, the subarachnoid space and CSF. Most cases are caused by microorganisms, e.g. bacteria, viruses or fungi, that spread into the blood and CSF.

Meningitis is a serious condition and can lead to many complications: hearing loss, headache, hydrocephalus, seizures and reduced consciousness, to name a few.

Bacterial meningitis is a medical emergency. It requires prompt recognition and treatment with antibiotics as an absolute priority. Bacterial meningitis may cause septic shock so supportive treatment is provided to treat circulatory collapse and prevent organ dysfunction (Oh 2003).

Vaccination programmes target certain strains of bacteria that cause meningitis as a preventative strategy in those most at risk (DH 2006, Health Protection Agency 2005).

- Identify which groups within society are targeted with immunisation programmes and why.

The brain (technically known as the **encephalon**) is made up of visibly distinct regions, each of a particular shape and texture, interlocking and nestling together. The primary regions are the **cerebrum**, the brain stem and the **cerebellum** (Figure 5.2).

The cerebrum has two clear halves, known as **cerebral hemispheres**, the surface of which is convoluted. There are numerous **gyri** (convolutions), which give the brain this appearance and greatly increase the surface area. The outer layer of the hemispheres is known as the **cerebral cortex**, or **grey matter**, and is made of up billions of neurons. Underneath this lies the **white**

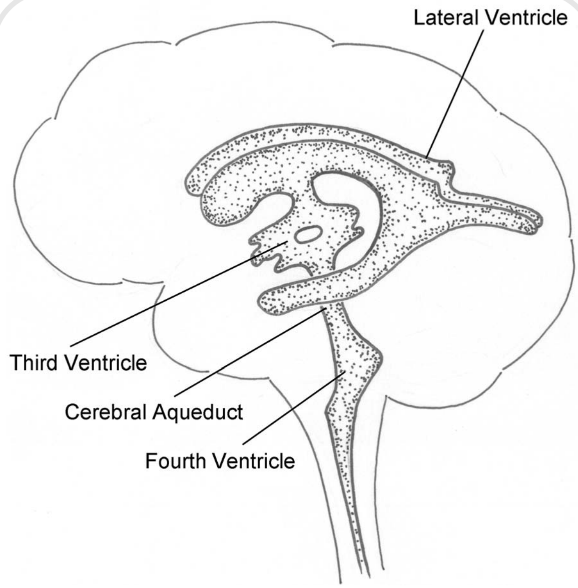

Figure 5.1 The cerebral ventricular system

matter containing nerve fibres and **neuroglia**. These fibres are bundled together and form **fibre tracts** within the CNS enabling the brain nerves to work together and communicate. Deep within the cerebral white matter is a group of nuclei called the **basal nuclei** or **basal ganglia**. These inaccessible structures are vital for complex aspects of motor function.

The cerebral hemispheres are made up of four pairs of lobes: **frontal**, **parietal**, **temporal** and **occipital** (Figure 5.3). In addition, the cerebrum also contains the **diencephalon**, which is composed of the thalamus, **hypothalamus** and **epithalamus** (Figure 5.2). The hypothalamus is connected by tissue to the **pituitary gland** (**hypophysis**) and the **pineal body**, which

Applying Theory to Practice: Exercise 5.4

The Cranial Nerves

- Name the 12 pairs of cranial nerves and identify their functions.
- During your clinical placement you may observe cranial nerve function being tested: familiarise yourself with the testing techniques used in clinical practice.
- Consider what the physiological consequences of damage to each of these cranial nerves would be and how this may manifest in a patient.

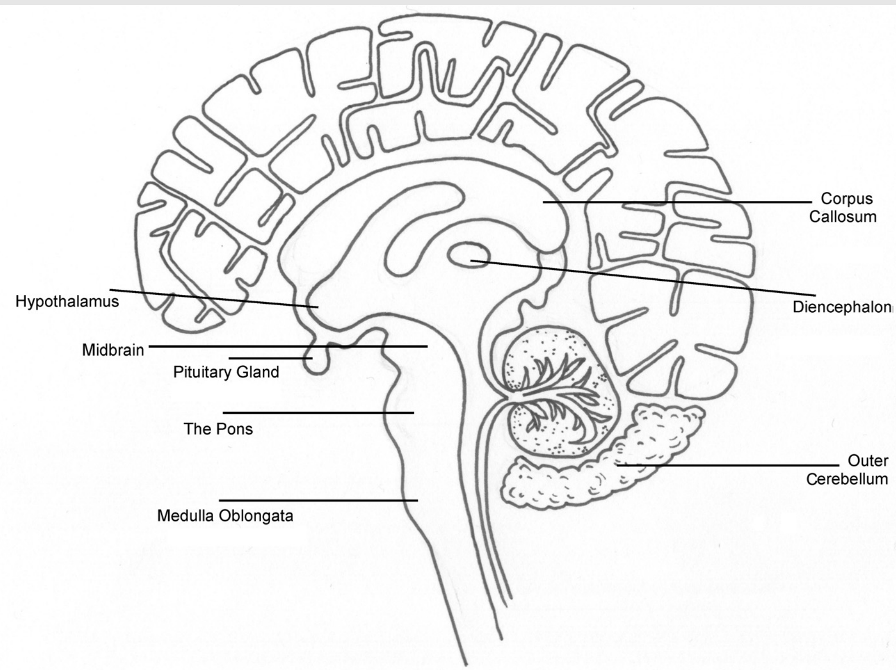

Figure 5.2 The principal anatomical regions, divisions and structures of the brain

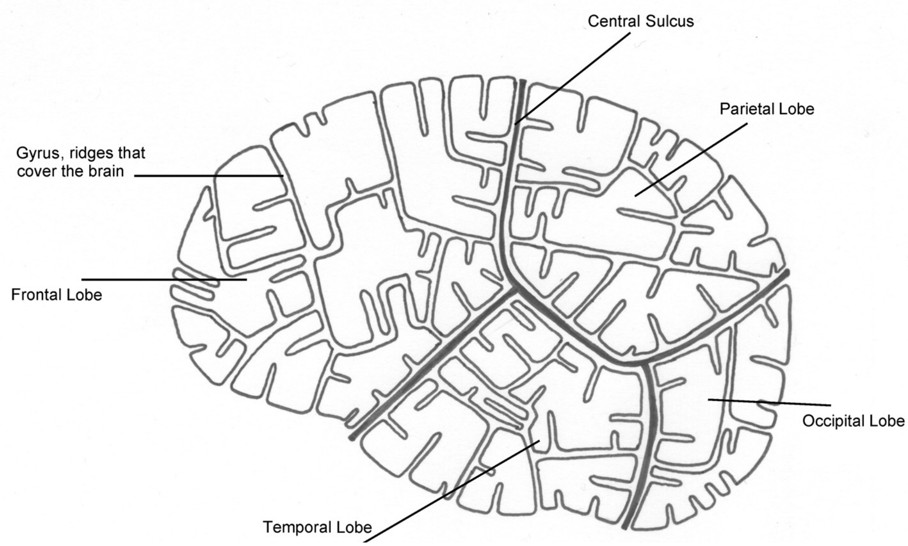

Figure 5.3 Lateral aspect of the brain featuring the principal functional areas

extends posteriorly from the epithalamus. The diencephalon forms the central core and is surrounded by the hemispheres; the diencephalon itself encloses the third ventricle.

The cerebral hemispheres appear to sit upon a thick stalk (**brain stem**), which eventually tapers to become the spinal cord. The brain stem contains significant anatomical parts which are vital for life and are subdivided into the **midbrain**, **pons** and the **medulla oblongata**, each approximately an inch long (Figure 5.2). The brain stem is also where 10 of the 12 pairs of cranial nerves originate; they provide a pathway between the PNS and the CNS.

The cerebellum (known as the little brain) is located just below the occipital lobes and protrudes outwards. It has a distinct cauliflower-like shape, is heavily convoluted, and accounts for 11% of total brain mass.

Continuous blood supply to the brain is crucial. The brain suffers irreparably from even short periods without oxygen and is totally dependent on glucose for metabolism. The brain is supplied with blood from the two pairs of arteries: the **internal carotid arteries** and the **vertebral arteries** (Figure 5.4):

- The internal carotid arteries enter the cranium through the base of the skull, passing through the dura, eventually reaching the upper brain where they branch off; the branches ensure blood is supplied to most of the cerebral hemispheres and the eyes.
- The vertebral arteries unite and become a single **basilar artery** at the level of the pons. The basilar artery subdivides again and supplies the cerebellum, brain stem and the posterior (occipital) part of the cerebrum.
- The anterior (carotid) circulation and the posterior (vertebrobasilar) circulation unite to become the arterial anastamosis known as the **circle of Willis**.

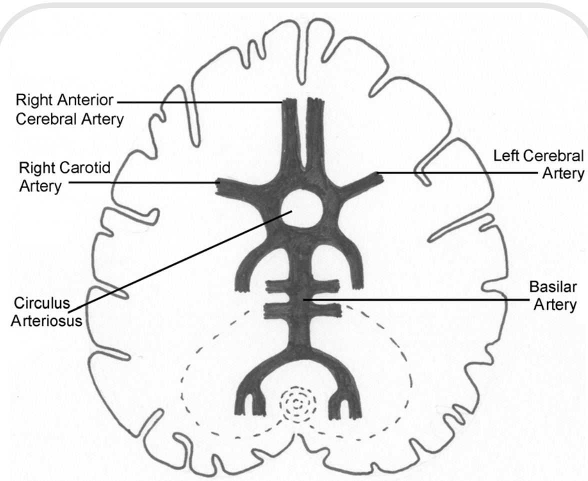

Figure 5.4 The circulatory system on the base of the brain, illustrating the circle of Willis

This circle of Willis is approximately 1 inch square, is located at the base of the brain and surrounds the pituitary gland. It is an important structure for the blood supply to the brain as it allows the blood pressure to be equalised, and in some circumstances provides an alternative route of circulation should an artery be occluded.

Having examined the structure of the brain and the main anatomical regions, we will now explore the matter of which the brain is composed, neurons, and how they signal to one another.

Neurons process all information and activity within the brain by conducting nerve impulses to, from and within the brain. The characteristics of each neuron depend on its function, but there are similarities in the anatomy of all neurons (Figure 5.5a).

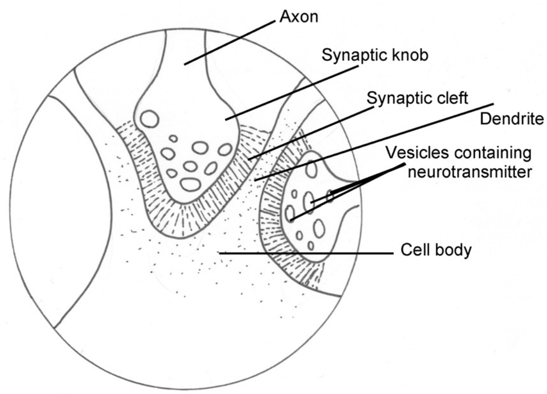

Figure 5.5b Post-synaptic neurone (synapse)

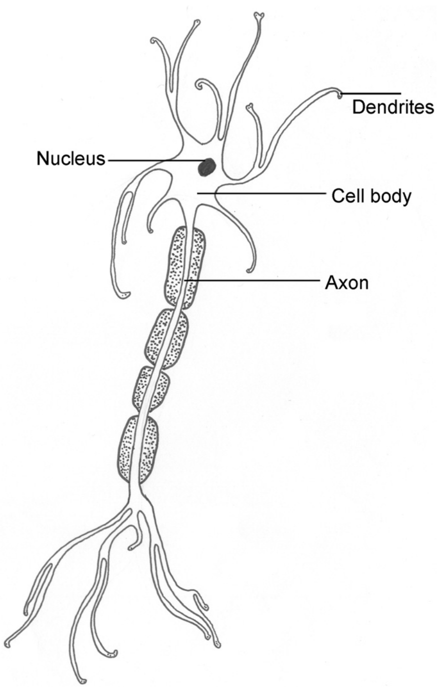

Figure 5.5a The basic structure of the neuron

All neurons have a cell body, with a nucleus, cytoplasmic material and processes extending from it. These processes are **dendrites** and **axons**. Dendrites conduct nerve impulses towards the cell body whereas axons conduct impulses away from the cell body. The numerous dendrites, associated with each cell body, create a vast surface area to receive nerve impulses. In contrast, a single neuron has a single axon. How quickly a neuron conducts a nerve impulse depends on the diameter of the axon and whether the axon is insulated with a fatty sheath known as the **myelin sheath**. The sheath is constricted at intervals. Within these intervals there are segments known as **nodes of Ranvier**, responsible for increasing the speed of nerve impulse conduction.

Anatomy and Physiology in Action: Exercise 5.5

A+P

Grey and White Matter

Within the CNS, some fibres are myelinated. These fibres form what is known as white matter and are primarily fibre tracts. The grey matter of the CNS is composed of cell bodies and unmyelinated nerve fibres.

- Which clinical conditions are synonymous with degeneration of these myelinated fibres?

Glial cells (or glue cells) are not neurons but are nonetheless plentiful in the brain, outnumbering neurons ten to one. There are various types of glial cells each with a different function. In general, their role is supportive, providing structural support, nourishment and protection for neurons.

Function

Nerve impulses occur as a result of the changes in cell membrane potential of each neuron. Alterations in the concentration of sodium and potassium on either side of the membrane stimulate the change in membrane potential. If the change in potential is great enough, an impulse is conducted. This is known as an **action potential** and is followed by a wave of depolarisation.

Axons and dendrites of neurons do not touch. When one neuron meets another or a neuron meets an effector cell (e.g. a muscle cell) there is a junction known as a **synapse**. Chemical substances found in the CNS, known as **neurotransmitters**, act as the messenger from the **pre-synaptic terminals** over the **synaptic cleft** to the **post-synaptic membrane**. Neurotransmitters either excite, inhibit or modify the response of the adjacent cell. Over 30 different neurotransmitters have been identified; Table 5.1 illustrates some of the better known.

Acetylcholine	The neurotransmitter between neurons and skeletal muscles and within the ANS, producing predominantly an excitatory effect
Noradrenaline	The main neurotransmitter in the sympathetic nervous system, where it has a mostly excitatory effect. It is found in the brain stem and hypothalamus where it controls activity and mood
Dopamine	Found mainly in the **substantia nigra** in the mid-brain and in the basal ganglia. Its effect is the coordination of movement and control of behaviour
Serotonin	Located mainly in the brain stem, where it controls mood, sleep, body heat and appetite
Glutamate	Widespread in the CNS where it has an excitatory effect; important in learning and memory
Gamma-aminobutyric acid (GABA)	Located in the hypothalamus, cerebellum, basal ganglia and spinal cord. It is the main inhibitory neurotransmitter.

Table 5.1 Neurotransmitters

Communication between neurons and between a neuron and an effector cell occurs, in health, in an organised and purposeful manner to bring about a specific function or behaviour.

Cerebrum

The cerebral cortex governs higher mental function. It is responsible for conscious awareness, thinking, understanding and perception, language, memory, sensation and movement. However, these functions are not necessarily associated with just one location, conscious behaviour often involves the whole cortex.

The two cerebral hemispheres appear to have distinct and different roles, yet they work together in most activities dividing their responsibilities. This is known as **lateralisation**. The left and the right hemispheres communicate together using fibre tracts. In the majority of people, the left cerebral hemisphere dominates for speech, language comprehension, writing and analytical thought. The right dominates in perception, generalised thought, non-verbal and spatial perception; the more creative and insightful side. The dominance of activity between left and right sides is known as **cerebral dominance**.

The sensory and motor areas are located within the cerebral cortex, spanning the left and the right hemispheres, the motor area in the **precentral gyrus** and the sensory area in the **postcentral gyrus** (Figure 5.6a, b). The sensory area's function is to perceive sensation and the motor area's function is to control movement. The fibres controlling sensation and movement cross over, or **decussate**, from left to right, thus, perception of sensation and control of movement occur on the opposite side of the body, i.e. is contralateral. The whole body can be spatially represented in the sensory and motor cortex almost like a map (Figure 5.6). The map, commonly called the **homunculus**, illustrates the amount of cortical tissue responsible for each body part and function. In reality, specific control of functions is not neatly arranged like this but is much more functionally arranged. This allows, for example, neurons that control various muscle groups and work together to be located near one another.

Certain areas of the cortex, but not all, appear to have a correspondence with different functions; these have been summarised according to the four lobes of each hemisphere in Figure 5.3.

The **basal ganglia**, or **nuclei**, deep within the cerebral white matter, are an important group of neurons working as a system. They work with the motor cortex to provide motor control over fine movements (particularly

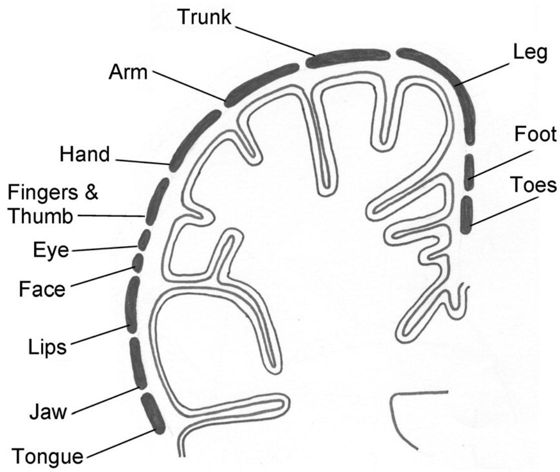

Figure 5.6a Motor areas of the cerebral cortex

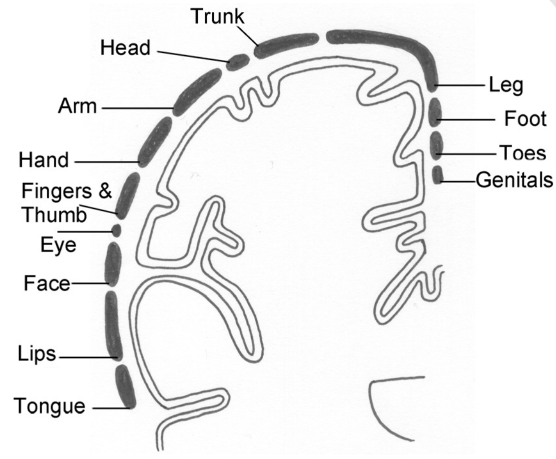

Figure 5.6b Sensory areas of the cerebral cortex

the hands and lower limbs) and are the neurons responsible for preparing for movement just before it occurs.

The **thalamus**, located within the diencephalon, acts as a relay station for sensory inputs. It adjusts and directs information to the correct area of the cerebrum for it to be received and responded to. It also has a role in focusing attention and collaborates with the reticular activating system (RAS) and the limbic system. The RAS and the limbic system span the brain and cannot be localised to one area. The RAS governs the arousal of the brain and

Anatomy and Physiology in Action: Box 5.1

A+P

Summary of the Functions of the Cerebral Cortex According to the Lobes	
Frontal	Concerned with higher mental activities such as cognitive functioning, reasoning, concentration and elements of memory Prefrontal cortex exerts control over aspects of emotional expression and behaviour Motor cortex is located here along with the premotor cortex, which coordinates muscles to work together in groups. It is also associated with learnt movements Motor control of speech through the **Broca's area**
Parietal	Functions associated with movement, orientation and spatial awareness Sensory cortex is located here which works closely with the thalamus and the sensory association cortex for analysis and interpretation of inputs
Temporal	Concerned with the interpretation and comprehension of speech and sound through the **Wernicke's area**. This allows understanding of the meaning of words, both heard and expressed by oneself Components of memory that are aided by visual, auditory, olfactory and sensory inputs to help store an experience or information and facilitate learning
Occipital	Mostly concerned with processing of visual information (visual perception) along with involuntary eye movements

Applying Theory to Practice: Box 5.2

The Glasgow Coma Scale

	Eye Opening Response	
4	Spontaneous	Without any physical or verbal stimulation
3	To speech	Calling the patient's name
2	To pain	Pain should be applied centrally (in case of existing peripheral damage)
1	None	No eye opening observed or the patient has extreme swelling to eyes (C)
	Verbal Response	
5	Orientated	Full awareness of time, place and person
4	Confused	Talking in sentences, but disorientated to time, place or person
3	Inappropriate words	Unable to talk in sentences, just occasional words (often in response to stimuli)
2	Incomprehensible sounds	Groaning or grunting
1	None	No response or the patient is unable to respond due to a tracheostomy or endotracheal tube (T)
	Motor Response	
6	Obeys commands	Responds appropriately to a command such as 'stick out your tongue', 'move your hand'. Gripping the hand may be a reflex response.
5	Localizes pain	Apply central pain, preferably to the supraorbital nerve. The patient must attempt to move the pain source – the hand must be raised above chin level. May use a trapezius pinch if there is trauma.
4	Flexion to pain (withdrawal)	Bending of the elbow
3	Abnormal flexion	Bending of the elbow with rotation of the wrist (spastic flexion)
2	Extension	Extension of the elbows
1	None	No movement observed

the limbic system allows recognition and expression of emotions.

The **hypothalamus** regulates physiological drives and maintains homeostasis in many ways:

- Controls autonomic nervous system activity via the brain stem centres
- Recognises and allows expression of emotions, as a major part of the limbic system
- Regulates biological rhythms and drives such as the sleep and wake cycle and sexual arousal
- Regulates body temperature and appetite
- Regulates water metabolism and thirst via

osmoreceptors and hormone secretion of antidiuretic hormone from the pituitary gland
- Controls pituitary secretions of other hormones.

Brain stem

The brain stem encompasses the midbrain, pons and between the spinal cord, lower brain regions, cerebellum and the cerebral hemispheres. The brain stem is important in the RAS and consciousness as well as in autonomic regulation. The medulla plays a vital role in body homeostasis housing the cardiovascular and respiratory centres; it also regulates activities such as coughing, swallowing, vomiting and sneezing. The hypothalamus sends impulses (acting as messengers) to the medulla to execute an instruction.

Cerebellum

The cerebellum is responsible for smooth, precise and coordinated motor activity; it also regulates posture and balance. All sensory inputs travel via the cerebellum giving information about the body and muscle activity. Information is relayed in pathways across the brain and fed back to allow for synergy throughout the body.

Neurological assessment

Neurological assessment skills are essential in nursing practice, assessment of consciousness being the most critical. Reduced consciousness or changing levels of consciousness indicate dysfunction and alterations in the normal transmission and processing of sensory information in the CNS.

Neurological assessment should include assessment of consciousness, limb power assessment, pupillary assessment and vital signs. The Glasgow Coma Scale (GCS) (Teasdale & Jennet 1974) is used internationally to assess consciousness. The individual score for each response is plotted on a graph, with the time of the assessment, and then totalled. The minimum score of 3 would indicate a completely unconscious patient, whereas the maximum score of 15 would indicate a fully alert and orientated patient.

The eye-opening response assesses mechanisms of arousal and control of the eyes. Arousal is governed by the RAS located in the brain stem; it is possible to be awake but not necessarily aware. The verbal response assesses cerebral functioning; the patient's ability to respond verbally assesses both the processing of information as well as comprehension and the capacity to articulate. The motor response assesses global brain function; the sensory and motor processes span both cerebral hemispheres and are truly integrated within the brain. The upper limb response is assessed alone as lower limb responses may be due to spinal reflex.

Limb power assessment is also important as an alteration in power of one limb compared to another indicates focal injury to the brain. Due to **decussation**, changes in limb power usually occur on the opposite side to that of the injury. The power in all four limbs should be observed in this part of the assessment.

Questioning Clinical Practice: Exercise 5.6

Head Injuries and Associated Risks

Consider what the implications of a reduced conscious level may be for the well-being and health of a patient.

The National Institute for Health and Clinical Excellence (NICE) in 2003 published guidelines for the management of head injuries. In their guidance, they recommend that patients with a GCS less than or equal to 8 should be referred immediately for management of their airway and breathing.

Patients with a reduced consciousness level will have a significant risk of obstruction of the airway and aspiration. Their capacity to breath will also be affected.

- Using your experience of different hospital environments, consider which settings would be the most appropriate for a patient with a reduced conscious level.

Finally, pupil assessment should include the size, shape and equality of the pupils, and their reaction to light stimulus. The presence of a light reflex relies on a functioning optic nerve, intact nerve impulse transmission to the midbrain and a functioning oculomotor nerve. This is an important prognostic factor.

Epilepsy

Scenario 5.1

Status Epilepticus

Mark James, a 35-year-old man, is admitted to the emergency department by ambulance with sustained seizures. He has been continually fitting for 15 minutes. On arrival he is unconscious and displaying rhythmic jerking movements of his whole body.

Airway: a **nasopharyngeal airway** has been inserted by the paramedic crew

Breathing: respiratory rate 31, oxygen saturation 98% on 15L oxygen via a reservoir bag mask

Circulation: pulse 124 regular, blood pressure 146/89, blood sugar 9.8 mmol/l

Disability: GCS 4/15, eyes 1, verbal 2, motor 1, pupils 5mm reacting bilaterally

Environment: body temperature is recorded as 36c, there are no signs of external injury

The paramedic crew inform you that they administered 5mg of **diazepam** rectally when they arrived at the patient's house, without therapeutic effect

PMH: **epilepsy**, depression

Mr James's girlfriend informed the paramedic crew that he had not been reliably taking his usual anti-epileptic medication recently and had been feeling particularly low in mood.

Assessment and analysis of patient presentation

Mr James's presentation indicates that he is in status epilepticus. **Status epilepticus** is a term used clinically when generalised seizures occur without improvements in conscious level between seizures, or when a seizure is sustained for more than 30 minutes. At the point of presentation, the seizure had been in progress for 15 minutes. Despite intervention with the administration of diazepam (Table 5.2), the seizure had been sustained. It is rare that a single convulsive seizure, in adults, lasts longer than a few minutes and it is accepted that early diagnosis and treatment are important in this form of epilepsy. It is usual for treatment for status epilepticus to be initiated before 30 minutes elapses as this condition has a high mortality and morbidity risk; it is therefore treated as a medical emergency.

The structured clinical assessment reveals important information about Mr James's condition and will direct his treatment. Due to the seizure activity and the alteration in conscious level (GCS 4/15), Mr James's airway is compromised. This has been protected with the use of a nasopharyngeal airway as an interim measure. He is **tachypnoeic** but well oxygenated, and **tachycardic**. Seizure activity places extreme metabolic demands on the body. These demands are met by an increase in respiratory rate to keep up with the body's oxygen demand, and an increase in heart rate to deliver oxygen and glucose to the body tissues. The only sign of consciousness that Mr James displays is a grunting noise, his pupils are equal and reacting to light. The elevation in blood glucose is a sympathetic response by the liver to make more sugar available for body demands. The immediate priority of care for Mr James is to gain control of his seizure activity and stabilise his condition.

Pathophysiology

Epilepsy is characterised by a sudden abnormal burst of electrical stimulation, interrupting normal neuronal conduction and normal cerebral function. There is an imbalance between excitation and inhibition within the CNS. Seizures lead to temporary impairment of consciousness, movement, sensation and memory.

Different epilepsies differ pathophysiologically, but there are common characteristics, these include alterations of synaptic and neuron properties, changes in ion channels and increased neuronal excitability and synchronisation. The neurotransmitters, glutamate and GABA are also thought to play a role.

Any type of seizure can proceed to become status epilepticus, if there is excessive excitation or failure of the mechanisms that terminate seizures.

Classification of epilepsy

The most widely accepted classification system of epileptic seizures is that established in 1981 by the International League Against Epilepsy (ILAE).

Partial seizures originate from a focal region of the cortex and are subdivided depending on their effect on consciousness:

- **Simple partial seizures** do not affect consciousness. Symptoms may include rhythmic movements of

Applying Theory to Practice: Box 5.3

Risk Factors for Seizures	
Low anti-epileptic drug levels (poor compliance or withdrawal) Drug toxicity Alcohol withdrawal or toxicity Hypoxia/anoxia Systemic or CNS infection Metabolic disorders (uraemia, electrolyte imbalance, hyper- or hypoglycaemia)	Head trauma Cerebrovascular disease, including stroke Brain tumour Neurodegenerative disorders Unknown aetiology

(Adam & Osbourne 2005, Hickey 2003)

the contralateral face, arm or leg and possibly hallucinations involving smell, sight or hearing or feelings of fear and panic or euphoria.

- **Complex partial seizures** are the most common type of seizure in adults, commonly lasting less than three minutes. There is sometimes a warning, an aura. Conscious level is affected; a person may appear awake but will be unresponsive, motionless and be correct. Repetitive movements, known as **automatisms**, are common such as fiddling with buttons, grimacing or lip smacking. There is usually no recollection of the seizure, but patients are often sleepy and confused and may have a headache; this is known as the **post-ictal phase**.

Generalised seizures affect the whole cortex with the patient's level of consciousness usually being impaired; there is often no aura or warning. Generalised seizures have varying characteristics:

- **Typical absence seizures** are distinguished by a transient loss of consciousness and awareness of the environment with a vacant appearance, which lasts just a few seconds.
- **Atypical absence seizures** resemble typical absence seizures but last longer and are often associated with minor automatisms.
- **Myoclonic seizures** are classified by sudden muscle contractions of specific muscle groups with no loss of consciousness.
- **Tonic-clonic seizures** involve bilateral extension of limbs followed by synchronous jerking movements. There is often a cry before the seizure, a fall to the ground followed by incontinence, tongue biting, foaming at the mouth and loss of consciousness. There is a post-ictal phase and when patients wake they have muscle tenderness, transient confusion and exhaustion.
- **Clonic or tonic seizures** exhibit one phase of the tonic-clonic seizure.
- **Atonic seizures** cause loss of muscle tone and a fall to the ground, often resulting in injury; it may be so brief that the patient is unaware of the loss of consciousness.

Questioning Clinical Practice: Exercise 5.7

- Reflect on your clinical experience to date; have you observed a patient having a seizure? What characteristics of seizure could you identify?
- How confident do you now feel in your knowledge of the characteristics of seizures and your ability to recognise a seizure?

Diagnosis of epilepsy is made based on clinical signs and symptoms and a detailed description of an event, usually given by a witness. Many conditions can resemble epileptic seizures so these are fully considered and investigated during the diagnosis process. An electroencephalogram (EEG) can be used alongside the clinical diagnosis.

The treatment of epilepsy with anti-epileptic drugs (AED) aims to control seizures and minimise side effects. NICE (2004), in their guidance on epilepsy, advise that drug choice should depend on the type of seizure the patient suffers. The patient should also have a structured treatment plan and regular follow-ups.

Applying Theory to Practice: Box 5.4

Brain Waves and EEG

The EEG records electrical activity from the brain cells just beneath the surface of the brain. This activity is known as brain waves. Electrodes are placed on the scalp and connected to the EEG. The EEG records patterns of neuronal activity in cortical areas.

In disorders such as epilepsy, where there is a surge of erratic electrical discharge, the EEG is useful in locating where damaged brain tissue lies in the cortex.

Diazepam	A sedative used for the control of seizures. In the pre-hospital setting, it is usually administered rectally or orally. In hospital, it can be administered intravenously (IV) for control of seizures.
Lorazepam or midazolam	Sedatives used in the hospital setting. Administered IV for control of seizures, including status epilepticus.
Phenytoin	Taken orally as a prophylactic. Administered IV for control of seizures, including status epilepticus, and for prevention of seizures.
Sodium valproate	Taken orally as a prophylactic. Drug choice depends on seizure type. (BMA 2007, NICE 2004)
Carbamazepine	
Lamotrigine	

Table 5.2 Summary of the Major Anti-Epileptic Drugs

The effects of epilepsy

Epilepsy affects most, if not all, aspects of a person's life. The diagnosis of epilepsy can have a profound effect on a person's self-esteem and body image. The unpredictability of seizures can limit a person's willingness and ability to socialise and form relationships. Fear of having a seizure in public, feelings of isolation and loss of control are common emotions for a person with epilepsy and can place significant restrictions and limitations on their life. Independence, employment, financial security and life insurance are all affected by the diagnosis. The nature of epilepsy also means that driving is not permitted and activities such as swimming alone and bathing are to be avoided.

It is not surprising, therefore, that there is a high incidence of anxiety and depression among people with epilepsy for which they often receive concurrent treatment.

The history of Mr James's condition indicated that he had been non-compliant with his AEDs, which increases the likelihood of seizures occurring and poses a significant risk to his health and life. Patients can find taking AEDs inconvenient and restrictive and the side-effects unpleasant. At a suitable time, it would be important for healthcare professionals to understand why Mr James has stopped taking his medication. He may need support and guidance to enable him to live safely with his condition and treatment, and enable him to have a full and active life.

Treatment of epilepsy focuses on empowering patients to manage their own condition. This includes avoiding known seizure triggers such as fatigue, sleep deprivation, stress, excess alcohol, drugs, flickering lights, certain music and low blood sugar. It also includes educating patients about their medication to encourage compliance. Support, guidance and education on how to adjust lifestyle to avoid triggers, to live with epilepsy safely and to enjoy a full and active life are important. All patients should have a thorough plan of care and have access to specialists, both nursing and medical (NICE 2004). All healthcare professionals have a responsibility to ensure that patients with epilepsy can be partners in their own care and be involved in decisions, essential for patients to feel empowered (DH 2004).

Scenario 5.2

Stroke

Eileen Applewood, a 71-year-old woman, is a patient on the acute stroke unit. She was admitted two weeks ago after suffering a stroke. This was diagnosed through history, clinical presentation and computed tomography (CT) findings.

You are looking after her today. You go to meet her, perform an initial neurological assessment and record her vital signs.

Airway – clear
Breathing – respiratory rate 18, oxygen saturation 98% on 2L oxygen via nasal cannula
Circulation – pulse 101, and irregular. Blood pressure 158/89
Disability & Neurological assessment – GCS 12/15 (E3, V3, M6)
Normal limb power to left arm and leg, no movement in right arm and severe weakness noted in right leg. Pupils equal and reacting to light (3mm)
Environment – temperature 36.7 C
PMH – coronary heart disease (CHD), atrial fibrillation

Developing and Delivering Expert Care: Exercise 5.8

Complete the following exercise to identify your current level of understanding:

- What risk factors for cerebrovascular disease and stroke do you know?
- What risk factors does Mrs Applewood have?
- Consider the nurse's role, as part of the multi-professional team in influencing the identification and management of these risks.
- How might educating patients regarding high-risk factors reduce both the morbidity and mortality rates?

Stroke

Assessment and analysis of patient presentation

From your initial assessment you identify that Mrs Applewood has a reduced GCS score indicating that her conscious level is compromised. Mrs Applewood's eye-opening response indicates an intact arousal mechanism. Her verbal response to questions is to reply with inappropriate words, indicating either a language, speech or comprehension deficit. A purposeful and intentional motor response indicates reasonable functioning of the cerebral cortex. Limb power assessment reveals a significant motor deficit, affecting the right arm and leg indicating functional damage; she has normal pupillary function.

A full examination to identify the extent of the physical, intellectual and emotional manifestations of the stroke is needed. Once this has been fully established, a thorough plan of care and rehabilitation can be implemented according to Mrs Applewood's needs.

Immediately after presentation, the nature and cause of Mrs Applewood's stroke would have been investigated and diagnosed to deliver correct treatment and to identify any remaining risk factors of a stroke reoccurring. In the Royal College of Physicians' *National Clinical Guidelines for Stroke* (CEEU 2004) a 30–43% increased risk of a secondary stroke within five years of the primary stroke is reported, as well as an increased risk of myocardial infarction. A high priority needs to be given to reduce these risks.

Pathophysiology

Stroke, also known as **cerebrovascular accident** (CVA), is defined as a sudden loss of brain function leading to a neurological deficit that lasts for 24 hours or more. Stroke occurs when blood flow to a local area of the brain is interrupted, leading to oxygen deprivation of the tissue (**ischaemia**), and eventually cell death or **infarction**. Neurons that die are irreparable, neurons that lie just outside the infarcted area, an area known as the **penumbra**, are often also damaged but these neurons may recover in time.

The causes of strokes are classified as either **ischaemic** or **haemorrhagic**:

- Ischaemic strokes account for 85% of all strokes. Cerebral blood flow is interrupted due to either an **embolus**, where a clot or atherosclerotic plaque dislodges and occludes one of the cerebral arteries, or **thrombosis**, where the vessel lumen narrows and causes ischaemia.
- Haemorrhagic strokes account for 15% of all strokes and involve rupture of a blood vessel. These are further divided into **intracerebral haemorrhage** (ICH), bleeding into brain tissue, or **subarachnoid haemorrhage** (SAH), bleeding into the subarachnoid space, often caused by an **aneurysm** or an **arteriovenous malformation**. Haemorrhagic stroke is linked closely to hypertension.

Transient ischaemic attacks (TIA) are episodes of inadequate cerebral blood flow leading to focal neurological symptoms; these attacks are temporary, lasting less than 24 hours, but are significant as they can be a warning sign of stroke.

Every stroke is different and no two people are affected in quite the same way. The degree and form of brain injury and neurological deficit depend on the area of the brain involved and the extent of the injury.

Motor deficits

Hemiparesis (weakness) or **hemiplegia** (paralysis) is one of the most common symptoms of stroke, usually affecting one side of the body. Voluntary control of the arm or leg is affected because of damage to the upper motor neurons. As upper motor neurons decussate, damage to neurons on one side of the brain will cause disability to the limb(s) on the opposite side of the body. Other motor functions that may be affected are: difficulty with swallowing due to muscle impairment, known as **dysphagia**; and difficulty with articulation of speech due to related muscle impairment, known as **dysarthria**.

Sensory deficits

Visual disorders manifest because sensory pathways between the eye and visual cortex are disturbed. Loss of half of the visual field can occur, which usually corresponds to the side of the body with hemiparesis or hemiplegia.

Proprioception and **perception** may be disturbed, which can manifest as unilateral limb neglect, disorientation to time, place or person, and sometimes **apraxia** where a person can no longer perform purposeful actions.

Language deficits

Dysphasia and **aphasia**, where speech is defective or lost completely may occur. The left cerebral hemisphere usually dominates for speech. Damage to the Broca's area may cause expressive dysphasia due to loss of motor control, and damage to the Wernicke's area can cause receptive dysphasia as comprehension and interpretation are disrupted.

Intellectual deficits

Memory, concentration, attention and learning can be affected along with a person's ability to think, reason, and make judgments and decisions.

Emotional deficits

Depression, sadness, anger, anxiety and low self-esteem are common emotions after a stroke. Often people find it hard to control their emotions, and they may cry, swear or laugh at inappropriate times.

Other deficits

Other symptoms that may manifest include **insomnia** and **fatigue** as well as bladder and bowel dysfunction leading to urgency, frequency and incontinence.

Risk factors and preventing stroke

In England approximately 110,000 people every year will suffer a stroke, with a cost to the NHS of over £2.8 billion. It is the third biggest cause of death and the largest single cause of severe disability in the UK (DH 2007a). The government aims to reduce death by stroke (and diseases related to CHD) by at least 40% in people under 75 by the year 2010. A National Stroke Strategy is being developed by the Department of Health (DH 2007b) with the aims:

- To raise awareness stroke symptoms and risk factors
- To improve access, response and provision of stroke services

Delivering and Developing Expert Care Box 5.5

Risk Factors for Stroke	
Age over 55 years	Smoking
Hypertension	Stress
Atrial fibrillation	Sedentary lifestyle
Valvular disease	Unhealthy diet
Clinical symptoms of CHD or ECG evidence	Obesity
Diabetes mellitus	High alcohol intake
Elevated blood lipids and cholesterol	Oral contraceptive pill
Heredity link mainly associated with hypertension and diabetes	

(Hickey 2003, Holland 2000)

- To enable high level support for stroke survivors on leaving hospital.

Prevention of cerebrovascular disease and stroke is more likely to reduce the incidence of stroke than any medical or surgical advance.

Early and accurate diagnosis of stroke is important to implement the most appropriate treatment and management. Diagnosis is made with medical history, clinical presentation and clinical examination alongside radiological diagnostic investigations such as computerised tomography (CT). A CT scan aids differentiation between an ischaemic and haemorrhagic stroke, which is vital in order to make appropriate decisions about treatment.

Mrs Applewood was diagnosed with an ischaemic embolic stroke secondary to atrial fibrillation, CHD and undiagnosed hypertension. Complete physical and neurological examination reveals that she has a right-sided hemiplegia of the arm and hemiparesis of the leg. She has expressive dysphasia and visual field disruption to the right side, along with unilateral neglect to that side.

Applying Theory to Practice: Exercise 5.9

Using the physical and neurological examination findings, alongside your new knowledge, can you identify which of Mrs Applewood's cerebral hemispheres sustained ischaemic damage and infarction during her stroke?

Mrs Applewood is being cared for in an acute stroke unit. The DH (2001), in the *National Service Framework for Older People*, recommends that patients who have had a stroke should be admitted to a stroke unit in a timely manner; prompt diagnosis is crucial for this to occur. There is considerable evidence showing improved survival and functional recovery when specialist care and treatment can be provided.

Plan of care

Control and elimination of risk factors are a mainstay of care to prevent Mrs Applewood from having a secondary stroke. Specifically, this would include control of hypertension and atrial fibrillation, and lifestyle adjustments.

Alongside medical and surgical management, ongoing neurological assessment as well as cardio-respiratory observation and physical assessment is important. Assessment findings will help the nurse identify changes in Mrs Applewood's condition, which may include extension of the stroke or the early signs of complications of immobility.

Developing and Delivering Expert Care: Exercise 5.10

- What complications of immobility do you know of and how would these manifest in a patient?

Medical and surgical treatment

Anti-thrombotic and **anti-platelet therapies**, such as **aspirin**, **clopidogrel** and **low molecular weight heparin**, may be implemented to prevent clot formation and emboli (Hickey 2003). **Thrombolysis** aims to dissolve a thrombus occluding an artery and restore cerebral circulation in the acute phase of ischaemic stroke. One drug available for this is **recombinant tissue plasminogen activator** (rTPA) (ISCTN 2007, IST-3 Thrombolysis 2007), but use of this treatment is still subject to randomised clinical trials.

Surgical management options in ischaemic stroke include **carotid endarterectomy** for atherosclerotic disease, in patients suitable for surgery, or **cerebral angioplasty** with or without **stenting**.

Treatment of haemorrhagic stroke is specific to individual cases but may involve surgery if the presence of the haemorrhage within the skull is compromising the survival and functioning of other brain tissue. For patients with SAH, a specific management strategy would be implemented.

Rehabilitation

For all survivors of stroke, an early focus on rehabilitation is crucial to optimise functional capability and recovery. Collaboration with allied health professionals is important in order to develop a plan of care to meet the patient's physical, cognitive, emotional and social needs while in hospital, but also during their transition back to the community. Physiotherapy, occupational therapy, speech and language therapy and social work support, alongside nursing care, are important in patient rehabilitation after a stroke.

Sometimes a stroke can be so extensive that a person's chance of survival is limited and subsequent possibilities for effective and meaningful rehabilitation hampered. In cases where this occurs, multi-professional opinion is sought and discussed to identify the most appropriate care management. It is important in these circumstances to also discuss the appropriateness of resuscitation, should events occur. Where possible, the patient, and those close to them, should be involved in discussions about care management and resuscitation, and their views taken into consideration. Sometimes, a stroke can be so extensive that a patient dies, and the focus of care changes to patient comfort and a peaceful, dignified death.

Parkinson's disease

Scenario 5.3

Parkinson's Disease

Wilfred Smith, a 74-year-old, is a patient on the elderly care ward. He has Parkinson's disease and was admitted to hospital by his GP three weeks ago from home.

Mr Smith has restricted and slow mobility, and regularly suffers freezing attacks. He currently has a healing laceration and bruised area on his forehead. He is frail, underweight and suffering from constipation.

It has been increasingly difficult for Mr Smith to look after himself independently and he does not have any close family to help him. In view of this, Mr Smith is now waiting for placement in a residential home, which he is looking forward to.

Assessment and analysis of patient presentation

Mr Smith's condition appears to have progressed and the manifestations of Parkinson's disease are affecting his well-being and health. He has significant mobility restrictions that are limiting his ability to perform normal daily activities independently. The bruising and laceration to Mr Smith's forehead may be indicative that he has fallen and injured himself. The weight loss and constipation may reflect poor nutrition and hydration. Multi-professional discussion and analysis of Mr Smith's condition, social situation, wishes and well-being have concluded that it would be in his best interests to live in a residential home. This will mean he has help at hand for all of his needs, and the risks of harm and ill health are reduced.

Pathophysiology

Parkinson's disease is a progressive neurodegenerative condition affecting the basal ganglia, deep within the cerebral white matter. It causes loss of the melanin pigmented neurons of the **substantia nigra**, one of the structures within the basal ganglia. Loss of these neurons leads to depletion of the neurotransmitter **dopamine** (Table 5.3). These degenerative changes mean there is less thalamic stimulation of the motor cortex and the control and coordination of movement are affected. Typically this disease starts to affect people in their fifties and sixties.

Currently no diagnostic test exists for Parkinson's disease. Diagnosis is made using clinical examination and history taking, often meaning diagnosis is delayed.

There are several signs and symptoms:

- **Bradykinesia** is difficulty initiating movement and maintaining it. A patient will have a stooped posture and will move with a shuffling gait; they may lose their balance easily and fall. They can also have an expressionless face and blink infrequently.
- **Tremors** are present in the arms and hands. A characteristic tremor known as pill rolling is seen, which may be aggravated by anxiety and concentration.
- Rigidity of the muscles is seen and is associated with bradykinesia, the muscles feel stiff and are difficult to move.

There are many other manifestations making it difficult for patients to perform the usual activities of living. Fine motor control is poor, patients may be clumsy, weak and fatigue quickly. Patients momentarily freeze mid-movement, the voice weakens and drooling is not uncommon. Patients frequently have signs of depression and dementia.

Plan of care

Drug therapy is the mainstay of the medical management of Parkinson's disease, with the aim of relieving symptoms (NICE 2006). Neuro-protective drugs, aimed at halting progression of the disease, are still being developed. Some surgical treatments exist but these are reserved for patients with severe disease who have developed complications to drug therapy. See Table 5.3.

Dopaminergic agents (levodopa)	Control of rigidity and bradykinesia
Anti-cholinergic agents	Control of tremor and rigidity
Dopaminergic agonists	Augment the effects of levodopa
(BMA 2007, NICE 2006)	

Table 5.3 Drug Therapy in Parkinson's Disease

Supportive therapy is pivotal in helping patients manage symptoms effectively and to facilitate maximal independence. The focus of care and therapy is on improving mobility, ensuring adequate nutrition, promoting good bowel function, enabling self-care and improving communication. Multi-professional teamwork is fundamental to maximising the benefits of therapy and enabling patients to live independently (NICE 2006).

Despite the progression in Mr Smith's condition, he should be encouraged to maintain as much independence as possible and his placement in residential care, rather than nursing care, reflects this. Symptom control will be essential and multi-professional advice necessary to enable excellent pharmacological and non-pharmacological management in the future.

Applying Theory to Practice: Exercise 5.11

Examples of Neurodegenerative Conditions

Alzheimer's disease
Dementia
Multiple sclerosis
Motor neuron disease

- Research the pathophysiological changes associated with these conditions; identify the clinical signs you would look for during your neurological assessment and how the care of these patients would be managed.
- Add these findings to your portfolio. You may also like to consider other acute disorders that can affect the nervous system.

Questioning Clinical Practice: Box 5.6

Stem Cell Research

Until recently, it was widely accepted that, unlike other cells in the body, neurons are not able to regenerate once damaged or destroyed. Therefore treatment has always focused on limiting the consequences of disease. However, scientific and medical advances over the last 20 years have revealed the remarkable possibilities that stem cells may offer in replacing damaged neurons.

Stem cells are very early cells that are uniquely able to divide, renew and differentiate into specialist cells, such as neuronal tissue. Stem cell therapy therefore offers new hope for the treatment of neurological disease. In the future, it is anticipated that stem cells may be used to treat conditions such as Parkinson's disease, spinal cord injury, Alzheimer's disease, multiple sclerosis, among many others (ISCR 2007, Marieb 2007).

There is a considerable controversy over stem cell research because it often relies on harvesting embryonic stem cells (other forms of stem cells originate from adults or umbilical tissue). For many people, it is unethical and unacceptable to use a human embryo for research, particularly as the embryos are eventually destroyed. People also argue that this is too close to human cloning. The British Government is supporting responsible stem cell research, of all types, believing that this offers the best opportunities for treatment of many conditions (DH 2005, ISCR 2007). This support ensures there is public and private funding for stem cell research in the future and sustains the British contribution to international debate and advances in research and medicine.

The spinal cord

Form

Protected and hidden within the vertebral column, the spinal cord is a long mass of nerve tissue with remarkable activity and responsibility. The spinal cord is continuous with the medulla oblongata and extends beyond the cranium, through the foramen magnum of the occipital lobe, into the vertebral column extending down until the level of the first or second lumbar vertebra. It is approximately 42–45cm long and 1.8cm thick, but tapers towards its end (Figure 5.7).

The spinal cord is protected by the three meningeal layers covering the brain, as well as cerebrospinal fluid and bone, in the form of vertebrae. There are seven cervical (C), twelve thoracic (T), five lumbar (L) and five sacral (S) vertebrae.

Applying Theory to Practice: Exercise 5.12

Cerebrospinal Fluid

In the spine, the subarachnoid space extends beyond the end of the spinal cord to the level of S2.

A procedure known as a **lumbar puncture** (LP) is performed to remove CSF for testing. A spinal needle is inserted between the lumbar vertebrae (L3/4 or L4/5) through the dura and into the subarachnoid space to sample the fluid. As the spinal cord is absent in this region, there is no risk of damaging the cord or nerves.

A lumbar puncture is a diagnostic procedure where both the pressure in the CSF and the contents of the CSF are examined.

- When might an LP be performed on a patient? And, what might an LP diagnose?

There are 31 pairs of spinal nerves relaying nerve impulses between the body areas they serve and the spinal cord; they establish the link between the peripheral and central nervous systems. Each nerve attaches via its root to the cord, and leaves the spinal region through openings between the vertebrae, known as intervertebral foramina. The spinal cord has two enlargements along its length, known as the cervical and lumbar enlargements. The enlargements allow innervation of the upper and lower limbs, the cervical enlargement innervating the upper limbs and the lumbar enlargement innervating the lower limbs. The lumbar and sacral nerve roots must angle sharply downwards and the nerves travel through the vertebral column to their intervertebral foramina. This is because the spinal cord itself terminates more superiorly to the exit points of these nerves (Figure 5.7).

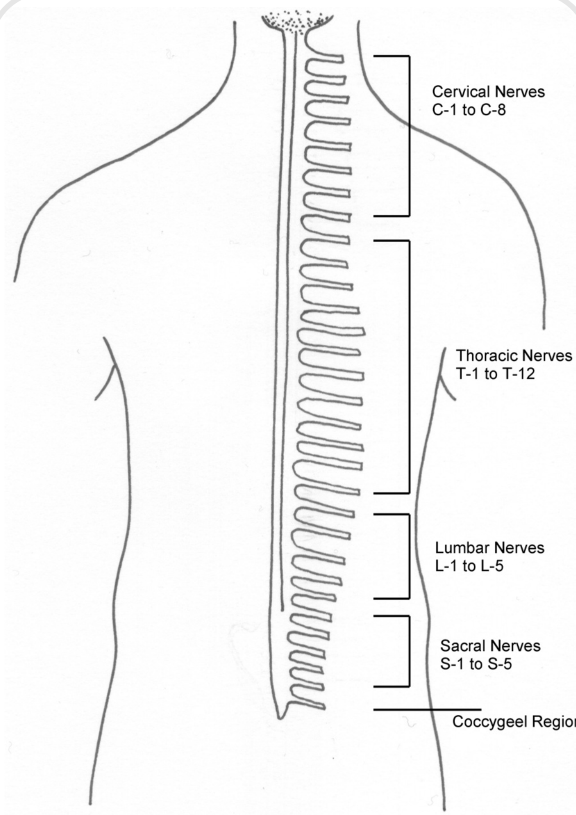

Figure 5.7 The spinal cord

Similar to brain tissue, the spinal cord is composed of grey and white matter. Unlike in the brain, the grey matter comprises the internal matter of the cord and is surrounded by the white matter. The grey matter consists of cell bodies of neurons and their projections (axons and dendrites), and the white matter consists of fibre tracts running **longitudinally**. These fibre tracts, some of which are myelinated, are either known as **ascending** or **descending tracts**. In addition to these longitudinal tracts, there are a few **transverse tracts**, relaying information across the cord. The grey matter forms a shape like the letter 'H'. The two anterior projections are known as

anterior (**ventral**) horns and the two posterior projections, the **posterior** (**dorsal**) horns. In the thoracic and superior lumbar regions, lateral horns are also present. The ventral horns carry nerve impulses to the somatic (motor) nervous system and the lateral horns to the autonomic nervous system; the dorsal horns receive afferent impulses from peripheral sensory receptors.

Function

Ascending pathways convey afferent nerve impulses from sensory regions of the body, **dermatones**, to the brain. The ascending pathways direct impulses from the dermatonal area, via the dorsal root, to one of three fibre tracts (spinothalamic, fasciculus cuneatus or gracilis and spinocerebellar), depending on the source and nature of the impulse. The impulse is sent either to the cerebellum or to the cortex via the thalamus.

The descending pathways are responsible for efferent impulses from the brain to the spinal cord and are divided into direct and indirect pathways. The pathways involve neurons referred to as upper and lower motor neurons. Upper motor neurons are located only in the CNS whereas lower motor neurons are located in both the CNS and PNS, and actually innervate skeletal muscle (Table 5.4).

The autonomic nervous system

The purpose of the autonomic nervous system (ANS) is to maintain a stable internal environment, which it does without conscious thought (Chapter 2). It is composed solely of motor neurons and governs the activity of visceral organs including cardiac muscles, glands and other smooth (involuntary) muscles. The hypothalamus is the overall control centre of the ANS sending impulses via the **medulla oblongata**.

As well as using nerve pathways, the ANS sends impulses by neurotransmitters, noradrenaline within the sympathetic nervous system, and acetylcholine within the parasympathetic (Table 5.1). The sympathetic division is activated under times of stress, known as the fright, fight or flight phenomena, leading to an increase in heart rate and blood pressure and vasoconstriction of peripheral blood vessels. The parasympathetic division is concerned with rest and relaxation, known as the feed and breed phenomena; it typically reduces heart rate and blood pressure and encourages gastrointestinal activity. Both divisions act together to maintain homeostatic balance.

Sympathetic neurons are located in the thoracic and lumbar regions of the spinal cord (T1–L2), they leave the cord via the ventral roots, travel just 1cm and join a chain of neurons, known as the **sympathetic chain**, which is located on each side of the spinal cord. These neurons are connected by longitudinal fibres and extend the whole length of the spinal cord. Eventually the nerve fibres rejoin the spinal nerves and extend to their visceral organs, glands or muscles.

Parasympathetic neurons are located in two sections: the brain stem and the sacral region of the cord. The cranial section acts via the oculomotor, facial, glossopharyngeal and vagus cranial nerves leading to constriction of the pupillary muscles and the glands of the head and mouth. The vagus nerve synapses with multiple visceral organs including the heart, lungs, stomach, liver and bowel. The sacral section innervates the bladder and bowel and is involved in emptying of the bladder and bowel. The sacral roots and the vagus nerve are connected, resulting in reflex arcs.

Spinal nerve root	Motor and sensory area
Cervical nerves C1–C8	Movement and sensation to the arms, neck and upper trunk, including the diaphragm and intercostal muscles
Thoracic nerves T1–T12	Movement and sensation to the trunk and abdomen
Lumbar and sacral nerves L1–L5, S1–S5	Movement and sensation to the legs, bladder, bowel and genitals

Table 5.4 Association between Nerve Roots and the Various Motor and Sensory Areas

Scenario 5.4

Spinal Cord Injury

David Adam, a 29-year-old man, is a patient on the neurosurgical ward. He fell from a ladder while at work two weeks ago. Anteroposterior and lateral X-rays were carried out in accident and emergency, followed by a CT scan. They confirmed that he had sustained a compression injury to his spine with a burst fracture of the vertebral body at T4 and transection of the spinal cord in this region. Mr Adam had surgical stabilisation of the fracture, with internal fixation, one week ago.

You go to meet Mr Adam, and record his vital signs:

Mr Adam is lying supine in bed. He is alert and orientated. During your initial conversation, he informs you that he has been unable to move or feel his lower body and legs since his accident.

Vital signs:
Airway: Mr Adams is freely talking
Breathing: respiratory rate 19
Circulation: pulse 65, blood pressure 125/73
Disability and neurological: GCS 15/15, patient has paraplegia
Environment: temperature 36.5C

Assessment and analysis of patient presentation

Mr Adam has a spinal cord injury with complete sensory and motor loss below the level of the injury to the cord, leaving him **paraplegic**. He complains of inability to move his body or legs, which are consistent with an injury at the level of T4. Spinal nerve roots exiting from T4 and below serve the mid-chest, the abdomen and the legs. A physical examination should reveal that Mr Adam has normal sensation and movement in his neck, shoulders and arms. Mr Adam's fracture has been stabilised meaning there is no risk of further damage to the spinal cord.

The patient's observations appear to be within normal range for a man of his age. This is an important element of the assessment, for many reasons, not least because Mr Adam's injury exposes him to potential cardiovascular instability and respiratory insufficiency. Damage to the spinal cord can affect respiratory muscle function, leading to respiratory failure and can also affect the autonomic nervous system resulting in cardiovascular instability.

Developing and Delivering Expert Care: Box 5.7

For any patient with an actual or suspected spinal cord injury, care should be taken to ensure the spine remains in anatomical alignment in order to reduce the risk of further damage to the spinal cord. This is achieved by positioning patients in a neutral anatomical position. The head and neck should be secured using a rigid collar and bolsters, sometimes called sand bags/head blocks, on either side of the head; these are then strapped to a secure point.

During moving or positioning the whole spine must be kept in the neutral position. A coordinated manoeuvre known as a **log roll** is performed using a minimum of four people. The nominated leader manages the patient's head and neck; this person will move the head through an arc as it rotates with the rest of the body, while keeping the spine in perfect alignment.

Pathophysiology

Any damage to the spinal cord, or the nerve roots, will lead to functional loss with paralysis and/or **parathesis** (sensory loss), as connection with the cerebral cortex is cut off. Most spinal cord injuries occur as a result of road traffic accidents, falls or sport; however, some are caused by disease, infection or bleeding (Spinal Injuries Association 2007). More men sustain injuries than women, with a significant proportion under the age of 30 years.

The effects of spinal cord injury depend on the type of injury and the level of injury. Lesions are described as either complete or incomplete. A **complete injury** means that there is total sensory and motor functional loss below the level of the injury. An **incomplete injury** means that there is some function below the injury; some sensory or motor fibres, or both, are undamaged.

Cervical injuries result in quadraplegia, injuries at C4 or higher may result in the inability to breathe. Patients will require a **tracheostomy** and be dependent on a ventilator. Lower cervical injuries may also have restricted respiratory function due to the functional loss of the intercostal muscles. Injuries from C5–C8 affect progressively more movement and sensation in the shoulders, upper arms and even the wrists. Dexterity and

Applying Theory to Practice: Box 5.8

Quadraplegia	An injury to the spinal cord above T1, paralysis affects all four limbs
Paraplegia	An injury to the spinal cord below T1, paralysis affects the legs only

manipulation are significantly restricted and patients require assistance with the activities of daily living.

Thoracic injuries result in paraplegia. Those with high thoracic injuries may have poor trunk control and lack abdominal muscle control, whereas with lower thoracic injuries patients have better trunk control and good use of the abdominal muscles.

Lumbar and sacral injuries result in a loss of control of the legs and hips and either complete or incomplete paraplegia depending on the level.

Paralysis also leads to loss of voluntary control of the bowel and bladder, loss of temperature control (**poikilothermia**) and the inability to sweat below the level of the injury. **Postural hypotension** may occur and the autonomic nervous system is disrupted below the injury. In men, sexual function may also be affected leading to fertility problems. It is not uncommon for patients to also suffer chronic pain.

Plan of care

Mr Adam's plan of care should be focused on recovery from his operation as well as his comprehensive needs following his injury. A multi-professional approach should be adopted to meet these needs and to facilitate maximum rehabilitation. Referral to a specialist spinal centre is a priority to ensure Mr Adam can access specialist rehabilitation in the future (Grundy & Swain 2002). Specific care should focus on encouraging and facilitating good respiratory function, as loss of abdominal muscle function means Mr Adam may not be able to cough effectively without treatment and education. He will require a regimen of care to enable good bladder and bowel function, and will need excellent nursing care to prevent any complications of immobility, of which there will be a significantly increased risk. Pain from muscle spasm is common and should be treated to ensure comfort and rest.

The devastating functional loss and disability associated with spinal cord injury are catastrophic. The nurse's role in supporting patients emotionally and psychologically should not be underestimated or dismissed in favour of a patient's physical needs. Often specialist care is required to enable patients to process events that have happened to them, to manage emotions and their reaction to the injury, and to enable patients to move forward and learn to live with their disability.

Conclusion

Developing a fundamental understanding of the form and function of the nervous system, alongside knowledge and appreciation of common disorders, is essential to nursing practice. As nurses we are empowered to use our knowledge, understanding and skill to care for patients expertly and compassionately. Irrespective of the location or specialty, a nurse will engage with patients who are living with chronic neurological disorders or who are experiencing acute problems. Having analysed and explored these disorders, the nurse will be in a better position to understand the pathophysiology, to appreciate the challenges and difficulties that a patient faces and ultimately to be insightful when caring for patients.

Chapter 5 Summary Quiz

1. The meninges consist of three layers, which is the correct order?

A. Dura mater – Pia mater – Arachnoid mater
B. Pia mater – Arachnoid mater – Dura mater
C. Dura mater – Arachnoid mater – Pia mater
D. Dura mater – Doesn't matter – Arachnoid mater

2. The primary regions of the brain are?

A. The cerebrum, the brain stem and the cerebellum
B. The cerebrum, the cortex and the cerebellum
C. The cortex, the brain stem and the cerebellum
D. The cerebrum, the brain stem and the cortex

3. How many pairs of cranial nerves are there?

A. 10
B. 21
C. 33
D. 12

4. Dopamine is a neurotransmitter, responsible for:

A. Sexual preference
B. Sexual behaviour
C. The coordination of movement and control of behaviour
D. Relaying messages, specifically regarding the mesenteric circulation

5. The lobes of the brain are:

A. The frontal, temporal, occipital and parietal
B. The Pons, and the circle of Willis
C. The frontal, temporal, occipital and parental
D. The occipital, the basal, the parietal and the temporal

6. The Glasgow Coma Scale is composed of how many sections?

A. 2
B. 3
C. 4
D. 5

7. Pupil assessment should include:

A. The size, shape and colour of the pupils, and their reaction to light
B. The shape and size of the pupil, and the colour of the iris
C. The shape, colour and equality of the pupils, and their reaction to light
D. The size, shape and equality of the pupils, and their reaction to light

8. Which risk factor is not associated with seizures?

A. Drug toxicity
B. Metabolic disorders (uraemia, electrolyte imbalance, hyper or hypoglycaemia)
C. Head trauma
D. A high pollen count

9. Which of the following is not a form of seizure?

A. Complex partial seizures
B. Simple partial seizures
C. Partial seizures
D. Total seizures

10. What are the three causes of 'stroke'?

A. An embolism, thrombotic, haemorrhagic
B. An embolism, phagocytic, haemorrhagic
C. Phagocytic, thrombotic, haemorrhage
D. A thrombus, embolism, phagocytic

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6

The renal system

Cliff Evans

Chapter 6 Learning Objectives

- Gain knowledge and insight into the anatomy and physiology related to the renal system and its components
- Gain insight into common conditions affecting the renal system
- Gain the ability to apply theory to practice by rationalising the physical manifestation of these illness in patients and instigating care
- Gain insight into commonly used medications directed at either preventing or treating relevant conditions
- Collect and assemble additional materials for your growing professional development portfolio
- Through the application of theory into practice question and critique the evidence base and effectiveness of the care you deliver

Introduction

This chapter discusses the renal, or urinary, system, which is a multifaceted, complex and vital structure. Diseases affecting this system are common, particularly infections, although failure of the system does not necessarily need to include an underlying infection as complete failure can result from many origins. Symptoms can be acute, insidious or chronic; this can make renal nursing an exciting and rewarding specialism. However, a nurse need not specialise in renal care to encounter patients experiencing renal dysfunction. During their career all nurses will be confronted by patients experiencing varying degrees of renal failure either as the patient's primary condition or as a secondary consequence. For knowledgeable practitioners with insight into the classic clinical signs and symptoms associated with an insult to renal function, the serious internal repercussions of leaving this condition untreated can be prevented.

This chapter initially focuses on providing the student with essential and relevant anatomy and physiology knowledge to enable them to understand the fundamental functioning of the renal system. Clinical signs and symptoms associated with the failure of this system are highlighted to provide the student with several prominent theoretical links to clinical practice. The chapter progresses into demonstrating some of the common illnesses associated with the renal system, highlighting the main causes of renal failure through the use of patient scenarios, which will also demonstrate many of the complexities associated with modern patient management.

Throughout the chapter the reader is asked to participate in and complete relevant exercises specifically designed to boost their developing portfolio of clinical practice and also to assist in the acquisition of essential skills associated with lifelong learning and the development of a strong and solid foundation of underpinning theoretical knowledge to their clinical practice.

Applying Theory to Practice: Exercise 6.1

Before reading on, compile two separate lists of:

Diseases you already know that affect the renal system

Potential instigators (causes) of renal failure

Add these lists to your developing portfolio. On completion of this chapter expand your portfolio by adding the new disorders you have gained knowledge on and elaborate on how these disorders affect physiological function.

Form

The renal system is composed of two **kidneys**, two **ureters**, a **bladder** and the **urethra**. The kidneys are classically described as two bean-shaped organs suspended at the rear, or posteriorly, within the abdomen (**retroperitoneal**).

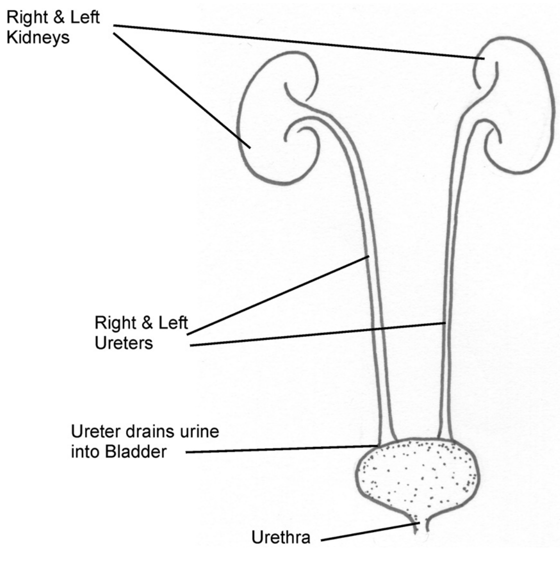

Figure 6.1 Overview of the components of the renal system

- The structure of a kidney can be described in two distinct parts:
- The **cortex** on the outside
- The **medulla** on the inside leading to the **renal pelvis**.

The centre of each kidney is called the hilum, which is concave in shape. This is where the nerves, blood and lymphatic vessels enter the kidney.

Each kidney is connected to the bladder via a ureter; the ureter also enters at the hilum. The urethra connects the bladder to the external environment and therefore provides the exit point for **urine**.

A layer of fat and **fascia** enclose each kidney providing localised protection. Blood supply is delivered via the renal arteries branching off from the main body of the aorta. Interestingly, the kidneys, that comprise only around 0.4% of the total body weight (around 160g), receive approximately a quarter of the entire blood supply or cardiac output each minute. Therefore if the cardiac output is 4900ml per minute, then the kidneys receive 1225ml (Clancy & McVicar 2002). Each kidney is composed of around one million excretory units called **nephrons** measuring around 3cm, each containing an extremely intricate pathway involving several prominent points essential to optimal renal function:

- The Bowman's capsule and glomerulus
- The proximal convoluted tubule
- The loop of Henle
- The distal convoluted tubule
- The collecting duct.

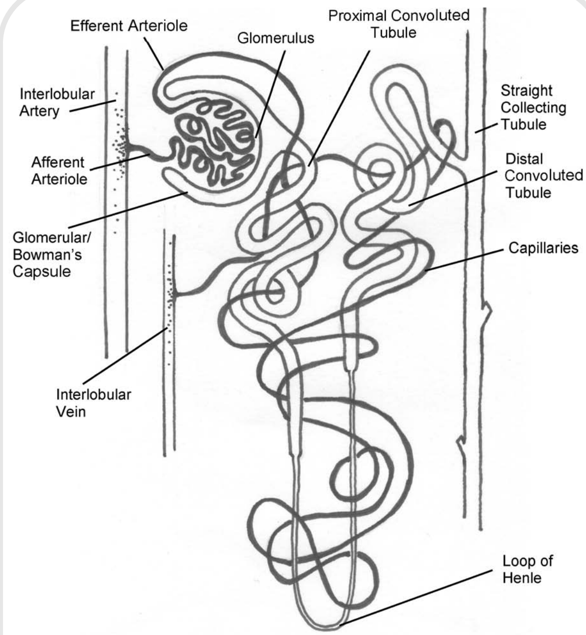

Figure 6.2 The intricate workings of a nephron

The ureters

The ureters are the muscular tubes leading from the kidneys to the bladder; they measure around 30cm and are around 3mm in diameter (Clancy & McVicar 2002). The ureters travel downwards and enter the urinary bladder from the posterior sides through openings in the bladder wall. These openings close when the bladder contracts to prevent urine from flowing back into the ureter (reflux/ regurgitation).

The urinary bladder

This vital organ serves as a muscular sterile reservoir positioned on the floor of the pelvic cavity; its size is variable due to its ability to stretch depending on how much urine is stored, and this normally ranges between 600–1000ml. The bladder is composed of several layers. The inside of the bladder has a special type of lining that can stretch as the bladder fills and expands; this layer, called the transitional epithelium, prevents urine being absorbed back into the circulation. In a relaxed or empty state the bladder's inner lining is arranged in folds (rugae), which expand as the bladder fills.

The urethra

The urethra forms the final passageway for the flow of urine; this thin-walled tube conveys urine from the floor of the urinary bladder to the outside. The opening to the outside is the external urethral orifice. The mucosal lining of the urethra is the transitional epithelium. The wall also contains smooth muscle fibres, supported by connective tissue. As the urethra leaves the urinary bladder it is initially surrounded by the internal urethral sphincter under autonomic control. The external urethral sphincter surrounds the urethra as it goes through the pelvic floor; this sphincter is under voluntary control. In females, the urethra is short, only 3–4 cm long. The external urethral orifice opens to the outside just anterior to the opening for the vagina. In males the urethra is around 20cm in length, and transports both urine and semen. The first part, next to the urinary bladder, passes through the prostate gland and is called the prostatic urethra. The second part, a short region that penetrates the pelvic floor and enters the penis, is called the membranous urethra. The third part, the spongy urethra, is the longest region. This portion of the urethra extends the entire length of the penis, and the external urethral orifice opens to the outside at the tip of the penis.

Applying Theory to Practice: Exercise 6.2

Cystitis refers to inflammation of the bladder, generally caused by a localised infection.

- Why do you think this condition may be more common in females than males?

Scenario 6.3 discusses infections of the urinary tract.

The following links provide additional information:

http://www.netdoctor.co.uk/diseases/facts/cystitis.htm
http://www.nhsdirect.nhs.uk/articles/article.aspx?articleId=119

Function

Renal function centres on the kidneys, which regulate both the volume and composition of body fluids. The renal system must continually function at an optimal level due to the narrow spectrum required to maintain homeostasis. The physical processes of metabolism produce a variety of waste products that, if allowed to accumulate within the body, will cause both localised damage to the kidneys, and directly poison the affected individual. Several systems are involved in the removal of these waste products but clearance centres on the renal system. Anatomically the urinary and reproductive systems develop together in the embryo, in men, the urethra has a dual function: to provide an elimination passageway for both urine and sperm. Due to the close links between these systems many specialists will treat both urinary and reproductive complaints (genitourinary disorders). At a microscopic level kidney function centres on the ability of the nephron and its components to filter, secrete and reabsorb electrolytes.

- **Excretion** refers to a route rather than a process of removing substances derived from body fluids no longer required within the body
- **Secretion** represents the internal process of facilitating substances from one area to another generally across cell membranes
- **Filtration** is the act of filtering water and other small particles out of the circulation (Chapter 4)

As blood plasma passes through the kidneys, filtrate is formed; filtrate is of a similar composition to blood

Applying Theory to Practice: Exercise 6.3

It has been identified that the driving force behind the formation and flow of filtrate is the pressure of blood within the capillaries. Answer the following questions to reinforce your understanding:

- What happens to the formation of filtrate when patients become hypovolaemic?
- In contrast what would happen if the distal pressure the filtrate meets increased?
- What could cause this?

Scenario 6.1 provides additional information.

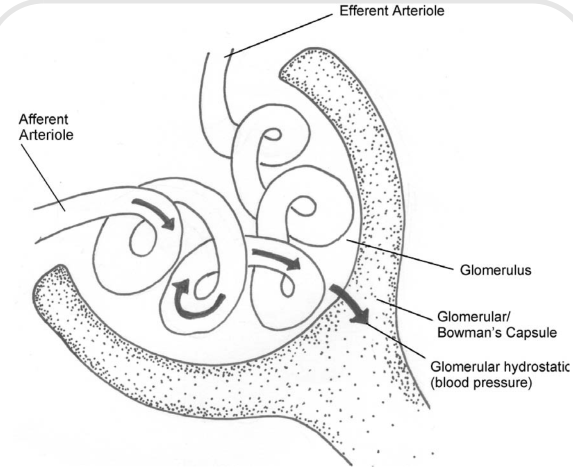

Figure 6.3 The effects of hydrostatic pressure gradient from the glomerulus to the Bowman space

plasma with larger molecules and cells remaining in the blood. Each glomerulus provides a large surface area for the formation of filtrate; this takes place within the Bowman's capsule. The rate at which plasma is passed through the gromeruli is called the **glomerular filtration rate** (GFR). The driving force instigating this **hydrostatic** pressure is the pressure of blood within the capillaries.

It is estimated that the average adult has a GFR of around 180 L/day (Clancy & McVicar 2002). This rate significantly decreases with age, and it is estimated that by the age of 65 an average adult has a reduced renal function of around 30%; this figure continues to increase with each additional year of life by 1–2% (Clancy & McVicar 2002, Feest et al. 1993).

A network of **afferent** arterial capillaries almost entirely enclose the Bowman's capsule. This tubular system then continues branching into three distinct parts.

- The proximal convoluted tubule
- The loop of Henle (medullary loop)
- The distal convoluted tubule; this segment leads into the collecting duct which facilitates the final concentration of urine and transports the urine into the renal pelvis.

The collecting ducts unite and lead into the minor **calyces**.

The functioning of the renal system centres on both a secretory and excretory ability summarised in Table 6.1.

Now you have gained insight into the various functions of the renal system you can see how complex and vital this system is. Despite its various functions, the central purpose of the renal system is the production of urine and

Anatomy and Physiology in Action: Exercise 6.4

A+P

Classically there are seven main functions of the renal system. On completion of this chapter you should be able to identify them.

Write a short summary of what you think these seven functions are, an example is displayed below as an aid:

- A prominent function of the kidneys is the role they play in maintaining **red blood cell production**. This is achieved by producing erythropoietin, a hormone that increases the production of red blood cells within the bone marrow.
- Add this function plus the others you know or can find out about to your portfolio. A visit to the following websites may prove fruitful:
  http://www.nephrologychannel.com/anatomy.shtml
  http://kidney.niddk.nih.gov/kudiseases/pubs/yoururinary/

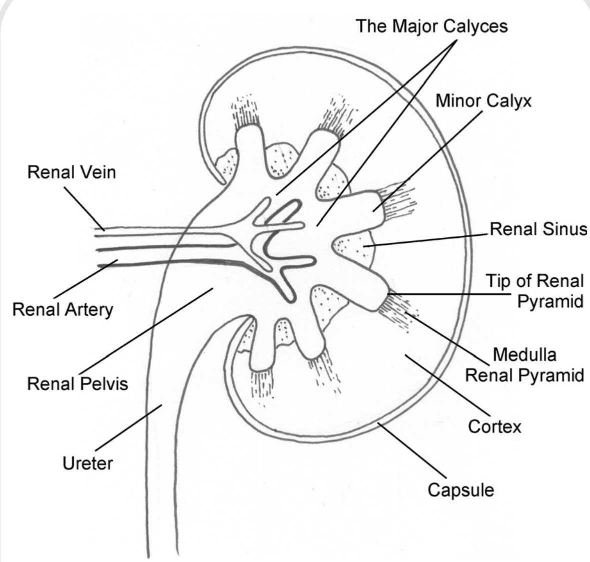

Figure 6.4 An overview of the kidney

Excretion	Secretion
Removes the waste products of cellular metabolism Concentrates or dilutes urine dependent on the current requirements of the body by removing or reabsorbing fluid Regulates **pH** levels by excreting hydrogen ions (**H+**) or conserving bicarbonate ions Regulates electrolyte levels	Adjusts blood pressure via both the removal of urine and the release of **renin** Maintains **homeostasis** through the regulation of red cell production by secreting **erythropoietin** Standardises uptake of calcium and vitamin D

Table 6.1 Functions of the Renal System

Anatomy and Physiology in Action: Exercise 6.5

Before continuing, write a short summary of how you think urine is formed and how this process is governed.

Add this to your portfolio. On completion of the following section insert the new information you have learnt into your portfolio.

the elimination or excretion of waste products and surplus water.

The urine

The composition of urine constantly changes depending on the current internal circumstance and regulatory requirements. Excessive amounts of any particular electrolyte can be passed within the urine; in addition electrolytes in short supply can be reabsorbed and recirculated.

The colour of urine partially reflects its concentration i.e. the lighter the urine, the less concentrated it is. It also reflects the amount of bilirubin and bile pigment present. Urine is composed of:

- 96% water
- 2% urea
- 2% chemicals, including sodium, potassium and ammonia.

It is estimated that the average adult produces 1.5 litres of urine each 24 hours, around 30–60ml per hour. It is necessary to generate and void around 30ml of urine per hour to eliminate the waste products of cellular metabolism (Clancy & McVicar 2002).

Applying Theory to Practice: Exercise 6.6

Examination of a patient's urine can consolidate many clinical findings. It is therefore essential for nurses to understand the basic components of urine and to comprehend the significance of increasing levels of certain waste or by-products and appreciate the importance of identifying substances that should not be found within the urine.

Complete the following exercise before continuing:

- Construct a list of what you would expect to find within the urine
- There are many different types of quick and easy to use test sticks or strips that enable the user to analyse a urine sample (**urinalysis**); identify the type used on your placements and read the instruction sheet that accompanies the test strips. This will provide you with essential information regarding obtaining a correct reading and will explain which substances that particular test strip can be used to identify.
- Add the leaflet to your developing portfolio and learn the significance of each potential finding.

Many external factors can influence the results of a urinalysis; these can result in false findings, potentially leading to a wrong diagnosis. The following list identifies some classic examples:

- Menstruation (blood)
- Ascorbic acid (can cause blood, glucose and nitrate anomalies)
- L-dopa (high levels of glucose)
- Salicylates (glucose; potential false negative reading) (Dougherty & Lister 2004).

Many different drugs will alter the colour of the urine. These include commonly used antibiotics such as clarithromycin and rifampicin. Even eating beetroot can cause the colour of urine to change to a similar colour to **frank haematuria**.

Blood should not be present within the urine; a multitude of reasons can result in blood entering the urine resulting in **haematuria.** These include direct trauma to any part of the urinary tract, (kidneys, ureters, bladder or urethra), or the presence of malignant cells found in cancer-affected areas such as the prostate in men. There are also transient causes found when the kidneys temporarily receive a reduced blood supply. This can be caused by strenuous levels of exercise particularly if prolonged such as in marathon runners (Saladin 2005). In these circumstances the glomeruli deteriorate, instigating the release of blood and protein into the filtrate. Localised infection can also result in haematuria, although this is generally found under microscopic examination or via test sticks rather than by the naked eye.

Developing and Delivering Expert Care: Box 6.1

Obtaining a Mid-Stream Urine Sample (MSU)

A urinalysis provides a quick and simple overview of the urine. If a potential infection is identified, a further specimen should be ascertained. This sample requires a mid-stream sample of the urine so that contaminates like bacteria that colonise around the end of the urethra are not included. The sample will be sent to a microbiology laboratory so that the bacteria can be grown and identified. The specimen is sent for micro-culture and sensitivity (MC&S), which means the identification of the bacteria (micro-culture) and what the specific bacterium is sensitive to, i.e. which antibiotic will destroy it and which antibiotics these bacteria are resistant to.

When using test sticks it is paramount that the instructions are followed precisely as the potential for an incorrect result is high; this is particularly so if the test is hurried and the correct exposure times are incorrectly followed.

The process of elimination

Once the urine is formed and filtered within the kidneys, it is propelled down the ureters by peristaltic contraction of the smooth muscle of the ureteral walls. This is a continual process with urine slowly trickling into the bladder. As the bladder fills and distends, the individual is aware of the need to urinate; this is usually sensed when the bladder holds around 400 ml of urine (Waugh & Grant 2007). The elimination or passing of urine is initiated by a reflex action whereby the bladder wall begins to contract as a response to the increasing wall tension and the stimulation of stretch receptors. As the bladder continues to fill the contractions increase, resulting in the internal urethral sphincter opening, the external sphincter relaxes and urine passes out.

This appears a simple process but, due to the reliance on sphincters, and in the male the prostate gland (Chapter 9), this can be a potentially problematic process.

Developing and Delivering Expert Care: Exercise 6.7

Anticipating and Monitoring Urine Output

Many patients are at direct risk of experiencing acute renal failure while they are hospitalised (RCUK 2006).

Answer the following questions and expand your answers after reading the following section.

- How can you identify those at increased risk?
- What can be done to prevent acute renal failure (ARF) developing?

Scenario 6.1 discusses ARF in detail.

Acute renal failure

Acute renal failure (ARF) can be defined as an acute or rapid deterioration in renal function that is potentially reversible. The causes are varied but the result is an inability to excrete the waste products of cellular metabolism, therefore creating an internal environment

Scenario 6.1

Acute Renal Failure

Zamid Khan is a 78-year-old man of Pakistani origin. He was admitted in the early hours of the morning following a collapse at home the previous evening. Mr Khan has had type 2 diabetes for six years; this is controlled by his dietary intake and oral medications (metformin and glicazide).

You are caring for him the following morning on an acute medical ward. During your initial assessment you note the following observations:

Airway – clear, patient is talking, AVPU = A
Breathing – respiratory rate 21, regular with full inspiration
Circulation – pulse 91 regular and strong, blood pressure 109/68, blood sugar 14.2mmol. His tympanic temperature was recorded as 37.6.

On admission Mr Khan appeared dehydrated and has received two litres of physiological saline since his admission. Mr Khan has not passed any urine and is still awaiting a urinalysis as part of the investigatory process.

PMH: hypertension and type 2 diabetes.

His blood results reveal increased levels of creatinine and urea.

incompatible with the maintenance of an efficient fluid and electrolyte balance. ARF affects an estimated 0.01% of the population; this rises to around 4% of hospitalised patients and 20% of critical care admissions making iatrogenic ARF a serious concern for all hospitalised patients (Sinert & Peacock 2006).

Assessment and analysis of patient presentation

The presenting history of Mr Khan's admission elicits more questions than it provides answers. The initial assessment identifies a stable patient who is potentially physiologically compensating to maintain homeostasis, demonstrated by a raised respiratory and pulse rate. This makes sense when combined with his relative hypotension and a physical presentation suggesting dehydration. This is magnified by the increased blood sugar level, which will result in a greater internal pressure to maintain homeostasis. Mr Khan has also been found to have a slight temperature indicative of an underlying disease process; this is by far the most common cause of collapse in this age group (Evans & Tippins 2007). A urinalysis is essential as soon as possible to identify a possible infection or to identify evidence of kidney failure.

The emergency department prior to his transfer should have excluded life-threatening pathology such as cardiac disease; additionally a local tool for identifying patients at risk will have been used to provide a safe transfer to a secondary setting (PAR/MEWS). The joint presentation of dehydration and collapse are a cause for concern when combined with a history of diabetes. Diabetes is frequently associated with the onset of acute renal failure due to the associated poor renal perfusion and reduced microcirculation to the kidneys. This is seen as a pathological cycle of events, as once the kidneys are starved of blood they initiate the release of renin, and the renin angiotensin aldosterone axis is instigated (RAAA) (Chapter 2). Mr Khan's blood has been found to contain excessive amounts of both urea and creatinine (both prominent signs of renal failure). Initial investigations will centre on identifying potentially reversible causes when renal function suddenly declines.

Pathophysiology

ARF may occur in three clinical settings:

- As an adaptive response to severe volume depletion and hypotension, with structurally and functionally intact nephrons
- In response to cytotoxic or ischaemic insults to the kidney, with structural and functional damage
- As a consequence of an obstruction to the passage of urine.

Therefore, ARF may be classified as **prerenal**, **intrinsic** and **postrenal**. While these classifications are useful in

Applying Theory to Practice: Box 6.2

Acute Renal Failure – Three Categories

Prerenal

Reduced perfusion of the kidneys results in the retention or accumulation of excessive nitrogenous compounds within the blood. Initially the kidneys are unaffected but if left untreated the GFR will be compromised, resulting in increasing prerenal uraemia directly affecting the actual kidneys. Instigating factors include:

- Dehydration
- Haemorrhage
- Burns
- Systemic Inflammatory Response Syndrome (SIRS)

Intrarenal

Damage directly affecting the kidneys:

- Acute tubular necrosis
- Acute glomerulonephritis
- Acute pyelonephritis

Postrenal

- The most common cause of postrenal failure is secondary to bladder outlet obstruction due to prostatic hypertrophy (Agraharker et al. 2006)
- Obstruction of the urethra due to calculi (Scenario 6.2), trauma or strictures
- Obstruction of the bladder due to cancer

Developing and Delivering Expert Care: Exercise 6.8

Observations for Patients Experiencing Potential Renal Failure

All patients experiencing ARF are at potential risk of fluid overload; this is particularly prominent in patients who have existing cardiac disease. Therefore close monitoring of their fluid balance is essential particularly during aggressive fluid resuscitation. Complete the following questions:

- What are the clinical signs of fluid overload?
- What changes would you be looking for in the patient's vital signs?

If suspected renal failure presents in combination with heart failure, a central line and urinary catheter are essential to monitor the patient's fluid status.

Daily weights will be used to ascertain if the patient is retaining or losing fluid:

- When are these recorded in your clinical areas?

A strict fluid input/output chart will also be employed:

- Are fluid charts known to be reliable?
- What might influence their accuracy?

establishing a differential diagnosis, many pathophysiologic features are shared among the different categories.

Mr Khan is suffering from prerenal insufficiency, a functional response of normal kidneys to acute hypoperfusion. Prerenal insufficiency accounts for approximately 70% of community-acquired cases of ARF worldwide and up to 60% of hospital-acquired cases (Devarajan 2006).

The acute phase of kidney compensation includes enhanced tubular reabsorption of salt and water initiated

Developing and Delivering Expert Care Box 6.3

Clinical Signs Associated with Acute Renal Failure

Urea is a by-product of protein metabolism commonly referred to as a nitrogenous waste; if allowed to accumulate, it will result in a physiological state referred to as **azotaemia**. This progresses into **uraemia** (excessive urea within the blood) which can be demonstrated by many clinical changes:

- Cardiac arrhythmias
- Dyspnoea
- Diarrhoea and vomiting
- Convulsions
- Coma
- Dry flaking skin
- Dimness of vision
- Weakness and lethargy

By identifying the clinical signs of impending renal failure swift action can reduce both mortality and morbidity rates (UKRC 2006).
http://www.nlm.nih.gov/medlineplus/ency/article/000471.htm

by the renin angiotensin aldosterone axis/system. In the case of Mr Khan rapid reversibility of the **oliguria** allows correction of the hypoperfusion and the re-establishment of renal perfusion. This occurs shortly after admission to the medical ward. Mr Khan was lucky: for many patients prolonged renal hypoperfusion can result in a shift from compensation to decompensation.

The physical consequences of ARF for the individual are wide-ranging and diagnostically include an excessive amount of urea and a rise in creatinine with or without a significant decrease in urine output. ARF can also be asymptomatic as significant renal dysfunction might be present even when serum creatinine is normal or only slightly abnormal, making the identification of those at risk essential to the early initiation of treatment and the prevention of the destruction of nephrons. The baseline rate of urinary protein excretion is the best single predictor of disease progression (Parmar 2002).

In the case of Mr Khan, his diabetes and history of hypertension predispose him to the development of both acute and chronic renal failure.

Psychosocial aspects

Mr Khan is of Pakistani origin genetically predisposing him to an increased incidence of both diabetes and renal failure (DH 2000, 2006).

Questioning Clinical Practice: Exercise 6.9

Ethical Dilemma – Screening Programmes

If certain nationalities are at an increased risk of developing serious diseases, should they be identified and regularly screened for potential disease development?

- How do you think indigenous groups might react when it is surmised that 'foreigners' are receiving preferential treatment?

Although in this case scenario Mr Khan will make a full recovery due to the quick delivery of intravenous fluids and maintenance of his electrolyte balance, he will need regular blood tests to monitor his kidney function. This will generally be undertaken by his GP, who will also need to closely monitor his medications, as many modern medications taken by diabetic patients to reduce their blood pressure and cholesterol levels have been shown to adversely affect the microcirculation of the kidneys, thereby insidiously damaging the nephrons and causing renal failure (DH 2000).

Developing and Delivering Expert Care: Box 6.4

Basic Nursing Skills

A patient experiencing the clinical signs of acute renal failure and an increased level of urea may have itchy flaking skin. This should be anticipated and a skin emollient applied at an early stage to prevent skin damage.

Professional issues

Diabetes and hypertension are the two most common causes of end-stage renal failure and are associated with a high morbidity and mortality rate; individuals with pre-existing diabetes and hypertension have an estimated 10–20 times higher mortality rate than the population at large (Parmar 2002). The current focus has, therefore, shifted to maximising the care of these patients during the phases of acute or chronic kidney disease, and before the onset of end-stage renal disease. This is particularly evident in the long-term treatment of Mr Khan, as preventing further damage to the inner workings of his kidneys is paramount to his long-term prognosis. Mr Khan must be offered information regarding the stabilisation of his diabetes. Offering him an informed choice about his chronic illness may assist him to closely monitor his blood sugars and prevent his quality of life from deteriorating. Nurses are in an ideal position for this type of health education and patient empowerment. Several government-driven targets have been identified in recently published documents directed at preventative medicine in these areas (DH 2000, 2005, NICE 2004).

Questioning Clinical Practice: Exercise 6.10

Urinary Catheterisation

- If it were suspected that Mr Khan had an underpinning urine infection but failed to pass urine, would this justify urinary catheterisation to obtain a sample?
- What would the potential risks be?
- Would they outweigh the benefits?

There are numerous clinical practices without an evidence base, carried out each day by healthcare practitioners unaware of the devastation they can cause to people they are apparently 'caring' for.

The following links provide additional information: http://www.nhshealthquality.org/nhsqis/files/Urinary_Cath_COMPLETE.pdf

www.dh.gov.uk/prod_consum_dh/idcplg?IdcService=GET_FILE&dID=147767&Rendition=Web

Chronic renal failure (CRF)

Regardless of the underpinning aetiology of the renal injury, if left untreated, progressive destruction of the nephrons will result in the kidneys maintaining the GFR by hyperfiltration resulting in **hypertrophy** of the functioning nephrons. This ability of the nephrons to adapt to meet the current requirements to maintain homeostasis allows for the continued clearance of filtrate to such an extent that substances such as urea and creatinine start to show significant increases in plasma levels only after the total GFR has decreased to 50% (Verrelli 2006). The plasma creatinine value will double with a 50% reduction in GFR. A doubling in the patient's serum creatinine baseline (potentially still within the normal range) can actually represent a loss of 50% of functioning nephrons (Sinert & Peacock 2006). Ultimately over time this innate compensatory mechanism will result in the nephrons becoming misshapen and ineffective.

Chronic renal failure is invariably a progressive process that results in end-stage renal disease and the need for dialysis or kidney transplantation (Parmar 2002).

Renal colic

Scenario 6.2

Renal Colic

Michelle Stevens, a 35-year-old Caucasian woman, is admitted to the emergency department after suffering severe right flank pain and vomiting for the past 2 hours.

On arrival she appears pale and clammy. She is unable to lie still and stands slouching over the hospital trolley.

During the initial assessment you record the following observations:

Airway – clear, patient is talking, AVPU = A
Breathing – respiratory rate 26, irregular and shallow
Circulation – pulse 129, regular and of good volume
Blood pressure 154/89
Temperature 36.4
PMH: Ms Stevens has no relevant medical history although she appears clinically obese.

Assessment and analysis of patient presentation

Michelle Stevens presents with the typical clinical signs and symptoms of renal colic; from her presenting data it can be deduced that she is suffering extreme pain. Michelle's vital signs demonstrate all too clearly the sympathetic response to pain; her breathing rate is fast, shallow and erratic, her pulse and blood pressure are raised, she appears pale and clammy. Although flank pain accompanied by vomiting can signify many clinical conditions, the most likely condition affecting this age range is renal colic. Other serious pathology should be excluded; these include peritonitis, appendicitis, bowel obstruction, urinary tract infection, pregnancy and constipation. Michelle's stance offers invaluable information regarding her illness. Many serious pathologies affecting the abdomen cause the sufferer to lie 'doubled-up' in pain, almost resembling the fetal position, but patients attending with renal colic commonly move around trying to find a comfortable position, often slouching against a wall or other object.

Applying Theory to Practice: Exercise 6.11

Predisposing Factors Associated with Calculi Development

The term 'colic' is used in many circumstances. Answer the following questions to gain insight into this common disease process:

- What is colic?
- Renal colic is commonly described as one of the most painful disease processes; why might this be?
- What other areas are affected by 'colic'?

Renal colic is classically described as an excruciating acute pain that can occur without warning. It is usually caused by **calculi** (stones) within the kidney, renal pelvis or ureter. The pain results from the associated local inflammation, dilatation, stretching and spasms. It is estimated that renal colic has an incidence of 12% for men and 4% for women (Leslie 2006). Acute renal colic may be the most excruciatingly painful disease an individual can experience. The sudden onset of extreme and unbearable pain is often described as worse than childbirth. Renal colic affects approximately 1.2 million people each year and accounts for approximately 1% of all hospital admissions within the USA (Leslie 2006). Rapid initial treatment and symptom relief are paramount as is patient education. The risk of stones is greater in higher socioeconomic groups. The peak age of onset is 35 to 45; presentations significantly outside this age group are often associated with a metabolic abnormality.

Pathophysiology

Calculi, otherwise known as stones, form due to an abnormal concentration of mineral salts or substances. Stones are not confined to the renal system, they are also commonly found within the biliary tract and around joints.

Anatomy and Physiology in Action: Exercise 6.12

- What increases the likelihood of developing a renal or urinary calculus?
- Do lifestyle choices affect an individual's chance of developing a renal calculi?

Add your answers to your portfolio and expand on them as you read the following section.

The classification of calculi can be separated into two main groups:

- **Small calculi**, which can pass through larger areas of the kidneys and become impacted as the pathway becomes increasingly smaller, generally within the ureters (Clancy & McVicar 2002). Although it is possible to have more than one circulating stone, commonly the obstruction occurs only on one side (unilateral). Spasmodic contraction and inflammation of the ureter ensue with the individual experiencing extreme pain on the affected side. The individual may even be able to directly pinpoint the location of the stone due to the direct localised inflammation and spasms as the urinary tract tries to force the stone down the system. Stones that are eventually forced down the pathway by ureteral contraction may be passed in the urine although it is possible for the stone to become lodged in the urethra.
- **Large calculi** can block areas proximal to the kidney resulting in occlusion within the renal pelvis and subsequent stagnation of urine and infection. Renal colic in combination with an underlying kidney infection (**pyelonephritis**) may directly lead to renal failure. Michelle is found to be apyrexial, which is considered to represent uncomplicated renal colic. If

pyrexia is present, this suggests infection and the temperature is usually very high, although this may not be the case in all presentations i.e. the elderly. Although renal colic is usually self-limiting, it does hold significant risk for those experiencing renal compromise e.g. those with a single kidney or azotaemia.

Developing and Delivering Expert Care: Exercise 6.13

Identifying Renal Stones

The initial diagnosis is based on clinical findings; definitive diagnosis can be established via various mediums. Many emergency departments will provide easy access to an intra-venous urogram (IVU) for the diagnosis of renal colic.

Many other tests exist with equal prognostic value to an IVU; helical CT scanning currently remains the gold standard (Leslie 2006).

- Identify which tests are available within your clinical areas.

By knowing which tests are available and how they are performed you will be able to inform the patient about what they are about to experience.

Many other non-specific tests exist in the identification of renal stones these include haematuria on urinalysis: stones often cause some bleeding into the renal tract resulting in a positive result for blood on stick testing, but a negative test does not exclude the diagnosis. Many studies have been undertaken to establish the reliability of urinalysis – 80–93% – therefore, the test is of some value but does not confidently confirm or refute a diagnosis (Malvinder 2004).

X-ray examination traditionally starts with visualising the kidneys, ureters and bladder (KUB). It has been estimated that around 75% of stones consist of calcium, and are therefore identifiable on X-ray examination (radio-opaque) (Leslie 2006). To increase the possible effectiveness of X-ray, an ultrasound scan can be added, an extremely easy to use tool.

Applying Theory to Practice: Box 6.5

Risk Factors Associated with Calculi Development

Many factors increase the likelihood of developing kidney stones:

- Dehydration can cause an increased reabsorption of water but does not change **solute** reabsorption, therefore resulting in a highly concentrated filtrate
- Excessive **calcium** in the urine
- Excessive **oxalate** in the urine
- Excessive **uric acid**
- Deficiency of **citrate** in the urine

Treatment and management

Pain relief must be the early priority. A pain assessment tool should be employed to guide and evaluate treatment. Non-steroidal anti-inflammatory drugs (NSAID) are usually the first-line treatment as they provide direct pain relief and may stop further pain development by reducing inflammation and spasms. Suppository administration is quick-acting and provides an easy route of administration for the typical age range associated with renal colic. If this fails to provide relief, intravenous opioids, such as diluted morphine should be titrated until pain relief is achieved, in combination with an anti-emetic to control nausea and vomiting.

Complications

- Complete obstruction of the urinary flow from a kidney decreases GFR and if left untreated may cause irreversible kidney damage.
- If infection co-exists, presentation can be life-threatening.
- Blood results may reveal a white cell count or a temperature may co-exist.

Psychosocial aspects

The association between renal colic and extreme pain is well documented; therefore, a designated plan of care should be implemented based on best practice. This usually consists of a multidisciplinary care pathway used to rationalise Michelle's care. This will expedite her treatment and provides quick and effective pain relief as analgesics and anti-emetics will be available via a patient group direction (PGD), meaning the nurse can dispense these drugs without waiting for a written prescription.

Professional issues

Many patients will be able to be discharged once pain relief is achieved and their symptoms subside. There are cases, however, where the patient will require hospitalisation:

- Clinical signs of infection, systemic illness
- A failure to achieve adequate pain relief
- An ureteral or urethral obstruction
- An inability to maintain oral fluids
- Patients outside the normal age-range i.e. the young or old. Elderly patients may have a similar presentation to renal colic with a leaking aneurysm
- A significant history of renal failure i.e. only one kidney
- Anuria.

Analysis

Health promotion can have a powerful preventative influence if heeded. Michelle should be encouraged to maintain a good fluid intake to keep her urine dilute. Avoiding a diet high in salt or protein may prove beneficial (NICE 2004).

Urinary tract infection

Patients experiencing urinary tract infections are a common presentation within all health settings. It is estimated that between 1–3% of all consultations relate to an infection of the urinary tract (UTI) and that in hospitalised patients UTIs account for 23% of all hospital-acquired infections (Naish & Hallam 2007). In the USA, the National Institute of Diabetes and Digestive and Kidney Diseases estimate that around 8.3 million people seek medical advice related to UTIs each year (NIDDKD 2005).

Assessment and analysis of patient presentation

Despite Mrs Forbes having vital signs within normal parameters for her age she appears confused and disorientated. She does not have a temperature, which might have made the diagnosis of an infection easy, but elderly patients frequently do not demonstrate a raised temperature even with severe infection (Berman et al. 1987).

Scenario 6.3

Urinary Tract Infection

Grace Forbes, an 81-year-old Caucasian woman, was admitted to the acute medical assessment unit late last night following a fall at home. Her symptoms include slight grazing to her right arm and unsteadiness on her feet. She has been referred to the medical team for a full medical assessment including occupational and physiotherapist opinions about her needs for a safe discharge.

During the morning handover her condition is described as stable and she is awaiting a senior medical opinion before, hopefully, being discharged that afternoon.

During your initial assessment you note the following observations:

Airway – clear, patient is talking, AVPU = A
Breathing – respiratory rate 17, regular and shallow
Circulation – pulse 71 regular and strong, blood pressure 142/89
Temperature 36.4°

Mrs Forbes appears vague and disorientated; she is playing with her nightdress revealing that she is not wearing underwear. She also smells offensive and when the sheets on her bed are examined they are saturated with urine from where she has been incontinent.

PMH: hypertension. Mrs Forbes takes atenolol to control her blood pressure.

All elderly patients demonstrating confusion or a sudden reduction in their cognitive ability should have an infection screen to rule out pathology.

The most likely pathology affecting Mrs Forbes is a urinary tract infection provisionally identified by the offensive smell of the urine, confused behaviour and perhaps the incontinence. The infection was confirmed by a urinalysis revealing leukocytes and protein, both of which indicate infection. The causative bacteria will be identified when a sample of urine is obtained for microculture and sensitivity (MC&S).

Questioning Clinical Practice: Exercise 6.14

Stereotyping Individuals

An elderly patient being admitted to hospital in a confused state is not uncommon. Complete the following exercise adding your work to your portfolio.

There are many pathophysiologies that can result in an individual becoming acutely confused.

- Make a list of which conditions you think commonly afflict the elderly
- How can they be excluded?
- What tests would an infection screen involve?

One common example is constipation, which can cause an otherwise healthy and coherent adult to become disorientated and irrational. Visit the following link to gain further insight into this topic: http://users.ecs.soton.ac.uk/id/Omega%20dying%20decisions.pdf

Elderly people are increasingly prone to UTIs due to several physiological changes:

- Reduced bladder emptying (contractility)
- A decreased mucosal barrier
- A loss of bladder tone (Banning 2005).

Pathophysiology

Infections affecting the urinary tract can be split into four distinct classifications; although any one can occur in isolation, many infections will be transient and travel from one area of the tract to another. Infections directly affecting areas of the kidney can lead to localised necrosis and long-term kidney damage and potential failure:

- **Urethritis** – inflammation of the urethra; characterised by pain on urination (can be caused by localised inflammation/infection or linked to gonococcal infection)
- **Pyelonephritis** – infection spreading from the renal pelvis to the cortex of the kidney. Commonly linked to infections below the ureters or within the bloodstream (SIGN 2006)
- **Pyelitis** – inflammation of the renal pelvis involving **pyuria**
- **Cystitis** – inflammation of the bladder; associated with a burning sensation on urination and frequency.

The aetiology of infection can vary between men and women. Infection in males can be directly linked to prostate hypertrophy and subsequent urine stagnation within the bladder, leading to initially a localised urine infection and the potential for cystitis. Females are at particular risk of UTIs, this is possibly due to a reduced fluid intake and the close proximity between the anus and the urethra which in females can lead to the urethra becoming colonised by particular strains of bacteria such as *Escherichia coli,* otherwise known as perianal flora. Bacteria can then ascend, or migrate, up the urinary tract infecting vital structures leading to the possibility of systemic illness (SIGN 2006). See Table 6.2.

Effect on Appearance of Urine	Possible Physical Effects
Cloudy urine	Dysuria
Offensive smelling urine	Frequency and urgency to urinate
Haematuria (may only be microscopic)	Pyrexia
Proteinuria (may only be microscopic)	Possible abdominal/loin pain
Concentrated urine (dark)	Cystitis – burning or discomfort on urination
Pyuria (contains pus)	Confusion/collapse
	Shock

Table 6.2 The Signs and Symptoms of Urinary Tract Infections

Psychosocial aspects

Many women in later life are prone to urinary problems particularly after childbirth. Stress incontinence is a common and embarrassing complaint. For men a common urinary problem is an enlarged or hypertrophic prostate leading to incomplete bladder emptying, and urine stagnation, the ideal breeding ground for bacteria. Both sexes therefore have their own particular problems regarding urination. For many these problems are highly embarrassing and patients may only present for medical assistance when they have systemic reactions i.e. they collapse or become confused. Despite urinary retention

Questioning Clinical Practice: Exercise 6.15

Conflicting Information and Care Delivery

Because urinary infections in women are so common, many are treated with antibiotics only when the patient demonstrates clinical symptoms (Table 6.2). Many healthcare agencies are currently differing in their testing regimens, treatment plans and health promotion, an example being that it has been common practice to send mid-stream urine samples for further analysis to confirm appropriate antibiotic cover following diagnosis via a urine dipstick. These guidelines and articles discuss the relevance of such tests and their cost effectiveness.

- Read the following guidelines/articles and identify how you will apply them to your future practice.

Prodigy Guidance (2006) Urinary Tract Infection (Lower): Women. NHS National Library for Health, Newcastle upon Tyne. http://cks.library.nhs.uk/uti_lower_men/view_whole_guidance

Scottish Intercollegiate Guidelines Network (2006) Management of Suspected Bacterial Urinary Tract Infection in Adults: A National Clinical Guideline. SIGN. Edinburgh. http://www.sign.ac.uk/guidelines/published/index.html

Health Protection Agency (2005) Investigation of Urine. National Standard Method BSOP. 41 5. (Under review) http://www.hpa-standardmethods.org.uk/documents/bsop/pdf/bsop41.pdf

Summarise your findings for your portfolio.

being a common, highly publicised condition in men (BAEM 2007), many have failed to seek any medical help despite years of urinary problems such as leakage or dribbling. Nurses can have a profound effect on individuals by raising awareness of these conditions and positively promoting health education. An adequate intake of water, as with most urinary problems, can be extremely beneficial. Women should be informed of wiping away from the urethra after emptying their bowels as this can directly cause stool particles to migrate into the urethra and vagina promoting or directly causing infection. By actively promoting an increased awareness of these conditions in patients attending for other reasons, preventative strategies can be used to reduce both future attendances and may help to dispel taboo subjects to the benefit of those who suffer from these conditions.

Professional issues

Much of the underpinning theory related to the tests, treatment and health advice offered to patients experiencing UTIs are currently under debate. There are also various claims regarding different foods and their ability to prevent or halt urinary infections, for example, yoghurt and cranberry juice. Much of the research for these products may be driven by the companies who produce them, so be sceptical in your approach. As a future nurse you will need to continually update your practice depending on future quantitative research and the publication of definitive guidelines. Your clients will listen to your opinions, and you will potentially have a great influence over a public who place trust in you because of your position.

Analysis

Dealing with a confused elderly patient is a skill all adult nurses require. A lone elderly patient on a general medical ward lying in her own urine with her hospital gown slung to one side is a shameful sight; the patient in a time of need has lost not only mental and physical functioning but also her dignity. This patient requires caring assistance and the nurse must maintain the patient's dignity in their role of patient's advocate.

Conclusion

This chapter has discussed both the form and function of the renal system, a system which is commonly undervalued. Over the coming weeks and months apply your new understanding to the patients you meet, identify which medications they take and recall if any of these can affect kidney function, look for signs of renal disease. You can now offer patients valuable information regarding both health promotion and education. Now that you have gained insight into the basic form and function of this system, reinforce your knowledge base by working your way through the summary quiz.

Chapter 6 Summary Quiz

1. The renal system is composed of:

A. Two kidneys, two ureters, and a bladder
B. Two kidneys, a common ureter, a bladder and the urethra.
C. Two kidneys, two ureters, a bladder and the urethra
D. Two kidneys, two ureters, two bladders and a urethra

2. Each nephron contains an extremely intricate pathway involving several prominent points essential to optimal renal function. These include:

A. The collecting duct, the distal convoluted tubule, the loop of Henle, the Proximal convoluted tubule, the Boatman's capsule and glomerulus
B. The distal convoluted tubule, the loop of Henle, the Proximal convoluted tubule, the Bowman's capsule and glomerulus
C. The distal convoluted tubule, the loop of Henle, the Inferior convoluted tubule, the Bowman's capsule and glomerulus
D. The collecting duct, the distal convoluted tubule, the bundle of His, the Proximal convoluted tubule, the Bowman's capsule and glomerulus

3. Cystitis refers to:

A. A sexual disease affecting women
B. Inflammation of the bladder, generally caused by a localised infection
C. Inflammation of the kidney
D. Localised infection within the kidney

4. The following are all functions of the renal system:

A. Acid-base balance, blood pressure control, hormone production, drug removal, fluid balance, toxin removal
B. Acid-base balance, cerebral spinal fluid regulation, drug removal, fluid balance, toxin removal
C. Acid-base balance, metabolism of drugs, hormone production, fluid balance,
D. All the above

5. Pyelonephritis describes which illness?

A. Inflammation of the bladder
B. Infection spreading from the bladder to the urethra
C. Infection spreading from the renal pelvis to the cortex of the kidney
D. Inflammation of the urethra

6. What tests are commonly available for the diagnosis of renal colic?

A. IVU
B. Helical CT scanning
C. KUB
D. All the above

7. Iatrogenic means:

A. Ill health or adverse effects resulting from medical treatment
B. Medical incompetence
C. A poor knowledge related to a nurse
D. An MRSA infection

8. Which of the following diseases predisposes individuals to renal disease?

A. Glandular fever
B. Cellulitis
C. Diabetes mellitus
D. Ovarian cysts

9. The internal urethral sphincter is under:

A. Involuntary control
B. Voluntary control
C. Remote control
D. All the above

10. In males the urethra is around how many centimetres long?

A. 25
B. 20
C. 10
D. 7

Further reading

Agraharker, M., Gupta, R., Agraharkar, A. & Workeneth, B.T. (2006) *Acute Renal Failure*. http://www.emedicine.com/med/topic1595.htm

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7

The gastrointestinal system

Paul Newcombe

Chapter 7 Learning Objectives

- Describe essential anatomy and physiology of the digestive system
- Identify relevant anatomical landmarks and surface anatomy
- Demonstrate knowledge of common diseases and conditions which affect the digestive system
- Apply theory to practice by exploring the physical manifestation of these conditions
- Develop a thorough approach to patient assessment in relation to the digestive system
- Describe common therapies utilised in the prevention and treatment of disorders of the digestive system
- Demonstrate the ability to explore and critique the underpinning evidence-base for planned care

Applying Theory to Practice: Exercise 7.1

Before reading on:

- Compile a list of conditions which affect the digestive system.
- Add this list to your portfolio, updating it as you continue through this chapter with consideration to how these conditions affect day-to-day functioning, and the role of the nurse in their assessment and management.

Introduction

A healthy digestive system is fundamental to supporting human life. Its ability to extract nutrients from the food we eat affects our general well-being in health and our response to illness in ill-health. Disorders of the digestive system range from mild and self-limiting to severe and life-threatening, but affect everyone to some extent and at some point during their life. This chapter provides a general overview of the digestive system, and then explores its components in greater detail. Common conditions are examined through patient scenarios.

Nurses are intrinsically involved with many aspects of the digestive system during patient care, thus the NHS Modernisation Agency's (NHSMA 2003) *Essence of Care* benchmarking guidance is applied to patient scenarios where relevant. Other key nursing roles discussed in this chapter include intravenous fluid and electrolyte management.

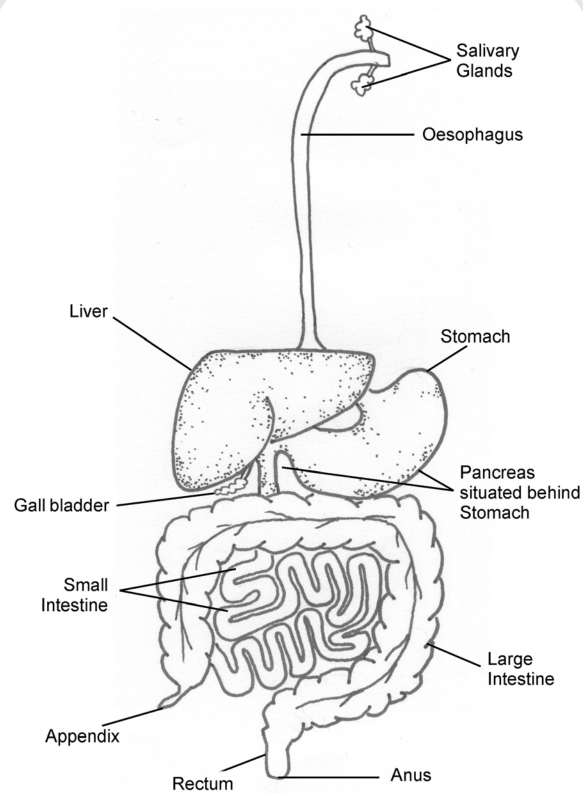

Figure 7.1 The digestive system

Overview of the digestive system

The digestive system is divided into two areas: the gastrointestinal (GI) tract (gut) and the accessory digestive organs. The GI tract is a 4.5m continuous tube (lumen) from the mouth to the anus. Between these ends it is divided into the pharynx, oesophagus, stomach, small intestine and large intestine. The walls of the GI tract have four layers: mucosa, submucosa, muscularis externa and serosa. The accessory digestive organs are exocrine glands and include the salivary glands, liver and pancreas.

The majority of the digestive system is contained within the abdominal cavity by the **peritoneum**, which has two layers. The visceral peritoneum covers the abdominal organs and is continuous with the parietal peritoneum, which lines the abdominal wall. Between these layers is a potential space called the peritoneal cavity containing serous fluid, which lubricates the organs. Some organs, such as the **pancreas**, are located behind the peritoneal cavity in the **retroperitoneum**. The peritoneum is connected by the mesentery, which secures the abdominal organs in place, provides a route for blood vessels and stores fat.

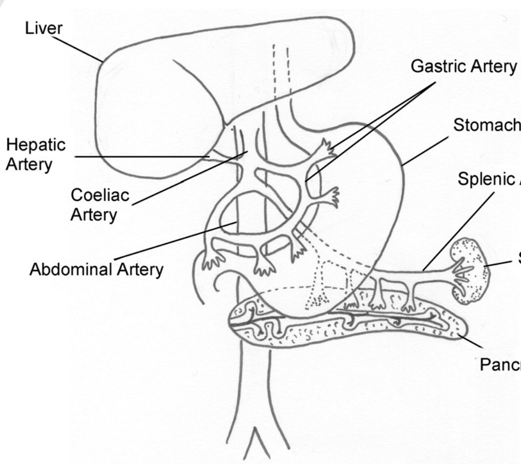

Figure 7.2 The splanchnic circulation

The digestive system is supplied by the splanchnic circulation (Figure 7.2), this conveys oxygen and nutrient-rich blood to the digestive organs allowing them to carry out their functions. However, as most of the nutrients are absorbed into the circulation via the digestive system, these blood vessels are also arranged to collect and process them effectively. The liver only receives 20% of its blood supply from the hepatic artery. The remainder comes from the hepatic portal vein, which brings nutrient-rich blood from the gut for processing in the liver before it returns to the systemic circulation.

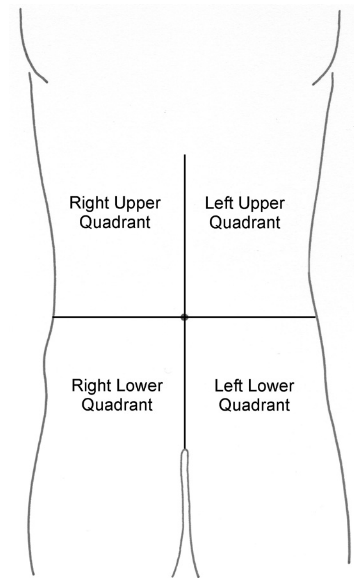

Figure 7.3 Anatomical areas of the abdomen

Anatomy and Physiology in Action: Exercise 7.2

A+P

Abdominal Surface Anatomy

- Compare Figure 7.1 with Figure 7.3 and identify which structures appear in which segment or quadrant. If possible, compare both with the abdomen of a willing companion or patient.
- Why do you think it is difficult to feel the liver?
- What happens to the abdominal contents on inspiration and expiration?

Mouth, oesophagus and stomach

Form

The mouth, or oral cavity, is usually where the digestive process begins. Some drugs are absorbed here, such as GTN, but little else. The condition of the oral cavity often reflects the health of an individual and is useful in assessment, for example, dehydration and ulceration. The mouth has several components used during digestion:

Anatomy and Physiology in Action: Box 7.1

Main Functions of the Digestive System

Ingestion – food and drink being taken into the GI tract via the mouth
Propulsion – swallowing and peristalsis
Digestion:

- Mechanical – mastication (chewing) in the mouth, churning in the stomach and mixing during peristalsis
- Chemical – breaking down of food into components suitable for absorption

Secretion – release of digestive juices for lubrication and digestion

Absorption – final components of digestion are transported across the membrane of the GI tract into the circulation

Elimination – passing of undigested material, bacteria and excreted substances as faeces, also known as defecation

Developing and Delivering Expert Care: Exercise 7.3

Oral Hygiene

There are many occasions when patients are not able to maintain their own oral hygiene. *Essence of Care* (NHSMA 2003) sets benchmarks for providing and monitoring standards of personal care, including oral hygiene:

- Individualised assessment (using a validated tool)
- Care planning, negotiated with client and/or carer
- Provision and evaluation of evidence-based mouth care.

For details of evidence-based mouth care, download guidelines from the British Society for Disability and Oral Health at: http://www.bsdh.org.uk/guidelines.html

- The human adult usually has 32 permanent teeth, made up of incisors and canines for cutting and tearing food, and premolars and molars for crushing and grinding food. Missing teeth can be replaced, but too few teeth or poor dental health can affect the ability to consume food.
- The tongue is a mobile, muscular structure that can change shape and position and has an important role in both eating and communication. Its dorsal surface is covered in projections of mucosa called papillae, which provide structure, texture, colour and also contain taste buds.
- There are three pairs of salivary glands: parotid, submandibular and sublingual. There are also some smaller buccal glands around the oral cavity. Serous and mucous cells produce saliva, which is largely water, but also contains salivary amylase, electrolytes, protective proteins and metabolic waste.

Continuous with the back of the mouth is the muscular pharynx. This is subdivided into the nasopharynx (not involved in digestion), the oropharynx and the laryngopharynx. The pharynx also contains the epiglottis, which covers the trachea during swallowing. The oesophagus joins the pharynx to the stomach via the thoracic cavity. It connects to the stomach at the cardiac sphincter which is surrounded by the diaphragm. Mucus is secreted by oesophageal glands for lubrication.

The **stomach** (Figure 7.4) is an expandable storage sac between the **oesophagus** and the **duodenum**. It is located below the diaphragm, in the left upper quadrant/epigastrium. There are three layers of muscle that contract to mix food and facilitate distension for storage. When the stomach is empty, the mucosal lining is folded into **rugae**. This lining is covered with a protective, tight layer of epithelial cells which produce mucus and alkaline fluid to prevent damage by stomach acid. Gastric juice is secreted by exocrine gastric glands which lie in deep gastric pits. The cellular composition of the gastric glands and the type of secretions differ between locations in the stomach:

- Parietal cells secrete hydrochloric acid (HCl) and intrinsic factor (facilitates absorption of vitamin B_{12} – essential for RBC production)
- Chief (or peptic) cells secrete pepsinogen – the inactive form of pepsin
- G cells secrete gastrin
- Enteroendocrine cells secrete chemical mediators, such as histamine which stimulates secretion of HCl.

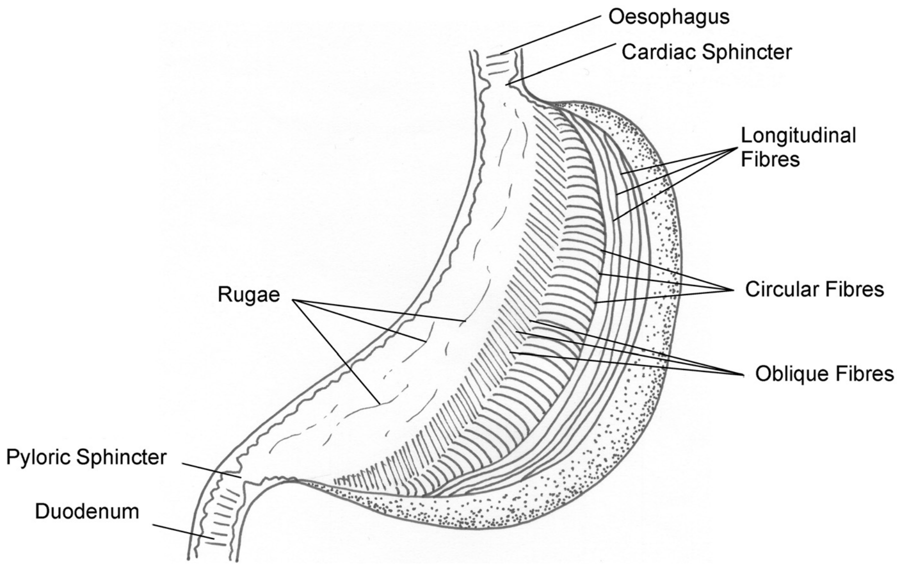

Figure 7.4 The stomach

Function

When food enters the mouth, salivation increases to hydrate and lubricate the food with mucus. Mechanical digestion commences with mastication which is partly voluntary and partly reflexive. The tongue forces food against the hard palate and mixes it with saliva, softening it and forming a **bolus**. Chemical digestion begins with the breakdown of starch by salivary amylase into smaller glucose molecules.

Once in the stomach, the food bolus is subjected to further mechanical digestion by muscular contractions which churn the bolus, breaking it up and mixing it with gastric juices to form a liquid called **chyme**. Chemical digestion is largely restricted to the initiation of protein

Anatomy and Physiology in Action: Exercise 7.4

A+P

Swallowing (Deglutition)

Three phases:

- Voluntary phase – initiated by the tongue which pushes the food bolus posteriorly into the pharynx.
- Pharyngeal phase – involuntary and commences with the activation of pressure receptors in the pharynx by the bolus. Respiration is paused and alternative routes are closed: the soft palate rises to seal the nasopharynx and the epiglottis and glottis seal the trachea. The upper oesophageal sphincter opens to allow the bolus into the oesophagus and closes again.
- Oesophageal phase – involves a peristaltic wave of contracting circular muscle. Gravity is helpful but this process also works upside down. As the peristaltic wave reaches the end of the oesophagus, the cardiac sphincter opens to allow the bolus into the stomach and then closes again, preventing regurgitation.

Dysphagia is the name for difficulty in swallowing and is common.

- What are the causes of dysphagia?
- What are the issues for a dysphagic patient?

digestion. The main substances absorbed in the stomach are aspirin and alcohol (both of which are gastric irritants).

Stomach acid denatures dietary protein to facilitate enzyme activity. HCl acid also activates the transformation of pepsinogen into pepsin. This enzyme, which works best in the acidic environment, hydrolyses (splits) denatured protein into polypeptides (shorter amino acid chains). These will undergo further digestion in the small intestine. In infants, renin is also secreted in the stomach to digest milk protein.

Gastric secretion and motility are controlled by nerves and hormones, such as gastrin and has three phases:

- The cephalic phase is initiated by the thought, sight, taste or smell of food.
- The gastric phase lasts three to four hours and commences when food enters the stomach.
- The intestinal phase begins when chyme leaves the stomach and enters the duodenum. Peristaltic contractions in the pylorus expel chyme through the normally relaxed pyloric sphincter and then close it.

Anatomy and Physiology in Action: Box 7.2

A+P

Vomiting

Vomiting, or emesis, is a reflex mechanism which protects the digestive system from toxins. Vomiting is controlled by the vomiting, or emetic, centre in the brain, and is precipitated by many peripheral and central causes, including:

- Over-distension of the stomach or intestine
- Irritation of the GI tract by drugs, chemicals, bacteria, blood, etc.
- Stimulation of the gag reflex
- Motion sickness
- Severe headaches and rising intracranial pressure
- Stimulation of the vomiting centre by drugs such as opiates and cytotoxics
- Electrolyte disturbances
- Particular sights, smells or emotions
- Painful stimulation of visceral organs such as the heart, bladder and testicles
- Increased hormone levels such as oestrogen in pregnancy
- Circulatory collapse.

Vomiting is usually preceded and accompanied by a feeling of nausea, pallor, salivation, sweating, increased heart rate and a fall in blood pressure. Just prior to vomiting deep inspiration occurs, the glottis closes to protect the trachea and the soft palate is elevated to close the nasopharynx. The diaphragm and abdominal muscles contract, the cardiac sphincter relaxes and the stomach contents are forced up through the upper oesophageal sphincter and out through the mouth. Contractions of the duodenum causes the vomiting of bile.

Developing and Delivering Expert Care: Box 7.3

Nausea and Vomiting

Caring for a patient who is experiencing nausea and vomiting is common. Excessive vomiting results in dehydration and electrolyte disturbances. There are many therapies used in the management of nausea and vomiting, and the appropriate treatment will depend on the exact cause. The NHS National Library for Health produces guidance for the management of nausea and vomiting in pregnancy (Prodigy 2007a) and palliative care (Prodigy 2007b). Commonly used drugs include:

- Cyclizine
- Metoclopramide
- Domperidone
- Prochlorperazine
- Ondansetron (JFC 2007).

Scenario 7.1

Gastrointestinal Bleeding

Steven Jenkins is a 33-year-old man who is rushed to hospital after an episode of haematemesis.

On arrival, an initial assessment shows:

Airway – clear, complaining of epigastric pain
Breathing – RR 28/min, pulse oximetry 97% on air
Circulation – radial pulse 124/min, regular but weak and thready, CRT 3 seconds, BP 92/65, pale and clammy
Disability – alert
Exposure – skin cool
PMH – takes non-steroidal anti-inflammatory drugs (NSAIDs) for an old knee injury. 15-year smoking history. Drinks 25 units of alcohol a week.

Haematemesis	Vomiting blood associated with an upper GI bleed. Fresh blood is bright red and old brown blood is termed 'coffee grounds' (not to be confused with haemoptysis which describes the coughing-up of blood).
Melaena	Black, tarry stool due to digested blood and usually associated with an upper GI bleed.
Haematochezia	Fresh blood passed per rectum usually associated with lower GI bleeding.

Table 7.1 GI Bleeding Terminology

Assessment and analysis of patient presentation

Mr Jenkins has presented with an upper GI bleed, a common medical emergency. He is displaying signs of hypovolaemic shock such as tachypnoea, tachycardia and hypotension. It is important to determine the cause of bleeding following initial resuscitation as management differs for particular causes, such as oesophageal varices (discussed later).

Pathophysiology

Peptic ulcer disease (PUD) is the commonest cause of GI bleeding and Mr Jenkins has many risk factors. Peptic ulcers occur in the stomach, but more frequently in the duodenum. Gastric (stomach) ulcers (GU) form when acid and pepsin erode the lining of the stomach where the protective mucosa is already damaged (due to NSAIDs, for example). Duodenal ulcers (DU) occur due to abnormally high levels of acid and pepsinogen in chyme leaving the

Applying Theory to Practice: Box 7.4

Causes of Acute Upper GI Bleeding (adapted from BSGEC 2002)

Diagnosis	Approx. %
Peptic ulcer	35–50
Gastroduodenal erosions	8–15
Oesophagitis	5–15
Varices	5–10

- What risk factors are associated with peptic ulcer disease?

stomach. If damage is severe enough or involves a blood vessel, GI bleeding occurs.

PUD is also the second commonest cause of dyspepsia, which patients describe as indigestion, reflux or heartburn. Dyspepsia is an imprecise term which encompasses epigastric or retrosternal pain, with or without other GI symptoms, and has a prevalence of about 40% in the UK. Dyspepsia is most often caused by the reflux of stomach acid into the oesophagus due to an incompetent cardiac sphincter or hiatus hernia which causes burning (Logan & Delaney 2002). Dyspeptic symptoms can be misleading as cardiac pain may be described as indigestion.

Applying Theory to Practice: Box 7.5

Helicobacter pylori infection

Helicobacter pylori is a bacterium commonly found in the human stomach. Most infected people are asymptomatic, but *H pylori* is acknowledged to be the principal cause of PUD and gastric cancer.

- *H pylori* colonisation causes inflammation and damage to the mucosa and also increases acid production.
- *H pylori* is diagnosed invasively, or via non-invasive investigations such as a breath, stool or blood tests.
- The decision to test for and/or treat *H pylori* is made by following protocols for the management of GI bleeding (BSGEC 2002) and dyspepsia (NICE 2004).
- Eradication usually includes a course of a proton-pump inhibitor, such as omeprazole, and two antibiotics, such as clarithromycin and amoxicillin or metronidazole – 'triple therapy'.

The plan of care

The priority for Mr Jenkins's care is immediate resuscitation in an appropriate environment. Mr Jenkins is currently alert and maintaining his own airway, but the risk of a decreasing level of consciousness and subsequent aspiration is high. Airway equipment should, therefore, be close at hand, particularly suction, and there should be a low threshold for calling an anaesthetist. High concentration oxygen should be applied via a reservoir bag mask at 10–15 L/min. A minimum of two large-bore cannulae should be sited in the antecubital fossae and fluid resuscitation commenced. Blood samples should be taken for full blood count (FBC), urea and electrolytes (U&E), liver function tests (LFT), clotting and a cross-match. Continuous cardiac and pulse oximetry monitoring should be implemented. Additionally more invasive monitoring may be necessary, such as urinary and central venous catheters.

Investigation and treatment

As Mr Jenkins has experienced a severe GI bleed he should be transferred urgently for an endoscopy once stable. An endoscope is a fibre-optic camera which is passed into the upper GI tract via the mouth, usually under sedation. This allows the clinician to directly visualise the GI tract, identify the source of bleeding and make a diagnosis. If the ulcer is still bleeding or at high risk of re-bleeding, then endoscopic therapy can be administered. This may include:

- Injection with epinephrine (adrenaline)
- Thermal haemostasis
- Mechanical clips.

In the minority of cases where one or more of these therapies are unsuccessful, surgical repair is indicated (BSGEC 2002). Following appropriate drug therapy patients with a gastric ulcer usually have a follow-up endoscopy after 6–8 weeks (NICE 2004).

Developing and Delivering Expert Care: Box 7.6

Fluid Resuscitation

Intravenous fluid therapy is targeted at replacing intravascular (IV) and/or extracellular (EC) fluid volume deficits (Chapter 2). An intravascular fluid volume (IVFV) deficit usually occurs as the result of blood loss, whereas extracellular fluid volume (ECFV) deficits are associated with other forms of fluid loss, such as dehydration. There are two main types of IV fluid available: crystalloids and colloids. Theoretically, IVFV losses should be replaced with colloids and ECFV losses should be replaced with crystalloids (Zander 2006). However, there is great debate about the use and efficacy of each fluid type, and a meta-analysis of studies in this area concluded that colloids had no advantage over crystalloids (Roberts et al. 2004). Crystalloids are cheaper than colloids and as a result they are used far more frequently for all fluid losses (Table 7.2).

The best fluid for the replacement of blood loss is blood itself. This is the only fluid which contains the oxygen-carrying component – haemoglobin. However, as blood transfusion is expensive, time-consuming and has many inherent risks, the decision to transfuse is made by experienced clinicians (Chapter 4).

Electrolyte replacement is also usually considered alongside fluid replacement, particularly with crystalloids (Table 7.2).

	Crystalloid	**Colloid**
Composition	Water and small molecules such as electrolytes and glucose	Water and large molecules such as starch (+/- electrolytes)
Movement	Diffuse freely from IV to EC spaces (some also reach intracellular space)	Starch molecules exert oncotic force which retains fluid in IV space
Destination	EC space primarily, IV space eventually: total body hydration	Remain in IV space mainly
Volume	At least three times as much as estimated blood loss	Small volumes equivalent to estimated blood loss
Timing	Slower to give due to large volumes and slower to see change in vital signs	Quick to give due to small volumes and usually swift acting
Tonicity & Types	Mostly isotonic, e.g. 'normal' saline (0.9% sodium chloride), Hartmann's solution, 5% dextrose Hypertonic and hypotonic solutions are determined by sodium/glucose content and used for particular indications	Mostly isotonic. Examples include gelatins (Gelofusine®, Haemaccel®), starches (hetastarch, Voluven®), albumin and dextrans. Colloids are also called 'plasma expanders'
Risks	Pulmonary oedema, haemodilution and hypothermia (unless warmed)	Anaphylaxis
Cost	Cheap (and long shelf-life)	More expensive
Usage	Very common	Less common

Table 7.2 Crystalloids versus colloids

Electrolyte & range	Location & function	Altered levels	Common causes	Signs & symptoms	Treatment
Sodium (Na^+) 135-145 mmol/L	Main extracellular cation. Osmotic properties govern fluid distribution and movement	Hyponatraemia (low sodium)	Sweating, vomiting, diarrhoea, water retention	Cerebral oedema – confusion, headaches, coma	Isotonic/hypertonic saline depending on cause & severity
		Hypernatraemia (high sodium)	Dehydration, salt overdose	Thirst, irritability, convulsions, coma	5% dextrose or fluid restriction
Potassium (K^+) 3.5-5.5 mmol/L	Main intracellular cation. Important role in neuromuscular function, especially cardiac muscle	Hypokalaemia (low potassium)	Increased diuresis, diarrhoea, vomiting	Arrhythmias, confusion, vomiting	Oral or IV replacement
		Hyperkalaemia (high potassium)	Renal failure, K^+ overdose, acidosis, trauma, burns	Arrhythmias, ECG changes, cardiac arrest, tingling	IV calcium, insulin & glucose infusion, haemodialysis
Magnesium (Mg^{2+}) 0.7-1.0 mmol/L	Abundant in bone. Involved in cellular energy production, neuromuscular and enzyme function	Hypomagnesaemia (low magnesium)	Malabsorption, renal losses, alcoholism, diarrhoea, vomiting	Arrhythmias, ECG changes, twitching, tremor, convulsions	IV replacement
		Hypermagnesaemia (high magnesium)	Renal failure, antacid overdose	Arrhythmias, coma, cardiac arrest	IV calcium, haemodialysis
Calcium (Ca^{2+}) 2.1-2.6 mmol/L (total)	99% in bone. Roles in neuromuscular function, clotting, and hormone secretion	Hypocalcaemia (low calcium)	Renal failure, hypoparathyroidism	Tetany, convulsions, irritability, fractures	Oral or IV replacement
		Hypercalcaemia (high calcium)	Renal failure, hyperparathyroidism	Weakness, confusion, nausea and vomiting	Restrict intake, haemodialysis
Phosphate (HPO_4^{2-}) 0.7-1.4 mmol/L	Abundant in bone. Inverse relationship with calcium. Vital for cellular energy and metabolism	Hypophosphataemia (low phosphate)	Malabsorption, hyperparathyroidism, refeeding syndrome	Weakness, confusion, nausea and vomiting, organ failure	Oral or IV phosphate with caution. Start feeds slowly
		Hyperphosphataemia (high phosphate)	Renal failure, hypoparathyroidism	Tetany, convulsions, irritability	Treat the cause, haemodialysis
Chloride (Cl^-) 95-105 mmol/L	Main extracellular anion. Works with sodium to govern fluid distribution. Role in acid-base balance	Hypochloraemia (low chloride)	Dehydration, GI loss, metabolic alkalosis	Symptoms associated with fluid loss	IV fluid replacement
		Hyperchloraemia (high chloride)	Sodium chloride over-dose, renal failure, metabolic acidosis	Weakness, Kussmaul respiration	Treat the cause

Table 7.3 Management of electrolytes (adapted from Moore, 2004)

Developing and Delivering Expert Care: Box 7.7

Drug Therapy for PUD/Dyspepsia (JFC 2007)
Antacids and alginates (Maalox®, Gaviscon®)
Antisecretory drugs
- Histamine H_2 receptor antagonists (ranitidine, cimetidine)
- Proton pump inhibitors (PPI) (lansoprazole, omeprazole)

H pylori eradication therapy

Psychosocial aspects

Mr Jenkins will need to be given lifestyle advice prior to discharge. This should include discontinuation of NSAIDs with suggestions for an alternative analgesic; education on the warning signs of another episode (dyspeptic symptoms) and appropriate action (contact GP); smoking cessation; reducing alcohol intake; weight reduction and healthy eating; and stepwise reduction of his prescribed medication.

Liver, gall bladder and pancreas

Form

The liver (Figure 7.5) is the largest gland in the body and occupies the right upper quadrant. It is divided into the left and right lobes and is composed of hexagonal units called lobules. Each lobule contains a central vein, which drains into the vena cava. Columns of hepatocytes (liver cells) and sinusoids (channels for mixed hepatic arterial and portal venous blood) radiate out from the centre. Between the hepatocytes run tiny bile canaliculi, which drain into bile ducts. At each corner of the lobule is a portal triad – a bile duct, a branch of the hepatic artery and a branch of the hepatic portal vein. The bile ducts converge to form the common hepatic duct.

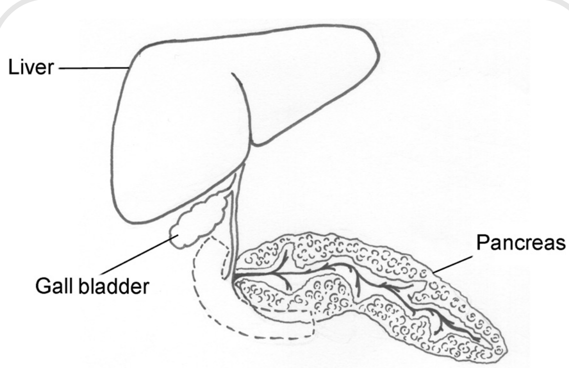

Figure 7.5 Liver, gall bladder and pancreas

The gall bladder is a pear-shaped sac, which lies on the posterior surface of the liver and protrudes below the right lobe. The gall bladder neck opens into the cystic duct, which combines with the common hepatic duct to form the common bile duct. This is joined by the main pancreatic duct before it joins the duodenum at the sphincter of Oddi.

The pancreas is located in the epigastrium/left upper quadrant and has both exocrine and endocrine functions. The exocrine tissue is composed of acinar cells, which produce the enzymatic component of pancreatic juice. These cells drain into pancreatic ducts which converge to form the main pancreatic duct. The endocrine cells, called Islets of Langerhans, are scattered among the acinar cells and secrete insulin and glucagon (Chapter 10).

Function

The liver is one of the most important organs in the body and has the unique ability to completely regenerate itself following removal of up to 75% of its size. It has numerous functions, many of which are associated with its vital role in processing nutrient-rich blood from the GI tract. Its main digestive function, however, is the production of 1 litre of yellow/green **bile** every day. Bile contains electrolytes, bile salts, cholesterol, phospholipids, toxic waste products and bile pigments, such as bilirubin. It is an alkaline solution, which allows bile to neutralise stomach acid entering the duodenum.

Bile salts are the most important digestive component of bile. In the small intestine they emulsify (break up) fats to provide small molecules for enzymatic action, and facilitate absorption. Bile salts are reabsorbed by the small intestine and recycled by the liver. They are also the main stimulus for bile secretion.

Bilirubin is a waste product of haemoglobin recycling performed by the liver. It is metabolised in the small intestine by bacteria to form stercobilinogen, which gives faeces its brown colour. Absence of bile produces pale, fatty stools which are difficult to flush – **steatorrhoea**. Failure to excrete bilirubin causes a build-up in the blood and subsequent **jaundice**.

The gall bladder stores excess bile produced by the liver and concentrates it by removing excess water and electrolytes. The release of bile is stimulated by the arrival

Anatomy and Physiology in Action: Box 7.8

Functions of the Liver

- Production and secretion of bile
- Carbohydrate metabolism:
  - Converts monosaccarides to glucose
  - **Glycogenesis** – converts glucose to glycogen for storage
  - **Glycogenolysis** – converts glycogen back to glucose for release into blood following secretion of glucagon by the pancreas
  - **Gluconeogenesis** – manufactures new glucose from amino acids and glycerol when blood levels are low and glycogen stores are exhausted
  - **Lipogenesis** – converts excess glucose to fat for storage
- Fat metabolism:
  - Synthesis of fats (lipoproteins) for transport, storage and secretion
  - Breakdown of fatty acids to ketone bodies
- Protein metabolism:
  - Deamination of amino acids for conversion to glucose or ATP
  - Production of urea for the removal of ammonia from the body
  - Production of plasma proteins (albumin, clotting factors)
- Storage of vitamins (A, D, E, K, B_{12}), iron, glycogen, protein and fat
- Recycling of **erythrocytes**
- Detoxification of alcohol, drugs, hormones and chemicals for excretion
- Contributes to immunity by cleaning portal blood of antigens
- Body heat production

of acidic, fatty chyme entering the duodenum. This causes the muscular gall bladder to contract, the secretion of pancreatic juice and the relaxation of the sphincter of Oddi. As a result, bile and pancreatic juice enter the duodenum.

The pancreas produces up to 1.5L of pancreatic juice per day. Like bile, it is an alkaline solution, which helps neutralise acidic chyme entering the duodenum, and provides an optimum pH for enzymatic activity. Pancreatic enzymes include amylase, lipase and trypsinogen. Most are secreted in an inactive form and only become activated in the duodenum by a series of reactions.

Applying Theory to Practice: Box 7.9

Gallstones

Gallstones are very common, particularly in women, and the incidence increases with age. They are often composed of cholesterol; hence they are also associated with a high-fat diet. Gallstones cause a range of diseases:

- **Cholecystitis** (inflammation of the gall bladder) occurs when stones block the outflow of bile. The bile becomes concentrated and infected leading to a swollen and oedematous gall bladder. The patient presents with severe right upper quadrant pain, fever and occasionally jaundice. Cholecystitis can be acute or chronic and is treated by surgical removal of the gall bladder – **cholecystectomy**.
- **Pancreatitis** occurs when pancreatic enzymes become prematurely activated. Autodigestion of pancreatic tissue causes local inflammation and oedema. The activated enzymes leak into the systemic circulation causing fluid shifts, hypovolaemia and damage to other organs. The patient presents with severe epigastric pain radiating to the back and shock. Treatment is mainly supportive, but may include surgery. Acute pancreatitis can be mild and self-limiting or severe and life-threatening. There are many causes, but gallstones are the most common, followed by alcohol. Alcohol is also usually the cause of chronic pancreatitis (UKWPAP 2005).

Applying Theory to Practice: Box 7.10

Liver Function Tests

Liver functions tests (LFT) are performed to detect liver damage. The profile combines markers of function with markers of damage (liver enzymes):

- Function
  - Albumin (Alb)
  - Bilirubin (Bili)
- Liver enzymes
  - Alanine transaminase (ALT)
  - Aspartate transaminase (AST)
  - Alkaline phosphatase (ALP)
  - Gamma glutamyl transpeptidase (GGT)

Other blood tests which reflect liver function include:

- Blood glucose level
- Clotting studies

Alcohol – the facts

Millions of people enjoy drinking alcohol in moderation. However, there is an increasing minority who misuse alcohol, causing health problems for themselves and/or contributing to social problems, such as anti-social behaviour. In the UK, alcohol misuse is estimated to be responsible for:

- Costing the British tax-payer £20bn per year
- 22,000 deaths per year
- 70% of A&E admissions at peak times
- Half of all violent incidents
- One-third of all domestic violence.

These issues are attributed to two main patterns of drinking:

- Binge-drinkers – more likely to be men under 25 years old; higher risk of alcohol-related accidents, violent incidents and committing sexual assault
- Chronic drinkers – more likely to be men over the age of 30; higher risk of alcoholic liver disease, cancer, stroke and suicide.

The rate of women misusing alcohol has increased dramatically over the last 10 years, particularly binge-drinking (COSU 2004). There is evidence that moderate alcohol consumption actually has a 'protective effect' against some diseases, particularly coronary heart disease. This is estimated at 1–2 units of alcohol 2–3 times per week. However, this apparent 'protection' is lost with alcohol consumption above this level (Paton 2005).

Pathophysiology

Alcohol (ethanol) is a drug which is absorbed in the stomach and small intestine. The rate of absorption is affected by:

- Concentration of alcohol
- Aeration with carbon dioxide
- Presence of food in the stomach
- Previous exposure to alcohol
- Body size and build
- Gender.

Alcohol is distributed throughout most tissues of the body, but particularly the liver, which eliminates over 90% as water and carbon dioxide (Paton 2005b). Alcohol causes inflammation and cancer of various parts of the GI tract, for example, gastritis and PUD. Excess alcohol consumption puts stress on liver function and at least some damage is inevitable, although the changes produce few symptoms until ALD is advanced. There are three stages of ALD (BLT 2005):

Scenario 7.2 *Alcoholic Liver Disease*

Adrian Price is a 47-year-old man who is admitted for observation after sustaining a head injury while drunk. On assessment in A&E he is unkempt, abusive to staff and refuses examination. He has a superficial graze and haematoma above his right eye, but no other apparent injuries. His GCS is 12/15 overnight (E3 V4 M5).

You are allocated to look after Mr Price next morning. He is now fully orientated (GCS 15/15) and apologetic. His vital signs are: RR 16/min, pulse 110/min, BP 148/90 mmHg, temp. 36.5 °C, BM 5.0 mmol/L. He is sweaty and shaky and complains of a headache and nausea.

On the ward round the doctor takes a thorough history and Mr Price admits to being a heavy drinker for many years. This has been particularly bad over the past few months since he lost his job. On examination he has an enlarged liver, but no ascites or jaundice. Blood tests show some of his LFTs are raised. Mr Price says he wants help to stop drinking.

Developing and Delivering Expert Care: Box 7.11

Head Injury and Alcohol: A Clinical Problem

Of the one million patients who present to A&E with a head injury every year in the UK, alcohol consumption is present in 25% of all cases (Huntley and Touquet 2005). As in the case of Mr Price, these patients are notoriously difficult to assess. Aside from the potential for anti-social behaviour, the effects of alcohol and the symptoms of a head injury are very difficult to distinguish. The golden rule is to never dismiss a patient as being 'just drunk'. Regular, thorough neurological observations are paramount.

Assessment and analysis of patient presentation

Mr Price has presented to secondary care due to a common health risk associated with alcohol use – trauma. He appears to have suffered only a minor head injury although continued neurological observation is prudent. There is some evidence of the sociological effects of alcohol misuse, such as self-neglect and unemployment. Fortunately, Mr Price is honest about his situation and has the desire to begin addressing it. Unfortunately, the effects of alcohol have already started to take their toll and Mr Price is displaying the early stages of alcoholic liver disease (ALD). Mr Price also has some symptoms of alcohol withdrawal, such as shaking and nausea, which need to be addressed. Hypoglycaemia is common and should be monitored.

- **Fatty liver** – more fat accumulates in the liver than normal. This stage may be detected by palpation of the enlarged liver. Fatty liver is common in excessive drinkers and is completely reversible with abstinence.
- **Alcoholic hepatitis** (inflammation of the liver) occurs in 20–30% of patients with fatty liver who continue to drink, and may be mild, or severe and life-threatening. LFTs are raised and the patient may be jaundiced with right upper quadrant pain and nausea. Mild alcoholic hepatitis resolves with abstinence, but severe cases need intensive care and have a 50% mortality rate from liver failure.
- **Cirrhosis** occurs in about 10% of heavy drinkers. Irreversible fibrosis (scarring) and the development of nodules severely affect liver function. LFTs are abnormal and the hard, irregular liver may be palpable. Symptoms vary but may include:
  - Lethargy
  - Anorexia
  - Nausea and vomiting
  - Weight loss
  - Jaundice
  - Itching
  - Fever and infections
  - Bruising and bleeding
  - Confusion.

Identification of the stage of ALD is confirmed by liver biopsy. One of the most significant sequels of cirrhosis is **portal hypertension** caused by resistance to blood flow

Questioning Clinical Practice: Exercise 7.5

Sensible Drinking?

- Alcohol content – one unit is equal to:
  - Half a pint of beer
  - One glass of wine
  - One measure of spirits
- Recommended daily intake should not exceed:
  - Men – four units
  - Women – three units (including two alcohol-free days a week)

Do you ever exceed these recommended limits?

If the answer is yes, how do you feel about challenging a patient's drinking behaviour? Is this hypocritical?

Developing and Delivering Expert Care: Box 7.12

Detecting Misuse: the CAGE Test (two or more correct):

- Have you ever felt you ought to cut down on your drinking?
- Have people annoyed you by criticising your drinking?
- Have you ever felt bad or guilty about your drinking?
- Have you ever had a drink first thing in the morning to steady your nerves or get rid of a hangover: eye opener?

For a more sensitive test refer to the World Health Organization's (2001) alcohol use disorders identification test (AUDIT).

through the liver due to scarring. Portal hypertension causes three serious complications of ALD:

- **Oesophageal varices** – increased portal pressure causes development of collateral circulation where blood supply bypasses the liver and is shunted mainly to veins of the lower oesophagus and stomach. Because these veins were not intended to carry such large volumes of blood they dilate and become fragile. These vessels are prone to rupturing with catastrophic consequences and carry a 50% mortality rate. The patient presents with copious haematemesis and melaena. Bleeding is further promoted by altered clotting, which often accompanies severe ALD. Initial resuscitation is the same for any GI bleed, as often the diagnosis is not confirmed until endoscopy. However, the volume of blood, lost will mandate aggressive fluid resuscitation (avoid saline), early transfusion and correction of clotting. Definitive management includes specific pharmacological therapy (e.g. glypressin), banding, sclerotherapy, balloon tamponade and surgery (Jalan & Hayes 2000).
- **Ascites** is an accumulation of fluid in the peritoneal cavity, and is attributed to cirrhosis in 75% of cases. Its presence suggests advanced ALD and is associated with high mortality. Ascites develops due to increased portal pressure, systemic vasodilation, reduced renal blood flow and subsequent sodium retention. Ascites causes tense abdominal distension which is very uncomfortable. Complications include compression of the abdominal organs and blood vessels, and respiratory distress due to diaphragmatic splinting. The cause is determined by history, examination, blood tests and ultrasound scanning. Treatment includes low-salt diet, potassium-sparing diuretics (spironolactone) and abstinence from alcohol. Abdominal paracentesis (ascitic tap) is performed to analyse and remove fluid. Care involves weighing the patient daily, strict fluid balance and monitoring electrolyte levels (Moore & Aithal 2006).
- **Hepatic encephalopathy** is a reversible state of impaired cognitive function due to advanced liver disease. The liver is unable to detoxify the blood because of hepatocyte damage and/or blood bypassing the liver due to portal hypertension. As a result nitrogenous waste, such as ammonia, travels to the brain causing encephalopathy. Symptoms include:
  - Drowsiness
  - Confusion
  - Lack of coordination
  - Hyperactive reflexes
  - Flapping tremor
  - Coma.

In the cirrhotic patient hepatic encephalopathy is precipitated by insults such as severe GI bleeding or infection. If hepatic coma has developed, supportive care should be provided in an appropriate specialist setting. Treatment is aimed at correcting precipitating factors, cleansing the GI tract of nitrogenous substances with lactulose, and restricting dietary protein (Krige & Beckingham 2001). Other causes need to be excluded through thorough investigation, but once ALD is implicated, early consideration should be given to liver transplantation. This is found to be successful in carefully selected patients, although six months of supervised abstinence is desirable (Devlin & O'Grady 1999).

Questioning Clinical Practice: Exercise 7.6

There is a long waiting list for liver transplants in the UK and many patients die from liver failure while waiting.

How do you feel about alcohol misusers being given the chance of liver transplantation?

Do we have the right to judge their behaviour?

Applying Theory to Practice: Box 7.13

Other Common Causes of Liver Disease

- Viral hepatitis (A, B, C, D or E)
- Drugs, for example, paracetamol overdose
- Trauma
- Cancer
- Abscesses

The plan of care

Mr Price's care will focus on facilitating alcohol detoxification while monitoring for the complications discussed above. Alcohol withdrawal produces symptoms such as agitation like those displayed by Mr Price, but can progress to delirium tremens ('DTs') which can be life-threatening. The mainstay of pharmacological therapy is a reducing dose of benzodiazepines, such as chlordiazepoxide. Monitoring for symptoms such as hallucinations, confusion and particularly seizures is essential, and emergency equipment should be available.

Alcohol misusers are often malnourished as food is replaced by alcohol, which can lead to serious problems. Vitamin B_1 (thiamine) deficiency is common and results in Wernicke's encephalopathy (WE). Deficiencies should be replaced prophylactically with IV Pabrinex, as the symptoms of WE are difficult to distinguish from either drunkenness or withdrawal. Patients should be discharged with a course or oral vitamin supplements (RCP 2001). Early dietician referral is recommended, especially if any dietary restrictions are necessary.

Psychosocial issues

Mr Price will require support to help him address his problems. Health professionals have been found to have negative attitudes towards patients who misuse alcohol (RCP 2001), limiting the development of an effective nurse–patient relationship. A non-judgemental approach is paramount as is involvement of his significant others. Health promotion is also often dismissed by health professionals as futile for alcohol misusers, but there is evidence that even interventions lasting as little as 10 minutes can be successful in promoting abstinence. It should be emphasised to Mr Price that as he is only in the early stages of ALD, total abstinence could completely reverse the damage thus far. He should be referred to appropriate primary care services and peer support, such as Alcoholics Anonymous (Ritson 2005).

Small intestine

Form

The small intestine is a 6m tube, which extends from the pyloric sphincter of the stomach to the ileocaecal valve of the large intestine, and is divided into three sections:

- Duodenum – 25cm long and containing the sphincter of Oddi where the common bile duct joins the small intestine
- Jejunum – 2.5m long
- Ileum – 3.5m long.

The small intestine provides a massive surface area for absorption due to deep folds in the mucosa and finger-like villi covered in microvilli (Figure 7.6). Each villus contains a lymph capillary called a lacteal and a blood capillary bed. The surface is comprised of absorptive epithelial cells whose membranes contain microvilli – the brush border. These bear the digestive brush border enzymes. The mucosa also contains goblet cells, which secrete mucus, endocrine cells, and lymph nodes called Peyer's patches.

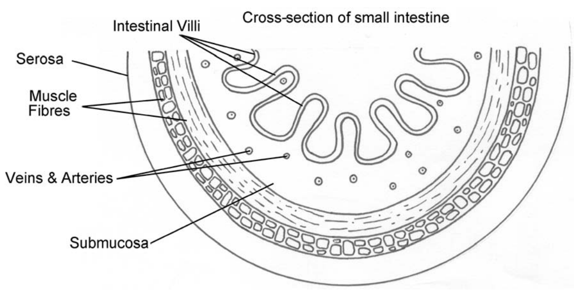

Figure 7.6a Structure of small intestine wall

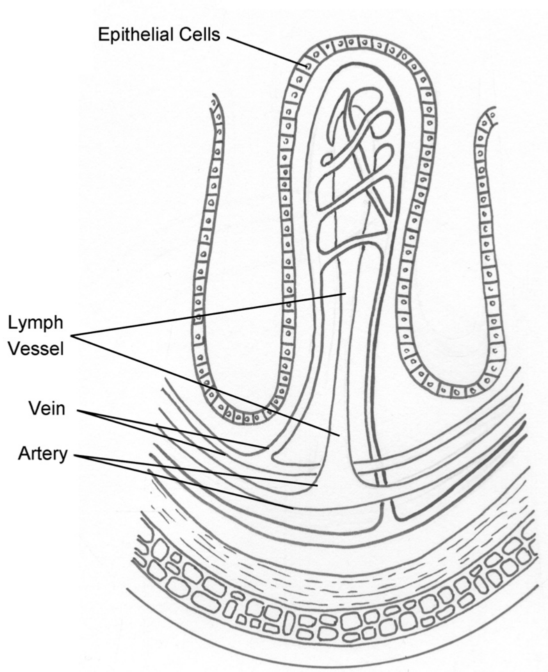

Figure 7.6b Structure of small intestine wall (close-up)

Between 1–2L of intestinal juice is secreted from Paneth cells in the crypts of Lieberkühn between the villi. This is a watery, alkaline solution containing mucus, electrolytes and antibacterial enzymes.

Function

The small intestine is the main location for digestion and absorption. The arrival of acidic chyme in the duodenum stimulates the secretion of bile, pancreatic and intestinal juice. Rhythmic peristaltic contractions (segmentation) mix the contents and move it towards the ileocaecal valve. Chyme takes 3–6 hours to pass through the small intestine. Once each food group has been broken down into small enough molecules, they are absorbed through the small intestine lining by diffusion, passive or active transport into either the blood or lymph capillaries. Chemical digestion, absorption, utilisation and sources of each food group are summarised below:

- **Carbohydrate** digestion, started in the mouth by salivary amylase, is completed in the small intestine by pancreatic amylase and brush border enzymes. The resulting monosaccharides pass into blood capillaries via active transport and facilitated diffusion. The primary use of carbohydrates (glucose) is cellular energy production. Carbohydrates mainly come from plants, for example, fruit, vegetables, grains, sugar cane, honey and also milk. Indigestible plant carbohydrates (cellulose) provide fibre and facilitate formation of faeces.
- **Protein** digestion, started in the stomach by pepsin, is completed by proteolytic enzymes in pancreatic juice and the brush border. Resulting amino acids enter blood capillaries by active transport and diffusion. Proteins are essential for making structural tissues, such as connective tissue and muscle, and also enzymes and hormones. Excess amino acids are used for energy production. Dietary proteins come from meat, dairy products, legumes, nuts and cereals. The small intestine also digests a significant amount of secreted enzyme proteins and sloughed mucosal cells from the GI tract lining.
- **Lipids** (fats) are emulsified by bile salts in the small intestine. Resulting triglyceride molecules are broken down by pancreatic lipase into fatty acids and monoglycerides. These associate with bile salts and phospholipids to form micelles which diffuse into the mucosal epithelial cells, and are then transported into lacteals as chylomicrons. Fat is eventually transferred from the lymph to the blood stream away from the gut. It is used for cellular energy or stored as adipose tissue. Saturated fats and cholesterol come from meat and dairy products, unsaturated fats come from seeds, nuts, olive and vegetable oils. Excess intake of certain fats causes obesity and heart disease.

Applying Theory to Practice: Exercise 7.7

A Healthy Diet

The UK government regularly publishes recommendations on lifestyle choices such as healthy eating. Visit the Department of Health website (www.dh.gov.uk) and download the latest guidelines.

The small intestine is also the site for vitamin and electrolyte absorption. Fat-soluble vitamins (A, E, D and K) are transported in micelles, and water-soluble vitamins (B and C) are absorbed by diffusion, active or passive transport. Vitamins are mainly ingested in food and are essential coenzymes for utilising the main food groups. Electrolytes are absorbed along the length of the small intestine via a variety of mechanisms. They come from ingested food and GI secretions; their functions are summarised in Table 7.3. Finally, the majority of water absorption also takes place in the small intestine. Nine litres of water, predominantly as GI secretions, enters the small intestine each day. Water mainly follows sodium absorption via **osmosis**.

Scenario 7.3

Malnutrition

Ethel Higgins is a 78-year-old retired cleaner who has been readmitted by her GP for non-specific symptoms of weakness, lethargy and depression. She was discharged a month ago following a fall at home which resulted in a fractured neck of femur. She is still only able to walk short distances around her house with a Zimmer frame. Mrs Higgins lives alone, has no family, close friends or home help. On assessment Mrs Higgins is awake but withdrawn and her vital signs are within normal limits for her age. She reports no past medical history and is not taking any medication. While helping her undress you notice that she is very thin and the surgical wound on her hip is not fully healed.

Assessment and analysis of patient presentation

Mrs Higgins received seemingly appropriate treatment for her previous presenting complaint – repair of a hip fracture, but her subsequent fundamental needs have been neglected. On discharge Mrs Higgins has been unable to mobilise enough to acquire or prepare her food and as a result has become malnourished. Evidence is found in her low energy levels, underweight appearance and delayed wound healing. This is an example of where malnutrition is both a cause and consequence of ill-health.

Malnutrition – the facts

Malnutrition is a global problem affecting one in three people worldwide (BAPEN 2003). While it is often predominately associated with developing countries, it is still relatively common in the UK. Approximately 5% of the British population are considered underweight. However, the proportions are much higher in the elderly, those with chronic diseases, those in care homes, those admitted to or discharged from hospital, and the poor or socially isolated (BAPEN 2003). Malnourished patients present a significant strain on health services, with longer hospital stays and approximately 50% greater costs (Stroud et al. 2003). The consequences of malnutrition include:

- Poor immunity
- Delayed wound healing and response to illness
- Reduced muscle strength and fatigue
- Impaired respiratory and cardiovascular function
- Increased risk of hypothermia
- Apathy and depression (Lennard-Jones 1992).

Applying Theory to Practice: Exercise 7.8

Malnutrition

The causes of malnutrition in the community and hospital are complex and multi-faceted. Compile a list of barriers to gaining adequate nutrition, considering physical, mental, socio-economic and service-related issues.

- What kinds of assistance are there within the community for individuals who require assistance with some of the activities of living?
- Who funds these services?

Pathophysiology

Malnutrition (or under-nutrition) occurs when the body's energy intake is less than the energy expenditure. During the processing of a meal, the body is in the absorptive state. Blood levels of nutrients such as glucose and lipids are high, and a proportion is delivered to body tissues for immediate metabolic needs. The rest is stored in the liver and muscles (as glycogen) and adipose tissue (fat). Between meals the body changes over to the post-absorptive state. Glucose levels are maintained by glycogenolysis and gluconeogenesis, and cells begin to utilise other sources of energy, such as fatty acids. As a result, in prolonged under-nutrition the body's stores of fat and muscle become slowly depleted (Smith and Morton 2001). Additionally, the reduced consumption of protein and micronutrients, such as vitamins and minerals, impair cell replication and the production of immune molecules (Strobel and Ferguson 2005).

The plan of care

Mrs Higgins's care will focus upon excluding other causes for her symptoms through history and examination. This should include blood tests to assess for electrolyte disturbances, and anaemia, etc. The extent of malnutrition should be measured objectively by nutritional assessment using a validated tool. She will then require appropriate nutritional support under the guidance of a dietician. Of paramount importance is the assessment of Mrs Higgins's social situation and the introduction of appropriate services to ensure the situation doesn't recur on discharge.

Nutritional assessment

All patients should be screened for malnutrition by an appropriately trained healthcare professional. This should occur on admission to hospital or a care home, on initial registration with a GP, on a first outpatient appointment or when there is clinical concern. Screening should be repeated weekly for inpatients (NCCAC 2006). General questions should be posed to patients and carers (Lennard-Jones 1992):

- Has food intake been reduced?
- If yes, why?
- Has weight loss been noticed?
- If yes, over what time period?
- Has there been a reduction in activity due to fatigue?

There are many nutritional assessment tools available. One example (Figure 7.7) is the 'Malnutrition Universal Screening Tool' (MUST) (BAPEN 2003). Height and weight measurements are used to calculate the body mass index (BMI). The MUST also takes account of recent unplanned weight loss and the effect of acute illness. The score establishes the overall risk of malnutrition and guides the user in planning appropriate care. Other tools also use further anthropometric measurements such as skin fold thickness. Ongoing assessment includes the use of food charts to document intake.

Developing and Delivering Expert Care: Exercise 7.9

Nutrition

BMI is calculated using:

$$\frac{\text{Weight (kg)}}{\text{Height (m)}^2}$$

- Calculate your own BMI and compare it to the chart in Figure 7.8
- Utilise the MUST in practice and compare the results with local tools
- Download Essence of Care (NHSMA 2003) and find out what the benchmarks are for food and nutrition: http://www.dh.gov.uk/en/Publicationsandstatistics/Publications/Publications PolicyAndGuidance/DH_4005475

Nutritional support

Nutritional support should be considered in all patients who are malnourished. The continuum includes:

- Oral nutritional interventions
  - Advice on food choices
  - Provision of nutritious and appetising food
  - Provision of an environment conducive to eating
  - Help with eating
- Oral nutritional supplements
- Artificial nutritional support
  - Enteral feeding (NG, PEG)
  - Parenteral feeding (IV) (BAPEN 2003)

Nutritional requirements should take account of:

- Energy, protein, fluid, electrolyte, mineral, micronutrient and fibre needs
- Activity levels and underlying clinical conditions

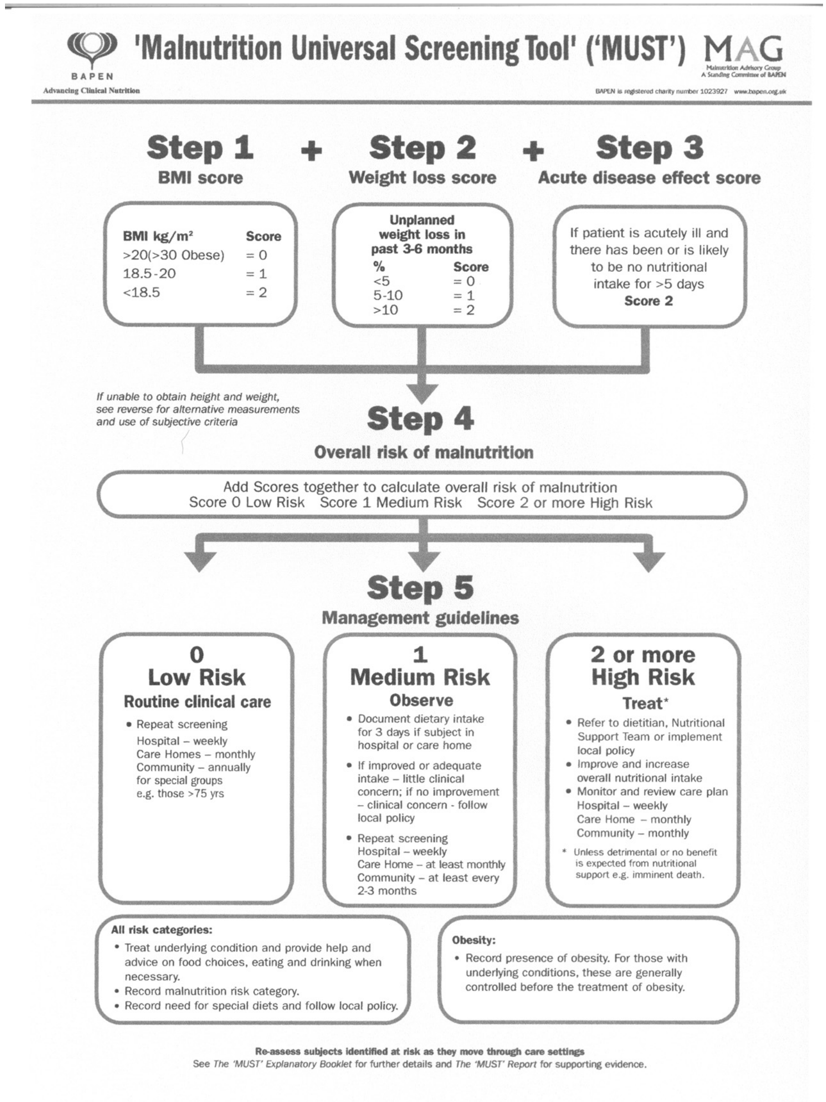

Figure 7.7 Malnutrition Universal Screening Tool (MUST) http://www.bapen.org.uk/must_tool.html

- Gastrointestinal tolerance and risk of re-feeding syndrome
- Likely duration of nutritional support (NCCAC 2006).

Large intestine

Form

The large intestine (colon) extends from the ileocaecal valve to the anus. It is 1.5m in length, but has a larger diameter than the small intestine. Its mucosa contains many mucus-secreting goblet cells, but no villi, and is colonised by a wide variety of bacterial flora. Subdivisions include the caecum, ascending colon, transverse colon, descending colon, sigmoid colon, rectum and anal canal. The caecum is a sac in the right iliac fossa below the ileocaecal valve, onto which the appendix is attached. This is an 8cm blind tube with no known function, but which readily collects debris and becomes inflamed. **Appendicitis** is one of the commonest reasons for abdominal surgery. The anal canal contains the internal and external sphincters.

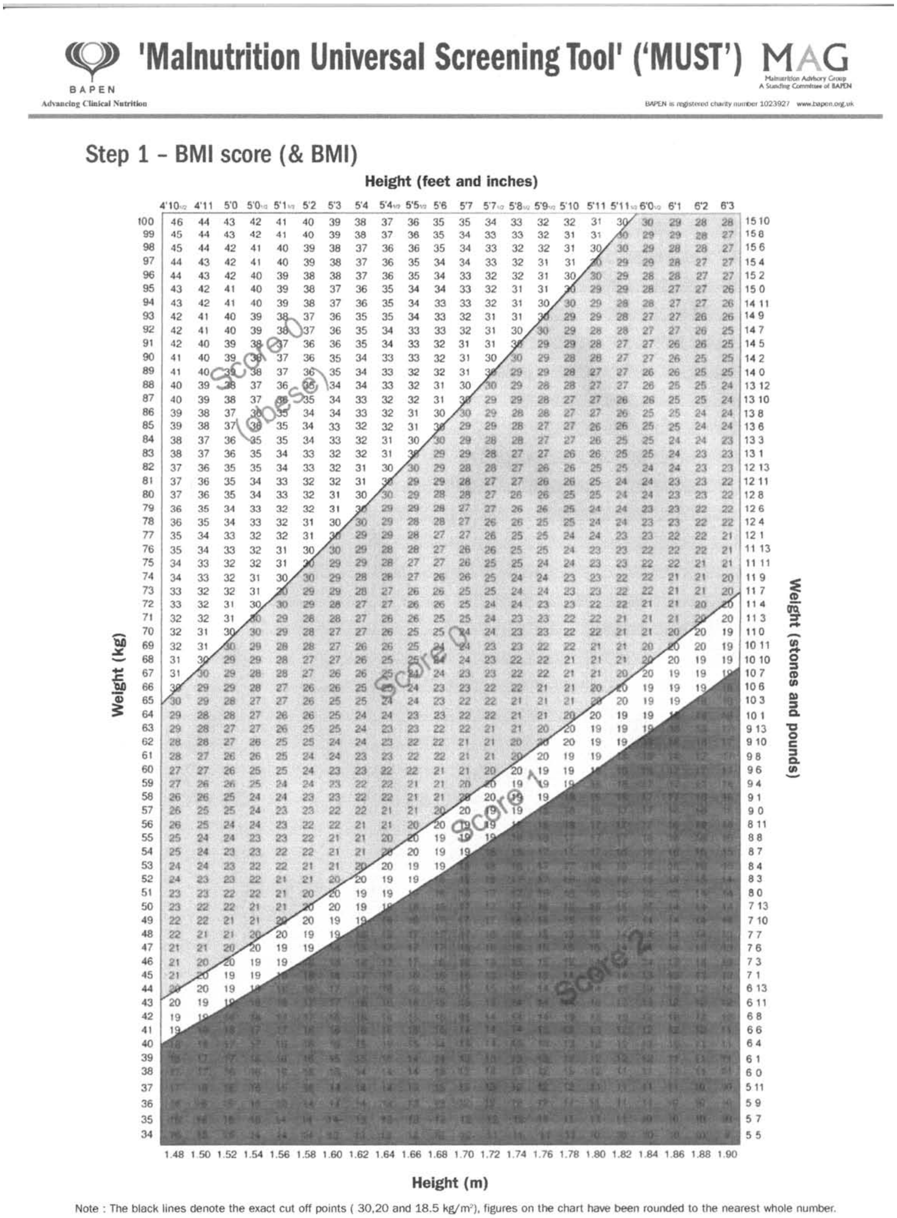

Figure 7.8 BMI chart (www.bapen.org.uk/pdfs/must/must_full.pdf)

Function

Main functions of the colon are absorption of remaining water, storage and elimination of faeces. Arrival of chyme in the caecum causes the ileocaecal valve to close preventing reflux of bacterial flora into the ileum. Peristaltic movements are slow and infrequent, and as a result contents take 12–24 hours to pass through the colon. The only digestion occurring is minimal further breakdown by bacterial flora. Water and electrolytes pass through the colon wall via the same processes described above. The resultant faeces is comprised of a small amount of water, undigested food residues, mucus, bacteria and sloughed mucosal cells. Arrival of faeces in the rectum initiates the defecation reflex, which provides the urge to defecate. This causes the sigmoid colon and rectum to contract, and the internal anal sphincter to relax forcing faeces towards the external anal sphincter. Opening of this is under voluntary control, and defecation is aided by

Developing and Delivering Expert Care: Box 7.14

Enteral Tube Feeding (Stroud et al. 2003)

Enteral tube feeding should be considered if oral intake is likely to be absent for more than five days. This may be due to surgery, unconsciousness, or dysphagia, for example. Specially formulated feeds are infused into the stomach or small intestine, usually via a **nasogastric** (NG) tube or percutaneous endoscopic gastrostomy (PEG) tube. Insertion of an NG tube is an important skill for nurses to develop. There are many inherent risks associated with their usage, such as aspiration.

Re-feeding syndrome is a risk in patients who have recently starved. Introduction of nutritional support can cause sudden fluid and electrolyte disturbances and can be life-threatening. For this reason feeds are initially started at very low levels and the patient is closely monitored.

Questioning Clinical Practice: Exercise 7.10

Food is medicine and the same ethical principles that apply to the giving, withholding and withdrawing of medicine also apply to food.

Apply what you know about ethics to nutritional support. Consider duty of care, informed consent, the competent adult and the Mental Health Act.

contraction of the abdominal muscles against a closed glottis. Gases are also present in the colon and are released in varying amounts as flatus. Most gas is from swallowed air, but it is also derived from bacterial fermentation.

Scenario 7.4

Diverticulitis

Janet Day is a 66-year-old charity worker who is admitted with severe left iliac fossa pain. She has not felt like eating and now feels nauseous. She also complains of fevers and loose stools.

On arrival her vital signs are:

Airway – clear, talking
Breathing – RR 24/min
Circulation – pulse 108/min, BP 132/84
Disability – alert
Exposure – temperature 38.2°C
PMH – constipation.

Assessment and analysis of patient presentation

Ms Day has presented with a common complaint – abdominal pain. The causes of abdominal pain are numerous, but when severe the phenomenon is termed the 'acute abdomen', and is often accompanied by a range of other symptoms. Ms Day's presentation is typical for acute diverticulitis, although she will require thorough assessment to confirm this and negate other potential diagnoses.

Applying Theory to Practice: Box 7.15

Causes of Acute Abdomen

- Appendicitis
- Cholecystitis
- Bowel obstruction
- Pancreatitis
- Peritonitis
- Renal colic
- Abdominal aortic obstruction
- Ectopic pregnancy

Diverticulitis – the facts

Diverticular disease is very common, and although some people can develop acute diverticulitis, most remain asymptomatic. Diverticula are herniations of mucosa through the wall of the colon. They are commonest in the sigmoid colon, and occur alone or in their hundreds. They are thought to be caused by increased pressure, weakening of the bowel wall and low dietary fibre. As a result, prevalence increases with age and it is considered to be a

Developing and Delivering Expert Care: Box 7.16

Assessment of an Acute Abdomen (Newcombe 2007)

PQRST mnemonic:
Precipitating factors – 'What were you doing when the pain started?'
Quality – 'What does the pain feel like?'

- **Visceral pain** originates from stretching or inflammation of an organ. It is poorly localised, intermittent and described as dull or crampy
- **Parietal (somatic) pain** is caused by inflammation of parietal peritoneum. It is easily localised, constant and described as sharp or stabbing. It is also exacerbated by movement.

Region and **R**adiation – 'Where is the pain?' 'Does it radiate elsewhere?'

- **Radiating (referred) pain** occurs because organs share nervous pathways with another area and pain is felt at a distance from the source – can you think of any common examples?

Severity and other **S**ymptoms – 'How bad is the pain?' (use a tool)
Other symptoms include:

- Nausea and vomiting (including haematemesis)
- Anorexia/weight loss
- Dyspepsia
- Constipation/diarrhoea/melaena/wind
- Distension
- Dysuria
- Fever

Timing and **T**reatment – 'When did the pain begin?' 'Does it come and go?' 'Have you taken anything for it?' 'Did it help?'
PMH – previous operations, GI or gynaecological problems?
Is the patient taking any drugs which affect the GI system?
Does the patient drink alcohol or smoke? Is there a recent history of foreign travel? Is there any family history, such as cancer?
Vital signs may show shock or an inflammatory process
An experienced clinician will perform a physical examination, including:

- Inspection
- Auscultation
- Palpation
- Percussion
- Digital rectal examination (DRE)

Further investigations may be indicated, such as blood tests, BM, ECG, urinalysis and radiography.

Western disease. Patients often have a history of constipation. Asymptomatic diverticula are usually found incidentally during screening.

Pathophysiology

Diverticulitis is acute inflammation of one or more diverticula and occurs in 10–25% of cases. Similar to appendicitis the small pouch is vulnerable to blockage with faeces. Due to local irritation, proliferation of bacteria, and ischaemia, the area becomes inflamed. Ms Day's pain is felt in the left iliac fossa due to the location of diverticula in the sigmoid colon. Associated symptoms include fever, tachycardia, nausea, anorexia and diarrhoea. Complications include abscess and fistula formation, obstruction, perforation, peritonitis and haemorrhage. Diagnosis is usually by history and examination, but further investigations may include chest and abdominal X-ray, contrast enema, CT or ultrasound scan.

Due to the location, differential diagnoses include Crohn's disease, cancer or gynaecological causes (Stollman and Raskin 2004).

The plan of care

Ms Day's care will focus on supportive treatment and observation. Most patients respond to conservative treatment within a few days. Ms Day may be allowed to drink clear fluids, but if she is nil by mouth (NBM) she will need IV fluids to maintain hydration. Broad-spectrum IV antibiotics will be given, followed by a course of oral antibiotics. She will need regular appropriate analgesia guided by an objective pain assessment tool. Cooling measures are controversial and the fever should reduce as she improves. Likewise her diarrhoea should resolve as the inflammation subsides, but she will require education on the prevention of constipation. Surgery will be required by 15–30% of patients for persistent symptoms, peritonitis or local abscesses, and may involve temporary formation of a **stoma** (Jones 1999).

Applying Theory to Practice: Exercise 7.11

Temporary or permanent formation of a stoma, such as a colostomy, may be necessary in many conditions. They present patients with significant physical and psychological issues to overcome. Nurses play an important part in assisting patients to care for their stoma and to overcome the initial psychological trauma.

- Find out about the features and management of stomas.
- How are patients assisted in overcoming this life-altering surgery?

Bowel care

In practice you will encounter bowel care in many settings, and it is a key feature of Essence of Care (NHSMA 2003).

Developing and Delivering Expert Care: Box 7.17

Bowel Assessment

There is a diverse range of 'normal' bowel habits – try to determine if there is a change from their normal. Most people open their bowels once a day, but some go several times a day and others may go for several days between bowel movements. Useful questions to ask include (Irwin 2003):

- How often do you normally open your bowels?
- When were your bowels last opened (BLO)?
- Have you had any difficulty opening your bowels?
- Are you passing wind?
- Have you had any diarrhoea?
- What is the stool consistency? (Figure 7.9)
- Have you had any incontinence?
- Is there any blood or mucus in the stool?

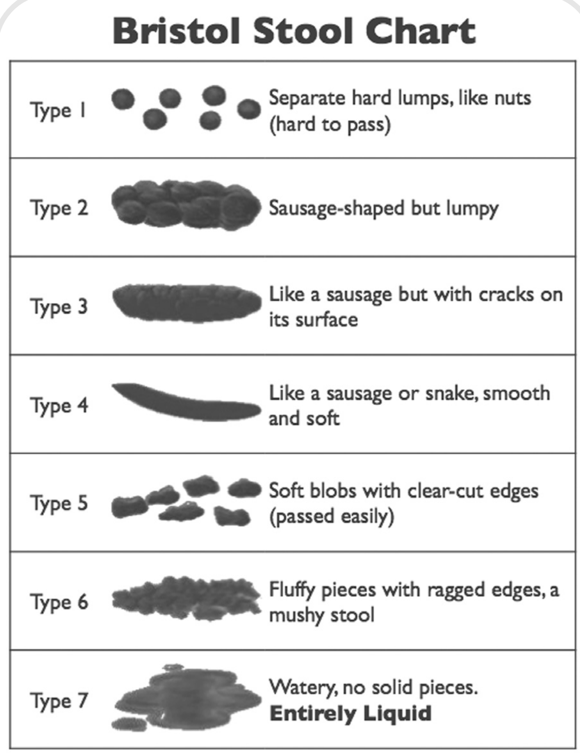

Figure 7.9 Bristol Stool Chart

Constipation is very common, particularly in the elderly, and is characterised by infrequent bowel movements, hard stools and straining at defecation. Causes include:

- Low fibre diet
- Poor fluid intake
- Reduced mobility
- Drugs (opiates)
- Neurological disorders
- Depression
- Bowel obstruction.

Management of constipation follows a stepped-care approach:

- Identify and treat underlying cause
- Change medication where appropriate
- Lifestyle changes, such as increasing fibre and fluid intake and exercise
- Consider laxatives:
  - Bulk-forming agents (ispaghula, methylcellulose)
  - Stimulant laxatives (senna, bisacodyl)
  - Osmotic laxatives (lactulose)
  - Faecal softeners (docusate sodium, liquid paraffin)
- Consider suppositories and enemas (Prodigy 2007c)

Diarrhoea is defined as the abnormal passage of loose or liquid stools more than three times per day (Thomas et al. 2003). Causes include:

- Bacteria
- Toxins
- Food
- Allergy
- Anxiety
- Over-use of laxatives
- Disorders such as inflammatory bowel disease.

Acute infective diarrhoea is a common cause of death in developing countries, particularly in children. Complications occur due to dehydration and electrolyte disturbances. Management is aimed at replacing fluids and treating the underlying cause, if appropriate. Antibiotics are only used for specific indications. Meticulous hygiene is essential as pathogens are spread via the faecal-oral route.

Faecal incontinence is distressing and embarrassing. Causes include:

- Sphincter weakness
- Neurological disorders
- Impaction
- Diarrhoea.

Careful assessment and identification of the underlying cause lead to effective treatment. Nurses have a key role in providing practical and emotional care.

Conclusion

Application of digestive anatomy and physiology is vital for understanding normal human function. Analysis of a range of disorders affecting the digestive system has illustrated patient assessment, pathophysiology and evidence-based management. Gaining knowledge of the role nutrition plays in both health and illness and the development of a range of skills reflecting the *Essence of Care* is essential for nursing practice.

Chapter 7 Summary Quiz

1. The digestive system is supplied by which circulation?

A. Portal circulation
B. Splanchnic circulation
C. Circle of Willis
D. Momentum artery

2. The main functions of the digestive system do not include:

A. Ingestion
B. Ovulation
C. Secretion
D. Elimination

3. The human adult usually has how many permanent teeth?

A. 60
B. 50
C. 42
D. 32

4. Vomiting is controlled by the vomiting, or emetic, centre in the brain, and is precipitated by many peripheral and central causes, including:

A. Stimulation of the gag reflex
B. Electrolyte disturbances
C. Particular sights, smells or emotions
D. Over-excitation of the sinoatrial node

5. Which of the following is not an-anti-emetic?

A. Metoclopramide
B. Cyclizine
C. Digoxin
D. Domperidone

6. Common medications used to treat peptic ulcers include:

A. Antacids and alginates
B. Histamine H_2 receptor antagonists
C. Proton pump inhibitors
D. All answers are correct

7. Which disease process is not a consequence of portal hypertension and ALD?

A. Oesophageal varices
B. Hepatic encephalopathy
C. Basal cell carcinomas
D. Ascites

8. The small intestine is composed of:

A. Duodenum, jejunum, ileum
B. Ileum, jejunum, oesophagus
C. Duodenum, appendix, jejunum
D. Ileum, appendix, duodenum

9. MUST stands for:

A. Malnutrition Underweight Sensitivity Tool
B. Malnutrition Universal Screening Tool
C. Minimal Underweight Selective Thinking
D. Malnutrition Universal Selection Training

10. Which of the following is not a cause of an acute abdomen?

A. Appendicitis
B. Pancreatitis
C. Peritonitis
D. Heart failure

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8

The musculoskeletal system

Karen Chivers

Chapter 8 Learning Objectives

- To gain knowledge and insight into the different components which comprise the musculoskeletal system
- To gain insight into both chronic and acute conditions related to these systems
- To apply theory to practice by gaining insight into the complexities of clinical assessment in relation to musculoskeletal problems
- To gain a solid understanding of the needs of patients when they are compromised by physical disability
- To construct solid evidence of professional development for your growing portfolio
- Continue to develop the ability to question and critique the evidence-base and effectiveness of a plan of care

Introduction

In order to fully appreciate the function and purpose of the musculoskeletal system, it is important that the reader fully understands the components which constitute this large and initially complex subject. Consideration needs to be given to the soft connective tissues of the musculoskeletal system, which comprise tendons, cartilage, ligaments and fascia, in combination with muscles and the joints. Each of these areas and their functioning will be discussed to provide the reader with a succinct overview of form and function. The chapter will then progress to identifying disorders/diseases that affect each area, highlighting the impact that injury and disease can have on the individual. Relevant treatments will be discussed thereby assisting inexperienced nurses in gaining the essential knowledge base and clinical skills necessary to provide effective evidence-based treatment for those placed in their care. The second part of the chapter will focus on how to assess individuals who present with an acute injury, using a systematic format.

Most injuries involving this system will be minor and will not significantly impact on the individual or their life. However, major injuries to this system can have an impact, therefore one of the scenarios will take an in-depth look at how major trauma can disrupt both an individual's physical health and ability to function within society, and how this can have an enormous psychological impact resulting in long-term consequences for the person affected and those close to them.

Applying Theory to Practice: Exercise 8.1

Before commencing this chapter:

- Compose a list of the diseases/injuries you already know that affect the musculoskeletal system (you may find this easier if you divide up the systems e.g. skeletal, muscular, joints etc.).

Add this list to your developing portfolio and on completion of this chapter expand your portfolio by writing a brief description of the new disorders you have gained knowledge on, elaborating on how these disorders affect physiological function and how to recognise a patient with them.

The skeleton

What is the skeleton?

There are 206 bones that form the framework of the adult skeleton (Figure 8.1). These bones support and protect the muscles and organs of the body. In children not all the bones are fully formed and develop gradually over years. The skeleton is predominantly divided into two parts: the axial and appendicular skeleton.

- The **axial** skeleton consists of 80 bones that support the head, neck and torso. It comprises the skull, vertebral column, ribs and sternum.

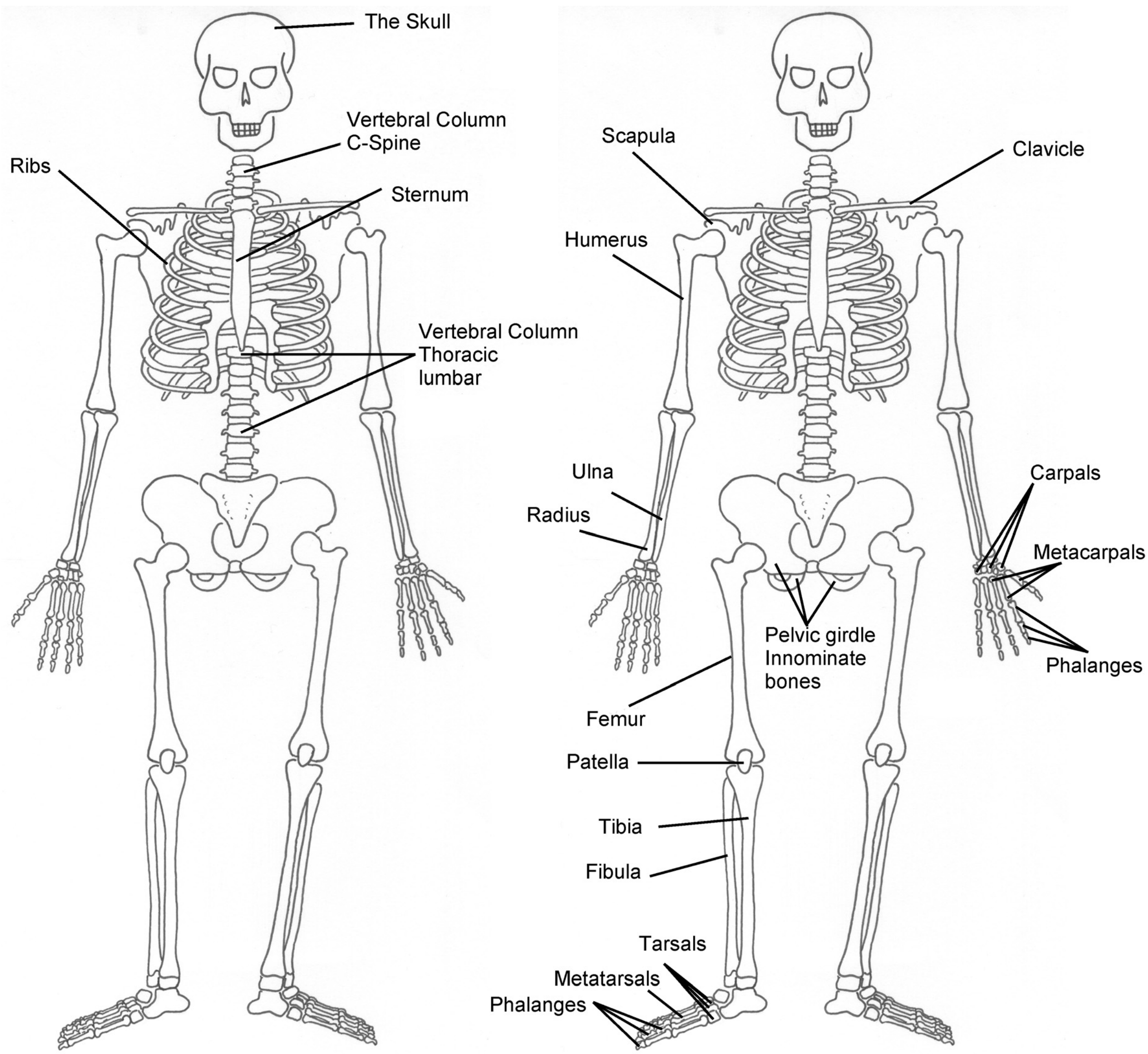

Figure 8.1 The adult skeleton

- The **appendicular** skeleton consists of 126 bones and supports the appendages, or limbs, attaching them to the rest of the body. It comprises the shoulder girdle – scapula, clavicle, upper limbs, pelvic girdle – the innominate bones and the lower limbs.

Functions of the skeleton

The skeleton provides seven main functions listed below:

- It provides shape and support for the body
- It provides a framework for all structures of the body
- It provides levers that are essential for movement
- It forms attachment points for muscles that move the joints, which in turn allows movement
- It provides protection for vital internal organs e.g. the cranium protects the brain, while the pelvic girdle protects the reproductive organs, bladder and intestines
- Red bone marrow within the bones manufacture blood cells
- The skeleton stores minerals, calcium and phosphorus.

Types of bone

There are two main types of bone tissue, **compact** and **cancellous**. Bone tissues varies in density and compactness. Most bones have a central cavity, containing marrow, a tissue that is the source of most of the cells within the blood and also a site for the storage of fats.

Bone is the hardest connective tissue in the body. It is composed of 25% water, 30% organic material – which includes cells, blood vessels, connective tissue and bone marrow – and 45% inorganic substances, such as calcium, phosphorus and salt.

Compact

The outer layer of bone is called compact bone. It appears solid, but on closer inspection it is made up of structures called **Haversian canals**. These run longitudinally through compact bone and contain blood, lymph capillaries and nerves. The larger the canal, the less dense and compact the bones.

Cancellous

The inner layer of bone is called cancellous bone. It is also commonly known as spongy bone. This is because it looks like a sponge and contains many holes. The structure of cancellous bone is like a latticework of bony spikes called **trabeculae**. These are arranged along lines of greatest pressure or stress, which in turn makes bones both strong and light.

Cancellous bone is filled with red bone marrow, which produces blood cells. In mature long bones the cancellous bone loses its ability to produce blood cells and red bone marrow changes to yellow bone marrow, which is fatty tissue.

Periosteum

The blood supply to bone is delivered via the periosteum. This is a tough membrane of fibrous tissue, which contains blood vessels and covers the surface of the bone wherever it is not covered by articular cartilage. It is essential for bone growth, repair and nutrition. It also serves as a point of attachment for ligaments and tendons.

Classification of bone types

Long bones

These are longer that they are wide, and function as levers to allow movement in limbs, e.g. the humerus, femur, tibia, clavicle, metacarpals and metatarsals.

Short bones

These are constructed predominantly of cancellous bone, with a covering of compact bone. These are very strong and subject to pressure type force. Their normal shape is cuboid or trapezoid and can be found in the ankle and wrist.

Flat bones

These are protective and have broad flat surfaces for muscle attachment, e.g. cranium, scapular, sternum.

Irregular bones

These are bones that do not fit into other categories, for example, most facial bones and vertebrae.

Sesamoid bones

These are bones that develop within a tendon, occurring in regions affected by significant pressure. There are only two in the body: the patella and hyoid bone.

Bone growth

The replacement of old bone with new bone is called remodelling. Bone tissue constantly renews itself throughout life; the bone redistributes its matrix along lines of mechanical stress. Special bone cells called **osteoclasts** and **osteoblasts** are intrinsic to this process. Osteoclasts destroy old or injured bone tissue and are responsible for the reabsorption of bone tissue. Osteoblasts constantly secrete new bone matrix in its place. There are certain vitamins and minerals which are essential for bone remodelling; these are highlighted in the following section. It is important to remember that a deficiency in some of these vitamins or minerals will have an effect on the healing process, and this must be considered in the hospitalised patient, or the patient presenting with a known deficiency. Hormones largely control the mineral concentrations within the blood.

Vitamins

Vitamin A helps to control the distribution and activities of osteoblasts and osteoclasts; deficiency or excess may cause small stature. **Vitamin C** is essential for collagen synthesis, which is required for the matrix. Any deficiency hinders fracture repair and also interferes with bone growth.

Minerals

Calcium and **phosphorus** are the primary components of the salts that make the bone matrix hard. **Magnesium** is needed to stimulate the activity of osteoclasts. **Boron** inhibits calcium loss and increases oestrogen levels. A deficiency of **manganese** will inhibit the laying down of new bone tissue.

Hormones

It is important to consider the role of hormones, which contribute to normal bone tissue activity.

Parathyroid hormone (PTH) helps to increase blood calcium levels. It stimulates the release of calcium from bone and inhibits calcium excretion by kidneys, which in turn helps to ensure more is maintained in the blood. It also stimulates the formation of calcitrol, which is a hormone that also promotes the absorption of calcium by the intestines. PTH is the most important hormone that regulates calcium exchange between bone and blood in the body.

Calcitonin is secreted by the thyroid gland and reduces the blood calcium levels. It inhibits the release of calcium from bone and stimulates calcium excretion by the kidneys.

Human growth hormone is released by the anterior pituitary gland and is responsible for the general growth of all tissues of the body. It helps to stimulate the growth of epiphyseal cartilage and stimulates calcium excretion by the kidneys and calcium absorption by the intestines.

The sex hormones (**oestrogen** and **testosterone**) stimulate bone formation and cause degeneration of cartilage in epiphyseal plates. Oestrogen prevents osteoporosis, which is possibly by a direct effect on osteoblasts.

Insulin increases bone formation when functioning at normal levels. Consider diabetic patients when reflecting on bone remodelling following a fracture.

Glucocorticoids, both **cortisol** and **aldosterone**, are produced in the adrenal cortex and reduce blood calcium levels.

The thyroid hormones, **thyroxine** and **triiodothyronine**, help to increase the blood calcium levels.

Diseases and disorders of the skeletal system

Paget's disease (osteitis deformans)

Paget's disease is a disorder of bone remodelling; excessive re-absorption occurs with a subsequent compensatory increase in new bone formation (Kumar and Clark 1998). The new bone is structurally abnormal resulting in a fundamental weakness within its structure. Paget's disease is a disorder that seldom affects men and women before the age of 40 (Adams 1986). There are often no symptoms and the condition is discovered incidentally during a radiology examination. It is possible that 60–80% of patients with Paget's disease are asymptomatic (Adams 1986) there appears to be a significant genetic component. There are increased numbers of osteoclasts containing an increased number of nuclei. Bone resorption does not occur in a uniform pattern with collagen fibres tending to be random, leading to a woven bone formation, which is weaker than unaffected bone. Paget's disease does not spread and so unaffected bone remains normal. The most common sites that are affected are the femur, pelvis, tibia, skull and the lumbosacral spine.

When patients are symptomatic (it is important to note that many patients do not experience symptoms and are diagnosed accidentally), their symptoms may include:

- Bone pain
- Deformities, most common in the skull or bowed tibia
- Joint pain, when bone close to a joint is affected, leading to cartilage damage and osteoarthritis.

Treatment

This depends on the presenting symptoms. Pain being the usual indicator, this is treated with analgesics and non-steroidal anti-inflammatory drugs (NSAID), which are normally adequate. Patients who are asymptomatic require no treatment.

Some patients can require further treatment, for example with oral bisphosphates. Kumar and Clark (1998) note that responses to bisphosphates are long-lasting with approximately a 50–70% reduction in serum alkaline phosphatase activity. When new bone is formed, it is lamellar rather than woven.

Osteoporosis

Osteoporosis is a condition of **porous** bones, and it occurs when bone resorption is quicker than bone deposition (Tortora 2001). The bone mass becomes depleted, and the mechanical stresses placed on the skeleton by everyday living are not tolerated. It is a disorder that affects mainly middle-aged and elderly women, although it can affect men too. It is mostly seen in the female population due to oestrogen levels falling rapidly in women after the **menopause**. The decline in testosterone in men is more gradual and therefore they suffer less osteoporosis. In osteoporotic bones the mineral density is decreased. Patients who are suffering from osteoporosis are more likely to suffer fracture of bones more frequently and to a greater degree than those not affected. The treatment is focused on prevention rather than cure.

Treatment

Preventative measures include adequate calcium intake and exercise earlier in life rather than reliance on drugs and calcium supplements at menopausal age. In post-menopausal women osteoporosis can be treated with hormone replacement therapy (HRT). HRT is the treatment of choice although the potential side-effects of HRT remain controversial, but the risk of side-effects is less than that of experiencing fractures without HRT (Kumar and Clarke 1998).

Applying Theory to Practice: Exercise 8.2

Over recent years there as been much debate surrounding the use of HRT. Complete the following exercise to gain insight.

- What are the possible side effects of HRT?
- What 'life-style' choices have been implicated in the development of osteoporosis?

Osteoarthritis

Osteoarthritis can be limited to only a single joint and can be triggered by localised wear and tear. Joint degeneration may be hastened by congenital defect, injury, infection or obesity. **Articular cartilage** begins to break down and become thinner and roughened. Bone beneath the cartilage eventually erodes so that the bone surfaces rub against one another causing discomfort. Commonly affected areas include weight-bearing joints like knees, feet and the back. Osteoarthritis in the spine is extremely common in the elderly population, although quite often it can be asymptomatic and may be discovered coincidentally when the individual is being treated for another complaint (McRae 2004).

Treatment

Unfortunately drugs cannot repair damaged bone and cartilage and their sole role is to reduce any inflammation and control pain. By acting in this way they can help to maintain joint mobility and minimise deformity to the affected areas. NSAIDs are prescribed primarily as long as they are not contraindicated in each individual case by any predisposing illness. Occasionally, injections of corticosteroid drugs are used for severely inflamed joints.

Osteomalacia

This condition differs from osteoporosis in that there is no loss of the bone's protein matrix; in osteomalacia bones are weakened by the loss of calcium and phosphorus. The bone calcification fails; as a consequence, the bones become soft and rubbery and are easily deformed. In children this is called rickets. A primary cause is a shortage of vitamin D, essential to enable the body to deal with calcium and phosphorus. Inadequate sunlight can also reduce vitamin D synthesis (Chapter 10).

Brittle bone syndrome (osteogenesis imperfecta)

This is an inherited disorder and there are four different types, notable by their varying clinical picture.

- Death in perinatal period (type 2)
- Severe bone deformity (type 3)
- Normal life span (types 1 and 4) (Kumar & Clark 1998).

The main clinical signs are very fragile and brittle bones that fracture frequently. It is important to note that other collagen-containing tissues can also be affected such as tendons, skin and eyes.

Type 1 sufferers present with mild bony deformities, but will experience other oddities such as blue sclerae, defective dentine, early onset deafness and heart valve disorders. It is these factors that assist the medical personnel in making a diagnosis.

The more severe forms present with multiple fractures and gross deformities. The severity of the disease will dictate the prognosis.

Treatment

Early recognition of the condition is vital for correct management. All fractures would be treated individually as they present to the emergency department.

Postural deformities

The spine has two natural curves: in the lumbar region there is an inward curve, and in the thoracic region an outward curve (Figure 8.2).

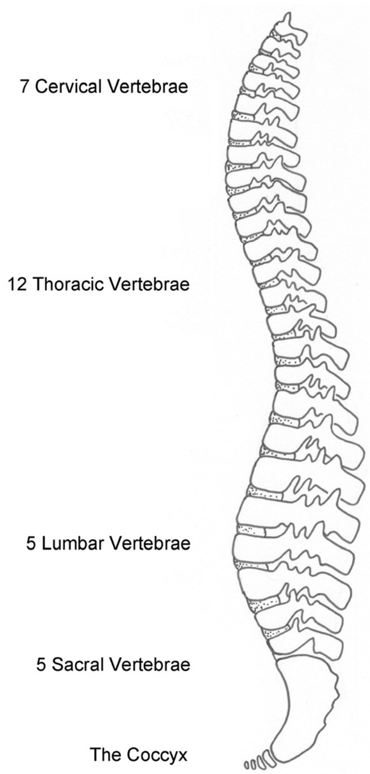

Figure 8.2 The spine

The spine is also known as the **vertebral column** and consists of 33 vertebrae; some of these bones are fused, so there are actually 26 individual bones, which are divided into cervical vertebrae, thoracic vertebrae, lumbar vertebrae, the sacrum and the coccyx. There are three main functions of the vertebral column:

- Allowing movement
- Protecting and enclosing the spinal cord
- Acting as a point of attachment for the ribs and muscles of the back.

There are a number of reasons why the natural curves of the spinal cord may become disrupted leading to postural deformities. The three main reasons why a postural deformity occurs are: following a traumatic event such as an accident; a congenital or heredity deformity present at birth; and environmental factors such as sitting and standing incorrectly resulting in long-term damage.

Types of postural deformity

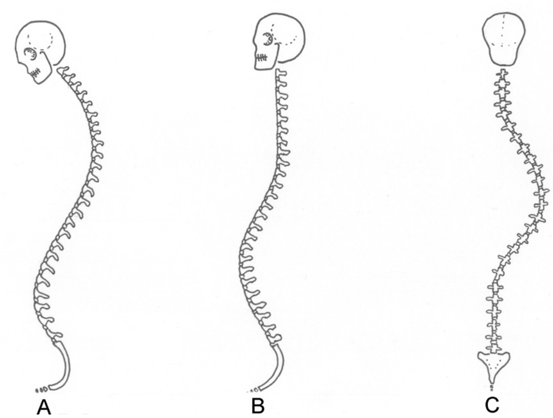

Figure 8.3 Postural deformities

Kyphosis–A
Kyphosis is an exaggerated outward curvature of the upper part of the back below the neck. It is usually obvious when the patient is viewed from the side. It generally affects the thoracic spine with several vertebrae being affected.

Scoliosis–C
Scoliosis is a sideways (lateral) curvature of the spine; there are two types, structural and non-structural. Structural scoliosis is the term used when there is a change in the shape and mobility of the vertebrae and the deformity cannot be altered by a change in posture. Structural scoliosis can be congenital. In non-structural scoliosis the deformity can occur from tilting of the pelvis and therefore becomes compensatory.

The prognosis of a patient with scoliosis is dependent on the age of onset, level of spine affected, the size and number of the primary curves and the type of structural scoliosis (McRae 2004). It is thought that when the skeleton has matured, deterioration stops, but it can continue due to disc degeneration and subluxation of the vertebrae; generally the higher the level of spine involved and the younger the patient, the worse the prognosis (McRae 2004). Scoliosis can be treated by the use of braces or fusion of the entire primary curve can be considered.

Lordosis–B

Lordosis is an exaggerated inward curvature of the spine, and can often result in a tip of the pelvis. The extent of postural deformity and the effect on life will depend on the treatment required. Some patients may need surgery to correct the deformity; others may just live with the deformity for life. Each case is assessed on an individual basis.

Spina bifida

Spina bifida is a congenital defect of the vertebral column, in which the laminae fail to unite at the midline (Tortora 2001). It can cause partial or complete paralysis, and absence of reflexes, and occurs when there is protrusion of the meninges around the spinal cord. It is often diagnosed on early pregnancy scans, and there appears to be documented evidence that it is associated with low levels of folic acid (Tortora 2001). This is why women are encouraged to commence folic acid prior to becoming pregnant and for the first three months of pregnancy, by which stage the vertebrae have formed.

Fractures

There are a number of different types of fracture and this text does not endeavour to go into great detail about the description of fractures and their treatment. The figures, however, help to demonstrate the text. A fracture is described as a bone that has broken either due to injury or disease. There are many different types of fracture.

Simple (sometimes called closed)

This is when a bone is broken in one place and has not damaged the tissue around it (Figure 8.4).

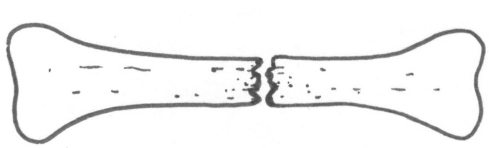

Figure 8.4 Simple fracture

Compound (sometimes called open fracture)

This is a fracture in which the fractured bone ends pierce the skin and communicate through the surface of skin through an open wound (Figure 8.5). As the skin is open over the fracture, or the bone has protruded through the skin, there is a high risk of infection. These types of fracture are covered promptly and treated with antibiotics to minimise risk of infection.

Figure 8.5 Compound fracture

Comminuted

The bone is broken in several places and is therefore fragmented (Figure 8.6). Injuries of this kind are normally caused by a direct force, and sometimes by a crush injury.

Figure 8.6 Comminuted fracture

Greenstick

This is an incomplete fracture of a long bone (Figure 8.7). It only affects the cortex on one side of the bone while the other side remains intact; common in soft and flexible bones, therefore, these are often seen in children.

Figure 8.7 Greenstick fracture

Buckle

This is where there is a small bulge in the outline of the bone. There is minimal damage to the periosteum and soft tissues. These type of injuries heal quickly, again common in children (Figure 8.8).

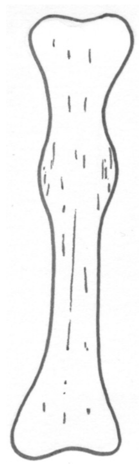

Figure 8.8 Buckle fracture

Impacted

This is a fracture that results in the broken ends being driven together by force (a good example is like one car shunting into the back of another), this type of fracture is often seen as a Colles fracture (Figure 8.9) and results as a direct fall onto an outstretched wrist. It can be associated with shortening, displacement and angulation.

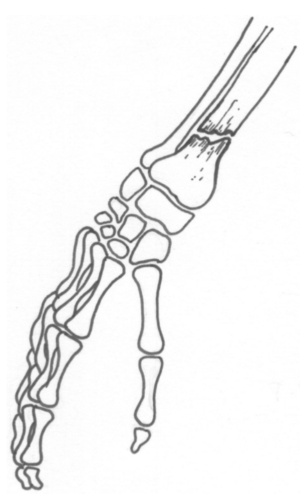

Figure 8.9 Colles fracture

Spiral

This type of fracture is the result of a twisting force and causes an obliquely angled spiral fracture. As the broken areas are larger it allows easier union, however, the angle of broken bone may encourage slippage, angulation and shortening (Figure 8.10).

Figure 8.10 Spiral fracture

Depressed

This is a fracture where the bone has been punched out and now lies in underlying soft tissues and often occurs in the skull (Figure 8.11).

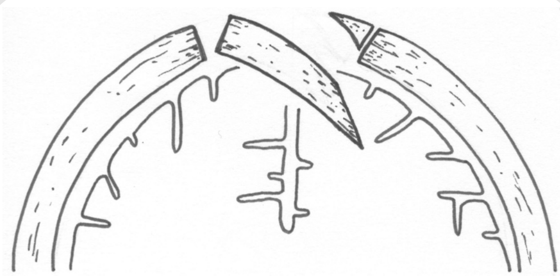

Figure 8.11 Depressed skull fracture

Crush

This occurs when a force is applied causing damage to the soft tissues and forcing the bones to crush, the commonest site is in the vertebrae (Figure 8.12).

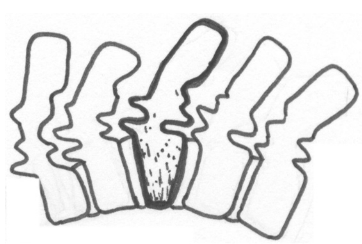

Figure 8.12 Crush fracture

Pathological

These occur when a disease has weakened the bone, commonly seen in patients who are suffering from cancer and have metastatic bone disease (Figure 8.13).

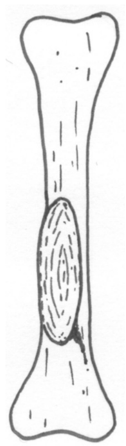

Figure 8.13 Pathological fracture

Complications of fractures

There can be many complications of fractures:

- Infection
- Delayed union
- Malunion
- Non-union
- Avascular necrosis
- Shortening
- Injury to major blood vessels
- Injury to nerves
- Injury to tendons
- Fat embolism
- Compartment syndrome.

When a patient presents with a fracture, the key is to have an understanding of the mechanism of injury and the probability of some of the above complications. A thorough assessment and history taking will enable the nurse to be able to administer the best treatment (this is discussed in depth in the latter part of this chapter). The best treatment is to immobilise the fracture, thereby reducing the pain and discomfort for the patient and allowing natural healing to occur. The basic principle to follow will be to inform the patient that if he gets an increased level of pain in the affected area, increased swelling, numbness or coolness of the limb then he needs to seek medical advice urgently.

Scenario 8.1

Fractured Leg

Mr Robert Smith, a 34-year-old man, is brought into the emergency department by ambulance. He was a motorcyclist, involved in a road traffic accident, where his vehicle skidded on ice and he lost control of the motorbike. When he fell to the ground, the motorbike fell onto his right leg and he was unable to get up. There was a possibility that he experienced a brief loss of consciousness, although he was wearing a crash helmet. At the scene of the accident it was noted that there was an obvious deformity to his right lower leg, which the ambulance crew realigned by applying a splint to the leg after administering morphine.

The emergency department had received warning of his imminent arrival, so a trauma team were assembled and awaiting his arrival.

Vital signs on arrival
Airway & C-spine: clear, patient is talking. AVPU = A
C-Spine is immobilised with hard cervical collar, blocks and tape.
Breathing: spontaneous, respiratory rate 20/min
Circulation: pulse rate 110, regular, BP 110/70, capillary refill <2 secs
Disability: patient alert, GCS 15/15, pupils equal and reactive to light
PMH: nil of note
Medication: nil
Allergies: elastoplast

Assessment and analysis of patient presentation

With any patient involved in a trauma scenario, it is important that a structured approach is used to guide the initial assessment and management. This commonly focuses on applying the Advanced Trauma Life Support (ATLS) guidance (ACS 2004). This ensures that each system is fully assessed and that any problems can be identified early and treated accordingly. Injuries to the musculoskeletal system often look dramatic, and hospital personnel can be easily distracted by their appearance. However, they are not as life-threatening as an injury to the airway, hence the A, B, C, D, E approach. Initially the primary survey takes place and then when all life-threatening potentials are stabilised, the secondary survey follows, and this involves a top-to-toe inspection of the whole patient.

Mr Smith has no apparent airway or breathing complications although his respiratory rate is above normal. He is already receiving intravenous fluids commenced at the scene of the accident. His pulse is raised and his blood pressure within normal limits. There is the possibility of haemorrhage and potential ischaemia to the injured leg. Assessment of vital signs assists healthcare professionals in monitoring the patient's condition, but visualisation of the patient is still vitally important, as is communication with the patient. An X-ray confirms that Mr Smith has a comminuted midshaft fracture to the right tibia and fibula; there is associated swelling of the soft tissues. Mr Smith will require further immobilisation of his leg, achieved by the application of a plaster of Paris to his right leg to immobilise the fracture prior to surgery.

Treatment of fractures

The main principle of treating fractures is to immobilise them to allow the bone to remodel and repair itself so that function can be restored. If the bone ends are well opposed, then a bridging process called **union** takes place; this is a temporary state on the way to permanent healing (Purcell 2004). When the broken ends of the bone are joined, they are still not sufficiently strong enough for normal function. The time scale for this part of the healing process takes 3–4 weeks, but will be dependent on the age of patient and any predisposing medical problems.

Compartment syndrome

Compartment syndrome is one of the most serious complications of injuries sustained; this is why assessment of a limb needs to be carried out as soon as injury occurs.

Questioning Clinical Practice: Exercise 8.3

Fracture Complications

While waiting for a bed to be transferred to, Mr Smith complains of severe pain to his right lower leg.

- What conditions must be considered and how can they be treated?

Developing and Delivering Expert Care: Box 8.1

Clinical Signs Associated with Compartment Syndrome

- Severe pain
- Extremely painful movements especially on passive extension
- Limb may be cool
- Patchy pallor of limb
- Skin may look shiny, tense bulging muscle
- Sensory deficit
- Pulses might be present and gradually weaken. NB: necrosis can occur while pulses are present.

Absent pulses are a very late sign of compartment syndrome.

Vigilance of a potentially affected limb has to be paramount.

Important to note that a vascular injury can only be identified in fully conscious patients (Edwards 2004).

The temperature of the limb, sensation, pallor and pulses all need to be assessed and accurately documented on a half-hourly basis. Compartment syndrome occurs when there is significant swelling, whether caused by trauma or haemorrhage, within a muscle compartment. In Scenario 8.1 it is likely that the area affected is the anterior tibial compartment, as there is severe pain in the front of the shin; this occasionally can be associated with foot drop. The most common site of compartment syndrome is the lower leg with the anterior compartment the most frequently affected (Abramowiz and Schepsis 1994), but this would be difficult to assess as the patient's limb is immobilised in plaster. The treatment required is that of immediate surgical decompression; this takes the form of **fasciotomy**. It is important to note that by performing a fasciotomy a closed lesion is being turned into an open wound and that heralds many complications (Fitzgerald 2000). Some of the complications that could occur include life-threatening infection, acidosis, renal failure and occasionally the loss of a limb. The reason for surgical intervention is to prevent muscle necrosis occurring. This can be a frightening experience for the patient, who is in severe pain. There is evidence to suggest that initial treatment with mannitol can decompress compartment syndrome and avoid the need for surgery (Porter & Greaves 2003).

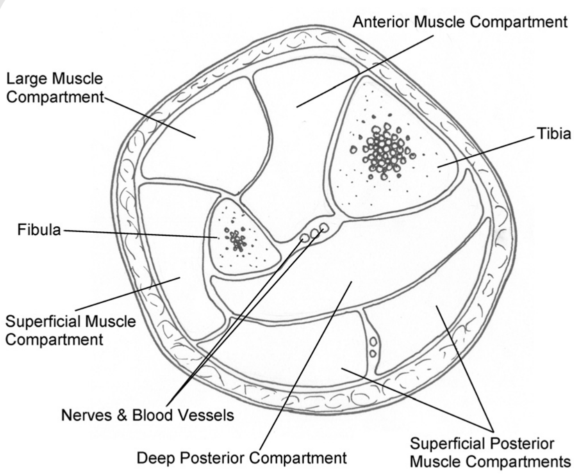

Figure 8.14 Limb compartments

Acute compartment syndrome is a common and potentially life-threatening condition that occurs in the limbs and abdomen, which requires prompt recognition and intervention (Edwards 2004).

One important consideration must be in patients presenting to the emergency department with fractures. Ethically should nurses advise them that compartment syndrome is a potential complication, or should the patient be informed that should they experience a sudden severe pain, numbness or coolness to the limb that they should return immediately? By taking the second course the nurse is warning them about the risks of compartment syndrome without mentioning the words. With access to the internet, patients are well informed and will often find out more information anyway.

Joints

A joint is the place where two bones meet; there are three main types of joint within the skeletal system:

- **Fixed** (also known as fibrous). These fibrous joints have no movement. An example of these is in the pelvic girdle bones.
- **Slightly movable** (also known as cartilaginous joints). An example is the white fibrocartilage between bones, e.g. vertebrae.
- **Freely movable** or **synovial**. Within this section there are five different types, which are discussed below:
  - Ball and Socket. This type of joint is the most movable and allows movement of action, for example, at the shoulder joint.
  - Hinge. This allows movement in one direction only, e.g. at the elbow where it can extend and flex. It is the simplest of joints.
  - Gliding. Here the bones glide over each other, e.g. tarsals or carpals. In these joints movement is still limited as there are strong ligaments encasing them.
  - Pivot. This allows movement around one axis, e.g. the first two vertebrae. The first vertebra, C1, known as the Atlas, allows the head to rotate and the second vertebra, C2, known as the Axis, allows the nodding action.
  - Saddle. This allows movement around two axes. It is only found between the phalanges of the thumb and metacarpal.

Conditions affecting joints

Rheumatoid arthritis

This is a form of arthritis that affects the auto-immune system. The immune system attacks the body tissues which is usually triggered by an antigen in a genetically predisposed person. The synovial membranes are attacked and they go on to degrade and malform the articular surfaces of the bones (Tucker 2005).

Rheumatoid arthritis of the wrist is common, due to thickening of the joint and related tendon sheaths, which leads to swelling, pain, stiffness and increased heat in the affected area. Many small joints are affected, for example on the hands and feet. In severe cases of rheumatoid arthritis joint spaces disappear and the angle at which the bone ends meet changes, due to ligament laxity. The bone ends become rough, eroded and noduled, by aggregates of inflamed tissue cells collecting around the bone ends. Above the nodules the skin is thin and fragile; this in turn results in restricted movement. A diagnosis is confirmed if a blood test detects an antibody that is associated with rheumatoid arthritis.

Treatment

The use of splints can help, especially for those patients whose wrists are affected and who suffer from increased pain at night. When the individual is not experiencing acute pain and is in remission gentle exercise can help to keep the affected joints mobile.

Gout

This is a condition that is caused by an excess of uric acid in the body, which is normally excreted in urine. In gout this substance collects in the synovial fluid of a joint forming needle-like crystals, which can cause sudden and severe pain, swelling and redness in a joint. Often the joint affected is the greater toe, although it can occur in any part of the body. It is known to affect the male population more than the female.

Diagnosis can be made from measurement of the level of uric acid in the blood if the patient presents in an acute phase.

Treatment

In the acute presentation treatment will be by NSAIDs to reduce the level of discomfort in the joint. To reduce the risk in the chronic phase the drug of choice is allopurinol (300–600mg), but it is not normally indicated unless the attacks are frequent or there is associated renal impairment.

The muscular system

While the bones and joints form the framework of the body, they are unable to move the body on their own. In order to create movement of the skeletal system, motion comes from the relaxation and contraction of muscles. Muscles constitute approximately 23% of total body weight in women and 40% in men.

The next section will examine the function of muscles and how normal function can be affected; common disorders will also be discussed.

Muscle tissue

There are three types of muscular tissue: skeletal, smooth and cardiac. For the purpose of this chapter only skeletal tissue will be addressed. Skeletal muscle is striated tissue that can be made to contract and relax by conscious control. They are controlled by a part of the peripheral nervous system known as the somatic nervous system.

Functions of skeletal muscle

Through sustained contraction or alternating contraction and relaxation, muscle tissue has six main key functions:

- Contraction of muscles that produce movement. This occurs through the ability to contract and relax in a coordinated manner
- Postural muscles maintain the body in a stable position
- Both muscles and tendons help to stabilise joints
- Assists the movement of substances within the body. As skeletal muscle contraction, helps to aid the return of blood to the heart
- Aids temperature control. This occurs as muscle contraction produces heat and shivering and vasodilatation of capillaries cools the body down, while vasoconstriction helps to retain heat
- The diaphragm regulates breathing.

Structure of skeletal muscle

Muscle cells are called fibres because of their cylindrical shape and long length. Each fibre has many nuclei and myofibrils that contain both actin and myosin filaments. The muscle cells appear striped due to the actin and mysosin filaments arrangement. The fibre is surrounded by a sarcolemma, which is the plasma membrane of a muscle cell that surrounds the sarcoplasm, the cytoplasm of a skeletal muscle cell.

How muscles work

In order for muscles to move, they need to be stimulated into action by a nerve impulse. This in turn will then cause the muscle to contract creating a movement. Motor nerves cause movement and break down into many nerve endings, with each one stimulating a single muscle fibre. When the muscle contracts, the actin filaments slide between the myosin filaments causing a shortening of the fibres.

Bones act as levers for movement. When the muscle contracts, it causes a muscle action at the joint. Muscles must cross a joint in order to cause a movement at that joint. There are many different actions for different muscles but all muscles work by contraction (Tucker 2005).

For a muscle to contract when stimulated by a nerve, its cells require oxygen and fuel in order to produce enough energy for muscle contraction to take place. For this purpose muscles use glucose and fats. Muscles have the ability to store glucose as glycogen, which is converted back to glucose when required for muscle action. Muscle burns the glucose and fats to produce energy by combining with oxygen. When a muscle is required to contract and relax over a long period of time more oxygen is required to burn the fuel. This results in heavy breathing so that an increased amount of oxygen can be obtained. If the muscle is not allowed enough time to recover, the muscle will become deprived of oxygen, causing a build-up of lactic acid, a by-product of energy production. When lactic acid builds up in a muscle it causes a burning sensation and presents in varying degrees of discomfort. Oxygen is needed to excrete lactic acid, so the individual will need to stop or slow down the activity being undertaken. Lactic acid affects the end plate of the nerve controlling the muscle and so prevents destructive overaction of the muscle.

Applying Theory to Practice: Exercise 8.4

- Compose a list of the different movements that you are aware of. Think about how you could describe these movements to a colleague.
- Why is it important to have knowledge of movements that the body can perform?
- Add this list to your developing portfolio and on completion of this chapter expand your portfolio with any new terminology that you have learnt.

Some of the movements that are created by muscles are mentioned below with brief descriptions. It is important to have an understanding of the terminology used to describe movements as it can make it easier when describing a patient's presenting condition or injury and also make documentation succinct.

- **Flexion –** bend or flex a limb inwards
- **Extension –** bend or extend a limb outwards
- **Abduction –** move a limb away from the midline
- **Adduction –** move a limb towards the midline
- **Inversion –** turning towards centre e.g. sole of foot
- **Eversion –** turning outwards from centre
- **Rotation –** rotate head at neck
- **Supination –** turn a limb to face upwards
- **Pronation –** turn a limb to face downwards
- **Dorsiflexion –** flexing/bending foot up (with toe up and heel down)
- **Plantarflexion –** flexing/bending foot down towards the ground (think of planting the foot to the ground!)
- **Opposition –** opposing the thumb to little finger

Demonstrating these movements with a colleague will help in an understanding of the different movements.

Disorders affecting the muscular system

Guillan–Barré syndrome

This normally occurs after one to three weeks following an initial infection. The cause of Guillan–Barré syndrome is often identified as campylobacter infection.

The patient may complain of muscle weakness in the distal limbs and often numbness in the same region too. Gradually this weakness and numbness progress and ascends; it can occur over several days or take up to several weeks to progress. The pattern appears to be that the weakness and numbness occur in the fingers and toes. There can be mild cases where there would be little disability before the patient recovers of their own accord, but there can be more extreme cases. In approximately 20% of cases the patient can become paralysed as their respiratory and facial muscles are affected (Kumar & Clarke 1998). These patients would need care in hospital with careful monitoring to ensure that their condition does not deteriorate and require further intervention. The diagnosis is confirmed from the clinical picture and from nerve conduction tests.

Treatment

Some cases do not require treatment and recovery seems to occur in approximately three weeks. In the more severe cases the paralysis may be severe and the patient requires assisted ventilation and the support of intensive care. Recovery from Guillan–Barré syndrome may be incomplete and there may be some residual paralysis.

Abnormal contractions of skeletal muscle

Cramp

This is a painful, spasmodic contraction, which is involuntary. The most usual cause is vigorous exercise, but it can also occur in certain metabolic disorders. For example, when there is a deficiency of sodium or water in the blood. A deficiency of calcium can also cause cramp, as can a lack of blood supplying oxygen to a certain part of the body, for example, sitting awkwardly. A common example of cramp is colic, when muscles in the stomach and other organs of the abdomen are affected.

Treatment

Most often cramp in a limb resolves spontaneously and requires no treatment, but if it is due to a metabolic disorder this will need treating accordingly.

Strain

Injury to a muscle or tendon is often caused by overexertion or overuse. Warming up before exercise is essential to prevent damage.

Treatment

Treatment depends on the severity of the sprain; the principal guidance is based on the PRICE acronym:

- Prevention
- Rest
- Ice (application in short bursts)
- Compression
- Elevation.

Myositis

Myositis is inflammation of a muscle.

Treatment

Treat with rest and NSAIDs if the condition is due to overuse of the muscle. It is rare to develop myositis spontaneously.

Ligaments

Ligaments are dense bundles of collagenous fibres that run in parallel lines. Their function is to connect bone to bone (Figure 8.15).

They are often formed from the outer layer of the joint capsule, but can also connect nearby non-articulating bones. Ligaments contain numerous sensory nerve cells, which are capable of responding to speed, movement and the position of a joint, as well as to stretching or pain. The sensory neurons constantly transmit such information to the brain, which in turn sends signals to the muscles via motor neurones. In this way the body is usually able to avoid damage or undue stress to ligaments through a corrective action. Even so, excessive movements or trauma may result in spraining or a rupture of the ligaments, common in injuries sustained through sporting activities.

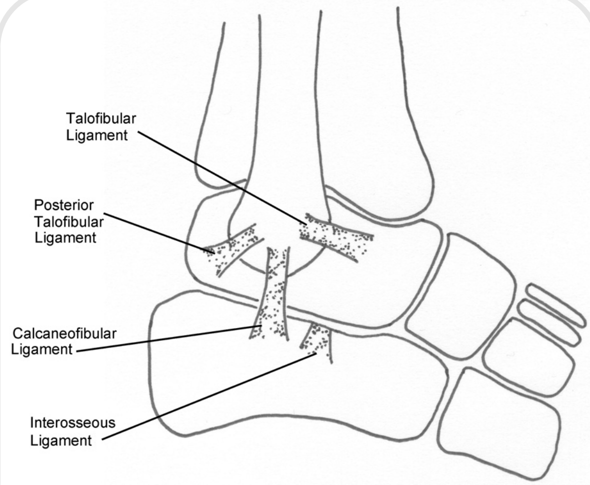

Figure 8.15 Ligaments

When damaged, ligaments are extremely painful, due to the high number of sensory nerve cells. Ligamentous damage does not repair quickly due to a limited vascular blood supply.

Function

The function of ligaments is chiefly to strengthen and stabilise the joint in a passive way. They are unlike muscles as they cannot actively contract, nor can they stretch. There are exceptions to this rule, with a few ligaments that contain a high proportion of yellow elastic fibres. Ligaments are placed under tension by certain positions of joints and slackened by others.

Injuries to or surrounding joints usually involve the tearing of a ligament, often accompanied by a muscle tear resulting in pain and varying degrees of swelling.

An ankle sprain is a common presentation to walk-in centres, minor injury units and even emergency departments. Normal history involves an inversion injury to the ankle while playing sport, but can occur with an eversion

Scenario 8.2

Right Ankle Injury

Sam Jones attends A&E with a complaint of right ankle injury. This was sustained one day previously while playing football. The injury he describes sounds like an inversion injury and he was unable to walk immediately or continue playing football. He limps into the emergency department.

On examination the ankle is swollen and bruised, this extends down to the dorsum of the foot. The skin is intact with no obvious deformity.

The ankle has a normal temperature, no excess warmth or coolness. Capillary refill is <2 seconds. Pedal pulses are present and equal.

Maximum tenderness can be felt over the lateral maleolus. There is no discomfort to the fifth metatarsal or head of the fibula.

Mr Jones is weight-bearing although in discomfort. (He has not taken any analgesia.)

Range of movement is limited, especially on dorsi and plantar flexion.

X-ray shows no bone injury. Mr Jones is diagnosed as having a sprained right ankle.

Applying Theory to Practice: Exercise 8.5

To gain further insight into soft tissue injuries complete the following exercise.

- What treatment will this patient require?
- Consider the importance of health education for this patient.
- Will a severe sprain result in long-term instability of the joint?

injury too. An appreciation of the anatomy of the ankle and the mechanism of injury can assist with the diagnosis. It is important to note that an X-ray is not always required and standard practice should be to follow the guidelines of the Ottowa Ankle Rules (Stiell et al. 1995) to avoid the necessity of an X-ray and the subsequent exposure to radiation.

Treatment

An X-ray confirms that there is no bone injury and therefore a diagnosis of sprain can be made. The treatment is to try and restore normal function as quickly as possible. RICE: Rest, Ice, Compression and Elevation are normally recommended, as the traditional method of treating soft tissue injuries. The use of tubigrip™ has generated a lot of debate in recent years. Pollard and Cronin (2005) write that sometimes compression bandaging can create swelling rather than reduce it. Sometimes patients feel that the tubigrip™ is assisting them. They should be advised on removal of the bandage at night and to continue with regular elevation.

Health education on care of the ankle following a significant injury needs to be addressed. Return to sports that involve running should be avoided until normal function is restored; this will vary on an individual basis, and should be gradual. The patient should also seek advice if function is not fully restored, as there may be a need for physiotherapy input.

Fascia

Fascia is made from white, fibrous, dense connective tissue and can be found in all parts of the body. Fascia plays an important part in the musculoskeletal system, and has different names depending on what it surrounds. Epimysium surrounds the whole muscle; perimysium surrounds the bundles/fascicles of fibres; and endomysium surrounds the muscle fibres/cells.

Superficial fascia

This is a continuous sheet of fibrous connective tissue and is found between the dermis of the skin and the deep fascia of the muscle. It is also called the subcutaneous layer when referring to the skin.

Functions

- to help the skin move over underlying structures
- To provide a passageway for nerves, blood vessels, lymph vessels
- To conserve body heat due to the presence of adipose tissue (fat)

Deep fascia

This is a sheet of dense connective tissue that is wrapped around a muscle forming an inelastic sheath to hold it in place. It is thicker in areas of the body that are unprotected.

Functions

- Assists muscle action through the tension and pressure it provides
- Provides a broad surface for muscle attachment

Tendons

These are formed from muscle and fascia combining together and extending beyond the end of muscle into flat bands or round cords. They are very strong and are not at all elastic; they have a poor blood supply and very few nerves. Tendons are made from white, fibrous, densely packed connective tissue. Under a microscope, closely packed bundles of parallel collagen fibres would be visible.

Function

To connect muscle to bone via the periosteum.

Injuries

There are two main injuries that occur to tendons:

- Rupture/division
- Acute or chronic inflammation due to overuse

Tendons tear when they are stretched to 5% or more beyond their normal length (Purcell 2004), but they can also be divided by blunt force or cut. Tendons with poor blood supply, for example, the distal part of the Achilles tendon, can be prone to rupture.

Achilles tendon injury

The Achilles tendon is the second most ruptured tendon in the body. Apart from the quadriceps, it suffers rupture more than any tendon (Ballas et al. 1998, cited in Kerr 2005). This occurs when there is sudden plantarflexion of the foot. Patients will often describe the injury as a sudden popping sensation to the ankle or as though they were kicked from behind in the leg above the heel. It is vital that these types of injuries are diagnosed promptly as misdiagnosis can have a long-term impact on the patient's everyday life. They may develop an abnormal gait or have chronic pain (Kerr 2005).

Treatment

Achilles tendon ruptures can be treated in two different ways: by surgical intervention where the ends of the tendon are reunited and surgically sewn together with sutures followed by immobilisation in a cast, with the ankle plantar flexed; or by conservative management where the leg is placed in a cast in plantar flexion held in equinus position. The objective is to enable the tendon ends to reunite by approximating them and then holding them in position to encourage healing. The cast is changed and the position of the foot gently altered over the course of treatment.

Both conservative and surgical measures have their advocates, but neither guarantees freedom from

Scenario 8.3

Limb Amputation

Boris Bulthorp-Smyth, a 38-year-old man, was brought into the emergency department three days ago following a high speed crash in which his car crashed into a ditch. His arm was crushed resulting in a comminuted compound fracture. The arm was unsalvageable and had to be amputated just below the elbow yesterday morning. He is now a patient on the orthopaedic ward where you are on placement. You are caring for him on a late shift; on assessment your findings include:

Airway clear, Mr Bulthorp-Smyth answers any questions you ask him but fails to engage in conversation. His respiratory rate is 14, pulse 71, blood pressure 131/72, temperature 38.8. You ask him to show you his dressing site as he has his arm covered by a blanket. His wound dressing is intact and there is no sign of bleeding or exudate penetrating through the layers. You notice that he has not washed or shaved and that his hair is uncombed. His dinner is still sitting on the bedside table untouched.

You complete a pain assessment and administer Mr Bulthorp-Smyth his medications, which include antibiotics and analgesics. He describes his pain score as 1 out of 4, which equals mild. You ask him if he has been undertaking his exercise plan. He states he cannot see the point, as the arm is useless. You inform him that if he fails to use his shoulder it may become frozen and that muscle wasting may ensue, resulting in poor healing of the wound and decreased focus. He states he does not care and wishes he were dead. He then turns his back towards you to end the conversation.

complications (McRae 2004). Possible complications include re-rupture, poor wound healing, infection, deep vein thrombosis from being in a cast, and chronic stiffness of the ankle. Some patients are more suitable for conservative treatment, for example the elderly or those considered a high anaesthetic risk, while the surgical route seems to be indicated in the younger, athletic patient.

Some of the common presenting complaints involving tendons include damage to extensor or flexor tendons resulting in trigger finger/mallet finger, and chronic inflammation of tendons generally through repetitive use i.e. tenosynovitis/tendonitis.

Assessment and analysis of patient presentation

Mr Bulthorp-Smyth has two immediate problems. First, he may be demonstrating signs of an acute infection; and because he has had surgery involving a major long bone there is the potential for osteomyelitis or septicaemia, both of which are life-threatening. Although Mr Bulthorp-Smyth is currently taking antibiotics, they will not necessarily be effective. His orthopaedic team need to be urgently contacted. They will visualise the wound, inspecting for any signs of infection such as heat, offensive odour, inflammation and tracking extending proximally up the arm. Increased pain is also a good indicator although complications such as compartment syndrome may cause this. The wound may have become infected during the initial surgery or during the first dressing change; the causative agent may be resistant to the antibiotics prescribed or the infection may exist in a part of the body such as the bone where this particular antibiotic is ineffective. His second problem is that he appears to be neglecting himself, demonstrated through his unkempt appearance, and is deliberately hiding the affected arm away.

Limb loss – the facts

There are many causes of an alteration in an individual's body image, these include:

- Traumatic amputations/injuries
- Cancerous growths or tumours
- Non-malignant growths
- Burn injuries
- Weight gain/loss
- The ageing process.

After the First World War it was commonplace to see young otherwise fit men using crutches due to traumatic amputations of their legs. Today, traumatic limb loss is again at an increased rate due to global conflicts such as Iraq and Afghanistan where soldiers are being physically traumatised by landmines or explosive devices. In African states such as Sierra Leone, young men have had the lower part of their arms removed with machetes due to differing political viewpoints. In the modern Western world most traumatic amputations are associated with industrial accidents or road traffic accidents. This can be devastating for the individual and end their intended career or lifestyle.

Psychosocial aspects

How an individual reacts to an acute alteration to their body image is dependent on many factors: for some the ability to overcome both the physiological and psychological trauma is almost seen as a challenge of physical and mental courage, this is clearly demonstrated by the story of Douglas Bader during the Second World War. His exploits have been immortalised in books and movies (Brickhill 2000). For others a lifetime of depression and social withdrawal are potentials.

Applying Theory to Practice: Exercise 8.6

Why do you think people react so differently when confronted by trauma or an alteration to body image?

How do you think you would react?

Would you expect others to act in the same way as you or do you accept that an individual's response will always be unique although many characteristics may be similar and happen at differing times?

Suffering a traumatic loss of a limb has been described in a similar way to the loss of a family member or friend, in that the individual must go through several stages of grief in order to regain a sense of normality and acceptance of their loss. These stages of grief are described as:

- Acceptance
- Denial (not believing/accepting the loss)
- Adjustments (getting on with ordinary life)
- Letting go.

Applying Theory to Practice: Exercise 8.7

Which of these stages do you feel Mr Bulthorp-Smyth is in?

- Do you have a duty of care to assist him with accepting the alteration to his body image or are you solely concerned with his physiological problems such as infection?

Professional issues

Nurses need to understand that the patient will have to live with an alteration of their body image for the rest of their lives and should therefore try and understand the viewpoint of the patient. Despite the wide use of the term body image, it is a poorly defined term. Atkinson (2002) describes body image as a non-static concept, developing early in life and altering at the key stages of life experience and development such as puberty, pregnancy and ageing. One definition of altered body image is a state in which personal distress indicates that the body no longer supports the individual's self-esteem, causing social dysfunction to the individual. This is caused by limited coping strategies or an overwhelming injury, disease, disability or social stigma (Price 1995). Gaining insight into the individual's feelings, showing empathy and empowering the patient to regain control of their life are essential elements to providing quality of care and assisting them to regain their long-term health and social well-being. Qualitative tools such as the Amputee Body Image Scale exist that can be used to assess or measure how a patient perceives, or feels about, his or her body disturbance (Breakely 1997).

Mr Bulthorp-Smyth is currently failing to accept the loss of his limb. His feelings probably involve anger directed at himself; these feelings can quickly be directed at others if he is pushed too far too early. This means a gentle, non-threatening approach to his care is essential; this will involve active listening skills. Encouraging the patient to eat is also essential to the physiological process of wound healing; supplements may need to be prescribed if failure to eat continues. Family support or the input from friends can provide far better outcomes than healthcare intervention alone. His friends and family will also have psychological needs, but they may be able to assist him into accepting this change and overcoming his newfound disability. Support networks have been shown to be extremely effective to the long-term prognoses of patients. Most debilitating or disease states have national and international support networks whereby those afflicted can discuss their personal experiences and share ways of overcoming problems they may encounter. There can be many positive aspects involved in this and patients should be given information on their existence. Counselling may also be an option; many associations or help groups will have details of reputable practitioners with whom the patient may seek a consultation.

Assessment of the musculoskeletal system

To be able to fully assess and treat injuries to the musculoskeletal system it is essential that a systematic approach be applied. This part of the chapter will look at a systematic approach that can be applied to both acute and chronic disorders of the musculoskeletal system. Before beginning an assessment of the injury, establishing cause and prior problems need to be discussed with the patient, as this in turn will have an impact on the physical assessment. The general pattern for assessment of an individual with a musculoskeletal injury is the Look, Feel, Move principle, but the same principle can be applied to any person with a musculoskeletal problem whether it is chronic or acute.

Acquiring information

When assessing patients with any injury or disorder of the musculoskeletal system, it is important to take a full history. It is best to allow the patient to tell you in their own words what has happened and the reason why they have attended. The patient may be a child, a person who cannot speak English or an elderly patient who has dementia. Always look at the individual and look for non-verbal cues, as this will help you gather important data, for example, how much pain they appear to be in. As well as asking about the injury you need to acquire other information, which is listed below:

Presenting complaint (PC)

- What has happened that has made the patient seek medical assistance?

Applying Theory to Practice: Exercise 8.8

Before commencing this part of chapter:

- Compose a list of the injuries to the musculoskeletal system that you think may require emergency treatment
- Write a list of the questions you need to ask when a patient presents with an acute injury
- What information helps you to ascertain the type of injury and the correct course of treatment?

Add this list to your developing portfolio and on completion of this chapter expand your portfolio with the new disorders you have gained knowledge on and elaborate on how these disorders affect physiological function and how to recognise a patient with them.

Think of the advice you would give to a patient presenting with these problems to ensure that they have a quick recovery and can return to normal function rapidly .

History of presenting complaint (HPC)

- How did it happen?
- When did it happen?
- Why did it happen?
- What happened?
- Where did it happen?
- Past medical history
- Medication
- Allergies
- Social history

When this information has been elicited, the patient will require examination. This can be applied by structuring the assessment in the following way:

Look

If the patient is walking, observation of their gait and posture is essential as this may lead you to document postural deformity, which may be a chronic problem or may give a clear indicator of an acute injury, for example, if they are limping. If examining a limb, the principles are the same and below are some aide-mémoires of what should be looked for and in turn documented.

Swelling

It is important to note if there is any swelling present and, if so, whether it is localised or diffuse. If the swelling is localised think of the underlying structures that therefore may be affected. This goes hand in hand with considering the mechanism of injury. Establishing this simple information can help you form a working diagnosis. If swelling is confined to a joint, it can be one of three problems:

- **Blood** (haemoarthrosis): this can occur from a recent injury, but can also occur if the patient is suffering from a blood coagulation defect. It would be unusual for a blood disorder to be discovered through an acute injury and is more likely to be an ongoing problem that the patient is aware of.
- **Effusion**: caused by excess synovial fluid. This can occur from trauma or a non-pyogenic inflammatory process. A couple of examples of the latter are rheumatoid arthritis or osteoarthritis.
- **Pus** (pyarthrosis): possibly from acute pyogenic infection (McRae 2004).

If swelling is diffuse and travels further than the joint, it can often indicate a more serious cause. This can be seen in the presentation of a patient suffering from a major infection, tumours or a problem with lymphatic and venous drainage.

Bruising

Is there any bruising present? This may be an indicator of trauma, and it is important to note whether the bruising is relatively new or if it is old; this can be apparent by the discoloration of the bruise. This is vitally important to document especially if there is any indicator of abuse, whether it be child abuse, elder abuse or if the patient is a victim of domestic violence. Potentially this could have been established from the history given of the injury by the patient.

Deformity

Is there any obvious deformity, and if there is, does it require urgent treatment to protect the integrity of the limb? Is the skin shiny and appears under pressure from the underlying bones? Patients presenting with an obvious deformity to a lower limb, often a fracture dislocation, need urgent treatment and this should not be delayed for X-ray.

Wounds

Are there any wounds, or is the skin intact? If there is a wound, what does it look like? Is it a straight laceration or jagged? Is the wound clean or dirty? Is the wound bleeding? Is it controllable or not? Is the wound deep? Are underlying structures visible and if so to what depth? Purcell (2004) writes that the fundamental concept of wound assessment and treatment is never to close a wound unless you have seen the base. Is there any evidence of necrosis to surrounding skin edges? Most of the above questions can be addressed by observing the wound with the naked eye. However, if the wound is bleeding excessively, it may hinder the ability to observe the base.

Discoloration or oedema

This may occur due to infection or trauma. Also consider past medical history as this may give information as to a potential reason for the oedema. For example, a patient who has had a mastectomy may have lymphoedema of the arm on the affected side, which has then been injured.

Muscle wasting

This occurs in a long-term condition and is rarely seen in acute injuries, although it may depend on the time lapse before the patient presents. It often occurs because of disuse due to pain or inability to move the affected area. It can also occur from denervation of muscles (McRae 2004).

Look to see if there is any change in the posture of the patient; consider congenital abnormalities, previous injuries and past medical history. Once the look phase has been performed, the feel/palpate process can be carried out and findings documented accordingly.

Quite often you will find a diagram of the affected injury in the patient's notes. This is particularly useful when describing and demonstrating certain injuries, especially wounds.

Under the look section it is important that the affected side is compared to the non-injured side.

Feel

Often this section of examination is termed as palpation. The object of feeling the affected area is to discover a variety of different factors, which are mentioned below. This assists in the differential diagnosis and helps to establish what might be wrong with the presenting symptoms.

Temperature

Establishing whether a limb/joint is warm or cool is important in a differential diagnosis. The information that you are looking for is whether the increase in temperature is localised or more diffuse. Generally, when the increase in temperature is localised, it suggests inflammation of underlying structures. If the warmth is more widespread, it means a larger amount of tissue is involved. If a limb is cool or cold it may indicate that for some reason the circulation is impaired.

Tenderness

Seeking where the point of maximum tenderness can be elicited is vital in trying to form a differential diagnosis. If there is generalised tenderness, it can make a diagnosis more difficult, but once again knowledge of the underlying anatomy can assist. When examining a joint it is important to examine the joint above and the joint below the affected area. Also the non-affected side should be examined and comparisons made.

Sensation

Sensation should be assessed in all patients who present with an injury, whether it is an ankle injury or a wound. Assessing sensation is vitally important as it may indicate areas of paraesthesia, which could direct you to a nerve injury. Sensation is assessed for both light touch and pin prick and there are a variety of different methods to assist in this assessment. If sensation is normal then this should be documented.

Perfusion

Assessing the capillary refill, which should be less than 2 seconds, is a key indicator of damage to the affected area. If there is a delayed capillary refill it should be reported on and acted on accordingly. Assessment of distal pulses should be assessed and documented. Any absent pulses need to be reported immediately, but beware that in the feet they can be difficult to find in the first place.

Movement

Generally, acute injuries that affect a limb will be associated with some restriction of movement within the related joint. Assessment of movement takes two forms: active movement and passive movement. Patient compliance is vital in order to be able to fully assess the range of movement of the injured part. First, the patient should be asked if they can perform a range of movements and any restriction documented. Once again it is essential that the good side be compared to the bad. The range of movements assessed will be dependent on the presenting complaint. This is also pertinent in the patient with a chronic condition or injury.

Once attempted active movement has been assessed the examiner will try and put the affected limb through a range of passive movements. Movement can be restricted due to an injury; also consider if the patient is in pain whether it is advisable to administer analgesia and then reassess the range of movement when it becomes effective. A restricted range of movement is normally always due to a mechanical cause.

Conclusion

Now that you have completed this chapter you will have gained considerable insight into both the functioning of the musculoskeletal system and the psychological and physical impact failure or alteration of the system can have. Reinforce your knowledge by continually reviewing the anatomy and physiology of the musculoskeletal system, as this is essential to adding this knowledge to your long-term memory. When you encounter new patients who have sustained injuries, imagine how these injuries or illnesses may have affected their lives. This may include minor changes, such as a reduced lifting capacity, through to the inability to play instruments or participate in their chosen career. By empathising with a patient's situation and understanding the inner workings of the body, nurses can have a significant impact on the future well-being of patients within their care.

Chapter 8 Summary Quiz

1. The skeleton is described as being predominantly divided into two parts:

A. The axial and appendicular skeleton
B. The limbs and the torso
C. The legs, arms and trunk
D. The torso and peripheries

2. There are two main types of bone tissue:

A. Long and flat
B. Compact and large
C. Compact and cancellous
D. Dense and superficial

3. Bones store minerals, why can this be dangerous?

A. Too much potassium can lead to the bone wasting
B. Too much calcium can lead to rickets
C. Poisonous minerals such as mercury can be accumulated leading to cancer
D. Storing minerals means the body could be in short supply

4. Common diseases affecting the bones include:

A. Osteoporosis
B. Paget's disease
C. Osteoarthritis
D. All of the above

5. Three common malformations of the spine are:

A. Scoliosis, moleosis, kyphosis
B. Lordosis, lumpyosis, kyphosis
C. Scoliosis, lordosis, kyphosis
D. Kyphosis, lumpyosis, scoliosis

6. Spina bifida is caused by:

A. A congenital deformity
B. Cancer of the spine
C. Interbreeding
D. A lack of fruit and vegetables

7. The spine consists of how many vertebrae?

A. 33
B. 31
C. 21
D. 65

8. Name the three types of muscular tissue:

A. Skeletal, rough and splenic
B. Skeletal, smooth and cardiac
C. Skeletal, smooth and cylindrical
D. Skeletal, bone and brain

9. Ligaments connect:

A. Bone to tissue
B. Bone to muscle
C. Bone to ligaments
D. Bone to bone

10. Eversion means:

A. Turning inwards
B. Twisting laterally
C. Turning outwards from centre
D. Bringing opposing bones together

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9

The reproductive system

Lucy Tebbit

Chapter 9 Learning Objectives

- To gain knowledge and understanding of the anatomy and physiology related to the reproductive system
- To gain understanding of several conditions related to the female and male reproductive systems
- To be able to apply theory to practice by understanding the physical signs of these illnesses
- To have insight into the psychosocial aspects of these patients
- To be aware of some of the ethical dilemmas that occur within clinical practice
- To construct solid evidence of professional development for your growing portfolio
- To continue developing the ability to question and critique the evidence base and effectiveness of plans of care

Introduction

The reproductive system is one of the only systems in the body that is dimorphic, meaning it is both functionally and structurally different in males and females.

This chapter will initially focus on the anatomy and physiology of the male and female systems. The reproductive system is particularly important as it enables the human species to survive, but when it becomes diseased or illness affects this system, it can have devastating consequences, both physically and psychologically. Both systems are able to function as a response to male and female sex hormones, which are secreted by the gonads or sex glands.

This chapter will begin with an overview of the reproductive systems, identifying the anatomy and physiology of the male and female systems. Some of the common diseases associated with this system will be addressed. The effect these diseases have on the individual and their partner will also be examined; this will enable the reader to explore both the physiological components of the disease process and the associated psychological aspects.

Applying Theory to Practice: Exercise 9.1

Before reading on:

- Compose a list of diseases you already know that affect both the male and female reproductive systems.

Add this list to your developing portfolio. On completion of this chapter expand your portfolio with the new disorders you have gained knowledge on.

Function

The reproductive system enables the human species to continue and genetic material to be passed from parent cells to daughter cells. Various organs of the reproductive system are formed during the embryonic stage, but normal functioning of the reproductive system begins at puberty and for women lasts approximately thirty years until the menopause occurs. For men the decline is more gradual and slows with the ageing process. The organs can be grouped by their function: the testes and ovaries are known as gonads and their function is to produce gametes and secrete hormones. The testes produce sperm cells and the ovaries produce ova. The ducts transport and store the gametes. Finally there are the accessory sex glands, which support the gametes by producing liquid to support the semen and cervical mucus to receive the spermatozoa.

The male reproductive system is made up of testes, ducts, accessory sex glands and supporting structures, which includes the penis. The penis and scrotum, which contain the testes, are all external organs, which can make them susceptible to damage, as they are not well protected. Conversely the organs of the female reproductive system are mainly located internally in the lower abdomen; here they are protected from physical trauma, but they can be injured or damaged by disease or infection.

The male reproductive system

Scrotum and testes

The scrotum (Figure 9.1) is a sac-like structure, which originates from the abdomen; it consists of loose skin and fascia. Its function is to support and regulate the temperature of the two testes. The scrotum is divided in two by a septum composed of superficial fascia and smooth muscle fibres, which are known as dartos muscle. This muscle allows wrinkling of the skin and is able to contract to regulate the temperature of the testes. The septum allows the testes to sit in separate sacs. Sperm can only be produced and survive if the temperature is three degrees lower than the core body temperature. The location of the scrotum and testes allows this temperature to be achieved. The cremaster muscle also helps with this regulation as it allows the testes to elevate or descend depending on the environmental temperature. When sexually aroused, the testes move closer to the pelvic cavity to enable the heat to be absorbed. The testes are located high in the abdominal wall during embryonic development; they begin to descend into the scrotum at approximately seven months' fetal development. The testes are oval glands that are approximately 5cm long and 2.5cm wide. The testis (one testicle) divides into 200–300 compartments, known as lobules. Within each lobule there are **seminiferous tubules**, where sperm are produced. The seminiferous tubules contain spermatogenic cells of varying stages of development. Those that are near maturity are known as spermatozoon; these move to the lumen of the tube where they are ready to be released into a series of ducts. They will then be stored in the **ductus epididymis** until they are needed. The youngest cells are known as spermatogonia and are found at the basement membrane, as they mature, they pass through the tubules.

Within the tubules are Sertoli cells (sustentacular cells), which are cells that aid the movement of, and provide nutrients and metabolites to the sperm cells. They also prevent blood-borne cells from reaching the sperm. This is known as the blood–testis barrier. This barrier is important as it prevents the immune system responding to the sperm, as it would be recognised as a foreign body when in contact with blood. This would produce an immune response that would attack the sperm cells. Seminiferous tubules also contain Leydig cells; these cells secrete the male hormone testosterone. The Sertoli cells also mediate the effect testosterone and follicle-stimulating hormone (FSH) have on the process of spermatogenesis – the production of sperm.

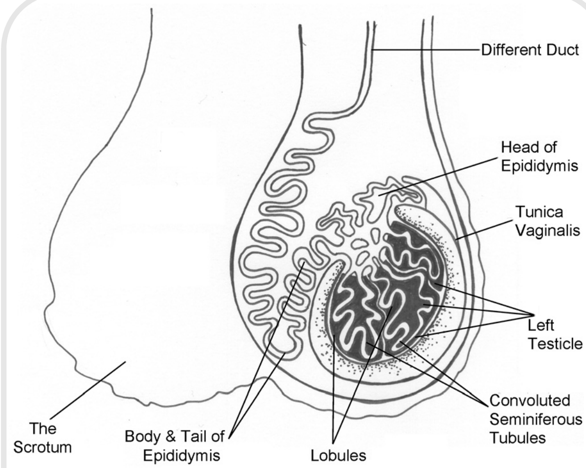

Figure 9.1 The scrotum, testicles and ducts

Scenario 9.1

Testicular Torsion

Rob Short, a 19-year-old Caucasian man, walks into to the emergency department after suffering a sudden onset of pain in his left testicle four hours before. He states that the testicle is swollen although it is not visualised at triage. He looks pale and is sweating.

His vital signs are as follows:
Respiratory rate 18, pulse 98, blood pressure 110/72, temperature 36.9
Pain score on assessment is 3 out of 4
He has no relevant medical history and no known allergies to medicines

Assessment and analysis of patient presentation

Mr Short has presented with clinical signs and symptoms of testicular pain. The most serious condition associated with the sudden onset of pain in the testicles is torsion of the testicle. His vital signs show an increased heart and respiratory rate, and he is sweating, a sympathetic response to pain. He also says that he has a pain score of 3 out of 4, categorised as severe pain. He asks that a male doctor examine him, as he feels very embarrassed. Mr Short falls within a high-risk category for testicular torsion due to his age. Testicular torsion is more common in teenagers but can occur at any age (NHS Direct 2007). The acute onset of his pain is also another indicator of testicular torsion, a more gradual onset could be a number of other conditions listed in Applying Theory to Practice: Exercise 9.2.

Applying Theory to Practice: Exercise 9.2

Illnesses or Diseases Related to Testicular Pain

Research and record the signs and symptoms of these conditions and possible treatment options:

- Epididymitis – inflammation or infection of epididymis
- Orchitis – inflammation of testes
- Varicocele – varicose veins around testes
- Testicular cancer – tumour of the testes

Pathophysiology

A testicular torsion is the twisting of a testicle. In many cases the men have what is known as a bell clapper deformity, when the testicles are able to freely rotate and the testicles sit significantly lower in the scrotum; the patient may not be aware of this deformity. Patients with bell clapper deformity are more at risk of torsion as the testicle can move more freely enabling the spermatic cord to become twisted. The spermatic cord contains the vas deferens, autonomic nerve, testicular veins and artery. When the cord becomes twisted, it occludes the blood supply to the testicle. If the testicle is not surgically untwisted within six hours, it will infarct and the testicle will perish. If the man ignores the symptoms for more than six hours, the testicle may be unsalvageable; this may lead to an orchiectomy (removal of testicle). The fertility or sexual function of these men should not be affected as the remaining testicle can still produce testosterone and sperm. If the blood supply is restored during surgery these men will have normal sexual function and fertility too.

In conjunction with Cancer Research UK, the Department of Health (2005) produced a document entitled *A Whole New Ball Game* to encourage men to examine their testicles regularly. It was also produced to raise the awareness of testicular cancer and to make men less embarrassed about seeking help when they have problems with their testicles.

Treatment

Mr Short was categorised as 'orange' by the triage nurse in accordance with the Manchester Triage Code (1994). He was taken to the 'majors' area of the department and seen by a male doctor. Mr Short was complaining of severe pain and requested analgesia. After an initial ABC examination the doctor ordered the insertion of a cannula, blood tests and analgesia. The cannula was inserted using an aseptic technique and bloods were taken for urea and electrolytes (U&E), full blood count (FBC), clotting and cross-match. These results would indicate an electrolyte imbalance (U&E), which would be unlikely as Mr Short is normally fit and healthy, raised white cells indicative of infection, bleeding (FBC), clotting disorders, and the cross-match would ascertain his blood group and enable the doctors to access blood transfusion if required during surgery. Mr Short was given morphine sulphate 10mg titrated to his pain. This was in accordance with local protocols and he was given 1mg at a time until his pain had subsided; he was also given an anti-emetic intravenously. The anti-emetic is given prophylactically to prevent nausea and vomiting, a common side effect of morphine.

After the pain relief the doctor was able to examine the testicle. The left testicle was swollen and extremely tender. These findings, along with the acute history of this problem, were indicative of torsion of the testicle. Mr Short was referred to the on-call urologists for further management. The urologist examined Mr Short and explained his findings; some NHS Trusts offer ultrasound as a diagnostic tool. The ultrasound will identify the blood flow to the testicle (UrologyHealth.org), but it is also recognised that time is the most important factor when a patient has a testicular torsion and therefore many urologists will be led by history and clinical findings.

The urologist was keen to take Mr Short to theatre as he had suffered the pain for four hours and the testicle is only viable up to six hours. The surgeon explained the risks of the surgery, and also explained that after he had untwisted the spermatic cord he would perform testicular fixation on both testicles. This procedure involves suturing the testicles to the inner lining of the scrotum preventing future torsion. Mr Short had to sign a consent form for the operation; the surgeon had to explain the risks of surgery, such as infection and also the possibility of proceeding to an orchiectomy if the testicle had already infarcted. Mr Short expressed his fear of having problems with sexual activity and fertility post-operatively. The surgeon had a responsibility to reassure him that sexual function would not be affected and that, despite an orchiectomy, sperm production would continue from the other testicle. He would also explain the likelihood of having to remove the testicle as he has been treated within four hours of initial onset. Mr Short was then taken to theatre for his operation.

Applying Theory to Practice: Exercise 9.3

Blood Test Results

Review and start to learn normal blood results. In clinical placements begin to build up a portfolio of blood results, look at the patients' clinical findings against their results. Identify markers for:

- Infection
- Anaemia
- Renal impairment.

Psychosocial aspects

It is important to consider Mr Short's fears and anxiety about the operation. It is important that he is able to understand the procedure and its possible outcomes; this may help allay his fears. Mr Short was admitted for emergency surgery so was unable to seek out information; his fear may have led to slower post-operative recovery. Giving pre-operative information can influence a patient's recovery, reduce anxiety and reduce pain scores. Giving good procedural information and behavioural instructions that include how to behave after the operation can result in better post-operative recovery. A further influence on the patient is the language the health professional uses to explain a procedure to them; a patient is more likely to comply and have surgery if they feel it will be of benefit to them. It is important that patients fully understand the procedure they are having. Mr Short was worried about the long-term effects on his fertility and sexual health; the surgeon must alleviate these fears.

Conclusion

Mr Short was admitted to the surgical unit post-operatively. He recovered well from surgery. After surgery the nurse measured his vital signs and monitored the wound on his scrotum. This was to ensure that he was haemodynamically stable and that he had no haemorrhage or infection from the wound. He was offered regular analgesia; when he accepted pain relief a pain score was taken before analgesia was given and then 30 minutes after to ensure that pain relief had taken good effect. It is important to reassess pain scores to evaluate the effectiveness of the analgesia given. Mr Short continued to recover well post-operatively and was seen by the consultant two days later and discharged home. Before being discharged he was given a leaflet about caring for his sutures. He was also advised to wear a scrotal support and the nurse sat with him and spoke to him about his concerns. He was told by the nurse what to expect during his recovery and was advised to have sexual intercourse when he felt ready, but if he had any pain to stop. She also told him the signs and symptoms of infection. It is important to give the patient time to discuss any concerns they have before discharge. It is also good practice to give written information for them to refer to. Many leaflets given out by NHS trusts have a contact telephone number; this enables the patient to leave feeling confident that if they develop any symptoms or concerns they have access to a healthcare professional.

Questioning Clinical Practice: Exercise 9.4

While on clinical placement discover what type of advice is given to patients on discharge from surgical units.

- Do all patients get verbal and written information?
- Can the patient get advice following discharge? Is there a contact number?
- Is there a failed discharge policy, for patients who are readmitted within 24/48 hours?

Epididymis, ductus (vas) deferens, ejaculatory duct and urethra

The seminiferous tubules move into the straight tubules that connect with a network of ducts known as the rete testis. The rete testis connect with the epididymis via the efferent ducts. The epididymis is an organ that is located on the posterior border of the testes. It is made up of tightly coiled tubes known as the ductus epididymis and is shaped like a comma. The epididymis is lined with pseudostratified columnar epithelium that is encircled by layers of smooth muscle. This smooth muscle helps propel the spermatozoa towards the urethra by a peristaltic action. If the spermatozoa are unused they can be stored for one month before degenerating; they are then reabsorbed by the ductus epididymis. This is possible as it also contains microvillli called **stereocilia**, which increase the surface area of the ductus epididymis, thus enabling reabsorption to occur. The main function of the ductus epididymis is to enable the maturation of the sperm. During this period the sperm increases its motility and becomes fertile.

The ductus epididymis is divided into three areas. The head is the largest portion and it joins the efferent ducts to the ductus epididymis. The body is the narrow, central portion of the epididymis and the tail the smallest area; this continues as the ductus (vas) deferens. It is a long duct that penetrates the inguinal cavity before ascending into the pelvic cavity; here it loops over the urinary bladder. It then dilates into the ampulla; this is located at the terminal end of the vas deferens. The ductus (vas) deferens is supplied with blood via a small vessel that comes from the superior vesical artery. These make up the spermatic cord.

The seminal vesicles (accessory sex gland) and the ductus (vas) deferens then unite; here they form the ejaculatory ducts. The function of the ejaculatory ducts is to eject spermatozoa into the urethra just prior to ejaculation.

The urethra is the final duct for both the urinary and reproductive system. Its function is to act as a passageway for both urine and spermatozoa and fluid known as semen. The male urethra is divided into three areas. The prostatic urethra passes through the prostate gland. As it passes through the urogenital diaphragm it becomes the membranous urethra. Finally it passes through the corpus spongiosum of the penis to the bulb of the penis, known as the spongy urethra. The angle between the membranous urethra and spongy urethra is abrupt; it is important to remember this anatomy when catheterising male patients. The spongy urethra then terminates at the external urethral meatus.

The prostate gland, seminal vesicles, and bulbourethral gland

The prostate gland, seminal vesicles and bulbourethral gland are also known as the accessory sex glands. These glands produce most of the liquid that makes up semen.

The prostate gland is a spherical-shaped gland that lies below the urinary bladder. It secretes a milky fluid that is made up of citric acid and enzymes, which include clotting enzymes and fibrinolysin, enabling the semen to clot after ejaculation; fibrinolysin then decomposes the clot. This fluid aids both the motility of the sperm and keeps it viable. The prostate gland can dramatically increase in size with advancing age (benign prostatic hypertrophy); this can result in partial obstruction of the urethra causing problems with urination.

The seminal vesicles are pouch-like structures that are located at the base of the bladder and lie laterally to the ampulla. This gland secretes alkaline fluid that contains fructose, prostaglandins and fibrinogen. The prostaglandins aid the motility of the sperm and stimulate muscular contraction within the female reproductive tract, thus enabling the sperm to be transported to the ovum. The alkaline in the fluid neutralises the acid within the female reproductive system; if it remained acidic, it would destroy the sperm.

The bulbourethral glands are found as a pair and are located beneath the prostate gland, within the urogenital diaphragm. These glands also secrete an alkaline fluid and mucus that additionally protects the sperm against the acidic environment within the urethra; the mucus acts as a lubricant.

The penis

The penis is a cylindrical structure that can also be divided into three parts: the body, the root and the glans penis (Figure 9.2).

The body has three types of tissue that are cylindrical in shape, known as the corpora cavernosa penis, which makes up two parts of the tissue mass, and the corpus spongiosum penis, which is smaller and contains the spongy urethra. The tissue is enclosed by fascia and skin; these contain erectile tissue, which enables the penis to become erect. The root of the penis is the attached part and contains the bulb of the penis. The glans penis is acorn-shaped and is located at the distal end of the penis. The external urethral meatus is the opening for urine and semen to pass through; this is located at the glans penis. The foreskin, known as the prepuce, covers the glans penis. During sexual stimulation

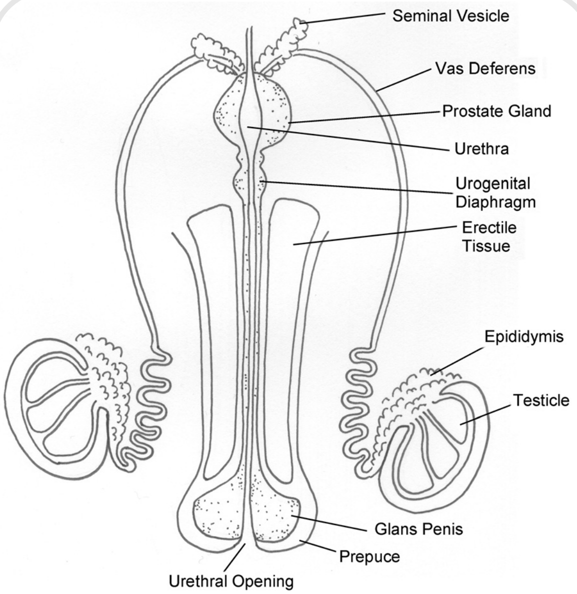

Figure 9.2 The penis

the arteries supplying the penis dilate and blood floods the blood sinuses. This in turn compresses the veins, trapping the blood in the penis causing an erection. While the penis is erect, ejaculation may occur. This is the forced expulsion of the semen. During ejaculation only semen is expelled as the smooth muscle sphincter located at the bladder closes to prevent urine loss, and also prevent semen entering the bladder. The function of the penis is therefore to expel urine and semen.

Scenario 9.2

Chlamydia

Billy Rodham is a 21-year-old who attends his local genitourinary medicine (GUM) clinic. He complains of a discharge from his penis. He feels otherwise well. He gives a sexual history of having unprotected sexual intercourse three weeks ago with a new partner whom he has only seen in the pub on occasions and is unsure of her name.

Vital signs: respiratory rate 10, pulse 64, blood pressure 128/68 temperature 36.4
No relevant medical history, no previous sexually transmitted infections (STIs)
No allergies

Assessment and analysis of patient presentation

Mr Rodham is physically well; all his vital observations are unremarkable. He is complaining of discharge from his penis and redness around the head of the penis, which he noticed three days ago but was too embarrassed to seek help. The nurse at the clinic establishes a sexual history from him, as this will ultimately aid diagnosis. He confirms that he had recent vaginal intercourse with her and has had unprotected vaginal intercourse twice in the last six months. He has never had a sexually transmitted infection (STI) before. Chlamydia and gonorrhoea are the two most likely causes of his complaint although the nurse feels it is most likely to be chlamydia.

Chlamydia – the facts

Genital chlamydia is the most common sexually transmitted infection (DH 2007). It is caused by the bacterium *Chlamydia trachomatis*. Prevalence is highest in sexually active women aged 16–29 and men aged 18–29 (DH 2007). The bacterium can cause an array of symptoms such as cystitis, vaginal discharge and pelvic inflammatory disease (PID). Ten to thirty per cent of women with chlamydia will go on to develop PID, a major reproductive health problem (DH 2007). PID is a major cause of infertility in women; it can also cause miscarriage and ectopic pregnancies. For men the symptoms include urethral discharge, urethritis (inflammation of the urethra) and epididymitis, and in rare cases a condition called Reiter's syndrome that affects the joints and eyes. It can also lead to impaired fertility in men. The incidence of chlamydia has risen 300% in the last 12 years. There has been a 200% rise in other STIs such as gonorrhoea, and a 300% rise in HIV (NICE 2007). It is suggested that opportunities to discuss and make a risk assessment of young people's risk of contracting an STI may arise while carrying out a consultation about contraception, cervical smears or even travel immunisations (NICE 2007). The aim is to provide one-to-one structured discussions with high-risk individuals in order to help them change their sexual behaviour. In 2002 the DH implemented ten national screening programmes for chlamydia, and by 2006 screening was available in 85 areas.

Psychosocial issues

Mr Rodham has delayed attending the GUM clinic for three days after the symptoms arose because of embarrassment. He was also having unprotected sexual intercourse with an unknown woman. This is a common presentation of a young person with an STI; unprotected sex is still a major issue in the UK. When deciding on the use of contraception, individuals use both developmental and decision-making processes (Sheeran et al. 1991). These can be categorised into four areas: first, the background of the person – women are more likely to use contraception than men and people with higher educational aspirations are more likely to use contraception than those with lower or no aspirations; second, the interpersonal skills possessed, including a person's attitude to contraception – for example, Mr Rodham may have felt that condoms ruin the spontaneity of sex; the third factor is interpersonal factors such as peers – if Mr Rodham's peers do not use contraception, he is unlikely to. Finally there are situational factors that contribute to the use of contraception. These factors include the spontaneity of the act; the accessibility of the contraception; and finally substance misuse prior to sex may make the individual take more risks. However, it is also important to point out that it may be a problem with confidence. Bandura (1997) believes in self-efficacy, which may occur after a person has had practice at using a condom or by watching a video on how to apply a condom, or by having peer group discussions. It is therefore important that young people have access to sex education in order to have self-efficacy when in situations where contraception is needed. The DH has a policy, (NSF 2004), which aims to deliver many skills including sex education and drugs awareness to children at school.

When discussing contraception with Mr Rodham it is important that the healthcare professional recognises the individual circumstance of each person. They must also take the opportunity to give health advice and safe-sex education to the patient.

Professional issues

There are two main areas when looking at Mr Rodham's care. One is the area of health promotion and the other is the health of the woman he had sexual intercourse with. Chlamydia has increased dramatically over the years and it can affect both men's and women's fertility. It is important that healthcare professionals offer immediate care and relief from the illnesses, but it is equally important to address the health promotion aspects of their care. The Health Belief Model (Rosenstock 1966) believes that a person may be motivated to carry out preventative health behaviours when they have had a perceived threat to their health. Mr Rodham has had a

Questioning Clinical Practice: Exercise 9.5

Questioning Your Own Beliefs

Think about your own beliefs about contraception and STIs.

- Do you believe in the use of contraception?
- Do you think only promiscuous people get STIs?
- Do you think sex education and safe sex should be taught to young children?

Write down your beliefs and reflect on how this affected your own sexual behaviour and how you will deal with patients who have very different belief systems.

test for chlamydia and he may perceive this as a real threat to both the health of his fertility and his sexual health. This may make him ready to listen to and act on advice.

It is important to advise Mr Rodham to use condoms when having sex with unknown partners. Condoms are a highly effective method of barrier contraception (Guillebaud 2000). The biggest advantage is that they are the only form of contraception that reduces the risk of both pregnancy and STIs. Remembering the issues surrounding his beliefs and self-efficacy, it is important to make sure he knows how to use a condom; it may be more appropriate if he talks to a male colleague or peer.

It is also important that if the patient has a positive chlamydia result, they ensure that any sexual partners are tested. As a healthcare professional it is important that this area is not forgotten. Mr Rodham had only met his most recent partner in a pub: it is therefore important that he knows the serious effect chlamydia can have on female fertility. There may be situations where the nurse knows the patient and his or her partner; this can cause ethical dilemmas as they are bound by the NMC Code of Professional Conduct (2004) not to break confidentiality, but they also have a duty of care. In this situation the nurse must advise the person to tell the partner, as they are not able to break confidentiality, but it is important that they too understand the seriousness of chlamydia. As part of the DH national screening programme there are forms that can be used to inform partners of a positive test result; this document recommends that partners from the last six months are contacted. This is important to convey to Mr Rodham, who may have had several partners who need to be tested. The GUM clinic may be able to help contact them.

Developing & Delivering Expert Care: Exercise 9.6

Ethical Dilemmas in Practice

- Mr Rodham is 21 years old, but what if he was 14? Ethically should you give him condoms?
- Do you have any obligation to inform his parents?
- How would your decision be supported by the code of professional conduct?

For more information about sexual health, visit www.fpa.org.uk or www.nhsdirect.nhs.uk

Treatment

Mr Rodham has presented to the GUM clinic with symptoms of chlamydia. The current test for men is a urine dipstick, which is slightly less reliable than a swab that can be taken from the opening of the urethra. This, however, is a more painful test than a urine sample. Women can also be tested by the use of urine samples or low vaginal swabs. There are also home testing kits, although these are thought to be less reliable. Mr Rodham is given the news he has chlamydia. The treatment of choice is antibiotics; the most commonly used are azithromycin and doxycycline. Azithromycin is administered as a single dose whereas doxycycline is taken twice daily for seven days. The possible side effects of diarrhoea, nausea and stomach pain are explained to Mr Rodham and he is advised to complete the course. If a patient follows advice and completes the prescribed course of antibiotics, they are likely to make a full recovery and be cured of chlamydia. He will be advised to have safe sex using a condom at least until he has completed the course. If he always uses a condom in the future he is unlikely to become re-infected with chlamydia or any other STI.

Male hormones and spermatogenesis

There are six key hormones that are relevant to male development and the reproductive system:

- Testosterone
- Dihydrotestosterone (DHT)
- Follicle-stimulating hormone (FSH)
- Luteinising hormone (LH)
- Gonadotrophin-releasing hormone (GnRH)
- Inhibin.

Testosterone can be found in the testes and is the main male sex hormone (androgen). It may be reduced and converted into another androgen known as dihydrotestosterone (DHT) in some target cells. There are several functions of testosterone. Prior to birth it stimulates the fetus to develop a male reproductive system and ensures the descent of the testes from the abdominal wall to the scrotum. During this stage of development the DHT stimulates the growth of external genitalia such as the penis. The androgens are also converted to oestrogens and this aids development of certain areas of the brain. At puberty, testosterone and DHT work to ensure the transition from child to sexually mature man. This includes growth of genitals, increased muscle mass and change in skeletal structure. It also deepens the male voice by increasing the size of the larynx. Finally it aids **spermatogenesis** (production of sperm) making the male fertile and is responsible for libido in both men and women.

The **anterior pituitary gland** secretes FSH and LH during puberty. These hormones are known as gonadotrophic hormones. The FSH is responsible for stimulating the Sertoli cells, which in turn initiates spermatogenesis. LH stimulates the Leydig cells to release testosterone. The **hypothalamus** also plays a part by secreting GnRH; this hormone is essential as it regulates the release of FSH and LH. The aim of regulating the hormones is to ensure that testosterone levels remain at a certain concentration in the blood. If the levels are too high, it inhibits the release of GnRH, which in turn reduces the release of LH, this then inhibits the release of testosterone. This is known as a negative feedback system. Finally inhibin is a hormone that regulates spermatogenesis. The hormone is located in the Sertoli cells and is released when spermatogenesis has reached an optimum level for reproduction. This in turn inhibits the secretion of FSH, which then slows the process of spermatogenesis.

Spermatogenesis is the process that occurs in order to produce spermatozoa. On average a man will produce 100 million sperm with each ejaculation. Once ejaculated, sperm have a lifespan of 48 hours in the female reproductive system, but up to 20% of these sperm are abnormal with no tails or two heads. Higher percentages of abnormal sperm or not enough sperm in the semen can lead to infertility. The process of spermatogenesis takes approximately 74 days, and has three phases: mitosis, meiosis and finally spermiogenesis.

Anatomy and Physiology in Action: Exercise 9.7

The previous section provided a basic overview, to reinforce and expand your new knowledge discover what the following terms mean:

- Oligozoospermia
- Azoospermia

Add this information to your portfolio.

The anatomy and physiology of the male reproductive system have been discussed. It is important to find out about some of the pathophysiological changes that can occur within or to this system.

Anatomy and Physiology in Action: Exercise 9.8

The Male Reproductive System

Discover what the following problems are and write a synopsis of your findings for your growing portfolio:

- Cryptorchidism epididymitis
- Inguinal hernia paraphymosis
- Benign protastic hypertrophy

Function of female hormones

In females, **oestrogens** promote the development of reproductive structures, in particular the changes in the endometrium with each cycle, development of the secondary sex characteristics, including development of breasts, voice pitch, hair pattern and the deposit of fat at the hips and abdomen. They also help maintain fluid and electrolyte balance.

Progesterone works with oestrogen to prepare the endometrium for a fertilised ovum and also prepares the mammary glands for milk secretion.

Inhibin, secreted by the corpus luteum (endocrine gland in ovary), inhibits secretion of GnRH and FSH during the uterine cycle.

Relaxin is produced in high quantities in the last trimester of pregnancy to relax the pubic symphysis and dilate the cervix during delivery.

The female reproductive system

Ovaries

The ovaries (female gonads) (Figure 9.3) lie in the pelvic cavity and are ovoid in shape. The function of the ovaries is to house and then expel ova (eggs). The ova are formed during the embryonic stages of life and remain there until puberty where they are released each month ready for fertilisation by the sperm. The ova develop into ovum by a process called oogenesis; this indicates the structural changes between being a collective within the ova and the single egg cell. This will be discussed later in this section. There are two ovaries, located either side of the uterus, and connected by the **fallopian tubes**. The ovaries are held in place by a series of ligaments: the broad ligament is part of the uterus and attaches the ovary to the mesovarium (peritoneum); the ovarian ligament attaches the ovary to the uterus, which is attached to the pelvic wall by the suspensory ligament. The ovaries are supplied with blood from the ovarian artery that is a branch of the abdominal aorta. It is made up of three layers: the epithelium, the tunica albuginea, which is connective tissue, and the stroma, which is made up of a dense outer layer known as the cortex. The cortex contains the ovarian follicles and has an inner layer called the medulla. The ovarian follicles contain oocytes that are at various stages of development. The **vesicular ovarian follicle** (graafian) contains an immature ovum, which is surrounded by fluid; it also releases oestrogens. The **corpus luteum** is a mature ovarian follicle that has ruptured releasing a secondary oocyte; this process is known as ovulation and occurs monthly once puberty has begun. More female hormones are secreted from the corpus luteum, namely oestrogen, progesterone and relaxin.

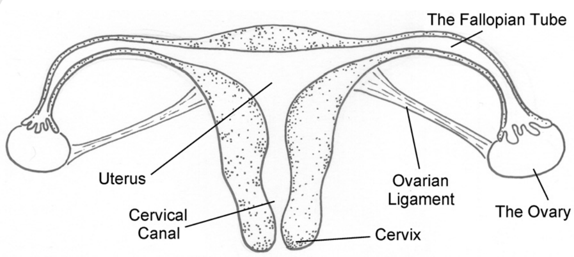

Figure 9.3 The female reproductive system

Fallopian tubes (uterine tubes)

There are two fallopian tubes (Figure 9.3), which connect the ovaries with the uterus. Their function is to propel the ova from the ovaries to the uterus. The opening near the ovary is called the **infundibulum** and is funnel-shaped; at its end there are fimbriae that are finger-like structures that move in a current-like way to allow the ova to pass with ease down the tube. The ampulla is the longest part of the tube; it is here that the ovum can be fertilised by the sperm on the day of ovulation or within 24 hours. The isthmus is the narrow part that joins the tubes to the uterus. The fallopian tubes are made up of three layers: the mucosa, the muscularis and the serosa. The mucosa can be found at the most internal point and is made up of ciliated epithelial cells, which aid the movement of the ovum. The middle layer (muscularis) is made up of an area of circular smooth muscle and an area of longitudinal smooth muscle, which along with the mucosa, aids the movement of the ovum. The serosa is the outer layer and is made up of a serous membrane.

Uterus (womb)

The uterus (Figure 9.3) is a pear-shaped structure and is located on the superior surface of the bladder. As the bladder fills, the position changes; it is then bent backwards on the **cervix** (retroflex). When examining a female abdomen, it is important to ascertain if her bladder is full or empty as this will help locate the position of the uterus. The uterus has several functions. First, it is part of the pathway for the sperm to reach the fallopian tubes, it then implants the fertilised ovum and enlarges to house the growing fetus. It is also the site of menstruation. The uterus has three areas: the fundus, the body and the cervix. The fundus is the dome-shaped structure that rises above the fallopian tubes, the body is the central area of the uterus, and the cervix is the narrow portion that descends into the vagina. The cervix has an internal and external os. The internal os connects the cervix with the uterine cavity via a small area called the isthmus. The external os is located at the end of the cervix and opens into the vagina. The os is usually closed except when a female experiences a miscarriage or is in labour.

The uterus is made up of three layers of tissue:

- The perimetrium
- The myometrium
- The endometrium.

The perimetrium is the outer layer and is part of the peritoneum. The middle layer is the myometrium, which forms most of the uterine wall; it is made up of three types of smooth muscle, which contract in a coordinated manner in order to expel the fetus during labour. The inner layer is the endometrium which is a highly vascular area that can be divided into two layers; the stratum functionalis, located closest to the uterine cavity, shed during menstruation, and stratum basalis, the permanent layer that aids the stratum functionalis to renew after each menstrual cycle.

Vagina

The vagina (Figure 9.4) measures approximately 10cm in length. The function of the vagina is to act as a passageway for blood flow during the menstrual cycle and the fetus during childbirth, and to receive semen from the penis during penetrative intercourse. The vagina is made up of smooth muscle called muscularis, which is able to stretch to allow a penis to enter the vagina and the fetus to leave the vagina. The lower end of the vagina is called the vaginal orifice where the mucous membrane called

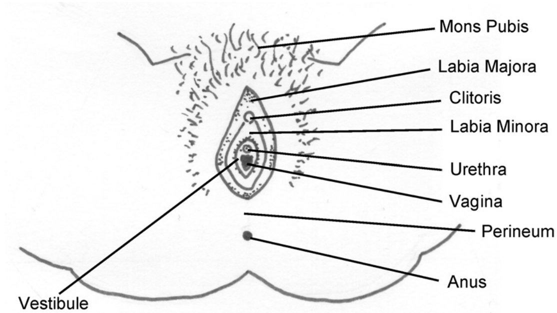

Figure 9.4 The vagina and external genitalia

the hymen is located. This partially closes the orifice but is usually torn during first sexual experience, or in some patients through sports.

External genitalia (vulva)

The external genitalia, or vulva (Figure 9.4), are made up of the following structures:

- Mons pubis – adipose tissue covered in skin and pubic hair
- Labia majora – two folds of skin either side of the vaginal entrance, which contain sebaceous and sweat glands and are covered with pubic hair
- Labia minora – two smaller folds of skin which contain sebaceous glands, not covered with pubic hair
- Clitoris – a small mass of erectile tissue and nerves, which becomes engorged with blood when sexually stimulated
- Vestibule – this area contains the vaginal orifice (opening), external urethral orifice and the para-urethral and Bartholin's glands that both secrete mucus.

Breasts/mammary glands

Before puberty male and female chests appear the same. At puberty the release of oestrogens and **progesterone** encourages breast tissue growth. At sexual maturity the ovaries secrete progesterone that continues to change the breasts until the mammary glands mature.

The breasts (Figure 9.5) are made up of adipose tissue; the amount of adipose tissue a woman has determines her breast size. The mammary glands are modified sweat glands that produce milk; each gland has 15 to 20 lobes. Each of these lobes then has smaller lobules that contain alveoli. These are milk-secreting glands that move milk into secondary tubules; from here milk enters the mammary ducts. These ducts expand into sinuses called the lactiferous sinuses to store milk. The sinuses terminate at the nipple where milk is ejected from the breast. There are 20–30 lymph nodes in the armpit, which drain fluid from the breast.

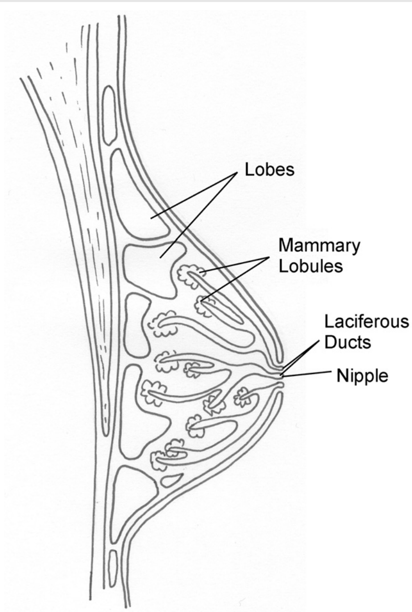

Figure 9.5 The mammary glands

Scenario 9.3

Breast Lump

Maria Harman is a 35-year-old Caucasian woman. She is married with children. She attends her GP surgery with a pea-size lump in her right breast. She noticed it in the shower; she examines her breasts regularly. It is not painful.
PMH: mild asthma

Assessment and analysis of patient presentation

On seeing the GP Maria explains she noticed the lump yesterday; her friend has recently been diagnosed with breast cancer so she has been carrying out regular breast self-examination (BSE) in order to detect any changes early. Through regular breast examination the patient or her partner will discover 80% of lumps (breastcancercare.org.uk 2007). The GP is female so did not require a chaperone to examine Mrs Harman. First, a history was taken including dates of her LMP as changes in the breast can be due to hormonal changes around the menstrual cycle. Also relevant medical and familial history was taken; Mrs Harman has no family history of breast cancer. The GP began the examination by looking for any irregularities in the shape or colour of the breast and nipple. She then examined the breast tissue including the lymph nodes under the armpit. This is because breast lumps and cancer can be located in the lymph nodes. The GP detected a lump approximately 1.5cm in diameter in the right breast, the left breast felt normal and no lumps were detected. The GP explained her findings to Mrs Harman; she advised her that she would be referring her to the local breast screening unit. She also informed her that it was probably a benign cyst as she did not have many risk factors, for example she had no family history of breast cancer and she was young. The GP tried to allay Mrs Harman's fears, by explaining the importance of definitive diagnosis; this would be achieved by the specialist carrying out an ultrasound and fine needle aspiration cytology (FNAC). Although the GP felt it was benign, these tests would confirm her provisional diagnosis. The waiting time for the clinic was approximately two weeks. Most clinics have a 2–10 week wait for non-urgent cases. Mrs Harman left the GP surgery and waited for the appointment to arrive.

Developing & Delivering Expert Care: Exercise 9.9

Breast Awareness

Mrs Harman was well informed about breast self-examination (BSE) as her friend had been diagnosed with cancer. BSE should be carried out several days after the menstrual cycle has finished. There are 5 steps to BSE.

- Find out how to carry out BSE.
- When on clinic placements decide if it is appropriate to offer this health education.

BSE is recommended by the Department of Health, NICE and Breast Cancer Care. Visit their websites, look at the health education advice and relevant statistics.

www.breastcancercare.org.uk www.nice.org.uk www.dh.gov.uk

Psychosocial aspects

Mrs Harman is very worried about breast cancer, as her friend has recently been diagnosed with it. When a friend or relative of similar age has been diagnosed with a disease, it can make people question their own mortality; it heightens awareness of that particular disease process. Mrs Harman's friend has taught her the importance of BSE, and also showed her the correct technique for examining the breasts. Ajzen (1991) wrote a theory of planned behaviour; from this it was noted that a person's behavioural intentions were based on how committed they were to the health belief. Mrs Harman believes that it is important to perform regular BSE to detect abnormalities early. She is committed to the belief that early detection increases survival and also she is committed to BSE as her friend has told her how important it is. Although she believes it is right to carry out BSE, now that she has found a lump and this has been confirmed by her GP, she has a fear of being diagnosed with cancer. It is therefore important that she is given time to discuss these fears with the GP and that she is given relevant literature to read while she waits for her appointment. It is suggested that the information must be simple and that it must be repeated; this will encourage patients to be compliant with the doctor's recommendations or treatments.

One way the healthcare professional can make sure the patient has comprehended the treatment or diagnosis is by asking them to explain what they have understood. This will ensure the nurse or doctor can clarify any points that have been misunderstood; this may make the patient more compliant to the treatment. Written information is also a key part in any care given to a patient, as they are able to take the literature away from the clinical setting and study it in a less stressful environment. Therefore it is important that Mrs Harman had written information as it would increase her knowledge of the breast screening unit and allay some of her fears, as she would have advance knowledge of the procedures that will take place.

Treatment

Mrs Harman waited two weeks for her appointment. The clinic advised her to bring a friend or partner for support. On arrival at the department she was greeted by a nurse who explained the procedures to her in detail. She also gave her written information to look at while she waited to see the consultant. It is important to give patients time to listen to and then read about the procedures; this will enable them to understand what is happening and also gives them the opportunity to ask questions. Mrs Harman appeared to have understood the procedure but was anxious about the findings. It is imperative that any anxieties are recognised and addressed by the nurse and time is given to the patient.

The consultant began by taking a brief history, she also explained that she would carry out all of the procedures herself and that they should have a result from fine-needle aspiration cytology (FNAC) that afternoon. First, the consultant inspected Mrs Harman's breasts, looking for any changes in shape, puckering of the skin, colour changes, rashes, inversion of the nipple and any discharge from the nipples. She reassured Mrs Harman that the breasts had no obvious deformities. The breasts were then examined and the lump palpated. Because of her age Mrs Harman would have an ultrasound scan. Women 35 years of age and under have an ultrasound scan as their breast tissue is more dense; over this age a mammogram is performed. The DH set up a national breast screening programme and by the mid-1990s all women over 50 years old were offered a mammogram every three years. The ultrasound confirmed a small 1.5cm lump. FNAC was performed; the consultant used a local anaesthetic and then took a small amount of aspirate for cytology. The consultant explained that the lump appeared to be a fibroadenoma, which is a benign lump but that cytology would confirm it. Fibroadenomas are common in young women and are hard moveable lumps approximately 1–3cm in diameter. They are believed to be caused by an increased sensitivity to oestrogen. Mrs Harman is told to take simple analgesia later that day as the breast may become tender or painful following the FNAC.

The results of the FNAC confirmed that Mrs Harman had a benign fibroadenoma. The consultant explained that there was no further treatment needed but if the lump grew she should see her GP again as they can be removed if they become troublesome. She was also advised to continue BSE and to encourage all her friends, relatives and colleagues to begin BSE as early diagnosis of breast cancer can reduce mortality by 24%.

Applying Theory to Practice: Exercise 9.10

Breast lumps can be malignant or benign. Below are some other causes of breast lumps:

- Ductal carcinoma in situ (DCIS)
- Lobular carcinoma in situ (LCIS)
- Phyllodes tumour

Find some possible treatments for these conditions and write your answers under the headings.

Female reproductive cycle

After puberty, women experience a monthly cycle, the length of which varies but is usually between 21–35 days.

Applying Theory to Practice: Exercise 9.11

Ethical Dilemmas

Some treatments such as perception have caused controversy, as they have not been widely available on the NHS. Find out who is allowed to be given perception by visiting www.nice.org.uk .

- How would you feel if a treatment of choice was not available in your NHS trust?
- Do you feel all patients should have equal access to treatments?

Hormones that are released by the hypothalamus, pituitary gland and ovaries control the cycle. The cycle has four phases:

- **Menstrual phase** – this lasts approximately five days. During this time a woman loses approximately 150ml of blood. The decreased levels of progesterone and oestrogen cause the uterine artery to constrict. This causes the lining of the endometrium to become ischaemic and shed via the vagina in the form of blood loss. During this phase there is a rise in FSH and primary follicles develop in the ovary; these also release small amounts of oestrogen. Towards the end of the menstrual cycle they begin to develop into secondary follicles; these contain an oocyte that continues to grow.
- **Pre-ovulatory phase** – during this phase one of the secondary follicles becomes larger than the rest; the others then degenerate. If this follicle is producing enough oestrogen to develop and grow, it is known as a **graafian** follicle or mature follicle, and is ready for ovulation. The oestrogen that is released stimulates the repair of the endometrium, so the lining becomes thick and the blood supply is improved. This is in preparation for a fertilised ovum.
- **Ovulation** – this usually occurs midway through the cycle at approximately 14 days. Some women report pain or discomfort during this time. Oestrogen stimulates the release of GnRH by the hypothalamus and LH is released by the anterior pituitary gland. The high level of LH stimulates the rupture of the graafian follicle which releases the secondary oocyte. Once this is

released, the graafian follicle collapses; this then develops into the corpus luteum.

- **Post-ovulatory phase** – the corpus luteum releases progesterone and oestrogen. The progesterone prepares the endometrium for a fertilised ovum. If a fertilised ovum is present, the corpus luteum continues to secrete hormones, maintained by the chorion, which releases the hormone human chorionic gonadotrophin (HCG). The chorion then develops into the placenta. If there is no fertilised ovum the corpus luteum degenerates and this initiates the menstrual phase.

Applying Theory to Practice: Exercise 9.12

There are many different types of pregnancy tests on the market.

- After reading the previous section, which hormonal release do you think these tests might measure?

During your placements identify which type of tests are available on the wards.

Pregnancy

Women are fertile during the years that they menstruate and they can become pregnant, if sexually active, during this time. Once the ovum has been fertilised by the sperm, the young embryo begins to develop. Pregnancy continues forty weeks from the date of the last menstrual period (LMP) to birth. The pregnancy is divided into three trimesters, which are approximately 12 weeks each. During the early stages the embryo is called a **zygote**; it develops through the mitotic division of cells. At day 6 or 7 the embryo implants itself in the uterus to ensure that the maternal blood supply feeds oxygen and nutrients to the growing embryo; the developing placenta will fulfil this role.

During the implantation stage the embryo is at risk of implanting in various sites such as the uterine tube; this is known as an **ectopic pregnancy**. Ectopic pregnancies are not viable and carry huge risks for the mother. If the pregnancy ruptures the fallopian tube, the mother can haemorrhage uncontrollably and requires urgent treatment.

Once the embryo is implanted, the cells release a hormone called human chorionic gonadotrophin (HCG), this can be detected in the mother's blood and urine. At this point the presence of HCG in the urine will result in a positive pregnancy test. HCG stimulates the corpus luteum to grow and secrete large amounts of progesterone and oestrogen. These hormones remain at a high level throughout the pregnancy to encourage the growth of the endometrium. The oestrogen also encourages the growth of the mammary glands so that the mother will eventually produce milk. The sharp increase in hormone levels can lead to morning sickness. This normally lasts during the first trimester, although some women experience it for longer periods of time.

If the mother has released more than one ovum during ovulation, two or more zygotes may form, so that the mother is expecting more than one baby; these are known as fraternal twins and are not identical. If at the beginning of cell division the zygote divides in two, the mother will be expecting identical twins as they have the same set of genes.

During the first trimester the embryo will develop all the major organs and a fetal heartbeat can normally be seen on a scan approximately 5–6 weeks into the pregnancy. The placenta will also develop to feed nutrients to the embryo via the mother's blood supply. At the end of

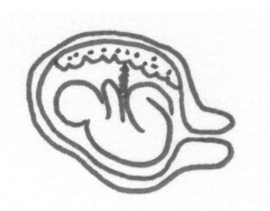

Figure 9.6 Stages of pregnancy: 1

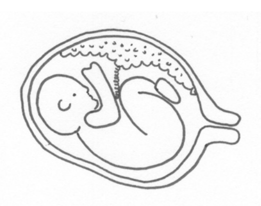

Figure 9.7 Stages of pregnancy: 2

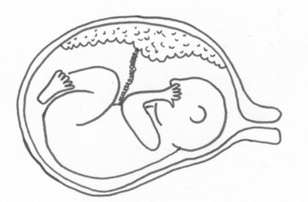

Figure 9.8 Stages of pregnancy: 3

the first trimester the embryo is known as a fetus.

The second trimester begins in the 13th week. During this trimester the mother general feels well as the morning sickness subsides. During this trimester the fetus has all the major organs and therefore begins to develop purposeful movement. The mother can detect fetal movements at 16 weeks onwards, although first-time mothers tend to feel them later. At approximately four months the uterus begins to contract; this is known as the Braxton Hicks sign. It is not fully understood why this occurs but the mother feels a tightening of her uterus. At approximately 20 weeks most mothers will have an anomaly scan which detects any abnormalities in any of the major organs. The sex of the baby can also be determined at this scan, but the embryo has begun to determine this after the 6th week of pregnancy.

The third trimester begins at week 27 and lasts until labour begins. Delivery after 37 weeks gestation is deemed normal, although some women will give birth in the 42nd week. A few days before the mother gives birth the levels of progesterone decrease; oestrogen then begins to excite the uterine muscles and contractions begin. As the cervix begins to dilate this stimulates the hypothalamus and the posterior pituitary gland to release oxytocin. This hormone encourages the uterus to contract, thus expelling the fetus down the vagina. If a woman is having a difficult labour and her contractions are not regular and strong, the midwife can administer oxytocin to increase them. Oxytocin also helps the uterus expel the placenta after the baby has been born. Once the placenta has been expelled the breasts begin to produce small amounts of colostrum, a thick, milky fluid loaded with antibodies. Breastfeeding encourages a surge in hypothalamic release hormone for prolactin to be produced. This in turn encourages milk production.

Scenario 9.4

Threatened Miscarriage

Ruksana Ali is a 26-year-old woman who presents at her GP surgery with per vaginam (PV) bleeding. She is approximately 8 weeks (8/40) pregnant. This is her first pregnancy. She is very tearful.
Vital signs are documented as: respiratory rate 14, pulse 72, BP 114/64, temperature 36.1
Allergies: penicillin
PMH: nil

Assessment and analysis of patient presentation

The initial assessment by the GP includes monitoring of her vital signs. Her vital signs are within normal limits although her respiratory rate is slightly above normal, which may be an early indication of shock. It is therefore important that the GP takes an accurate history of her condition, including the amount of blood loss. Mrs Ali is able to give the date of her last menstrual period (LMP) as eight weeks and two days ago. She has had no problems within the first eight weeks. Today she awoke and found a small amount of blood in the gusset of her pyjama bottoms. She has been spotting ever since, has not passed any clots and the blood is dark red. This indicates to the GP that her blood loss is minimal and that the blood she describes is not a fresh bleed. Mrs Ali is not aware of her rhesus status; the GP notes this, as a blood test will need to be taken. If she is rhesus negative, she will need to have an anti-D injection to prevent complications in future pregnancies. The GP asks to examine Mrs Ali, with a nurse to chaperone him to protect both the patient and doctor from allegations of inappropriate behaviour, as he will be examining her abdomen. Each NHS trust or GP surgery has a policy on chaperones, to which staff must adhere.

On palpation of her abdomen, the GP finds her abdomen soft and non-tender, she also states she has no abdominal pain. This would indicate that an ectopic pregnancy (fetus growing outside the uterus) is unlikely as abdominal pain and tenderness are a classic sign, but until she has had an ultrasound scan, which assesses the exact location of the fetus, it cannot be completely ruled out. At this early stage of the pregnancy the uterus is still lying below the pelvis so it cannot be felt; as the pregnancy progresses, the uterus can be palpated. Many GPs will not do a vaginal examination (VE) as it is contraindicated if the patient has a possible ectopic pregnancy. However, a VE can be done if an ectopic has been ruled out; this will ascertain if the cervical os (neck of the womb) is open. The GP feels that Mrs Ali is haemodynamically stable and that it is most likely that this is a threatened miscarriage. He speaks to the early pregnancy assessment unit (EPAU) at the local hospital. They are able to see Mrs Ali within the next three hours. The GP therefore feels that a VE is not necessary as she will have an ultrasound scan and possibly VE at the hospital. The Royal College of Obstetricians and Gynaecologists (2006) recommends that EPAUs are widely available. Within this unit are facilities for ultrasound, blood tests, leaflets, referrals and algorithms for each condition that presents.

Mrs Ali is happy to visit her local EPAU later that day. The GP explains that she will need a full bladder, as this will enable the doctor to palpate the uterus more easily.

Anatomy and Physiology in Action: Exercise 9.13

There are different types of miscarriage; look up the following and write a synopsis of each. Describe what is happening physiologically. Add this to your portfolio. The Royal College of Obstetricians and Gynaecologists (RCOG) have clear explanations of each type of miscarriage:

- Threatened
- Inevitable
- Incomplete
- Complete
- Missed
- Early fetal demise.

Miscarriage – the facts

One in five pregnancies will ended in miscarriage (Miscarriage Association 1996), of these one in 100 women will have recurrent miscarriages, thus each of these women have three or more. However, 50–80% of women who have bleeding in the first trimester of pregnancy will continue to have a normal pregnancy (Allan 1995). Many miscarriages occur within the first trimester, although miscarriage can occur up to 24 weeks. If a pregnancy spontaneously aborts after this time and is delivered dead, it is classed as a stillbirth. In October 2006 the RCOG published guidelines on the management of early pregnancy loss, which examined both the physical and the psychological needs of the patient. There can be many reasons for a miscarriage, but there are four main reasons (Cecil 1996). The first cause is a genetic abnormality that is incompatible with life. Infection such as rubella (German measles) can result in miscarriage; colds and minor infections are not deemed to be associated with miscarriage. Immunological problems, for example, problems with blood vessels that supply the placenta and hormonal imbalance, may also be a cause. Finally, an anatomical abnormality in the mother, such as a weak cervix, may cause a miscarriage, as the cervix is more likely to open during pregnancy instead of remaining closed and retaining the pregnancy in the uterus.

Treatment

A midwife sees Mrs Ali in the EPAU; there is also a registrar on duty to perform the ultrasound. Initially the midwife takes a history and checks Mrs Ali's vital signs, which have remained within normal limits. The next test performed is urinalysis, which reveals that beta-HCG is present; no abnormalities are detected on urinalysis. The presence of HCG confirms that she is pregnant – the developing placenta releases this hormone. Blood may also be taken to confirm a steady rise in HCG; this is useful if they are monitoring for an ectopic pregnancy because the fetus may not have been detected. If HCG levels continue to rise, this could indicate that the fetus is growing outside the uterus. Blood samples will also be taken to ascertain her Rhesus status and her full blood count; if she were losing a large amount of blood, she might become anaemic. Mrs Ali is anxious to have the ultrasound scan, as this will give her a definitive answer about her pregnancy. The midwife explains to her that they will begin by doing an abdominal ultrasound, but if they do not get a clear view of the gestation sac, fetus and fallopian tubes, they will need to do a vaginal scan. The scan is taken by inserting a probe into the vagina; this is done in very early pregnancy and can detect smaller fetal poles. From approximately 7 weeks the fetal heart can be seen.

The registrar carries out the ultrasound, and confirms that there is a sac present in the uterus but there is no fetal heart detected. A vaginal examination confirms the os is closed and so a vaginal ultrasound is carried out; this confirms there is no fetal heart and the fetus appears small, approximately 5 weeks gestation. He explains to Mrs Ali that her dates may be wrong and that it may be too early to detect the fetal heart or it may be a delayed miscarriage; this is when the fetus has died days or weeks earlier. Mrs Ali is extremely upset by this news and needs time to understand what has been said. The midwife explains that they will repeat the scan in one week to see if the fetus has developed. During this time she may begin to bleed more heavily, which may indicate and result in a miscarriage. Mrs Ali is advised to rest and is given leaflets about miscarriage; she is also advised to return if she develops abdominal pain or heavy vaginal bleeding.

Conclusion

Mrs Ali develops abdominal pain and vaginal bleeding three days later. She is admitted to the gynaecology ward. Her vital signs are recorded and she is haemodynamically stable. The consultant carries out an ultrasound scan and confirms that she has had a miscarriage.

Applying Theory to Practice: Exercise 9.14

Mrs Ali has been given bad news. On clinical placements think about how bad news is broken.

- Does the area have a room for the patients or relatives to have privacy and time to ask questions?
- Who do you think should break bad news?

Find out about some other voluntary organisations that may be able to offer further advice and support.

www.miscarriageassociation.org.uk

Anatomy and Physiology in Action: Exercise 9.15

Pathophysiology of the Female Reproductive System

Discover what the following diseases are and write a synopsis of your findings. These can be placed in your portfolio.

- Endometriosis
- Polycystic ovary syndrome
- Fibroids
- Bartholin's cyst.

Conclusion

The male and female reproductive systems have been discussed in depth. The development of the reproductive system and the hormones involved in the male and female systems have been identified, including the changes that occur in puberty and pregnancy. The types of disorder associated with this system have been examined in the form of clinical scenarios. These scenarios have highlighted some of the most common patient presentations. It is important to update personal portfolios when new illnesses or diseases are seen in clinical placements.

Chapter 9 Summary Quiz

1. The reproductive system is one of the only systems in the body that is dimorphic, meaning it is:

A. Able to change throughout the life cycle
B. Changes during puberty
C. Functionally and structurally different in males and females
D. Functionally and structurally the same in males and females

2. Leydig cells are responsible for the production of:

A. Oestrogen
B. Testosterone
C. Progesterone
D. Adrenaline

3. Identify three functions of the vagina:

A. Acts as a passageway for both blood flow during the menstrual cycle and the fetus during childbirth, receives semen from the penis during penetrative intercourse
B. Provides a passageway for both blood flow during the menstrual cycle and for urine during urination
C. Acts as a passageway for the fetus during childbirth, acts as a temperature control mechanism
D. Provides a passageway for both blood flow during the menstrual cycle and for urine during urination, receives semen from the penis during penetrative intercourse

4. The penis is a cylindrical structure that can be described in three parts:

A. The root, the shaft and the base
B. The body, the root and the glans penis
C. The shaft, the end and the root
D. The root, the glans penis and the epididymis

5. The most common sexually transmitted infection is:

A. Syphilis
B. Genital chlamydia
C. Gonorrhoea
D. Herpes

6. A pregnancy is divided into three trimesters, which last how long?

A. Approximately 12 weeks each
B. Approximately 8 weeks each
C. Approximately 16 weeks each
D. Approximately 2 weeks each

7. There are 20–30 lymph nodes in the armpit; what is their purpose?

A. Drain fluid from the breast
B. Increase breast size
C. Act as a reservoir for milk
D. Release specific hormones that initiate the menstrual cycle

8. What percentage of pregnancies result in miscarriage?

A. 10%
B. 90%
C. 2%
D. 20%

9. What role does oxytocin play?

A. This hormone encourages the uterus to contract thus expelling the fetus down the vagina
B. This hormone allows the development of the breasts
C. This enzyme increases hair growth
D. This hormone encourages mood swings

10. The menstrual cycle can be broken down into four phases:

A. Menstrual phase, prepulsion phase, ovulation, post-ovulatory phase
B. Menstrual phase, pre-ovulatory phase, bleeding phase, post-ovulatory phase
C. Hormonal phase, pre-ovulatory phase, ovulation, post-ovulatory phase
D. Menstrual phase, pre-ovulatory phase, ovulation, post-ovulatory phase

Further reading

Government Statistics (2005/06) www.statistics.gov.uk
Miscarriage Association (2007) www.miscarriageassociation.org.uk
NHS Direct (2007) *Health Encyclopaedia – Chlamydia.* www.nhsdirect.nhs.uk
NICE guidelines (2007/013) NICE guidance call for more to be done to halt the rise of STIs and prevent under-18 conceptions. www.nice.org.uk
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http://www.netdoctor.co.uk/health_advice/facts/venerealdiseases.htm
http://www.nlm.nih.gov/medlineplus/pregnancy.html

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10

The immune/lymphatic and endocrine systems

Clare Culpin

Additional contribution by Cliff Evans

Chapter 10 Learning Objectives

- Gain knowledge and insight into the anatomy and physiology related to these systems
- Gain insight into several predominant conditions related to these systems
- Apply theory to practice by understanding the impact of these conditions on the individual
- Gain insight into several commonly used medications within these specialties
- Construct solid evidence of professional development for your growing portfolio
- Continue developing the ability to question and critique the evidence base and effectiveness of plans of care

Introduction

This chapter addresses two systems commonly not considered as 'dramatic' as the cardiovascular or nervous systems, and which to the uninformed may appear more complex. Both are vital in not only maintaining health and well-being, but also life, as illnesses affecting the functioning of these systems can be fatal. Two of the world's most infamous diseases relate to these systems; one is a world pandemic (HIV) (UNAIDS 2006) and the other, a potential epidemic (diabetes mellitus) (DH 2006).

The immune system in combination with the lymphatic system provides the first line of defence against the potential dangers of the outside world and provides a pivotal role in preventing disease and destroying malformations from within. This is an essential function, otherwise small injuries such as cuts and sprains would never heal. The endocrine system provides the balance for life, regulating and secreting hormones, thereby maintaining homeostasis.

This chapter will provide an overview of the function of each of these systems highlighting the essential associated anatomy and physiology. Common illnesses affecting these systems will be discussed with clinical scenarios demonstrating the devastating effects these illnesses can have on the affected individual. The scenarios will also address common professional issues that the student nurse may encounter while on placement, with learning exercises providing many opportunities to further their knowledge on various relevant issues, including current treatment regimens and evidence-based initiatives. The reader will be encouraged to explore his or her own feelings thereby aiding the process of clinical decision-making and developing the essential skill of reflective thinking.

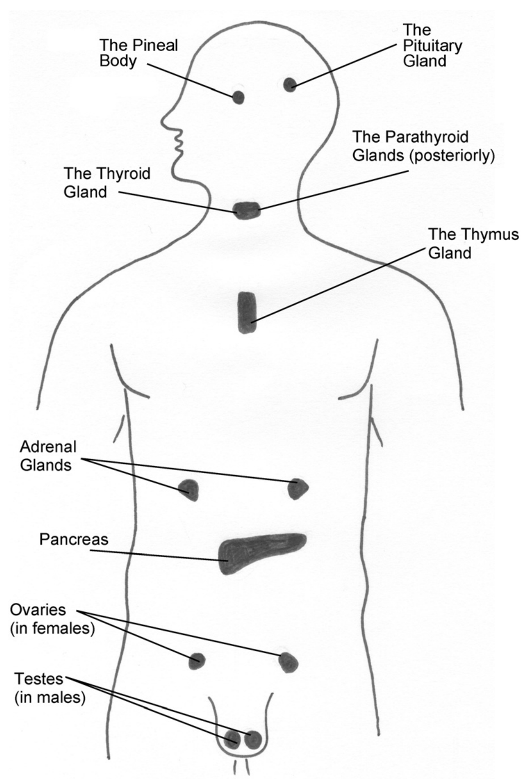

Figure 10.1a The endocrine system (isolated)

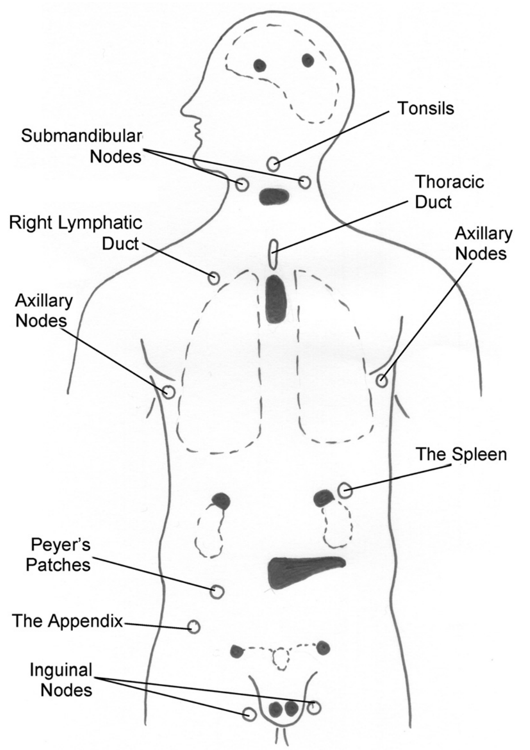

Figure 10.1b The major components of the immune/lymphatic and endocrine systems

Function

As we go about our daily lives our bodies are working hard to respond to the ever-changing internal environment, and the constant threat of foreign invaders and toxins that have the potential to lead to disease. The intricate, but fascinating, immune system is composed of two distinct functioning categories, which share many characteristics:

- Non-specific defence mechanisms
- Specific defence mechanisms.

Both categories work in partnership to provide a comprehensive defence mechanism. The skin, which provides the major component of the non-specific function of our immunity, works in partnership with the specific immune responses, involving the B and T lymphocytes, proteins produced by the plasma cells called **antibodies**, along with other chemicals including **immunoglobulins**, all of which play an essential role in maintaining homeostasis. The immune system is greatly influenced by most of the other systems, in particular the lymphatic, blood, skeletal and endocrine systems. Many life factors can negatively affect the system, including the effects of ageing, poor nutrition and fluid balance, as well as the individual's emotional well-being. Many aspects need to be considered when assessing an individual's ability both to prevent and fight infection and to heal injuries.

Non-specific immunity

The skin

The most obvious physical defence barrier we have is our skin, often described as the body's largest organ (Brooker 2000), and one that we probably pay attention to for reasons other than defence. Yet this external covering has within it a number of important mechanisms and plays a major role in the first line of general defence. The skin itself consists of two layers: the epidermis, which sits superficially to the deeper layer, the dermis. Both the epidermis and the dermis are attached to underlying structures by subcutaneous and adipose tissue, which will become familiar terms when administering medications by injection.

The epidermis is the visible layer of skin, varying in thickness depending on the local requirements: it is thicker on the soles of the feet and thinner over the eyelids. The epidermis is largely formed of dead skin cells, which begin their life deeper in the skin tissue, gradually over a period of weeks working their way to the surface where eventually they flake away, through exfoliation, to be renewed by other skin cells. This process is most rapid during childhood, slowing down with the ageing process, something that needs to be considered when caring for the older adult, making them more vulnerable to pressure-related tissue damage, and influencing the rate and ability of wound healing. Stratum layers within the epidermis, containing **spinosum** (more commonly known as prickle cells) and basal cells, are responsible for the pigmentation of the skin through the production of melanin by the melanocyte cells.

The dermis, situated beneath the epidermis, is a much deeper, complex layer of the skin incorporating many structures such as sweat glands, sensory nerve endings, hair follicles each with their own muscles attached, veins, arteries, lymph vessels and connective tissue.

A+P

Anatomy and Physiology in Action: Exercise 10.1

Carcinomas affecting the skin are responsible for thousands of deaths each year. The three main types are directly related to the above-mentioned layers and cell types. Complete the following exercise to apply your anatomy and physiology knowledge to clinical practice.

- Write a short summary of the three main types of skin cancer and identify what has gone wrong with the cells to cause them; your summary should also include the possible causes.

Add this work to your portfolio.
If you encounter difficulty, the following website may prove helpful:

http://www.bad.org.uk/public/leaflets/skin_cancer.asp

http://www.nhsdirect.nhs.uk/articles/article.aspx?articleId=83

www.virtualsciencefair.org

The skin serves eight essential functions: easily remembered as **SHAPES V**ery **M**uch.

- **Secretion** – secretes sebum lubricating hair shafts and providing a natural moisturiser for the skin, acting as a barrier against bacteria
- **Heat regulation** – provides a dual function cooling or warming the body
- **Absorption** – can absorb certain substances
- **Protection** – from the effects of sunlight and harmful substances and organisms
- **Elimination** – removes waste products
- **Sensation** – the peripheral nerves 'sense' danger
- **Vitamin D** – maintaining bone density
- **Melanin** – a substance which darkens the skin resulting in increased protection for the underlying structures as radiation is absorbed

Other non-specific immunity

- Other non-specific components of the immune system are gastric juices (hydrochloric acid) found in the stomach, which destroy many organisms. In addition, vomiting rejects any unwanted food or organisms recognised as potentially harmful.

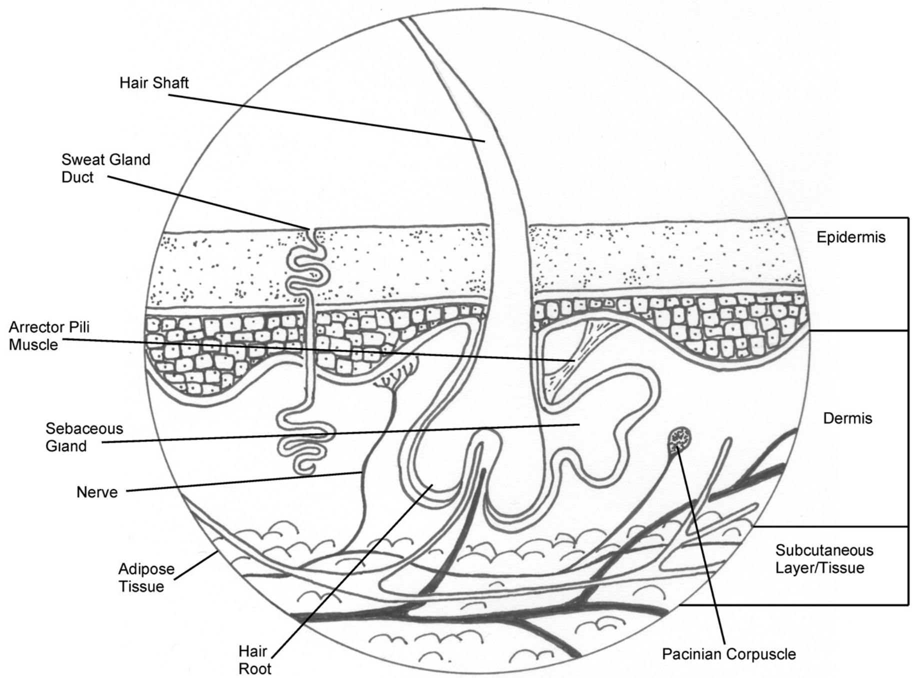

Figure 10.2 The skin, identifying its main components

Applying Theory to Practice: Exercise 10.2

Before reading on:

- Compose a list of interventions and practices carried out by the nurse which compromise the integrity of the patient's skin.
- What impact does this have on the well-being of their immunity?
- What potential problems can result from these practices?
- What can the nurse do to prevent potential problems and complications?

- Saliva in the nose and mouth contains a protein called lysozyme, also present in other body fluids (except urine and cerebrospinal fluid), which has antibacterial properties.
- Cilia are hair-like projections originating in certain types of cell within the respiratory system; they move foreign bodies and mucus away from the respiratory tract in waves (Chapter 3). Sneezing takes care of larger foreign bodies which may have escaped these defences, in the same way that coughing removes particles from the lungs or the respiratory tract.
- Villi within the gastrointestinal tract have a function similar to cilia; mucus protects the delicate lining from the effects of acid; and normal flora (micro-organisms which are found in the body) provide a barrier against pathogens in a similar way to the normal flora found in the vagina.
- Eyelashes, and the action of blinking in combination with lysozymes within the tears provide all-round protection for the eyes.

Anatomy and Physiology in Action: Exercise 10.3

Before commencing the following section write a short piece identifying the cells you know that work to prevent infection and maintain healing within the body.

Add your summary to your portfolio.

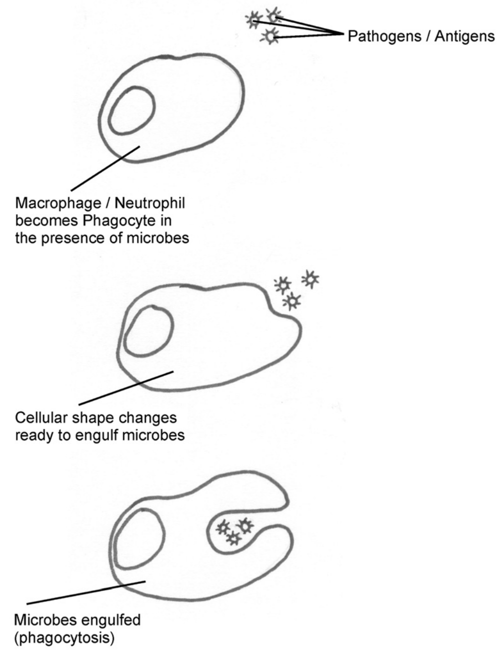

Figure 10.3. Phagocytosis

Phagocytes (eating cells)

There are a number of cells that also have a role in non-specific immunity. Phagocytes are cells which can be found in most tissues and include some leucocytes, for example, neutrophils, eosinophils, monocytes and macrophages. These phagocyte cells collaborate with chemicals called **immunoglobulins** and a substance called **complement**. Complement is a collection of specific plasma proteins, which assist in the destruction of foreign invaders or microbes. The combined action of these cells and chemicals is an elaborate process called **phagocytosis**, aimed at destroying foreign invaders (chemical or non-chemical), and dead or damaged cells. The phased process of phagocytosis commences with the identification for destruction of the foreign invaders, or damaged cells, by immune complexes i.e. antibodies. The phagocytes then engulf the cells, ingesting and absorbing them. Macrophages survive this ordeal to fight again; the leucocytes are destroyed resulting in the formation of **pus**. This process is all part of the body's natural inflammatory response. Despite this sophisticated process, it is not fail-safe and does not always work for every invasion. Some invaders are too strong to overcome and the phagocytes become victims themselves, weakening the body's defence mechanisms.

Structures	Cells and Chemicals	Actions
Skin	Epidermis Dermis	Provides a barrier when intact
Stomach	Hydrochloric acid	Destroys many organisms ingested
Stomach		Vomiting rejects any unwanted food
Nose and mouth	Lysozyme found in saliva	Antibacterial
Nose and mouth	Hair-like cilia cells and mucus	Debris attaches to the mucus and the cilia cells to move out of the nose and mouth
Respiratory tract		Coughing removes particles which may have travelled into the lungs
Gastrointestinal tract	Mucus	Protects the delicate lining from the effects of acid
Gastrointestinal tract	Normal flora	Provides a barrier against pathogens
Vagina	Normal flora	Provides a barrier against pathogens
Eyelashes		Blinking protects the eyes from particles
Eyes	Lysozyme found in tears	Antibacterial
Body tissue and blood	Phagocytes Macrophages Leucocytes ■ Neutrophils ■ Eosinophils ■ Monocytes	Phagocytosis
	Immunoglobulins	
	Complement	
Body tissue and blood	Natural killer cells	Lysis (decompose)
Infected cells or T lymphocytes	Interferon	Stops the virus multiplying and stimulates macrophages and natural killer cells into action

Table 10.1 Non-specific immune function summary

Applying Theory to Practice: Exercise 10.4

The Inflammatory Response

Consider all the causes of inflammation that you are aware of.

- Write a short piece for your portfolio on how many diseases or patient presentations may have an inflammatory cause or involve inflammation.

The primary physiological effect of the inflammatory response centres on increasing blood and blood cells to an area experiencing disease or trauma. The blood vessels surrounding the affected site dilate; this allows increased blood flow to the area. Cell walls that surround the area dilate producing an increased permeability. This allows the immune cells which are larger than other cells to pass through. As a result of the increased blood flow, the immune presence is strengthened. Many different immune cells congregate at the site of inflammation, along with a large supply of proteins, which fuel the immune response. There is an increase in body heat production, which can have an antibiotic effect.

The main clinical findings associated with the inflammatory response are:

- Tissues become red and hot as a result of the increased blood flow reaching the site
- Tissues become swollen due to the congregation of blood cells, lymph and proteins
- The area is painful due the expansion of tissues, causing direct pressure on nerve cells, and also due to the presence of pain mediators such as prostaglandins.

Now that you understand this response:

- How do you think it ends?

The websites below provides a quick resource:

http://www.sumanasinc.com/webcontent/anisamples/dynamicillustrations/inflammatory.html
http://alan.kennedy.name/crohns/primer/inflresp.htm

Natural killer cells

There is another important member of the non-specific immunity team, the natural killer cell. These cells are also present in the body's tissue and blood, but work in a different way to those involved in phagocytosis. Natural killer cells recognise infected cells, or cells which have abnormal changes due to malignancy, and go on to destroy them through a process called **lysis**.

Interferons

When a virus infects a cell, the cell produces a protein called interferon. The purpose is to prevent the virus spreading to other cells, this is achieved by inhibiting the virus's ability to reproduce. Macrophages are stimulated and natural killer cells destroy the abnormal cell. Interferons will be further explored as part of the specific immune system, as T lymphocytes also produce interferon as part of their role.

Inflammatory response

Inflammation is the body's response to injury; this may be physical injury or caused by a chemical or micro-organism. The local tissue involved in the injury utilises the non-specific immunity cascade, limiting the damage, and removing the causative agents, along with dead cells that result from this process. Tissue becomes red, hot, swollen and painful; if the inflammation is gross, it may limit the movement of a limb.

Applying Theory to Practice: Exercise 10.5

The physical or clinical signs of inflammation and possible infection have been discussed, but how do you know if a patient is going through a 'normal' response?

Cells		**Action**
B lymphocytes	Born in the bone marrow Matured in lymph tissue When stimulated, undergo further changes which result in them becoming either a plasma cell or memory cell	Plasma cells (or effector cells) produce antibody Memory cells record the type of antibody required and store it in case it is required in future; this may involve changing its shape to become unique to the antigen (foreign invader), which may take between 2–3 weeks Memory cells may float around in the blood for some time after, waiting to be called into action Once called into action they can quickly respond to produce more antibodies
Antibody (also known as immunoglobulin)	A protein produced by the B lymphocyte	Combines with the antigen and destroys it through ■ Lysis ■ Stimulating and supporting phagocytosis by the macrophages ■ Hampering the antigen's ability to invade other cells
T lymphocytes	Born in the bone marrow Matured in the thymus gland When stimulated, move into lymph tissue to further develop Emerge as: ■ Killer T cells ■ Helper T cells ■ Suppressor T cells ■ Memory T cells	Killer T cells attach themselves to the antigen (foreign invader) and secrete lysosome, destroying it and the antigen Helper T cells support the B cells to produce antibody, therefore the increase in T helper cells increases the effectiveness of the B lymphocytes Suppressor T cells, once the invasion has been dealt with, reduce the activity of both the B and T cells in order to prevent an overreaction, and so are important in regulating the responses of the B and T cells

Table 10.2 Specific Immunity Function Summary

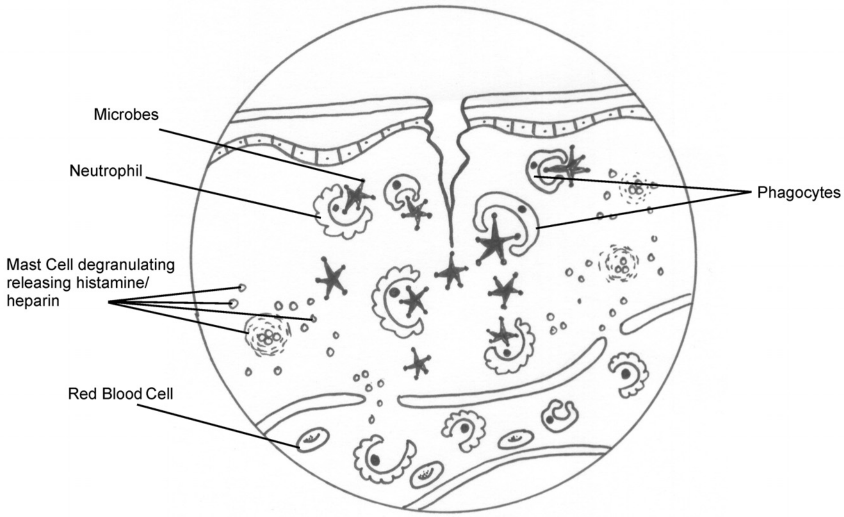

Figure 10.4a Non-specific immune response

Specific immunity

Should a foreign invader move beyond the defences of the non-specific immunity, the specific immunity responses are stimulated into action. Specific immunity is also activated when an abnormal cell is detected (i.e. malignant cell), as well as transplanted cells.

Symptoms of a normal immune response

Acquired immunity

The immune response, outlined in Figure 10.4, is one of active, naturally acquired immunity, where the individual has had the disease, illness or infection. The memory cells go on to prepare the body for further invasion by the same organism, either by knowing exactly which type of antibody to produce, or by their newly defined unique shape that

Applying Theory to Practice: Exercise 10.6

Before reading on:

- Compose a list of all the vaccinations you have received
- Why do you think it is important for nurses to have received all their routine childhood vaccinations?
- Which vaccinations are offered to healthcare workers specifically and why?

Also refer to Exercise 10.5.

Anatomy and Physiology in Action: Box 10.1

Diseases that can be vaccinated against

United Kingdom	**Other**
Diphtheria Tetanus Whooping cough (pertussis) Hib (*Haemophilus influenzae*) type B – protection against some types of meningitis Polio (oral preparation) Measles Mumps Rubella BCG (bacillus of Calmette–Guérin) protection against TB Hepatitis A and B	Typhoid Chorea Smallpox Yellow Fever Rabies Tick-borne encephalitis Japanese encephalitis

Source: (NaTHNaC 2006)

attaches itself to the antigen. This kind of immunity can be artificially produced, as active artificially acquired immunity, through vaccination programmes. Vaccines contain a weaker or slightly altered strain of the disease or infection, not strong enough to cause the individual to experience and suffer the full extent of the disease, but enough to stimulate the specific immune function and confer immunity. National vaccination programmes, beginning in childhood, have proved to be effective in controlling the spread and effects of many diseases. Travel advice now also includes vaccination to prevent disease and infections common to other continents (NaTHNaC 2006).

The effects of ageing

As we age, our cell function deteriorates due to the cells' inability to repair, renew and regenerate. In addition, some errors in the cells' renewal process can lead to abnormal cells being present and even malignancy (Farley et al. 2006). This ultimately has an impact on the effectiveness of the immune system:

- Slower to react and respond
- Unable to fight antigens due to the decline of the B and T lymphocytes
- Inefficient in removing free radicals and toxins leading to further deterioration of the cells
- Some autoimmune activity (due to the presence of some abnormal cells) means the older adult may have inflammation and swelling present most of the time (Farley et al. 2006).

Scenario 10.1

Chest Infection

Andrew Macey, a 72-year-old man, has been admitted to the acute medical ward with a severe chest infection. He has difficulty breathing and a constant productive cough, which has prevented him from sleeping and eating. As a result he has lost weight, is exhausted and weak.

Assessment and analysis of patient presentation

Mr Macey's immune system is currently very active but clearly having difficulties overcoming the cause of the infection.

- The expectorant is a result of phagocytosis in the lungs and the production of pus and mucus within the airways.
- Mr Macey's difficulties in breathing are likely to be due to the inflammation caused as part of the immune response, which is reducing the effectiveness of his airway.
- A combination of the energy demands of the immune response coupled with energy required to cough is contributing to Mr Macey's fatigue.
- Fluid used in the immune response may draw from reserves elsewhere leading to a risk of dehydration.

See Table 10.3 for a Nursing Care Plan.

Abnormal immune responses

Thus far, the immune system has been discussed based on the principle that immunity is the result of an interaction between antibodies with an antigen resulting in a comprehensive defence mechanism designed to recognise the antigen, respond and destroy it, memorise, adapt and prepare for further potential invasions. However, there are occasions when the defender becomes the attacker.

Allergic reaction

Allergic reaction can occur during the second and subsequent encounter with an allergen (an antigen causing the reaction). During their initial encounter with the allergen, the individual develops a specific antibody, immunoglobulin E that binds to the allergen. This in turn sensitises the mast cells (responsible for the release of histamine and heparin). Further exposure to the allergen stimulates the mast cells to degranulate and release histamine and heparin. The degree of reaction to an allergen can be varied, with some very mild reactions with minimal symptoms. However, when this reaction is sudden, rapid and intense in nature, and histamine and heparin are released in excess amounts, this can result in anaphylactic shock (Brooker 2000, Evans & Tippins 2005, Ross & Wilson 1990). Anaphylaxis is a life-threatening event and for a positive outcome must be dealt with immediately. It is essential, therefore, that all healthcare professionals are able to recognise anaphylaxis, and know how to respond to it (Figure 10.5).

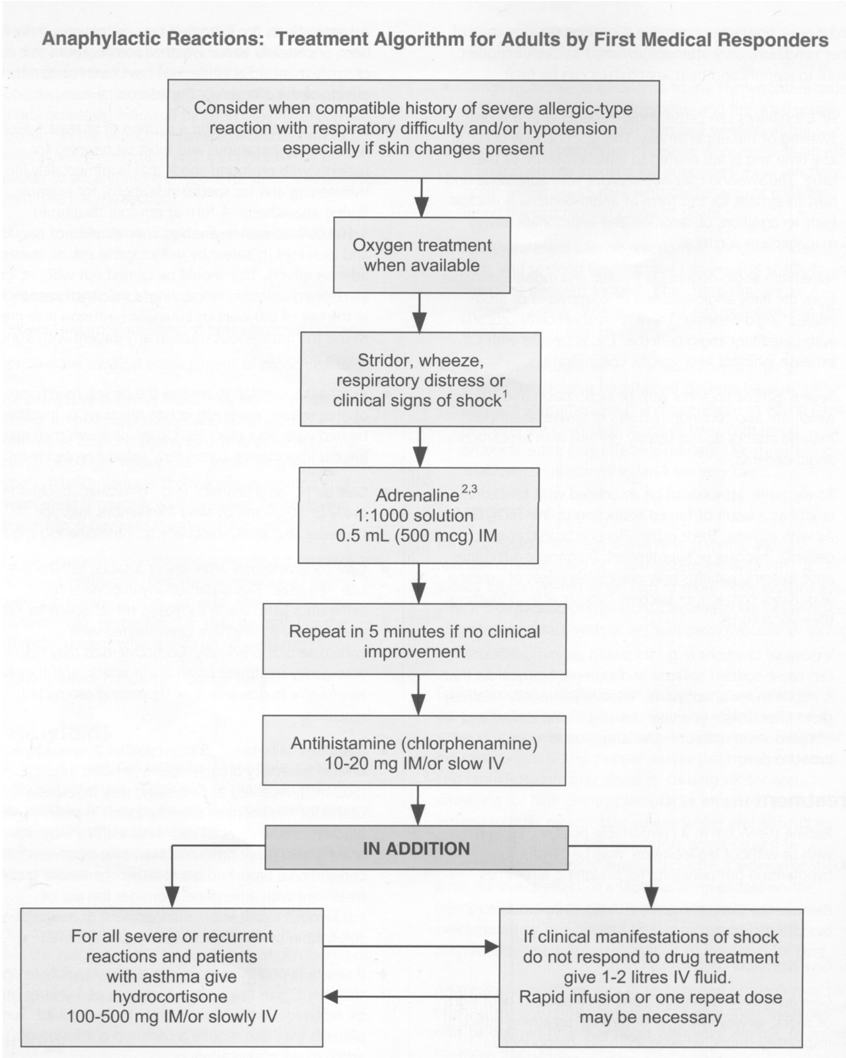

Figure 10.5 Anaphylactic reaction treatment algorithm for adults (Reproduced with permission from RC(UK) (2006)

Developing and Delivering Expert Care: Box 10.2

Signs and Symptoms of Anaphylactic Shock

Early signs and symptoms

- Urticaria
- Rhinitis
- Abdominal pain
- Vomiting
- Diarrhoea

Severe signs and symptoms

- Sense of impending doom
- Flushing/pallor
- Marked upper airway oedema
- Bronchospasm
- Stridor or wheezing

Actual and potential anxiety – caused by difficulty in breathing and new environment	
Care	**Rationale**
Introduce yourself and the clinical team	Reduces the patient's actual and potential anxiety Supports the patient's emotional and psychological well-being
Orientate Mr Macey to his bed space and the ward environment	The patient knows where things are Reduces and relieves any actual or potential anxiety Maintains his independence where possible Promotes his dignity
Explain all procedures and care, allowing him to ask questions, answering any questions or concerns he may have	Supports Mr Macey in informed decision-making processes
Allow the patient time to talk about his concerns or ask questions	Maintains effective communication and overcomes the barriers caused by the patient's difficulty in breathing and cough
Difficulty breathing and productive cough	
Care	**Rationale**
Help the patient position himself in an upright position	Enables more effective chest expansion to increase effectiveness of breathing and gas exchange
Administer medication as prescribed and monitor the effects	Assesses and monitors the effectiveness of medications prescribed Safe and effective administration of medication
Provide the patient with clean containers in which to expectorate, with soft tissue to help him keep a clean mouth	Maintains the patient's hygiene Maintains the patient's privacy and dignity Prevents cross-infection
Administer medication as prescribed to manage his cough	
Ensure the patient has oral fluids and mouthwashes within easy reach	Maintains the patient's fluid balance (homeostasis) Supports his oral hygiene needs Maintains his independence and privacy and dignity
Monitor and assess the patient's fluid intake and output	Prevents dehydration and maintains the patient's fluid balance (homeostasis)
Examine the patient's mouth on a regular basis	Detects and treats an adverse effect of limited fluid intake and poor appetite
Place the nurse call bell within easy reach and explain how to use it	Maintaining effective communication with your patient Maintaining the patient's safety and independence Maintaining the patient's dignity

Table 10.3 Nursing Care Plan

Weakness	
Care	**Rationale**
Assess the patient's risk of falling with a recognised 'falls assessment tool'	Preventing and reducing the risk of fall Maintaining the patient's safety
Provide the patient with a urinal if unable to walk to the toilet	Maintaining the patient's safety and independence Maintaining the patient's dignity
Encourage gentle daily exercise	Counteracting the weakness Preventing complications of immobility
Assess the patient's risk of developing pressure tissue damage due to limited mobility and weakness with a recognised 'pressure ulcer risk assessment tool'	Preventing and reducing the risk of pressure tissue damage
Provide the patient with assistance with his personal and oral hygiene needs	Maintaining personal and oral hygiene Maintaining the patient's privacy and dignity
Poor appetite and weight loss	
Care	**Rationale**
Weigh the patient and calculate his body mass index (Chapter 7)	Assesses and monitors the extent of the patient's weight loss
Assess the patient's nutritional status using a recognised 'risk assessment tool'	Identify possible influencing factors and the extent of risk

Table 10.3 Nursing Care Plan (continued)

Anatomy and Physiology in Action: Box 10.3

Potential allergens

Injected
- Chemicals used in vaccines
- Chemicals and substances used in injected or intravenously administered medicines/substances
- Insect bites
- Venom

Ingested
- Large molecule medicines, e.g. penicillin
- Some foods

Inhaled
- Dust
- Pollen
- Chemicals

Superficial
- Contact with chemicals
- Contact with metals

Autoimmune responses

Autoimmunity is the failure of an organism to recognise its own constituent parts as 'self', which results in an immune response against the identified cells and tissues; an autoimmune response. This can happen in the following situations:

- During transplantation of donor tissue or organs leading to rejection of the tissue or organ, only successful with supporting drugs to suppress the immune response
- During transfusion of blood products
- When the immune system wrongly identifies its own body cells as an antigen and acts to destroy them.

Immunodeficiency

Immunodeficiency is the inability or inadequacy of the immune system to respond effectively, leaving the body's defence system depleted and the individual vulnerable and susceptible to infections, diseases and malignancies (Brooker 2000). The causes of immunodeficiency can be genetic defects; acquired; due to drugs – particularly cytotoxic therapy; malnutrition or disease.

Applying Theory to Practice: Exercise 10.7

Before reading on:

- What responsibility do healthcare professionals have for preventing the spread of hospital-acquired infections (HAI)?
- What HAI are commonly transmitted between patients by healthcare professionals?
- What steps can healthcare professionals take to prevent the spread of HAI?

Diseases of the immune system

Human immunodeficiency virus (HIV) – the facts

HIV was first detected in the early 1980s when a number of homosexual men were diagnosed with a new type of pneumonia, *Pneumocystis carinii pneumonia* (PCP). Shortly after, the US Centers for Communicable Disease and Prevention recognised a global public health issue (Murray & Johnson 1996) as HIV began to be identified as a disease complex, with a whole spectrum of other associated illnesses, and the causative agent of AIDS (acquired immune deficiency syndrome).

Epidemiology

HIV infection is currently responsible for a worldwide epidemic of AIDS, with an estimated 38.6 million people infected with the virus (UNAIDS 2006). According to data produced by the Health Protection Agency (HPA 2007) 63,500 people (over the age of 15 years) were living with HIV in the UK in 2005. Approximately one-third of that population were unaware that they were HIV positive due to the fact that they may have experienced very minor, or no symptoms for a number of years (NAM 2006).

The majority of acquired HIV infection remains in the sex-between-men group and, despite focused health awareness campaigns, there remains little change over recent years in the incidence. However, the incidence of HIV among heterosexuals has risen in the past decade and more recently the incidence of heterosexually acquired HIV has overtaken the incidence of that acquired through sex between men. A large percentage of those were infected outside the UK, with the majority being acquired in Africa. Approximately one-third of individuals acquiring HIV heterosexually are unaware of their status (HPA 2007a).

The impact on the immune system

The HIV attaches its own surface molecules (glycoprotein GP120) to receptors on the T helper cells and some phagocytes. Once attached, the HIV fuses with its host cell. The HIV goes on to convert the host cells, deoxyribonucleic acid (DNA) the 'blueprint' of the cell containing all its defining genetic material, into its own genetic material called ribonucleic acid (RNA) by using an enzyme present only in retroviruses known as reverse transcriptase. As a result the HIV has converted the host cell into one of its own. Therefore, once triggered to reproduce, it no longer reproduces another T cell, but instead an HIV.

During this initial stage, referred to as **seroconversion**, which can last 1–6 weeks (Gilson 1996), individuals infected by HIV may experience only very mild flu-like symptoms. The infected cell may remain undetected for some time until the immune system is stimulated further at a later stage. It is therefore possible for the individual to be completely symptom-free for a number of years (Gilson 1996).

When the immune system is activated, the newly infected T cells are stimulated to reproduce, believing it is to take on its usual role in the body's immune response. However, changes to the T cell DNA mean that in its place more HIV cells are born, and each T cell can be tricked into producing a considerable number of new HIV, a process more commonly known as 'budding' (Pratt 1992). The impact of this on the immune response is:

- A reduction in T cells
- A reduction in the support the T cell normally provides for the B lymphocytes in their action of producing antibodies, phagocytosis and destruction of antigens by lysis.

Overall there is a deficient and less effective immune system leading to the individual being immunodeficient, compromised and vulnerable.

AIDS-related illnesses and infections

Since AIDS was first described, the definition of AIDS has evolved as a result of more being learnt about the disease, including better testing. The Centers for Disease Control in America has redefined on a number of occasions the

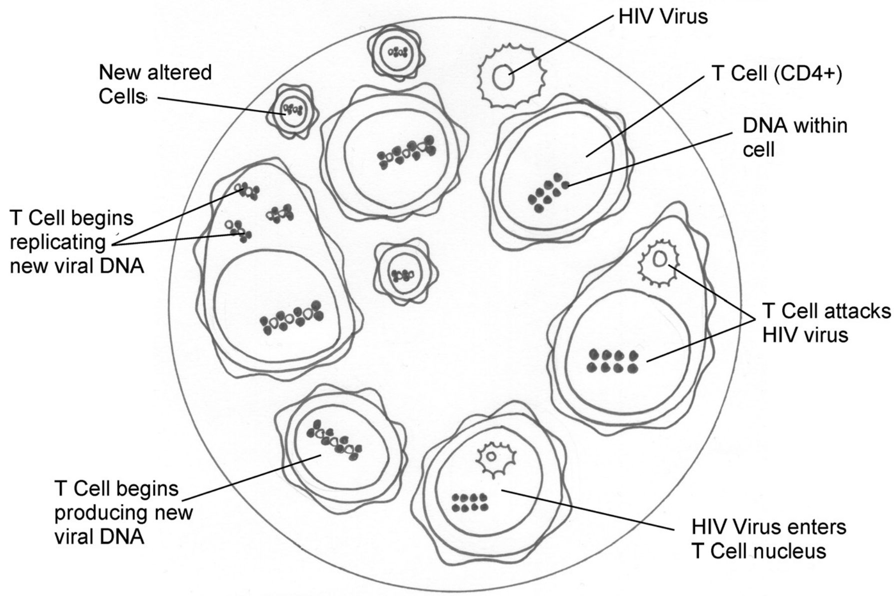

Figure 10.6 HIV and T-cell infection process

factors, such as the level of CD4 T-lymphocytes in the blood, and associated illnesses caused by HIV, which lead to a diagnosis of AIDS. All of the definitions used today are a reflection of a positive HIV status combined with a number of illnesses or 'opportunistic infections' caused by the lack of the ability of the T-Cells to function (Walters 1996).

Scenario 10.2

Infectious illness

Charlie George is a 38-year-old Caucasian man who has been admitted with weight loss, lethargy, persistent cough, a sore dry mouth, a raised temperature and what he describes as ' a sore and uncomfortable chest'.

- What should you first consider when admitting Mr George to the ward environment?
- Is he an infection risk to others?
- Are others an infection risks to Mr George?

Assessment and analysis of patient presentation

Mr George clearly has the classic signs and symptoms of an infection and therefore may be infectious to others, particularly those patients with poor or compromised immune systems. It is difficult to be certain at this stage, but as you do not know the cause of the infection, isolation needs to be considered. As Mr George is quite unwell, it is important to ensure that he can be observed easily as part of monitoring his condition.

Applying Theory to Practice: Exercise 10.8

- As nurses how do we manage this situation?
- What are the local policies and guidelines to support your conclusion?

Mr George may also have a compromised immune system himself and therefore could be at risk of contracting an infection from other patients and healthcare workers.

On admission Mr George's symptoms suggest he is suffering from an acute chest infection, or pneumonia. In this situation the priority is to relieve his chest symptoms to aid his breathing, and reduce his pain and discomfort.

Clinical investigation, using chest X-ray and sputum samples will help determine the micro-organism causing the pneumonia and direct treatment plans. Mr George is also complaining of a sore, dry mouth, which, alongside his cough and lethargy, have decreased his appetite and

Agent	Illness
Virus	Cytamegalovirus (CMV) affects the eyes, gut, lungs and nervous systems and can lead to blindness if left untreated
	HIV encephalopathy, caused by the HIV virus affects the central nervous system. Can cause degrees of symptoms based on severity from changes in coordination and concentration to loss of control, mental health problems and suicidal impulses (NAM 2007)
	Hepatitis B causes liver damage and may lead to liver cancers
	Hepatitis C causes fatigue, weight loss, some food intolerance, upset stomachs with diarrhoea and swollen abdomen, jaundice, internal bleeding, nausea and vomiting. May lead to cirrhosis and liver cancers
Bacteria	MAI causes weight loss, fever and diarrhoea and can be contracted from tap water or soil
	Tuberculosis (TB) causes chest problems including pain, coughing and weight loss. TB is the leading cause of illness and death for individuals who are HIV positive
Protozoa & parasites	Toxoplasmosis contracted through raw or meat that is undercooked, causes cysts in the brain which lead to headaches, fever, fits and in serious situations, coma
Fungi & yeast	Candidiasis (thrush) affects the throat, mouth, vagina, anus and penis. Thrush can be painful
	Cryptococcal meningitis affects the lungs resulting in chest infection and may lead to meningitis
	Pneumocystis carinii pneumonia (PCP) affects the lungs causing inflammation, cough, pain and difficulty breathing. PCP can be fatal if untreated
Cancers & malignancies	Karposi's sarcoma (KS) is a cancer affecting the skin, but may also affect some organs and the gut
	Lymphoma is a cancer affecting the lymph system

Table 10.4 AIDS-related illnesses and infections

contributed to his weight loss. White plaque present inside his mouth suggests oral thrush. Administer oral antifungal therapy as prescribed, ensure you support the patient with his oral hygiene needs and promote oral fluids. Assessing his nutritional status, including body mass index (BMI) will identify if the support of the dietetic team is necessary. Either way, Mr George will need some assistance in regaining his appetite and nutritional intake, which has a vital role in supporting the immune system.

Considering the overall assessment and well-being of Mr George, and from what has been discussed so far

Applying Theory to Practice: Exercise 10.9

- What immediate strategies would you employ to address these priorities?

Consider: cough suppressants, additional oxygen therapy if required, fluids and good positioning to promote lung capacity and comfort.

about the immune system, it suggests that he has an underlying immune deficiency and it is therefore probable that clinical investigations will conclude that Mr George is suffering from *Pneumocystis carinii* pneumonia (PCP). PCP is one of the illnesses that indicate the patient is HIV positive and is also one of the AIDS-defining illnesses (Miller 1996, Mitchell 2007, NAM 2007). Mr George will thus receive two serious diagnoses at the same time.

Applying Theory to Practice: Exercise 10.10

- What are the implications of this diagnosis?
- What is your role in supporting the patient who is receiving this kind of information?
- What are key areas you will need to consider when supporting Mr George and preparing him for discharge home?

Psychosocial

Recent changes to the law ensure that it is now illegal to discriminate against an individual who is HIV positive, and yet despite this, discrimination continues to exist (NAT 2006). The main causes are thought to be largely due to lack of knowledge and ignorance of HIV and how it is transmitted (NAM 2007). Moral judgements, based on people's existing knowledge and information about how HIV is transmitted, for example sexually acquired or through injecting drugs, reinforce existing prejudices about the individuals who participate in these activities, such as gay or bisexual men. In the UK there is still a large percentage of the population who believe individuals with HIV are in some way to blame for their diagnosis (NAM 2007). These prejudices are damaging. They prevent people from using healthcare services, seeking advice or HIV testing, which may delay treatment, affect their general well-being, and contribute to feelings of isolation. National campaigns, led by HIV and AIDS foundations and groups challenge these beliefs and behaviours, and seek to remove them (NAT 2006).

Treatment of HIV

Drug therapy for HIV has developed rapidly since HIV was first recognised. Drugs are now available which target every stage of the HIV infection and reproduction sequence within the host cell, designed to:

- Prevent the HIV attaching to the T cell
- Stop the HIV and host cell fusing together
- Prohibit the HIV converting its RNA to DNA using its reverse transcriptase
- Prevent the HIV from producing enzymes to help in the process of inserting its own DNA into the host's DNA
- Stop the host cell from being used as an HIV reproduction line
- Help stop the 'budding' process of new HIV.

Since the introduction of these drugs, it is considered to be more effective if they are prescribed in combination, that way attacking the HIV at all stages. This combination of therapy is referred to as highly active antiretroviral therapy (HAART). However, none of these drugs are without side-effects and treatment is obviously necessary on a continuous basis, therefore requiring commitment from the patient to adhere to their medication regimen.

The lymphatic system

The lymphatic system plays an ancillary role supporting the cardiovascular system and an essential role as part of the immune system. As fluid circulates throughout the body, plasma leaves the circulation and bathes the cells (interstitial fluid). Plasma contains proteins that are too large to be returned via the small capillaries of the venous system, it is collected by the vessels of the lymphatic system transported to the two lymphatic ducts and returned to the venous blood through small connections to the subclavian vessels.

Form

A network of vessels, cells, tissues, and organs constitute the lymphatic system. Included in this network are:

- Lymph vessels
- Lymph nodes
- The spleen
- The appendix
- The thymus
- Lymphocytes (lymphatic cells).

Running throughout this network is a watery fluid called lymph (*lympha* means 'clear water').

Lymph

Lymph is any fluid that enters the lymph vessels. It is similar to blood plasma, containing more WBCs. Lymph circulates throughout the tissues delivering food, oxygen and water to cells, simultaneously removing waste materials. In the limbs, lymph is rich in protein, especially albumin. In the bone marrow, spleen and thymus, lymph contains higher concentrations of WBCs; in the intestines lymph contains lipids absorbed during digestion.

Lymph vessels

Lymph vessels, also called lymphatics, carry lymph in only one direction – back towards the heart. Throughout all the tissues of the body, lymph vessels form a complicated, spidery network of fine tubes. The smallest vessels, called lymph capillaries, have a closed or dead end in contrast to the cardiovascular system, forming a closed circuit. The walls of these capillaries are composed of only a single layer of flattened cells. The pressure inside these walls is lower than that of the venous capillaries making them accessible to the large molecule fragments of damaged cells and micro-organisms that they are required to filter. Lymph capillaries in the villi of the small intestine are called lacteals. These specialised capillaries transport the fat products of digestion, such as fatty acids and vitamin A.

Lymph nodes

Scattered along the pathways of lymph vessels are oval or kidney-bean-shaped masses of lymphatic tissue called lymph nodes acting as filters (Table 10.5). The smaller lymph nodes are often called lymph nodules. Lymph nodes occur in clusters or chains. The neck, armpits, chest, abdomen, pelvis and groin are areas where the nodes can be palpated. Damaged cells are taken to the lymph nodes to be destroyed. The nodes can become increasingly swollen and tender if the micro-organism is not easily destroyed, i.e. cancers.

Function

Scenario 10.3

Diseases Affecting the Lymphatic System

James Nesbitt is a 19-year-old who attends his local walk-in health centre due to a two-week history of lethargy and sporadic fever.

He states that he is feeling progressively weaker and just wants to sleep most of the time.

His respiratory rate is 21, pulse 98 and regular, blood pressure 108/64. His temperature is recorded as 38.2.

He has no relevant medical history, takes no medication and has just begun university.

Assessment and analysis of patient presentation

The physical observations suggest a slight raise in Mr Nesbitt's metabolism. This is commonly caused by an underlying infection, which is confirmed by the sporadic temperature. The presenting history of increasing lethargy and weakness are common symptoms that develop during a viral infection and can also continue for an extended period afterwards. Recently starting university may provide a clue to the source of infection and meningitis

Function	**Structures**
Drainage of intercellular fluid (including large proteins and microorganisms)	Lymph capillaries and vessels
Filters lymph and destroys micro-organisms (phagocytosis)	Superficial and deep lymph nodes remove micro-organisms
Manufacture of lymphocytes, monocytes and antibodies	Lymphatic tissue within the nodes, spleen, tonsils, adenoids and thymus gland in infancy
Transports digested fats after absorption	Lymph capillaries attached to the intestinal villi drain into lymphatic vessels (lacteals)
Breaks down red blood cells and platelets: pigments are distributed to the liver and iron to the bone marrow	The spleen and cells within the liver and lymph nodes

Table 10.5 The Function of the Lymphatic System

should be excluded as a serious possibility. Another common viral infection associated with communal living and close contact is glandular fever. The cause of glandular fever (infectious mononucleosis) is the Epstein–Barr virus (EBV).

Pathophysiology

The EBV is a member of the herpes family. It is an infectious illness that can result in tender swelling or enlargement of the lymph nodes as the defence system endeavours to fight the virus. The most common age to catch glandular fever is between the ages of 16 and 25 (HPA 2007b). As with most viral infections, once an individual has been exposed at a young age they acquire immunity by producing specific antibodies. The Health Protection Agency advises that young children do not need to be taken out of school or nursery when they have glandular fever (HPA 2006). This is because the infection is usually mild in young children, and the incubation period is so long that it is hard to work out the source.

Glandular fever is an infectious illness and can be passed on to family and friends, but most adults exposed to glandular fever have previously been infected with the EBV and are therefore not at risk of developing symptoms. Glandular fever is usually passed on through intimate contact between an uninfected person and someone who has the EBV but is not showing any symptoms. The EBV is normally spread via the saliva. This is most frequently seen in teenagers and young adults. It is thought to spread in a similar way to many other viruses, from saliva, and is sometimes jokingly referred to as the 'kissing disease' as it is often passed from partner to partner.

Applying Theory to Practice: Box 10.4

Signs and Symptoms of Glandular Fever

- Lethargy and weakness
- Recent flu-like symptoms
- Headache and sore throat
- Sweats and alterations to body temperature
- Enlarged lymph nodes – neck, armpits, abdomen, groin
- Pale and gaunt physical appearance
- Extensive muscular pains
- Possible splenomegaly

Glandular fever often commences with a few days of mild symptoms, including headaches and tiredness. The main symptoms then develop, lasting for up to three weeks, although post-illness lethargy can continue for an extended period (NCID 2007). The effect on the individual varies.

The plan of care

There is no specific treatment for glandular fever. Antibiotics do not combat viral infections. Anti-inflammatory analgesics may relieve some of the symptoms, due to the pain being caused by inflammation, and antipyrexials such as paracetamol will relieve the pyrexia and make him feel better. Mr Nesbitt should be encouraged to continue his normal lifestyle, take extra fluids and supplement his diet with vitamins and minerals directed at aiding his own immune system, such as zinc and vitamin C (although there is limited evidence to support this). An increasing number of antiviral medications are being developed directed at preventing viral proliferation, thereby enabling

Applying Theory to Practice: Exercise 10.11

Antivirals and Vaccines

As a student nurse you will need to develop an excellent knowledge of medications.
Complete the following exercise and add the results to your portfolio.

- Identify at least four different vaccinations.
- What are the potential side effects of these drugs?

There are many myths surrounding vaccines and what they actually contain and how the individual gains immunity from this process.

- What do vaccines really contain?
- Identify three different types of antiviral drug.

There are many complementary therapies directed at boosting the immune system. Unlike prescription medications they may not have undergone extensive research.

- What complementary therapies can you find that have a research base?

A couple of examples may include echinacea and zinc.

the immune system to eradicate the virus. Vaccines have been developed against many viral infections. A specific vaccine provides the immune system with the ability to quickly and effectively fight a particular virus.

Applying Theory to Practice: Exercise 10.12

Common Pathologies Affecting the Lymphatic System

- Lymphangitis
- Hodgkin's disease
- Lymphoedema

Research the possible physical changes resulting from these processes and identify the clinical signs you would look for during the assessment process and how the care of these patients would be managed.

Add the findings to your portfolio, which on completion of this chapter should form the foundation from which you can build an in-depth knowledge within the aforementioned areas.

The endocrine system

The endocrine system is largely concerned with regulation and therefore has a pivotal role in maintaining the body's balance. The system itself is not connected anatomically, but is a system made up of glands positioned throughout the body.

The purpose of the endocrine system is to:

- Produce and release chemicals called hormones
- Release hormones to the tissues and cells to control the body's reaction and enable it to adapt to changes thereby maintaining balance and homeostasis
- Control the body's metabolism.

Form

Abnormalities of the endocrine system are largely due to three overarching reasons; a disordered endocrine system, which may be as a result of a genetic abnormality, overproduction or underproduction of a particular hormone. One of the most common diseases of the endocrine system is **diabetes mellitus**, affecting around 180 million of the world's population (WHO 2007) with this figure steadily rising (Holt & Hanley 2007). It is likely that you will care for patients with diabetes throughout your nursing career in all specialties.

Scenario 10.4

Diabetes

Mrs Khan is 65-year-old woman of Asian origin who is having problems with recurring urine infections.

She has been found to have a consistently high blood glucose level and has been diagnosed with type 2 diabetes.

- What care and considerations are required to ensure Mrs Khan manages her diabetes safely and effectively?

Diabetes mellitus occurs when there is a consistently raised level of glucose in the blood (hyperglycaemia), which can be detected very simply by using a small device (a glucometer) with only a tiny amount of fresh blood taken from a finger prick. Hyperglycaemia results when there is a lack of the hormone insulin, which is produced by the beta cells of the islets of Langerhans situated in the pancreas. The problem may be with the production and release of the hormone or the action of the insulin or indeed both.

There are 1.8 million people in England who have been diagnosed with diabetes and the number is increasing (DH 2003). However, if this number included all those individuals living with diabetes, but yet undiagnosed, the number would be closer to 2.4 million. This group are sometimes referred to as the 'missing million'.

There are two main types of diabetes mellitus (Table 10.7), simply called type 1 and type 2. In type 1 diabetes the body does not produce any insulin and is, therefore, completely dependent on insulin replacement therapy to survive. Out of all the people diagnosed with diabetes, type 1 accounts for 5–10% of cases (Evans & Tippins 2007). Mrs Khan has been diagnosed with type 2 diabetes. In this type of diabetes, individuals are able to produce some insulin, but often not as much as they require, or the body is resistant to the effects of insulin (Holt & Hanley 2007). This type of diabetes accounts for 85–90% of all diabetic cases (Phillips 2007).

Gland and anatomical position	Hormone	Function
Pituitary gland situated in the hypophyseal fossa of the sphenoid bone of the skull	Antidiuretic hormone	Reduces urine production in the kidneys
	Oxytocin	Produced in the hypothalamus but stored and secreted by the pituitary gland. Its role is in childbirth
	Melanocyte stimulating hormone	
	Human growth hormone	Stimulates growth of body tissue: bone, cartilage and muscle. Also influences the metabolism of fats, proteins and carbohydrates. Can be affected by exercise, emotional well-being and nutrition
	Prolactin	Stimulates lactation
	Follicle stimulating hormone	Stimulates the development and ripening of the ovum
		Stimulates spermatozoa production
	Luteinising hormone (LH)	Works with FSH to stimulate ova or spermatozoa
	Thyroid stimulating hormone (TSH)	Stimulates growth and activity of the thyroid gland to secrete thyroxin
	Adrenocorticotrophic hormone (ACTH)	
Hypothalamus situated above the pituitary gland in the brain	Thyrotrophin releasing hormone (TRH)	
	Prolactin inhibiting hormone (PIH)	Regulates the level of prolactin produced by the pituitary gland, thought to be the neurotransmitter dopamine
	Prolactin releasing hormone (PRH)	Stimulates the production of prolactin by the pituitary gland
	Gonadotrophin releasing hormone (GnRH)	Secreted at puberty to mature the gonads
	Somastostatin	Inhibits the release of glucagons and insulin

Table 10.6 Endocrine system – Form & Function

Thyroid gland situated in the neck in front of the larynx and trachea	Thyroxine	Regulates metabolic rate and the metabolism of carbohydrates. Also regulates growth and development and functioning of the reproductive system and nervous system
	Calcitonin	Regulates calcium in the blood
Parathyroid gland situated on the posterior wall of the thyroid gland	Parathyroid hormone (PTH)	Regulates serum calcium levels
Adrenal and suprarenal glands situated above the kidneys	Epinephrine	
	Glucocorticoids including hydrocortisone, corticosterone and cortisone	Control metabolism of glucose and how they are stored and released from the liver. Also influence fatty acids, sodium and water levels. Regulate some aspects of the immune system, i.e. gastric juices, enzymes and inflammatory response and allergy
	Aldosterone	Regulates haemostasis
Islets of Langerhans situated in the pancreas	Insulin	Reduces the level of glucose in the blood and stimulates the tissues to absorb
	Glucagon	Increases the level of sugars in the blood
Pineal gland situated under the brain	Melatonin	Poorly understood, but thought to be involved in puberty. Also thought to influence mood in relation to light levels
Ovaries	Oestrogen	Sex hormones
Testes	Testosterone	Sex hormones
	Dihydrotestosterone	

Table 10.6 Endocrine system – Form & Function (continued)

The treatment of Mrs Khan's diabetes, as with all patients, is individualised to her, with medication, which may be a combination of therapies (NICE 2002) being prescribed alongside consideration of her current lifestyle such as diet and weight management, which may be having an impact on her diabetes and general well-being. As most patients who are diagnosed with type 2 diabetes are overweight at the point of diagnosis (IDF 2005), it is possible that Mrs Khan will need support and advice about how to manage her weight effectively. As well as affecting her body's metabolism, being overweight can increase her resistance to insulin (Lowey 2005), and increase her risk of developing hypertension and high cholesterol, both of which can lead to cardiovascular disease. Cardiovascular disease is said to be responsible for approximately 75% of deaths in patients with diabetes (Lowey 2005).

It is vital that patients with diabetes, like Mrs Khan, learn not only to control their blood glucose levels, but also have a good understanding of how to maintain their

Type 1 – insulin-dependent diabetes	Type 2 – non-insulin-dependent diabetes
Sudden destruction of insulin-secreting cells leads to acute hyperglycaemic episodes characterised by insulin deficiency and ketosis resulting in gastric stasis, coma and death if left untreated Accounts for 10–15% of cases (DH 2001b) Results early in life as a consequence of an autoimmune reaction (presentation <25) with destruction of pancreatic islet beta cells Daily insulin injections needed to sustain life Insulin requirements, physical levels of activity and diet need correlation Potential for hypoglycaemia high Can be idiopathic Life expectancy reduced on average by 20 years	Insidious onset characterised by increasingly defective ability to secrete and utilise insulin, eventually leading to hyperglycaemia Not traditionally associated with ketosis, results in many associated disease processes being present when disease is first diagnosed Accounts for 85% of cases (DH 2001b) Traditionally associated with middle age onset (>40) Increasing teenage/young adult onset: direct correlation with increasing levels of obesity (DH 2001) Considered a preventable disease Commonly associated with high fat/calorie diet, lack of exercise and obesity (ADA 2005) In many cases diet and lifestyle modification may curtail symptoms and disease establishment Life expectancy reduced by 10 years (dependent on age of onset)
Prolonged exposure to hyperglycaemia causes widespread tissue damage. Commonly affected areas include the eyes, kidneys and feet. Diabetes is the leading cause of renal failure and blindness (in working age) and the second commonest cause of limb amputation. Diabetes accounts for 5% of total NHS resources. It is estimated that 10% of inpatient services are used by those with diabetes.	

Table 10.7 Presentation, Classification and Pathophysiology

general health and well-being to prevent associated illnesses. However, managing weight loss may not be as straightforward for some patients. The older adult may have other illnesses or conditions which limit their mobility, and so developing an exercise programme may be more challenging (IDF 2005).

Religious and cultural differences may have an impact on any weight loss plan and need to be carefully considered. It may be necessary for patients to develop a whole new approach to food, meal preparation and mealtimes, which can be greatly influenced by whether or not the patient is dependent on others. It is also therefore necessary to not only educate Mrs Khan, but also her family and carers, which may require enlisting the support of a range of professionals and agencies.

It is possible for patients with type 2 diabetes to adequately manage their disease by making the necessary adjustments to their diet and lifestyle. However, it may also mean that Mrs Khan will require medication, such as anti-diabetic drugs as outlined in Table 10.8. It is also

Applying Theory to Practice: Exercise 10.13

Consider the impact of diabetes for the older adult who may:

- be less able to exercise due to other illnesses and conditions
- not have access to equipment or support, such as a gymnasium
- be less able to prepare fresh meals
- rely on others for their food shopping
- have a decline in their cognitive function
- have poor visibility.

Group of drugs	**Action**	**Drugs**
Sulphonylureas	Stimulate the release of insulin from the pancreas Only effective if the patient has some beta – cells functioning Drugs in this category are wide-ranging in the length of time they remain active in the body and range between 4–30 hours	Gliclazide Glibenclamide
Biguanides		Metformin
Alpha-glycosidase inhibitors	Support the breakdown of carbohydrates in the intestine preventing absorption	Acarbose
Rapid-acting insulin secretagogues	Target post-meal blood glucose control	Repaglinide Nateglinide
Glitazones	Combat insulin resistance	Rosiglitazone

Table 10.8 Drug treatment of diabetes

possible that she will require insulin injections at a later date in the disease trajectory (IDF 2005, NICE 2002, Wallymahmed 2006).

Adherence to a medication regimen is important for Mrs Khan to ensure safe and effective management of her disease. This will also require a degree of education.

The Department of Health, alongside the National Diabetes Team, advocates structured education programmes for patients diagnosed with diabetes. This would be essential for Mrs Khan to gain a good understanding of her disease management, but her individual needs should also be considered. Information should be provided in a language and manner that she understands, and is able to retain and relate to her own disease management. Patient participation is vital if you are to ensure independence and self-management of long-term conditions such as diabetes, and has now been recognised as the key to preventing complications.

One of the complications of diabetes is nephropathy. Nephropathy is damage to the kidneys and it is estimated that 25% of all patients with diabetes experience nephropathy after 25 years (Lowey 2005). Mrs Khan therefore requires further investigation into her recurring urine infections beyond the influence of hyperglycaemia. Another complication of diabetes is retinopathy. It is suggested that more than half of patients with type 2 diabetes will have some degree of retinopathy, damage to the retina, after 20 years (Watkins 2003). Neuropathy, damage to the nerves, is also associated with diabetes, particularly where blood glucose levels are poorly managed or controlled and can lead to a number of symptoms such as numbness to the extremities and peripheries, particularly the legs and feet, as well as pain, which can lead to the patient developing ulcers.

Diabetes – the facts

The Government has clearly recognised the need to ensure that patients have access to effective healthcare, irrespective of where they live, and has outlined national standards for the provision of diabetes care in the *National Service Framework for Diabetes* (DH 2001) and the follow-up *Delivery Strategy* (DH 2003). In addition, the National Diabetes Support Team has produced guidance and best evidence-based practice initiatives to support healthcare teams and organisations to develop and achieve excellence in diabetes care.

The NSF emphasises the need to ensure that individuals at risk of developing diabetes are given advice and education to prevent development of the disease. It is estimated that the majority of diabetes cases are preventable, that is about two-thirds of all cases.

Risk factors

- Environmental
- Diet
- Obesity
- Ageing population
- Decrease in levels of exercise and physical activity.

In addition, the 'missing million' are provided with access to a diagnosis and treatment to prevent further complications of the disease.

Professional issues

Nurses have an important role to play in educating patients in living healthier lifestyles through a balanced diet, exercise and avoidance of obesity:

- Routine screening of urinalysis and blood glucose levels
- Empowering patients diagnosed with diabetes to be self-caring in managing this long-term condition for the optimum health and quality of life.

Resources and guidance to help you understand how services have been developed for patients with diabetes in the UK

- *National Standards, Local Action – health and social care standards and planning framework 2005/6–2007/8* (2004) Department of Health, London. www.dh.gov.uk. This document outlines key targets for improving the health of the nation, supporting patients with long-term conditions and engaging patients in their healthcare.
- *Commissioning Framework for Health and Well-being* (2007) Department of Health, London. www.dh.gov.uk. Builds on the above guidance by providing a framework designed to help commissioners create services that deliver the choices identified by patients, underpinned by quality and access, thereby reducing inequalities in healthcare. This document emphasises the need for collaboration between service providers.
- The National Diabetes Support Team (NDST) established in 2003 with the purpose of providing guidance and support to ensure the effective implementation of the NSF. The team produce some excellent guidance documents that have been the basis for services and care provided to patients with diabetes. Provides clear and concise information that supports healthcare professionals to deliver and share good practice. The NDST produce briefings, updates and newsletters with links to resources and information websites. www.diabetes.nhs.uk

  National Diabetes Audit (NDA). www.icservices.nhs.uk

Conclusion

This chapter has provided an overview of the immune/lymphatic and endocrine systems and described common diseases that can affect these systems. Neither of these systems works autonomously and many of the diseases described will be affected or have an impact on other systems outlined in other chapters of this book. It is important to be able make these links in order to fully understand these complex systems.

Chapter 10 Summary Quiz

1. Which of the following are fundamental roles of the skin?

A. Protection, sensation, heat regulation
B. Protection, reproduction absorption
C. Insulin secretion, elimination, vitamin D production
D. Heat regulation, secretion, urea regulation

2. What drugs may be given to combat an anaphylactic reaction?

A. Norepinephrine, aspirin, digoxin
B. Norepinephrine, antihistamines, salbutamol
C. Epinephrine, salbutamol, steroids
D. Paracetamol, epinephrine, steroids

3. Which of the following are both antiviral drugs?

A. Abacavir, zidovudine
B. Didanosine, amoxycillin
C. Abacavir, ciprofloxacin
D. Prednisolone, enfuvirtide

4. The endocrine system consists of which components?

A. Liver, heart, kidneys
B. Spleen, liver, gall bladder
C. Lungs, trachea, bronchioles
D. Hypothalamus, parathyroid gland, adrenal glands

5. Which cells play a major role in immunity?

A. Mast cells, neutrophils
B. Beta cells, basophils
C. Thrombocytes, leucocytes
D. Mast cells, red blood cells

6. Which common disease processes are associated with diabetes mellitus?

A. Heart disease, lymphatic cancer, foot ulcers
B. Kidney disease, heart disease, retinopathy
C. Retinopathy, foot ulcers, diverticulitis
D. Erectile dysfunction, foot ulcers, pathological fractures

7. What clinical signs frequently accompany anaphylaxis?

A. Marked upper airway oedema, intense thirst
B. Bronchospasm, urticaria
C. Constipation, expiratory wheezing
D. Seizures, headache

8. The lymphatic system contains:

A. The spleen
B. The liver
C. The kidneys
D. The brain

9. How many people are estimated to be living with HIV in the UK?

A. 2,000
B. 100,000
C. 1,000,000
D. 63,000

10. Which acts undertaken by healthcare professionals compromise the integrity of the patient's skin and therefore predispose the patient to infection?

A. Venous cannulation
B. Applying oxygen therapy
C. Assisting a patient to wash
D. Recording a temperature

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11

The senses

Cliff Evans and Emma Tippins

Chapter 11 Learning Objectives

- Gain knowledge and insight into the anatomy and physiology related to the structures associated with the senses
- Gain insight into common conditions that can result in a profound effect on the senses
- Gain the ability to apply theory to practice by understanding the holistic needs of individuals afflicted by diseases affecting these systems
- Understand how the ageing process impacts on these systems
- Gain insight into commonly used medications directed at either preventing or treating relevant conditions
- Collect and assemble additional materials for your growing professional development portfolio
- Through the application of theory into practice question and critique the evidence-base and effectiveness of the care you deliver

Introduction

This chapter focuses on several organs that collectively provide the individual with their insight into the outside world. The ability to 'sense' is a primitive function developed through thousands of years of evolutionary change. The senses are taken for granted by those with a fully functioning ability, but for many a combination of congenital, degenerative and acute pathologies results in a decreased ability in one or more of these functions. This can have major effects on the individual's ability to function, their mental health and the way they are perceived and treated by the society they live in. The chapter is divided into sections describing the form and functioning of each component. A clinical scenario is used to address and discuss many of the issues nurses will meet in their everyday duties. Common pathologies, their recognition, possible treatment and the effects on the individual will all be discussed. Several further learning opportunities will provide the reader with the ability to gain extensive materials for their developing portfolio as well as offering the opportunity to work in combination with others and share thoughts, feelings and knowledge for mutual benefit.

Anatomy and Physiology in Action: Exercise 11.1

Before continuing, complete the following exercise:

- Write a list identifying all the organs of sense.
- What diseases can you think of that affect each of them?
- Are any of the diseases hereditary or congenital?

The eye (sight)

Form

When you think about the ability to see, the immediate focus centres on the eyes, but the eyes are only one of a number of structures involved in achieving the sense of vision, others include:

- The eyelids
- The lacrimal glands
- The extrinsic muscles of eye movement.

The eyelids are composed of very fine skin and muscle (the thinnest skin area on the body), connective tissue containing oil-secreting sebaceous glands and the conjunctiva, a mucous membrane that lines the inner surface of the eyelids and extends onto the anterior surface of the eyeball. The lacrimal gland is anatomically located laterally and superiorly within the eye orbit. This gland works in unison with glandular cells to lubricate and moisten the eye.

The eye consists of three prime components forming a spherical ball-shaped body, around 24mm in diameter.

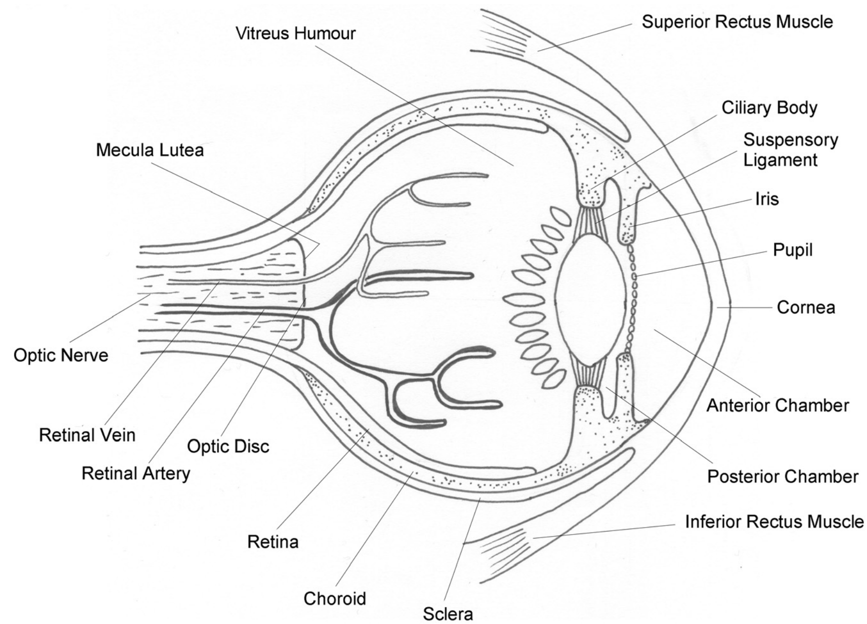

Figure 11.1 Lateral view of the eye and its components

The tunics consist of three layers:

- An outer fibrous layer consisting of the sclera (the white of the eye), which forms the transparent cornea at the front of the eye. The cornea is surrounded by a thin layer of modified skin extending from the eyelids, called the conjunctiva
- The uvea, the middle or vascular layer containing the choroids, the ciliary body and the iris
- The retina, which lines the posterior two-thirds of the eyeball thereby forming the inner layer.

The **optical components** consist of:

- The lens, composed of lens fibres, suspended behind the pupil by a fibrous ring called the suspensory ligament stabilised by its attachment to the ciliary body
- A serous fluid called aqueous humour, which fills the space between the iris and the lens called the posterior chamber. It continues into the space between the cornea and the iris called the anterior chamber. This fluid is drained out via the scleral venous sinus
- A transparent jelly called the vitreous body or vitreous humour, which fills the large space behind the lens.

Nerve supply

Many nerves combine to control a full range of eye movement. The main nerves are the oculomotor and trochlear nerves that stimulate muscles that control eye opening and rotation or movement. The optic nerve fuses with the sclera at the rear of the eye where nerve fibres from the retina become part of the optic nerve.

- The retina (located in the eye's inner layer): a complex structure consisting of many distinct layers, which are thin and delicate. The light-sensitive layer consists of rods and cones
- The optic disc: a small area of the retina where the optic nerve leaves the eye.

Anatomy and Physiology in Action: Exercise 11.2

Rods and cones are the eyes' visual receptors.

Complete the following exercise to enhance your understanding on the eyes' anatomy and function:

- What particular function do rods play?
- Does the eye contain more rods or cones?

Figure 11.2 Anterior photograph of the eye

Function

The function of the eyes centres on providing the individual with vision. Vision consists of several vital concurrent functions, the properties of which include brightness and colour. When vision is normal, seeing is so effortless that the individual functions that comprise vision are imperceptible.

Vision is composed of three distinct perceptions:

- Forms
- Colours
- Movement.

Thus, we have form perception, colour perception and motion perception.

Overview

The cornea receives light as it enters the eye. The light particles continue through the lens eventually disseminating into the receptor cells of the retina. The retina contains an area called the fovea, which is densely populated by cone cells and limited numbers of rod cells. The central point of our vision is focused on the fovea for high definition, colour and clarity (Clancy & McVicar 2002). Due to the small size of the receptor cells, light particles may enter some and not others thereby enabling an increased ability to distinguish particular details. This ability to perceive detail is called visual acuity. The visual field is a term used to describe the breadth of vision; this results from a combination of the iris aperture, the lens and the cornea. Due to the curvature of the cornea, vision extends beyond 180 degrees.

When light fragments enter the retina, the signals are relayed to the optic nerve. These signals are now converted into electrical activity for transmission and interpretation within the brain. The right side of the brain interprets signals from the left side of the retina and the left side of the brain vice versa. This process facilitates depth of vision as both eyes provide varying data to the brain.

Central interpretation

The occipital lobe, areas of both the frontal and motor cortex and the brain stem are all involved in the central act of visual perception.

To maintain vision the eyes must continually adapt to meet the external environment. In bright daylight the eye uses photopic vision, the scientific term for human colour vision under normal lighting conditions during the day. Colours are varied and easily distinguishable due to the action of three different types of cone cells that culminate to sense three respective bands of colour. In very dim light, scotopic vision is the primary source of vision; since cone cells are nonfunctional in low light, scotopic vision is produced exclusively through rod cells which only respond to luminance differences, therefore there is no colour perception; vision is purely centred on varying shades of grey. In twilight, when both rod and cone cells function, we have mesopic vision; a combination of photopic and scotopic vision. This combination effect results in an inaccurate visual acuity and colour discrimination with a resulting higher total sensitivity for the blue range of colours.

Lubrication

Keeping the eye moist is an essential function as without lubrication the eye is placed at a greater risk of infection and will become increasingly painful. The lachrymal glands (referred to as the tear glands) (Figure 11.3) provide secretions for the cornea. The secretions then drain out via the nasal cavity and the lacrymal duct. Tears continually irrigate dust and foreign particles out of the eye.

Visual defects

The cornea at the front surface of the eye acts as a lens. In perfect sight, the image is brought into sharp focus at the back surface of the eye on the retina. Problems with vision occur when the image is not accurately focused on the retina and the vision becomes blurred. This distortion to

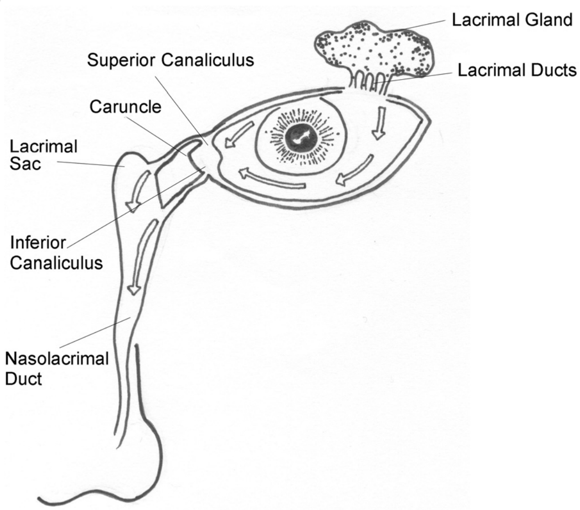

Figure 11.3 The eye and lachrymal gland demonstrating the flow of secretions

normal vision can be corrected with glasses or contact lenses.

Short sight (myopia)

Short sight is hereditary and develops through the teens, affecting approximately 20% of the population (James et al. 2004). The focusing power of the eyes is too strong. Objects at a distance appear blurred with close vision clear. Glasses will make things look smaller when held at arm's length. Laser surgery reduces the thickness of the cornea in the central zone, reducing its focusing ability. Images are then brought into correct focus. Treatment for myopia is very simple and effective and centres on three different corrective actions:

- Optical devices (glasses and contact lenses)
- Corneal refractive procedures (photorefractive surgery/laser therapy)
- Intraocular procedures (the insertion of clear plastic implants into the cornea, an interventional procedure aiming to restore eyesight in short-sightedness) (NICE 2007).

Long sight (hyperopia)

The term hyperopia refers to an inability of the focusing power of the eyes resulting in long-sightedness. Objects are more comfortably viewed at a distance rather than close up (less than 6 feet). Corrective treatment centres on magnification. In severe cases vision is not clear at any distance. Treatment is still considered experimental by many ophthalmic surgeons (James et al. 2004).

Visual tests

There are many different tests that can be used individually or that can be combined to build a constructive view of an individual's vision. These include:

- Visual acuity
- Visual field
- Contrast sensitivity
- Colour vision
- Visual adaptation.

Questioning Clinical Practice: Exercise 11.3

The tests listed above represent only a handful of several delicate and qualitative tests currently available to healthcare professionals to enable them to assemble an informative overview of an individual's sight ability.

Complete the following exercise to gain further insight and knowledge into this fascinating topic, add your findings to your portfolio:

- Identify the tests available within your placement areas.
- Are any of these tests used to identify insidious diseases that can affect eyesight rather than an actual eye problem (primary vs secondary cause)?
- Think back to when you commenced nursing. Did you have your eyes tested?
- Which test was this, and what was the rationale?

Drugs affecting the eyes

Many drugs can affect the eyes' ability to function normally even when very low or therapeutic doses are given. Most of these drugs either dilate the pupil, known as mydriatics, or constrict the pupil, known as miotics.

Mydriatics

Drugs that have a mydriatic effect simply result in a dilated pupil. They can be used to examine the eye as they prevent muscle around the eye contracting the pupil; therefore, the pupil remains dilated. Within clinical practice atropine is commonly administered as an eye drop to dilate the pupil for examination of the retina/optic disc. Drugs do not necessarily need to be administered directly to the eye to have a dilatory effect, for example, atropine given intravenously for heart conditions will also result in dilated pupils; this dilatory affect can last for hours resulting in temporary blurred vision.

Applying Theory to Practice: Exercise 11.4

Overdoses of many drugs will also result in pupillary changes, which can mean the patient attends hospital with a good clinical indicator of the underlying cause of their problem.

- Make a short list of any drugs, legal or illegal, that affect the size of the pupil.

Read the next section and add to your current knowledge base.

Miotics

Miotics result in a constriction of the pupil by constricting muscles that surround the eye. Constriction of the eye can also be caused by metabolic disorders; these include renal failure (Chapter 6).

Scenario 11.1

Acute Conjunctivitis

Gabrielle Downing, a 29-year-old mother of two young children, arrives at the GP surgery where you are on placement. Gabrielle has an emergency appointment with the practice nurse. Her presenting complaint is a two-day history of a red, inflamed and painful right eye. This morning her eyelids were stuck together and she has a sensation of grit in her eye. On examination her vital signs are normal for her age and she is apyrexial.

Ms Downing has no relevant medical history and is allergic to penicillin.

Assessment and analysis of patient presentation

Ms Downing is presenting with the classic clinical symptoms of conjunctivitis. This centres on the physical presentation of an acute and non-traumatic red eye. Conjunctivitis can be defined as inflammation of the conjunctiva, the transparent membrane that covers the inner surface of the eyelid and most of the anterior surface of the eyeball. Because the conjunctiva has such an excellent nerve and blood supply it can become extremely swollen and painful when irritated. The cause can vary from localised infections through to allergic reactions.

Applying Theory to Practice: Exercise 11.5

There are many conditions that can result in a red and itchy or painful eye. Classically described as bloodshot, this umbrella term for several clinical conditions results in 35% of ocular attendances within primary care each year within the UK (MHRA 2004). Recent changes have now allowed the main drug used in its treatment being sold without a prescription within the UK. This is an interesting change, as many causes of a red eye are not related to an infection caused by bacteria.

Complete the following exercise to gain further understanding of acute eye conditions:

- Identify at least six different conditions that can result in the conjunctiva becoming inflamed and painful.
- What tests are available to assess the extent of damage to the affected eye/eyes?
- Could any of these acute conditions result in long-term blindness?

To help you research these questions the following sites are recommended:

http://www.eye-care.org.uk/information_listing.php?content_id=4

http://www.gpnotebook.co.uk/simplepage.cfm?ID=818937918

Conjunctivitis – the facts

Conjunctivitis is an extremely common presentation to all acute healthcare services (MHRA 2004). It is characterised by either unilateral or bilateral symptoms. These include:

- Swollen eyelids
- Inflamed inner eyelids
- Red watery eyes
- Purulent discharge resulting in sticky eyes and crust-like formations around the lids.

There are two main types of conjunctivitis:

- **Allergic**. An antigen stimulates the inflammatory response; this can be self-limiting or can continue as a hypersensitivity reaction. Causative agents include pollen and make-up.
- **Infective**. Caused by viruses or bacteria infecting the eye. The immune system is stimulated by the invading pathogen and begins trying to halt the pathogen's proliferation.

Infection is the most common cause of conjunctivitis. This condition is generally considered self-limiting. It is however, very uncomfortable and unpleasant. In infective conjunctivitis, as part of the inflammatory response to rid the disease, a rapid increase in mucus production is common. This mucus contains many white cells emanating from the blood supply. The end result is pus formation (a collection of white immune cells and destroyed bacteria). The purulent fluid clumps on the eyelashes making them stick together. The common cold can cause conjunctivitis, spreading from the patient's mouth or nose to their eyes. Infection of the eyes with chlamydia or herpes can be far more severe and take longer to treat (Watkins 2004). However, conjunctivitis caused by the common cold is very infectious and can spread rapidly between people. Various primary healthcare practitioners frequently prescribe antibiotics; the most common form, chloramphenicol, can now be obtained without a prescription.

Pathophysiology

Conjunctivitis can be caused by a multitude of organisms or varying stimuli. The most common presentation is bacterial infection caused by colonisation of the conjunctiva by pathogens such as *Haemophilus influenzae*, *Streptococcus pneumoniae* and staphylococcus (Prodigy 2007). Infective conjunctivitis is associated with many underlying causes; these include anything that can result in superficial damage to the eye, such as foreign bodies, scratches and direct entry through localised contamination, for example, rubbing the eye with dirty fingers.

Clinically it is problematic to differentiate between a bacterial or viral cause; therefore the treatment centres on eradicating bacteria so that even if the infection is caused by a virus, the administration of antibiotics will stop opportunistic bacterial proliferation.

Allergic conjunctivitis is increasingly prevalent in the spring and summer months with many cases being attributed to a hypersensitivity reaction to pollen. When the patient's clinical symptoms also include a runny nose (rhinitis), this is termed hay fever (Watkins 2004). In allergic conjunctivitis, both eyes are usually affected at the same time. Pollen irritates the eyes and causes the conjunctiva to swell; excessive mucus is produced to irrigate and cleanse the conjunctiva of the causative agent (Table 11.1). The mucus or watery discharge is clear and uninfected. In infective conjunctivitis, the infection may start in one eye, but can spread to both. The discharge is usually purulent and greenish in appearance.

Allergic	Infective
Pollen Cat and other animal hairs Make-up Chemicals Contact lenses	Bacteria Viral Fungal

Table 11.1 Causes of Conjunctivitis

Psychosocial aspects

Pain or discomfort are the main reasons for people to seek healthcare (DH 2001). It is therefore essential to treat these symptoms before detailed examination and diagnosis.

Possibly the greatest fear patients associate with disorders affecting the eyes is blindness (Evans et al. 2005). Blindness has several causes, from congenital abnormalities and ageing-related macular degeneration through to localised disease and trauma. Blindness does not mean a complete inability to see or perceive light; in the UK the statutory definition of blindness refers to persons who are so blind as to be unable to perform any work for which eyesight is essential. The causes of blindness can be categorised into three classifications or collective groups:

- Childbirth to adolescence: In the developed world

Developing and Delivering Expert Care: Box 11.1

As previously discussed, the local application of antibiotics is the main treatment plan for conjunctivitis; however, there are many adjuncts to treatment that may limit further episodes and improve the overall quality of care, these include:

- When the presenting history and symptoms suggest an allergic cause and the patient wears contact lenses, advise them to seek the advice of their supplier in case the lenses are a contributing factor, particularly outside of the summer months
- The application of cold compresses may soothe irritation and assist in reducing oedema
- Antihistamines will prevent further swelling by antagonising the further release of histamine
- Eye specialists may prescribe steroid drops to reduce inflammation
- Topical anti-inflammatory preparations including sodium cromoglicate may halt localised inflammation
- The concurrent use of NSAIDs will reduce pain and assist in reducing inflammation

In infective conjunctivitis:

- Bathe the affected eye/eyes with clean warm water frequently each day
- Avoid cross-infection with an unaffected eye
- Avoid spreading the causative agent with members of the same family by sharing towels and flannels
- Always complete a cause of antibiotics to avoid recurrence and future resistance; even if symptoms stop, the antibiotics must be completed
- Avoid wearing contact lenses until symptoms resolve
- If symptoms persist or proliferate, specialist advice should be sought particularly if there is a possibility of herpes infection

blindness at this age is usually due to genetic disease and birth trauma

- Adulthood to 60 years: Largely caused by diseases of the retina, and the secondary effects of diseases such as diabetes and hypertension that result in retinopathy
- Over 60 years: Macular degeneration. Glaucoma and cataracts are increasingly prevalent (Galloway & Amoaku 1999).

The psychological impact of receiving a diagnosis of impending blindness or a sudden traumatic loss of sight can be devastating. Jackson et al. (1998) describe several stages of emotional transition or progression that individuals go through in the search of inner understanding and acceptance of their condition or prognosis. Breaking bad news can be both distressing and uncomfortable for many nurses (York 1980). Many of these feelings can be explored through the formation of regular peer support groups or informal clinical supervision sessions. These sessions provide a forum for group discussion where individual staff members can discuss their feelings and explore ways of dealing with difficult case scenarios in the future. Reflective practice and the ability to critique current and previous methods of practice are paramount to professional development and these sessions are pivotal to achieving good practice. In practice, mandatory sessions for manual handling, basic life support, and other clinical issues leave little time to explore feelings but sessions based around clinical supervision are just as, if not more, important.

Macular degeneration

Age-related macular degeneration (AMD) is the number one cause of registration for sight impairment within the UK (Bembridge 2005). This is due to degeneration of the small area of retina at the rear of the eye called the macula. Early symptoms include small distortions in the individual's vision; as the degeneration continues they may lose their central vision, inhibiting their ability to read, define colours and drive. The inability to drive can be a life-altering event for many sufferers for whom it may mean a loss of their independence (Hartry 2007).

Applying Theory to Practice: Exercise 11.6

Within clinical practice many issues are frequently discussed with those that are perceived most distressing normally taking precedence.

Complete the following research on your clinical placements. This may provide you with the information necessary to choose an area that you feel would be supportive when you begin work as a newly qualified nurse.

- Does the clinical area facilitate regular staff forums?
- How is the information gathered used to change practice or working conditions?
- Are debriefing sessions held after conflicts or following clinical incidents, cardiac arrests or deaths?

Professional issues

Applying Theory to Practice: Exercise 11.7

There are several disease processes that can lead to blindness or a severe compromise of an individual's vision.

- Make a list of any diseases that can lead to blindness you already know.
- Identify any other common eye conditions that you can think of.

Read the following sections on common eye disorders and add a brief summary to your portfolio.

Glaucoma

Glaucoma is a collective term used to describe diseases that damage the optic nerve caused by the effects of raised ocular pressure. The intraocular pressure needs to remain within a narrow spectrum. This equilibrium is maintained by the production and removal of aqueous humour.

Cataracts

A cataract is an opacification of the lens of the eye and the commonest cause of treatable blindness in the world (James et al. 2004). Most cataracts result from cumulative exposure to environmental influences e.g. UV radiation, smoke, chemicals (Galloway 1999).

Figure 11.4 The Snellen chart

Patient confidentiality

During the educational course you are undertaking to become a nurse you will have many discussions on confidentiality and how important it is to any healthcare profession. Patients consenting to healthcare usually disclose personal information to professionals with the expectation that this information will be used to provide effective healthcare. Sometimes healthcare professionals can find themselves in a compromising situation with the patient's rights on one hand and the beliefs or expectations of society on the other. One example is demonstrated in Scenario 11.2.

Developing and Delivering Expert Care: Box 11.2

The Snellen Test

Recording visual acuity in a patient attending for a eye-related problem is essential in establishing a basic insight into their ability to see.

The Snellen chart is used as a quick and effective method of testing for acuity of distance vision. It usually consists of a wall-mounted chart with an identified line drawn 6 metres away from where the reader or patient will be asked to stand and identify the letters, numbers or symbols placed on the chart (Figure 11.4).

In clinical practice, due to space constraints, the chart can be 3 metres away, with the size of the chart correspondingly reduced. Each row is individually numbered to represent the distance at which an individual could read that line with standard vision, in combination with the distance the patient was placed at and the individual row they were able to complete, so that a score represents both the distance and the particular line.

The first number given in the result of a Snellen test is the distance in metres from the chart and then the row number e.g. a reading of 6/36 would imply the patient had completed the line numbered 36, while standing 6 metres away.

To qualify for a driving licence within the UK the applicant is required to read a number plate from a specified distance (20.5m), equivalent to a reading of 6/12 on the Snellen chart.

Unaided visual acuity is the term used to denote vision without glasses; best corrected visual acuity means vision with glasses. Normal or standard vision is equivalent to 6/6 on the Snellen chart.

Scenario 11.2

Macular Degeneration

A 76-year-old man presents with a slight infection of his right eye. While having his visual acuity tested it is noted that the sight in both his eyes is poor. He states that it has been deteriorating over the last few years and that he now has problems reading newspapers. You know that he drove to the walk-in centre because he is unaccompanied and came in asking for change for the car park. He is given chloramphenicol for his conjunctivitis and provided with information about cross-infection and additional methods of eradicating the infection. You ask him how he is going to get home and he states he has no problem driving and that is what he intends to do. You inform him that this may be extremely dangerous and that in your opinion he is unable to drive. He calls you ageist and leaves heading for his car.

Assessment and analysis of patient presentation

Once informed that their eyesight ability does not reach the minimum standard, it is the individual's responsibility to inform the Driver and Vehicle Licensing Agency (DVLA). In this case scenario the driver refuses to do so and is about to drive, resulting in the patient's right to confidentiality conflicting with the greater public interest (NMC 2005). Although the patient's wishes need to be considered, protecting the public is paramount. This scenario could end with the patient leaving the department and due to his failing eyesight running through a zebra crossing and killing several schoolchildren on their way home. A relationship based on trust is essential to delivering effective healthcare, because patients must divulge potentially sensitive information to their healthcare provider to obtain a diagnosis and subsequent treatment. Nurses are answerable for all actions and omissions and, just like all citizens, must uphold the law. If the nurse reports the patient to the DVLA, there will be an established breach of patient confidentiality. The NMC (2004) state that if nurses decide to release personal information they must obtain consent; this further complicates the issue rather than offering assistance in decision making. Exceptional communication skills are vital in

Questioning Clinical Practice: Exercise 11.8

Scenario 11.2 provides all the essential information to create an interesting debate. Try discussing these issues with either some of your colleagues or your class.

- What would you do when placed in this situation?
- Do you have an obligation to protect the public or is your sole concern to maintain your patient's confidentiality?

Compare the class's attitudes and then complete the following section.

- Did you and your colleagues raise the issues identified?

establishing both a good rapport with patients and delivering effective care.

In this case scenario utmost attempts should be used to alert the patient to the potential danger to himself and the public at large. If this fails to persuade him to change his mind, it should be clearly documented that he has refused to be reasonable and he should be informed that this information will be released with or without his agreement. The appropriate authorities should then be contacted and the facts documented in the patient's notes. The documentation process is imperative as the patient's notes may be requested in the future as evidence of your actions. It is generally recommended that a breach of confidentiality should only take place in exceptional circumstances (DH 2003, NMC 2005); regrettably they both fail to provide a definition of 'exceptional'. Therefore each time you encounter a potentially serious ethical dilemma it is best to compose yourself and explore several avenues before committing to an action. Seek advice from senior colleagues but remember their opinions may differ from yours and it is you who are accountable for patients placed within your care.

The Public Interest Disclosure Act 1998 cited in Hartry (2007) identifies six circumstances where disclosing confidential information can be justified:

- Where a criminal offence has been, is or is likely to be, committed
- That a person has, is or is likely to fail to comply with any legal obligation to which he is subject
- That a miscarriage of justice has, is or is likely to occur
- That the health or safety of any individual has been, is or is likely to be, endangered
- That the environment has been, is or is likely to be, damaged
- That information tending to show any matter falling within any one of the preceding paragraphs has been, is, or is likely to be, concealed.

These guidelines simplify the nurse's decision making due to their broad nature. Almost any breach of confidentiality could be included within these six areas regardless of how trivial or complex the issue was as long as the information was disclosed to an appropriate source and not the press or media.

Questioning Clinical Practice: Box 11.3

Ethical Considerations

Professional judgements and sound clinical decision making are key to delivering quality care that is seen to be beneficial to both patients and society. It is therefore essential that you place as much emphasis on professional issues as on disease. The following texts are highly recommended to provide the reader with a solid knowledge base in the ethical dilemmas they will encounter throughout their clinical practice:

Tingle, J. & Cribb, A. (2002) *Nursing Law and Ethics.* Blackwell Science: Oxford.
Dimond, B. (2005) *Legal Aspects of Nursing*, 4th edition. Pearson Education: New York.

The ears (hearing)

Form

The ears are composed of three distinct sections:

- Outer ear
- Middle ear
- Inner ear.

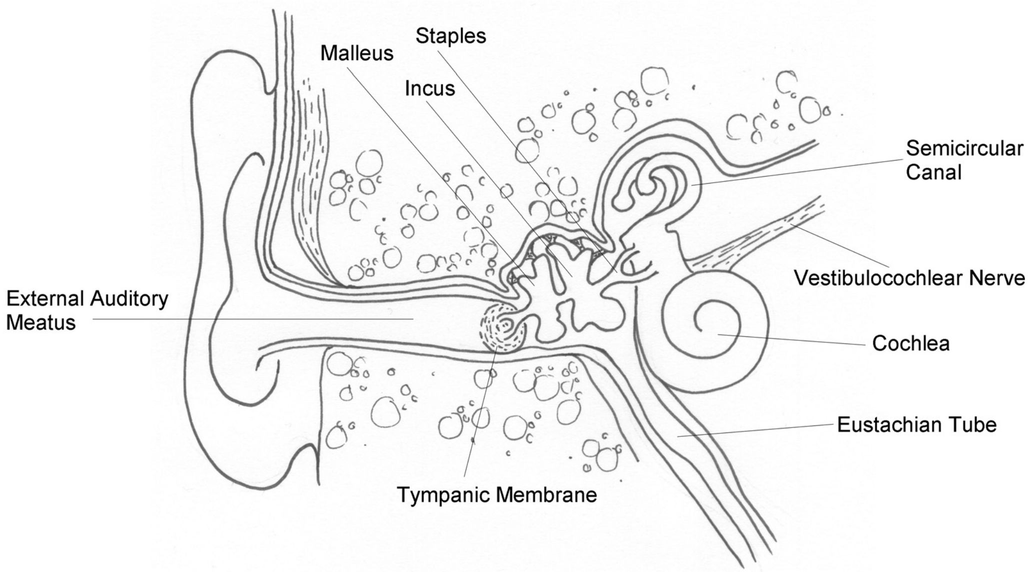

Figure 11.5 The structures of the ear.

Outer ear

The flexible external ear consists of the pinna, the external auditory meatus, the auditory canal and the lateral surface of the eardrum – the tympanic membrane. The outer ear canal is cartilaginous in its outer third and bony in its inner two-thirds. The outer third of this canal has a bony framework (Figure 11.5).

Middle ear

The tympanic membrane separates the outer and middle ear. This pearl-grey structure consists of three layers:

- Skin
- Fibrous tissue
- Mucous membrane.

The middle ear consists of the medial surface of the tympanic membrane, the tympanic cavity, the Eustachian tube and the mastoid air cells. Within the tympanic cavity are the three auditory ossicles – these transmit and amplify sound from the external ear and tympanic membrane to the inner ear. The Eustachian tube serves to equalise the air pressure between the middle ear and the atmosphere. It also connects the ear's sterile area to the nasopharynx. Upper respiratory tract infections can affect the tube by obstructing drainage from the middle ear causing otitis media or effusion.

Inner ear

The inner ear consists of closed, fluid-filled spaces within the temporal bone. It contains the bony labyrinth, which includes three connected structures: the vestibule, the semicircular canals and the cochlea. The vestibular part of the inner ear is concerned with balance; the cochlea is concerned with hearing (Figure 11.5).

Function

The ear has two main functions: hearing and balance.

Hearing

When sound waves reach the outer ear, structures transmit the waves through the auditory canal to the tympanic membrane, and onto the structures of the middle and inner ear. The cochlea branch of the acoustic nerve (cranial nerve VIII) transmits the vibrations to the temporal lobe of the cerebral cortex, where the brain interprets the sound.

Balance

Structures in the middle and inner ear control balance. The semicircular canals of the inner ear contain cristae, hair-like structures, which respond to body movement. Endolymph fluid bathes the cristae. Movement causes the cristae to bend, releasing impulses through the vestibular portion of the acoustic nerve to the brain, which controls balance. When a person is stationary, nerve impulses to the brain orientate them to their position; the pressure of gravity on the inner ear helps maintain balance.

Overview

There are 8,945,000 deaf or hard of hearing people in the United Kingdom (Royal National Institute for the Deaf (RNID) 2007). The term deaf is used in a general way to refer to people with all degrees of deafness. There are four levels of deafness, defined according to the quietest sound that can be heard:

- Mild deafness – some difficulty following speech mainly in noisy situations, quietest sounds heard are 25–39 decibels
- Moderate deafness – difficulty following speech without a hearing aid, quietest sounds heard 40–69 decibels
- Severe deafness – heavy reliance on lip reading, even with a hearing aid, quietest sounds heard 70–94 decibels
- Profound deafness – British Sign Language (BSL) is usually the first or preferred language, or reliance on lip reading, quietest sounds heard 95 decibels or more.

Hard of hearing is the term used to describe people with a mild to severe hearing loss, usually people who have lost their hearing gradually. People who were born with the ability to hear and become severely or profoundly deaf after learning to speak are often described as deafened. This can happen suddenly or gradually.

Communication

When communicating with patients who have a degree of deafness it is important to consider non-verbal skills of communication so that we maximise our interaction without being perceived in a negative way. BSL is the most widely used method of signed communication, but there are thought to be only 50,000 BSL users (RNID 2007). Many deaf people can, to varying degrees, lip read; some people find it more difficult than others. How people speak can affect how well the person can lip read, many people do not speak clearly and lip reading an unfamiliar accent may make the skill more difficult. When communicating with a patient who is lip reading, it is important to speak in as usual as way as possible; overemphasising certain letters or syllables may lead to confusion. It is also not necessary to shout at a deaf or hard of hearing person, as when people shout they distort their voices and make it more difficult for words to be identified. Instead of shouting, or speaking too slowly or exaggerating lip movements, it is important to speak clearly. Words should be formed properly and normal volume maintained.

Scenario 11.3

Otitis Media

John McNamara is an 18-year-old mechanic who had a sudden onset of right-sided ear pain two days ago. He took analgesia for this with good effect but the pain has continued. When John awoke this morning he noticed some discharge from his ear on the pillow and as he arose he realised his hearing was muffled. He does not have any problems walking and is not experiencing any loss of balance. John has attended the health clinic where you are on placement and is assessed by you under the guidance of a practice nurse.

John's vital signs are recorded as: respiratory rate 16 and regular, pulse rate 89 strong and regular, blood pressure 118/72, temperature 37.6.

When inspected through otoscopy it is noted that the ear canal is inflamed and there is evidence of a dried discharge. The tympanic membrane is intact, although bulging.

John has no previous medical history or allergies. He has recently suffered from what he calls flu-like symptoms and still has nasal congestion and a sore throat.

Assessment and analysis of patient presentation

John McNamara is presenting with the classic signs and symptoms of an infection affecting the middle ear. His recent history of a possible viral infection affecting the upper respiratory tract is a frequent finding (Browning 1998). Mr McNamara's vital signs exclude systemic sepsis and indicate a localised infection. There are several different classifications of ear infection dependent on the particular area of the ear affected (Applying Theory to Practice: Exercise 11.9). John has mild pyrexia demonstrating his immunologic response; this is also demonstrated through the purulent discharge he has experienced. Hearing loss or the loss of certain frequencies is a common finding.

Applying Theory to Practice: Exercise 11.9

Infections Affecting the Ear

- Otitis media – affecting the middle ear
- Otitis externa – affecting the outer ear

Read the information provided by NHS Direct to gain further information: http://www.nhsdirect.nhs.uk/articles/article.aspx?articleID=609

The facts

Acute otitis media is an infection of the middle ear mucosa resulting in localised inflammation, pain and pyrexia. It is usually of rapid onset and short duration. It is associated with fluid accumulation in the middle ear producing the signs and symptoms of ear infection. These include a bulging eardrum, which can become perforated, the production of pus, and fever. Chronic otitis media involves persistent inflammation of the middle ear following an acute infection. Fluid referred to as an effusion is present; this fluid accumulation is far more prevalent in children and not always associated with a recent infection (glue ear). Chronic otitis media can cause damage to the middle ear and eardrum, continuing ear pressure, a subtle loss of hearing and a popping noise can be persistent for months.

Professional issues

Although Mr McNamara's presentation signifies a mild localised infection, it is extremely painful and uncomfortable. He will require a quick pain assessment and then the administration of appropriate analgesics will be the immediate priority. Antibiotics are not always prescribed as infections can be self-limiting and resolve after 2–3 days. If his eardrum had perforated he would require a follow-up appointment at the health clinic. He should be told to return if the symptoms fail to ease, or increase.

Pathophysiology

The middle ear sits in the small space behind the eardrum and is normally filled with air. It connects to the back of the throat via a small channel called the Eustachian tube. The most important factor in middle ear disease is Eustachian tube dysfunction whereby the mucosa at the pharyngeal end of the Eustachian tube is part of the mucociliary system of the middle ear. Negative pressure or oedema can facilitate direct entry of infectious agents such as viruses or bacteria into the middle ear causing inflammation. Therefore this space can fill with mucus as a consequence of a viral infection such as a cold.

Questioning Clinical Practice: Exercise 11.10

Recording and Requesting Appropriate Data

When initially assessing a patient, nurses have an exhaustive array of tests and data they could collect. It is paramount that only essential or relevant tests are made as gathering and waiting for irrelevant tests can be time-consuming and have significant cost implications. The possibility of gathering wrong test results also increases.

- Which tests would you perform on Mr McNamara and why?

Write down each individual test and rationalise why this particular test would assist in establishing his illness or excluding a differential diagnosis.

Psychosocial aspects

Showing empathy for the clinical symptoms such as pain that the patient is suffering is fundamental to a perceived caring profession. Empathy not only has to encompass physical signs but also has to extend into psychological elements such as the concerns Mr McNamara may be experiencing regarding the temporary loss of areas of his hearing. Hearing loss, even if temporary, can have an enormous psychological impact on an individual. No two individuals will have the same reaction to a potentially life altering event. Hearing loss can make interaction with the outside world difficult and at times impossible. Experiencing a loss of hearing has been described as an invisible physical disability, especially in the social realm. Helen Keller once said that deafness cuts one off from people, whereas blindness cuts one off from things (Kaland & Salvatore 2002).

Common presentations

The most common ear complaints are hearing loss, tinnitus, pain, discharge and dizziness. Hearing loss and tinnitus are usually caused by long-term problems; diabetes can cause hearing loss and hypertension can cause high-pitched tinnitus. If a patient has a chronic disorder it is important to establish treatment and medications; certain antibiotics and other medications can cause hearing loss.

Questioning Clinical Practice Exercise 11.11

A toxic reaction to a drug can cause a rapid loss of hearing. Drugs that may affect hearing include some NSAIDs, loop diuretics, aminoglycosides and several chemotherapeutic agents.

- Look these drug types up and familiarise yourself with specific names of drugs that can affect hearing.
- What would you do if a patient in your care, who was taking one of these drugs, reported hearing loss to you?

Pain, discharge and dizziness usually result from short-term conditions. Serous otitis media, inflammation of the middle ear, is common in people with environmental or seasonal allergies. Otitis externa, inflammation of the outer ear, can be caused by allergic reactions to personal care products, for example shampoos, hair dyes.

The olfactory sense (smell)

General overview

Smell is referred to as one of the chemical senses; this is because the sense of smell is an evolutionary skill developed to gain insight into the world and its inhabitants. All organic substances are composed of, and emit chemicals which, depending on the particular sensitivity skills of the individual or species, can be interpreted or sensed.

An advanced ability to smell potential dangers or locate food sources is associated with animals such as wolves. Humans, however, do have an incredibly acute ability to identify danger. A good example is demonstrated by the involuntary act of breathing (Chapter 3). Without being consciously aware, we are continuously testing the consistency of the air we breathe; we can sense potential dangers such as smoke or toxic gases, e.g. methane. For humans to interpret the chemicals surrounding us, our sensory systems need to contain certain properties. Odour molecules must be small enough to be volatile (less than 300–400 relative molecular mass) so that they can vaporise, reach the nose and then dissolve in the mucus. This tells us that smell can travel over long distances thereby creating an early warning device. This innate ability to detect noxious substances begins in childhood, and develops to include an experiential component throughout life. There are suggestions that smell can influence mood, memory, emotions, mate choice, the immune system and the endocrine system (hormones). We can communicate by smell – without knowing it. In fact the sense of smell could be said to be at the mind–body interface.

Function and form

The nose is more than the sensory organ of smell; it also plays a vital role in the respiratory system by filtering, warming, and humidifying inhaled air.

Air entering the nose passes through the vestibule, which is lined with coarse hair that helps to filter dust. Olfactory receptors lie above the vestibule in the roof of the nasal cavity and the upper third of the septum. This area, the olfactory region, is rich in capillaries and mucus-producing goblet cells that help warm, moisten and clean inhaled air.

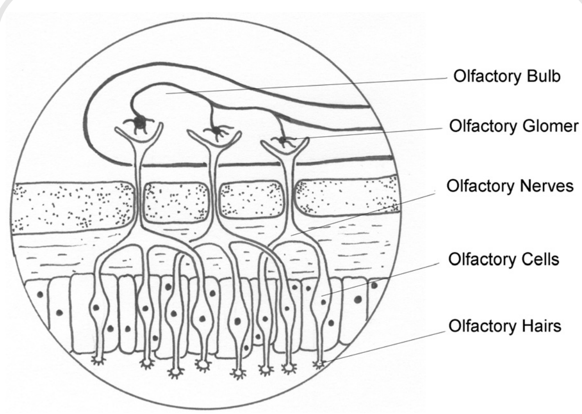

Figure 11.6 The olfactory system

The lower two-thirds of the external nose consist of flexible cartilage, and the upper third is rigid bone. Posteriorly, the internal nose merges with the pharynx and anteriorly with the external nose. The internal and external nose is divided vertically by the nasal septum. In the roof of each nostril is a region called the nasal mucosa. This region contains the sensory or olfactory epithelium covered by mucus. The epithelium contains both sensory cells and Bowman's glands, which produce the secretion that bathes the surface of the receptors. The nasal epithelium contains an estimated 10 million receptor cells.

Four pairs of paranasal sinuses open into the internal nose:

- Maxillary sinuses – located on the cheeks below the eyes
- Frontal sinuses – located above the eyebrows
- Ethmoidal and sphenoidal sinuses – located behind the eyes and nose.

The sinuses serve as resonators for sound production and mucus secretion. Because the opening between the sinuses and the nasal cavity is lined with mucous membranes that can become inflamed and swollen, they can easily become blocked.

Common presentations

The most common complaints of the nose are: epistaxis (bleeding nose), blocked nose, runny nose, deformity (usually due to an injury), and non-smelling nose. Nasal and paranasal disorders may also present with regional symptoms such as headache, facial pain, excessive tear production, double vision, bulging eyes and orbital pain.

The most common site of nosebleeds is in the Kiesselbach's area, located in the anterior portion of the septum. They are usually caused by an injury, although can occur spontaneously. Mechanical abnormalities, for example, a deviated septum or nasal polyp, will usually cause a constant obstruction, whereas the nasal cycle and seasonal allergic rhinitis are usually intermittent, the former alternating between nostrils.

A diminished sense of smell (hyposmia) or no sense of smell (anosmia) can occur as a result of trauma or following a viral infection. Sudden loss of smell may result following a head injury, although this would need to be severe in order to tear the olfactory fibres that emerge through the cruciform plate. Some patients may report a loss in their sense of smell following an upper respiratory tract infection, known as post-influenza neuritis. In many patients who suffer from hyposmia or anosmia, however, the cause will remain unknown.

The gustatory sense (taste)

Function

The tongue is a large, mobile organ comprising several muscles and covered by a mucous membrane. The base of the tongue is bound laterally by the anterior and posterior tonsillar pillars between which, and on either side, lie the tonsils. The parotid, submandibular and sublingual salivary glands secrete saliva into the oral cavity keeping it moist and aiding the first stage of swallowing. Food entering the mouth is chewed and mixed with saliva to facilitate swallowing. As well as being an important organ of speech and taste, the tongue has a role in both the mixing of a food bolus and in propelling the bolus towards the pharynx.

Like the olfactory system, taste is a chemical sense that requires a substance to be dissolved before it can be tasted. Odours from food pass upwards into the nasopharynx and nasal cavity to stimulate olfactory receptors. Much of our interpretation of taste is actually gained through the sense of smell. A given concentration of a substance will stimulate the olfactory system thousands of times more strongly than it stimulates the gustatory system.

Form

The receptors for taste are located in the taste buds. Of the nearly 10,000 taste buds in a young adult the majority are found on the tongue, with some also on the soft palate, larynx and pharynx. The sense of taste deteriorates with age as the number of taste buds decline.

Each taste bud, which is oval is shape, consists of three kinds of epithelial cell:

- Supporting cells
- Gustatory cells
- Basal cells.

The supporting cells form a capsule, which contains approximately 50 gustatory (taste) receptor cells. Each of these receptor cells has a single gustatory hair projecting through an opening in the taste bud, called the taste pore. The gustatory hairs make contact with taste stimuli through the taste pore. At the periphery of the taste bud, near the connective tissue, are the basal cells. Taste buds occur in elevations on the tongue called papillae; these give the tongue its rough appearance. There are four

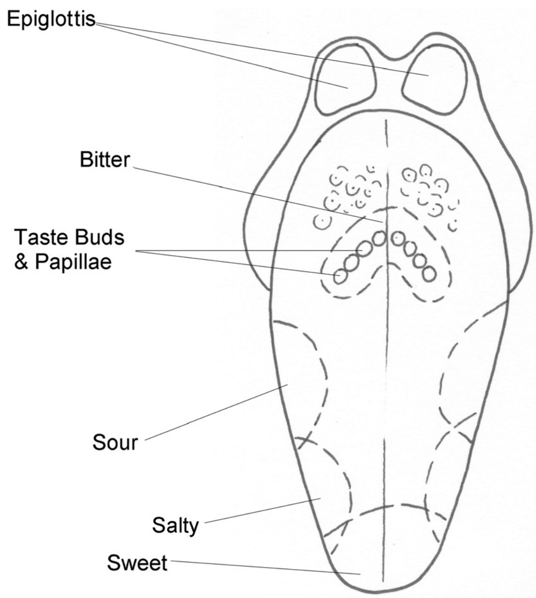

Figure 11.7 The gustatory system

primary taste sensations: sour, salty, bitter and sweet. All tastes are combinations of these four, modified by accompanying olfactory sensations. Some individual gustatory receptors may respond to more than one of the four primary tastes, but receptors in certain regions of the tongue react more strongly than others to the primary taste (Figure 11.8).

Questioning Clinical Practice Exercise 11.12

One of the functions of the tongue is to facilitate swallowing.

- Identify some clinical conditions that can affect a patient's ability to swallow.
- How can the nutritional demands of these patients be met?

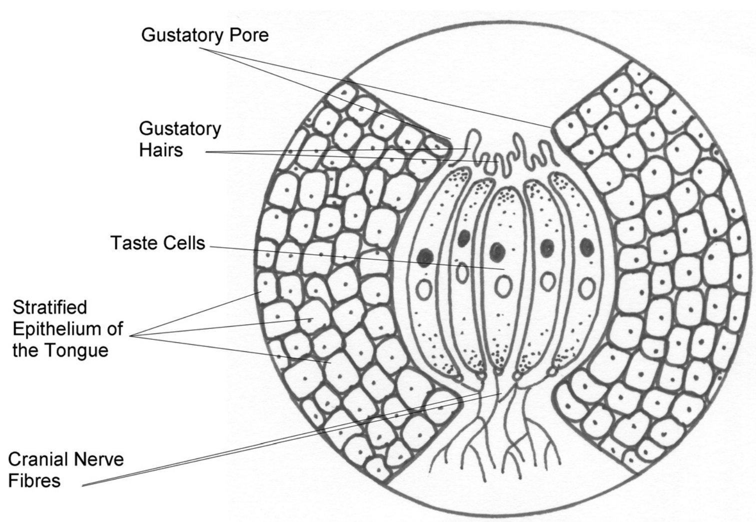

Figure 11.8 Gustatory receptors

Conclusion

The senses facilitate many essential roles to maintain homeostasis and to allow an individual to experience the outside world. These include the ability to perceive and communicate. Through every moment of life an individual will be using at least one of their five senses. These five senses culminate to allow the brain to adapt to differing environments and to make higher levels of decision making. A loss of one or more of these functions is life-altering and can have a massive impact on an individual and their ability to perform within society. Complete the following quiz to reinforce your developing knowledge base within this area.

Chapter 11 Summary Quiz

1. Vision is composed of three distant perceptions:

A. Forms, colours, movement
B. Colours, light, movement
C. Light, forms, colours
D. Movement, forms, light

2. Short sight is referred to as:

A. Myopia
B. Utopia
C. Antropia
D. Mytopia

3. Which of the following is not a visual test?

A. Visual acuity
B. Visual field
C. Visual displacement
D. Colour vision

4. Miotic drugs:

A. Result in a constriction of the pupil
B. Result in a constriction of the iris
C. Result in a dilation of the pupil iris
D. Result in a dilation of the pupil

5. Conjunctivitis is not associated with:

A. Purulent discharge resulting in sticky eyes and crust-like formations around the lids
B. Swollen eyelids
C. Red watery eyes
D. Double vision

6. Causes of conjunctivitis do not include:

A. Pollen
B. Viral
C. Bacteria
D. Wearing glasses

7. The number one cause of registration for sight impairment within the UK is:

A. Conjunctivitis
B. Age-related macular degeneration
C. Diabetes mellitus
D. Hypertension

8. Glaucoma is a collective term used to describe diseases that damage:

A. The pupil
B. The optic nerve
C. The oculomotor nerve
D. The iris

9. The ears are composed of three distinct sections. Which of the following is not one of them?

A. Middle ear
B. Outer ear
C. Central ear
D. Inner ear

10. There are four primary taste sensations; which of the following is not one?

A. Sour
B. Sweet
C. Nasty
D. Salty

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Part 3
Nursing in practice

The child and the Children Act

12

Steve Campbell

Chapter 12 Learning Objectives

- To gain an understanding of what is meant by being a child, infant, young person or adult
- To have a brief understanding of the history of child care in the 20th and early 21st century to understand better current practices
- To be aware of some of the differences physically and psychosocially between children and adults
- To understand some notions of family-centred care and family nursing
- To be aware of some of the principles behind the national service frameworks that apply to the care of children
- To be aware of some of the history of child protection in the UK
- To understand the fundamental duties of all health professionals in child protection

Introduction

The registered nurse needs knowledge of children whether they are practising in a specialist children's area or not. The reasons for this vary, but can be exemplified by two examples: the nurse working in the emergency department, and the nurse caring for an adult patient who has been subject to violence in the home.

The first example is, perhaps, easy to understand; such nurses will care for child patients, especially when there is no designated paediatric emergency department. The nurse will need to understand how children differ from adults. Some of the reasons are a matter of physical and physiological importance (e.g. drug dosages), others are about the support systems for children at different ages when growing up. Children cannot cope with trauma in the same manner as adults, and need the psychological support of parents and prime carers. Since the 1950s changes in the way children are cared for away from the home have led to children being less 'scarred' by the process, and systems of care have been developed in hospital and primary care that are sensitive to these needs, such as family-centred care or family nursing.

The second example is both technical and obvious. If there has been violence in the home where a child lives, then, on whomever this violence has been perpetrated, the police must carry out investigations. This is a technical issue because the law has only recently been changed to require this action, but it is also obvious because of the potential impact upon the development of a child caused by living in a violent home. Other recent changes have made it everybody's business to contribute to child safety, so the nurse caring for a patient who has been subject to violence is now required, as is every other professional, to ensure that this child, and its circumstances, are reported to the child protection team. Previously, the fact that the patient was an adult and, say, an inpatient on an adult admission ward, would have led to the presumption that such matters were the business of others.

These two examples provide a framework for this chapter as they lead to areas of necessary knowledge for the registered nurse practising within the UK. These areas are:

- What is a child?
- What is childhood?
- Where do infants and adolescents fit in?
- Why are children different – psychosocially and physiologically?
- What are the systems that promote the normal development of children when they come in contact with services in the NHS?
- How do all professionals contribute to child protection?

Childhood: infants and adolescents

There are various definitions of childhood, some of which are driven by age, and others by events in development. They are important in finding the right environment for the child. A general definition in terms of time might be from birth until adulthood. This is rather broad, and includes babies all the way up to adolescents, who may not appreciate being referred to as a child, let alone being admitted to a children's ward. Other definitions use the period of time from infancy to the onset of puberty. Within most contemporary definitions of childhood, there is reference to this period as being one of nurturing by parents or equivalent to allow the child to become an individual and to reach full potential.

There is therefore a need to have some notion of what an infant is. Again, some view this as set by a clear time period: from birth up to 24 months of age. Interestingly, the word infant is derived from Latin *infans*, which means not to speak or speechless. This definition was based on developmental milestones with the Romans taking a view that speech for children would arrive at about two years, and those that could not speak were infants. In current times a child who could not speak at two years would be seem as unusual and in the UK would probably be referred to a speech therapist for investigation.

A medically directed definition of adolescence might be the period of physical and psychological development from the onset of puberty to maturity. However, both the start and finish of this period are very difficult to define. Some young girls show signs of puberty at 9 or 10. It is difficult to interpret them as being adolescents in the general public's notion of the word. Similarly for maturity, a young person might regard him or herself as mature, but his or her parents might not agree. Such matters become important around, for instance, informed consent for procedures. There is not the opportunity to deal with this issue in depth here, but while 16 years might be regarded as the legal age of consent, such issues as Frazer competence have meant that due consideration needs to be given to the views of the young person. While EU law might have superseded Frazer competence, most practitioners would wish to have the consent of the young person as well as the parent/guardian.

The Canadian Pediatric Society (2003) produced a paper that considered age limits and adolescents. They did so for a number of reasons, but the 'automatic' movement of young people to adult services at a certain age might not be the most appropriate action. Their definition of adolescence was:

> Adolescence begins with the onset of physiologically normal puberty, and ends when an adult's identity and behaviour are accepted. This period of development corresponds roughly to the period between the ages of 10 and 19 years, which is consistent with the World Health Organization's definition of adolescence. Those responsible for providing healthcare to adolescents must allow sufficient flexibility in this age span to encompass special situations such as the emancipated minor or the young person with a chronic condition leading to delayed development or prolonged dependency.

In other words, some young people might be so mature that keeping them in children's areas is inappropriate, in the same way as other children, despite their chronological age, might not be mature enough to cope in an adult environment, and so should stay in the child's or young person's environment. Definitions are difficult, but helpful in opening up certain debates. In this section, the term 'young person' has been used. The expression is in common use, but has not settled down to a clear and consistent definition. Some use it as an alternative to adolescent; it seems more friendly and less medically or socially laden. Others use it in a wider fashion to indicate anybody over age ten and late teens, even early twenties.

Most of the physical and mental development of a human being takes place in childhood. It is the important period when an individual can develop strong coping skills, which will be essential in later life. It is also a period when good habits such as partaking in exercise and understanding nutritional needs are established; these can transmit into adult life.

By the age of 7, most of the motor control mechanisms are present and the child rapidly develops physical motor skills. During the dominant growth periods (for girls between the ages of 9 and 12 years, and for boys between 11 and 14 years) general exercise promotes growth of muscles, tendons and bones, but too much activity can damage bones and joints. The dangers of excessive exercise are not just physical but also mental.

Why are children different?

Children, from babies through to adolescents, differ from adults, as they are vulnerable outside their normal environment, as they are still growing and developing. As such, they have special needs that health services, including preventative health services, need to be aware of. The modern history of childcare has been described many times, but continues to be central to understanding why children's acute healthcare is designed in its current form. In the UK, during the Second World War, the removal of children from dangerous areas of big cities during periods of bombing, to the safety of the countryside, was seen at the time as being idyllic and good for the children. Without their parents, however, these children were vulnerable, and some of them showed the psychological effects of this for the rest of their lives. There was no malice in this process; indeed it fitted the current knowledge of child development at the time. Children's hospitals were run in similar ways; children would be taken to the children's hospital for planned surgery and passed to the nurses, with parents only allowed to visit at very limited occasions during the week. If the child got upset during this period, this was seen as a sign of how inappropriate it was to allow parents to visit. In the 1950s, various researchers changed the view of childcare, most notably John Bowlby and the Robertsons. The latter's work included the filming of toddlers in an orphanage showing the effect of removing the regular carer from the child. For most people who have seen this film and the reaction of this child, the image remains, and, while 'traumatic', serves as a genuine reminder of the importance of a prime and consistent carer. John Bowlby's book *Child Care and the Growth of Love* made it even clearer that children needed, according to the expertise of the time, to be with their mothers. As a result, a slow process of change began, children's wards in general hospitals and children's hospitals changed their practice. The Platt Report (MoH 1959) was pivotal, but even in the 1980s some of the recommendations of this government report still had not been enacted consistently across the country. The key issues were the admission of the mother/parent/prime carer with the child, and caring for children in different environments from adult patients with similar diagnoses. Parents, who previously had very restricted visiting of their sick child were now allowed open access to their child and indeed the care of the child developed into a partnership between parents, child, the nursing team and the general care team in hospital. There are a number of terms used for this kind of care; some refer to it as family-centred care and others as family nursing (Campbell & Summersgill 1993; Campbell et al. 1993).

For the acutely ill child and their family there have been many changes in the last few years. Medical technology has improved the prognosis of many seriously ill children; however, this has also meant that families have had to deal with prolonged and open-ended periods of care. It remains a challenge to understand the ways in which families deal with serious illness. Approaches to care, such as family-centred care, emphasise the importance of the family, but the family processes to cope are not well known and, therefore, not as well supported by care professionals (Rennick 1995; Haines 2005). In practical terms, in the UK the Labour Government has adopted many of the principles of family-centred care within its National Service Framework, and this is discussed later in this chapter.

Applying Theory to Practice: Exercise 12.1

- What behaviour would you expect from a young child separated from his/her parent without notice?
- How would you avoid this happening when this young child is admitted to a children's ward?
- What would you want the parent to tell the child about the reason for his or her admission?
- What would you want the parent to tell the brothers and sisters about the reason for the sibling's admission?

The above systems concentrate on ill health. The vast majority of children will only have one admission to a hospital, and this will probably only be overnight or a visit to the emergency department. Normal development including healthy development takes place in the home and school, with little input from health professionals in terms of time spent with individuals. One way to view the world of children is via Bronfenbrenner's ecological model (1979), which has a series of concentric circles, with the child at the centre. Early in infancy the mother is closest, but as the child progresses towards adolescence, the child's peers have the greatest influence on development. The roles of health visitors, school nurses, and the services of general practitioners remain important in health educational and health promotional terms (Lloyd et al. 2007).

Physical differences in children – physiological and anatomical

One of the most obvious differences between adults and children is that children are smaller than adults. This seems a blindingly obvious statement, but treating children as mini-adults is not appropriate.

Applying Theory to Practice: Exercise 12.2

- For an adolescent which people are most important to them?
- What proportion of time do you think adolescents spend with their friends and how much with their parents?
- When an adolescent has to attend the accident and emergency department, who do you think he/she wants to attend with him/her?
- Which other people would think that they should be there with their adolescent?
- Do friends of the adolescent and the family of the adolescent necessarily want each other present?
- How do health professionals resolve these issues, or are they not their business?

Temperature regulation

In most biology at school, children are taught that the elephant or the whale are well suited to dealing with changes in temperature as they have a low surface area to volume ratio. Conversely children have a high surface to area ratio and can become hypo- and hyperthermic very quickly. This, combined with young children having an immature temperature control system, leaves them vulnerable to the effects of high and low temperatures. When young children acquire infections and are pyrexial, this is a concern and opens up the potential for febrile convulsions. This is why health professionals are diligent with young children about giving anti-pyretic drugs, such as paracetamol (acetaminophen) and ibuprofen; these can be administered in combination with removal of outer layers of clothing to keep the child cool. Other more extreme practices such as cold baths can quickly induce the potential of making the child hypothermic; this is a clear example of why children are not mini-adults.

Airway

Children have much smaller airways, thus the potential for airway obstruction increases. Infants breathe through their nose only up until the age of six months. In children, the cricoid ring is the narrowest part of the upper airway; in adults it is the larynx.

Breathing

Children have a higher metabolic rate and accompanying oxygen demand, contributing to a higher respiratory rate than in adults. Initially children compensate well for a mild breathing difficulty but due to immature muscle development and, in the infant, diaphragmatic breathing they are more prone to muscle fatigue and sudden respiratory failure.

Circulation

Children have a comparatively smaller stroke volume (Chapter 2), and a higher cardiac output than adults; this is facilitated by relative tachycardia. The stroke volume increases with age; consequently heart rate falls as the child matures. Children do not possess the cardiac reserve of an adult, therefore when confronted with severe blood or fluid loss a child will quickly become critically ill.

Age (years)	**<1**	**2–5**	**5–12**	**>12**
Pulse (BPM)	110–160	95–140	80–120	60–100
Respiration	30–40	25–30	20–25	15–20
Systolic BP (mmHg)	70–90	80–100	90–110	100–120

Table 12.1 Normal Ranges of Vital Signs for Age of Child

Other considerations

Glycogen stores in the liver are limited and hypoglycaemia can be present in any paediatric patient who has been too ill to feed or subjected to high metabolic demands because of illness.

With respect to drugs, the dosage for children will, in most cases, be less than the adult dose, but the dose for children will also vary dependent upon the way in which children absorb and metabolise the drug. In recent years it has been recognised that the drug industry has failed to investigate fully the physiological behaviour of drugs in children and are now being required to do so with new drugs. Studies with adults have previously been extrapolated theoretically to children. Paediatricians and children's nurses are aware of the different ways of calculating the correct dose of a drug for children of different ages and developmental stages. Registered nurses administering drugs to children have a similar professional responsibility to be aware of the expected drug dose, i.e. is this in the right general level? If you are not sure it is right, then do not give it. Getting the dose correct for the child can also be challenging. This might require a calculation (Applying Theory to Practice: Box 12.1). (See Chapter 16 for more on pharmacology.)

Applying Theory to Practice: Box 12.1

For instance:

Case 1. The child is prescribed 125mg of an antibiotic that is contained in a solution of 250mg in 5ml.

The simple formula that most children's nurses use is:

$$\frac{\text{What you want}}{\text{What you've got}} \quad \text{multiplied by what the solution comes in}$$

In Case 1: What you want is 125mg multiplied by 5ml = 125 X 5 = 2.5ml.

What you have is 250mg.

You can use the same formula for tablets/capsules if you are able to halve them (if they are scored for this purpose).

Until you become competent and confident at this method of calculation, administering medications to children can be dangerous and should be left to those competent at this skill.

Getting a child to take a medicine is a different matter; this includes how to deal with the toddler who dribbles some of it out, thereby not getting the full prescribed dose.

Various other differences are important in relation to drugs and children. Registered nurses are not expected to know all of these, but should be aware that there are many factors beyond the obvious that have to be taken into account when dispensing and administering drugs to children. High surface to area ratio in children, especially young children, means that for topical drugs there is greater potential for absorption into the general metabolic system. A topical steroid would be a good example, although these are used with great caution with children as they can damage the young skin; gastrointestinal effects are also important. Neonates have a slightly different stomach pH, so some drugs that are pH dependent can be made less effective in neonates. Similarly, neonates have slow emptying of the stomach compared with adults, and so the dosage and efficacy of drugs in young children are unclear when given by the oral route (Johnson 2007). As a result, many drugs are given via the intravenous route (or less commonly intramuscularly for the same reason), and this requires particular care of small vessels and skilled splintage and support around the IV site, especially in the very young, and toddlers and children too young to understand the importance of the intervention.

Applying Theory to Practice: Exercise 12.3

Have a look at some children's medication in two ways. Ask a friend or relative who has small children whether they have any medicines that they give to their children, such as liquid paracetamol.

- Ask them what dose range they are meant to give to their child.
- Now use the calculation format in Exercise 12.3 to calculate the quantity required for yourself.
- Ask them how they actually administer the medicine to the child.

Repeat the same exercise when on a children's area, but working with a qualified member of staff with access to the drugs and the drug prescriptions for different children.

Applying Theory to Practice: Exercise 12.4

- List some physical differences between children and adults.
- Identify three physical differences and explain why these are important in the care of children.
- Why would young children and babies receive some drugs intravenously when adults would normally receive the equivalent by mouth?

The National Service Framework for Children, Young People and Maternity Service Standards for Hospital Services

The *Standards for Hospital Services* was published in advance of the full *National Service Framework for Children* in response to the concerns raised in the Kennedy Report. This report focused on the management of the care of children receiving complex cardiac surgical services at the Bristol Royal Infirmary between 1984 and 1995.

The recommendations of the Kennedy Report used the following guiding principles:

- The complexity of the NHS as an organisation must be recognised
- Patients must be at the centre of the NHS, and thus the patient's perspective must be included in the policies, planning and delivery of services at every level
- The dedication and commitment of NHS staff are and must remain at the core of the service
- The quality of healthcare must include all aspects of care: clinical and non-clinical
- Patients' safety must be the foundation of quality
- Systems of care, and facilities, as well as individuals, affect the quality of healthcare
- Learning from error, rather than seeking someone to blame, must be the priority in order to improve safety and quality
- Openness and transparency are as crucial to the development of trust between healthcare professional and patient, as they are to the trust between the NHS and the public
- The particular needs of children's healthcare services must be addressed

The final guiding principle links directly to the content of the NSF, but the other principles are clearly present throughout. The NSF was also a reaction to the

Developing and Delivering Expert Care: Box 12.2

The Principles of the Children's NSF

In *Building a Strategy for Children and Young People*, a set of principles was put forward, and these are at the forefront of the children's NSF, which maintains that all policies and services for children and young people should be:

- *Centred on the needs of the young person:* the best interests of the child should be paramount, taking into account their wishes and feelings
- *High quality:* policies and services should aspire to and reach high standards of quality for the benefit of their customers
- *Family orientated:* full recognition must be given to family members who contribute to the well-being of children
- *Equitable and non-discriminatory:* all children should have access to and be able to participate in services that they need, when they need them, in a way that respects diversity and their individual needs
- *Inclusive:* policies and services should be sensitive to the individual needs and aspirations of every child
- *Empowering:* children should have opportunities to play an effective role in the design and delivery of policies and services
- *Results orientated and evidence-based:* high quality research, evaluation, monitoring and review should ensure that decisions that affect children are well informed
- *Coherent in design and delivery:* services should be woven together in a coherent, integrated and cross-sector form
- *Supportive and respectful:* policies and services should be delivered in as manner that is respectful and supportive of children and ambitious for the future
- *Community enhancing:* communities should be empowered to make positive changes for their children so improvements can be owned and sustained locally.

recommendations of the Victoria Climbié Inquiry (Laming 2003) (discussed in relation to child protection in this chapter), which advocates services being designed and delivered geared to the needs of users of services, through:

- Interagency partnerships
- Involving children and families in choices about their care
- Seamless care pathways of care
- Robust clinical governance arrangements
- Child-friendly environments.

The Hospital Standard of the children's NSF has three main aims:

- Improving services: ensuring services are of high quality, appropriate and accessible, and provided in a modern environment. This includes providing sustainable improvements in services and training and development for staff. Ultimately, all services will be child- family-friendly, including those for pregnant women.
- Tackling inequalities: working alongside initiatives designed to reduce poverty, health services for children will have a commitment to reducing health inequalities, including reducing the infant mortality rate by 10% by 2010. The importance of social inclusion is implicit within this aim, and children in special circumstances and with disabilities are specifically targeted.
- Enhance partnerships: coordination of partnership working between services to reduce the duplications that children and families experience is a key aim. Developments within strategic planning frameworks, including the Preventative Strategy, will help achieve this aim.

The Standard for Hospital Services for Children

The NSF's overarching aim is to deliver hospital services that meet the needs of children, young people and their families and provide effective and safe care through appropriately trained and skilled staff working in suitable, child-friendly and safe environments.

The standard applies to every department and service within a hospital that delivers care to children and young people.

The standard has three parts, reflecting the three dimensions of quality that a hospital needs to get right if it is to provide the service that children deserve:

Part 1: Child-centred hospital services
Part 2: Quality and safety of care provided
Part 3: Quality of setting and environment

The contents of these parts are summarised below:

Part 1: Child-centred hospital services

Children should receive care that is integrated and coordinated to their particular needs, and the needs of their family. They and their parents should be treated with respect, given the support and information they need to understand and cope with the illness or injury, and treatment required. They should be encouraged to be active partners in decisions about their health and care and where possible, be able to exercise choice.

Children, young people and their parents will participate in designing NHS and social care services that:

- Are readily accessible
- Are respectful
- Are empowering
- Follow best practice in obtaining consent
- Provide effective response to their needs.

Child-centred hospital services will:

- Consider the 'whole child', and not simply the illness being treated
- Treat children as children and young people as young people
- Be concerned with the overall experience for the child and family
- Treat children, young people and parents as partners in care
- Integrate and coordinate services around the child and the family's particular needs
- Graduate smoothly into adult services at the right time
- Work in partnership with children, young people and parents to plan and shape services and to develop the workforce.

Part 2: Quality and safety of care provided

Children and young people should receive appropriate high quality, evidence-based hospital care, developed through clinical governance and delivered by staff that have the right set of skills.

This means:

- Clinical governance systems that give proper and explicit focus to the different needs of children and young people
- State treating and caring for children having the education, training, knowledge and skills to provide high quality care.

Part 3: Quality of setting and environment

Care will be provided in an appropriate location and in an environment that is safe and well suited to the age and state of development of the child or young person.

That is:

- Child-friendly hospitals
- Hospitals that are safe and healthy places for children.

Applying Theory to Practice: Exercise 12.5

- State the three aims that govern the NSF for children and young people in hospital.
- What are the three principal parts of *The Standard for Hospital Services for Children*?
- What will the results be for children, young people and their parents participating in designing NHS and social care services?
- What are the characteristics of child-centred hospital services?

Child protection

This section will provide aspiring nurses with the essential information, relevant knowledge, history and policies to enable them to gain an understanding of child protection. This will be achieved through the following sections:

- An understanding of child abuse and neglect
- Roles and responsibilities in child protection
- What to do if you are concerned about a child
- How to access advice, guidance and support.

The Laming Report (2003) reported on the events that led to the death of Victoria Climbié in London and changes to systems that needed to be developed to avoid any recurrence in the future. This inquiry was not the first of its kind; each generation seems to have its own example. In 1984, Maria Colwell's death at the hands of her stepfather highlighted a similarly serious lack of coordination among services responsible for child welfare. As a result the Laming Report took seriously the previous history of failed coordination and made a series of recommendations (DH 2003):

- The creation of a children and families board chaired by a senior government minister to coordinate policies and initiatives that have a bearing on the well-being of children and families
- A national agency for children and families, led by a children's commissioner, should be established to ensure local services meet national standards for child protection and implement reforms
- Committees for children and families should be established by councils, with members drawn from social services, education, housing, the NHS and the police
- New local management boards – chaired by council chief executives with members from the police, health, social services, education, housing and the probation service – should be set up. The boards would appoint a local director of children and family services to monitor effective interagency working on child welfare and protection
- The creation of a national children's database that keeps a record of every contact a child has with a member of staff from the police, health and local authorities.

Everybody's business

> All those who come into contact with children and families in their everyday work, including practitioners who do not have a specific role in relation to child protection, have a duty to safeguard and promote the welfare of children.
>
> (DH 2003)

This is an important principle for child protection, because it makes explicit the role of every professional. In the past, non-children's specialists shied clear of child protection, understandably, as it is a challenging area of practice. Current legislation makes it everybody's business.

The legislative context

While there have been many Acts that have defined child protection processes in this country, the current situation can be sourced to the Children Act 1989. In this Act two issues were established: key principles in keeping children safe, and the welfare of the child as the paramount consideration. This was confirmed and reinforced in the Children Act 2004. Concurrently the Human Rights Act was published in 1998 to which the UK was a signatory. Included in this Act was Article 19 which identified protection (of children) from abuse and neglect.

What is safeguarding and promoting the welfare of children?

- Protecting children from maltreatment
- Preventing impairment of children's health or development
- Ensuring that children are growing up in circumstances consistent with the provision of safe and effective care; and undertaking that role so as to enable those children to have optimum life chances and to enter adulthood successfully.

These statements seem self-evident, but there are problems or have been problems, for instance, in defining the failure to thrive of an infant as a result of maltreatment, or impairing the child's health and development.

Section 31(9) of the Children Act 1989 (as amended by the Adoption and Children Act 2002) defines 'harm' as ill-treatment or the impairment of health or development, including, for example, impairment suffered from seeing or hearing the ill treatment of another; 'development' is defined as physical, intellectual, emotional, social, or behavioural development; 'health' means physical or mental health; and 'ill treatment' includes sexual abuse and forms of ill treatment which are not physical.

Under Section 31(10) of the Children Act 1989, where the question of whether harm suffered by the child affects the child's health and development, his health or development shall be compared with that which could reasonably be expected of a similar child. This is particularly helpful for the example of a toddler who is failing to thrive, as harm can be identified by a significant difference from normal development. Physical development uses 'normograms' that show growth ranges of children and so sets definitions as to what is 'normal'.

What is abuse and neglect?

> Abuse and neglect are forms of maltreatment of a child. Somebody may abuse or neglect a child by inflicting harm, or by failing to act to prevent harm. Children may be abused in a family or in an institutional or community setting; by those known to them or, more rarely, by a stranger. They may be abused by an adult or adults or another child or children.
>
> (DH 2006)

Categories of abuse

There are many forms of abuse and they have been categorised in the flowing manner:

- Physical abuse
- Neglect
- Emotional abuse
- Sexual abuse.

It is important for all professionals to have a clear notion of what constitutes abuse in order to know whether they need to act in line with the legislation.

Physical abuse

> Physical abuse may involve hitting, shaking, throwing, poisoning, burning or scalding, drowning, suffocating or otherwise causing physical harm to a child. Physical harm may also be caused when a parent or carer fabricates the symptoms of, or deliberately induces illness in a child.
>
> (DH 2006)

Neglect

> . . . the persistent failure to meet a child's basic physical and/or psychological needs, likely to result in the serious impairment of the child's health or development. Neglect may occur during pregnancy as a result of maternal substance misuse. Once a child is born, neglect may involve a parent or carer failing to provide adequate food and clothing, shelter including exclusion from home or abandonment, failing to protect a child from physical and emotional harm or danger, failure to ensure adequate supervision including the use of inadequate care-takers, or the failure to ensure access to appropriate medical care or treatment. It may also include neglect of, or unresponsiveness to, a child's basic emotional needs.
>
> (DH 2006)

Emotional abuse

> Emotional abuse is the persistent emotional maltreatment of a child such as to cause severe and persistent adverse effects on the child's emotional development. It may involve conveying to the child they are worthless or unloved, inadequate, or valued only insofar as they meet the needs of another person. It may feature age or developmentally inappropriate expectations being imposed on children. These may include interactions that are beyond the child's developmental capability, as well as overprotection and limitation of exploration and learning, or preventing the child participating in normal social interaction. It may involve seeing or hearing the ill treatment of another. It may involve serious bullying causing children frequently to feel frightened or in danger, or the exploitation or corruption of children. Some level of emotional abuse is involved in all types of maltreatment of a child, though it may occur alone.
>
> (DH 2006)

Sexual abuse

> Sexual abuse involves forcing or enticing a child or young person to take part in sexual activities, including prostitution, whether or not the child is aware of what is happening. The activities may involve physical contact, including penetrative or non-penetrative acts. They may include non-contact activities, such as involving children in looking at, or in the production of pornographic material or watching sexual activities, or encouraging children to behave in sexually inappropriate ways.
>
> (DH 2006)

There are internationally identified indicators of risk and vulnerability. The factors give some notion of increased risk of potential harm and abuse taking place in the family. It must be stressed that they do not mean that abuse is taking place. There are families who have most of the indicators but provide a highly supportive and nurturing family environment. Evidence of harm and abuse must be literally that: evidence of harm and abuse.

Indicators of risk and vulnerability to the child in parents and families

- Lonely and socially isolated
- Childhood was deprived
- History of being abused themselves
- First baby before 20 years of age
- Failure to attend antenatal appointments or prepare for baby
- Young, immature parents
- Jealousy and rivalry towards child
- Unreal expectations of the child
- Unable to cope with the child and life in general
- Unstable or violent adult relationship
- Not parent of the child
- Frequent and different relationships
- Antagonistic to authority
- Problems of drug or alcohol abuse
- Mental illness or learning difficulties
- Aggressive behaviour
- History of violence and strict disciplinarian, previous abuse
- Rejection and negative attitude
- Asking for child to be removed

Applying Theory to Practice: Exercise 12.6

- What is meant by safeguarding and promoting the welfare of children?
- What are the four forms of abuse and maltreatment of children?

Define each of these and add your summary to your expanding portfolio.

Indicators of risk and vulnerability to the child in the child

- Premature
- Neonatal problems (bonding)
- Unwanted
- Different in some way
- Difficult or slow feeder
- Cries a lot
- Unresponsive
- Fearful
- Role reversal i.e. the child cares for the parent

Roles and responsibilities in the health services

Health professionals have a key role to play in actively promoting the health and well-being of children. Health professionals working directly with children need to ensure that safeguarding and promoting the welfare of those children form an integral part of the care they offer. Other healthcare professionals who come into contact with children in the course of their work, including when they are not directly responsible for the care of the child, also need to be aware of their responsibility to safeguard and promote the welfare of children. In cases of suspected abuse, the duty of care that a health professional owes to a child as his or her patient will take precedence over any obligation to the parent who may be suspected of abuse. The National Service Framework for Children, Young People and Maternity Services sets out a ten-year programme for improving the quality of services for children, young people and pregnant mothers. Safeguarding children is a theme throughout the National Service Framework and one of its eleven standards deals with safeguarding and promoting the welfare of children.

The involvement of health professionals in safeguarding and promoting the welfare of children is important at all stages of work with children and families:

- Recognising children in need of support and/or safeguarding, and parents who may need extra help in bringing up their children, and referral where appropriate
- Contributing to enquiries about a child and family
- Assessing the needs of children and the capacity of parents/carers to meet their children's needs
- Planning and providing support to children and families, particularly those who are vulnerable
- Participating in child protection conferences, family group conferences and strategy meetings
- Planning support for children at risk of significant harm
- Providing therapeutic help to abused children and parents under stress (e.g. mental health problems)
- Playing a part, through the child protection plan, in safeguarding children from significant harm
- Providing ongoing preventative support and work with families contributing to serious case reviews (DH 2006)

All professionals should:

- Be alert to the indicators of abuse and neglect
- Be alert to the risks potential abusers pose to children
- Share and help analyse information to assess need
- Contribute to whatever actions needed
- Take part in regular reviews of plans
- Work cooperatively with parents – unless inconsistent with safety of child (DH 2006)

Actions for all health professionals start from when there are suspicions of abuse. These might be when you observe signs and indications of abuse, you are made aware of an allegation or report of abuse by another, someone admits to you that they are harming a child, or finally on receiving a cry for help by a child. All of these should set in motion a sequence of events in which the child's welfare is paramount. In every public organisation there is a system of advice and support in which a health professional can, for instance, discuss the basis of fact in concerns. This system takes the form of designated and named professionals, including child protection advisors. Local child protection manuals will make this clear and most organisations place these prominently on their intranet. The procedures will also be there, and these will be seen to be multi-agency; training will be similarly carried out. All health professionals have to undertake level 1 child protection in-house training as part of their mandatory training.

In summary, the nurse and any other health professional's role in safeguarding children is guided by the following:

- In all matters the child's welfare is paramount
- Be alert to signs of abuse
- Via your child protection advisor make enquiries to child protection register when appropriate
- Refer your concerns on to the correct agency
- Work together with your colleagues and professionals of all kinds to promote child welfare
- Follow the local child protection procedures as laid down in your organisation
- Share information about the child and your concerns
- Record accurately your concerns and do this contemporaneously
- Consult and get advice from senior colleagues and your designated child protection advisor.

Conclusion

This chapter has discussed something of the nature of childhood, particularly milestones, and the notion of infancy, childhood and adolescence.

The vulnerability of children has been discussed. For psychological development the need for a prime carer, particularly for the young, has been made clear. Physiological differences are numerous, but the vulnerability to temperature change and need to recalculate drug dosages for small children have been elucidated.

Normal development at home has been discussed; the systems such as family nursing and the NSF for children have also been described.

The principle of child protection has been described as well as the legislation and processes to ensure that the welfare of the child is paramount.

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Misconceptions and the reality of mental illness

13

Nick Wrycraft

Chapter 13 Learning Objectives

- To consider our own preconceptions of mental illness
- To examine common preconceptions of mental illness within society
- To define mental illness
- To gain an understanding of how the law applies to mental illness
- To identify common mental health problems
- To develop knowledge of care in the community
- To gain an understanding of the *National Service Framework for Mental Health* (DH 1999)

Introduction

In all practice settings nurses will encounter patients with mental health problems. This chapter considers society's' misconceptions and encourages the reader to question and examine their own views, feelings and attitudes towards mental illness. Acquiring an awareness of the different ways that mental illness can manifest itself is essential if nurses are to work effectively and provide the most appropriate treatment for an individual. Developing empathic and non-judgemental attitudes is a central part of nursing practice, consistent with the role of advocate, stated within the professional nursing Code of Conduct (NMC 2004).

At any one time a significant number of the adult population experience mental illness and the majority live within the community (SCMH 2002). Despite being so widespread, mental illness is still frequently misunderstood and often the subject of stigma. The damage caused by negative perceptions of mental illness limits the participation of these people within society and in turn prolongs the experience of mental illness and prevents successful recovery. A goal of government policy in recent years has been to promote social inclusion of people with mental health problems (DH 2004a). Therefore, it is vital that modern nursing not only understands how mental illness affects people but also promotes positive values and non-discriminatory practice.

There are a wide range of mental illnesses, which can affect people in different ways: physically, psychologically and socially. This chapter will consider what constitutes mental illness in relation to consent and the law. The chapter progresses into providing the reader with a brief overview of common mental health problems. Care in the community will then be considered before discussing the NSF for Mental Health (DH 1999a).

Scenarios and examples of mental health problems will be presented throughout the chapter to illustrate the issues discussed and the clinical and professional complexities involved. Several exercises are included to help the reader identify areas they can develop through further research, reflecting on their own practice experience and action points that can be addressed on clinical placements to facilitate further lifelong learning.

Common misconceptions of mental illness within society

Before examining common preconceptions of mental illness that exist within society, it is important for the reader

Questioning Clinical Practice: Exercise 13.1

Write down what types of behaviour you might expect from a person with a mental illness.

- From the behaviours you have listed, which of these are negative qualities?
- Once you have read this chapter, re-examine what you have written and reflect on whether your views remain the same, or whether they have changed and in what way?

After writing down your thoughts file them in your professional portfolio.

to identify their own thoughts, feelings and attitudes towards mental illness. Exercise 13.1 will help the reader to focus their ideas.

Mental illness is a common feature of everyday life for many people. At any one time mental ill health can affect one in six people of working age (DH 1998, NIMHE 2004). It is estimated nearly half of all women and a quarter of all men will experience depression, the most frequently occurring mental health problem, before they reach 70 years of age (DH 1998; NICE 2002).

Despite being a major part of daily life for so many, mental illness is misunderstood and little known about. Often society has intolerant views, for example, people with a mental health problem are regarded as malingerers who simply ought to 'pull themselves together'. At the other extreme people who are acutely mentally ill are viewed as homicidal, crazed and unpredictable individuals who represent a danger to society (DH 1998, 1999b). These negative perceptions draw heavily on isolated high profile cases, for instance the tragic death of Jonathon Zito who was killed by Christopher Clunis.

Television, film and drama productions can also portray mentally ill people as villains and bad people, prone to violence and murderous behaviour, with few redeeming features (Sayce 2000). While this may add to the dramatic effect, there is no real evidence to suggest these distorted perceptions of mental illness have any basis in reality (University of Manchester 2006). The highly potent fear of being murdered by a person with a mental health problem who was not known to the victim or 'stranger homicide' is no more likely than the risk of being the victim of 'stranger homicide' by a person without a mental illness (BBC 2006; University of Manchester 2006). While some people with mental health problems do commit acts of violence and murder, statistics suggest the risk is no more prevalent than with any other sector of the population (University of Manchester 2006).

A recent government report concluded community care has not increased the risk to the general public (University of Manchester 2006). Furthermore the established trend that murders often occur within the family or among people known to one another extends to mental illness where the majority of violent crimes committed by people with mental health problems were against people known to the perpetrator (University of Manchester 2006). Rather than that of violence towards others, the more frequent risk factors associated with people with mental health problems is the likelihood of them committing suicide, self-harming or being a victim of violence and abuse (DH 1998, 1999a; University of Manchester 2006).

The stigma surrounding mental illness causes discrimination and a lack of opportunities for employment, meaningful occupation and the chance for people with, or recovering from, mental illness to contribute to society (DH 1998, 1999a, 2006a). It has been suggested that, to avoid attracting disapproval, people with a mental health problem feel unable, for example, to phone in sick at work due to mental health reasons and are more likely to substitute an alternative physical reason (Sayce 2000). Other consequences of mental illness are to prevent people seeking help as they fear for job security, loss of promotion opportunities and increases in home and travel insurance (DH 2006a).

People with mental health problems frequently have low incomes and socio-economic status; these factors can exert a detrimental effect on their mental health creating a vicious cycle, which is compounded by society's negative perceptions (O'Brien et al. 2001; Singleton et al. 2001). The necessity of providing effective support in the community to those people with severe mental health problems to reduce suicides or the potential of their mental health causing a threat has been a strong focus of government mental health policy in recent years, as a result of Care in the Community (DH 1998, 2006b; Social Exclusion Unit 2004).

Defining mental illness

It is necessary to identify mental illness in order to offer appropriate specialist help for people in mental distress or who are acutely mentally ill. However, defining mental illness is complex, as it exists on a continuum with mental health (Hart 2004). Identifying physical illness is not a problem as when we are well we do not need healthcare, yet when we are unwell we receive a diagnosis and treatment for a particular problem or undergo investigations to locate the cause. In contrast mental illness covers a range of disorders with various origins; these include social, psychological, genetic, biological and chemical causes. Mental illness under the Mental Health Act 1983 is defined as including one or more of the four elements listed below:

- Incomplete development of the mind
- Psychopathic disorder
- A disturbance which prevents normal development

- A mental disturbance which interferes with normal behaviour and daily life.

(Department of Health and the Welsh Office 1999).

The Mental Health Bill of 2006 (DH 2006a) revises mental health legislation and will use one definition of mental health which instead focuses on the problems the service user is experiencing rather than diagnosis within the above criteria.

Everyone experiences some symptoms of mental ill health at some time, for example, it is perfectly normal to be anxious over a driving test or exam, or to feel very low in mood over a bereavement or significant loss. Due to the body's fight or flight instinct, heightened alertness occurs in response to a perceived threat of danger and serves a useful role in self-preservation and efficient performance of certain tasks (Hart 2004). In many circumstances these feelings, while uncomfortable, are time limited, or in response to specific events.

Applying Theory to Practice: Exercise 13.2

Consider a time in practice where you have felt anxious, for example, when being assessed carrying out a technical skill under supervision by a qualified nurse.

- What physical changes did you feel?
- What helped you to feel less anxious?

Write down your reflections and include them in your professional portfolio.

- What learning points can you translate to your practice on coping with feelings of anxiety?

Mental illness can be said to occur where the response is prolonged, is triggered by inappropriate events, or where the effects limit the person's quality of life and/or cause significant distress. Yet at what point a person is said to be mentally ill depends very much on the individual case and the circumstances. Mental illness is also prone to misinterpretation as frequently people who are mentally ill display erratic or unusual behaviour, have an inaccurate perception of reality, or express views which differ from the majority of the rest of society (Hart 2004) with the potential they can become confused with people who are simply regarded as eccentric, antisocial, deviant or criminal.

Once a person is diagnosed with a mental illness, they may require treatment; the following commonly used interventions and services are available to work with people experiencing mental illness:

- In secondary care: inpatient services, intensive community-based multidisciplinary mental health teams, community mental health teams, day hospitals and day centres
- In primary care: specialist mental health teams of trained counsellors and mental health workers, for example, graduate workers and link workers or gateway workers who provide access to secondary services
- Interventions by mental health nurses within the above services working with service users to provide support and care, and the input of the specialist roles of other mental health professionals in these teams, for example, occupational therapists, social workers and psychologists
- Psychiatric medications may be overseen by a psychiatrist but, under the new wave of prescribers, monitored and managed by mental health nurses
- Psychological therapies including cognitive behavioural therapy (CBT) as recommended by NICE (2004a, b) and other therapies, for example, psychodynamic interventions provided by trained nurse therapists and other mental health professionals such as psychologists and occupational therapists
- Independent services that often work alongside and in collaboration with statutory mental health specialist services
- Other interventions including referrals for exercise, self-help groups, advice on employment and voluntary work and complementary therapies.

Prior to providing appropriate treatment, it is necessary to gain consent, which will now be discussed in the following section.

Consent to treatment, mental health and the law

In some cases a person who is mentally ill requires treatment for a period of time in an inpatient setting. In many cases individuals agree to this and are regarded as 'informal' admissions. Yet in some instances people who are acutely mentally ill lack insight into their condition and are reluctant to accept help. Their behaviour may jeopardise their own well-being and/or the safety of others, so it may become necessary to detain them for compulsory treatment. While mental health legislation affects a relatively small number of the population at any time, according to the Department of Health (2006b) there were 14,700 patients in England and 545 in Wales detained under the Mental Health Act 1983 at 31 March, (2005), its importance ought not to be underestimated, as the Mental Health Act is the only statute outside the criminal justice system which allows individuals to be legally detained against their will.

Under the current legislation if a person is to receive treatment against their consent, there has to be a second medical opinion recommending the treatment. Furthermore the treatment can only be carried out if it is:

- Necessary to save the person's life
- Necessary to avoid a serious, irreversible deterioration in the person's health
- Necessary to alleviate serious suffering and is not hazardous
- Necessary, not hazardous, and the minimum treatment to prevent the person harming themselves or other people (DH & Welsh Office 1999).

While people detained in hospital are defined as experiencing mental illness, the Mental Health Act 1983 does not actually present a definition. Instead mental disorder is defined within four categories: see Applying Theory to Practice: Box 13.1.

Applying Theory to Practice: Box 13.1

Types of Mental Disorder

- Mental illness
- Severe mental impairment
- Psychopathic disorder
- Mental impairment (Mitchell 2004)

The Mental Health Bill (DH 2006a) proposes replacing these areas with a single definition focused on the problem(s). The design of the legislation strives to respect the rights of the individual while safeguarding society, and as a guiding principle for treatment the least intervention necessary to address the problem is the preferred solution. Detaining someone under the Mental Health Act 1983 ought to be a choice of last resort after all other options have been exhausted (DH & Welsh Office 1999).

Under English law, consent is the voluntary permission of the person for a treatment based on having reasonable knowledge of the likely effects and purpose of the treatment, the likelihood of its success and an awareness of any risks or alternatives; the patient can also withdraw their consent at any time (DH & the Welsh Office 1999).

To be informed consent, the criteria in Applying Theory to Practice: Box 13.2 must be met.

Applying Theory to Practice: Box 13.2

Informed Consent

- The person must not be under coercion
- The person must understand the procedure to which they are consenting
- The person must be legally of an age to give consent and mentally competent, or capable of giving consent (Mitchell 2004)

There are numerous different sections of the Mental Health Act 1983 which are suitable for various aspects of patient care. Applying Theory to Practice: Box 13.3 lists a selection of those sections most commonly used.

The decision to impose a section of the Mental Health Act 1983 is often based on the action which will then need to be taken to assist the person's mental health but also respect their rights. It is a crucial consideration for nursing staff to make a person aware of their rights and the conditions of their section of the Mental Health Act 1983 by which they are being detained and explain their right to apply to a tribunal and the Mental Health Act Commission if they wish to contest the section.

Significantly, the mental health legislation is centred on the detention of the person for the purpose of treatment of their mental health. In the review of the Mental Health Act 1983 a significant issue of debate concerned the status of people with personality disorders. Personality disorders are defined as difficulties resulting from a person's character, whereby a person experiences problems due to their attitudes and behaviour, for example, difficulties with relationships, finances and employment.

Applying Theory to Practice: Box 13.3

Sections of the Mental Health Act 1983

Section 2: A compulsory admission for assessment, which lasts up to 28 days. The recommendation of two doctors is required and the person has the right to appeal within 14 days.

Section 3: An admission for treatment for six months. The section can be renewed for an additional six and then annually. The recommendation of two doctors is required and an approved social worker or the next of kin. The person can appeal at any time within the six months of the duration of the section.

Section 136: The police power to remove a person to a place of safety, preferably a hospital for assessment by a doctor and approved social worker. The section lasts for up to 72 hours.

While personality disorders are not amenable to treatment for mental health problems, nevertheless many people with personality disorders come into contact with mental health services; it is an ethical dilemma as to whether it is an acceptable interpretation of the Mental Health Act 1983 to detain a person for treatment who has a primary diagnosis of a personality disorder. Under the Mental Health Bill (DH 2006a) it is proposed that service users with a personality disorder or other problems which do not fall within the four criteria of the 1983 Act but who nevertheless have a mental health problem are eligible for treatment.

Questioning Clinical Practice: Exercise 13.3

Informed Consent

- How do you think having treatment under a section may affect an individual's future life?
- When you applied for nurse training, did you have to disclose any history of mental illness?

The first major review of the mental health legislation since the 1950s was announced in 1998 and there ensued a lengthy process of consultation and discussion with stakeholders before the Mental Health Bill finally passed through parliament in late 2006.

The Bill amends rather than replaces the 1983 Act, although a number of alterations have been made to the existing mental health legislation and it will be implemented in April 2008. There are three main areas of change and each will be discussed in more detail.

Provisions of the Mental Health Bill 2006

1. To make provision for people with serious and ongoing mental health problems to receive necessary treatment, and to maintain their safety and that of the public.
2. To widen the range of healthcare professionals able to perform roles identified in the 1983 Act to reconfigure the legislation to reflect the multidisciplinary nature of modern mental health services and allow them to act more rapidly and flexibly in response to service users' needs.
3. To protect the rights of people who do not have the capacity to provide consent and whose circumstances are not covered by the 1983 Act.

1. The Mental Health Bill 2006 proposes that the focus of the legislation is shifted to emphasise the treatment of mental health illness, as opposed to allowing access to treatment based on diagnosis, which overlooks those who do not fit neatly into a pre-existing category of mental illness (DH 2006a). It is intended to replace the four categories of mental illness outlined in the 1983 Act with one definition, which, rather than categorising specific mental illnesses, instead focuses on mental health needs, risk and the action which then ought to be taken with an emphasis on treatment (House of Commons 2007). The most controversial measure in the Mental Health Bill (DH 2006a) is supervised community treatment orders (CTO) which are based on the notion that some service users who have been compulsorily detained and received a period of inpatient treatment can receive the treatment

they need in the community, which reduces the social exclusion which might be experienced through a prolonged period of detention. CTOs are recommended for use in circumstances where service users present a risk to their own safety, or that of the public, and are intended to promote compliance with treatment and prevent relapse. CTOs do not diminish the service users' rights; an application can be made by the service user for the CTO to be withdrawn to the Mental Health Review Tribunal (discussed in more detail below); and treatment can only be provided if a service user who is capable of providing consent accepts treatment. Where treatment is refused it may be necessary to return a service user to hospital for treatment (DH 2006a).

The introduction of CTOs has been greeted with concern by some service users and independent groups because of the potential for the increased use of compulsion to infringe on the rights of service users to choose whether or not to accept treatment, when, for example in the case of some psychiatric medication there are potentially unpleasant side effects (King's Fund 2007). Furthermore, the role of the nurse as advocate for the service user has the potential to be compromised if implementing a programme of care where the service user is expected to comply with treatment, or receive the same treatment compulsorily in an inpatient setting (NMC 2004). However, it has also been argued that CTOs provide another useful treatment option as an alternative to the 'revolving door' phenomenon whereby service users are repeatedly admitted to inpatient settings through not complying with treatment (DH 2006a, King's Fund 2007). In terms of the evidence base supporting CTOs, they have been in use in a number of countries including the United States, Canada, New Zealand and Australia for some years and in Scotland since 2005, and while there are positive reports from healthcare practitioners, the research literature on the clinical effectiveness is limited (King's Fund 2007).

2. The Mental Health Bill (DH 2006a) proposes to widen the range of different healthcare professionals who can carry out functions under the 1983 Act, from approved social workers and responsible medical officers to include staff with appropriate training from disciplines including nurses, occupational therapists and social workers. Previously under the Mental Health Act 1983 mental health nurses' powers were limited to Section 5(4), which was a holding power of six hours maximum duration and intended to allow for further assessment under the Act to be made (DH & Welsh Office 1999). Increasing the role of nurses within the mental health legislation has the potential to change the nurse's therapeutic relationship with the service user with the implication that there may be less trust, and the nurse's role within the multidisciplinary team will be more focused on managing care as opposed to its delivery.

3. Protecting the rights of service users who are not able to provide consent follows from the introduction of the Mental Capacity Act implemented in April 2007. The Mental Health Bill outlines the Bournewood provisions, which are intended to protect the rights of people whose circumstances are not otherwise accounted for in the Mental Health Act 1983.

Other aspects of the Mental Health Bill protect the rights of service users include improving access for service users to the Mental Health Review Tribunal (MHRT). The MHRT is an independent organisation which considers whether a service user ought to continue to be detained under a section of the Mental Health Act 1983 to prevent them being detained too long or inappropriately. The Mental Health Bill states that a maximum period of time will be identified, before which if a service user or someone on their behalf has not applied independently to the MHRT, the hospital managers will ensure an application is made. Furthermore, access to the MHRT not only applies to inpatient detention, as those subject to a CTO are also to be eligible to appeal to the MHRT. Finally, the nearest relative of a service user detained under a section of the Mental Health Act 1983 has a range of powers, from being able to request the service user's discharge from detention to applying for or preventing detention, requesting the detention is reviewed, and being permitted to receive particular information about the service user. The new Bill makes provision to allow service users to apply through the county court for their nearest relative to be displaced, or for the nearest relative to be displaced because they are not suitable to act in that role. Civil partners have the same rights as a husband or wife.

Types of mental health problem

In this section the broad range of different mental illnesses will be discussed and some scenarios presented of individuals who may be experiencing these problems.

Broadly speaking, mental health problems can be classified as either functional or organic.

Functional mental health problems are subdivided into psychotic disorders, which include schizophrenia, and mood disorders and other affective disorders including depression, anxiety, obsessive-compulsive disorder, phobias, anorexia nervosa and bulimia nervosa.

Organic mental health problems are due to the effects of physical causes on the action of the brain, including dementia-type illnesses, infectious causes and also alcohol and substance misuse.

Other types of mental health problems include personality disorders where a person's attitudes and choices of behaviour lead them into making chaotic life choices, for example, in relationships, employment, housing and other areas of their life.

While there are a wide range of different types of mental health problems, Applying Theory to Practice Box 13.4 identifies a succinct overview adapted from Hart's (2004) model. The types of problems listed will then be briefly discussed; but the reader ought to consult more specific texts for a more comprehensive understanding of each mental illness.

Applying Theory to Practice: Box 13.4

Types of Mental Health Problems

- Depression and anxiety
- Bipolar mood disorders
- Psychotic disorders and schizophrenia
- Psychoactive substance misuse
- Self-harm
- Eating disorders
- Dementia

Depression and anxiety

Depression and anxiety are the most common mental health conditions. In reality people more often experience a mixture of both depression and anxiety. In this chapter they are discussed separately.

Depression is evident where five or more of the symptoms listed below have been experienced for two weeks continuously:

Applying Theory to Practice Box 13.5

Diagnostic Criteria for Depression

- Depressed mood most of the time
- Markedly reduced interest in all, or almost all, activities for the majority of the time nearly every day
- Significant unplanned weight loss (5% of total body weight within a month, or the equivalent) or weight gain occurring
- Insomnia or hypersomnia most of the time
- Psychomotor agitation or retardation most of the time
- Feelings of fatigue and a lack of energy and interest most of the time
- Feelings of worthlessness, or guilt most of the time
- Reduced and slowed down ability to think, concentrate or make decisions most of the time
- Recurrent thoughts of death or suicidal ideation most of the time

(American Psychiatric Association (APA) 1994)

Other symptoms may also be evident, for example, agitation and restlessness, preoccupation, loss of libido and muscular pains. Often depression can be triggered by an ongoing life-limiting physical condition such as diabetes, chronic obstructive pulmonary disease (COPD) or cardiac problems (Kisley & Goldberg 1996); in this type of scenario, depression is less likely to be identified and diagnosed and classified as a secondary condition. The person's wider social network, family and life situation ought not to be forgotten in assessment as people do not exist in a vacuum and their behaviour both affects and is affected by significant others.

Anxiety is evident where a person is preoccupied with heightened or exaggerated concern and attention to specific issues. The person may display a heightened level of responsiveness and be hyper-alert or vigilant. While certain levels of anxiety are a part of normal life, where this exerts a detrimental effect on the person's functioning and quality of life, they may experience a mental health problem. Typical presentations of anxiety are in the form of:

- **Panic attacks** – where physical symptoms are experienced associated with the body being highly responsive. These include palpitations, chills, hyperventilation, dizziness, chest pain, choking, nausea and

Scenario 13.1

Depression

Dave experienced a myocardial infarct approximately eighteen months ago. He is 52 and gave up smoking five years ago. Prior to this he smoked up to twenty cigarettes a day for thirty years. Previously Dave worked as a successful building contractor, which often involved living away from home for several months at a time. During these periods Dave's diet was poor and he regularly drank large amounts of alcohol as part of his social life.

After having the heart attack Dave began to feel low in mood, had difficulty sleeping, woke up early in the morning and generally lost interest in life. Dave describes himself before the heart attack as a 'happy go lucky' sociable character, but since his physical illness he has not worked, abandoned many former interests, lost contact with his friends and lacks motivation. Due to losing interest in eating Dave has become underweight and his wife is worried about his physical health. Dave feels he has lost confidence and is reluctant to leave home. Recently he has been asked to look after his 3-year-old grandson while his daughter-in-law works. Dave wants to do this as he values his family but worries he will have another heart attack while caring for his grandson. On several occasions recently Dave has had chest pain and attended the emergency department (ED) at the local hospital, but no physical problems were found. Dave experienced this pain again during a weekend when his GP was unavailable so his wife drove him to the ED.

Applying Theory to Practice: Exercise 13.4

Under the supervision of a qualified member of staff you are assigned to assess Dave's condition.

- What effect do you think his state of mind might be having on his physical condition?
- What verbal and non-verbal cues would you look for in Dave's communication?
- What questions would you ask Dave to ascertain how he feels?

Scenario 13.2

Anxiety

John is 35 years old and attending a pre-admission clinic for an arthroscopy on his left knee as a result of repeated wear and tear through playing football. You are taking John's observations. Initially he appears very positive and cheerful but then you notice he begins to appear anxious. On taking John's blood pressure his hands seem sweaty. John becomes increasingly agitated, repeatedly seeking reassurance from you that he will be all right and then confides that he is worried about dying during the surgery as an uncle some years ago underwent a routine operation but never regained consciousness.

Questioning Clinical Practice: Exercise 13.5

- How do you respond to John's concerns?

The NMC Code of Conduct (2004) identifies the role of the nurse as to advocate on behalf of the patient.

- Is it your role to reassure John and, if so, is it ethical for you to reassure him when you know that, however slight, there may be an element of risk in his undergoing surgery?

stomach churning. It has been suggested the physiological basis of panic attacks has a physical origin and is a fear response triggered in reaction to a perceived but unidentified threat (Hart 2004).

Other forms of anxiety include:

- **Phobias** – evident as focused aversions or highly reactive fears to specific phenomena, for example, fear of spiders or heights
- **Obsessive compulsive disorder** – occurs where the person experiences persistent obtrusive negative thoughts and carries out specific tasks or actions to prevent feared outcomes from occurring; examples include hand washing, checking, collecting, hoarding, touching and counting rituals. In some cases the ritualistic behaviour can be of a self-harming nature, for example, skin picking or hair pulling (trichotillomania). Frequently people experiencing obsessional thoughts are aware of the problem but due to the strongly compelling sensations are unable to resist the compulsion and break the cycle of obsessional behaviour (Hart 2004).

Bipolar mood disorders

Bipolar disorder affects mood, thinking and behaviour and is characterised by mood swings. When in a high phase the person can display grandiose behaviour and express delusions but when low they become deeply depressed and, due to the impulsive and emotion driven nature of the condition, there is a high risk of suicide. The symptoms outlined below describe a person in the elevated phase but when low the person will present as deeply depressed.

Applying Theory to Practice: Box 13.6

Symptoms of Bipolar Disorder

Mood

- Elevated and expansive or euphoric
- Irritable and impatient
- Rapidly changing

Thought

- Flight of ideas
- Grandiose delusions
- Jealous or persecutory views

Speech

- Rapid delivery
- Loud in volume and expansive delivery
- Singing or rhyming words together

Behaviour

- Emotionally inappropriate and disinhibited
- Uncharacteristic actions, for example, overspending
- Unusual or colourful choices of clothing

Bodily functions

- Insomnia
- Increased activity levels
- Increased appetite
- Increased libido

Perceptions

- Illusory ideas
- Misunderstanding of other people's communication
- Jumps to conclusions
- Lack of insight and congruence with reality

(Hart 2004)

Psychotic disorders and schizophrenia

Psychosis leads the person to lose touch with reality and develop personalised or unusual interpretations to events or phenomena. The causes of psychosis can vary from a response to traumatic events or problems at a particular time in life, for example, starting university and living away from home, divorce, bereavement or redundancy, to the use of illicit substances. Frequently people can experience an episode of psychosis and fully recover.

A linked but separate mental health problem is schizophrenia. While the cause of schizophrenia is not definitely known, it is felt some physical factors are active (NHS Direct 2007a.). Schizophrenia is a fragmentation of the person's perception and grasp of objective reality, which makes it difficult for them to separate their own thoughts and perceptions from objective reality. Generally the onset of the illness is from late teens to early twenties for men and mid-twenties to early thirties for women (NHS Direct 2007a).

Commonly people with schizophrenia experience sensory delusions (unusual beliefs which are not shared by other people) and hallucinations (hearing, smelling or tasting something which is not real), commonly hearing voices and, due to the influence of this phenomenon, the person experiences difficulty thinking logically and acting

Applying Theory to Practice: Box 13.7

Symptoms of Schizophrenia

Delusions – abnormal beliefs that are not real

Hallucinations – the feeling of having an experience, which is not real

Disordered thoughts – which result from the delusions and hallucinations

Abnormal behaviour – which occur through responding to the delusions, hallucinations and disordered thoughts

(NHS Direct 2007a)

appropriately in social situations. Symptoms are summarised in Applying Theory to Practice: Box 13.7.

Schizophrenia is acutely distressing and life-limiting for the person and their family and significant others, yet it is the subject of much fear and stigma in the general population, which limits the opportunity for social inclusion and the meaningful participation of people with a psychotic and schizophrenia-related illness in the community.

Applying Theory to Practice: Box 13.8

Substance Misuse

- A persistent desire for, and preoccupation with, the substance
- Activities to acquire supplies of the substance
- Absence of control in taking the chosen substance
- Tolerance to the chosen substance leading to increased intake being required to achieve the same effect
- Psychological and/or physical dependence leading to difficulties with withdrawal, reduction or abstention
- Reduction in participation of other activities

Psychoactive substance misuse

Substances, which can be misused include nicotine, caffeine, alcohol, amphetamines and associated compounds, cannabis, cocaine, opioids, hallucinogens, inhalants, sedatives, hypnotics and anxiolytics. The effects vary depending on the choice and in some cases a combination of these substances are used. Frequently people experience low mood, personality changes or impulsive behaviour or impaired judgement through using substances.

Self-harm

Self-harm frequently occurs as a method of relieving pent-up feelings of emotion or anger and is caused by low mood, depression, and feelings of self-loathing or worthlessness (NHS Direct 2007b). Other causes may be sexual, psychological or emotional abuse, neglect and bullying, or harassment and it is more prevalent in adolescence and among females than males (NHS Direct 2007b). Frequent parts of the body which are self-harmed are the wrists, upper thighs, inner arms and upper chest, although self-harm can also include skin picking and the deliberate breaking of bones (NHS Direct 2007b). The most commonly used method of self-harm is knives or blades, yet it can occur in subtle and varied forms (NHS Direct 2007b). People who self-harm tend to be ashamed of their behaviour and conceal their injuries and also therefore the means by which they carry out self-harm and so the chosen methods vary and can be very discreet (NHS Direct 2007b).

Scenario 13.3

Self-harm

Sophie is 14 years old. Her school is located near the hospital. At two o'clock she is visiting her father, John, after his arthroscopy. She is dressed in a dishevelled manner and seems preoccupied and low in mood. When you ask if she is okay, Sophie avoids eye contact, replies in an offhand way and appears to become defensive, explaining that due to a teacher being taken ill she has been granted a non-pupil afternoon and that this often happens. As you leave the bedside you notice the left-hand sleeve of her shirt is rolled up and the inside of her forearm has raised horizontal pale welts from what you think is scarring. The other sleeve is pulled down and what appear to be bloodstains have soaked through the material.

Questioning Clinical Practice: Exercise 13.6

Substance Misuse

- How would you attempt to engage with Sophie?
- Is it in accordance with the NMC Code of Conduct (2004) to ask further questions about Sophie's well-being or is that exceeding the acceptable role of the nurse?

While it may be felt self-harming behaviour is associated with suicide, no direct connection has been identified and it could be argued that relieving tension in this way prevents a build-up of negative emotion which could cause suicidal behaviour. Yet death may occur accidentally as a result of self-harm (NHS Direct 2007b).

Eating disorders

Eating disorders include a range of problems. In some cases the person does not eat because they mistakenly believe they are overweight and introduce a rigorous regime of dietary control and deprivation of food (anorexia nervosa). Another form of eating disorder is where the person binge eats large amounts of food and then purges through vomiting or using laxatives (bulimia nervosa) (NHS Direct 2007c). These conditions, while varied on presentation, share some common characteristics:

Applying Theory to Practice: Box 13.9

Eating Disorders

- An abnormal attitude towards food
- Difficulty controlling the amount which is consumed, either too much or too little
- Choices relating to food, which are harmful to health

Identifying an eating disorder can be difficult due to society's preoccupation with weight and peer pressure, especially among women, promoting certain expectations regarding body size and attitudes towards food. However, eating disorders are linked to mental health; causes include loneliness, boredom, anxiety, abuse, low self-esteem, guilt and the need to feel in control (NHS Direct 2007c).

Scenario 13.4

Eating Disorders

Ellen is a 25-year-old student nurse in your intake. She moved from her home some distance away to live in university accommodation when she began training and at the same time ended a long-term relationship with her boyfriend.

While on placement Ellen does not eat, providing the reason that shifts interrupt the usual pattern of meals. She also does not keep food in the kitchen she shares in a communal flat with other students as she lives on a bursary and enjoys spending her money on clothes and travel.

During the eighteen months of the course to date Ellen has lost a significant amount of weight and often looks pale and tired. On more than one occasion you have heard other people remark to Ellen that she appears to be underweight.

Ellen responds to these comments as compliments, stating that it is fashionable to be thin and when growing up her mother always criticised her for being overweight but that now she is able to live up to that ideal. Recently on a particularly busy shift Ellen appeared to faint and lose consciousness briefly but when recovering would not seek help. She increasingly appears to have difficulty concentrating and focusing on her work and her recent marks in assignments are lower than previously on the course.

Questioning Clinical Practice: Exercise 13.7

- Are you obliged to notify the university of your concerns about Ellen? If so, how would you describe what these concerns were and your rationale to support your observations?
- Within the scope of the NMC Code of Conduct are qualified members of staff obliged to report similar instances regarding colleagues?

Once you have answered these points, read through the Code of Conduct and see if your thoughts and feelings match the professional guidelines identified by the NMC.

Dementia

Dementia is not a disease but a group of symptoms which occur as a result of a number of different illnesses, but which all cause degenerative changes in brain tissue leading to a progressive decline in cognitive functioning. Typical changes which occur in dementia are loss of memory, confusion, and change in personality, mood and behaviour (Hart 2004). While commonly regarded as a disease of older age, dementia can affect younger people: illnesses such as Korsakoff syndrome and Creutzfeldt–Jakob disease (CJD) have affected people of all ages. Examples of dementia-type illnesses are Alzheimer's disease, Lewy body, vascular disease and Pick's disease. Cerebral haematomas or space-occupying lesions in the cerebral cortex can also produce similar symptoms to dementia.

Scenario 13.5

Dementia

George is 78 years old and was bereaved of his wife, Joan, eighteen months ago. George's daughter, Sarah, became concerned, as shortly after this event she went away with him on holiday and found that he could not remember where his room was and became very easily confused and disorientated. When he returned to his home George did not understand where he was, and recently he has not known who Sarah was. When she has asked him about this, George feels it is all a part of the ageing process. Lately, George has been forgetting to wash and eat, and has neglected his needs. Late on a Sunday evening, Sarah was phoned by a neighbour of George's who found him wandering outside his house and only partly clothed.

Sarah has brought George to the ED department; she is very tearful and when registering his details with the receptionist explained she can no longer care for her father and needs urgent help.

Applying Theory to Practice: Exercise 13.8

- What techniques would you use in a conversation with Sarah to provide support and reassurance while also gaining suitable information to be able to effectively assess George?

Care in the community

For most of the twentieth century the mental healthcare system in the UK was organised around a number of large inpatient mental health hospitals. Commonly, mental health hospitals were discreetly located just outside major towns with average patient populations of up to 2,500 per hospital (Jones 1993). There were a consistently large number of inpatients reaching a peak of over 151,400 in 1955, which was nearly 3.4 per thousand of the total UK population (Jones 1993). There was a modest reduction of inpatients between 1954 and 1959 due to the development of outpatient treatment; but in the inpatient sector there was little development in the rehabilitation of long-stay patients, and expenditure on mental health services in the community actually decreased (Jones 1993).

Yet in March 1961 the Health Minister, Enoch Powell, in a keynote speech, surprisingly announced the Government's intention to abolish long-stay mental hospitals and reduce psychiatric inpatient bed capacity nationwide by 75,000. This would have far-reaching implications for the provision of mental health services, and, while the number of inpatient beds reduced to approximately 50,000 by 1992 (Coppock & Hopton 2000), this was not a smooth transition and took many years to fully implement. In effect this represented a complete U-turn in government policy from inpatient provision for mental health services to a community-based system. Unfortunately, there was no planned development to provide for the needs of mental health patients reprovisioned within the community and there was no introduction of mental health services that could serve these patients (Coppock & Hopton 2000). Furthermore, the change was not based on research that community care could produce better outcomes for the mentally ill.

Applying Theory to Practice: Box 13.10

Care in the Community

1. Pharmacological developments
2. Legal and organisational developments
3. Economic factors
4. Ideological and social changes

This change in policy has been attributed not just to one cause but several (Coppock & Hopton 2000).

1 **Pharmacological developments**: In 1953, there was a major breakthrough in medication, with the development of a new class of drugs called phenothiazines. Chlorpromazine (largactil) was the first of these new drugs, and they led to the availability of more effective medication to treat a range of acute mental health problems, which alleviated the distress of patients who were not amenable to other forms of therapy. The effect was to transform mental hospitals from forbidding environments designed to contain aggression and distress to institutions which permitted staff to work more proactively with patients and offer the possibility of life within the community, due to the better management of psychiatric symptoms. Yet it has been claimed the impact of this development has been overemphasised, as there was a successful recovery movement that pre-existed for many years prior to the development of this new medication (Coppock & Hopton 2000). Furthermore, while phenothiazines provided effective alleviation of symptoms, they were not a cure and there were side-effects with these drugs (Jones 1993). Bearing this in mind, it can still be stated that developments of new and effective pharmacological treatments for the acutely mentally ill were active alongside other factors in a changing environment of service provision. Today ranges of psychotropic medications have been developed to alleviate the symptoms of mental health problems from depression to acute agitation and psychotic symptoms.

2 **Legal and organizational developments**: Historically the provision of care for the mentally ill has represented a dilemma between balancing the needs and rights of the mentally ill individual with the safety of the wider community. The availability of improved medication for acute mental illnesses, together with ideological and social changes as discussed below, created a more positive view of mental illness as amenable to treatment. The introduction of the NHS in 1948 led to mental health services being aligned with health; previously they had been managed by local authorities. A review of the legal status of the mentally ill was regarded as long overdue and necessary to reflect changes in the role of the mentally ill within society. Before the Mental Health Act of 1959, magistrates determined the detention of people due to mental illness, so mental illness was regarded as a matter of public order. Yet the 1959 Mental Health Act placed the responsibility for detaining a person for reasons of their mental health under the remit of psychiatrists. Acknowledging the role of psychiatrists served to confirm their status alongside that of medical doctors and defined mental healthcare statutorily within healthcare as opposed to the criminal law (Jones 1993).

Organisationally, a consequence of these changes was to shift the emphasis of mental healthcare from containing the mentally ill to providing a health-focused service. The culture of the mental hospital system was required to undergo a momentous culture change through amalgamation with health services.

3 **Economic factors**: As a consequence of becoming part of the National Health Service it soon became apparent that the existing mental health service provision was inadequate (Coppock & Hopton 2000). Many of the buildings dated from the nineteenth-century Victorian and Edwardian eras and were in dire need of repair and maintenance. In some cases, due to overcrowding, patients slept in beds inches apart or in corridors (Jones 1993). By the mid-1950s it was clear to the Government that a programme of inestimable investment was necessary simply to maintain many of the buildings, which were antiquated and outdated for use as modern hospital buildings (Jones 1993). For the Government, scaling down the mental health inpatient provision and centring care in the community offered the prospect of financial savings.

4 **Ideological and social changes**: Before the Second World War, large-scale institutions reinforced a sense of order and equilibrium within society, which disempowered patients. In the postwar era groups and therapeutic communities were established to treat large numbers of soldiers who were psychologically traumatised by their experiences. This experimental and innovative work of Bion and Foulkes fundamentally altered mental healthcare, but was also very successful and was adopted and then further developed by psychiatrists such as Laing (1959). Mental health patients were seen as active participants in their care, by forming therapeutic relationships with their carers.

In 1961, the same year as Enoch Powell's speech (as Health Minister), three major academic works appeared which were all highly critical of mental health institutions: Erving Goffman's *Asylums* (1961); Thomas Szasz's *The Myth of Mental Illness* (1961); and Michel Foucault's

(1967) *Madness and Civilization.* All three writers came from differing academic backgrounds. Goffman was a sociologist, Szasz, a psychiatrist, and Foucault, an academic. Foucault and Goffman particularly criticised large-scale mental institutions as not only failing to work therapeutically for patients' mental well-being, but as actually exerting a detrimental and coercive effect on an individual. Despite all three texts taking radically different perspectives they were all unanimous in condemning mental health institutions, arguing they were anti-therapeutic, and these authors fundamentally questioned the biomedical model of psychiatry by claiming authority yet offering little in the way of effective treatment.

The direct influence of these writers in initiating change has been doubted; it is felt their work was more notable in capturing a prevailing trend internationally away from institutional care, which had simply become outmoded. This was due to changes in society's expectations and views of mental illness and the way therapeutic relationships were formed and conducted in the care of those with mental health problems (Coppock & Hopton 2000). The emergence of care in the community as the predominant philosophy of care for the mentally ill therefore reflected changes on a legal, organisational, ideological and social level on how care of the mentally ill ought to be organised and delivered.

The National Service Framework for Mental Health

In this section a brief outline is first presented of the background to the mental healthcare system before providing a more detailed discussion of the scope and goals of the *National Service Framework for Mental Health* (DH 1999c).

The government policy to dismantle large-scale mental hospitals was slow to take effect (Coppock & Hopton 2000). While the inpatient sector dwindled in numbers between the 1960s to the latter part of the 1980s, in spite of repeated calls for improvements, community-based services as a result of years of under-investment were not well developed nationally and a cause of much concern and criticism (Coppock & Hopton 2000).

Under pressure to act, the Government appointed Sir Roy Griffiths to produce the Griffiths Report (1988), which recommended a mixed economy of care in the community combining statutory, voluntary and private sector services; with social services leading in decisions over the provision of community care. Following on from this, the White Paper *Caring for People* (1989) and the NHS and Community Care Act 1990 instituted fundamental change in the delivery of health and social care by:

- Introducing a market-orientated approach to services with competitive tendering
- A purchaser–provider split between the service commissioner and the service provider.
- Encouraging GP fundholding to control the purchase of care.
- Using self-governing hospital trusts and mechanisms to measure outcomes (Coppock & Hopton 2000).

While these changes reformed the infrastructure of the healthcare system to deliver care in the community more flexibly and responsively to the needs of service users, there was still concern that services for mentally ill people in the community were insufficiently developed (Coppock & Hopton 2000).

The NSF for Mental Health was the first comprehensive statement of what was expected from mental health services in England, focusing on the care of working-aged adults from 16 to 65. Mental healthcare services for children, adolescents and older adults are considered in the NSF for Children, Young People and Maternity Services (DH 2001a) and the NSF for Older People (DH 2001b).

The vision of the government contained in the NSF for Mental Health (DH 1999c) was to provide services, which are presented in Applying Theory to Practice Box 13.12.

Improving the services for people with severe and enduring mental health was the first milestone with the

Applying Theory to Practice Box 13.11

NSF for Mental Health – Principles

- **Safe** – to protect the public and care for those with mental health problems at the time care was needed
- **Sound** – to ensure service users and carers are able to access a full range of services appropriate to their need when they need it
- **Supportive** – working together with service users, their families, carers and significant others to build healthier communities

(DH 1999c)

wider implementation of the other goals envisaged to occur over the next ten years until 2009. Historically, specialist and inpatient mental health services existed separately from those in primary care with limited contact and communication. An important consideration was the necessity of establishing a more fluid continuum between primary and secondary services to improve access for service users to secondary care and enhance the level of mental health services provision available in primary care (DH 1999c).

The NSF for Mental Health lists seven standards for the mental healthcare of adults up to the age of 65 in five groups with standards 2 and 3, 4 and 5 generally being paired together as these standards relate specifically to primary care and secondary care respectively: see Applying Theory to Practice Box 13.13.

An interim report *The NSF–Five Years On* by the mental health tsar, Sir Louis Appleby, was published by the DH (2004) and provided insightful commentary on the progress up to that point in each of the seven standards:

- With regards to mental health promotion it was found that while a wide range of health promotion strategies had been carried out, the effectiveness of these measures was severely limited by a lack of expenditure. The target outlined in the NHS Plan to recruit and train staff to provide mental health interventions in primary care to support GPs was not met.
- A requirement of the NHS Plan was to develop a new gateway worker role to provide a conduit for access between primary and secondary services. In 2004 there was very limited evidence of this goal being met. Access to mental health services 24 hours a day, seven days a week has not been achieved nationally.
- The NHS Plan sought to develop teams to provide community interventions therefore reducing the demand for inpatient beds. The three areas where these teams were developed were assertive outreach, crisis resolution and early intervention. Yet in 2004 these teams were not available in sufficient numbers across the country or with enough staff to constitute a nationwide service; most areas reported the service was not adequate to meet local need.
- There were increases in the numbers of secure and psychiatric intensive care beds and an emphasis on improving the environment on mental health inpatient units generally. Acute forums for service users have been established everywhere and acute admissions were reducing.
- The suicide rate is now at its lowest recorded figure with the suicide rate among younger males reduced for the first time since the 1970s (DH 2006b).

While a number of the targets were not achieved by 2004, this does not mean the NSF for Mental Health has not been a success. Positive outcomes have included the development of a more cohesive and planned mental health service on a national basis; improved communication and liaison between primary and secondary services (DH 2004); access to mental health services in many areas for people with mental health problems in primary care who would not otherwise have received access; and new and highly innovative practice and innovations in primary care mental health (Baguley et al. 2007).

Applying Theory to Practice Box 13.12

NSF for Mental Health Service Developments

Primary care:

- Support for GPs working with common mental health problems by employing 1000 primary care mental health specialist workers (GRADUATE workers)
- Support for primary care, ED and NHS Direct in working with mental health problems by the employment of 500 community mental health workers

Secondary care:

- The creation of 50 early intervention teams nationally to work with young people experiencing first episode psychosis
- Establishing 335 crisis resolution teams to relieve pressure on acute inpatient teams
- Developing 220 teams to support service users living in the community who are reluctant to engage

(DH 1999c)

Applying Theory to Practice Box 13.13

NSF for Mental Health – Standards

Standard 1: Health and social services should promote mental health and work with individuals and the community, combat discrimination against mental health problems and promote social inclusion.

Standard 2: Service users contacting their primary healthcare team with a mental health problem which is regarded as commonly occurring in the population should receive an assessment, their mental health need(s) should be identified and they should be offered appropriate further assessment, treatment and care, or if necessary referral to specialist services.

Standard 3: Any person with a mental health problem which is regarded as commonly occurring in the population should have access to services suitable to meet their mental health needs 24 hours a day, seven days a week and NHS Direct ought to be available for first-level advice and referral to specialist help-lines or local services.

Standard 4: All mental health service users registered on the Care Programme Approach (CPA) should receive care which engages them to the optimum, and strives to reduce risk or crisis; should receive a copy of a written care plan which states the action(s) to be taken by the service user, their carer and the care coordinator in the event of a crisis and advising the GP on how to respond. The care plan should be regularly reviewed by the appointed care coordinator; and the service user ought to have access to services which are available 24 hours a day, 365 days a year.

Standard 5: Every service user who is assessed as requiring a period of care which involves them being away from their home should have access to a suitable hospital or alternative bed or place as close to their home as possible, and in the least restrictive environment to protect both the service user and the public. On their discharge, they should receive a written copy of an agreed care plan identifying the care and rehabilitation which are to be provided, the care coordinator, and the action(s) to be taken in a crisis.

Standard 6: Individuals who provide regular and significant levels of care for a person on CPA ought to receive an annual assessment of their caring and physical and mental health needs and a copy of their own written care plan which is carried out in discussion with them.

Standard 7: Local health and social care communities should prevent suicides by promoting mental health among individuals and communities (cross-referenced with Standard 1); provide effective primary mental healthcare (cross-referenced with Standard 2); ensure people with mental health problems are able to access local services through primary care team, helplines or ED (cross-referenced with Standard 3); ensure people with a severe and enduring mental illness are provided with a care plan which is specific to their needs and provides access to services 24 hours a day, 365 days a year (cross-referenced with Standard 4); provide safe hospital facilities for service users requiring inpatient admission (cross-referenced with Standard 5); facilitate the carers of people with severe mental health problems to access support to allow them to continue in the caring role (cross-referenced with Standard 6). Also to support prison staff in preventing the suicide of prisoners; ensuring staff are competent in assessing the risk of suicide and that adequate audit systems are in place to learn and implement necessary changes.

(DH 1999c)

Conclusion

Regardless of whichever setting adult nurses specialise in, mental illness will be encountered within their clinical practice. You have now gained insight into some of the many causes of mental illness and numerous clinical manifestations. You have gained insight into how governments, scientific breakthroughs and public opinion influence healthcare. The role of the nurse is pivotal in promoting positive, patient-centred care and is crucial in advocating for our patients and in supporting their recovery and optimum capacity for health.

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Misconceptions and the reality of learning disabilities

14

Alex McClimens

Chapter 14 Learning Objectives

- To appreciate the socially constructed nature of learning disability
- To understand the historical precedents that inform current thinking
- To be aware of the wide variety of causal events, processes and circumstances that can impact on these individuals
- To learn about some of the more common syndromes and associated conditions
- To be able to distinguish between the label and the living person when they present in a clinical situation
- To see the true value of definitions when set against lived reality
- To question the representation of learning disability in popular culture
- To challenge the ethics that operate around learning disability in health and social care settings
- To understand that communication is a skill that needs to be practised

Introduction

People labelled with learning disability suffer a disproportionately higher level of ill health compared to the rest of the population; they are also more likely to die younger (DH 2001). Respiratory disease is the highest cause of death; other conditions such as epilepsy, obesity, diabetes, endocrine disorders, mental health problems, sensory impairments and gastrointestinal cancers are also prevalent (DRC 2006; NHS Scotland 2004).

From this it should be clear that healthcare professionals would be in frequent and regular contact with individuals from this particular social grouping over the course of their professional careers. Caring for someone identified as having a learning disability requires as much care and attention as a patient with a physical illness, while taking into account some discussion on causes, conditions, cultural influences, medical strategies, health economics, clinical interventions and social responses to impairment issues. It is also a matter of legislation and policy initiatives.

This chapter will be presented in six sections. The first will deal with some philosophical and theoretical issues that are fundamental to an understanding of the concept of learning disability. The rationale for this is that it can be useful to reach such an understanding before going on to care for individuals who have to live with the label. The second section will incorporate the distinction between disability and impairment and introduce what is known as the **social model of disability**. The third section will deal with the epidemiology of learning disability with reference to some basic facts and figures. The fourth section will consider the broader historical, social and cultural implications that have led to our present appreciation of what constitutes learning disability, including some discussion on disability ethics. The fifth section examines in detail two of the better-known exemplars of learning disability with emphasis on the healthcare implications for the clinician. The chapter ends with a brief discussion on recent policy initiatives of relevance to the healthcare of this patient group.

Philosophical and theoretical issues

Below is an account of what happened when a patient, J., had to go into hospital for a routine procedure:

> It said I had a learning disability on the case notes. They [the nurses] talk down to you. They explained it [the procedure] to my carer, not to me. I felt upset and kept it all bottled up.

J. is a grown woman who can articulate perfectly well but the people who were supposed to be looking after her could not see past the label and ended up treating her badly. Her colleague K. initially had the same kind of experience but he found a way to change things. He could not understand what the consultant was saying when he was in hospital for investigations. But when he asked for an explanation in simple language the consultant was very helpful. He stopped talking in what K. calls 'medical jargon' and drew a diagram. K. was much better informed regarding his care. It is important to remember that patients with 'learning disabilities' are not stupid, they have a 'learning disability'. When communicating with someone who is identified as having a 'learning disability', remember, it is the person who is sick, not his or her label. Try talking to them first. It will not always work but some common courtesies can go a long way towards a more comfortable encounter with healthcare.

We need now to briefly mention something called **social constructionism**. This philosophy challenges preconceived notions about how the world is understood by asking us to think about the way we all invent our own version of reality. Most of the time this is shared unproblematically but now and again, as in the case of 'learning disability', the understanding that emerges is skewed. Why do you think this might be? Look at Exercise 14.1 and see if that helps your understanding.

Applying Theory to Practice: Exercise 14.1

When were teenagers invented? This may appear ridiculous but think about it for a minute ... when? One answer might be that they came into being around twelve years after our species learned to walk upright. Another way of looking at it would be to consider the social forces that have organised an age group into a collective noun. Try the same argument with the words 'nursing' or 'nurses'. Now repeat the process with 'learning disability'. And when you think you might have answered the 'when' question; try this: why?

Some would suggest that there is no such thing as 'learning disability', but what about people who have 'learning disabilities'? An example could be patients you have cared for who have Down syndrome or cerebral palsy. Some believe that these people have impairments and that is not quite the same as disability. This distinction is important, especially to anyone who is serious about a career in health and social care.

Applying Theory to Practice: Exercise 14.2

List the different definitions of an impairment and a disability.

Impairments and Learning Disabilities	
Disability	Impairment

In the left-hand column of Exercise 14.2 list a few examples of what you think counts as a disability. Now do the same for the impairment column. Not as easy as it looks, is it? Where do you put dyslexia, for example?

Think about it this way. Do YOU have any impairments? Do you, for example, wear glasses? People wear prescription glasses, or contact lenses, because of a defect or impairment to their vision. This is corrected by wearing lenses. Some people have a condition called asthma. It can be very serious or merely inconvenient. Medication is available to alleviate the condition. Asthma need not prevent anyone from living a 'normal life' although it may stop you running for the bus.

The list goes on. So, what other conditions would you add to the list of what we are now going to call 'impairments'? Jot a few more down and see if there might be any linking themes. You should find that common elements here are clustered around function, use, 'normal' and physical ability. The point to grasp is that impairment can be amenable to some form of intervention (therapy, medication, equipment) that corrects the impairment, or reduces its effects and so brings the functioning of that person closer to the established norm (e.g. 20/20 or 1.0 visual acuity, full range of movement).

The social model of disability: architecture and attitudes

A lot of talk about disability is really about impairment; impairment can be treated, but what of 'learning disability'? Think of precisely *where* you find it. For the person who needs a wheelchair to assist their mobility due to athetoid cerebral palsy occurring as a result of severe brain damage at birth, is their 'learning disability' then in their legs?

No, there's only one place you'll ever find any variety of 'disability' and that's in someone's head. And it is not usually in the head of the person living with the label.

Disability is a concept or social construction which provokes an 'attitude', or way of behaving in those who are confronted by persons assumed to have a 'disability'. This attitude is most frequently expressed in language (e.g. he's got a 'learning disability', she's a wheelchair case, they're cripples, idiots, spastics) or by access points in the built environment.

Think of the person using a wheelchair. They can get around unimpaired until they come across a steep kerb, a flight of stairs, a selfishly parked car, some forms of public transport or any other arrangement of physical objects that defeats their immediate social purpose of getting from A to B. Disability, where it exists, is a direct result of the social organisation of contemporary life which pays insufficient heed to the immediate aspirations of those who live with a variety of impairments. Such people are effectively disenfranchised from full and active engagement with their local cultures when structural responses operate to impede their physical, social and intellectual progress.

Attitudes to limited intellectual capacity also limit social activity and generally reduce life-enhancing opportunities for inclusion and participation within anticipated norms and roles.

Some people have said that under such conditions the concept of disability is more than merely descriptive but actually presents an example of socially oppressive practices, which harm human rights.

The origins of this argument come from the Union of the Physically Impaired Against Segregation. They issued a manifesto *Fundamental Principles of Disability* in 1976 (http://www.leeds.ac.uk/disability-studies/archiveuk/UPIAS/). The world has changed since then. The division between the social and the biological is not quite so clear. This will be discussed later when we talk about phenylketonuria (PKU). People are certainly disabled by society, but they are equally disabled by their own bodies. A new version of the social model of disability needs to address this. The situation is currently vacant. But whatever definition of disability you favour, you will always find that architecture and attitudes are implicated somewhere.

Applying Theory to Practice: Exercise 14.3

You have a visitor from Mars staying with you for the summer.

- How do you explain the term 'learning disability' to them?

Basic facts and figures

Definitions are easy to find; understanding, though, is harder to come by. Learning disability is characterised by three main components:

- Intelligence (as defined by measurement arrived at via an I.Q. test)
- Adaptive behaviour (as assessed by psychologists)
- Developmental aspect (understood within a medical/biological framework), which recognises that onset should occur during childhood or certainly before eighteen years.

This is an extract from the DSM-IV, the *Diagnostic and Statistical Manual of Mental Disorders* (APA 2000). ICD-10 (The International Classification of Diseases) and the AAMR (American Association on Mental Retardation). Both use the same three main criteria for classification, as does *Valuing People* (DH 2001), which adds the proviso that a low IQ in itself is insufficient to categorise people (2001: 14).

As outlined, there are three ways to decide whether someone has a learning disability or not. But are they any good? Measuring intelligence is a highly contentious. It is generally accepted that the Wechsler scale (1998) provides a reliable tool. Clinical psychologists, to classify individuals referred to them for assessment, use this widely. As suggested earlier, the IQ on its own is not sufficient to make a judgement. Another scale is used to assess adaptive behaviour. Here a popular tool is the Vineland scale. If you have the opportunity to talk to a clinical psychologist, ask them how they feel about the process; see the viewpoint of one in Box 14.1.

The third diagnostic criterion is that onset should be before age 18 and relates to maturity of the brain and 'normal' development. The main impact here is administrative and determines whether an individual is cared for

Questioning Clinical Practice: Box 14.1

Intelligence Testing and IQ (Intelligence Quotient)

Intelligence testing and IQ (Intelligence Quotient) form one of the three criteria for being diagnosed as having a learning disability. The tests with the longest history in this area are the Wechsler Intelligence Scales. The first version was developed in 1939 as the Wechsler-Bellevue Intelligence Scale. The most recent version is the Wechsler Adult Intelligence Scale, third edition (WAIS-III) (Wechsler et al. 1998). The WAIS-III has 13 subtests, each assessing a different aspect of cognitive, e.g. spatial, ability, working memory, understanding of vocabulary. The average IQ score is 100. People with learning disabilities will score at least two standard deviations below the average score of their peer group (IQ below 70).

The WAIS-III can be of great use to psychologists. It can, usually in combination with other tests, identify a person's strengths and difficulties allowing interventions to be planned that can help that person achieve their aims. This is not done by looking at the overall IQ score but by comparing scores from different parts of the test (Crawford 2004) and by gaining qualitative information from the way the person completes the subtests.

Sadly, intelligence test scores have had a long history of being misused, not to understand people's abilities better but simply to make judgements about whether people should be excluded from or included in services. For example, a common misuse of an IQ score is the assumption that it predicts people's ability to parent (Tymchuk & Andron 1990).

In the USA the use of IQ scores has been used as a cut-off for claiming social security. This has been criticised by Folstein (1989) who cites the cases of people with Huntington's disease who because of the disease cannot work, but due to their potentially normal IQ cannot claim benefits either. IQ testing and therefore the WAIS have become tainted because of such examples.

If we have one message about the WAIS-III, it would be to alert people to its misuse. If anyone tries to tell you that they can understand a person just by looking at their IQ score, then do not believe them.

Suzie Beart & Zara Clarke

in child, transition or adult services. That is why a child with brain damage due to encephalitis, for example, gets the diagnosis of learning disability whereas an adult would be labelled with acquired brain injury.

By whatever means you categorise, classify or label people there are roughly one and a half million individuals in England who are currently described as living with some degree of learning disability. The figures provided by the Department of Health divide the population further into people with severe and profound learning disabilities, whom they estimate at just over 200,000, and those with what they term mild to moderate learning disabilities, numbering approximately 1.2 million. This gives an overall prevalence rate of around 25 per 1000 (DH 2001: 6.1).

Applying Theory to Practice: Exercise 14.4

The previous figures reveal that approximately 1.5% of the population experience a learning disability.

- How do you think these people are spread across the country?
- Would you expect to find a higher level of learning disability in cities or in rural areas?
- In economically deprived areas or affluent parts of the country?
- And what factors, if any, might influence this? What do you think?

Lies and damned lies

The word 'approximately' has been used a lot when quoting figures. That is because there are real problems here in estimating numbers, even for experts. For example, if you consider the developmental aspect of identifying learning disability in a young child, then it is clear that some cases will not become apparent perhaps for several years as the child grows and develops. Hence, all the figures you will ever read will be approximations or estimates. This is because there are no reliable official statistics concerning the number of people with learning disabilities in the UK (Emerson et al. 2001). This anomaly contributes to the difficulties of planning services, recruitment and education across a whole range of disciplines. Epidemiology, which is what we have just been discussing, is not confined to learning disability studies. It is the study of the occurrence of disease processes (and related conditions/syndromes) and as such is a very broad topic. There are some related terms you will also need to understand; they appear in Box 14.2.

Applying Theory to Practice: Box 14.2

Prevalence: the number of cases, old and new of a disease/syndrome/condition existing within a population at any given time

Incidence: the number of new cases of a disease/syndrome/condition occurring within a population over a fixed timescale

Aetiology: the study of the causes of diseases/conditions/syndromes

Causes and conditions

In combination with statistical material, the causes and conditions of learning disability must also be considered. You might think that identifying causes would be a straightforward process; this quotation from Emerson at el. (2001) suggests otherwise:

> It is now known that biological, environmental and social factors are all involved in causing learning disabilities. It used to be thought that severe learning disabilities were caused by biological factors and that mild learning disabilities were caused by social and environmental factors. Most experts, however, now believe that the picture is not quite as clear-cut as this.

A simple framework of causes can nevertheless be seen by looking at the timing of the event that results in the diagnosis of learning disability being made. This applies particularly to 'biological' causes. Social and environmental factors are harder to pinpoint. Hence there are three key times to consider: preconceptual, perinatal and postnatal.

In the case of preconceptual diagnoses, causes are heredity (parental genetics leading to diagnosis of, e.g., fragile-X syndrome) or congenital (leading to diagnosis of, e.g. Down syndrome). Also at this stage the immediate social conditions (drug misuse, extreme poverty) or the more global environment (radiation, pollution) may also damage the mother's womb resulting in brain damage in the fetus. Fetal alcohol syndrome, despite longstanding medical evidence, has only recently been acknowledged as an increasingly significant contributory factor associated with learning disability (Sreissguth 1997). At the perinatal stage a typical example is cerebral palsy (CP) caused by poor oxygenation. It should be noted that not all individuals born with CP necessarily develop any learning disability since this is determined by the extent and severity of the brain damage. Postnatal causes include infection (e.g. rubella), direct trauma (e.g. head injury) and a mix of social and/or environmental conditions. For example, being born and brought up in a war zone, or having a socially deprived childhood, may result in severe developmental problems in later life.

However, in each scenario there always remains the possibility that the specific nature of the learning disability will remain unknown, which is to say that none of the circumstances identified can be implicated sufficiently to attribute cause. It is here that the psychological impact of socio-economic factors (family circumstances, parenting skills, immediate local conditions, nutrition) could influence cognitive development (Dallison & Lobstein 1995). Yet even after taking all of this into account., some instances will remain in the category of 'unknown'.

This chapter has identified how social/environmental causes and biological factors are implicated in learning disability and has discussed them as if they were entirely separate, but it is more complex than that. To illustrate this, an example from Rothman (2002) will be used. Rothman uses phenylketonuria (PKU) to show how there is never a case for saying that any cause is 100% environmental/social or biological.

With a prevalence of 1 in 10,000, PKU is a very rare autosomal recessive gene disorder. This means that BOTH parents need to carry the same altered gene, resulting in a 1 in 4 risk of having a child affected by the condition. The heel pinprick test performed on all newborns is for phenylalanine. Phenylalanine is an essential amino acid: essential because it cannot be synthesised from artificial sources. The amounts of these amino acids in the blood are crucial to well-being and too much phenylalanine leads to PKU. This is because during digestion phenylalanine is broken down to tyrosine (another amino acid); this does not occur in the person with PKU and it is the accumulation in the blood that causes brain damage. If left undiagnosed, the metabolic changes can lead to brain damage and result in progressive learning disability and possibly epilepsy. The effects of PKU, when diagnosed, can be readily controlled by diet. The cause of PKU then may be genetic in origin but it is entirely environmental/social in its prevention and treatment.

Culture and society

At somewhere around 1.5% of the population, it is perhaps not such a surprise to find that people labelled with 'learning disability' do not feature prominently in the media, popular culture or the entertainment industry. After all, how many of you readers have direct social, rather than professional acquaintance of someone who has a learning disability? Statistically at least the chances are slim. Because of this, much of our attitude towards all manner of disability comes second hand from our exposure to portrayals in the media in general and from our viewing habits in particular.

Soap operas, for example, are a useful barometer of socio-cultural awareness. They deal with controversial and topical social issues and generally reflect an approximation of the *Zeitgeist*. But if we consider the profile of other minority groupings, and taking age and gender into account, we see that they generally get fair representation on screen, in statistical terms at least.

When you filter out physical impairment from the equation, the presence of people with learning disabilities is significantly reduced. Paula Sage and Cara Readle are two examples. Paula has Down syndrome and Cara has cerebral palsy. Paula starred in the 2004 movie *Afterlife* and has since gone on to feature in the Scottish soap opera *River City*. Cara is a regular in the children's show *Tracey Beaker* where she plays the character Layla. These two may be exceptional in terms of their acting talent but it is unlikely that they will graduate to presenting the news or the weather where the preference for 'hair and teeth' presenters is so entrenched. Nor are they likely to feature on *Countdown* or *15 to 1* while the quiz show template demands fast minds and faster fingers. So while disability is not necessarily a barrier to a screen career, it nevertheless limits the horizons of the actor with a disability to a severely limited range of opportunities in the light entertainment industry.

It is not just in the visual media where learning disability is ignored. When did you last read a book where the central character has a learning disability? You can go back to the classics for caricature and demonisation. Just have a look at Dickens or Shakespeare who both populated their stories with entertaining monsters. But where in contemporary popular fiction will you find a sympathetic modern-day portrait? For one possible answer read *The Incredible Adam Spark* by Alan Bissett (2005). This should be on every reading list that attempts to deal with disability issues in contemporary society.

Questioning Clinical Practice: Exercise 14.5

Attitudes Towards Disability

- How many people with a learning disability do you routinely see on the television? Not many? Why is that?

Identify some of the reasons you can think of and add these to your portfolio.

History, ethics, eugenics and euthanasia

None of us is free of the past; how we live today is shaped by history. This is particularly true for people labelled with learning disability. In this section some short history lessons will be used to set out some of the conditions that have influenced the way our society shapes and responds to the concept of learning disability and to the people who live with the label. The medical and nursing professions are two of the major institutions to have played a role here, and in the second part of the section this will be illustrated with reference to two common conditions and how they continue to influence attitudes to care and treatment.

The Abortion Act, which came into effect in April 1967, was a true social landmark. Its repercussions are with us still, particularly in light of the changes brought about by the 1991 Human Fertilisation and Embryology Act. Not only did this more recent piece of legislation lower the upper limit for abortion to 24 weeks, it also overruled the fetal viability clause and now permits abortion for fetal handicap right up until birth, that is *any fetus* where some impairment or abnormality is detected can legally be terminated at any point up to term even if it is deemed capable of being born alive. Tom Shakespeare's (1998) view on this was: 'Current abortion law discriminates against the impaired fetus ... The law should not discriminate between impaired and non-impaired fetuses: a common time limit should be adopted for all pregnancies.'

This debate gets to the very core of **euthanasia, eugenics** and **disability ethics**. The implicit assumption appears to be that some lives are inherently worth more than others, with the implication that a life lived with some degree of impairment will automatically be of less value. If you want to fast-forward this line of thought then it is not long before you get to a situation where a clinician may have to make a decision on allocating treatment resources. The Nuffield Council on Bioethics, for example, produced a report in 2006 which recommended that doctors do not intervene with babies born prior to 22 weeks. What are your views on this? Tough questions need to be asked and answered. For example, within a limited healthcare budget, who should get that very expensive heart operation?

One response to this comes in the shape of **QALYs and DALYs** (Jelsma et al. 2002). The argument is very persuasive if you can stick to the figures and ignore the human factor. You may want to discuss this with your colleagues during the next coffee break: but be warned, these issues can cause much distress. Under some healthcare economic calculations, for example, it is theoretically possible to be better off dead, literally. So far no one has been able to produce any empirical evidence to support this claim.

Questioning Clinical Practice: Exercise 14.6

Ethics Decision Making

You have three candidates for cosmetic surgery but you can treat only one. Who is it going to be?

- Candidate A: 19-year-old man who wants cosmetic surgery to remove a disfiguring facial birthmark
- Candidate B: 19-year-old woman who wants breast augmentation to advance a modelling career
- Candidate C: 19-year-old person with mosaic variety Down syndrome who just wants to look 'normal'

Down syndrome and cerebral palsy

This chapter will now examine in detail two conditions associated with learning disability: cerebral palsy (CP) and Down syndrome (DS). These conditions were chosen for several reasons:

- They are among the most common conditions associated with learning disability and will therefore already be 'known' to some degree by students and practitioners
- Both have very many health-related implications for the individual and are therefore of professional interest to the clinician
- Both were 'discovered' at approximately the same time with implications for our present cultural understanding
- Both have subsequently been 're-branded' for modern times with different labels now being applied to the individuals who live with the condition(s)
- Both are conditions in which the person 'looks different' with implications for how we as individuals respond to their presence within wider society
- Both highlight the divide between 'impairment' and 'disability'
- DS introduces genetics, screening and selective abortion.

In London during the 1860s two medical discoveries were made which were to have a significant impact on how we understand learning disability. John Langdon Haydon Down (1828–1896) and William Little (1810–1894) were close contemporaries. Neither man was able at that time to correctly identify what science would later confirm. Even so, both had, through their clinical observations, begun a process of medical inquiry that would eventually establish trisomy 21 and cerebral palsy as diagnostic conditions amenable to care and treatment.

Currently, in the early 21st century, understanding of both conditions has undergone some revision. Those individuals who live with the conditions have had some battles to fight over naming rights. The scientific tradition of the nineteenth century demanded that names were attached to conditions and as such 'Little's disease' was the popular name for the variety of cerebral palsy that Little documented. Similarly Down's name became attached to the syndrome he is credited with discovering. And yet this was a much more gradual process. The original label conferred by Down was 'mongolian idiocy'. The way that individuals labelled with Down syndrome and cerebral palsy have been reinvented since the original 'naming' has gone through several revisions. Significant changes in public attitude, for example, have reshaped perceptions, just as policy and practice have altered to accommodate changes in public understanding.

Questioning Clinical Practice: Exercise 14.7

Modern Correctness

Many readers may be familiar with the name Scope from their high street shopping. Scope is the name of the charity that represents individuals labelled with cerebral palsy. Originally collectively formed by parents as The National Spastic Society in 1952, an extraordinary AGM in 1994 voted to change the name to Scope.

- Why do you think they did this?
- Why is mongolian idiocy now referred to as trisomy 21 or Down syndrome?

Down syndrome

Today Down syndrome is just one of many conditions detectable by routine prenatal screening. It is also the most common genetic cause associated with learning disability. It results from the failure of chromosome 21 to segregate normally during cell division (meiosis). This disruption produces the 'extra' chromosome; hence the scientifically accurate name for the condition is trisomy 21. The extra chromosome may be present in all or only some of the cells in the body. The risk of Down syndrome varies with maternal age from 1:1500 at age 20, 1:800 aged 30; 1:270 at 35; 1:100 at 40 to more than 1:50 at >45. Two main avenues can detect its presence: serum and ultrasound.

For serum screening a blood sample is tested for a combination of proteins and hormones. During the first trimester the combination is free beta-hCG and placenta associated plasma protein A (PAPP-A). During the second trimester the combination is more likely to be alphafetoprotein (AFP) and free beta-human chorionic gonadotrophin (beta-hCG).

An early ultrasound scan can be used to measure the thickness of fluid at the nape of the fetal neck; the nuchal translucency. An increased amount of fluid may indicate that the fetus has Down syndrome or some chromosomal abnormality. As a result the number of terminated pregnancies with Down syndrome has increased, and the prevalence of Down syndrome births has decreased from 1 in 700 to about 1 in 1000 (Roizen & Patterson 2003).

Questioning Clinical Practice: Exercise 14.8

Questioning Your Beliefs

Suppose you and your partner discover after screening that your unborn child has a high risk of being born with Down syndrome. You will automatically be offered the chance to terminate the pregnancy.

- What would you do?

There are three distinct varieties (technically genotypes) of Down syndrome:

- Mosaic 1–2%
- Translocation 4–5%
- Trisomy 21 95%.

Refer to Figure 14.1 for a graphic illustration.

These are only detectable under a microscope and not during a social encounter. All individuals, no matter what chromosomal variety they live with, share the physical characteristics to some extent. The standard variety of trisomy 21 is far more common and this is the classic

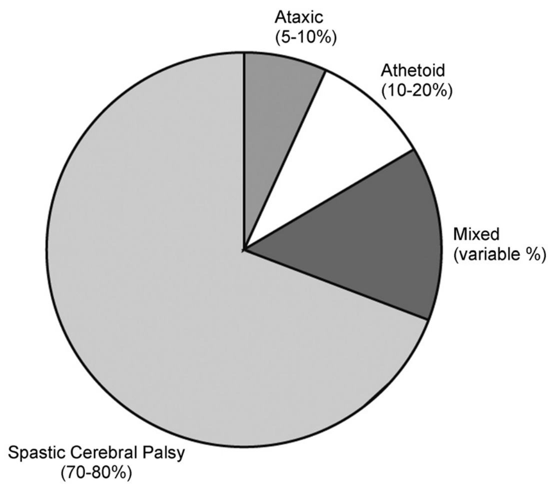

Figure 14.1 Down syndrome genotypes

presentation. The individual will have short stature, upward slanting eyes, lowered muscle tone, a small mouth (giving the appearance of a large tongue), a single crease across the palm of the hand, a significant gap between the large and second toes and fine dark hair. Some degree of learning disability will always be present.

The translocation or Robertsonian variety occurs rarely. The mechanics of this means that the extra 21st chromosome replaces some of the 14th chromosome. This very rare mosaic variety means that not all cells are affected by trisomy 21. In these cases the degree of learning disability may be much reduced and the appearance of the individual less affected.

Cerebral palsy

In a series of nine lectures delivered at the Royal Orthopaedic Hospital, William Little described the distorted postures and rigid muscle tone of some newborns on his caseload. He also noted that the condition was undocumented in medical science. By 1861, after studying the disorder for 20 years, he had tabulated over 200 cases. In a thesis before the Obstetrical Society of London he proposed that the causes of this previously overlooked disorder included asphyxia at birth, premature birth and direct mechanical injury.

The derivation of the term 'cerebral palsy' is cerebral = concerning the brain, and palsy = paralysis. This is not a single particular disease or illness. The term covers a range of physical conditions which affect movement as a result of an injury to the brain. The main clinical points to note are:

- The incidence of cerebral palsy is approximately 3 per 1000 births
- It is non-progressive (the condition remains stable throughout the life course)
- Babies born pre-term have a slightly higher incidence
- In the majority of cases the damage occurs before or during birth
- The most common cause is cerebral hypoxia (reduced oxygen supply to the brain)
- Most, but not all, affected individuals will have a degree of learning disability.

Cerebral palsy can be defined as:

> the commonly used name for a group of conditions characterised by motor dysfunction due to non-progressive brain damage early in life . . . The range of severity may be from total dependency and immobility to abilities of talking, independent self-care and walking, running and other skills, although with some clumsy actions (Levitt 2004).

Mobility is a big issue, and the input of physiotherapists and occupational therapists should not be underestimated as they form the core of any treatment regime.

The classification of CP can be addressed in two main ways: by affected limb(s) or by the origin of the brain damage. See Figure 14.2.

By limb the classification is as follows:

- **Tetraplegia/quadriplegia**: all four limbs equally affected
- **Diplegia**: either arms or legs are affected
- **Hemiplegia**: the arm and leg on one side of the body are affected.

By origin within the brain the taxonomy is as follows:

- **Spastic cerebral palsy** (spasticity): caused by impairment in the cerebral cortex (the outer layer) of the brain. This leads to disordered control of movement and accounts for approximately 60% of all cases.
- **Athetoid cerebral palsy** (athetosis): caused by impairment in the basal ganglia area of the brain. This causes involuntary spasms with jerky arm and leg

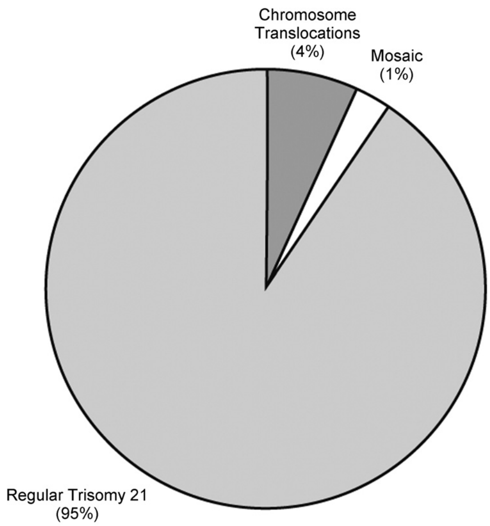

Figure 14.2 Cerebral palsy classification

movements and accounts for approximately 20% of all cases.

- **Ataxic cerebral palsy** (ataxia): caused by impairment in the cerebellum. This causes a lack of balance and spatial awareness leading to severely affected walking/gait. This accounts for approximately 10% of all cases.
- **Mixed**: many people have a permutation of the above types.

From this it will be obvious that people with cerebral palsy will also have to live with a variety of extra impairments that are associated with the condition. The problems they experience in using and controlling muscles cause mobility problems and difficulty with all activities of daily living. The consequences of this condition are global in their application. As something like 30% of people who have CP also have epilepsy, the impact on quality of life can be severe. The ageing process also leaves them more susceptible to Alzheimer-related disorders (Holland 1999).

The comedian Laurence Clark (http://www.laurenceclark.co.uk/) has cerebral palsy. He performs a routine about trying to look macho in the local pub while sitting in a wheelchair and drinking beer from a plastic cup with a spout-lid and two handles.

Questioning Clinical Practice: Exercise 14.9

Questioning Beliefs and Attitudes

- Is it acceptable to make fun of people with impairments and disabilities or are some subjects taboo?
- Can comedy reduce barriers or does it draw attention to the obvious differences between people?
- If your football team, race, nation, religion or hair colour becomes the butt of jokes, what does this do for your social standing? And how should you respond?

Q: What did the guy with trisomy 21 say to his dog?
A: Down, syndrome!

- Was that funny?

Questioning your beliefs and the beliefs of those around you provides valuable insight into the 'hows' and 'whys' in modern society.

Healthcare for people labelled with 'learning disability'

It is an unfortunate paradox that living with a learning disability does not provide immunity from the whole range of physical, emotional and psychological problems that beset human beings. It is often as a result of living with learning disability that the individual is even more susceptible in the first place. In this section material that illustrates the discrepancies apparent in the provision of health and social care will be discussed.

Part of the reason for people labelled with learning disability living with a lower level of general health is that their overall well-being is often compromised by associated conditions such as epilepsy and musculoskeletal problems. The National Patient Safety Agency (2004) acknowledges the difficulties people face with regard to access to treatment. Symptoms are not always diagnosed early enough, which can lead to serious health conditions deteriorating and the occurrence of avoidable deaths. Consequently 'diagnostic overshadowing' occurs when a condition is ignored or misdiagnosed because the label of 'learning disability' takes precedence. This is probably what happened to J., from earlier in the chapter, when she was in hospital. Now take a few minutes to do the Exercise 14.10.

Applying Theory to Practice: Exercise 14.10

Think back to the last time you were in pain.

- Describe the pain.
- What made the pain better?
- What made the pain worse?
- How did being in pain affect your behaviour?
- How did being in pain affect your thinking?
- How would someone who does not know you well know you are in pain?
- How do you treat pain?

Add your findings to your growing portfolio.

Now consider the following brief scenario, what would you do?

Scenario 4.1

The Case of Sarah

Sarah approached me (psychologist) at the day service. She placed her hand rather heavily on my shoulder. She then held her tummy and I asked her if she was OK. She shook her head and said 'No'. I said I was sorry to hear that; then I walked away. When I turned away to talk to a member of staff Sarah spat at me.

Assessment and analysis of patient presentation

Sarah was a 43-year-old woman diagnosed with moderate learning disabilities. She has very limited verbal communication skills. She also has a history of behaviours that challenge services and she can be aggressive to herself and to others. There was evidence of faecal smearing and while the reasons for this were not fully understood at the time, Sarah had a history of chronic constipation. Despite considerable weight loss, her stomach was distended and she was often seen with her hand up her jumper, rocking and crying.

Was Sarah's behaviour due to her learning disability? When Sarah was referred to the chronic pain team at her local hospital, initial investigations for gynaecological problems proved inconclusive. However, further tests revealed that Sarah had a massive gallstone, which had to be surgically removed, and type II spina bifida, which would account for her constipation. Although people with learning disabilities have conditions one would associate with pain, they are rarely referred to specialist pain services.

Questioning Clinical Practice: Exercise 4.11

Does Labelling Affect Access to Healthcare?

Endometriosis is an extremely painful condition, which affects 1 in 10 women and can occur at the onset of puberty and last until menopause. None of my colleagues can think of one woman with a learning disability having been treated for it.

Think about common elective surgical procedures.

- How often do the patients have a history of learning disability?

The benefits of people with learning disabilities accessing mainstream expertise cannot be underestimated; yet we know difficulties persist. Furthermore, they are often excluded from health promotion initiatives such as cervical screening, which raises another important issue. There is a strong argument that people with learning disabilities should be included in strategies relating to National Service Frameworks (NSF). However, as with cancer, comorbidity issues are different, and by concentrating on what is prevalent in the general population one could argue that instead of reducing inequalities, we could actually be widening the gap.

Questioning Clinical Practice: Exercise 14.12

Class Discussion

- Should people labelled with a learning disability be cared for in segregated or integrated services?
- What differences do you think it would make?

People attend clinics, surgeries, hospitals and other treatment centres for only one reason: they need some form of medical attention. This may be in the shape of therapy, investigation, medicine, surgery, screening, counselling/advice or a permutation of any of the above. It is almost certain that a nurse or allied healthcare professional will be involved somewhere along the line, and that person might be you.

People labelled with learning disability usually have their own carers, so you might feel entitled to ask why you need to get involved at all. Maintaining good health is a complex business and it frequently involves many areas of expertise; when dealing with individuals labelled with learning disability, this can get even more complicated, so some degree of inter- and intra-professional collaboration is often required.

Valuing People (DH 2001) was the first government White Paper to focus on learning disability for thirty years. As with much legislation, it was long on rhetoric but short on action. It did, however, contain some useful initiatives. Putting these into practice is often the responsibility of the community nursing teams. The focus on health in *Valuing People* has provided the impetus for community learning disability teams to further develop the process of partnership working with primary and acute care services. Mainstream health staff need to be aware of the inclusion of people labelled with learning disabilities within their services, as this is crucial to the debate on access to ordinary health services.

The strategy has emphasised that a primary role of the teams is to support access to mainstream services. More recently, the Department of Health's (2007) report *Promoting Equality* further promotes this key role as a way of 'closing the gap' of inequality for people with learning disabilities. This means in practice that learning disability nurses, and other members of the community learning disability team, work in partnership with primary and acute care services either by working on a one-to-one basis with individuals to support their understanding of their own health and so enable access to services that way, or working with the mainstream health services to develop their skills and knowledge around the health and support needs of people with learning disabilities. This is helping to provide better health outcomes for people with learning disabilities. *Valuing People* also identified health action plans and health facilitators as a way of supporting people with learning disabilities to meet their health needs. The person chooses their health facilitator who helps them to collect information about their own health and have a health screening at their GP practice.

The health facilitator does not need to be a nurse; they can be a parent, friend, support worker or key worker. However, people with more complex disabilities and medical needs may have a community learning disability nurse as their health facilitator. The facilitator then supports the person, or in the case of someone with multiple and profound disabilities, the people who know them best, to identify their health needs. They then ensure that the plan is written in a format which the person can understand. A copy of the plan is usually given to the primary care practice either with the person's consent, or for people who cannot give informed consent, by following best practice guidance, which is outlined in the Mental Capacity Act.

As well as the usual gamut of physical ailments, people labelled with learning disability are often prone to other conditions that complicate their overall health and wellbeing. In an introductory chapter it is impossible to cover all eventualities. This will, therefore, be limited to discussion of a cursory examination of two of the most common 'overlying' conditions, while introducing the concept of consent.

Mental health

People who are labelled with learning disability sometimes have overlying mental health problems. This may affect on estimate up to 30% of the population (Cole 2002). Sometimes referred to as 'dual diagnosis', this can be difficult to establish. Typically the potential for overlap between what is commonly known as 'challenging behaviour' and genuine mental health problems can be hard to untangle. Also there are difficulties in providing an accurate assessment for people living with severe learning disability and, to a lesser extent, to fit standard diagnostic criteria, although this has been addressed by the recent DC-LD (2001) which is a relatively new classificatory system designed for use with adults with learning disabilities and intended to be complementary to ICD-10 (WHO 1992).

Another problem arises from the fact that the figures may well be inflated by the inclusion of individuals who are somewhere on the autistic spectrum of disorders. Their place within mental health or learning disability services is highly contentious and represents an example of what Cole (2002) refers to as 'people falling between eligibility criteria and through the net of service provision'.

Autistic spectrum disorder

As with the sub-population of individuals labelled with learning disability and the wider population of the country, the range of ability and intelligence on display within the so-called autistic spectrum is very wide. Some few individuals living with what is sometimes called high functioning Asperger's syndrome operate at extremely high IQ levels, while those more severely affected by autism may have badly affected social competence and seriously compromised intellectual ability.

There is still no definitive cause identified. Leo Kanner in America first described what we now understand as autism in 1944. Hans Asperger in Austria in the same year described the syndrome that now bears his name. Both were thought of as two sides the same coin. It was largely the work done by Wing and Gould (1979) that eventually separated the two, conceptually at least. Wing describes a 'triad of impairments' affecting communication, interaction and imagination. While textbooks are useful, sometimes another angle is necessary to approach understanding.

Consent: The Bournewood case

It is common for a doctor or a dentist to ask carers to sign a consent form for an adult with learning disabilities. This is not legally acceptable and has no basis in law (Matthews 2003). The European Court of Human Rights had to review the case of HL *v* United Kingdom – known as the 'Bournewood' case from the institution where Mr L., a 49-year-old man with autism, was an inpatient. In summary it was agreed by all concerned that Mr L. lacked capacity to consent to treatment. Since he was not detained (under the Mental Health Act 1983) but was cared for in his own 'best interests', his legal team were able to argue that he was in effect kept in hospital in contravention of Article 5 of the European Convention on Human Rights. This has led to a change to the 2005 Mental Capacity Act. Anyone in Mr L.'s position now needs to have an independent mental capacity advocate (IMCA) to represent him or her during the assessment/treatment process. The DH website (http://www.dh.gov.uk/en/index.htm) has comprehensive coverage of the legal, ethical and clinical implications of this case for practising healthcare professionals.

Conclusion

People labelled with learning disability have the same rights as the rest of the population. That includes access to health and social care services. They have higher levels of ill health, including epilepsy and mental health problems, and many have communication difficulties. They have lower income, less secure tenure, poorer education and reduced social prospects. Very few have a proper job, and intimate personal relationships are rare. Many live in accommodation not of their choosing, and are subject to ridicule and harassment in their own local communities. A small minority are subject to physical, financial and sexual abuse from the people employed to provide their care. Like the rest of us they sometimes need to access health and social care services. As a healthcare provider you can now have a direct impact on the standard of treatment they can expect and receive.

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First aid knowledge and skills

15

Dimple Charters and Cliff Evans

Chapter 15 Learning Objectives

- Gain knowledge and insight into common injuries that would benefit from immediate first aid intervention
- Gain understanding of the professional issues involved in attending accidents
- Gain insight into several commonly used first aid techniques including dressings and bandages
- Apply relevant anatomy and physiology knowledge to clinical practice by identifying potential injury patterns
- Construct solid evidence of professional development for your growing portfolio
- Continue developing the ability to question and critique your care delivery by adding essential professional regulatory information to your practice

Applying Theory to Practice: Exercise 15.1

Do pre-registration courses prepare future nurses for emergency situations?

If your friends and family know you are a nurse, they may expect you to have more than just basic first aid skills. Many nurses feel completely lost when placed outside their normal working environment. It is therefore essential that nurses gain a solid understanding of how they can apply their generalised nursing knowledge to everyday situations.

- How has your nursing course prepared you for encountering either a minor injury in the community or an emergency situation?
- Do you feel your chosen course should include aspects of first aid?

Introduction

Possessing the underpinning theoretical knowledge and skill base to enable a rapid, but thorough, initial assessment of a potentially unwell individual, and the ability to initiate treatment, are essential skills that all student and qualified nurses require (NMC 2004). The Department of Health (DH) and the Nursing and Midwifery Council (NMC) have both published documents directed at ensuring that all healthcare professionals acquire certain fundamental skills that can be translated or adapted to multiple environments (DH 2001; NMC 2004). The NMC Code of Professional Conduct, Standards and Ethics (2004): clause 8.5 states, 'In an emergency, in or outside the work setting, you have a professional duty to provide care. The care provided would be judged against what could reasonably be expected from someone with your knowledge, skills and abilities when placed in these particular circumstances.'

First aid is the care given to a sick or injured person before professional help arrives. It can come from a member of the family, a friend, or a stranger who happens to be present. The help they give can literally mean the difference between life and death. The key aims of first aid are:

- To preserve life and limb
- To prevent the injury/injuries from becoming worse
- To promote recovery.

This list can be extended to include:

- The prevention of further injury to the individual or yourself.

The most serious of injuries can leave no apparent bleeding or potential life-threatening signs; by using a structured or methodical approach to the assessment process these types of injury can be identified and life-altering damage prevented. This is achieved by applying the airway, breathing and circulation (ABC) approach to all patient assessments.

Applying Theory to Practice: Exercise 15.2

Before reading on:

- Compose a list of common injuries you associate with requiring first aid.

Add this list to your developing portfolio. On completion of this chapter expand your developing portfolio by adding some of the many conditions contained within this chapter. This can include the immediate safety issues, the immediate assessment and your approach to maintaining both your own safety and that of the individuals you may encounter.

Applying basic life support

Basic life support (BLS) is a tried and trusted method of both assessing and, more importantly, applying basic techniques that can preserve life (RCUK 2006).

Applying Theory to Practice: Exercise 15.3

All nurses need to be proficient in the provision of BLS and this is a mandatory component of all pre-registration courses. Complete the following exercise to gain further insight and experience in this area.

Visit the Resuscitation Council (UK) website; familiarise yourself with its format and content. This site provides all the information you require!

- Identify the BLS algorithm for children; distinguish the differences between how the two age groups are treated. Why do you think there are differences?

The Resuscitation Council also provide an in-hospital approach to BLS. Familiarise yourself with this as you will certainly be performing this act sometime during your working life.
www.Resus.org.uk

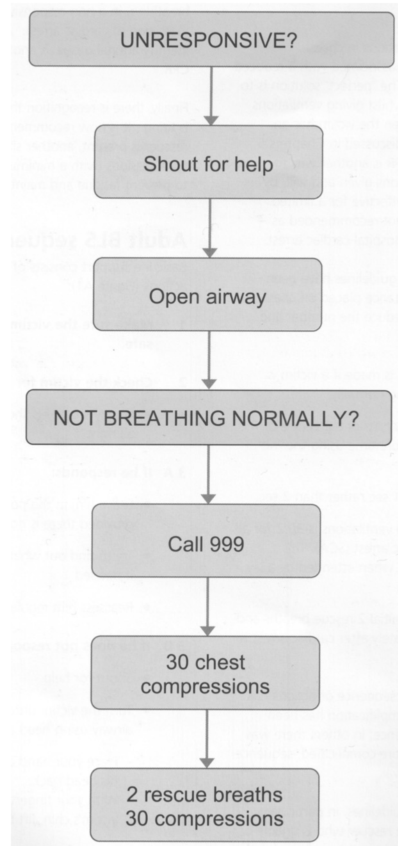

Figure 15.1 The basic life support algorithm (Source Resuscitation Council UK (2006) (Reproduced with permission)

Basic life support should consist of the following sequence of actions:

1. Make sure the casualty, any bystanders, and you are safe. When approaching any scene involving casualties the rescuers' personal safety must be your primary concern, due to two main factors: first, depending on the cause, what has affected the casualty may affect you! Secondly, many hidden dangers are faced by good Samaritans assisting those who do not appreciate help; there is also the chance of being assaulted by the casualty or other assailants. The manner in which you approach a particular incident will depend on the nature of that individual incident, although many basic principles can be universally applied. When approaching the scene of an accident or a casualty:

- Inspect for danger – ensure that injured individuals, any onlookers, and you yourself are free from any actual or potential dangers.

- Approach all situations in a calm and collected manner, thereby instilling confidence in the injured. This will also provide you with time to collect your thoughts and structure your assessment.
- Be observant, visually assess the local environment, identify the nature of the problem.
- How many injured are there?
- If there are several injured, call for help before continuing, then approach those with what appear to be serious injuries first (triage).

2. Check the casualty for a response. If the casualty does not appear alert, assess their responsiveness, or level of consciousness, by gently shaking them, simultaneously asking in a very loud manner 'Hello, can you hear me, are you all right?' This is based on the AVPU approach applied throughout this book.

3. If the casualty responds:

- Leave them where they are and ensure that no further danger is imminent.
- Ascertain what the problem is and obtain help or alert emergency services if necessary.
- Keep the casualty warm and reassure them that the emergency services are on the way.
- Continually reassess the casualty and the safety of the situation.

4. If they do NOT respond: During your initial assessment if the patient fails to respond to both verbal stimulation and shaking, you will classify them as unresponsive. You must then move immediately into the BLS algorithm (Figure 15.1).

- Shout for help.
- Turn the casualty onto their back and then open the airway using head tilt chin lift (Figure 15.2).

5. Keeping the airway open – look, listen and feel for normal breathing.

- Look for chest movement.
- Listen at the patient's mouth for breath sounds.
- Feel for air on your cheek.

Figure 15.2 The head tilt chin lift manoeuvre

Assess for normal breathing for no more than 10 seconds; if you are in any doubt whether breathing is normal, assume it is not normal.

An alert patient may still have an underpinning problem that may lead to severe **airway** compromise. Follow these next steps to quickly assess for potential compromise:

- Has the injury involved smoke inhalation or facial burns? If so, there is a significant risk of impending airway compromise. Assess the airway and nasal passages for signs of swelling, singeing or soot and if present inform the emergency services of the immediate risk to life
- Assess the patient's **breathing** using the **look**, **listen** and **feel** approach. Remember you are looking to make sure they are breathing symmetrically, with a good inspiratory depth, and that their breathing rate is within the normal parameters (Chapter 3). You are listening for signs of difficulty in either getting air into or out of their lungs. There can be many reasons for breathing difficulties, which are discussed in Chapter 3. Feeling the patient's chest can have a dual purpose: initially you can quickly identify if the chest is moving symmetrically by placing one hand on each side of the chest wall (in the rib area); secondly, you can feel for any **crepitus**, the noise or sensation that broken pieces of bone will have as you run your hand over them. The noise is a slight cracking sound: remember if identified to take a mental note of the area and do not press any harder. The casualty may want to guard the area if conscious. If no open wound is present, applying gentle pressure over the area may result in

greater lung expansion and an increase in the effectiveness of their breathing.

6. If they are breathing normally:

- Put the casualty into the recovery position (Figure 15.3).
- Send or go for help, or call an ambulance.
- Check for continued breathing.

If the casualty is breathing and you are competent to, check for a carotid pulse at the side of the neck, simultaneously look down their body for signs of life. If you cannot feel a pulse and there are no signs of life commence BLS as described below.

If the casualty is breathing and has signs of circulation, but remains unresponsive, place them in the **recovery position**. It may be fatal to leave an unresponsive person on their back as there is a serious potential that their airway will become obstructed by either soft tissues such as the tongue falling backwards, or if they vomit they will be unable to clear the vomit, resulting in **asphyxia**.

Recovery position

Kneel beside the unresponsive casualty between the hip and shoulder. Straighten out the arms and legs. With the arm closest to you at a right angle to the body and the palmar side of the hand facing up, place the casualty's other arm across the chest with the hand across the other side of the cheek. Position your hand under their knee (the leg that is away from you) bringing it up into a right-angle position. Remember to keep their hand pressed against their cheek. Support their head with your other hand ensuring that their airway is open and patent by lifting the head and tilting the chin. Grasp their opposing hip and roll them towards you. Adjust the upper leg that the hip and knee from a right angle to the body.

Figure 15.3 The recovery position

7. If they are not breathing normally:

- Ask someone to call for an ambulance or, if alone, call yourself even if you need to leave the casualty. Start chest compressions.

Delivering chest compressions

Kneel beside the patient, lean over the patient with your arms straight, place the heel of one hand on the centre of the patient's chest then place the heel of your other hand on top of the first one, keeping your fingers interlocked (Figure 15.4).

Position yourself above the patient's chest and, keeping your arms straight, press down on the sternum 4–5cm. Following each compression release all the pressure on the chest; repeat at a rate of about 100 compressions a minute (compression and release should take an equal amount of time).

Figure 15.4 Hand positioning for chest compressions

Combined chest compressions with rescue breaths

After 30 compressions open the airway using head tilt chin lift manoeuvre; pinch the patient's nose closed using the index finger and the thumb of the hand you had placed on their forehead. Take a normal breath and place your mouth around the patient's mouth ensuring there is a good seal.

Blow steadily into the mouth while watching for the patient's chest to rise. It takes about a second for the chest to rise in a similar fashion to normal breathing. This is considered as an effective rescue breath. Maintain the head tilt chin lift and remove your mouth from the patient and watch for the patient's chest to fall. Take another normal breath and give another effective rescue breath – two in total. Return your hands without delay to the correct position on the sternum and give a further 30 chest compressions. Continue with chest compressions and rescue breaths in a ratio of 30:2.

However, if the rescue breaths were not sufficient to make the chest rise, you should check the following before attempting another rescue breath:

- Check the casualty's mouth for any visible obstruction and remove it (as discussed previously).
- Reassess that the degree of head tilt chin lift is sufficient. You may need to either extend or flex the neck a small amount to fully open the airway or remove soft tissues from blocking the **oropharynx**.

Chest compression only CPR

If you would prefer not to give rescue breaths, give chest compressions only; in this instance chest compressions should be continuous at a rate of 100 per minute. Only stop to reassess the patient if they start breathing normally.

Developing and Delivering Expert Care: Box 15.1

You might be justifiably concerned about your own safety when delivering mouth-to-mouth ventilations. The Resuscitation Council UK recommends that chest compression only CPR may be administered in cases where the rescuer is unwilling to put their mouth in contact with the casualty's. Your local resuscitation officer (usually based in the acute hospitals) can provide you with a protective airway device that is sold within a key fob. This device has a one-way valve so that body fluids from the casualty cannot enter your mouth; the device is simply placed between your mouth and theirs. This device makes an excellent key ring and may prove invaluable one day.

Resuscitation should continue until:

- Further qualified help arrives
- The patient shows signs of life – reassess ABC
- The rescuer becomes exhausted.

Go back to the casualty's head and assess that the airway remains open, check breathing and again check for signs of life and a carotid pulse.

Developing and Delivering Expert Care: Box 15.2

Remember:
If You Mess, Reassess!
Meaning: if you suddenly alter the position of the casualty you may also alter their airway alignment, so always reassess and evaluate after implementing any action.

Road traffic accidents

The scene surrounding a road traffic accident can be full of actual and potential dangers: an example of an actual danger is being struck by a passing car and an example of a potential danger is an explosion due to a leaking fuel pipe. From this you can see that a quick, but thorough, examination of the surrounding area is essential. Your own safety must come first; call the emergency services and try to protect the scene from other vehicles. Approach the scene only once you have established the stability of the vehicles involved. Call out and see if there is any response from the driver or passengers (be aware that in high speed crashes occupants may have been ejected from the vehicle or there may be casualties under the vehicle). Approach the vehicle and immediately switch off any engines that are running. If there is no response from the casualty immediately apply the ABC format. Because there is a risk potential for C-spine damage the casualty's spine will need to be immobilised or stabilised at the same time as their airway is assessed; this is achieved in an unresponsive casualty slumped over the steering wheel by firmly placing one hand on either side of their neck and

Figure 15.5 Stabilising a potential C-spine injury

jaw line (Figure 15.5) and assisting them into a neutral position. Listen carefully to their airway in the neutral position for breath sounds; if absent or there are no pulse/signs of life and you are able to remove them from the vehicle do so, and commence BLS; if the casualty is breathing maintain their position until help arrives. Their level of consciousness may increase, at this time you will need to provide psychological support for them by gently reassuring them. It will be beneficial to their long-term outlook if you to build a solid rapport with them.

Do not put the patient in the recovery position if a spinal injury is suspected. Maintain their C-spine alignment until the emergency services arrive; they will immediately fully immobilise them.

Motorcycle helmets

If the casualty is wearing a protective helmet it is best to leave it in place unless you have received specific training on removal techniques. If the casualty is unconscious, they may vomit; this is the only time you will need to turn them on their side to prevent asphyxiation and possible instant death. Try to maintain C-spine alignment, although the airway clearance must come before spine immobilisation.

First aid for epilepsy/seizures

When encountering an individual experiencing a seizure many people feel unprepared to deal with the circumstance. Seizures are not only associated with long-term conditions such as epilepsy (see Chapter 5), they are also associated with significant head trauma and in children they can be a consequence of a prolonged high temperature.

In most cases of recurring seizures the National Society for Epilepsy recommend there is no need to call an ambulance (National Society for Epilepsy 2007). Most seizures occur unexpectedly and last for a short time and usually stop by themselves (self-limiting). Many seizures can be characterised into two main types: generalised seizure or partial seizure that involves a fairly short period of absence.

Medical assistance is indicated if:

- This is the person's first seizure
- The person has injured themselves during the seizure (a dislocated shoulder or a head injury are common findings)
- The casualty experiences difficulty in breathing after the seizure
- When the seizure continues with no recovery period (tonic clonic).

Characteristics of a generalised seizure	Characteristics of a partial seizure
Person may lose consciousness Body stiffens, often becomes floppy High incidence involving falls Shaking or jerky movements Breathing might be affected and there may be a blue tinge around the mouth Incontinent of urine or bowels The casualty may bite their tongue resulting in blood around the mouth	Twitching Glassy stare Disturbances in one of the senses i.e. taste, smell, hearing or vision Inappropriate responses to questions Not totally aware of their surroundings Wandering around aimlessly Smacking of lips and chewing movements Agitated and fidgeting with objects

Table 15.1 Characteristics of seizures

What to do during a generalised seizure

- Stay calm
- Try and prevent further injury
- If possible, keep a record of the length of seizure
- Try and achieve a safe, comfortable environment for the individual
- Look for any medical alert bracelets
- Do not try and restrain the casualty, consider your own safety. The casualty might be agitated or be thrashing around, try and limit the local risk potential
- Do not attempt to put anything into the casualty's mouth (including medication)
- Remember and apply the ABC approach
- If the seizure is not self-limiting, call for help or dial 999

What to do during a partial seizure

- Stay calm
- Place the casualty away from danger, but do not restrain them, as they might get upset or increase the confusion
- Stay with casualty until they become fully recovered
- Reassure the casualty

Remember that after a seizure a person is at risk of vomiting so place them in the recovery position until they are fully alert. After seizures the person will awake in a confused and disorientated frame of mind; they will require reassurance and protection during this period. Stay with the patient until they recover and become orientated, if in any doubt of their well-being call for an ambulance.

First aid for a choking casualty

Applying Theory to Practice: Exercise 15.4

- If you witness someone who finds it difficult to breathe or cough due a potential obstruction in his or her throat what would you do?

By identifying your current approach you will be directly able to see how your practice could change for the benefit of those you come into contact with by applying your newly found insight.

To initiate what could be life-saving first aid you will initially need to be able to identify the underpinning problem. This is made easy with some conditions such as cuts and grazes, slightly harder when the individual can only inform you of what they are experiencing, and, depending on your knowledge base, quite difficult when their ability to communicate is lost. According to the American College of Emergency Physicians (1992) the international distress sign for someone physically choking is clinically demonstrated by them clutching at their throat.

Treating a choking conscious patient

If the person has the ability to speak, encourage them to cough. Do not interfere with their throat but encourage the victim to continue coughing and if the foreign body if visible in their mouth remove it. However, if the patient is unable to speak and the airway is compromised the initial treatment is to give five back slaps (by hitting them firmly between the shoulder blades using the heel of the palm of your hand). The effectiveness of this procedure can be increased if you bend the casualty forward (RCUK 2006).

Check the mouth after each blow for any obvious dislodged obstruction.

If choking continues, administer five abdominal thrusts.

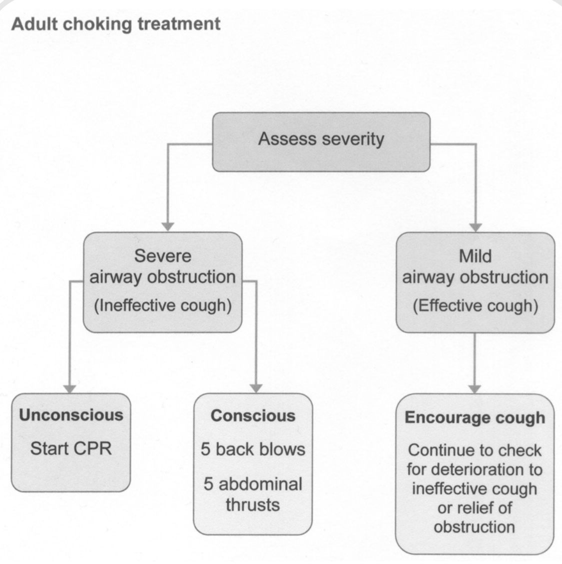

Figure 15.6 The choking algorithm (Source: Resuscitation Council UK (2006). Reproduced with permission)

stand behind the patient's waist, with a clenched fist placed just below the xiphisternum between the navel and the bottom of the breastbone; place your other hand over the clenched fist then pull inwards and upwards approximately 6–10 times alternating with the back slaps.

Complications – pregnancy/obesity

If the casualty has a misshapen anatomy due to pregnancy or severe obesity, you will need to adapt the technique for it to be safe or effective. Chest thrusts can be substituted for abdominal thrusts: place the thumb of the left fist above the middle of the casualty's breastbone, place your right hand over your fist then compress the chest approximately four times fairly quickly. Be careful to avoid the abdomen as compressing here can lead to damage of vital organs.

If the casualty becomes unconscious

- Guide them safely to the ground
- Call for help/ambulance
- Begin BLS/CPR

Eye injuries

Most eye injuries result from foreign objects or particles entering and subsequently irritating the surface of the eye (Rosenburg & Dougherty 1996). Chapter 11 explores both the anatomy and physiology of the eye; it is therefore recommended that the reader review this chapter before continuing.

Occasionally eye injuries can be dangerous or sight-threatening. Suspicious findings include:

- A sudden loss of vision
- A feeling of increasing pressure within the eye.

Problems affecting the casualty's vision may be caused by trauma to the head or the eye/eye socket; this includes retinal detachment, a serious complication.

In these scenarios the casualty should seek immediate professional care.

Corneal abrasions

A corneal abrasion is an injury or scratch involving the outer layer of the eye, usually resulting from a superficial scratch to the surface. The cornea has multiple nerve endings under the surface, which can make a corneal abrasion very painful.

Causes of corneal abrasions

Everyday activities may lead to corneal abrasions, common causes include playing sports, rubbing or directly scratching an eye (children are frequently implicated), prolonged application of contact lenses and exposure to ultraviolet light from sun lamps or welding arcs which can result in damage to the corneal structure and should be treated as a burn injury to the eye.

Signs and symptoms

- The feeling of sand in the eye
- Blurred vision or distortion of vision
- Increased sensitivity
- Redness around the eye
- Increased watering of the affected eye
- There may be a sensation that there is something in the eye but the casualty cannot get it out.

Immediate treatment

Use clean water or a saline solution to immediately wash the eye out (irrigation). Encourage the casualty to repeatedly blink as this natural defence mechanism will remove any small dust or sand particles that might be causing irritation and damage. Gently extend the upper eyelid over the lower lid as the eyelashes can brush and remove foreign bodies from the under-surface of the eyelid.

If a foreign body appears embedded within the eye, or if the mechanism of injury suggests a high impact such as industrial injuries involving metal filings etc., do not try and remove the particle; immediately seek medical assistance. If the particle is visible, to provide stabilisation and further protection surround the particle with a rigid shield without applying pressure or keep the eye closed and seek medical assistance.

If chemicals are involved, irrigate the eye vigorously holding the eye open, call assistance and get the casualty to hospital as soon as possible.

Wounds

An accurate and quantitative assessment of a chronic or acute wound is essential to the initiation of appropriate and effective treatment. There are many types of injury that can result in damage to the skin's integrity. Remember this also means that bacteria have an entry point for colonisation, therefore all wounds have the potential for infection.

Scenario 15.1

Minor Injuries

You are out on a Sunday afternoon in the park with a friend and her 8-year-old son, when he suddenly falls and grazes his knee. He has not sustained a head injury and is crying and holding his knee. On inspection you note superficial skin loss to the wound and slight bleeding.

- What would you do?

Applying Theory to Practice: Exercise 15.5

There are various terms used to describe wounds. Read the following terms and see what your current understanding of them is by writing a short description of each.

- Abrasion
- Incision
- Puncture
- Laceration
- Avulsion
- Amputation

Compare your answers to the following section; add your findings to your portfolio for direct evidence of your new understanding.

To appreciate the potential hazards related to what are commonly termed minor injuries you will need to have an understanding of the structures involved; Figure 15.7 identifies the skin and its superficial structures and components. Chapter 8 discusses deeper structures, which should also be considered.

Abrasions are classified as a superficial injury where the epidermis is wounded from a rubbing or frictional type injury occurring against its soft outer surface. The wound can be linear in nature described as a 'scratch'. If the border is involved, for example, if a cyclist has fallen from his pushbike and skidded across the tarmac, this is described as a 'graze'. Most commonly affected areas are the elbows and knees; the resulting wounds are generally

Figure 15.8 Superficial abrasion injury

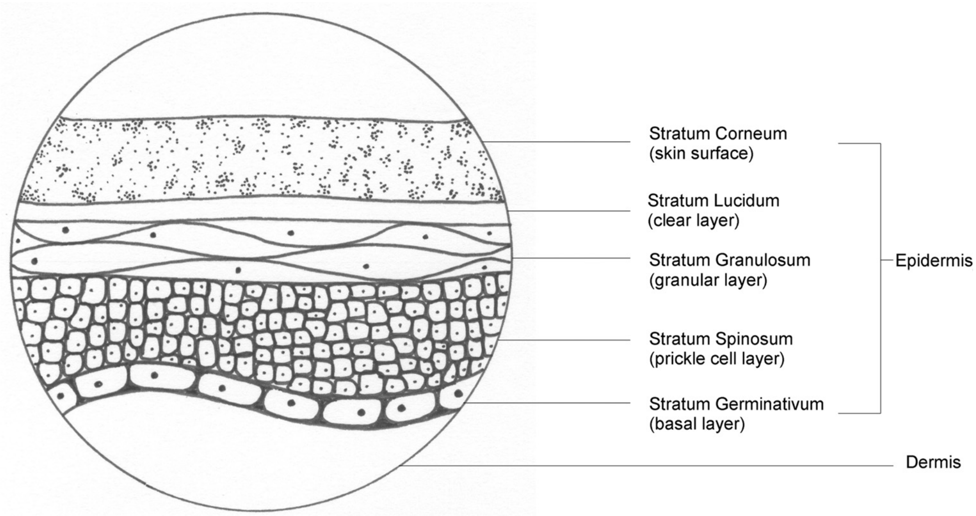

Figure 15.7 The skin

Figure 15.9 Incisional injury

Figure 15.11 Skin laceration

superficial although an extreme version of a graze is a degloving injury in which enough force was applied to the skin that it results in the skin being forced away from its underlying attachments.

Incisional wounds are normally smooth-edged and associated with knives or as a result of broken glass. The potential damage varies dependent on the size and depth of the incision and the exact position of the entry. Stab wounds can be classically deceiving to the inexperienced eye as the length or depth of the injury might look superficial due the muscle and skin contractility close to the wound which often obscures the actual size and extent of the wound.

Figure 15.10 Puncture wound

Puncture wounds result from a sharp, piercing object that goes through the both the epidermis and dermis. This type of injury can result in life-threatening internal damage when deeper structures or organs are involved. Puncture wounds are generally sustained from animal/human bites, nail punctures, splinters. Animal, and in particular, human bites are prone to high rates of infection. It is therefore essential to seek medical assistance for both antibiotic and tetanus prophylaxis.

Lacerations are commonly referred to as 'cuts' or 'gashes' affecting the skin. They commonly have jagged, irregular edges. Lacerations commonly occur over bony structures such as the eyebrows and knees. Lacerations can result from sharp objects or blunt trauma involving the various layers of the skin. They commonly bleed profusely.

Avulsions result in a noticeable absence of tissue, rapid bleeding and can involve a large surface area depending on the mechanism of injury.

Amputations can occur when a body part such as a toe or finger are partially or completely cut off.

Initial treatment/first aid

- Stop or control any bleeding/haemorrhage
- Prevent contamination i.e. clean and cover/dress the wound to avoid further infection potential
- Be aware that further medical assistance may be needed if the patient is demonstrating signs of haemodynamic compromise or if the mechanism of injury is significant.

Applying Theory to Practice: Box 15.3

Clinical Signs of Haemodynamic Collapse

When confronted by a casualty who is potentially seriously ill, regardless of the setting, a nurse is expected to make a quick but factual assessment of the casualty's circulation.

Many ways exist to assess circulation, the last tool you require is a DINAMAP!

These signs include:

- Increased respiratory rate and depth
- Absent or weak radial pulse
- Prolonged capillary refill time (CRT)
- Decreased level of consciousness
- Sweaty/clammy appearance
- Pale, cyanosed or mottled appearance.

Radial pulses provide an excellent indication of the patient's circulation.

Once the blood pressure has fallen to <90mmHg, the radial pulse will become progressively weaker until it is lost (Evans & Tippins 2007).

How to control bleeding

Apply direct pressure over the wound with a dressing or improvise by using material with a clean absorbent substance e.g. a rag, towel or piece of clothing. In the case of amputation, wrap the affected area in wet gauze and if possible seal in a bag with water and ice. This needs urgent medical attention.

Do not remove the bandage if the bleeding seeps through the dressing. Apply a new dressing over the previous dressing, ensuring the bleeding wound is not disturbed thereby allowing it to stop bleeding and for any clot formation not to be dislodged.

Frequently check the bandage and the circulation of the patient as it may become too tight due to swelling. Check the circulation distal to the wound by either using the CRT or if possible palpating the pulse.

If the wound is on the arm or leg and there is no suspicion of an underlying fracture, the limb should be elevated above the level of the patient's heart while direct pressure is maintained. Elevation of the wound allows gravity to reduce the flow of blood to the area.

Reassure the casualty.

If the bleeding is continuous and uncontrollable, try applying pressure over the major artery that is supplying the limb. Try and immobilise the injured part and get medical attention; if necessary call 999.

Direct pressure should not be applied if there is a:

- Protruding bone
- Potential skull fracture
- Embedded object.

Dressing of a minor wound

Once the bleeding has stopped, the wound should be cleaned and dressed to prevent infection.

Clean the area with normal tap water ensuring that the water flow is directed away from the wound.

Once the wound is cleaned and dried apply a bandage, monitor the site in case bleeding recommences. If the casualty requires no further treatment remind them to see their GP for advice on tetanus vaccination.

Types of dressing

- Gauze impregnated with petroleum jelly to aid moisture and subsequently wound healing
- Adhesive strips i.e. traditional plasters
- Non-adherent dressings
- Foams (very absorbent)
- Alginates i.e. kaltostat seaweed-based highly absorbent dressings
- Carbon-infiltrated dressings
- Hydrogels
- Hydrocolloids i.e. Duoderm, Granuflex, which promote debridement and healing.
- Transparent adhesive films/semipermeable films i.e. Biocclusive, Tegaderm that provide the ability to visualise the wound.

To aid wound closure Steristrips or tissue glue can be applied to a wound that has stopped bleeding and that has been cleaned.

Slings

The sling is probably one of the most useful pieces of equipment in first aid, with the aim of providing localised support and reducing further damage and pain. Slings are multipurpose:

- Broad arm sling
- High arm sling
- Also can be used in innovative ways: the army use improvised slings for battlefield first aid dressings that can be adapted to suit almost every circumstance

Broad arm slings are normally used in arm (wrist/elbow) injuries and can be applied to support the arm if the casualty has a suspected fracture of the clavicle (collarbone).

Application of a broad arm sling

1. Place the sling on the casualty's chest on the injured side with the shortest corner under the elbow and one point over the injured shoulder
2. Place the casualty's arm across their waist at 90 degrees
3. Bring the third end of the sling over to the uninjured side/shoulder
4. Tie at the back of the neck in a reef knot (avoiding catching hair or skin)
5. Finally fold the corner piece over the elbow and secure it with a pin or tie a small knot

Figure 15.12 Application of a broad arm sling

High arm slings provide elevation to facilitate haemostasis and the reduction of swelling. High arm slings will also provide support for the hand and forearm.

Application of a high arm sling

1. Assist the casualty to bend the injured arm and place it on the uninjured/opposing shoulder
2. Place the sling on top of the injured arm with the shortest corner over the elbow and one point at the uninjured shoulder
3. The free side/point of the sling is brought under the elbow to the side of the body and tie a knot across the back
4. Finally fold the piece over the elbow and secure it with a pin or tie a small knot

Figure 15.13 Application of a high arm sling

Splinting

The use of a sling in splinting a limb is a temporary measure and when properly applied it can aid in the immobilisation of a fracture, thereby reducing the potential for further blood loss, shearing of internal vessels or nerve damage. Immobilising an injured area will also provide pain relief.

First aid for nosebleeding (epistaxis)

Nosebleeds often appear frightening for both sufferer and onlooker. Many nosebleeds look much worse than they really are. The application of basic first aid skills can prevent casualties requiring further medical attention.

Most nosebleeds originate from the anterior of the nose, where the vessels sit close to the surface (Evans 2005). However, some bleeds originate from the posterior of the nose; this involves larger vessels and is usually associated with older people (Corry 2005). Atherosclerosis and high blood pressure are predisposing factors. Nosebleeds originating in the posterior vessels are notoriously difficult to stop and may require further medical attention.

Causes of nosebleeds

- Nose-picking (epistaxis digitorum)
- Blowing the nose with force
- Dryness
- Use of medication e.g. aspirin, anticoagulants
- Injuries
- Allergies
- Introduction of foreign objects, most common in children
- High blood pressure
- Atherosclerosis
- Blood clotting disorders
- Use of cocaine or other inhaled drugs (amphetamines)

For most nosebleeds the application of simple first aid can usually stop the bleeding.

Applying first aid

- Regardless of the amount of blood loss, stay calm
- Sit with the casualty and loosen any tight clothing around their neck
- Assist the casualty in tilting their head slightly forward, encouraging the casualty to breathe through their mouth
- If the casualty is able to, assist them to apply their thumb and index finger over the soft portion of the nose (just under the bridge; if you apply pressure too low it will fail to be effective), and firmly squeeze the nostrils together
- Apply this pressure for at least 10 minutes; this is essential as every time you remove the localised pressure and assess for bleeding the newly formed clot may dislodge and the casualty is in the same situation as you found them. Resisting the temptation to look can prove difficult for both the rescuer and casualty
- Reassess after 10 minutes. If the bleeding does not stop continue to apply pressure for a further 10 minutes and if available apply an ice pack across the bridge of the nose or to the back of the neck. Be careful not to burn the skin.

If the bleeding stops, advise them to avoid blowing their nose for a couple of hours, avoid hot drinks and avoid picking the nose.

If the patient feels faint, lay them in the recovery position and elevate the legs if necessary. Remember to continually assess and reassess their haemodynamic status: by monitoring their respiratory rate, radial pulse, and CRT. The casualty's colour will also show obvious signs of deterioration.

If the bleeding continues for more than 20 minutes or as a result of an accident, injury to the head, or a punch to the face, seek urgent medical attention.

If this is a recurring problem, encourage the casualty to make an appointment with their general practitioner and possible follow-up in a specialist clinic with the ENT (ears, nose and throat) specialist.

Tips on preventing further nosebleeds

- Keep the nostrils moist, for example, in the winter by use of a cool mist vaporiser or humidifier in the bedroom
- Apply petroleum jelly or other nasal lubricant inside the nostril
- Avoid picking the nose
- Open the mouth when sneezing, blow gently one side at a time; this will reduce localised pressure

Assessing and managing burn injuries

According to the National Burn Care Review in 2001, in the UK it is estimated that around 250,000 people experience burn injuries annually. The causes vary and include hot surfaces and fluids, electrical sources,

Applying Theory to Practice: Exercise 15.6

Burn injuries can result in varying degrees of damage.

How do you think these are classified?

Figure 15.14 Superficial burn

Figure 15.15 Partial thickness burn to right foot

chemicals and flames. Approximately 90% of these injuries can be safely treated in a primary care setting; however, there will be times when the individual will require hospitalisation and specialist treatment, due to the severe effect burn injuries can have on the individual (National

Depth of burn	**Skin structures involved**	**Key signs**	**Healing information**
Superficial: i.e. sunburn, minor scalds Superficial dermal/ partial thickness: (often a scald injury) Deep dermal partial thickness: (usually caused by hot liquids, steam, flames) Subdermal full thickness: over a limited area (hot oil, hot materials) Full thickness: over an extensive area	Epidermis Epidermis and superficial dermis (papillary layer) Epidermis, deep dermis, including the superficial parts of hair follicles, sweat and sebaceous glands Epidermis and dermis both destroyed. In cases of chemical and electrical involvement the subcutaneous tissues and deeper structures can be involved Epidermis and dermis	Erythema, painful Absence of blisters, skin is dry and intact Painful, red and mottled in appearance, swelling and blistered areas, may have weeping, hypersensitivity to air May be painful but generally areas are insensitive. Exposed dermis white/yellowish creamy, does not blanch, no capillary refill Painless, no capillary refill, generally dry May appear dark (charred), grey, cherry red, leathery, waxy white (which might be mistaken for unburnt skin)	Not life-threatening, no obvious scarring, heals within a few days Should heal within 2–3 weeks if there is no infection, pressure or trauma within or on the wound. May experience hypo/ hyperpigmentation depending on the remaining intact melanocytes Any period from 3–8 weeks for healing with variable degrees of scarring. Surgical intervention may be required to maximise healing and a functional recovery Requires surgical repair and skin grafting

Table 15.2 Burn injury classifications

Figure 15.16 Varying depths of burn
(Reproduced with permission of Dr. Adel Aulaqi).

Burn Care Review 2001). When sustaining a serious burn, failing to seek specialist assistance can result in a reduced function of an affected limb, increased scarring of facial injuries and infection-related problems due to the loss of the skin's integument (Chapter 10).

This section provides the reader with an in-depth knowledge of the immediate treatment of burn injuries, but it is paramount that expert assistance is sought as soon as possible for burns that result in more than superficial skin damage.

According to the National Burn Care Review report (2001), of the 175,000 people that attended accident and emergency departments annually, 13,000 were admitted for further hospital treatment.

What is a minor burn?

There are a variety of definitions which describe a minor burn or scald injury, the most commonly used definition of a minor burn is a superficial burn involving less than 5% total body service area (TBSA) in adults (Fowler 1998).

Depth of the burn

In the past burns were described as first, second and third degree. However, this terminology leaves the definition open to a great deal of potential subjectivity on the assessor's part and therefore practically unreliable. It is therefore commonplace within emergency care in the UK to describe burns by the extent of visible damage (Evans & Tippins 2007). This classification scale provides a basic descriptive tool that can be used to quickly establish the amount and severity of damage following an injury. The classification of a burn is not a life-saving act; remember ABC. Identifying the depth of damage can be undertaken after the initial assessment, i.e. ABC and secondary assessment of the casualty including an in-depth examination of patient, history of the burn/incident, cause of the burn and the first aid treatment delivered.

The severity of the burn is also judged by the amount of total body surface area (TBSA) involved. Healthcare workers commonly use the Wallace (1951) rule of nines to determine the percentage of TBSA affected. For a more detailed calculation of the burn size, the Lund & Bowder chart (1944) can also be used.

Alternatively one of the casualty's palmar surfaces with fingers closed can be used to provide a crude estimation of approximately 1% of their TBSA. This is useful for quick and early assessment of a casualty who has sustained small and multiple burns over their body (Mertens et al. 1997).

Treating burns

The initial first aid for a burn injury can be essential to the long-term prognosis. An easy to remember acronym will be applied to the initial management for burns to aid consistency in the early and essential treatment phase:

Applying Theory to Practice: Box 15.4

The Rule of Nines

Age	Adult	Child
Head	9%	18%
Chest	18%	18%
Back	18%	18%
Arm	9%	9%
Leg	18%	13.5%
Groin	1%	1%
Total	100%	100%

SCALD
Stopping the burning process
Cooling the burn
Analgesia
Last tetanus
Dressing the burn

Stopping the burning process

Remove the casualty from the heat source. If in flames the affected area should be submerged in water, or rolled on the ground to smother the flames. This can also be achieved with a blanket or coat. In the event of an electrical burn turn the electricity off at the mains before assisting the casualty. If the casualty is still in contact with a live source of electricity, call for assistance and avoid touching them, as you may well become the next casualty. Clothing should be removed as it is a source of heat and the burning process can continue, but do not remove clothing if the burns are extensive and if the material is adherent to the skin, e.g. nylon, as this could exacerbate the injury. Submerge the affected area in water. The rescuer should ensure that they do not jeopardise their own safety.

Cooling the burn

It is suggested that the affected area be cooled for a minimum of 20 minutes. This cooling process eliminates the heat and prevents further damage to the tissues. It should be noted that very cold water or the use of ice should not be used as it causes vasoconstriction with the likelihood of further tissue damage or burn progression (remember ice can burn!). Special attention should be taken when cooling large areas as this can lead to hypothermia. Recommendations vary with regard to the water temperature. Mccormack et al. (2003) suggest that temperatures between 5 and 25 degrees Celsius have been proven to be the most effective method of cooling burn wounds. Chemical burns should be treated as a normal burn, but in addition to normal treatment they may require copious amounts of irrigation to remove the offending particles (this is particularly evident in alkaline injuries involving the eyes). The exception to this rule is electrical burn injuries, where an electrical source has travelled through the body and out of an exit point. This is an interesting phenomenon as an electrical burn to the shoulder may exit at the foot resulting in internal damage to both areas.

Analgesia

In major burns with moderate to severe pain opioids are indicated for the initial pain control, but with superficial or mild burns effective first aid in the form of cooling may bring instant relief. NSAIDs such an ibuprofen or combination drugs involving paracetamol and codeine may be effective (all of which are easy to obtain).

Last tetanus booster

Check tetanus immunisation status for casualties sustaining burns, particularly those who originate from outside the UK, as they may not have had childhood immunisation.

Dressings

Initially wrap the burn with cling film or a clean plastic bag as it is non-adherent, water-resistant, keeps the wound clean, prevents air flow over the skin and is translucent for further examination. Cling film should be applied in layers to prevent a tourniquet effect. Many different nationalities have traditional remedies for burns; many involve applying toothpaste to the burnt area. Avoid putting anything on the wound other than water.

Overview: putting theory into practice

The collapsed adult or child

Although this book is directed at students undertaking the adult branch or specialty of nursing, frequent encounters requiring the provision of first aid may include children and pregnant women. This may appear daunting to the inexperienced practitioner, but, by employing a solid structure to your assessment of the situation and the individual's needs, you can and will be competent and confident to assist and potentially deliver life-saving assistance to all casualties.

What can cause a person to suddenly collapse?

The previous chapters in this book have identified many conditions or illnesses that could lead to a person collapsing. The intention of this chapter is not to make a diagnosis but to manage the care of an individual outside the protective atmosphere of modern hospitals.

The assessment process

- **A**: Airway and C-spine immobilisation
- **B**: Breathing and ventilatory support
- **C**: Circulation and haemorrhage control

- **D**: Disability and neurological assessment
- **E**: Exposure (assess full body for potential injuries) and environment (temperature control)

Recognition of airway and breathing difficulties

Look: Airway obstruction – foreign bodies within the mouth (including blood and vomit); soft tissues such as the tongue can also obstruct the airway. Count the respiratory rate; look for an increased respiratory rate although bradypnoea may develop as a preterminal sign. See if the patient is using the accessory muscles of respiration. Sweating and a clammy appearance may also be present. Hypoxic patients often become agitated and confused, this progressive state continues with the patient becoming drowsy and eventually unconscious.

Listen: For any of the following:

- Gurgling: Presence of liquid in the upper airway
- Snoring: Obstruction of the pharynx by the soft tissues or tongue
- Crowing: Laryngeal spasm
- Stridor: Upper airway obstruction (i.e. choking)
- Wheeze: Lower airway collapse during expiration; a silent chest can indicate complete airway obstruction or severe respiratory failure.

Identify if the patient can complete a sentence without stopping to gasp air.

Feel: Air movement at the mouth, adequate chest rise and fall (this can be assessed by assisting the patient to sit up). Ascertain if the patient is excessively hot (sepsis/infection) or cold (sepsis/hypothermia).

Recognition of circulatory failure

- Pale and sweaty in appearance, possible decrease in level of consciousness
- Pulse rate/rhythm/depth; tachycardia can indicate compensation although extreme bradycardia can also lead to haemodynamic collapse
- A weak barely palpable pulse when combined with blood loss is a bad sign
- Reduced capillary refill time
- Cold clammy limbs may indicate physiological shock development

Conclusion

As a trained nurse you have a duty of care and are required to assist those in need even when off duty. By gaining insight into some of the simple techniques in this chapter you may save a life one day or genuinely make a difference to someone's life. Assessment of immediate physiological needs, reassurance and the use of the recovery position are all essential first aid skills. The number one intervention remains assisting the patient to breathe when they have a reduced level of consciousness; this straightforward skill is simply put – life-saving. Always remember your own safety and when in doubt call for immediate assistance; this is what is minimally required within the NMC's Code of Conduct (NMC 2004). Possessing first aid skills can be extremely rewarding particularly when dealing with members of your own family or friends.

Chapter 15 Summary Quiz

1. What are the key aims of first aid?

A. To preserve life and limb
B. To prevent injury/injuries from becoming worse
C. All answers are correct
D. The prevention of further injury to the individual or yourself

2. What is the correct order of approach to patient assessments?

A. Breathing, Airway, Circulation
B. Airway, Breathing, Circulation
C. Circulation, Breathing, Airway
D. Breathing, Circulation, Airway

3. List three possible scenarios where medical assistance is indicated in an epileptic fit:

A. Their first seizure (ABC)
B. They have injured themselves during seizure i.e. dislocated shoulder, head injury
C. The person experiences difficulty in breathing after the seizure, compromised airway
D. When the seizure affects a known epileptic and is self-limiting

4. Which of the following is a characteristic of a partial seizure?

A. A high incidence of a fall
B. Shaking or jerky movements
C. A glassy stare
D. Incontinent of urine and bowels

5. What is the international distress sign for someone choking?

6. You are out at a restaurant when a person at the next table starts coughing and clutching his throat. They are able to speak to you. What would be your initial treatment?

A. Give 5 abdominal thrusts
B. Give the person something to drink
C. Stay calm, continue to speak to the person and encourage them to cough. If any foreign body is visible remove it
D. Give 5 backslaps

7. Which of the following is not associated with corneal abrasions?

A. Playing sport
B. Rubbing or directly scratching the eye (children are frequently indicated)
C. Prolonged application of contact lenses
D. Swimming without goggles

8. Which of the following best describes the following: 'a superficial injury where the epidermis is wounded from rubbing or friction against the outer surface'?

A. Abrasion
B. Avulsion
C. Laceration
D. Puncture

9. A patient presents to an A&E department after spilling hot coffee on their hand. It is very painful and there is erythema but no loss of skin. How would you best describe the burn?

A. Subdermal/partial thickness
B. Superficial
C. Full thickness
D. Second degree

10. List three common causes of nosebleeds/epistaxis.

A. Nose picking
B. Blowing the nose with force
C. High blood pressure
D. Anaphylaxis

Further reading

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Historical

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16

Pharmacology and drug calculations

Andrew Frazer

Chapter 16 Learning Objectives

- Gain understanding of what is meant by the terms pharmacology, pharmacodynamics and pharmacokinetics
- Learn about the stages of absorption, distribution, metabolism and excretion of medication
- Understand the importance of careful prescribing for older patients
- Understand the importance of patient education and concordance in provision of medications
- Define an adverse drug event and learn how to avoid them
- Learn how to deliver medication safely through a variety of routes
- Learn about the major classes of drugs, with some specific examples
- Apply theory to practice by performing drug calculations related to specific medications and patients

Introduction

A large percentage of a qualified nurse's time is spent in dispensing medication and related information and advice. A sound knowledge base is required if potentially catastrophic errors are to be avoided, and medication is to have the desired effect.

A chapter of this length cannot hope to provide a comprehensive introduction to all classes of medication, but it will offer indications for further study in the practice area, and provide the basic principles for the safe provision of medication to patients.

An understanding of pharmacology requires consideration of the concepts of **pharmacokinetics** and **pharmacodynamics**. These appear to be complex terms, but are relatively simple concepts, and should be understood by anyone giving a potentially toxic substance to a patient. The potential toxicity of all medications may lead to an adverse drug event (ADE), particularly in elderly patients. Potential sources of ADEs will be examined, and strategies outlined to protect against them.

Errors in drug calculations are the cause of many ADEs, and methods of calculation, along with practical examples, will be provided to ensure the reader can effectively and safely calculate medication doses in practice.

Definitions

Pharmacology derives from the Greek *pharmakos* (drug) and *logos* (science). It is concerned with the study of how a substance interacts with an organism to produce a change. We tend to consider only pharmaceuticals (substances with medicinal properties) in relation to pharmacology, but foodstuffs may also have important effects on the organism, and are also studied pharmacologically. We may give drugs for a number of reasons, for diagnostic purposes, for prophylaxis, or for a therapeutic effect. The central concepts in pharmacology are pharmacokinetics and pharmacodynamics.

Pharmacokinetics is concerned with the study of the effects of the body on the drug, including absorption, distribution, metabolism and excretion. Pharmacodynamics, on the other hand, is concerned with the study of the effects of the drug on the body, including effective doses and response.

Absorption begins once the drug accesses the body (through the many potential routes, including oral ingestion, topical administration, intravenous injection, etc.). The rate and method of absorption affect the **bioavailability** of the drug (how much of the drug reaches its intended target, and how quickly it does so). Absorption is affected by the physical properties of the drug itself (capsule, tablet or liquid form), as well as by the physiology of the person taking the drug (e.g. how long it takes the drug to move through the digestive tract). If the drug is released too swiftly, an excessive response may occur due to high blood levels. If it is released too slowly, it may be eliminated in the faeces prior to being absorbed.

Manufacturers formulate medications to ensure specific drugs are released at the rate calculated to maximise effective absorption. This may entail delivering the drug in a capsule, which will rapidly dissolve, or in an injectable form when the drug may not survive the acidity of the stomach. An enteric coat may be provided, to protect the drug from the stomach's acidity, or the stomach itself from the harmful effect of the drug. These drugs are absorbed in the small intestine.

Crushing medications (for example, to allow them to be passed down a nasogastric tube); should only be undertaken where it can be confirmed that it is acceptable. This could fundamentally affect the absorption of the drug, particularly in the case of modified or slow release medications, which are designed to release a steady drug level over 12 or 24 hours. A large toxic dose may be provided if you crush such a tablet. If you are considering crushing a tablet, you should establish if a liquid formulation is available – this will be preferable.

Anatomy and Physiology in Action: Exercise 16.1

Examine the anatomy and physiology of the gastrointestinal tract, and consider how alterations in its function may affect drug absorption – particularly in relation to diarrhoea, ingestion of high fibre foods, or surgical removal of parts of the GI tract.

Once the drug has accessed the body, it will generally be absorbed via passive diffusion across a cell membrane (the only exceptions to this being inhaled and intravenous medication).

Once absorption has begun to occur, and the drug enters the bloodstream, **distribution** of the drug can take place. The rate at which the drug is delivered (and the amount of drug) are determined by the rate and quantity of blood perfusing the part of the anatomy targeted. There are a number of other factors which impact on drug distribution. Water-soluble drugs remain within the blood and interstitial spaces, whereas fat-soluble drugs (lipophilic) cross cell membranes more easily.

Drugs may bind to plasma proteins within the bloodstream, being released when the plasma concentration (of 'free' drug) falls. The protein-bound portion is generally inactive, and therefore provides an effective reservoir of the drug, which is released as the level of free drug in the plasma decreases. Problems arise with this system when a drug displaces another drug by preferentially binding with its protein sites e.g. verapamil displaces digoxin from its protein binding sites, releasing the free drug into the bloodstream with potentially toxic effect.

Applying Theory to Practice: Exercise 16.2

Warfarin is heavily bound to plasma proteins (99%), but is displaced by a number of drugs (and foodstuffs). Obtain a copy of the *British National Formulary* (BNF), and examine warfarin in the appendix on interactions.

Consider how knowledge of these interactions will affect the advice you provide to patients on warfarin.

Metabolism of a drug involves chemical alteration of the drug by the body into a metabolite. The body will attempt to metabolise what it sees as a potential toxin as fast as it can. This generally occurs in the liver, and can either activate or deactivate the drug – some drugs (termed prodrugs) are given as inactive substances, which are then metabolised into an active form. A group of enzymes termed the cytochrome P-450 enzymes are primarily responsible for drug metabolism in the liver. This can lead to problems where several drugs compete for levels of the enzyme. Where one drug inhibits the enzyme-mediated metabolism of another drug (which would normally render it inactive), the second drug may accumulate to a toxic level. There are naturally occurring substances, which affect the P-450 enzymes, including grapefruit – patients

Applying Theory to Practice: Exercise 16.3

Look up grapefruit juice in the interaction section of the BNF.

Consider how you will obtain information on your patient's diet, and what advice you will need to provide for patients on vulnerable medication.

While you are there, look up dairy products and alcohol too.

should be advised not to take grapefruit juice if they are taking some medications.

A drug will be metabolised prior to excretion, which generally helps to make it more water-soluble, enabling elimination via the kidneys. Elimination refers to the removal of the drug from the body. Some drugs are excreted in sweat, saliva, breast milk, and in the case of inhaled anaesthetic agents, exhaled air.

Some drugs are excreted unchanged in bile, which then enters the gastrointestinal tract. The drug is then excreted in faeces, or reabsorbed and 'recycled'. This explains why such a low dose of oestrogen may be used for the oral contraceptive pill, as it is constantly recycled. Any diarrhoea may reduce this enterohepatic cycling, rendering the contraceptive pill ineffective. Women should be advised when taking antibiotics (which may cause diarrhoea through alterations in the natural gut flora) to take additional contraceptive precautions while on the antibiotics, and for one week afterwards.

The primary route for excretion is the kidney, however. Elimination via the kidneys is affected by urine flow, the rate of blood flow through the kidney, and the health of the kidneys. Patients with hypertension, diabetes, or recurrent kidney infections may have impaired ability to eliminate drugs, and will require a dose reduction. Kidney function decreases with age – a person aged 70 will have only 50% of the renal function they had at 30. This is one of the reasons why great care must be taken in prescribing for the older patient.

Drugs and the older patient

Elderly patients have a higher level of chronic disease than other patients – by their seventies, three out of four patients will have at least one chronic disease. They may be subject to polypharmacy (treatment with a number of drugs for a number of conditions), and are often given drugs to counteract the side-effects of other medications. The ability of elderly patients to eliminate drug metabolites may be significantly reduced due to poor hepatic or renal function, or in acute illness. Age-related changes affect all four pharmacokinetic stages:

- Absorption is affected in most routes of administration. Transdermal patches may not be as effective in patients with poor circulation. Increased gastric acidity, reduced intestinal motility and delayed gastric emptying may all serve to reduce the effective absorption of oral medications in the elderly patient.
- Distribution of drugs may be significantly altered in elderly patients. Altered body composition (an increase in body fat, decrease in lean muscle mass and decrease in total body water) may mean that hydrophilic drugs (such as digoxin, which normally distributes through lean body mass) may accumulate in the circulation, exceeding therapeutic levels. Lipophilic drugs, on the other hand, are stored in the larger fat tissues in the elderly patient, resulting in reduced clearance and potentially prolonged effect (e.g. benzodiazepines). Poor nutrition can reduce serum albumin levels, resulting in less protein binding, causing higher than normal levels of 'free' drug in the circulation, potentially producing undesirable effects (remember that warfarin is 99% protein bound).
- Metabolism of drugs is significantly affected by the relative health of the liver. Decline in function in the hepatic system associated with ageing may cause altered metabolism – a typical 65-year-old patient has an almost 50% reduction in hepatic blood flow compared to a 25-year-old.
- Elimination is affected by the relative health of the kidneys. A natural decline in function may be exacerbated by concomitant diseases such as hypertension and urinary tract infection.

Applying Theory to Practice: Exercise 16.4

Review the medication for a patient over 65: find a patient on five or more drugs – check the BNF to establish what they are for, and whether there are any interactions between them. Then check the appendices in the BNF on liver disease and renal impairment.

Add the findings to your portfolio.

Most doctors are aware of the dangers of overprescribing in the elderly patient, but it may be unavoidable in patients with several co-existing conditions, which require treatment. The fact that 27% of all reported adverse drug events happen in elderly patients, and 10–12% of emergency hospital admissions in the over-70s are caused by prescribed drugs (McGavock 2005), mean that special care must be taken to ensure that patients know how to take their drugs correctly, and have the physical and mental capacity to do so. Nurses are perhaps best placed to ensure this understanding prior to the patient's discharge from hospital, or while caring for the patient in the community.

Elderly patients may have difficulty in swallowing, possibly leading to tablets dissolving in the mouth and causing ulceration. They should be advised to take their tablets with plenty of fluid. Frail or confused patients require supervision of medication, and the district nursing service may need to be mobilised to ensure that appropriate medication is taken at the right time. If patients have carers or relatives and are happy to have their medication discussed with them, this may help to ensure concordance with a medication regime.

Concordance implies an agreement to the regime by the patient; 'compliance' (which was the word previously used when discussing patients and medication) means agreeing to do what you are told. Patients are far more likely to take their medication if they understand what it is for, what the side-effects might be, and what the relative risk/benefit of the drug is to them as an individual. Investing some time in personalised drug education will ensure the patient understands why they are taking the drug, improving concordance, and efficacy of the treatment (Ryan & Chambers 2000).

Applying Theory to Practice: Exercise 16.5

Find several patients on five or more medications. For each drug, ask the patient:

- What they are for
- How they work
- What the potential side effects might be.

Devise a short education programme for each patient.

Ensuring that a patient is fully educated may help to reduce adverse drug events (ADEs). While drug interactions may cause an ADE (and the risk increases with each new drug the patient takes), we can minimise the risks to the patient by taking some elementary precautions. Ensuring that we know *all* the drugs that a patient is taking will help us to reduce potential ADEs. Asking a patient what medications they take may elicit only a list of prescription medications from their GP. You must ask specific questions in addition, including:

- Do you take any herbal medication? (Patients on St John's Wort significantly alter the cytochrome P-450 activity of the liver.)
- Do you take any recreational drugs, including alcohol?
- Do you take any other drugs? (Patients occasionally self-medicate with their partner's medication!)

Apart from drug interactions, a major source of ADEs, and one that is particularly important to nurses, is 'medication error'.

Perhaps the best available definition of a medication error comes from the National Coordinating Council for Medication Error Reporting and Prevention in the USA (2007):

> A medication error is any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the healthcare professional, patient, or consumer. Such events may be related to professional practice, healthcare products, procedures, and systems, including prescribing; order communication; product labelling, packaging, and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use.

This definition provides a wide spectrum of potential error, from prescription through to education, and encompasses the system within which the medication is provided. While individuals may provide incorrect doses to wrong patients through the wrong route, there are arguments in the literature which state that the errors spring from a weak system, rather than (simply) an individual weakness. A hospital which allows its staff to keep concentrated potassium where it can be easily accessed has a much higher risk of an adverse drug event than one which stores it only in the pharmacy.

The 'five rights' of medication administration are often quoted in the literature:

- The right patient
- Should receive the right drug
- In the right dose
- At the right time

- Via the right route (NMC 2002).

Checking a patient's wristband before giving them any medication is essential. Every qualified nurse has a story about a patient who cheerfully admitted to being Mrs Smith, and taking her medication, when she was in fact Mrs Jones. Where there are two 'Mrs Smiths' on the ward, special care must be taken. Checking all details on the wristband is a good habit to adopt.

Provision of the right drug should be simple, but occasionally (often due to handwriting issues) is not. If you are not 100% sure what has been written, check it with the prescriber – if you are unable to decipher the prescription, it is unlikely a colleague will have any more luck. If something plainly incorrect has been prescribed (for example, the patient has a documented allergy to penicillin, but augmentin has been prescribed), then this should also be drawn to the prescriber's attention. Many errors of prescription are picked up by nurses and subsequently corrected – your vigilance should not stop at ensuring the prescription is correctly spelt, however! You should have an awareness of the appropriateness or otherwise of the drug for the patient – this means ensuring your drug knowledge is current and comprehensive. This may be difficult initially, but noting each unfamiliar drug you are asked to give, and looking it up in the BNF, will soon ensure you have the necessary knowledge to provide safe care.

Providing the right dose is also fundamental to safe provision of medication. Moving a decimal point in error one place may involve giving 10 times the recommended dose, and mistaking micrograms for milligrams will involve an error in the magnitude of 1000 times the dose! If you find yourself drawing up several vials of a drug, or getting more that two tablets for a dose, it is worth checking to ensure you have the right dose. Always check the strength of the medication you are about to give – something with which you feel you are familiar may have a new supplier, with a different strength. There may be a national shortage of a certain drug, entailing the use of higher strength preparations, or different sizes of the preparation may have different strengths (e.g. enoxaparin, a heparin preparation for injection, has a strength of 100mg/ml in doses up to 100mg, but a strength of 150mg/ml in 120mg and 150mg doses).

Medicines that are prescribed as a weight-related dose (e.g. mg/kg) entail accurate weighing of the patient. Estimating weights is very difficult, especially in the prone patient – some medicines have a very narrow effective dose related to the patient's weight, and under- or over-estimating the weight may reduce their effectiveness.

Applying Theory to Practice: Exercise 16.6

Estimate the weight of a variety of your colleagues. Weigh them and check your accuracy. Try the same exercise with patients (where this can be done without causing them discomfort).

Providing medication at the right time is necessary to provide the consistent therapeutic level designed by the drug's manufacturer. Missing doses or providing them early or late may entail unwanted effects or reduced efficacy.

Medication may be given by a variety of routes:

- Oral
- Buccal
- Intravenous
- Aural
- Sublingual
- Rectal
- Nasal
- Transdermal
- Intramuscular
- Subcutaneous
- Inhaled
- Topical
- Vaginal
- Urethral
- Intrathecal.

Medicines are licensed for specific routes – giving an intramuscular injection intravenously, or vice versa, may be painful and ineffective or even deadly. If you are unsure of the correct route, check it.

Applying Theory to Practice: Exercise 16.7

Look up the terms enteral and parenteral in relation to drug administration – place each of the above-mentioned routes into one of the categories.

In addition to the five accepted 'rights' of drug administration, we should add the 'right documentation'. If the drug is not signed for, or timed or dated, there is a risk that the dose may be repeated. By the same token, if a dose is omitted, the reason should be documented and the prescriber contacted if appropriate.

Methods of administration

The correct method of administration must match the route, that is, provision of an intramuscular injection must not be given subcutaneously or intravenously, both of which may occur with incorrect technique.

Oral medication may come in a number of forms, e.g. liquids, tablets, capsules. Patients who have difficulty swallowing will benefit from a liquid formulation – do not crush tablets, or ask the patient to chew or break the tablet, unless specifically instructed to do so. Some oral medications should be taken with food; some before or after – check which one applies and follow the instructions correctly – remember that absorption may be significantly affected if you fail to do so.

Skin patches are used for a variety of sustained release preparations – any previous patches should be removed before the new one is put on. They should be applied to skin that is clean, dry, has little or no hair, and no cuts or irritation (this is why it is best not to shave an area before applying a patch). New patches should be applied in a different area from previous patches. If a patch falls off, you should not try to stick it back on – a new patch will have to be applied.

Suppositories should be inserted by the patient, if they are able to do so, after instruction. Provide the patient with a glove and lubricant. Advise them to lubricate the suppository, lie on their left side, drawing their right leg up, and push the suppository well into the rectum. If a patient is to be sent home with suppositories, they should be advised to keep them in a cool place, as they may melt in warm conditions, making them very difficult to insert. If this occurs, advise the patient to place them in the fridge for a while, where they will re-solidify.

Eye drops should be applied by the patient if they are able to do so. Separate bottles should be provided for each eye to avoid cross-contamination of infection, and labelled as left eye and right eye to avoid confusion. The container should be kept tightly closed to avoid contamination, and should not be allowed to touch the surface of the eye if possible. The patient should wash their hands, tilt back the head, and pull the lower eyelid away from the eye, dropping the required number of drops into the resulting space. They should gently close the eye and keep it closed, without blinking, for one minute. For eye ointment the same technique applies, where a thin strip of ointment is applied to the space – approximately 1cm in length – again without touching the eye, and the eye is closed for one minute.

Ear (otic) drops are applied while lying down so the ear requiring treatment is uppermost, gently pulling the earlobe up and back (down and back for children) and placing the required number of drops into the ear canal. The patient should lie in the same position for five minutes if possible, to allow the drops to fully penetrate the canal. Once again, the container should be kept tightly closed and should not make contact with the ear, to prevent contamination.

Buccal medications should be placed under the upper lip against the gum, or between the cheek and the gum. The tablet should be allowed to dissolve slowly – the patient must be advised not to chew or swallow the tablet. They should not touch it with their tongue, or drink hot fluids while using the medication, as this will increase the rate at which the tablet dissolves. If the patient has a very dry mouth, then moistening the area before placing the tablet will be helpful.

Sublingual medications should be placed under the tongue (as far back as possible) until they melt – the same advice regarding chewing or swallowing of hot fluids applies to these medicines.

Subcutaneous injections are administered into the subcutis, the layer of skin below the dermis, composed primarily of adipose tissue. The small amount of blood flow to fatty tissue means that medication given by this route is absorbed slowly, which makes it a very useful route for giving insulin. The most easily accessed sites for subcutaneous injection are the outer area of the upper arm, the upper outer thigh, or the abdomen (not the 2-inch area around the navel). Injection sites should be rotated to avoid scarring and hardening of the tissue. It is helpful to use the same relative site, however, for insulin injection – e.g. giving the morning injection in the abdomen, and the evening injection in the leg, will provide consistency of absorption for patients on long-term therapy. Grasp the skin between thumb and forefinger as shown in Figure 16.1.

Insert the needle at a 90 degree (right) angle (for people with very little subcutaneous fat, or children, a 45

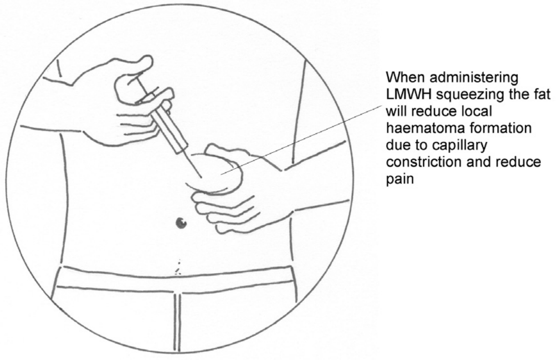

Figure 16.1 Subcutaneous injection

degree angle may be used). Release the skin, pull back the plunger of the syringe to ensure you are not in a blood vessel (blood will appear in the syringe if you are – remove the needle and find another site – using a new syringe and medicine) and inject the medication at a slow steady rate.

Intravenous injections are given directly into a vein – normally through an intravenous cannula, but also through 'central' lines, where the cannula is placed in a large vein (usually superior or inferior vena cava). Infection control is extremely important for any procedure involving direct access to the bloodstream – hands should be washed and disposable non-sterile gloves worn when drawing up the injection and during its administration. The cannula site should be examined for signs of infection; if present the cannula should be removed and another one re-sited prior to administration of the medication. (Cannulae should be changed every 72 hours, irrespective of the presence of infection.) Medicines should be prepared and administered using a 'no touch' technique – this means avoiding touching critical areas, such as needles, syringe tops and infusion ports.

Intramuscular (IM) injections offer more rapid absorption than subcutaneous injections, but take effect more slowly than intravenous injections. They are generally given into either the deltoid muscle (upper outer arm, about one-third of the way down the humerus), the vastus lateralis muscle (middle outer third of the thigh muscle), or the gluteus medius muscle – also known as the ventrogluteal route. This is preferable to the better-known dorsogluteal site (the upper outer quadrant of the buttock), as it is less likely to be covered with adipose tissue, and is not near the track of the sciatic nerve. Finding the site is slightly more difficult, but comes easily with practice – place the heel of the hand (left hand for right hip, right hand for left hip) over the greater trochanter (hip joint) of the femur with fingers pointing towards the patient's head. Place your index finger over the anterior superior iliac spine and the middle finger over the posterior iliac crest. Inject into the triangle formed by the separated fingers (Figure 16.2).

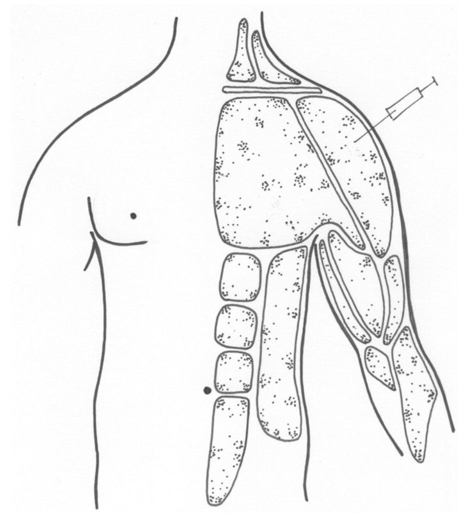

Figure 16.2 Intramuscular injection

Anatomy and Physiology in Action: Exercise 16.8

Examine the anatomy of the deltoid, vastus lateralis and gluteus medius muscles – especially the relevant landmarks for the ventrogluteal route.

Practise locating them on different people.

Prepare the skin by wiping with an alcohol swab and allowing it to dry. Hold the syringe with the thumb and forefinger of the dominant hand, piercing the skin and entering the muscle in a swift but controlled manner to lessen the patient's discomfort. If there is not much muscle mass, especially in children or older patients, you may need to pinch the muscle between finger and thumb to provide more tissue to inject into. Aspirate at the injection site in the same manner as for subcutaneous injection – if blood is aspirated, remove the needle and prepare a new injection for a different site. If no blood is aspirated, slowly inject the medication at a constant rate.

Withdraw the needle quickly to minimise patient discomfort.

Inhaled medications are given by a variety of devices, notably metered dose inhalers (MDIs), nebulisers and rotary inhalers, or other dry powder devices that do not use chemical propellants. Metered dose inhalers are the most commonly used inhalers provided to many asthmatic patients. They provide a measured dose with each triggering, but require a specific technique – the patient must be taught to breathe in as the inhaler is triggered. This is imperative if the medication is to reach the lower airways. Ensuring a patient is able to use their inhaler properly is very important, even if they have been using them for some time – studies show that approximately half of patients with asthma do not use their inhalers correctly (BTS 2005). MDIs can be used with a spacer (Figure 16.3), which allows the patient to simply breathe in and out normally, while still allowing the active medication to access the lungs. This makes it particularly useful for children, who may not comply with an ordinary inhaler.

Figure 16.3 Spacer devices

Nebulisers deliver a fine mist of medication which the patient breathes in through a mask or mouthpiece. They can be driven by oxygen or air – the prescription should make it clear if they are to be air driven, which is sometimes required in patients with long-standing lung disease. These routes can be used to deliver all the major classes of drugs. There is insufficient space in one chapter to review the very large number of medications available, but it is instructive to examine some of the major subdivisions, looking at some of the pitfalls associated with their administration.

Medications

Antibiotics

Antibiotics can be subdivided into bacteriostatic and bacteriocidal medicines. Bacteriostatic medicines do not destroy the invading organism. They work by inhibiting reproduction of the bacteria, allowing the host's natural defences to eventually overcome them. Many organisms are becoming resistant to antibacterial drugs – this may entail modification of treatment, the most important being not using antibiotics where there is no indication for them.

Prior to giving antibiotics it is very important to ask about previous drug reactions – patients may state they are allergic to penicillin, when what they have experienced is a mild sensitisation rash. If a patient reports a previous allergy, however, they should not be given penicillin without discussion with the prescriber, as it can (on rare occasions) cause a rapid and severe anaphylactic reaction. Ideally the patient should be observed for at least 30 minutes after a penicillin injection, especially if there is a history of allergies to drugs or foodstuffs.

Gentamicin is an effective antibiotic when maintained at the correct blood levels. The dose may need to be adjusted based on a 'gentamicin level' which is a blood test usually measured every 48 hours. Gentamicin is

Applying Theory to Practice: Exercise 16.9

Look up the definitions of anaphylactoid and anaphylactic reactions, and the treatment thereof.

Establish how you would provide that treatment in your current practice area.

eliminated via the kidneys, whose function may worsen in acute illness, leading to significant toxicity (Chapter 6). If giving gentamicin, you need to establish that levels have been measured and the dose adjusted as required.

It is very important that patients are advised to take their antibiotics at the recommended intervals and for the full duration of the treatment. Failure to do so may render them ineffective, or worse, may encourage the development of resistant strains of the bacteria – the treatment of these resistant strains may prove to be one of the most significant challenges in medicine over the next 50 years.

Analgesics

Analgesic agents are used to relieve pain. They work at various sites. Opioid drugs work at the level of the brain or spinal cord to reduce the perception of pain. They have powerful central nervous system (CNS) and respiratory depressant effects, potentially producing significant drowsiness. These effects, if severe, may be reversed with the opioid antagonist naloxone, which competes for the opioid binding sites and has a rapid effect – it is often used for patients with a suspected heroin overdose.

Although long-term use of opioid analgesics may encourage dependency, this is not a reason to avoid their use in the short term for patients in pain – patients may need to be reassured that they will not instantly become addicted to morphine from one dose! Morphine is often given intravenously for severe pain. It is generally given as a 1mg/ml injection (10mg made up to 10ml with water for injection) and titrated to the patient's pain – i.e. small amounts are given until the patient's pain is relieved. The results are dependent on the size of the patient and the relative pain – a 100kg man with a partially amputated leg may require significantly more than a 55kg woman with a pretibial laceration! Morphine can precipitate vomiting, and an anti-emetic is often given concurrently (most commonly metoclopramide 10mg IV).

Codeine is a derivative of morphine, with approximately one-seventh of the potency – it is often given combined with paracetamol as a mild oral analgesic. It shares similar properties to morphine and has a significantly constipating effect.

Non-steroidal anti-inflammatory drugs (NSAIDs) are used in the treatment of less severe pain. The term encompasses a large number of drugs, the common feature being suppression of prostaglandins, substances which arise due to cell damage and inflammation, and cause swelling and pain.

Anatomy and Physiology in Action: Exercise 16.10

To gain further insight into common concepts identify the following terms:

- The gate control theory of pain
- Prostaglandin formation

The NSAIDs have analgesic, anti-inflammatory and antipyretic properties. Paracetamol has virtually no anti-inflammatory action, but, unlike the other NSAIDs, it does not cause indigestion or gastric bleeding. This is because most NSAIDs block enzymes concerned with the production of prostaglandins cyclooxygenase 1 (COX 1) and cyclooxygenase 2 (COX 2). Prostaglandins produced by COX 2 cause pain and inflammation, but those normally produced by COX 2 have a protective effect on the gastric lining. Giving NSAIDs blocks this protective effect, and may leave the patient susceptible to peptic ulceration, not through the local irritant effect on the stomach lining – giving these drugs via the rectal route can still have the same effects on the stomach. NSAIDs should be cautiously used in the elderly or those patients on warfarin, or with a history of peptic ulceration or bleeding disorders.

Paracetamol, while safe and effective at normal dosage, has a relative low margin of safety (the ratio of drug needed to give adverse effects against therapeutic effects), with only 2–3 times the normal dose potentially precipitating liver damage. Patients who are given a course of paracetamol must be advised to check any other medication they may take to ensure it does not contain paracetamol – many cough, cold and 'flu' remedies contain it.

Applying Theory to Practice: Exercise 16.11

Look up the emergency treatment of poisoning in the BNF, look at both the non-opioid and opioid sections.

Cardiac drugs

An understanding of how cardiac drugs work requires knowledge of the normal cardiac cycle.

Anatomy and Physiology in Action: Exercise 16.12

Study the factors that determine cardiac output, and the causes and consequences of cardiac failure (Chapter 4). Pay attention to the renin-angiotensin mechanism.

Diuretics

Diuretics, no matter what their class, work by decreasing re-absorption of water and electrolytes by the renal tubules. The various classes are: osmotic diuretics, loop diuretics, thiazide diuretics and potassium-sparing diuretics.

Applying Theory to Practice: Exercise 16.13

Look up diuretics in the BNF. Examine the different classes – look at the physiology of the kidneys (Chapter 6) to establish the mechanism for potassium loss with diuretics.

Diuretics are often discontinued by patients because of the need to go more frequently to the toilet, which may be more difficult for patients with infirmities. You should establish the patient's ability to reach the toilet, especially at night, and it may be necessary to provide a commode for the patient's use at home. If the patient develops diarrhoea or vomiting, the diuretic should be temporarily discontinued, to minimise fluid and electrolyte loss.

Digoxin

Digoxin has two effects that make it a useful cardiac drug – it has a positive inotropic effect (this means it strengthens the heart), and it slows the heart through its effect on the parasympathetic nervous system. In order to obtain a rapid effect, digoxin is often given with a loading dose, which serves to obtain an effective level of the circulating drug as quickly as possible. The patient's apical heart rate (Chapter 4) should always be checked before giving digoxin – if less than 60, you should withhold the drug and discuss with the prescriber.

Antihypertensives

There are a number of classes of antihypertensive drugs:

- Vasodilators act on the smooth muscle cells of blood vessels to decrease peripheral resistance to blood flow.
- Sympathetic blocking drugs also decrease peripheral resistance by blocking vasoconstrictor nerve supply to small arteries and arterioles.
- Angiotensin-converting enzyme (ACE) inhibitors work by inhibiting the conversion of angiotensin 1 to angiotensin 2, which inhibits the release of aldosterone, further reducing sodium retention. Since water follows sodium, the effect is to reduce the circulating volume, and consequently the blood pressure falls.

Applying Theory to Practice: Exercise 16.14

Find the section on hypertension in the BNF.

- Find an example of each of the classes of drug
- Write a short description of each class

This knowledge or insight will gain you respect from clinical mentors.

In addition to providing medication, you should give patients advice on diet, lifestyle and smoking cessation. If antihypertensives are ineffective, it should be established that they are being taken appropriately. Patients sometimes stop medications because of the troublesome side-effects from these drugs (e.g. persistent dry cough with ACE inhibitors, syncope).

Whatever drug you are giving, the correct dose is critical. A significant source of ADEs is the provision of a wrong dose (DoH 2004). While the majority of these are not fatal, they are never acceptable, and the practitioners responsible may feel that the subsequent problem far outweighs the small amount of trouble required to ensure a correct dose.

Drug calculations

In order to perform drug calculations correctly, you must be able to manipulate the values of the accepted international scale of weight (kilogram, kg) and volume (litre, L) the *système internationale* or SI units. Understanding the sizes of the relevant units and how they relate to each other is fundamental to correctly calculating doses.

Various other units are used to denote sizes that are smaller than the standard unit, e.g. 1 kg is 1000 grams (g). Rather than writing 0.75kg, it is conventional to use the smaller unit for clarity, i.e. 750g, unless the larger unit is exceeded, e.g. 1300g = 1.3kg. Weight equivalents are:

- 1 kilogram (kg) = 1000 grams (g)
- 1 gram (g) = 1000 milligrams (mg)
- 1 milligram (mg) = 1000 micrograms (should not be abbreviated)
- 1 microgram = 1000 nanograms (should not be abbreviated)
- 1 nanogram = 1000 picograms (should not be abbreviated).

The only volume equivalent you will probably require in practice is 1 litre (L) = 1000 millilitres (mL), (1000 microlitres = 1 mL). The capital 'L' is often used to denote litres, as the small 'l' is easily mistaken for a figure 1.

In order to convert from a larger unit to a smaller unit, you therefore simply need to multiply by multiples of 1000 (e.g. 1mg = 1000 micrograms, but also 1,000,000 nanograms (1000 x 1000). In contrast, to convert from a smaller to larger unit, you need to divide by multiples of 1000 (e.g. 1500mL = 1.5L). Conversions between units can be made by simply by moving the decimal point three places to the left to divide by 1000 (e.g. 1750 mL = 1.75L) or three places to the right to multiply by 1000 (e.g. 3g = 3000mg).

Medicines can also be expressed as a weight contained in a given volume – e.g. epinephrine is often prescribed as either 1 in 1000 or 1 in 10,000. While this may appear confusing, if you understand that the first figure relates to the weight in grams, and the second to the volume in ml, it becomes clearer – 1 in 1000 means there is 1g of epinephrine in 1000mL, whereas 1 in 10,000 means there is 1g in 10,000mL. Further subdivision enables us to obtain a realistic dose – if 1000mL contains 1g, it also contains 1000mg (1g = 1000mg), giving us a strength of 1mg in 1mL. In contrast, 1mL of 1 in 10,000 will contain only 100 micrograms.

You may also see moles or millimoles mentioned on some medication doses – e.g. 10mL of 10% calcium chloride (the dose given in cardiac arrest) contains 6.8mmol (millimoles) of calcium. This is a complex measurement of the amount of a substance based on the relative atomic weights of its constituent atoms. You should not have to deal with millimoles in your everyday practice (except when recording a patient's blood sugar, which is also measured in mmol).

Once you are able to easily convert between the units, you can use various methods to work out the amount of medication you need to provide. If you are asked to give 500mg of paracetamol, and you have 500mg tablets, then no calculation is required! Where your medication strength does not exactly match what you have, or where the strength of medication contained in a liquid is required, you will find it helpful to use one of the methods below.

Applying Theory to Practice: Exercise 16.15

Convert the following units:

A) 0.066g to milligrams
B) 1.35mg to micrograms
C) 4.4 Litres to millilitres
D) 0.06g to micrograms (careful with this one – check your units)
E) 1600 micrograms to milligrams
F) 2200 mg to kilograms (check your units again!)

Answers are found in Answers to Box 16.11.

Calculating the number of tablets

If you divide the dose that has been prescribed (what you want) by the strength of the tablet that you have (what you have), this will provide you with the number of tablets you need. Ensure that the units you are using are the same, so dividing 500(mg) by 500(mg) is fine, but dividing 500(mg) by 0.5(g) will give you a quite different answer!

For example – you have 25mg tablets of diclofenac, and you have been asked to give 75mg. Dividing what you want (the prescribed dose of 75mg) by what you have (25mg tablets) tells you 3 tablets to administer:

$$\frac{\text{(What you want) 75mg}}{\text{(What you have) 25mg}} = 3$$

Calculating solutions/mixtures/injection volumes

This is slightly more complex. A tablet contains a specific amount of medication in each unit – e.g. paracetamol has 500mg in each tablet. Solutions are the same, but the ratio varies – e.g. amoxicillin comes as 125mg in 5mL and 250mg in 5mL strengths. This adds an additional step to your calculations.

You start by dividing your prescribed dose (what you want) by the stock strength (let us use amoxicillin 125mg/5mL, so our stock strength in this case is 125mg).

You then need to multiply the resulting figure by the stock volume (in this case 5mL) to give the amount of solution in mL. In this example, if we wanted to give 250mg, using the 125mg/5mL solution, we have the calculation:

$$\frac{\text{(What you want) 250mg}}{\text{(Stock strength) 125mg}}(2) \times \text{(stock volume) 5mL} = 10\text{ml}$$

If we still wanted 250mg, but were using the 250mg/5mL solution, our calculation would read:

$$\frac{\text{(What you want) 250mg}}{\text{(Stock strength) 250mg}}(1) \times \text{(stock volume) 5mL} = 5\text{ml}$$

A number of drugs are prescribed based on the patient's body weight. This simply involves an additional step prior to the drug calculation – e.g. the patient is prescribed a drug at 30 micrograms per kilogram body weight. To derive the dose required, a simple multiplication of the patient's weight in kg (e.g. 75kg) by the amount per kg (in this case 30 micrograms) gives a dose of 30 x 75 = 2250 micrograms. The dose calculation can then be processed in the normal fashion.

In addition to dosage calculations, you may be required to calculate the rate of an infusion. Infusion pumps provide a continuous infusion at a given rate, so it is important to be able to programme them to ensure an accurate hourly dose is delivered.

To calculate the flow rate, the prescribed volume (in mL) is divided by the duration of the infusion (in hours) – e.g. 1000 mL over 4 hours requires a flow rate of 1000/4 = 250 mL per hour.

Calculating the rate of an infusion which contains a medication requires a further step – first, the stock concentration must be calculated – this is the medication strength (generally in mg) divided by the volume of infusion fluid in which it is contained – e.g. if we add 900mg of amiodarone to 500mL of dextrose, we have a stock concentration of 900/500 = 1.8mg/mL. Working out the required infusion rate (in mL/hour) then involves dividing the dose required (in mg/hour) by the stock concentration – e.g. if we want a rate of 60mg hour, the calculation will be 60/1.8, which gives an infusion rate of 33.3 mL/hour.

If you are asked for a minute rate (e.g. 1mg/min), then deriving an hourly rate simply involves multiplying the minute rate by 60 to give the hourly rate.

It is rare that you will have to prepare medications on your own. If you are in any way unsure, get someone to check your calculations. A few seconds spent checking a dosage or unfamiliar medicine may save you many weeks of anguish, and perhaps the life of your patient.

Applying Theory to Practice: Box 16.1 Answers to Exercise 16.15

A) 66mg (1000 x 0.066 – decimal point moves 3 places to the right)
B) 1350 micrograms (1000 x 1.35 – decimal point moves 3 places to the right)
C) 4400 mL (4.4 x 1000 – decimal point moves 3 places to the right)
D) 60000 micrograms (0.06 x 1,000,000 – decimal point moves 6 places to the right)
E) 1.6 milligrams (1600/1000 – decimal point moves 3 places to the left)
F) 0.0022 kilograms (2200/1,000,000 – decimal point moves 6 places to the left)

Conclusion

Accurate and competent drug calculations are part of every qualified nurse's clinical armament. You should ensure that you feel competent and confident to undertake the calculations discussed in this chapter before venturing to prepare infusions or undertake a drug round. The most important attribute is not a mathematical turn of mind, however, but rather a commitment to safety and accuracy in the patient's best interest. This is the cornerstone of all excellent nursing care. By demonstrating to your mentors or preceptors in clinical practice that you have some insight into medications and how to calculate the dose, you are far more likely to receive beneficial input from them. If at the start of your placements they identify you know little about commonly used medications they potentially will not trust you to administer drugs. When asked by mentors about drugs, never lie, be honest, no-one expects you to know every drug in the BNF! Both pharmacology and drug calculations play a major role in your future chosen career; remember practice may not make you perfect but it certainly helps.

Chapter 16 Summary Quiz

1. Drug metabolism is affected by relative:

A. Hormone secretion
B. Kidney function
C. Liver function
D. Clotting factors

2. Drug excretion is affected by relative:

A. Blood volume
B. Plasma concentration
C. Kidney function
D. Liver function

3. Which of the following is not one of the 'five rights' of medication administration?

A. The right patient
B. At the right time
C. Administered by the right person
D. Via the right route

4. Medication may be given by a variety of routes, which of the following is not one?

A. Oral
B. Rectal
C. Nasal
D. Mural

5. Subcutaneous injections are administered into the subcutis, the layer of skin below the dermis, composed primarily of:

A. Adipose tissue
B. Connective tissue
C. Elastic tissue
D. Muscle tissue

6. Into which of the following areas is a intramuscular injection not given?

A. The deltoid
B. The vastus lateralis
C. The pectoral muscle
D. The gluteus medius

7. Which of the following is not a class of antibiotic?

A. Penicillin
B. Cephalosporins
C. Macrolides
D. Aminoglycosides

8. What is the antagonist for opioids?

A. Naloxone
B. Protamine sulphate
C. Vitamin K
D. Charcoal

9. Which of the following is a side-effect of morphine?

A. Constipation
B. Respiratory arrest
C. Sedation
D. All of the above

10. Which of the following does not lower blood pressure?

A. ACE Inhibitors
B. Beta blockers
C. Calcium channel blockers
D. Histamine antagonists

Further reading

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Glossary

A

Abrasions: (graze) superficial area of skin loss normally caused by friction.

Absorption the taking up of substances by the mucous membranes of the digestive tract.

Acetylcholine: Acetylcholine is one of many neuro-transmitters in the autonomic nervous system (ANS) and the only neurotransmitter used in the somatic nervous system (SNS).

Acid base balance: the equilibrium between acid and alkaline necessary to maintain homeostasis. For the blood to function at an optimum level the serum pH must remain between 7.35 and 7.45.

Acidosis: is an increased acidity of the blood plasma, acidosis is said to occur when arterial pH falls below 7.35.

Action potentials: describes the cycle of events leading to a cell becoming electrically positive on the inside.

Acute coronary syndromes (ACS): is a set of signs and symptoms, usually a combination of chest pain and other features, interpreted as being the result of abruptly decreased blood flow to the heart.

Acute myocardial infarction (AMI): occurs when the blood supply to a part of the heart is interrupted. The resulting ischemia causes damage and potential death of heart tissue.

Adrenal insufficiency crisis: failure of the adrenal glands to secrete essential hormones i.e. mineralocorticoid and Glucocorticoids, if untreated will become life threatening.

Aetiology: the study of the causation of disease and how illness is introduced to the host.

Afferent: carrying towards - an afferent nerve carries impulses from the body to the brain.

Agonist: In pharmacology pertains to an excitory effect.

Allergens: a substance capable of inducing an allergic reaction, includes animal hairs, proteins and dust.

Allergic Reaction: being affected by an allergen, can result in various symptoms including a running nose, itchy skin and urticaria. Severe reactions can result in an anaphylactic reaction.

Alzheimer's Disease: a progressive form of **dementia**. Characterised by personality changes, disorientation and memory loss.

Amputations: can occur when a body part such as a toe or finger are partially or completely cut off.

Anaemia: collective term used to describe the end result of many disease processes in which the blood cannot carry enough oxygen.

Analgesics: pain killers; can be split into two main groups: Narcotics and non-Narcotics.

Anaphylaxis: A severe allergic reaction resulting in shock development.

Aneurisms: a localized, blood-filled dilation of a blood vessel caused by disease or weakening of the vessel wall.

Angioplasty/Percutaneous coronary interventions: the mechanical widening of a narrowed or totally obstructed blood vessel.

Antagonist pertains to an inhibitory effect.

Antibodies: cells that destroy or render foreign substances inactive.

Anti-Diuretic Hormone: a hormone found in most mammals, including humans. One of its most important roles is to regulate the body's retention of water, being released when the body is dehydrated; it causes the kidneys to conserve water, but not salt, by concentrating the urine and reducing urine volume.

Anti-platelet agents: drugs that reduce platelet activity, including aspirin and clopidogrel.

Antipyrexials: Medications such as Paracetamol used to reduce a patient's temperature.

Apex: anatomical term used to describe the top or tip (pointed end) of an organ or body.

Aphasia: deficient in use of language, usually due to damage to the cerebral hemisphere.

Apnoea: suspension of external breathing.

Appendicitis: inflammation of the appendix, can be life-threatening.

Apraxia: inability to maintain posture or perform learned movements.

Arachnoid membrane: a thin, delicate layer loosely covering the brain.

Arachnoid villi: point where most of the CSF is reabsorbed.

Arteriosclerosis: a disease affecting arterial blood vessels. It is a chronic inflammatory response in the walls of arteries, in large part due to the deposition of lipoproteins.

Articular cartilage: surface material of a joint.

Ascites: is an accumulation of fluid in the peritoneal cavity, attributed to cirrhosis in 75% of cases.

Aseptic: without disease, free from pathogens.

Asphyxia: a condition of severely deficient supply of oxygen to the body that arises from being unable to breathe normally.

Asthma: a disease synomimous with bronchial constriction and over production of mucous. Can be seasonal or brittle. A hypersensitivity reaction.

Asymptomatic: without symptoms.

Asystole: an absence of electromechanical activity throughout the heart traditionally referred to as a 'flat line'.

Atheromatous deposits: disposition of hard plaques of fat within the arteries.

Atherosclerosis: Fatty deposits that adhere to the inner lumen of arteries.

Atrial fibrillation: is a cardiac arrhythmia that involves the two upper chambers (atria) of the heart fibrillating rather than pumping in unison. It is defined as being irregularly irregular, and can often be identified as such when taking a pulse.

Atrioventricular (AV) node: an area of specialised tissue between the atria and the ventricles of the heart, which conducts the normal electrical impulse from the atria to the ventricles.

Auscultation: the technical term for listening to the internal sounds of the body, usually using a stethoscope.

Autonomic nervous system (ANS) regulating activity of smooth muscles, cardiac muscles and glands. Its activity is involuntary, outside of our control. The ANS is functionally divided into the parasympathetic and the sympathetic branches.

Autosomal recessive gene disorder: both parents need to carry the same altered gene, resulting in a 1:4 risk of having a child affected by the condition.

Avascular necrosis: reduction or cessation of blood flood to an area eventually causing death, the scaphoid bone provides an example.

Avulsions: forcing and tearing away of a body part or internal structure such as a small fragment of bone from a ligament.

Axons: the conducting area of a nerve cell. Electric impulses are conducted away from the cell body.

Azotaemia: The pathological presence of nitrogenous wastes, principally urea within the blood, commonly seen in renal failure, gastrointestinal haemorrhage and dehydration.

B

Bacteria: unicellular microorganisms, some of which can cause bacterial disease.

Bacteriocidal: destroy bacteria.

Bacteriostatic: inhibiting reproduction process of a bacteria.

Baroreceptors: detect the pressure of blood flowing through them, and can send messages to the central nervous system to increase or decrease total peripheral resistance and cardiac output.

Basal ganglia: area of the brain concerned with modifying and coordinating voluntary muscle movement.

Basal metabolic rate (BMR): the amount of energy, which is needed to maintain physiological equilibrium whilst at rest in a fasted state (kcal/day).

Beta-blockers: a class of drugs used for various indications, but particularly for the management of cardiac arrhythmias and cardioprotection after myocardial infarction.

Beta 2 agonists: drugs such as Salbutamol that cause relaxation of bronchial muscles, elevate blood pressure and increase the heart rate.

Bile: alkaline green/yellow fluid secreted by the liver and stored in the gallbladder. Aids digestion by emulsifying fats within the duodenum.

Bioavailability: how much and how quickly a drug reaches its intended target.

BIPAP: Bi-level Positive Airway Pressure; a breathing assisting device that is worn over the mouth or nose.

Bi-polar disorder: affects mood, thinking and behaviour and is characterised by mood swings. When in a high phase the person can display grandiose behaviour and express delusions but when low they become deeply depressed and due to the impulsive and emotion driven nature of the condition there is a high risk of suicide.

Bisphosphates: drugs that bind directly to bone minerals because of their specific chemical structure. Once bound to the bone, these drugs inhibit bone loss by reducing the action of bone cells that normally degrade bone during the remodeling process.

Bladder: a hollow, muscular, and distensible organ that sits on the pelvic floor. It is the organ that collects urine excreted by the kidneys prior to disposal by urination.

Blood pressure: the force exerted by circulating blood on the walls of blood vessels, one of the principal vital signs.

Body Mass Index (BMI) chart: a scale designed to identify extremes of weight. Has been controversial due to its inability to be consistent with varying client demographics.

Bradyarrhythmias: abnormal and slow heart rates. Can result in haemodynamic collapse and cardiac arrest.

Bradykinesia is difficulty initiating movement and maintaining it. A patient will have a stooped posture and will move with a shuffling gait, they may loose their balance easily and fall. They can also have an expressionless face and blink infrequently

Brain stem: area of the brain containing the pons varolli, medulla oblongata and midbrain.

Broad complex tachycardia: a rate exceeding 100 per minute that may be of ventricular origin i.e. delayed.

Broad-spectrum antibiotic: an antibiotic with activity against a wide range of disease-causing bacteria.

Broca's area: motor control or area of speech within the cerebrum.

Bundle of His: a collection of heart muscle cells specialized for electrical conduction that transmits the electrical impulses from the AV node (located between the atria and the ventricles) to the point of the apex of the fascicular branches.

C

Calcification: hardening of an anatomical region caused by calcium salt deposits.

Calorigenic effect: heat and energy producing effect.

Cannula: indwelling device such as a venous cannula.

Capillary refill time: the rate at which blood refills empty capillaries. It can be measured by pressing a fingernail until it turns white, and taking note of the time needed for color to return once the nail is released. Normal refill time is less than 2 seconds. The capillary refill time (**CRT**) is a common measure of peripheral perfusion.

Cardiac Arrest: the sudden cessation of cardiac function, resulting in the loss of effective circulation

Cardiac cycle: is the term referring to all or any of the events related to the flow of blood that occur from the beginning of one heartbeat to the beginning of the next.

Cardiac output: is the product of the heart rate multiplied by the stroke volume (HRxSV=CO)

Cardiogenic Shock: is based upon an inadequate circulation of blood due to primary failure of the ventricles of the heart to function effectively.

Cardiovascular disease (CVD): is the collective name given to diseases affecting the heart and circulatory system

Cataracts: progressively developing clouding of the lens of the eye. Can be surgically removed.

Catecholamines: chemical compounds derived from the amino acid tyrosine containing catechol and amine groups i.e adrenaline/noradrenaline.

Central line: an indwelling venous or arterial cannula.

Central nervous system (CNS): the brain, spinal cord and nerves.

Cerebellum: the small area at the back of the brain, responsible for coordination of fine voluntary movements.

Cerebral Cortex: the outermost cellular layer of grey matter covering the cerebrum; controls higher mental activities.

Cerebral dominance: the dominance of activity between left and right sides of the brain.

Cerebral hemispheres are made up of four pairs of lobes: frontal**,** parietal**,** temporal and occipital.

Cerebrospinal fluid (CSF): a clear, colourless, odourless liquid that surrounds the brain and the spinal cord. It acts as a shock absorber, floating and cushioning the brain and spinal cord from trauma.

Cerebrovascular accident (CVA): is defined as a sudden loss of brain function leading to a neurological deficit that lasts for 24 hours or more.

Cerebrum: main part of the brain identified in pictures i.e. the largest part.

Chain of survival: Several key actions have been identified that improve the management of patient's potentially or actively experiencing cardiac arrest.

Chlamydia: a parasitic organism, commonly implicated in sexually transmitted infections.

Chloramphenicol: a bacteriostatic antibiotic, commonly used for eye infections.

Cholecystitis: (inflammation of the gallbladder) occurs when stones block the outflow of bile. The bile becomes concentrated and infected leading to a swollen and oedematous gallbladder. The patient presents with severe right upper quadrant pain, fever, and occasionally jaundice. Cholecystitis can be acute or chronic and is treated by surgical removal of the gallbladder (**cholecystectomy).**

Choroid plexuses: projections of blood vessels from the pia mater into each of the ventricles of the brain.

Chronic obstructive pulmonary disease: a chronic and debilitating disease continuum in which localised irritation of the bronchioles and lungs results in increasing airflow obstruction which is usually progressive.

Chyme: partially digested food passing from the stomach into the small intestine.

Ciliated tissue: cells or tissue containing hair like projections, found in the airway tracts.

Circle of Willis: the anterior (carotid) circulation and the posterior (vertebrobasilar) circulation unite to become the arterial anastamosis.

Cirrhosis: Irreversible fibrosis (scarring) and the development of nodules severely affect liver function.

Clotting factors: Specific components of blood that combine to stop bleeding.

Coeliac disease: an autoimmune disorder of the small bowel that occurs in genetically predisposed people of all ages from middle infancy.

Colloids: thick fluids such as gelofusion which remain in the blood stream, referred to as plasma expanders.

Congenital: from birth.

CPAP: a device that delivers 'continuous positive airway pressure', regardless of inspiration or expiration making the effort to breathe easier. Can be delivered via mouth, nose or via breathing tubes.

C reactive protein (CRP): A globulin that appears in the blood in certain acute inflammatory conditions, such as infections.

Crepitus: cracking sound commonly found in arthritic joints and fractures.

Creutzfeldt-Jakob disease (CJD): a form of encephalopathy of viral origin.

Crystalloids: a fluid containing a true solution i.e. physiological saline.

Cyclizine: an anti-emetic.

Cystic fibrosis: a hereditary disease that mainly affects the lungs and digestive system, causing progressive disability and for some, early death.

Cystitis: inflammation of the bladder.

Cytology: study of the function and pathology of body cells.

D

Dalton's law: states that the pressure exerted by a mixture of gases are equal to the sum of the partial pressures of the gases in mixture.

Decussate: (decussation) the crossing of symmetrical structures in the form of an X.

Defibrillation: the application of an electrical current to the heart muscle may result in the chaotic rhythm and fibrillating muscle mass becoming organised again, thereby returning a cardiac output.

Delusions: abnormal beliefs that are not real.

Dementia: is not a disease but a group of symptoms which occur as a result of a number of different illnesses but which all cause degenerative changes in brain tissue leading to a progressive decline in cognitive functioning.

Dendrites: associated with each cell body creating a vast surface area to receive nerve impulses.

Depolarisation: discharging of an electrical current.

Depression: Although common, clinical depression is associated to the individual's ability to cope with everyday life.

Dermis: the true skin lying beneath the epidermis.

Diabetes mellitus: is a disease characterized by disordered metabolism and inappropriately high blood sugar (hyperglycemia) resulting from either low levels of the hormone insulin or from abnormal resistance to insulin's effects coupled with inadequate levels of insulin secretion to compensate.

Diaphragm: a sheet of muscle separating the thorax and abdomen.

Diarrhoea is defined as the abnormal passage of loose or liquid stools more than three times per day.

Diastole: the relaxation phase (filling) phase.

Diencephalon: part of the cerebrum containing the thalamus, hypothalamus and most of the third ventricle.

Diffusion: the net movement of particles from an area of high concentration to an area of low concentration.

Dimorphic: meaning it is both functionally and structurally different in males and females.

Diplegia: either arms or legs are affected.

Distribution: the passing or delivery of a substance within or throughout the body.

Distributive shock: as in hypovolemic shock, caused by an insufficient intravascular volume of blood. This form of relative hypovolemia is the result of blood vessel dilation, i.e septic shock and anaphlaxis.

Diverticular disease: inflammation of the diverticula, can lead to bleeding and ulceration.

Domperidone: anti-emetic.

Do Not Attempt Resuscitation Orders (DNAR): relates to the act of administering CPR. All UK hospitals should have an agreed DNAR policy, based on national guidelines.

Dopamine: Found mainly in the substantia nigra in the mid brain and in the basal ganglia. Its effect is the coordination of movement and control of behaviour.

Down's syndrome: a congenital anomaly affecting chromosome 21. Those affected experience mental and physical compromise.

Doxycycline: antibiotic.

Duodenum: 25cm long and containing the sphincter of Oddi where the common bile duct joins the small intestine

Dura mater: is the outermost layer of the meninges. It is a tough double-layered membrane attached to the bones of the cranium, housing the veins and arteries supplying the skull.

Dysarthria: difficulty in articulating words.

Dyspepsia: characterised by heartburn and a feeling of fullness.

Dysphagia: is the name for difficulty in swallowing and is common.

Dysuria: difficulty passing urine.

E

ECG -12 lead (electrocardiogram): uses 10 actual positions, but through combining some of these reveals 12 actual views of heart activity.

Effusion: the escape of fluid into a tissue or cavity.

Electrolytes: a liquid or fluid capable of conducting electricity.

Embolus: a clot originating from another area (clot on the trot).

Empyema: a collection of pus within the pleural cavity.

Epidemiology: studying the causes, incidence, distribution and control of disease in a population.

Epidermis: the external, non-vascular layer of the skin.

Epididymis: surrounds the testis conveying the spermatozoa from the testis to the vas deferens.

Epilepsy: a condition associated with convulsions, caused by an abnormal discharge of nerve impulses in the brain.

Epinephrine: a hormone when carried in the blood and a neurotransmitter when it is released across a neuronal synapse. It is a catecholamine, a sympathomimetic monoamine derived from the amino acids phenylalanine and tyrosine.

Epithelium: a tissue composed of a layer of cells, Epithelium lines both the outside (skin) and the inside cavities and lumen of bodies.

Epstein-Barr virus: a virus of the herpes family (which includes *Herpes simplex virus* and *Cytomegalovirus*), and is one of the most common viruses in humans.

Equinus position: people with equinus develop ways to ''compensate'' for their limited ankle movement, often leading to long term foot, leg and back problems. The most common methods of compensation are flattening of the arch or picking up the heel early when walking, placing increased pressure on the ball of the foot. Patients compensate by ''toe walking'', whilst others take steps by bending abnormally at the hip or knee.

Erythrocytes: red blood cells.

Erythropoietin: the production of red blood cells.

Euthanasia: the act of terminating the life of another who is experiencing irreversible illness or pain.

External respiration: the exchange of gases between the atmosphere and the pulmonary loop of circulation including the lungs.

Exudate: fluid that passes through a vessel or membrane into surrounding space or tissues.

F

Fallopian tubes: ducts that open out of the upper part of the uterus.

Fascia: the soft tissue component of the connective tissue system that permeates the human body. It interpenetrates and surrounds muscles, bones, organs, nerves, blood vessels and other structures.

Fascicles of the bundle of His/Purkinje fibres: a small group of nerve or muscle fibres.

Fasciotomy: incision of a fascia.

Filtrate: the liquid produced after filtering a suspension of a solid in a liquid.

Foetus: an unborn child.

Follicle-stimulating hormone (FSH): stimulates the graafian follicles of the ovary, in men stimulates the production of spermatozoa.

Fovea: a area of the retina, which is densely populated by cone, cells and limited numbers of cone cells.

Frank haematuria: presence of fresh blood in the urine.

Frank-Starling law/principle: The greater the stretch of the myocardium the greater the force of contraction.

Frazer Competence: Children are not deemed to be automatically legally competent to give consent. The courts have determined that children can be legally competent if they have ''sufficient understanding and intelligence to enable him or her to understand fully what is proposed''. This concept is known as Gillick competency. The term Fraser competency is also used in this respect as Lord Fraser was the judge who sat on the case.

G

Gamma-amino butyric acid (GABA): Located in the hypothalamus, cerebellum, basal ganglia and spinal cord. It is the main inhibitory neurotransmitter.

Gametes: mature reproductive cell.

Gestation: the development process between conception to birth.

Glandular fever: *Infectious mononucleosis***,** (also known as the kissing disease) is seen most commonly in adolescents and young adults, characterized in teenagers by fever, sore throat, muscle soreness, and fatigue.

Glaucoma: collective term used to describe diseases that damage the optic nerve caused be the effects of a raised ocular pressure.

Glial cells: supportive cells in the central nervous system. Glial cells do not conduct electrical impulses, they surround neurons and provide support and insulation between them.

Glomerular filtration rate (GFR) the rate at which plasma is passed through the gromeruli.

Glomerulus: minute section of the kidney containing arterial capillaries and connective tissue.

Glutamate: Widespread in the CNS where it has an excitatory effect. It is important in learning and memory.

Gonads: essential sex glands.

Glomerular filtration rate: the volume of fluid filtered from the renal (kidney) glomerular capillaries into the Bowman's capsule per unit time. Clinically, this is often measured to determine renal function.

Gluconeogenesis: manufactures new glucose from amino acids and glycerol when blood levels are low and glycogen stores are exhausted.

Glycogenesis: converts glucose to glycogen for storage.

Glycogenolysis: converts glycogen back to glucose for release into blood following secretion of glucagon by the pancreas.

Glucometer: a small medical device that tests the amount of sugar in the blood, taken from a finger prick.

Granulocytes: a category of white blood cells characterised by the presence of granules in their cytoplasm.

Grey matter: nervous system tissue consisting of cell bodies.

Guedel Airway: orophangeal airway device.

Guillan Barre Syndrome: the patient may complain of muscle weakness in the distal limbs and often numbness in the same region too. Gradually this weakness and numbness progresses and ascends, it can occur over several days or take up to several weeks to progress.

H

Haematemesis: vomiting blood associated with an upper GI bleed. Fresh blood is bright red and old brown blood is termed 'coffee grounds'.

Haematuria: Presence of blood in the urine; can be microscopic.

Haemoarthrosis: blood within a joint space, definition may also include synovial fluid or pus.

Haemodynamic collapse: loss of circulating volume or severe dilation of vessels resulting in a massive drop in blood pressure.

Haemoglobin: the iron-containing oxygen-transport metalloprotein in the red blood cells of the blood.

Haemolysis: the breaking open of red blood cells and the release of haemoglobin into the surrounding fluid.

Haemoptysis: describes the coughing-up of blood

Hallucinations: the feeling of having an experience, which is not real.

Haversian canals: These run longitudinally through compact bone and contain blood, containing lymph capillaries and nerves.

Head Tilt chin lift: manouvere opening the airway in an unconscious or arrested patient.

Heart attack: see acute myocardial infarction.

Heart blocks: a disease in the electrical system of the heart.

Heart rate: a term used to describe the frequency of the cardiac cycle. Usually it is calculated as the number of contractions (heart beats) of the heart in one minute and expressed as beats per minute (bpm).

Hemiparesis: (weakness) or paralysis affecting one side of the body.

Hemiplegia: paralysis affecting the arm and leg on one side of the body.

Heparin: naturally occurring anticoagulant, commonly used in immobile patients to prevent thrombosis.

Hepatic Encephalopathy is a reversible state of impaired cognitive function due to advanced liver disease.

Hepatitis (Alcoholic): (inflammation of the liver) occurs in 20-30% of patients with a fatty liver who continue to drink, and may be mild, severe and life threatening. LFTs are raised and the patient may be jaundiced with right upper quadrant pain and nausea.

Hereditary: genetic factors responsible for the presence of particular characteristics in successive generations.

Herpes: a sexually transmitted, double-stranded DNA virus, called *herpes simplex virus* (HSV) type 2. This virus is closely related to herpes simplex virus type 1, which is the cause of common non-sexually-transmitted cold sores.

Hilum: concave in shape. This is where the nerves, blood and lymphatic vessels enter the kidney.

Homunculus: a small model of the human body.

Human chorionic Gonadotrophin (HCG): produced in the placenta during the first trimester of pregnancy, its presence in blood or urine confirms pregnancy.

Human Immunodeficiency Virus (HIV): virus that causes **AIDS**.

Humidified oxygen: adding moisture to supplementary oxygen to prevent the drying out of membranes and components of the respiratory tract.

Hydrocephalus: an excess of cerebral spinal fluid within the brain or the membranes. May be caused by infection, tumour or developmental anomalies.

Hydrostatic pressure: the pressure exerted by blood or other body fluids.

Hypercapnia: a condition where there is too much carbon dioxide (CO_2) in the blood.

Hypercholesterolaemia: is the presence of high levels of cholesterol in the blood.

Hyperglycaemia: results when there is a lack of the hormone **insulin.**

Hypersensitivity reaction: an exaggerated internal response to an allergen.

Hypertension: commonly referred to as high blood pressure, is a medical condition in which the blood pressure is chronically elevated.

Hypertrophy: the increase of the size of an organ or in a select area of the tissue.

Hypothalamus: links the nervous system to the endocrine system via the pituitary gland. The hypothalamus is located below the thalamus, just above the brain stem.

Hypoxaemia: is a pathological condition in which the body as a whole (generalised hypoxia) or region of the body (tissue hypoxia) is deprived of adequate oxygen supply

Hypoxia: see hypoxaemia.

Hypovolaemic Shock: a state of decreased blood volume; more specifically, decrease in volume of blood plasma.

I

Iatrogenic: ill health or adverse effect or complication caused by or resulting from medical treatment.

Idiopathic: no known cause.

Immunodeficiency: the inability or inadequacy of the immune system to respond effectively, leaving the body's defence system depleted and the individual vulnerable and susceptible to infections, diseases and malignancies.

Inferior: lower aspect or beneath.

Infertility: inability to reproduce.

Inflammatory response: a protective immune response characterised by localised heat, swelling and pain.

Insomnia: inability to sleep.

Insulin: hormone produced by the pancreas that enables the body to utilise glucose. Excess causes hypoglycaemia, deficit causes hyperglycaemia.

Interferons: When a virus infects a cell, the cell produces a protein called Interferon.

Internal respiration: describes the process whereby gases diffuse between the blood capillaries and the cells of the body.

Intracerebral haemorrhage (ICH): bleed within the brain.

Intubation: Tracheal intubation is the placement of a flexible plastic tube into the trachea to protect the patient's airway and provide a means of mechanical ventilation.

Inversion injury: where the ankle is twisted inwards.

Ischaemia: reduction of blood to an area, can result in pain and a reduced distal pulse if a limb is involved.

J

Jaw Thrust: a manoeuvre to open the airway whilst stabilising the C-spine.

Jejunum: second part of the small intestine.

K

Kidneys: organs that filter wastes (such as urea) from the blood and excrete them, along with water, as urine.

Korotkoff's sounds: the five phases of sounds heard when a stephoscope is placed over brachial artery to measure blood pressure with a sphymomanometer.

Korsakoff syndrome/psychosis: chronic condition following delirium and toxic states. Often involves hallucinations.

L

Lateral: meaning side, away from the midline.

Lateral horns: When looking at the core of grey matter, it appears to create the letter H. these Horns, which are paired projections of grey matter throughout the spinal cord, are appropriately determined by the direction of their projection. Therefore, the paired horns, which extend posteriorly, are known as the posterior horns, and the anterior horns are those, which project anteriorly. The shorter pair of lateral horns extend to the sides.

Leucocytes: White blood cells or leukocytes are cells of the immune system, which defend the body against both infectious disease and foreign materials.

Leydig cells: cells of the testis that produce the male sex hormone.

Limbic centre: area of the brain involving the senses such as emotions and feelings.

Lipogenesis: the production of fat.

Low molecular weight heparin: a type of heparin given via subcutaneous injection, which requires little monitoring.

Lymphodema: accumulation of lymph within subcutaneous tissue normally due to faulty lymph drainage.

Lymphoid: The lymphatic system is a complex network of lymphoid organs, lymph nodes, lymph ducts, lymphatic tissues, lymph capillaries and lymph vessels that produce and transport lymph fluid from tissues to the circulatory system. The lymphatic system is a major component of the immune system.

M

Malleolus: part of a bone shaped like a hammer i.e. the lower end of the fibula.

Malnutrition: (or under nutrition) occurs when the body's energy intake is less than the energy expenditure

Mannitol: osmotic diuretic often given in severe head injuries.

Mastectomy: removal of a breast.

Mean arterial pressure: a term used in medicine to describe a notional average blood pressure in an individual. It is defined as the average arterial pressure during a single cardiac cycle.

Medial: towards the middle.

Medulla oblongata: upper part of the spinal cord containing the autonomic control centres.

Meiosis: the division of sex cells, constriction of the pupil.

Menopause: the cessation of menstruation.

Menstruation: (period) the physiological shedding of tissue and blood from the non-pregnant uterus.

Metabolism: the end result of physical and chemical changes within the body affecting nutrition and substances such as drugs.

Metaclopramide: an anti-emetic.

Midbrain: part of the brain stem connecting the cerebrum with the pons and the cerebellum. Involved in motor coordination.

Miotics: drugs that constrict the pupil.

Multi-organ dysfunction syndrome: previously known as **multiple organ failure (MOF)**; altered organ function in an acutely ill patient requiring medical intervention to maintain homeostasis.

Mydriatics: drugs that dilate pupils.

Myelin sheath: a fatty white sheath surrounding nerve fibres.

Myofibrils: long fibrils that combine to make up a muscle fibre.

N

Narrow complex tachyarrhythmia: a heart rate above one hundred that conducts quickly i.e. originates above the ventricles.

Nasopharyngeal airway: a tube inserted into the nose, directed towards the throat with the intension of opening the airway.

Negative feedback system: Many biological process use negative feedback. Examples include the regulating of body temperature and blood glucose levels. The disruption of negative feedback can lead to severe results. In the case of blood glucose levels, if negative feedback fails, the glucose levels in the blood may begin to rise dramatically causing diabetes.

Nephron: is the basic structural and functional unit of the kidney. Its chief function is to regulate the concentration of water and soluble substances like sodium salts by filtering the blood, reabsorbing what is needed and excreting the rest as urine. Components consist of

- The Bowman's capsule and glomerulus
- The Proximal convoluted tubule
- The loop of Henle
- The distal convoluted tubule
- The collecting duct

Neuchal Transluceny: a measurement of the size of the translucent space behind the neck of the fetus using ultrasound at between 10 and 14 weeks of pregnancy. Nuchal translucency tends to be increased in chromosome disorders such as Turner syndrome and Down syndrome,

Neuroglia: tissue that supports the central nervous system.

Neuropathy: umbrella term for disease of the nerves can cause a sensation of burning, severe pain tingling and numbness.

Neurotransmitters: a chemical substance that facilitates the transmission of nerve impulses within the brain and central nervous system.

Neutrophils: the most abundant type of white blood cells and form an integral part of the immune system.

NICE: National Institute for Health and Clinical Excellence.

Nitrates: a salt of nitric acid with an ion composed of one nitrogen and three oxygen atoms.

Non-granular leucocytes: pertaining to lymphocytes and monocytes.

Non-invasive ventilation therapy (NIPPV)**:** is the accepted initial mode of treatment in subsets of patients with acute respiratory failure, the foremost being exacerbation of chronic obstructive pulmonary disease.

Non-specific defence mechanisms: the non-specific defence mechanisms are very diverse. They include

- mechanical barriers to invasion i.e. the skin and mucous membranes
- mechanical reflexes such as coughing, sneezing and the watering of the eyes
- effects of body temperature
- effects of chemical substances such as sebum and gastric acid
- the activity of phagocytic cells such as neutrophils and macrophages

Norepinephrine/Noradrenaline: a catecholamine and a phenethylamine. It is released from the adrenal medulla of the adrenal glands as a hormone into the blood, but it is also a neurotransmitter in the central nervous system and sympathetic nervous system.

NSAIDs: Non-steroidal anti-inflammatory drugs. Drugs that inhibit prostaglandins reducing inflammation thereby stopping pain.

O

Obsessive compulsive disorder: occurs where the person experiences persistent obtrusive negative thoughts and carries out specific tasks or actions to prevent feared outcomes from occurring; examples include hand washing, checking, collecting, hoarding, touching and counting rituals.

Obstructive Shock: shock caused by obstruction of blood flow

Oesophageal Varices: increased portal pressure causes development of collateral circulation where blood supply bypasses the liver and is shunted mainly to veins of the lower oesophagus and stomach.

Oestrogens: promotes development of reproductive structures, in particular the changes in the endometrium with each cycle. Development of the secondary sex characteristics, including development of breasts, voice pitch, hair pattern and the depositing of fat at the hips and abdomen. They also help maintain fluid and electrolyte balance.

Ondansetron: an anti-emetic.

Opiates: the narcotic alkaloids found in opium, the main opiates derived from opium are morphine, codeine.

Orchiectomy: removal of testicle.

Oropharynx: the mouth to the pharynx.

Orthopaedic ward: also referred to as trauma ward; caring for those with injuries related to bone.

Orthopnoea: Inability to breathe when lying flat or tilted, usually due to heart failure and the accumulation of fluid in the lungs.

Osmosis: the movement of a substance such as water through a semi permeable membrane from a solution of a low pressure to one of a higher solute concentration. Continues until concentrations are equalised.

Osteoblasts: a bone-forming cell.

Osteoclasts: cells that remove/destroy unwanted bone.

Osteomalacia: bones are weakened by the loss of calcium and phosphorus. The bone calcification fails; as a consequence the bones become soft and rubbery and are easily deformed. In children this is called rickets.

Osteomyelitis: inflammation of bone caused by infection. Can be limb and life threatening.

Osteoporosis: loss of the density of bone with increasing bone space. Leads to bone weakness and pathological fractures.

Ovaries: sex glands of the female.

Ovulation: part of the menstrual cycle where the ovum is discharged after the rupture of the graafian follicle.

P

Palmer: palm of the hand.

Pancreatitis: (inflammation of the pancreas) occurs when pancreatic enzymes become prematurely activated. Autodigestion of pancreatic tissue causes local inflammation and oedema

Panic attacks: where physical symptoms are experienced associated with the body being highly responsive. These include palpitations, chills, hyperventilation, dizziness, chest pain, choking, nausea and stomach churning.

Paracetamol: is the active metabolite of phenacetin, it is effective for its analgesic and antipyretic properties.

Pathogenesis: the mechanism by which a certain etiological factor causes disease. The term can also be used to describe the development of the disease, whether it is acute, chronic or recurrent.

Patient at Risk Scores (PAR/MEWS). Early warning scores aimed to assist nurses in recognising physiological deterioration.

Patient group direction (PGD), meaning the nurse can dispense drugs without waiting for a written prescription.

PEEP: positive end-expiratory pressure.

Pelvic inflammatory disease (PID): Gynaecological condition caused by an infection, can be sexually transmitted spreading from the vagina to the upper parts of a woman's reproductive tract in the pelvic cavity.

Penumbra: literally meaning, ''dim light''; the shadow that results when only part of the bright object is occluded.

Peripheral nervous system (PNS): Consists of neurons connecting the central nervous system (the brain and the spinal cord) to the rest of the body. Sensory neurons bring information to the central nervous system from sensory receptors of the body

Peritoneum: has two layers. The visceral peritoneum covers the abdominal organs and is continuous with the parietal peritoneum, which lines the abdominal wall. Between these layers is a potential space called the **peritoneal cavity** containing serous fluid, which lubricates the organs.

Phagocytosis: (eating cells) aimed at destroying foreign invaders (chemical or non-chemical), and dead or damaged cells.

Pharmacokinetics: the effects of the body on the drug

Pharmacodynamics: of the effects of the drug on the body

Phenylketonuria (PKU) is a very rare **autosomal recessive gene disorder.** This means that both parents need to carry the same altered gene, resulting in a 1:4 risk of having a child affected by the condition.

Phobias: focused aversions or highly reactive fears to specific phenomena, for example fear of spiders or heights

Photopic vision: the scientific term for human colour vision under normal lighting conditions during the day.

Pia mater: innermost layer of the meninges.

Pineal body: A tiny organ in the cerebrum that produces melatonin. Also called pineal gland or pineal organ

Pituitary gland: An endocrine gland located at the base of the brain that produces hormones, such as growth hormone, luteinizing hormone, follicle stimulating hormone and thyroid stimulating hormone.

Plasma: the yellow-colored liquid component of blood, in which blood cells are suspended.

Pneumonia: Pneumonia is an illness, which can result from a variety of causes, including infection with bacteria, viruses, fungi, or parasites.

Poly: used at the beginning of many words to mean many, multiple or excessive.

Pons: (Latin for bridge) lies between the medulla and cerebellum and appears as a broad band of transverse fibres.

Portal hypertension: A condition caused by cirrhosis of the liver. It is characterised by impaired or reversed blood flow from the portal vein to the liver, an enlarged spleen, and dilated veins in the oesophagus and stomach.

Positive inotropic effect: results in both an increase to the heart rate and force of contraction.

Postcentral gyrus: a prominent structure in the parietal lobe of the human brain and an important landmark.

Posterior: behind, back side.

Posterior (**dorsal**) **horns:** see **lateral horns**

Postictal: pertaining to the period following a seizure or convulsion; postictal drowsiness.

Postural blood pressure: recording the pressure changes in a patient from a lying to sitting position with their legs hanging over the bed. Can reveal a drop in the face of compensatory shock or reveal evidence of over active changes associated with anti-hypotensive medications.

Postural hypotension: also known as orthostatic hypotension results in dizziness caused by poor regulation of blood pressure after suddenly standing up. See **Postural blood pressure**.

Precentral gyrus: the convolution of the frontal lobe, contains the motor area.

Primary care: the first contact a patient has with the health care system, before being referred elsewhere. ''Family doctors'' and emergency departments are common sites for primary care.

Prochlorperazine: antipsychotic and anti emetic drug used to treat schizophrenia and to combat nausea and vomiting.

Progesterone: works with oestrogen to prepare the endometrium for fertilised ovum and also prepares the mammary glands for milk secretion.

Prophylactic: is any medical or public health procedure whose purpose is to prevent, rather than treat or cure, disease.

Proprioception: sensory system that allows us to know the position of body parts and the motions of muscles and joints.

Proximal: used to describe the area of the limb closest to the body.

Puberty: A complex biological and psychological process involving sexual development and accelerated growth.

Pulmonary oedema: is swelling and/or fluid accumulation in the lungs. It leads to impaired gas exchange and may cause respiratory failure.

Pulseless electrical activity (PEA) organised electrical rhythm without a cardiac output/pulse, i.e. the patient is pulseless despite a potentially normal electrical rhythm.

Pulseless ventricular tachycardia (PVT): one of the cardiac arrests rhythms.

Pulse pressure: the change in blood pressure seen during a contraction of the heart, i.e. the difference between diasystolic and sytolic; roughly 40mmHg.

Pus: (pyarthrosis) collection of white blood cells in tissue fluid, it may be either a sign of infection or inflammation.

Pyelitis: inflammation of the renal pelvis.

Pyelonephritis: infection spreading from the renal pelvis to the cortex of the kidney. Commonly linked to infections below the ureters or within the bloodstream

Pyuria: Pus in the urine

R

Ranvier (nodes of): also known as neurofibril nodes, are regularly spaced gaps in the myelin sheath around an axon or nerve fibre.

Recombinant tissue plasminogen activator (rTPA): type of thrombolytic/fibrinolytics agent.

Renin angiotensin aldosterone axis (RAAA): a complex cascade of regulatory events leading to an increase in blood pressure and sodium retention.

Renal cortex: the outer portion of the kidney between the renal capsule and the renal medulla.

Renal medulla: the innermost part of the kidney. The renal medulla is split up into a number of sections, known as the renal pyramids.

Renal pelvis: the funnel-like dilated proximal part of the ureter in the kidney.

Repolarisation: recharging.

Respiratory effort: the amount of physical work a patient uses to maintain oxygenation whilst at rest.

Retroperitoneal: located behind the peritoneum and outside the peritoneal cavity.

Rhabdomyolysis: the rapid breakdown of skeletal muscle tissue due to traumatic injury, either mechanical, physical or chemical.

Rheumatoid Arthritis: This is a form of arthritis that affects the auto immune system. The immune system attacks the body tissues, which is usually triggered by an antigen in a genetically predisposed person, the synovial membranes and attacked and they go on to degrade and malform the articular surfaces of the bones.

S

Schizophrenia: a collective term for several mental illnesses characterised by disorganisation of the personality, progressive withdrawal from society and perceived abnormal behaviour.

Scotopic vision: is the primary source of vision.

Secondary Care: Services provided by specialists who generally do not have first contact with patients.

Section 2: a compulsory admission for assessment, which lasts up to 28 days.

Section 136: Is the police power to remove a person to a place of safety, preferably a hospital for assessment by a doctor and approved social worker. The section lasts for up to 72 hours.

Seizures: Simple partial seizures: do not affect consciousness. Symptoms may include rhythmic movements of the contralateral face. **Generalised seizures**; affect the whole cortex with the patient's level of consciousness usually being impaired, there is often no aura or warning. **Myoclonic seizures;** are classified by sudden muscle contractions of specific muscle groups with no loss of consciousness. **Typical absence seizures;** are distinguished by a transient loss of consciousness and awareness of the environment with a vacant appearance, which lasts just a few seconds. **Complex partial seizures;** are the most common type of seizure in adults, commonly lasting less than three minutes**. Tonic-clonic seizures;** involve bilateral extension of limbs followed by synchronous jerking movements. There is often a cry before the seizure, a fall to the ground followed by incontinence, tongue biting, foaming at the mouth and loss of consciousness. There is a postictal phase and when patients wake they have muscle tenderness, transient confusion and exhaustion.

Self-harm: frequently occurs as a method of relieving pent up feelings of emotion or anger and is caused by low mood, depression, and feelings of self loathing or worthlessness.

Seminiferous tubules: this is where sperm are produced.

Septicaemia: blood poisoning. Rapid multiplication of bacteria and toxin production within the blood.

Serotonin: located mainly in the brain stem, where it controls mood, sleep, body heat and appetite.

Shock: a serious, often life-threatening medical condition where insufficient blood flow reaches the body tissues. As blood is the body's carrier of oxygen and nutrients, this leads to a deficiency of these essential inputs to life and an accumulation of waste products.

Sickle cell anaemia/disease: is a group of genetic disorders caused by sickle haemoglobin.

Sinoatrial (SA) node: is the impulse generating (pacemaker) tissue located in the right atrium of the heart, and thus the generator of sinus rhythm.

Skull: also the cranium; the bone encasing and protecting the brain.

Snellen Test: a visual acuity test easily performed via a chart.

Social constructionism: this philosophy challenges pre-conceived notions about how the world is understood by asking us to think about the way we all invent our own version of reality.

Solute: is a substance dissolved in another substance, known as a solvent.

Somatic (voluntary) nervous system: conducting impulses to skeletal muscles only.

Spastic cerebral palsy (spasticity): characterised by rigidity in muscles, which cause stiffness and restricted movement.

Specific defence mechanisms: certain types of cell designed to halt or terminate foreign invaders.

Spina Bifida: This is a congenital defect of the vertebral column, in which the laminae fail to unite at the midline.

Spirometry: measures lung function, specifically the measurement of the amount (volume) and/or speed (flow) of air that can be inhaled and exhaled.

Splenomegly: enlarged spleen.

Sterile: refers to anything that has been through a sterilisation process that effectively kills or eliminates transmissible agents (such as fungi, bacteria, viruses, prions and spore forms etc.) from a surface, equipment, foods, medications, or biological culture medium.

Stomach: an expandable storage sac between the oesophagus and the small intestine.

Stroke: the clinical designation for a rapidly developing loss of brain function due to an interruption in the blood supply to all or part of the brain, can be caused by thrombosis, embolism, or hemorrhage.

Stroke volume: The stroke volume can be defined as the amount of blood in the ventricles immediately before they contract (preload).

Subarachnoid haemorrhage (SAH): a bleed below the arachnoid space, associated with a high mortality and morbidity rate.

Subluxation: a partial dislocation of a joint in which the bones become out of alignment, but the joint itself is still intact.

Substantia nigra: part of the brain that produces dopamine.

Superior: towards the top or upper portion of the structure.

Synaptic cleft: small gap at a synapse, between neurons, where neurotransmitters are released.

Synovial joints: the most common and most moveable type of joints in the body.

Systole: the contraction phase.

T

Tachyarrhythmias: heart rate exceeding 100bpm can be of various causes including: atrial fibrillation and ventricular tachycardia.

Tachycardia: a heart rate of above 100 beats per minute.

Tachypnoea: increased rate of breathing.

Testosterone: male sex hormone (androgen).

Tetraplegia/quadriplegia: all four limbs equally affected.

Thalamus: located within the diencephalon, acts as a relay station for sensory inputs

Thermoregulatory Centre: the body temperature is monitored and controlled by the thermoregulatory centre in the brain. This centre has special cells sensitive to the temperature of blood flowing through the brain. Temperature receptors in the skin also send nerve impulses to this centre giving information about skin temperature.

Thrombocytes: cell fragments circulating in the blood that are involved in the cellular mechanisms of primary homeostasis leading to the formation of blood clots.

Thrombolysis: aims to dissolve a thrombus occluding an artery and restore circulation in the acute phase of ischaemia.

Thrombus: where a clot or atherosclerotic plaque dislodges occluding a vessel causing ischaemia.

Thyroxine: is the major hormone secreted by the follicular cells of the thyroid gland.

Torsion: twisting; commonly affects the testicles or ovaries.

Trabecula: fibrous bands of connective tissues that extend into the interior of an organ from its surrounding to stabilise the functioning cells.

Transient ischaemic attacks (TIA): ischaemic episode affecting the brain, initially the patient may appear to have suffered a stroke but signs and symptoms will resolve within 24 hours.

Tremors: involuntary, purposeless movements with various causes including: Parkinson's disease, alcohol withdrawal, anxiety states and old age.

Troponin: a complex of three proteins that is integral to muscle contraction in skeletal and cardiac muscle, but not smooth muscle.

Tuberculosis: a common infectious disease caused by mycobacteria, mainly *Mycobacterium tuberculosis*. Tuberculosis most commonly attacks the lungs (as pulmonary TB) but can also affect the central nervous system, the lymphatic system, the circulatory system, the genitourinary system, bones, joints and even the skin.

Tympanic: meaning the tympanum, a thin semitransparent membrane in the middle ear that transmits sound vibrations to the internal ear.

U

Ulna: the bone on the inner side of the forearm.

Ultrasound: a device that converts high frequency sound waves into heat which is reflected in differing degrees of various tissues.

Uraemia: A clinical syndrome synonymous with failing kidneys whereby excessive amounts of urea are found within the blood.

Urea: the waste product of protein metabolism. Can accumulate in the blood in the presence of renal failure or excessive production.

Ureters: the ducts that carry urine from the kidneys to the urinary bladder.

Urethra: a tube, which connects the urinary bladder to the outside of the body.

Urethritis: inflammation of the urethra; characterised by pain on urination (can be caused by localised inflammation/infection or linked to gonococcal infection)

Uric acid: an acid formed via the metabolism of proteins, can cause stone formations.

Urine: a liquid produced through the kidney, collected in the bladder and excreted through the urethra.

Urinalysis: a test performed on urine and one of the most common methods of medical diagnosis. A part of a urinalysis can be performed by using urine dipsticks, in which the test results can be read as color changes.

V

Vaccine: an antigenic preparation used to establish immunity to a disease.

Vagina: musculomembranous genital canal lying inbetween the urinary bladder and the rectum.

Venous return: the rate of blood flow back to the heart is the venous return, it normally limits cardiac output.

Ventricular fibrillation (VF): a condition in which there is uncoordinated contraction of the cardiac muscle of the ventricles in the heart. As a result the heart fails to adequately pump blood and hypoxia will occur followed by cardiac arrest.

Ventricular tachycardia: a rapid heart beat initiated within the ventricles, characterised by 3 or more consecutive premature ventricular beats, can be pulseless and lead to ventricular fibrillation.

VIP Score: visual infusion phlebitis score, a tool for assessing a cannula site for signs of infection/damage.

Viruses: a large group of disease producing agents only visible under microscope. Responsible for chickenpox, measles, herpes zoster and the common cold.

W

Warfarin: an oral anticoagulant, used to prolong the clotting time in patients at risk of clot formation.

Waterlow score: a structural tool that provides an estimate of the risk of a patient developing a pressure sore whilst hospitalised.

X

Xiphisternum: the end section of the sternum.

Y

Yankauer suction catheter: a wide bore tube facilitating the removal of fluids from the oropharynx.

Z

Zygote: A single diploid cell resulting from the fusion of male and female gametes at fertilisation.

Appendix: Answers to end of chapter quizzes

Chapter 2
1. B
2. A
3. B
4. D
5. C
6. D
7. A
8. A
9. D
10. A

Chapter 3
1. A
2. B
3. C
4. C
5. A
6. B
7. C
8. A
9. D
10. C

Chapter 4
1. B
2. D
3. C
4. D
5. C
6. C
7. A
8. B
9. D
10. C

Chapter 5
1. C
2. A
3. D
4. C
5. A
6. B
7. D
8. D
9. D
10. A

Chapter 6
1. C
2. B
3. B
4. A
5. C
6. D
7. A
8. C
9. A
10. B

Chapter 7
1. B
2. B
3. D
4. A
5. C
6. D
7. C
8. A
9. B
10. D

Chapter 8
1. A
2. C
3. C
4. D
5. C
6. A
7. A

8. B
9. D
10. C

Chapter 9
1. C
2. B
3. A
4. B
5. B
6. A
7. A
8. D
9. A
10. D

Chapter 10
1. A
2. C
3. A
4. D
5. A
6. B
7. B
8. A
9. D
10. A

Chapter 11
1. A
2. A
3. C
4. A
5. D
6. D
7. B
8. B
9. C
10. C

Chapter 15
1. C
2. B
3. ABC
4. C
5. The individual clutching at their throat
6. C
7. D
8. A
9. B
10. D

Chapter 16
1. C
2. C
3. C
4. D
5. A
6. C
7. C
8. A
9. D
10. D

Index

Locators shown in *italics* refer to boxes, figures and tables.

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