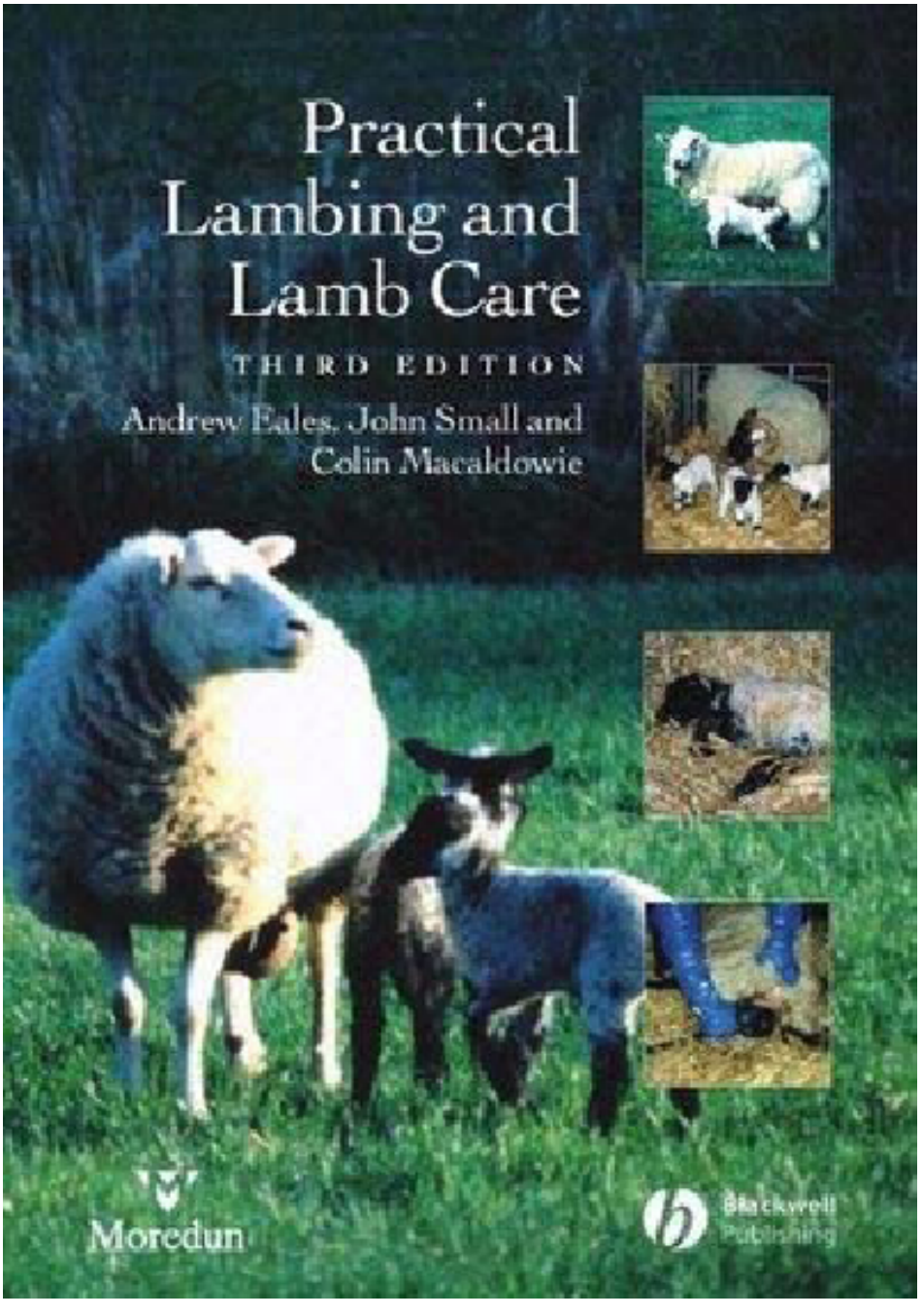
Practical Lambing
and
Lamb Care



Practical Lambing and Lamb Care

A Veterinary Guide

Third Edition

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Preface to the First Edition

Each year millions of newborn lambs and tens of thousands of ewes die at lambing time. This level of loss is unacceptable, and management from before tupping to lambing itself must be aimed at reducing it to an absolute minimum. This book is concerned with one small but important part of this management – veterinary care of lambing.

We have addressed ourselves to those who care for lambing ewes and newborn lambs, principally shepherds, and of others closely concerned with lambing management: veterinary surgeons, agricultural and veterinary students and agricultural and veterinary teachers.

To some extent this is a 'how you do it' text, but we have tried to introduce an understanding of the various problems and techniques discussed. Thus, in the first chapter, we have concentrated on the factors which make newborn lambs apparently so prone to problems in the first few days of life. The prevention of problems in newborn lambs depends on an understanding of these factors.

We have assumed throughout that the shepherd has a sympathetic relationship with his veterinary surgeon. It is, of course, totally impractical for the veterinary surgeon to attend each difficult lambing, each sick ewe and each sick lamb. The cost would be prohibitive, treatment in many cases would inevitably be given too late and there are not enough vets to go around anyway. This means that the veterinary surgeon must assume the role of consultant. Before lambing, the problems likely to be encountered

should be discussed, treatments defined and techniques learned. The role of the veterinary surgeon does not cease here. New problems will arise and the treatment of routine problems should be monitored. An occasional visit during lambing is most helpful. On-going problems can be reviewed and mental notes made for improvements in the future.

This text may be used solely as a first-aid reference for when things go wrong, but to get maximum benefit we would suggest that it is read before lambing. This should ensure that the necessary equipment is to hand and that valuable time is not wasted looking for the appropriate section by torchlight at three o'clock in the morning!

In writing this book we have drawn freely on the work of our colleagues at the Moredun Research Institute and many friends and colleagues from the Agricultural Development and Advisory Service, the Hill Farming Research Organisation, the Meat and Livestock Commission, the Rowett Research Institute and the Scottish Agricultural Colleges. We hope our text does full justice to their work.

We thank Dr W.B. Martin DVSM PhD MRCVS FRSE, Director of the Moredun Research Institute, for encouragement throughout this project.

We are indebted to B.J. Easter C&G Adv. and A. Inglis C&G Adv., whose photographic skills are displayed throughout the text.

We thank the undermentioned who reviewed the original draft and made many helpful and constructive suggestions: R.M. Barlow DSc DVM&S MRCVS; W.S. Dingwall BSc PhD, J. Fitzsimmons NDA; J.A. Gilmour BVM&S FRCVS; Lorna A. Hay BVMS MRCVS; D.C. Henderson BVM&S MRCVS and G.E. Jones BVSc DTVM PhD MRCVS.

The drafts were most ably typed by Ms R. Cannel, Miss J. Goodier and Mrs K. Mark.

Finally we received unfailing support from our families throughout the composition of this work and we offer them our sincere and humble thanks.

ANDREW EALES
JOHN SMALL
Moredun Research Institute, Edinburgh
December 1984

Preface to the Second Edition

The reception of the first edition of this book has been most gratifying and has encouraged us to proceed to this second edition.

In this new edition we have incorporated recent developments, of which there have been many, and also extended the scope of the text to include infectious abortion in ewes and problems in lambs to weaning. We hope our readers will find these additions helpful.

We have also added a new chapter on welfare at lambing. Lambing is a busy time for all shepherds and sheep farmers, but it is also the time when most problems arise. Understaffing and tiredness can easily lead to problems missed and unnecessary suffering. A little forethought will prevent most of these problems.

We thank B.J. Easter C&G Adv. for his skilful help with photography.

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The drafts were most ably typed by Mrs J. Whitehouse and Mrs S. McGill.

We thank Christine and Vasanthi for carefully checking the drafts and for their forbearance during our many 'editorial meetings'.

Finally we are grateful to our publisher, Longman Higher Education, for their support, understanding and co-operation in this venture.

ANDREW EALES
JOHN SMALL
July 1993
Edinburgh

Preface to the Third Edition

It has now been eight years since the last edition of *Practical Lambing and Lamb Care* was published yet the regard in which it is held by farmers, vets and students shows no apparent signs of diminishing. As a result, it has been our privilege to update the contents for the new Millennium. Very sadly, Dr Andy Eales died during the course of the revision after a long illness faced with courage and dignity. However, in tribute to his memory, we have strived to retain the essence of his thoroughly practical, yet humorous, approach throughout.

This new edition maintains the impressive scope of the earlier books, but also incorporates as many of the latest husbandry and healthcare developments as possible. Revised areas include: resuscitation of the newborn, prevention and treatment of parasitic gastroenteritis, prevention of infectious abortion, lambing under organic management systems, safe use of medicines, the requirements of the new sheep welfare codes and humane slaughter of lambs and ewes. Many of the original illustrations have also been revised, replaced or added to as necessary.

Many thanks to Dr David Buxton BVM&S PhD FRCPath MRCVS for reviewing the new material and to other colleagues at Moredun Research Institute and elsewhere for making many helpful and constructive comments. Thanks also to Professor Karl Linklater BVM&S PhD MRCVS and Mr Alastair Greig BVM&S FRCVS of the Scottish Agricultural College for access to their unrivalled slide collections. We are also indebted to Mrs Sandra

McGill for recovering the original text and Hazel Simm for preparing the line diagrams.

Finally we are also grateful to our publisher, Blackwell, for their support and cooperation in this venture and for making sure that Andy's excellent book is available to everybody once again.

COLIN MACALDOWIE
JOHN SMALL
September 2003
Edinburgh

To the memory of our late friends and colleagues

John S. Gilmour
BVM&S MRCPath FRCVS

and

Frank Andrew (Andy) Eales
BVSc BSc MSC PhD DSHP MRCVS

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Further Reading

Cardell, K. (1998) *Practical Sheep Keeping*. The Crowood Press.

Charnley, J. & Winter, A.C. (1999) *The Sheep Keeper's Veterinary Handbook*. The Crowood Press.

Clarkson, M.J. & Faull, W.B. (1985) *Notes for the Sheep Clinician*. Liverpool University Press, Liverpool.

DEFRA (2000a) *Codes of Recommendations for the Welfare of Livestock (Sheep)*. TSO Publications, London.

DEFRA (2000b) *Improving Lamb Survival*. TSO Publications, London.

Henderson, D.C. (1990) *The Veterinary Book for Sheep Farmers*. Farming Press, Ipswich.

Martin, W.B. & Aitken I.D. (eds) (2000) *Diseases of Sheep*, 3rd ed. Blackwell Scientific Publications, Oxford.

Meat and Livestock Commission (1983) *Feeding the Ewe*. MLC, PO Box 44, Queensway House, Bletchley, Milton Keynes, MK2 2EF.

UKROFS (2003) *Standards for Organic Food Production*. UKROFS.

1 The Newborn Lamb

What makes the newborn lamb prone to so many problems? This is a complex subject and researchers are still looking for many of the answers. Research has, however, revealed much that is useful to those of us who work at the 'sharp end'. In the next few pages we have summarised this knowledge. First we shall look at what we might call the 'perfect' lamb, such as a good single out of a mature ewe in good body condition, and see how this lamb is disadvantaged when compared with adult sheep. Then we will examine the various factors that can cause newborn lambs to be less than 'perfect' and more prone to problems in the first few days of life.

PROBLEMS FACING THE 'PERFECT' LAMB

Most problems in newborn lambs are associated with nutrition, temperature regulation or infectious disease and it is useful to consider the differences between the adult and the newborn under these three headings.

Nutrition

When considering nutrition in the newborn lamb we are mainly concerned with energy. Protein and other nutrients are of course essential for growth, but we are most interested in survival for the first few days of life and a shortage of energy is most likely to

reduce viability. When compared with the adult sheep the newborn lamb has three problems:

(1) The lamb has lower energy reserves in its body in the form of stored fat and carbohydrate. Total energy reserves in the newborn lamb only account for about 3% of body weight – the corresponding figure in the adult sheep is 10–15%.
(2) Whereas the adult sheep feeds itself, providing fodder is available, the newborn lamb is totally dependent on its mother for its food supply.
(3) The newborn lamb needs more energy than the adult sheep on a body weight basis. This statement requires a little explanation. The most important use of energy in any mammal in a cold climate is the maintenance of body temperature – keeping warm. An animal loses heat mainly through the skin, and if the body temperature is to be maintained heat must be produced to equal this heat loss. The crucial point is that the newborn lamb has, in proportion to its body weight, considerably more skin than the adult sheep and thus proportionately it loses more heat. To give an example: a 4 kg lamb has proportionately three times more skin than a 60 kg adult sheep. This means that in proportional terms it will lose three times as much heat and to maintain its body temperature it will have to produce three times as much heat. To do this it needs three times as much energy, i.e. food.

In summary, the lamb has limited energy reserves stored in its body, is totally dependent on its mother for its energy supply and, in proportion to its body weight, needs considerably more energy than the adult sheep. It is not surprising that starvation is a major killer of newborn lambs.

Temperature regulation

We have seen already that a lamb must produce as much heat as it loses if it is to maintain its body temperature. If a lamb loses too much heat or cannot produce enough heat its body temperature will fall (hypothermia) and it will die.

Let us first consider the problem from the heat-loss point of view. We already know that the newborn lamb has proportionately more skin than the adult sheep and so has an inherent higher rate of heat loss. There are two further factors that increase the rate of heat loss from newborn lambs:

(1) the birth coat has a low insulation value when compared with the full fleece of the adult sheep;

(2) the newborn lamb is wet when it is born. This not only reduces the insulation value of the fleece but also leads to a high rate of heat loss caused by the evaporation of water from the coat, especially in windy conditions. Anyone who has stepped out of a piping hot bath into a cold draughty bathroom will appreciate this problem.

The ewe plays a very important part in reducing the rate of heat loss from the newborn lamb. The faster she licks her lamb dry, the lower is the rate of heat loss and the risk of hypothermia. Shelter also reduces the risk of hypothermia and stone dykes or walls of straw bales greatly moderate the effects of a strong wind. Housing, of course, is the best form of shelter.

These three factors – a large area of skin through which to lose heat, a birth coat of poor insulation value, and being born wet – all add together to make the newborn lamb highly susceptible to hypothermia due to exposure in the first five hours of life. Hypothermia during this period probably accounts for one-quarter of all lamb losses.

The 'perfect' newborn lamb is an excellent generator of heat. A 6 kg lamb can produce as much heat as a 100 watt light bulb! *but* a high rate of heat production can only be maintained if energy is available. If a lamb starves, its body energy reserves quickly become exhausted and heat production practically stops. Hypothermia, in this case caused by starvation, is the inevitable result, even in a warm environment such as a sheep house. Lambs can die from hypothermia due to starvation before they are twelve hours old. This problem accounts for another quarter of all lamb losses.

Resistance to infectious disease

In the adult sheep, resistance to many diseases caused by agents such as bacteria and viruses is acquired by previous exposure to the agent. This may be by exposure to the disease itself, or by treatment with a vaccine such as a clostridial vaccine, which induces resistance to a disease without actually causing it. Vaccination has two effects on the body's immune system: first, the expansion of immune cell (lymphocyte) populations and production of antibodies found in the blood and elsewhere is stimulated. If infection occurs later these immune cells and antibodies 'attack' the disease agents or their products and render them harmless. Second, the immune system is 'primed' so that when infection does occur, more of the appropriate antibody is quickly produced. With many vaccines the initial course of treatment consists of two

injections with an interval between them. The first injection primes the immune system and stimulates the production of some antibody. The second injection stimulates the already primed immune system to produce more antibody. After the initial course of injections only a single booster injection is required periodically to stimulate the production of more antibody.

The newborn lamb has a problem. It has experienced neither disease nor vaccination. The antibodies in the ewe's blood cannot pass to the foetus (the developing lamb in the womb) and thus vaccination of the ewe confers no immunity on the lamb before birth. (The same situation exists in the cow but in some species, such as man, antibodies can pass from the mother to the foetus before birth.) While antibodies in the ewe's blood cannot cross the placenta to the foetus they do cross into the udder and are concentrated in the colostrum (first milk), which is produced for a few days before and for up to 18 hours after birth. When the lamb sucks colostrum the antibodies are absorbed through the wall of the small intestine and enter the lamb's blood where they circulate to all the organs of the body to provide instant protection against infection. The benefits of vaccination in the ewe are thus passed on to the lamb. But this benefit will only be fully acquired if the lamb sucks plenty of colostrum as soon after birth as possible and throughout the first twelve to fifteen hours of life. An average-sized, healthy lamb will actually consume as much as one litre (two pints) of colostrum during this period providing it is available. As well as providing antibodies to prevent infection, this quantity of colostrum will supply all the lamb's energy needs over these first few hours. After this time the digestive system matures and the antibodies are broken down instead of being absorbed through the wall of the small intestine. Some of the antibodies in colostrum manage to remain active within the gut itself, thus intestinal diseases, such as enteritis, are also much less likely if a lamb receives adequate colostrum.

The antibodies obtained from colostrum slowly wane in the lamb's blood over the first four to twelve weeks of life, for the immune system of the lamb itself has not been primed to produce antibodies. The lamb must later be vaccinated if protection is to be continued.

Colostrum is obviously of great benefit to the newborn lamb but it can only give protection against diseases which the ewe has previously experienced itself by either infection or vaccination. If the lamb becomes infected with a bacterium or virus that the ewe has not previously met, it will have little defence. For this reason a

high standard of hygiene is an essential part of good lambing management. Ewe nutrition will also significantly affect the quantity and quality of colostrum produced, something which must be considered throughout pregnancy (Chapter 6).

In summary, when a lamb is born it has practically no defence against infectious disease. The sucking of colostrum, up to one litre over the first few hours of life, goes a long way to remedy this situation. It must be remembered, though, that colostrum itself is not enough. The newborn lamb is much more susceptible to infectious disease than the adult sheep and management must be adjusted accordingly.

An extra route for infection

An increased susceptibility to infection is bad enough, but the newborn lamb also has an extra route by which infection may enter the body – the navel. To understand the significance of this route we must examine a most fascinating aspect of physiology – how blood circulates in the foetus and the newborn.

Figure 1.1 shows a diagrammatic representation of the adult circulation (in both sheep and man). Oxygenated blood is pumped from the left heart into the aorta and round the body, where it supplies oxygen and takes up carbon dioxide. The oxygen-depleted blood is returned in the veins to the right heart. The right heart in turn pumps the blood through the lungs where it loses carbon dioxide and takes on more oxygen, and then to the left heart where the circuit begins again: a nice, simple, efficient arrangement.

The situation in the foetus is not quite so simple (Fig. 1.2). The components in Fig. 1.1 – lungs, heart and body – are still there,

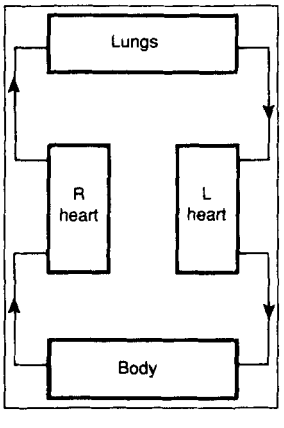


Fig. 1.1 Blood circulation in the adult.

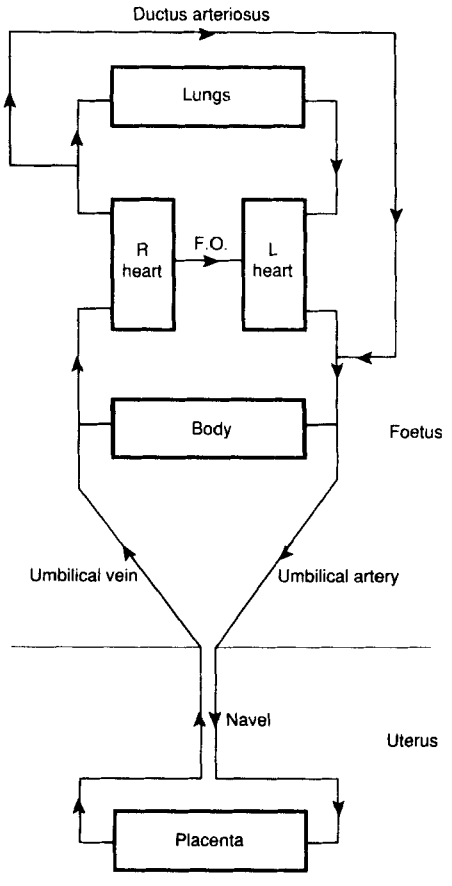


Fig. 1.2 Blood circulation in the foetus (F.O. = Foramen Ovale).

but we have gained the placenta, which for the foetus performs the function of the lungs, in addition to transferring nutrients from the ewe to the foetus.

Let us now commence our circuit, as before, in the left heart. Forty percent of the left heart output perfuses the body, but 60% leaves the body via the umbilical artery and the navel to perfuse the placenta. Blood returns from the placenta via the navel and the umbilical vein to join the blood returning from the body. This mixed blood returns to the right heart.

The lungs in the foetus are not functioning. They are simply growing. Thus the requirement of the lungs for blood supply is much less than in the breathing lamb or adult sheep. A reduced blood supply is achieved by means of two short circuits (Fig. 1.2), the *foramen ovale* (round hole) and the *ductus arteriosus*. The foramen ovale is in fact a hole connecting the right and left sides

of the heart. If the foramen ovale persists after birth, it is known as a 'hole in the heart'.

The effect of these short circuits is that approximately only 10% of the blood leaving the right heart perfuses the foetal lungs; 50% passes through the foramen ovale and 40% through the ductus arteriosus. Our circuit is now complete.

What happens at birth? The dramatic event we see is accompanied by equally dramatic unseen changes in the circulation.

As the lamb falls to the floor the umbilical cord breaks. This tearing action is vital, for in response the umbilical vessels contract and constrict, preventing haemorrhage. Cutting the cord eliminates this response and a fatal haemorrhage can occur.

Breaking of the umbilical vessels cuts off the placental supply of oxygen to the lamb, and very soon a shortage of oxygen to the brain stimulates breathing. As the first breath is taken, the foramen ovale and the ductus arteriosus functionally shut and the newborn lamb suddenly acquires the circulation of the adult (Fig. 1.3).

In a premature lamb (Fig. 3.28, p. 86) the lungs may not fully expand. If this occurs the foramen ovale and the ductus arteriosus

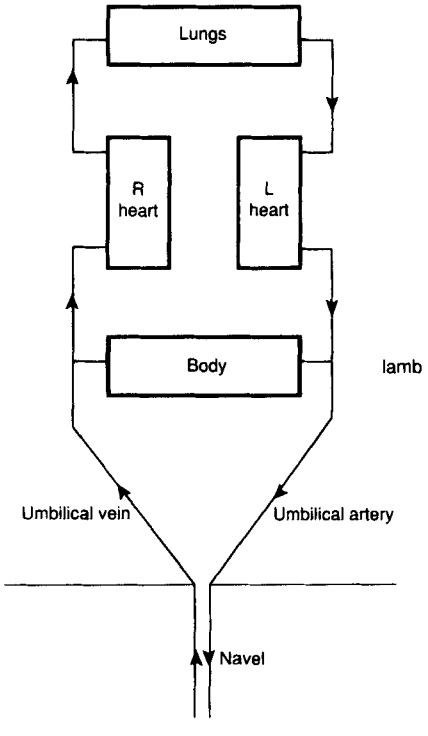


Fig. 1.3 Blood circulation in the newborn lamb.

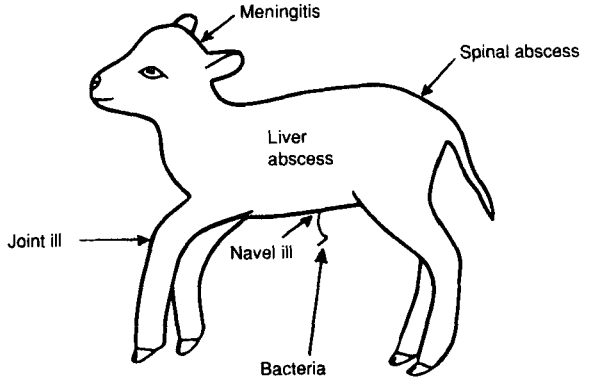


Fig. 1.4 Diseases that can result from the entry of bacteria via the navel.

may not shut properly. Poor lung function and a leaky circulation may thus handicap the premature lamb.

What is the significance of this remarkable sequence of events to infectious disease? Although the umbilical artery and umbilical vein in the navel are functionally shut, preventing the leakage of blood, they are not anatomically shut for some time. The umbilical artery leads to the *aorta* (the major artery of the body), whilst the umbilical vein leads, via the liver, to the *vena cava* (the major vein of the body). Thus there is a potential route for infection to gain entry via the umbilical vessels into the general circulation, and then to lodge anywhere in the body. Figure 1.4 illustrates the common consequences of such infection.

Prevention of navel infection depends on three aspects of good management: first, keep the lambing environment as clean as possible – plentiful new bedding is essential; secondly, dress navels promptly after birth (Chapter 7); thirdly, ensure lambs receive adequate colostrum in the first hour of life. This last point is crucial to the prevention of all disease in newborn lambs.

In problem situations, preventive antibiotics may be required. This, however, must be regarded as a last resort, as the damage may already be done and excessive use of antibiotics contributes towards problems of drug resistance.

CONSTRAINTS ON LAMB VIABILITY

In spite of the inherent problems of the 'perfect' lamb, most such lambs survive and losses are much more likely to occur in lambs in which have been compromised in some way. Many of the factors

Table 1.1 The relative importance of the different causes of lamb death.

Foetal stillbirth (death before lambing)	10–20%
Parturient stillbirth (death during lambing)	10–20%
Hypothermia due to exposure	15–25%
Hypothermia due to starvation	20–30%
Infectious disease	10–15%
Congenital abnormalities	c.5%
Other causes	c.5%

that reduce viability are largely related to events during the period of pregnancy – before the lamb is even born (Table 1.1).

Life starts at conception with the fertilisation of one or more eggs (*ova*) by sperm. For the next two weeks the embryo (fertilised egg) develops without any attachment to the ewe's womb (*uterus*). It receives its nourishment and oxygen from the fluid in the uterus. During the third week the developing embryo becomes attached to the wall of the uterus, in a process known as *implantation*, and the placenta starts to develop.

We recognise the placenta at birth as the 'afterbirth' or 'cleansing'. This organ, which is part of the foetus, as the embryo is now called, attaches to the wall of the uterus and carries food and oxygen to the foetus and waste products in the opposite direction. In the sheep (and the cow) the attachments are at specific sites. On the mother's side, on the wall of the uterus, are small button-like structures called *caruncles* (this word literally means a fleshy lump). When the placenta contacts a caruncle, a corresponding cup-like structure is formed in the placenta – the *cotyledon* (derived from the Greek word *cotyle* meaning a cup) (Figs 1.5 and 1.6). The cotyledons are the raised structures that we see in the afterbirth. It is through these units, each consisting of a caruncle and a cotyledon, that nourishment passes from the ewe to the foetus.

From weeks four to ten the major development in the uterus is the growth of the placenta. Comparatively little foetal growth takes place – a single lamb destined to weigh 5 kg (10 lb) at birth may weigh less than 0.5 kg (1 lb) at mid-pregnancy. The second half of a pregnancy is devoted to foetal growth, during which time foetal weight may increase more than tenfold.

With this background we shall now consider some of the specific factors which can affect the development of the foetus and in turn the viability of the newborn lamb.

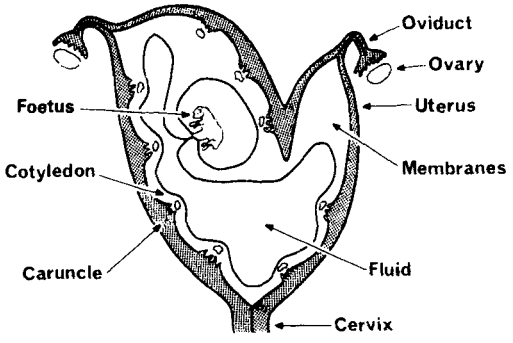


Fig. 1.5 A schematic representation of a uterus 40 days after conception (adapted from Hunter 1980).

Fig. 1.6 The contents of a uterus 90 days after conception. The blood vessels running from the cotyledons to the umbilical (navel cord) can clearly be seen (picture by Dr D. Buxton). See also colour plate section.

Placental constraints

The major determinant of foetal development and eventual newborn lamb weight is placental size. If only a moderate restriction is imposed a normal lamb will be born, but it will be small, have low body energy reserves and may be born prematurely. If a more severe restriction is imposed the foetus will be short of oxygen in addition to food and a very small, weak lamb will be born prematurely. If the placenta is very small the foetus may die and be stillborn – a foetal stillbirth. There are two factors that can influence placental size: litter size and ewe nutrition.

Placental development and litter size

The placenta is a part of the growing foetus, and when there are two foetuses (twins) there will be two placentae. Triplets will have three placentae and so on. So far so good – but there is a problem. The number of caruncles (buttons) on the wall of the uterus is limited, around 100–120 by the end of pregnancy, and when there is more than one foetus the number of caruncles for each foetus is reduced. The size of each placenta is also reduced and so therefore is its capacity to transfer nutrients from the ewe to the foetus. It is not surprising therefore that twins tend to be smaller than single lambs and triplets smaller than twins. This problem of smaller placental size can be especially serious when the two or three foetuses do not divide the available caruncles equally between them, leaving one foetus with a very small placenta indeed. The 'runt' lamb in a set of triplets is a consequence of this situation.

Occasionally, a ewe in good condition may produce a pair of small twins. Research has revealed one explanation for this. The 'twins' are not twin lambs at all – they are triplets! The 'missing' triplet died early in the pregnancy, but after the distribution of the uterine caruncles between the three foetuses had taken place. The remaining two foetuses were unable to expand into the area of uterus occupied by their former mate and thus for the remainder of the pregnancy they received the nutrient supply appropriate to a triplet even though there were only two of them. Foetal death in early pregnancy is often associated with rough handling or poor nutrition.

In summary, twins and triplets are likely to be smaller and less well developed than single lambs because they have smaller placentae that restrict the passage of nutrients to the foetuses in the second half of pregnancy.

Placental size and ewe nutrition

It has become clear over recent years that ewe nutrition in the first half of pregnancy can affect the growth of the placenta and thus the later development of the foetus. However, the relationship between ewe nutrition and placental growth does not seem to be as simple as *more food = more placenta.*

The ideal would appear to be to maintain a nutritional level before and during mating to produce lowland ewes of condition score 3½ (Chapter 6). After tupping, the level of nutrition should be continued to maintain body condition or to permit a gradual loss of condition of half a condition score (but no more) over the first half of pregnancy.

What must be avoided is any abrupt change to nutritional plane, either up or down. If ewes are moved to flush grass for tupping, perhaps supplemented by concentrates, and then at the end of tupping are returned to bare pasture, detrimental effects on placental growth and subsequent lamb growth can be expected.

Ewe nutrition

We have summarised the effects of nutrition during pregnancy in Table 1.2. Poor nutrition can have very different effects depending on its timing. The significance of poor placental development can clearly be seen. The effects of poor nutrition in the first half of pregnancy cannot be fully overcome by improved nutrition in the second half. By contrast poor nutrition in the second half of pregnancy following good nutrition in the first half has minimal effects on lamb growth, but disastrous effects on ewe condition and colostrum production.

In addition to the effects noted in Table 1.2, poor nutrition at tupping will result in a low ovulation rate and thus fewer lambs conceived. It will also result in an increased rate of embryonic mortality – death of fertilised eggs before they become attached to the wall of the uterus.

Ewe age

Mortality is generally higher in lambs out of either very young or very old ewes. The young ewe is an inexperienced mother. She takes longer to lick her lamb dry and may be unwilling to stand for sucking. These problems are most evident when twins

Table 1.2 The effects of nutrition during pregnancy.

Nutrition		**Effects on:**				
First half	**Second half**	**Placental growth**	**Foetal growth**	**Birth**	**Ewe condition at lambing**	**Colostrum supply**
Good	Good	Good	Good	Normal	Good	Good
Poor	Poor	Poor	Poor	Premature	Thin	Little or none
Poor	Good	Poor	Poor	May be premature	Fair	Fair
Good	Poor	Good	Moderate	May be premature	Thin	Little or none

are produced. By contrast, the older ewe tends to be a good mother, but poor nutrition, often related to teeth or feet problems, can lead to the birth of small weak lambs and a shortage of milk.

Congenital abnormalities

A congenital abnormality is any abnormality present at birth. These abnormalities result from some interference in the development of the foetus during pregnancy. The problem may be inherited from one of the lamb's parents. *Entropion* (turning-in of the lower eyelid) would seem to be one example, since it is more common in some breeds than in others. Other conditions are not inherited and are acquired from some outside interference. Swayback is one example in lambs (Chapter 3) and the thalidomide disaster in children in the 1960s was a tragic example from the human world.

Many congenital abnormalities do not threaten life directly but may do so indirectly. Entropion, a problem where the lamb's eyelids turn in and rub on the eye (Chapter 3), if not treated, leads to blindness and thence starvation. Deformities of the jaw or palate can have the same result since they often make sucking either difficult or impossible.

Parturition

Two aspects of birth can markedly affect viability. The first is prematurity and the second is hypoxia (a shortage of oxygen) during birth itself.

Premature birth is associated with poor ewe nutrition and with twin or triplet litters. It may also be caused by infectious diseases such as enzootic abortion. In all cases the result is the birth of small, weak lambs of low viability. The more premature the birth the greater the problem. Premature lambs have poor birth coats and a low capacity to produce heat and are thus very susceptible to hypothermia. These lambs are also physically weak and so may not be able to suck. Even if they can suck they often go hungry, since ewes which lamb prematurely often have no colostrum. Premature lambs can have breathing problems because the lungs are immature and may not fully expand when the first breath is taken (Figs 1.7 and 1.8). With careful nursing many premature lambs will survive, but this is a time-consuming and often frustrating exercise and prevention is much better than cure.

Severe hypoxia during birth is a problem that probably affects about 3% of all lambs born. During pregnancy, and most of the birth process, the lamb derives its oxygen supply from the ewe via the placenta. The task of supplying oxygen is taken over by

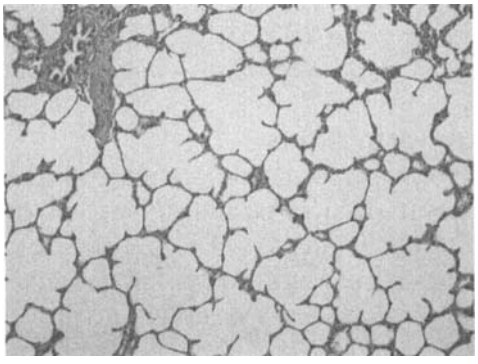


Fig. 1.7 A histological section (tissue seen under the microscope) showing lung from a healthy newborn lamb. See also colour plate section.

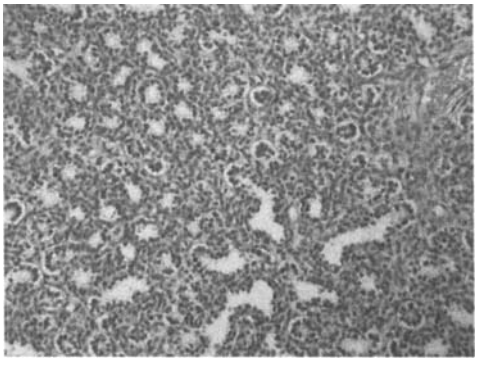


Fig. 1.8 A histological section of lung taken from a premature lamb. The lung has not expanded. See also colour plate section.

the lungs when the lamb starts to breathe immediately it is born. Inevitably, in many births there is a gap between stopping the placental supply of oxygen and starting to breathe. Provided this gap is fairly short no problems arise. But if the gap is unduly prolonged, as might occur in a difficult lambing, the lamb may die from hypoxia and be stillborn – a parturient stillbirth. Some lambs affected by hypoxia do survive, but only just. These lambs appear lifeless after birth and quickly become hypothermic, for they can produce very little heat.

This lifeless state is thought to be caused by acidity (low pH) of the lamb's blood, a product of the hypoxic period. This condition, known as *metabolic acidosis*, is self-correcting provided hypothermia is prevented and any underlying brain damage due to oxygen starvation is not too severe. Affected lambs should be dried and placed in a warmer for the first few hours of life (Chapter 7).

SUMMARY

All lambs are disadvantaged when compared with adult sheep because:

- they have a high energy requirement but low energy reserves and are totally dependent on the ewe for food;
- they have poorly-insulated coats and are born wet;
- they have little resistance to disease (this problem is overcome to a large extent when the lamb sucks plenty of colostrum).

Viability is further restricted if:

- the lambs are twins or triplets;
- ewe nutrition is poor;
- the ewe is either very young or very old;
- the lamb is affected by a congenital abnormality;
- the lamb is born prematurely;
- the lamb suffers severe hypoxia during birth.

By now you may have the impression that most lambs are born with a death wish. They are not! The notes above do tell us something positive:

- Good management both before and at lambing can avoid many problems.
- We know which lambs are likely to require most attention at lambing. A single out of a fit ewe will do very well without our interference, whereas triplets out of an old ewe or twins out of a ewe lamb will probably benefit from a little human help.

2 Lambing the Ewe

Much has been written over the years about assisting the lambing ewe, but many lambs and ewes still die needlessly. This is not through any lack of effort by lambing shepherds, but is usually a case of doing the wrong thing at the wrong time and not knowing when to stop and seek professional assistance. In the notes below we have described common problems met at lambing and how these should be approached. Throughout, we have tried to indicate when the shepherd should stop and summon professional help.

THE NORMAL LAMBING

Signs of lambing may be seen some time before the birth actually begins. The ewe may not come to the feed trough and may separate herself from the flock. If closely watched she may be seen to lift up her head periodically and purse her lips – a sign that her uterus (womb) is contracting. These uterine contractions become progressively more frequent until the ewe starts to strain and bear down and it is obvious that something is happening.

The first physical sign of lambing at the vulva varies from ewe to ewe. The 'water bag' (fluid-filled membranes) may be ejected and hang from the vulva or, in some cases, the bag may burst within the ewe and only fluid be expelled. In some cases the first observed sign might be part of the unborn lamb. In a normal

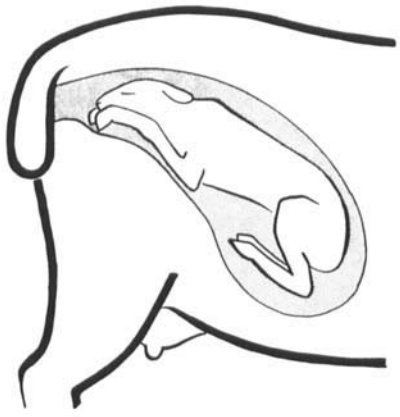


Fig. 2.1 Lambing – normal presentation.

Fig. 2.2 Lambing – external appearance, normal presentation. See also colour plate section.

presentation (Figs 2.1 and 2.2) the forefeet appear first with the head just behind. The ewe may take anything from a few minutes to half an hour to complete the delivery. Older ewes are generally quicker, as are ewes having twins or triplets. If a ewe does have twins or triplets the second lamb may be delivered within minutes of the first, but in many cases contractions cease and the delivery of the next lamb may occur after a delay of up to an hour. This delay has some advantages for it gives the ewe time to lick the first lamb dry.

Most of us assume that the normal lambing position is the 'diving' position, with front legs fully extended (Fig. 2.3). However, research has shown that this is not the case. The normal position involves bending of both elbow and shoulder (Fig. 2.1). In an unassisted birth this flexed position presents no problems, but if a birth is to be assisted by applying traction to the front legs the position must first be changed to the 'diving' position. To

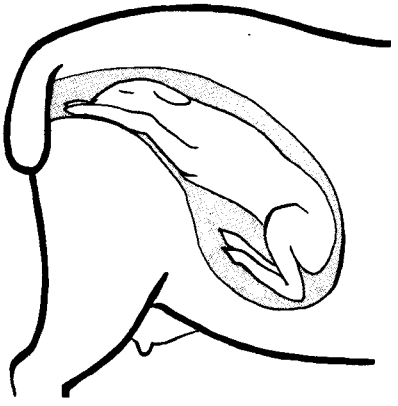


Fig. 2.3 Lambing – forelegs extended; position necessary for assisted birth.

straighten the leg, cup the elbow joint with one hand and pull the leg with your other hand. Once the legs are straight the ewe can be lambed easily.

APPROACH TO ASSISTANCE

When to interfere

There are a number of circumstances in which help is clearly required. These include:

- only the head appears;
- the water bag has been delivered or has burst and there has been no progress for 30 minutes;
- the total period of lambing has exceeded 90 minutes;
- a tail or only one leg has been delivered.

On many occasions, however, the situation is not so clear-cut. If in doubt, the ewe must be examined to check that all is well, not necessarily to deliver the lamb. If the lamb is alive (see below), and in normal presentation (Fig. 2.1), the ewe may be left for another 30 minutes. A forced lambing before the birth canal is fully open is at least very painful for the ewe and at worst may kill her. However, if the lamb is dead or incorrectly presented help is needed.

Hygiene

Be as clean as you possibly can. Poor hygiene at lambing leads to *metritis* (a serious infection of the uterus) (Chapter 4) and dead

Fig. 2.4 Lambing – assisted delivery, note use of protective gloves. See also colour plate section.

ewes. The area around the vulva should be dagged, if this has not already been done, and the whole area washed with soap and water containing a non-irritant disinfectant solution such as chlorhexidine, Dettol® or Savlon® diluted according to the manufacturer's recommendations. Place a clean paper sack under the ewe's hindquarters to help keep the working area clean. Thoroughly wash your hands and arms with soap and disinfectant and remember to keep nails well trimmed. If at all possible have an assistant hold the ewe. This not only helps you to keep clean, you will also be gentler.

Because of *zoonotic infections* (diseases that can be passed from animals to humans) such as enzootic abortion and Q fever (Chapter 5), you should always wear disposable plastic arm-length gloves to protect yourself whilst delivering lambs (Fig. 2.4). Although they may feel slightly strange at first, most people quickly become used to them. Gloves also have further advantages in that they work well with lubricant and are generally cleaner than using bare hands. Even if using gloves, you should wash your hands before putting them on (in case they burst) and should rinse them in diluted disinfectant before examining the ewe, unless they are sterile. At the very least, you must wash your hands thoroughly after delivering every lamb and on leaving the lambing area after handling any ewes or lambs.

Lubrication

Good lubrication is essential if damage to the ewe is to be avoided. A number of lubricant creams, gels, oils and powders are available. These should be used with plenty of clean water for maximum effect.

Gentleness

Be gentle at all times. Force rarely achieves results, and damage to the ewe and her death is the likely sequel. When delivering the lambs try to work in time with the ewe's contractions and do not be too quick to sever the umbilical cord otherwise unnecessary blood loss may occur. Remember to remove any wristwatches and rings!

Ewe position

This is a matter of personal preference, but it often helps when in difficulty to position the ewe so that the lamb's offending limb or head is uppermost. Occasionally it can help to raise the ewe's hindquarters off the ground using a hay bale or cradle. This takes the weight and pressure of the abdominal contents off the uterus and may ease the correction of a malpresentation. Keep the ewe in this position for a short time only, as it will make it difficult for her to breathe. Ewes should never be suspended by the hind limbs using ropes or other devices. This is likely to cause unnecessary pain and distress as well as breathing problems due to the weight of abdominal contents pressing on the diaphragm.

Retropulsion

All malpresentations are much easier to correct if the lamb is first pushed back into the uterus. This is called *retropulsion.* Retropulsion always creates much more room to work in and is best achieved by pushing steadily on the lamb for a few seconds. Do not use excessive force or you may damage the birth canal and rupture the uterus.

Identification of legs

It will often be important to decide on feel alone whether a leg is a foreleg or a hind leg. This is simple providing that you have practised on a newborn lamb beforehand. The knee joint of the front leg feels very different from the hock joint of the hind leg. Working your fingers up a foreleg you will feel the sharp spine of the shoulder blade. Working your fingers up a hind leg will bring you to the pelvis and behind that the tail. It is equally important to be able to check that the two legs that you have found are a pair belonging to the one lamb. First check that they are a pair: two forelegs or two hind legs. If the legs do belong to one lamb you should be able to run your fingers up one leg and down the other without losing contact with the lamb.

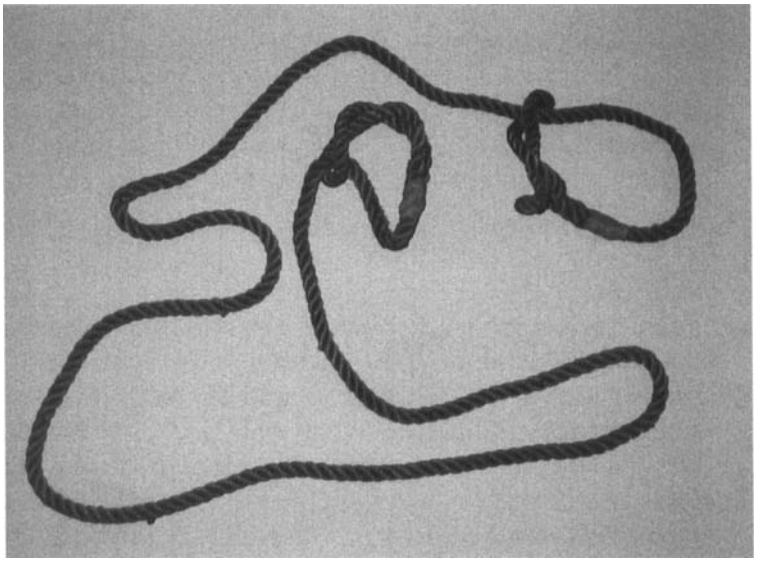


Fig. 2.5 Soft lambing rope fitted with loops at both ends.

Is the lamb alive?

In some cases it may be obvious that the lamb is dead. The fleece or even parts of the lamb may come away in your fingers. If unsure, place your finger in the lamb's mouth. A healthy live lamb will respond with a suck. If no suck is felt the lamb is either very weak and in serious trouble, or dead.

Lambing aids

Two aids can be of great benefit, ropes and a snare.

The traditional lambing rope is baler twine but soft ropes fitted with loops at both ends (Fig. 2.5) are much easier to use and are kinder to the lamb's legs. Ropes can be most profitably used for securing a leg that has to be moved to enable a lamb to be repositioned. Once the manipulation has been achieved, the leg can easily be regained.

The snare (Fig. 2.6) is a most useful piece of equipment, and its use is fully described below. The snare must be positioned behind the lamb's ears (Fig. 2.7) otherwise it will fall off.

Time

Most successful shepherd interventions are completed within five minutes of starting. If you have made no significant progress within ten minutes you are probably stuck! Unless you are very experi-

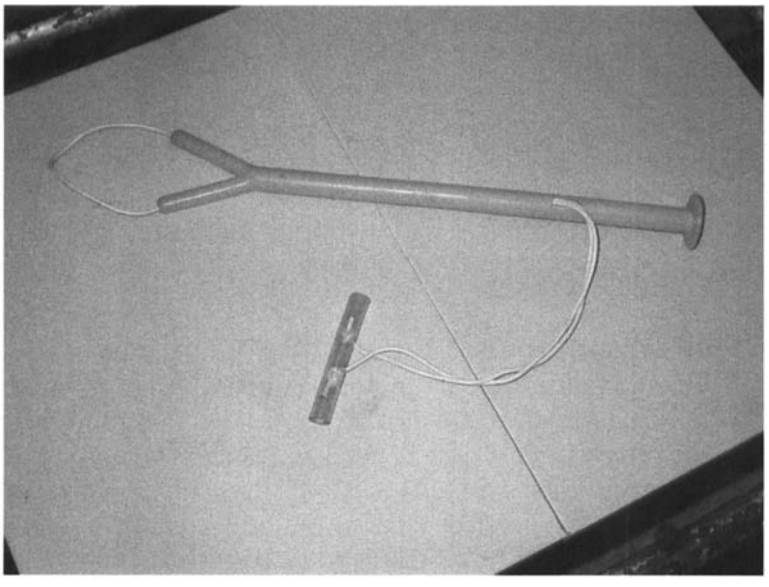


Fig. 2.6 Lambing snare.

Fig. 2.7 Snare and ropes positioned on a lamb. Snare must be behind the ears. See also colour plate section.

enced and know exactly what you are doing stop and get help from your veterinary surgeon. Try to avoid the communication sequence of student–tractor-driver–shepherd–foreman–farm manager–vet! This leads to dead lambs, dead ewes and frustrated vets!

Using your vet

It is most helpful if you discuss the management of lambing problems with your veterinary surgeon before lambing starts. In many cases it will be preferable, and usually less expensive, for you to take the ewe to the surgery.

Training

If you have not done so already, find out about Lantra National Training Award approved lambing courses at your local agricultural or further education college (www.lantra.co.uk) or ask your vet about the possibility of running private courses for clients at the surgery.

SPECIFIC PROBLEMS

Normal presentation

If your examination reveals a normal presentation (Fig. 2.1), leave the ewe for a further 30 minutes. If after this time there is no further progress, ensure that the birth canal is well lubricated, check that each leg is straight and pull the lamb down towards the ewe's hind feet. It often helps to pull the legs alternately and to slightly rotate the head. If this is of no avail it is likely that the lamb is very big and your vet's help will be needed.

Front leg(s) back

This is probably the most common malpresentation (Fig. 2.8). One or both legs may be turned back. Draw the offending limb into the correct position by cupping the foot in your hand to protect the wall of the uterus. In the case of a second twin or a comparatively small lamb it may be possible to deliver the lamb with one leg back. This should not be attempted with a big lamb, especially if out of a maiden ewe.

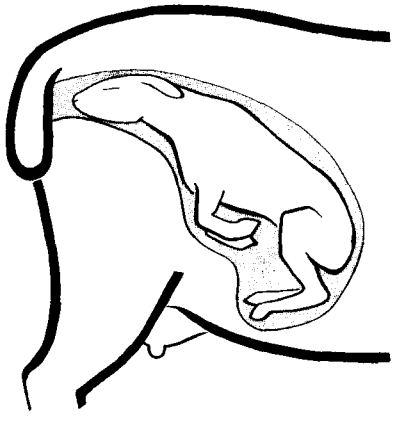


Fig. 2.8 Lambing – two forelegs back (bilateral shoulder flexion).

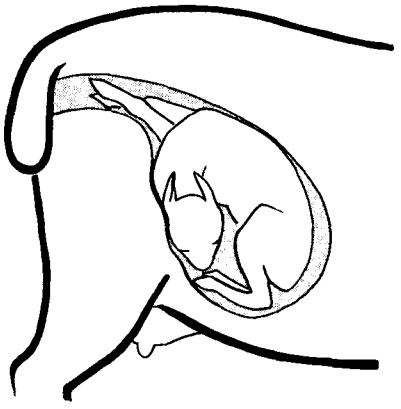


Fig. 2.9 Lambing – head back (lateral deviation of the head).

Head back

One or two forelegs are presented but the head is deflected (Fig. 2.9). This can be a most difficult problem to resolve. It is often possible to reposition the head by cupping it in your hand, but it is lost again each time delivery of the lamb is attempted. This problem is best corrected using the snare. Apply the snare behind the lamb's ears (Fig. 2.7) and secure both forelegs in the birth canal with ropes. Apply gentle traction to the snare and guide the lamb's nose towards the birth canal. Once the nose is within the pelvis the head cannot be lost. Now gentle traction on the snare and the ropes should achieve delivery.

Posterior presentation

This is simply a case of the lamb coming backwards and is quite common in multiple births (Fig. 2.10). It is inadvisable to attempt to reverse the lamb's position. Deliver the lamb in this position ensuring plenty of lubrication. Sometimes a lamb in posterior presentation is also upside down, i.e. the lamb's belly is nearest to the ewe's back. Deliver this lamb by pulling straight out of the birth canal – not towards the ewe's feet as this could damage the lamb's spine.

Breech presentation

This term describes a lamb in posterior presentation but with the hind legs pointing towards the ewe's head (Fig. 2.11). Using plenty of lubrication, each hind foot is cupped in the palm and brought into the birth canal. This sounds quite simple but if it is a large lamb it may be extremely difficult. Seek help if you are in doubt.

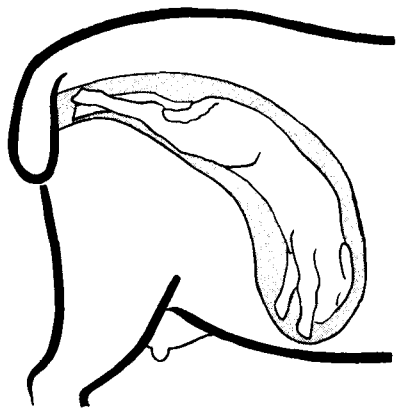


Fig. 2.10 Lambing – lamb coming backwards, hind feet first (posterior presentation).

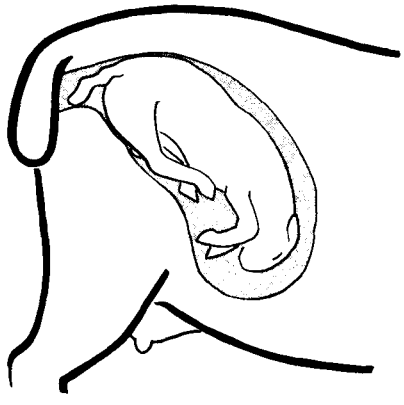


Fig. 2.11 Lambing – breech presentation. The hind legs are pointing forwards.

Twins

Twins present no specific problems providing you are sure which legs belong to which lamb (Fig. 2.12).

Ewe lambs and gimmers

Ewe lambs and gimmers present special problems. There is less room for manoeuvre in these ewes and the correction of malpresentations tends to be more difficult. This does not mean that these ewes should be assisted in lambing at the earliest possible moment. To do so would be harmful, for these ewes need longer to lamb to enable the birth canal to open fully. It does mean, however, that these ewes should be checked at an earlier stage to ensure that everything is correct. Two forelegs back in a ewe lamb is easier to correct before the head has come out. After the head

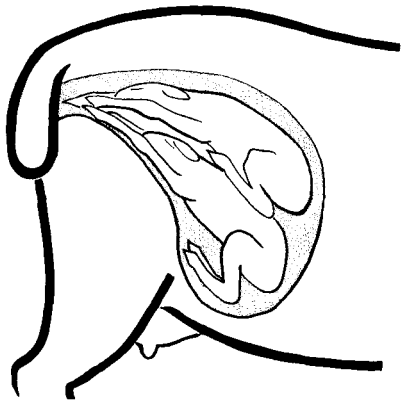


Fig. 2.12 Lambing – twins. Both lambs are in normal presentation.

has come out it can be almost impossible. Lambing problems in ewe lambs and gimmers are often associated with overfatness. This should be avoided.

Dead lambs

Dead lambs present the lambing shepherd with some difficult problems, especially if decomposition has set in. The ewe's lambing efforts may be half-hearted and the contents of the uterus are likely to be dry, making progress slow and difficult. Copious lubrication is required together with absolute gentleness since the wall of the uterus may be easily damaged. If in any doubt contact your veterinary surgeon.

Ringwomb

In this condition the entrance to the uterus, the cervix, fails to dilate although it is clear that the lambing process has started. A small hole, the size of a ring (hence the name) is felt. Check the ewe 30 minutes later and again one hour later. If there is no change contact your vet. A Caesarean section may be required. Ringwomb is sometimes confused with an incomplete relaxation and opening of the birth canal. In this condition the hand can be introduced and the lamb felt but there is insufficient room for delivery. This is most common in fat ewes that often appear to give up the lambing effort. Clenching of the fist within the birth canal may help in some cases but unless swift progress is made you need veterinary help.

Uterine inertia

This is a comparatively rare problem in sheep. It means literally that the uterus apparently makes no expulsive efforts. Inertia can

occur in two situations. In primary inertia the uterus fails to contract at any time. The cervix is often found to be open and lambs can be felt, but the uterus seems to be making no effort to expel its load. The second type of inertia, secondary inertia, occurs after the uterus has made prolonged but unsuccessful efforts to expel the lamb. The problem in this case is simple muscle fatigue. Whatever the cause, the procedure is the same. Observing all the precautions outlined, especially copious lubrication, attempt to deliver the lambs.

Do not persevere too long, ten minutes is quite enough. The survival of the lambs is at considerable risk. If your efforts prove unsuccessful take the ewe to your veterinary surgeon. A Caesarean section may be required.

Uterine torsion

This is another relatively unusual condition, but one to which shepherds should be alert. The term uterine torsion describes a twist of the uterus within the body at lambing, the twist being around the cervix and the vagina. This inevitably blocks the exit of the lambs from the uterus. The ewe enters first-stage labour, uterine contractions only, but makes no progress. The observant shepherd will notice this ewe and when progress is clearly not being made, will examine her. This examination will reveal that the birth canal is totally blocked and your hand feels as though it is being turned as it enters the torsion.

This is an emergency. If remedial action is not quickly taken the lives of the ewe and the lambs are at risk. Attempts can be made to correct the twist by rolling the ewe on her back from side to side – roll the body in the opposite direction to the twist. A hand held in the birth canal whilst rolling the ewe will reveal if you are successful. The aim of this exercise is to roll the body around the uterus. *Under no circumstances should any attempt be made to roll the uterus within the body by internal manipulation.* If successful, lambing may proceed normally but keep a careful watch on the ewe. The cervix may fail to dilate properly and veterinary help may be required. If your rolling efforts are in vain take the ewe to your veterinary surgeon. A Caesarean section is required.

RESUSCITATION OF THE NEWBORN

One of the most frustrating situations faced by us all at lambing is the newly-born live lamb that obstinately refuses to breathe.

Some of these lambs will never breathe, but some can be saved by resuscitation.

There are a number of causes of failure to breathe, the commonest of which is prematurity (Chapter 3). In these lambs, the lungs are not fully mature and expansion may be impossible, or only partial expansion may be achieved. Resuscitation may have beneficial effects in some of these lambs.

Blockage of the airways with mucus may cause suffocation in some lambs. If the blockage can be relieved, resuscitation may well be effective. Some lambs suffer hypoxia (a shortage of oxygen) during birth and may be too weak to breathe. Resuscitation will hopefully benefit them. Bear in mind, if resuscitation is successful, that these lambs are at high risk of developing hypothermia. A few lambs are born fit and healthy but seem a little lazy in commencing to breathe. The first breath may only be taken a minute after birth. Inevitably resuscitation in these lambs is very successful!

For practical use we need a resuscitation regime which we can apply to all problem lambs. This regime must achieve two aims:

(1) removal of any airway obstruction; and
(2) inflation of the lungs.

Removal of any airway obstruction is easier said than done. The traditional method of swinging the lamb whilst holding by the back legs is always worth a try but don't overdo it. Once round is quite enough. Several commercial suction (aspiration) and inflation (resuscitation) devices are also available (Fig. 2.13). Most designs incorporate a sealed mask that fits over the lamb's nose and mouth and a pump to provide suction and deliver air. These help to remove mucus from the airways and allow the lungs to be artificially inflated. They are relatively cheap and ideally should be available and ready for use at every lambing. Increased awareness of the risks associated with zoonotic diseases, such as enzootic abortion and Q fever (Chapter 5), means that mouth to mouth resuscitation either directly or via tubes inserted into the lamb's airway can no longer be recommended on health and safety grounds.

AFTER AN ASSISTED LAMBING

Ensure that *all* the lambs have been born. Most of us have been caught out at one time or another! Administer long-acting antibiotic by injection to the ewe (consult your veterinary surgeon about this before lambing starts). Check that the ewe has not

Fig. 2.13 Artificial aspirator and resuscitator (picture by Ritchey Tagg plc., Masham).

Fig. 2.14 Ewe tending her lamb after an assisted lambing.

suffered physical damage – if she has, take professional advice. Keep an eye on the ewe to check that the placenta (cleansing, afterbirth) comes away cleanly. Retention of the placenta, which can lead to metritis, is more common after an assisted lambing. If the ewe is fit and strong, place the lambs at her head and leave them alone (Fig. 2.14). If the ewe is weak, the lambs will need drying and feeding to prevent hypothermia.

Don't forget:

- be gentle – do not use force;
- use copious lubrication;
- be as clean as you possibly can;
- do not hesitate to summon professional help.

3 Problems in Lambs

In this chapter we have listed alphabetically the common problems of lambs. References to entries elsewhere in the chapter appear in bold face. Brief notes on causes, symptoms, treatment and prevention are provided. Where appropriate, the reader is referred to the relevant section in Chapter 7. The need for brevity inevitably means that much detail has been omitted. We would encourage readers to consult their own veterinary surgeon and also the literature included in the further-reading list for more information.

Every shepherd should regularly consult his or her own veterinary surgeon for guidance on the treatment of the conditions likely to occur in his or her flock. Routine treatments can be discussed and criteria for deciding when professional help is needed established. Ideally such discussions should take place well in advance of lambing, when things are quieter and there is more time to review current procedures and to implement any new recommendations. They should also form part of wider discussions on disease prevention and control strategies for the whole flock, leading to the production of a written flock-health plan. All shepherds should also remember that written flock-health plans are now a requirement under the United Kingdom codes of recommendations for the welfare of livestock (Chapter 8).

ABSCESS

See **Liver abscess** and **Spinal abscess.**

ACIDOSIS

See **Ruminal acidosis.**

ARTHRITIS

See ***Erysipelothrix*** **infection.**

ATRESIA ANI

This is a congenital condition in which the opening of the back passage – the anus – is missing. In some cases only a thin membrane blocks the anus, and if this is perforated, all is well. In more serious cases the rear portion of the hind-gut is also missing and there may be other deformities associated with other internal organs.

Symptoms

Initially the lamb appears perfectly normal. After a day or so the abdomen enlarges and straining may be seen. A close examination reveals the problem. If only a membrane is blocking the anus a swelling may be found in the anal region caused by the accumulation of faeces in the bowel.

Treatment

This is most definitely for your vet.

Prevention

The precise origin of this congenital defect is not clear. There is no cause for concern providing only the occasional lamb is affected.

ATYPICAL PNEUMONIA

Atypical pneumonia occurs in lambs aged more than two months, though in some circumstances lambs aged only three weeks can be affected. Many lambs in a flock can be infected but mortality

is generally low. This complicated disease is caused by combined infection with both *Mycoplasma ovipneumoniae* (a small bacterium) and the bacterium *Mannheimia (Pasteurella) haemolytica.* Exposure to respiratory viruses such as *Parainfluenza 3* may also predispose animals to infection by causing initial lung damage.

To a considerable extent, atypical pneumonia is a disease of intensive husbandry, being practically unknown in lambs on the hill, but relatively common in intensive, indoor finishing systems where infection can spread easily from lamb to lamb.

Symptoms

Chronic coughing is the common sign, especially when lambs are disturbed or driven. Many lambs remain bright but some may appear depressed. Growth rate is likely to be reduced. The occasional death may occur.

Treatment

Atypical pneumonia can be treated with antibiotics, but these tend to depress the infection rather than eliminate it. This treatment is probably inappropriate in lambs that appear bright, only exhibiting the occasional cough. Treatment is indicated in lambs that appear depressed by the infection.

Prevention

Vaccination and antibiotics have no part to play in preventing this condition. The approach must be a management one. In housed lambs, careful attention must be paid to stocking rate and ventilation. The aim must be to reduce the burden of infection within the lambs' environment. In intensive feeding systems it is preferable to avoid mixing batches of lambs, at least until the lambs have adapted to new feed and a new environment. Hill lambs are especially unlikely to have any resistance to this infection and mixing these naïve lambs with infected stock is a recipe for disaster.

BLADDER STONES

See **Urinary calculi.**

BLOAT

Bloat is a relatively unusual problem in sheep unless the animal is cast on its back and is unable to *eructate* (belch). However it can

occur especially in young, artificially reared lambs, normally aged less than one month.

Symptoms

The abdomen is considerably distended. The condition in young lambs often tends to be more chronic than in adult ruminants, and the lambs may well continue to walk around. Loss of appetite is common.

Treatment

In the adult sheep or the ruminating lamb (aged more than three months) the problem is ruminal bloat. A heaped teaspoon of soap powder or a walnut-sized block of margarine given by mouth, whilst keeping the animal walking to encourage eructation, can be an effective treatment for mild cases. In severe cases, where the animal is suffocating due to pressure on the lungs from the swollen rumen, emergency treatment with a trocar and cannula (or failing this a sharp knife) high up on the left flank over the swollen rumen may bring relief by releasing the excess gas. Occasionally emergency treatment will not relieve the problem because froth bubbles instead of free gas cause the bloat. In this instance, carefully instilling vegetable oil at a rate of 10–20 ml/kg body weight directly into the rumen via a cannula, using a clean stomach tube, will help to hasten relief by breaking down the froth. When using a trocar and cannula, you must ensure that stomach contents or oil do not spill out of the rumen into the abdomen, otherwise peritonitis will develop and the animal may die. As soon as the emergency is passed, get your vet to check the animal. Specialist follow-up treatment will certainly be needed.

In non-ruminating lambs, dilation of the abomasum (fourth stomach) is the problem. Do not attempt surgical treatment. Contamination of the peritoneal cavity (body cavity) with abomasal contents will lead to a fatal peritonitis. In chronic cases, antibiotic treatment is indicated to control the bacterial fermentation in the abomasum that is causing gas production. Antibiotics must be given by injection; agents given by mouth will probably not reach the abomasum. In acute cases seek urgent veterinary assistance.

Prevention

Abomasal bloat in young lambs is related to feeding practice. Twice-daily bottle-feeding with large quantities of warm milk,

especially from dirty equipment, predisposes to uncontrolled multiplication of certain bacteria which may cause this condition. The problem is exacerbated by the hunger that naturally develops between feeds. The lambs pick around the pen consuming everything from bits of wood to wool and baler twine. These indigestible objects lodge in the abomasum interrupting the normal flow of ingesta. Abomasal bloat is rarely seen in lambs fed on ad-lib cold milk from clean feeding equipment (see Fig. 7.22, p. 195).

It is sometimes recommended that formalin (37% formaldehyde) be added to the milk as a preservative at the rate of 0.1% (i.e. 1 ml/l) to prevent this problem. However, extreme care has to be taken when adding the formalin to ensure that the recommended dose is not exceeded, otherwise it will poison the lambs.

BLOWFLY STRIKE (MYIASIS)

This must be one of the most distressing diseases of sheep, both for man and beast. Open wounds and fleece contaminated with faeces attract the attention of flies such as the black blowfly, the bluebottle or the greenbottle. These flies lay their eggs on damaged or affected skin and they quickly hatch into larvae. These larvae (maggots) then proceed to attack the skin and literally eat the sheep alive!

Symptoms

On examination the condition is obvious – an open, foul-smelling wound with maggots in evidence. The detection of a struck ewe or lamb from a distance is not quite so simple, but it is an art that must be learnt. An experienced shepherd will detect a struck animal from a distance exceeding 100 yards, as it will be restless and behaving in an unusual way. It may attempt to kick or bite the affected part. Grazing is much reduced.

Treatment

Once detected, the struck sheep must be treated promptly. Clip the surrounding wool and remove as many maggots as possible – a perfect job for your student apprentice! Then apply a larvicidal ointment or powder. Antibiotics by injection may well be indicated to control secondary bacterial infection. Keep the sheep indoors until the wound is fully healed. Remember, the rest of the flock will be at risk.

Prevention

There are two approaches to prevention. First, avoid the factors which attract the flies. In lambs, scouring due to parasites is a major problem. Control the parasites (see below). If fleece soiling is present, remove the wool in the contaminated area (crutching or dagging). Wounds should be avoided at all times, but especially during summer months when flies are active. If wounds do occur, and there is a risk of blowfly, treat the wounds with a larvicidal ointment and check the animals over the next few days.

The second approach is to use an insecticide either as a dip or a pour-on preparation. This treatment must be given before the anticipated risk period. The use of insecticides is an additional means of prevention, not an alternative to good husbandry, e.g. controlling parasites and treating wounds.

BONE ABNORMALITIES

See **Rickets.**

BORDER DISEASE

Border disease is a virus infection. Infected ewes show no signs of disease themselves but problems can arise when they become infected for the first time during pregnancy. Infection passes from the pregnant ewe to the foetus in the first half of pregnancy. This can cause abortion at about 90 days of pregnancy or can lead to the birth of weak, deformed lambs. Infection occurs most commonly in young ewes, ewe lambs and gimmers because immunity develops after exposure.

Symptoms

Symptoms are variable. Abortion at around 90 days may be observed, and an unusually large number of ewes may be barren at lambing. Affected live lambs may be merely weak or may show the characteristic 'hairy shaker' signs (Fig. 3.1). The 'hairy shaker' lamb has a coarse birth coat and in smooth-coated breeds the coat may be pigmented. Tremors may be observed over the back and in the legs due to virus-induced brain damage. The head may appear domed in shape and defects of the jaws and legs may be present (Fig. 3.2). These lambs usually harbour the virus and therefore pose an infection risk to other sheep.

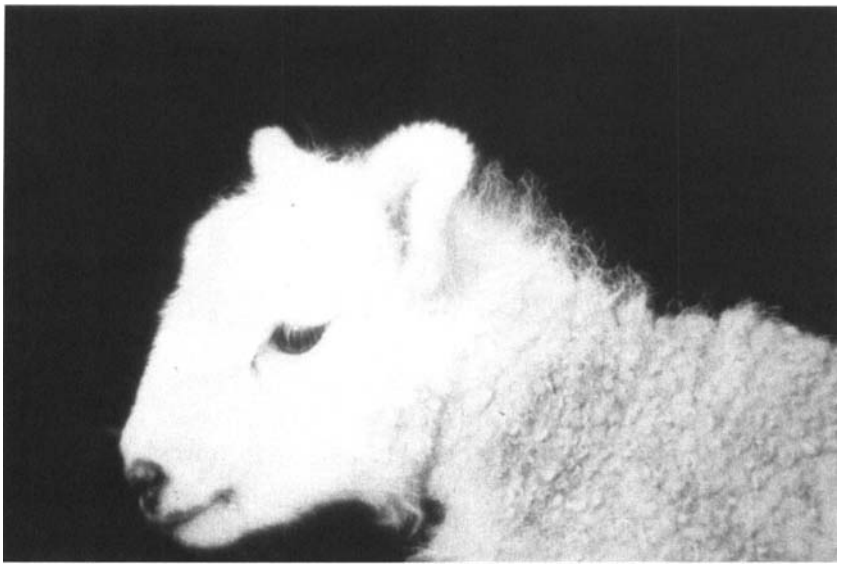


Fig. 3.1 'Hairy shaker' lamb infected with Border disease virus – note hairy appearance of wool coat around the ears and neck. This lamb also showed signs of trembling and incoordination due to brain damage.

Fig. 3.2 Skinned lamb showing limb and joint deformities (*arthrogryposis*) caused by Border disease virus infection. See also colour plate section.

Treatment

There is no specific treatment. Affected lambs may survive with careful nursing, but they seldom thrive.

Prevention

Consult your veterinary surgeon for an accurate diagnosis and assessment of the problem. Affected lambs should not be retained for breeding, and should be slaughtered at least one month before

tupping begins so they do not infect pregnant sheep, leading to further problems at the next lambing (see also Chapter 5).

BROKEN LEG

See Fractures.

CASTRATION (INCORRECT)

Occasionally an inexperienced operator fails to use the rubber-ring method of castration correctly. Either only one testicle is included below the ring, pushing the other testicle high into the *scrotum* (purse), or the ring may be applied too high, interfering with the *urethra* (the tube connecting the bladder to the penis) (Fig. 3.3).

Symptoms

Both the problems referred to above result in pain and discomfort in excess of that normally associated with castration. A few hours after castration, when most lambs appear normal, affected lambs stand awkwardly with the hind legs apart. They are unwilling to walk. If the urethra is involved the lamb will not be able to urinate and may die from a ruptured bladder.

Treatment

Remove the ring. This is made easier if a small blunt instrument such as a teaspoon handle is first passed between the ring and the skin. The ring may then be cut safely without risk of cutting the

Fig. 3.3 Incorrect rubber-ring castration causing urethral obstruction and bladder distension (arrow). *See also colour plate section.*

skin. If there is any doubt as to whether the lamb has sucked plenty of colostrum, give antibiotics and tetanus antiserum (consult vet). Leave castration to another day – the lamb has had enough.

Prevention

Proper instruction (Chapter 7).

CEREBROCORTICAL NECROSIS (POLIOENCEPHALOMALACIA, CCN)

This is an acute nervous disease of sheep, especially growing lambs, caused by a deficiency of vitamin B_1 (thiamine). In healthy sheep the ruminal bacteria produce thiamine but in some circumstances other ruminal bacteria produce the enzyme thiaminase, which destroys thiamine. The result is thiamine deficiency and acute disease.

Symptoms

If the early stages are detected, animals may scour and appear dejected. In many cases, however, the first sign of trouble is a recumbent sheep displaying nervous signs due to brain damage. Initial signs include depression, trembling, blindness and wandering aimlessly. Usually, affected animals deteriorate rapidly, often within 12 hours. Eventually, the animal may be found lying on one side paddling its legs with its head held well back (Fig. 3.4). Often only one or just a few animals are affected.

Treatment

Treatment is only successful if given at the earliest possible stage. The sheep should be injected with thiamine or a multivitamin preparation containing thiamine. An intravenous injection by your veterinary surgeon will achieve the best result. Recovering animals should receive careful nursing. Treatment should never be delayed when CCN is suspected. It will do no harm even if this disease is not the problem.

Prevention

The exact reason that some ruminal bacteria produce thiaminase is not known, but it is likely to be diet related. Thus it makes sense to change the diet, which will in turn cause a change in the ruminal bacterial population. This will often mean a move from lush to bare pasture, or withdrawal of concentrates.

Fig. 3.4 Lamb suffering from CCN. Note the characteristic position of the head.

CHILLING

See Hypothermia.

CLEFT PALATE

Cleft palate is a developmental defect in which the roof of the mouth is not properly formed. The result is a physical connection between the mouth and the nasal passages. Affected lambs cannot suck properly.

Symptoms

Starvation will probably be the first symptom seen. If the lamb is fed with a bottle, milk may be seen running out of its nose. The lamb will easily choke and inhalation pneumonia is a common complication. An examination of the lamb's mouth with a finger will reveal the problem.

Treatment

None. Affected lambs should be humanely destroyed.

Prevention

Take professional advice if more than the occasional lamb is affected.

COBALT DEFICIENCY

See Pine.

COCCIDIOSIS

Coccidiosis is another disease of intensive husbandry. It is caused by infection of the intestine with a protozoan parasite called *Eimeria.* Lambs are most commonly affected at four to six weeks of age. Infection, which occurs in most lambs in lowland systems, leads to life-long immunity. A low-level infection produces no clinical signs of disease, but a heavy infection does produce serious disease.

Symptoms

Acute diarrhoea accompanied by dullness and abdominal pain with inappetence are the presenting signs. The scour can sometimes contain streaks of blood. The disease leads to dehydration and in severe cases death. Affected lambs lose condition rapidly.

Treatment

A number of effective drugs are available. Drenching with anticoccidial drugs such as diclazuril or injecting with sulphonamide antimicrobials are the treatments of choice. In severely affected lambs the dehydration must be corrected by fluid given by stomach tube. Remember, other apparently healthy lambs are at risk.

Prevention

Ewes carry a very low level of infection and produce few infected oocysts (eggs). This low number of oocysts poses no immediate threat to lambs. Indeed, there is evidence to suggest that a low level of infection in newborn lambs may help to stimulate immunity and prevent serious disease later in life. In intensive situations, however, a low level of infection in lambs, derived from the ewes, can lead to problems. The lamb infected with a low dose of oocysts acts as a multiplier, passing out many more oocysts than it consumed. After a few cycles of this process the ground becomes heavily contaminated with oocysts. This presents a serious challenge to lambs, which will then succumb to clinical disease.

This pattern of infection gives some clues to the management of lambs to prevent coccidiosis. When ewes and lambs leave the sheep house they should proceed in a radial manner, each group going to clean fresh pasture. Do not pass all the lambs through the same series of pastures: this is a recipe for coccidiosis. Move feeding troughs daily to avoid creating a heavily contaminated area. If management measures are unsuccessful, some form of medication must be used. The method and drug used will depend on the rearing system.

Strategic treatment of lambs with anti-coccidial drugs is probably the preferred method, dosing the lambs at three to four weeks of age or before the known risk period. This approach allows lambs sufficient exposure to develop their own immunity but stops the coccidial population from increasing to the point at which clinical disease occurs.

Drug treatment before and after lambing by adding decoquinate under veterinary prescription to ewe concentrate rations, lamb creep feed and high energy feed blocks has also been suggested to reduce oocyst output. However, ewe and lamb feed consumption can be highly variable during this period so there is no guarantee that sufficient levels of drug will be eaten to control the disease effectively. The value of this technique is therefore open to question.

CONSTIPATION

This is an unusual condition in newborn lambs. Failure to pass the first dung, the meconium, may occur in watery mouth but this is a consequence of this condition and not a cause. Constipation itself is most likely in lambs that have failed to suck properly and have been fed by stomach tube.

Symptoms

The lamb appears listless and may not suck. It may or may not strain. The anal region is clean.

Treatment

Give 5 ml liquid paraffin by mouth, safest by stomach tube, and administer an enema (Chapter 7).

Prevention

Lambs that suck well from birth are unlikely to suffer from this problem.

COPPER DEFICIENCY

Copper deficiency in the ewe leads to **swayback** in lambs (see below), but copper deficiency in growing lambs can have deleterious effects, even in the absence of swayback in a flock. The problem is most commonly seen in hill lambs grazing improved pastures.

Symptoms

Symptoms are vague and non-specific. They include a staring greyish coat, poor growth rate, anaemia (seen as paleness of the gums, conjunctiva or vulva), susceptibility to fractures and an increased susceptibility to infectious disease.

There is a problem in detecting this condition. In many diseases, the sick animal is obvious since it differs in behaviour and appearance from the rest of the flock. Not so in copper deficiency: all the lambs are similarly affected. The most likely complaint to the veterinary surgeon is that the lambs are not doing as well as was hoped. Investigation by your veterinary surgeon is required. Flock treatment for copper deficiency is expensive, will be of no benefit and may be harmful (*see* **Copper poisoning**), if the wrong disease is treated. Samples must be taken for analysis to confirm copper deficiency, and to detect other problems such as cobalt deficiency and parasitic gastroenteritis.

Treatment and prevention

Copper can be given to the lambs either orally or by injection. Copper oxide needles contained in capsules are the oral treatment of choice (Chapter 6). The needles lodge in the abomasum where copper is slowly released. A number of injectable preparations are available. Some of these agents can cause a reaction at the injection site. In excess, copper is highly toxic (see **Copper poisoning**). Thus, only one form of copper supplementation should be used. Do not treat lambs if they are soon to be moved to a situation where dietary copper will be readily available, e.g. hill lambs being sold to intensive finishers.

COPPER POISONING

Copper poisoning may be acute or chronic, and is normally related to a high copper content in feed, unnecessary copper

supplementation or both these factors. Breed plays a part. Scottish Blackface sheep are relatively resistant to copper poisoning whereas Suffolks, Texels and many other continental breeds are highly susceptible.

Symptoms

Acute symptoms of poisoning often follow copper supplementation, especially by injection, within two to three days. Death is the commonest sign. In early chronic poisoning, however, the signs are vague and non-specific. An animal will be a 'non-doer', but eventually a crisis point is reached. The animal becomes acutely ill and death follows rapidly. Occasionally, the animal may show signs of *jaundice* (yellowing of the gums, conjunctiva or vulva) due to liver damage and rupturing of red blood cells caused by excess copper in the bloodstream. An accurate diagnosis must depend on detection of excess copper in liver samples from the dead lamb and in blood samples from the live lamb.

Treatment

Treatment of the acutely ill sheep may well be unsuccessful, but detection of the problem indicates preventative treatment for similar stock. Injection and feeding of molybdenum compounds (e.g. ammonium tetrathiomolybdate) decrease the absorption of copper and increase its excretion. All concentrate feeding must stop.

Prevention

Copper must never be supplemented unless there is good indication for doing so (e.g. low blood copper values). To do otherwise is a waste of money and courts disaster. Care should be taken to ensure that copper in sheep concentrates does not exceed 15 ppm. Concentrates formulated for other species, e.g. cattle and especially pigs, may exceed this level and should never be fed to sheep or lambs. Vitamin/mineral supplements should be added to feed in the proportions indicated and no more. It is illegal for manufacturers to add copper to sheep feed but it may be present as a contaminant. If any doubt exists as to a feed's copper content, it must be analysed. Avoid copper supplementation if animals are to be housed for any time. The copper availability of conserved forages and concentrate feeds considerably exceeds that of grass.

Take especial care with breeds known to be susceptible to copper poisoning, e.g. North Ronaldsay, Charollais, Texel and Suffolk. A number of expensive disasters have occurred, even without copper supplementation.

CRIPPLES

See **Joint ill** and **Tick pyaemia.**

DAFT LAMB DISEASE

This problem is an inherited nervous disease that seems to be most common in the Border Leicester and their crosses, such as the Scottish half-bred. The incidence in a flock is normally low.

Symptoms

This problem is normally evident soon after birth. In severe cases the lambs, which are in physically good condition, may be unable to stand. In milder cases lambs may be able to stand and walk. The head is held high giving a 'star-gazing' appearance (Fig. 3.5). The lamb may walk in circles or wander apparently aimlessly. Affected lambs may not be able to suck from a ewe but will suck from a bottle. These lambs seldom thrive.

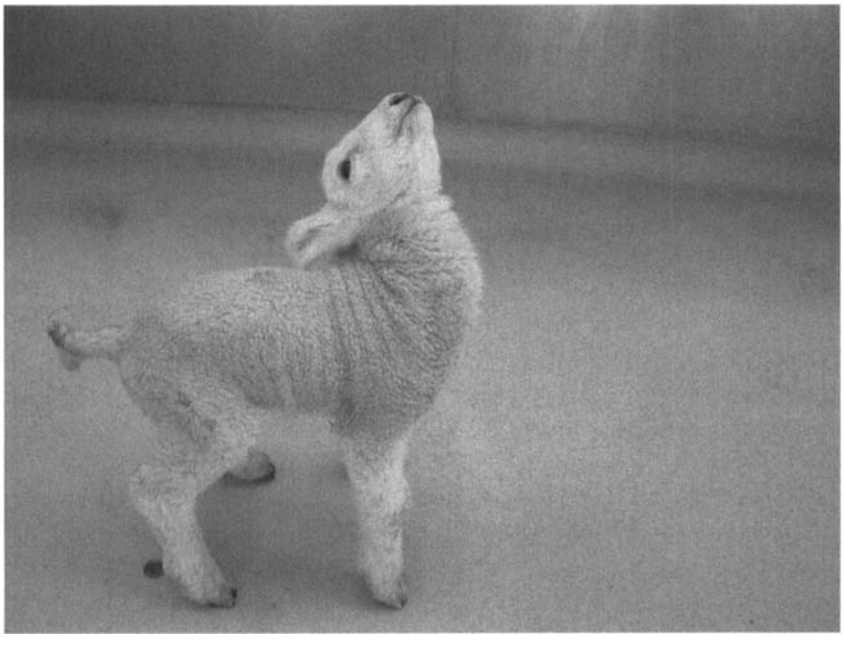


Fig. 3.5 Star-gazing lamb suffering from daft lamb disease (picture by Mr N. Palmer and Dr S. Scholes).

Treatment
There is no specific treatment. Mild cases can be reared with careful nursing, the nervous symptoms tending to regress with age.

Prevention
Since the disease appears to have a genetic basis, affected lambs should not be retained for breeding. If disease incidence increases after the introduction of replacement breeding stock, including rams, then these should also be removed from the flock. Consult your veterinary surgeon since this condition can be confused with **Swayback, Border disease** and **Stiff lamb disease.**

DIARRHOEA

See **Coccidiosis, Enteritis, Lamb dysentery** and **Parasitic gastroenteritis.**

ENTERITIS

Enteritis means an inflammation of the lining of the gut. This results in an influx of fluid into the gut from the rest of the body and increased gut movements. Scour (diarrhoea) is the result. Enteritis in lambs may be caused by **Lamb dysentery,** other infections, including *E. coli, Rotavirus* and *Cryptosporidium,* or by digestive upsets resulting from a sudden change of diet, such as when a lamb which is being fed milk replacer is fostered onto a newly-lambed ewe. The remainder of this entry is devoted to enteritis not associated with lamb dysentery.

Symptoms
Clinical signs give some clue as to the cause of enteritis but a precise diagnosis depends on laboratory examination of faeces or a post-mortem examination. A precise diagnosis has implications for treatment and prevention in the future.

Digestive enteritis
Scouring is the obvious symptom, but the lamb generally appears bright.

E. coli infection
K99-positive *E. coli* infection causes acute diarrhoea in newborn lambs as young as two days of age. Affected lambs have a profuse pale or watery scour and are clearly ill.

Rotavirus infection

Diarrhoea is the main feature and, provided dehydration is prevented, lambs remain fairly bright.

Cryptosporidium infection (cryptosporidiosis)

This infection can occur alone or along with other infections. It often occurs in lambs seven to ten days old. With this infection, lambs are distinctly ill, stop sucking and assume a tucked-up appearance.

Treatment

The successful treatment of enteritis is nine-tenths nursing and only one-tenth drugs. It is most important that dehydration and starvation should be prevented (*see* **Hypothermia**). Affected lambs should be fed three times daily with a solution containing both glucose (for energy) and electrolytes (to replace salts lost in the scour) by stomach tube (Chapter 7). Hypothermia is a common complication of enteritis and the lamb's temperature should be checked if there is any doubt. Since the cause of the enteritis may be infectious, scouring lambs should be isolated. Contaminated pens should not be used for more lambs. After treating affected lambs, the hands should be washed and equipment such as stomach tubes sterilised before further use.

Digestive enteritis

Control milk intake and provide fluids until diarrhoea stops. No other treatment should be required.

E. coli infection

Oral or injectable antibiotic treatment will be required. Preventative oral antibiotic treatment to in-contact lambs may well be indicated.

Rotavirus and cryptosporidiosis

Provide sufficient fluids. No other treatment should be required. Your veterinary surgeon may advise antibiotic treatment to prevent secondary bacterial infection.

Prevention

Ensure that all lambs receive plenty of colostrum within a few hours of birth. Keep the bedding in lambing pens clean. Ideally, the bedding should be changed between ewes, but at least ensure that fresh straw is added. In severe outbreaks, oral antibiotics can be used under veterinary supervision as a preventative measure,

Fig. 3.6 Zoonotic diseases, such as cryptosporidiosis, orf and many causes of infectious abortion, can affect humans. Take sensible hygiene precautions after handling lambs and other stock (picture by Dr M. Dagleish).

but this is a last resort and is unlikely to have a permanent beneficial effect. It should be remembered that some infections in lambs, e.g. cryptosporidiosis, can also cause disease in man – young children and the elderly are especially at risk (Fig. 3.6). Take sensible precautions – wash your hands. Bear in mind that enteritis is also caused by Lamb dysentery. At the end of lambing, buildings must be thoroughly cleaned and disinfected. If lambing outside use a fresh site next year if possible. These precautions are desirable even if no enteritis problems have occurred.

E. coli infection

Ewes can be vaccinated against this infection, the protection being passed to the lambs in colostrum (Chapter 6).

ENTROPION

This is a turning-in of the lower eyelid. If left untreated, the constant irritation caused by the in-turned eyelashes leads to ulceration of the *cornea* (the front layer of the eye) and blindness finally results. This condition appears to be inherited, being more common in some breeds than in others.

Symptoms

A close examination may be necessary to spot this condition in the early stages, but very soon it becomes obvious. The affected eye weeps and will often be closed. If both eyes are affected the lamb may be practically blind and unable to find the teat and suck. Eventually the cornea becomes white and opaque.

Treatment

This condition can usually be treated successfully provided the problem is spotted early. In many cases the in-turned eyelid can be simply flipped into the correct position by pulling down the skin below the eye with the fingers but *not* by interfering with the eye itself. If this is not successful some surgical interference is necessary. Contact your veterinary surgeon about this.

There are a number of techniques that may be used. In the technique shown in Fig. 3.7, surgical clips (Michel clips) are inserted in the skin below the eyelid. This draws the eyelid into the correct position. The clip may fall out of its own accord but if it does not it should be removed after seven days. If the eye has become infected (this is common), an antibiotic eye ointment should be applied for a few days (Fig. 3.8 and Chapter 7). Your veterinary surgeon will advise on this. While the lamb is recovering ensure that it is well fed – supplement by stomach tube if necessary (Chapter 7). Under no circumstances should entropion be left untreated – this would be the height of cruelty.

Prevention

Since this condition is thought to be inherited, affected lambs should not be retained for breeding. If the incidence is high, changing the rams should be considered.

Fig. 3.7 Lamb with Michel clips placed under the eye to correct entropion. See also colour plate section.

Fig. 3.8 Antibiotic eye ointment being applied to treat infection resulting from entropion. See also colour plate section.

ERYSIPELOTHRIX INFECTION

Erysipelothrix rhusiopathiae is a bacterium, which causes erysipelas in pigs and humans. It is not a species-specific bacterium, and also infects sheep. The infection gains entry to the newborn via the navel and perhaps the gut, and in the older lamb via wounds and abrasions. Severe outbreaks in the latter have been reported as a result of using dip that has become contaminated with bacteria after being left lying in the plunge bath for several days. The bacteria settle in the joints causing a painful arthritis. More than one joint is commonly affected.

Symptoms

Lame, stiff lambs are the normal sign. The joints may not be swollen or hot and this condition is often missed in the early stages. For a positive diagnosis, your veterinary surgeon must take samples from joint fluid or affected organs for bacteriological examination.

Treatment

This problem responds well to antibiotic treatment provided that it is instituted at the earliest stage. Treatment for seven to ten days is advised to prevent recurrence. Treatment commenced later in the condition cannot repair damaged joints.

Prevention

Maintain good hygiene at lambing with plentiful clean bedding. Navels should be dressed promptly (Chapter 7). Ensure that lambs

get early and adequate colostrum. Take care to avoid dirty surroundings and instruments at procedures such as castration, docking, shearing and dipping. In problem situations, ewes can be vaccinated against *Erysipelothrix* using vaccines available for pigs. Temporary immunity will then be passed to the lambs via colostrum. If problems are experienced in older lambs, they can be vaccinated from six to eight weeks of age.

EXPOSURE

See **Hypothermia.**

EYE INFECTIONS

Infections of the eye, sometimes called contagious keratoconjunctivitis (CKC), pink eye or heather blindness, can be a considerable nuisance in intensive lambing situations. The infection passes easily from lamb to lamb and if not promptly treated can lead to temporary blindness and starvation.

Symptoms

In the initial stages, a discharge is seen – excessive tears. Soon a pronounced inflammation of the *conjunctiva* (the fleshy surrounding of the eye) develops and the eye may close. Finally, the cornea may become involved and become opaque and ulcerated. In a few exceptional cases the cornea may become severely ulcerated, leading to the risk of eye rupture.

Treatment

Consult your veterinary surgeon for the correct antibiotic treatment for this problem. Treatment will usually be administered in the form of an ointment (Fig. 3.8), an injection or both.

Prevention

The condition spreads from lamb to lamb by direct contact or via the surroundings, e.g. troughs. Infected lambs should be isolated. In severe outbreaks, routine treatment of all lambs may be needed, but the problem may reappear within a few weeks.

EYELID (TURNED IN)

See **Entropion.**

FAECAL SPOILING

This is a problem that all shepherds recognise. Quite simply, the sticky dung of the lamb becomes stuck to the wool surrounding the anus and often the tail. In some cases the anal opening becomes practically blocked. Decomposing faeces next to the skin causes infection, inflammation and a thoroughly miserable lamb.

Treatment

In early cases the offending dung can be pulled off safely. In more advanced cases this will result in skin damage and the faecal mass should be softened before removal by immersing the rear end of the lamb in a bucket of warm soapy water.

Prevention

Some shepherds associate sticky dung with either the type of ewe feeding or the use of milk replacers for lamb feeding – they may be right. This problem is easily reduced to no more than a nuisance by spotting affected lambs in the early stages.

FOOT AND MOUTH DISEASE

After a major outbreak in 2001, the United Kingdom is currently free of this viral disease, and hopefully will remain so. However, freedom depends on the vigilance of all concerned with stock; the slightest suspicion must be reported immediately. Foot and mouth disease is one of the most contagious diseases known; it literally flies from farm to farm, either on the wind or carried by insects or birds. Thus even a few days' delay in reporting a case can lead to extensive spread. In 2001, widespread commercial movement of animals between farms and auction markets also contributed significantly to the severity of the outbreak.

Symptoms

Symptoms in sheep vary markedly and, although mortality amongst healthy adult animals is usually low, the debility resulting from

infection can significantly affect productivity. Lameness is normally the first sign seen. On a close examination, excessive salivation and a discharge from the nose may be apparent. *Vesicles* (small, raised, fluid-filled blisters or swellings) may be found in the mouth and between the digits, although sometimes lesions can be very mild and difficult to detect. Infection in pregnant ewes can cause abortion or the birth of premature or weakly lambs that die due to virus-induced heart failure. In some cases lamb mortality rates of up to 90% have been reported.

Treatment and prevention

Report any suspicions to your vet or local animal health office immediately. *Delay is illegal and utterly inexcusable.*

FRACTURES

Bone fractures in newborn lambs are becoming increasingly common with more intensive lambing. The most commonly seen include fractures of the lower jaw as a result of careless interference during lambing, fractured ribs resulting either from crushing during lambing or accidents after lambing (most often being lain on by the ewe) and fractures of the legs, normally the result of careless handling.

Symptoms

These depend on the site of the fracture. A lamb with a fractured jaw will be unable to suck. Fractured ribs make breathing, and indeed any movement, painful. A leg fracture will, of course, result in lameness. This is most obvious in the case of a forelimb fracture, for the front legs support two-thirds of the lamb's weight. It may not be so obvious in the case of a hind-leg fracture where confusion with conditions such as joint ill may occur unless a careful examination is performed.

Treatment

The treatment of fractures is a complex subject depending not only on the bone or bones involved but also on the type of fracture present. Consult your veterinary surgeon. The correction of a jaw fracture is a difficult job and your veterinary surgeon may advise humane destruction. Fractures of the ribs nearly always necessitate humane destruction. Fractures of the legs can normally be treated by the application of some form of external support. In

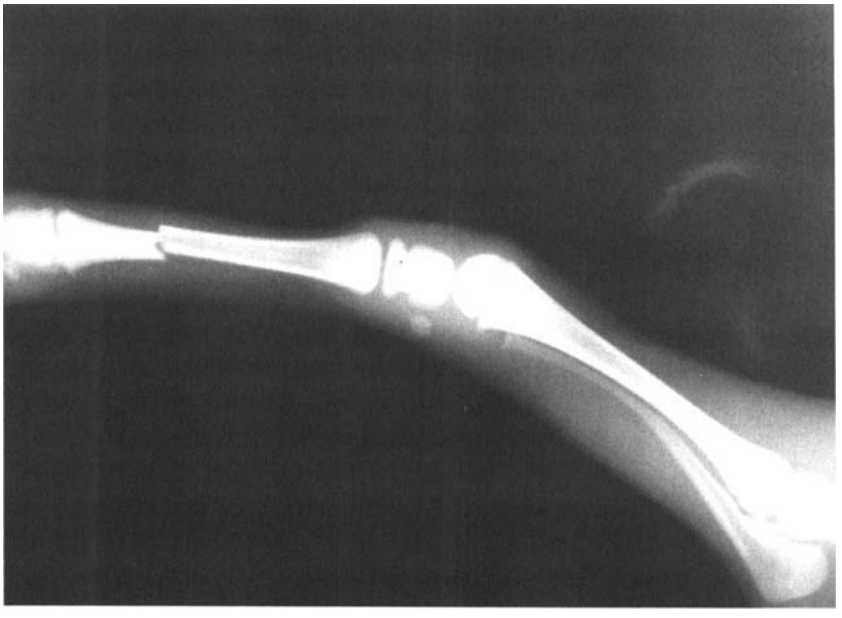


Fig. 3.9 An X-ray of a fractured foreleg (metacarpus).

Fig. 3.10 An X-ray of the fracture shown in Fig. 3.9 three weeks after treatment with Zimmer splints.

Fig. 3.11 The lamb referred to in Figs 3.9 and 3.10 two weeks after application of Zimmer splints.

general, fractures of the lower leg are easier to treat than those higher up (Figs 3.9 and 3.10). Your veterinary surgeon may use either a plaster or fibreglass cast or Zimmer splints. Zimmer splints are strips of aluminium lined with foam padding which are strapped to the lamb's leg. The lamb shown in Fig. 3.9 was treated in this way (Fig. 3.11).

Do not attempt treatment of a fracture yourself. You will cause unnecessary pain and distress to the lamb.

HAIRY SHAKER

See **Border disease.**

HERNIA

See **Umbilical hernia.**

HUSK

See **Lungworm.**

HYPERTHERMIA

Hyperthermia means an abnormally high body temperature – the opposite of hypothermia. In temperate climates, such as prevails in the United Kingdom, this problem is only likely to arise when hypothermic lambs are rewarmed without adequate care and attention (*see* **Hypothermia**). This condition is rapidly fatal. A mild degree of hyperthermia may be associated with an infection (fever) but in this situation the lamb's temperature is steady and not rising rapidly, as is the case when a lamb is warmed excessively.

Symptoms

An affected lamb will appear weak and will pant in a fashion similar to that seen in the dog. This state quickly progresses to coma and death. A tentative diagnosis is easily confirmed by taking the lamb's temperature (Chapter 7). The normal temperature is 39–40°C (102–104°F). If the temperature of a lamb in a warming box (Chapter 7) is more than 41°C (106°F), it is hyperthermic.

Treatment

Remove the lamb from the heat source, e.g. warming box. In mild cases this will suffice, but in severe cases the lamb should be cooled with cold water. Take care not to overshoot and cause hypothermia. Practically, this means stopping cooling measures 1–2°C before normal temperature is reached.

Prevention

Common sense. The temperature of the warmer should be carefully regulated (never more than 37°C, 99°F) and the lamb's temperature should be checked while it is being warmed (Chapter 7).

HYPOTHERMIA

Hypothermia means a below-normal body temperature (normal for a lamb is 39–40°C, 102–104°F). This problem accounts for almost one-half of all postnatal losses. There are two distinct causes; the first is a high rate of heat loss from the wet newborn lamb aged up to about five hours – hypothermia due to exposure (Fig. 3.12); the second is a low rate of heat production in lambs aged more than six hours (and more commonly 12–72 hours)

Fig. 3.12 A hypothermic lamb aged two hours. The hypothermia was caused by exposure after lambing outdoors.

Fig. 3.13 A hypothermic lamb aged 24 hours. The hypothermia was caused by starvation.

related to starvation and exhaustion of the lamb's body energy reserves (Fig. 3.13).

Hypothermia due to exposure is more likely to occur outdoors, especially in bad weather, but it does occur inside, especially in

the small, weak lamb, e.g. triplets or quads. Hypothermia due to starvation occurs both inside and out. All lambs are susceptible to hypothermia of both types but in general the problem is much more common in twins and triplets and in lambs out of ewes in poor condition.

Lambs affected by hypothermia due to starvation have two problems. The first is hypothermia and the second is hypoglycaemia – a low level of blood glucose (sugar). This low blood glucose level must be corrected before the lamb is warmed. If it is not, it is likely that the lamb will die during warming as its metabolic rate increases using up all remaining glucose reserves. In this case, the brain becomes starved of glucose and fit-like behaviour occurs (often confused with recovery) quickly followed by death.

Symptoms

The appearance and behaviour of the hypothermic lamb are related to both the cause of hypothermia and to body temperature (Fig. 3.14). Lambs suffering from hypothermia caused by starvation tend to be weaker than those suffering hypothermia caused by exposure. This is because of the low blood glucose level in the starving lamb. Diagnosis of hypothermia is a simple matter, provided a thermometer is used (Chapter 7). It is an expensive folly to rely on sticking one's finger (even an educated one) in the lamb's mouth.

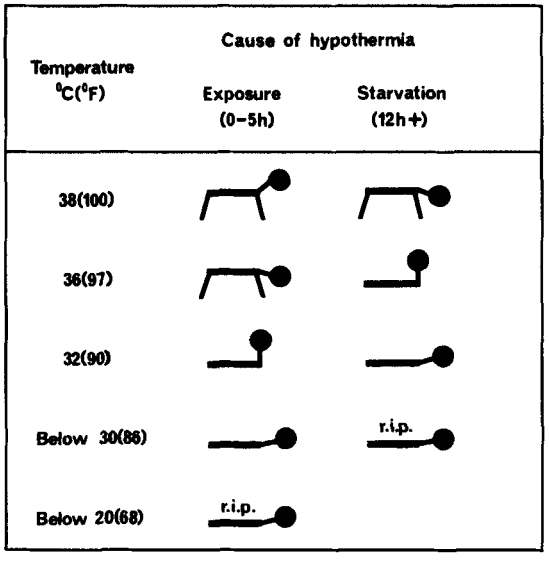


Fig. 3.14 The appearance of a hypothermic lamb related to rectal temperature and the cause of hypothermia.

Table 3.1 The treatment of hypothermia.

Temperature	Age	Treatment
37–39°C (99–102°F)	Any age	Dry the lamb. Feed by stomach tube. Give shelter with ewe and other lambs. Check temperature again soon.
Below 37°C (99°F)	0–5 hours	Dry the lamb. Warm lamb in a warmer until temperature recovers to 37°C. Feed by stomach tube. Return to the ewe or transfer to 'weak lamb unit'.
Below 37°C (99°F)	More than 5 hours and able to hold up its head	Dry the lamb. Feed by stomach tube. Warm lamb in a warmer until temperature returns to 37°C. Feed by stomach tube. Return to the ewe or transfer to 'weak lamb unit'.
Below 37°C (99°F)	More than 5 hours and not able to hold up its head	Dry the lamb. Give intraperitoneal injection of glucose. Warm lamb in a warmer until temperature reaches 37°C. Feed by stomach tube. Return to the ewe or transfer to 'weak lamb unit'.

Treatment

Treatment depends on both age and body temperature (Table 3.1). Full details of the techniques used will be found in Chapter 7.

Prevention

This is largely a matter of common sense. Of prime importance is ewe nutrition. Good nutrition during pregnancy should ensure strong lambs with plentiful energy reserves and a ewe with plenty of milk. When lambing outside, the provision of simple shelter will reduce the risk of hypothermia due to exposure, and when lambing inside, especially at high lambing percentages, special attention should be paid to twins and triplets that are most likely to starve. Prompt use of the stomach tube (Chapter 7) will prevent many problems.

INHALATION PNEUMONIA

In the first week of life, the most common type of pneumonia is inhalation pneumonia, normally caused by careless bottle-feeding or the presence of a congenital defect such as a **Cleft palate.** Weak lambs are unable to suck properly, and when fed with a bottle, a few drops of milk can easily enter the *trachea* (windpipe) and set up an infection in the lungs.

Symptoms

Commonly the lamb is found dead. If still alive the lamb is weak and breathing appears laboured. Characteristic soft crackling noises may sometimes be heard in the chest when the lamb breathes.

Treatment

Vigorous antibiotic therapy is required – consult your veterinary surgeon. Treatment however is unlikely to be successful.

Prevention

Do not bottle-feed weak lambs – use a stomach tube (Chapter 7). Careless bottle-feeding is a dead loss. Note that pneumonia in lambs aged more than seven days is likely to be infectious in origin (see below). A full veterinary investigation is required in these cases.

IODINE DEFICIENCY

Iodine deficiency is uncommon in the United Kingdom but it does occur in some areas such as Derbyshire. Feeding excessive quantities of kale, rape and cabbage may also induce iodine deficiency, as these crops contain toxic substances, known as *goitrogens*, which inhibit iodine uptake.

Iodine is a major component of the thyroid hormones produced by the thyroid gland in the neck. These hormones regulate metabolism and are important in practically all body functions. Not surprisingly the most dramatic effects of iodine deficiency are seen in the foetus and newborn.

Symptoms

Signs include late abortion, the birth of weak lambs and the birth of lambs with enlarged thyroid glands, seen as a swelling on the front of the neck (goitre).

Iodine deficiency rarely shows as clinical disease in adult stock, but it would seem likely that it would result in sub-optimal performance. A diagnosis of iodine deficiency can be confirmed by examination of tissue, particularly the thyroid gland, at post-mortem examination, or by analysis of blood samples.

Treatment

Oral supplementation is the normal route for supplying iodine.

Prevention

Iodine is routinely incorporated in concentrate feeds and in vitamin/mineral supplements. Care should be taken in feeding diets composed mainly or solely of brassica crops, especially in late pregnancy.

JAW DEFECTS

Two defects affecting the lower jaw (*dysgnathia*) are found in newborn lambs: the lower jaw may be too short – undershot or 'parrot-mouthed' (Fig. 3.15); or too long – overshot or 'sow-mouthed' (Fig. 3.16). The end result, sometimes also termed 'open mouth', is the same. The lamb has difficulty in sucking and may starve.

Treatment

Clearly there is no specific treatment for these problems. Care must be taken to ensure that affected lambs are sucking and if they cannot they must be fed by stomach tube (Chapter 7). After a day or so some lambs get the knack of sucking from the ewe but others are unable to do this and must be artificially reared.

Fig. 3.15 A lamb with an undershot lower jaw – 'parrot-mouth'.

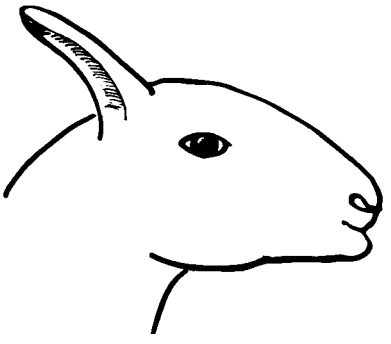


Fig. 3.16 A lamb with an overshot lower jaw – 'sow-mouth'

Prevention

Jaw defects are the result of some disturbance in foetal development. It is not known whether this is genetically controlled or not although the problem has been frequently noted in highly inbred flocks. If more than the occasional lamb is affected, the rams should be examined for evidence of similar defects. Needless to say, affected lambs should not be retained for breeding – at the very least they will find feeding difficult.

JOINT DEFECTS

Occasionally, defects of the lower joints of the legs, especially the forelegs, are encountered. The lamb may be unable to straighten the lower limb and knuckles over (Fig. 3.17).

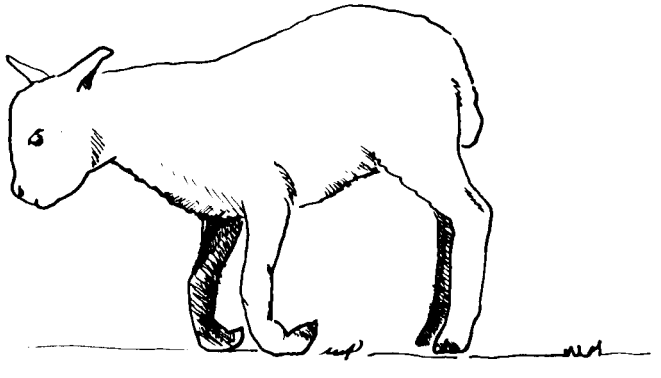


Fig. 3.17 A lamb with joint defects. The lower joints of the forelimbs have not extended (straightened) properly.

Treatment

In some cases, application of a well-padded splint or a bandage may help to extend the affected joints, but in very severe cases this is unlikely to be successful and humane destruction may be the most sensible course of action. Lambs with joint defects may have feeding problems and supplementation may be necessary.

Prevention

Joint defects reflect an error of foetal development. Providing only the occasional lamb is affected, there should be no cause for alarm. However, defects can also occur as a result of foetal exposure to **Border disease** virus (Fig. 3.2) so if several lambs are affected it would be worthwhile asking your veterinary surgeon to test them for evidence of infection.

JOINT ILL

Joint ill is a bacterial infection of one or more joints, which causes swelling, pain and lameness. Unless treated promptly, permanent joint damage results. The bacteria gain access to the lamb either via the navel at birth, via wounds such as docking or castration or via the gut, especially when colostrum intake is deficient or delayed. In tick-infested areas **Tick pyaemia** can also cause joint ill in lambs aged over two weeks.

Symptoms

Joint ill is characterised by severe lameness, loss of appetite and general depression. A close examination reveals pain and swelling in one or more joints (Fig. 3.18).

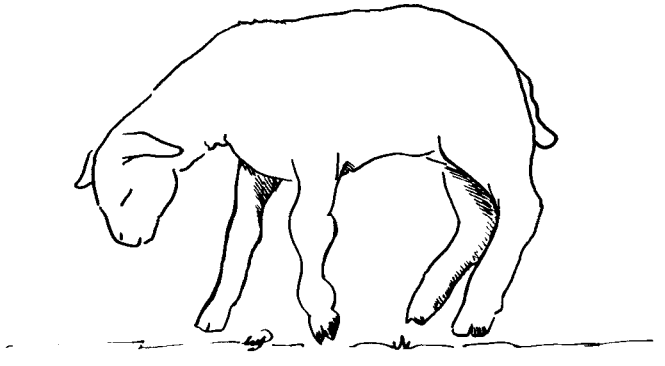


Fig. 3.18 A lamb with joint ill

Treatment
Prolonged antibiotic therapy is required.

Prevention
Ensure that lambs get plenty of colostrum. This will enhance their resistance to infection. Navels should be dressed immediately after birth to prevent the entry of bacteria by this route (Chapter 7). Since the lambs become infected with bacteria from their immediate environment, a high standard of hygiene in the lambing house will reduce the incidence. Instruments used for docking and open castration should be kept clean.

LAMB DYSENTERY

Lamb dysentery is a fatal disease affecting lambs in the first two weeks of life. The disease is caused by a bacterium called *Clostridium perfringens* Type B that multiplies in the gut and releases toxins (poisons) which cause the lamb's death (Fig. 3.19).

Symptoms
Lambs may simply be found dead. More often, affected lambs appear dull, do not suck and develop a bloodstained scour. Death follows within a few hours.

Treatment
There is no effective treatment.

Prevention
Fortunately this horrific disease can be prevented by vaccination of the ewe (Chapter 6). Protective antibodies pass to the lamb in the colostrum. This disease should be part of history, but

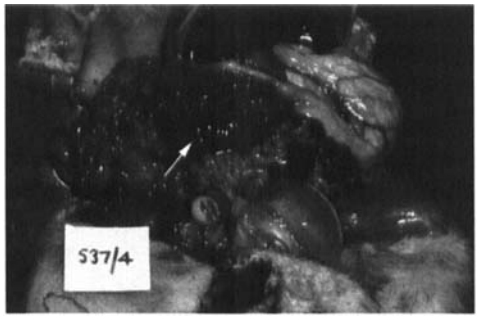


Fig. 3.19 Intestinal damage (arrow) caused by lamb dysentery. See also colour plate section.

cases still occur. These cases are commonly associated with non-vaccination of the ewe, faulty vaccination (wrong time or too low a dose) or failure of the lamb to suck adequate colostrum.

LEGS (BROKEN)

See Fractures.

LISTERIOSIS

Listeria bacteria can cause abortion in ewes (Chapter 5), encephalitis in ewes (circling disease, caused by inflammation in the brain) and septicaemia in lambs, normally less than three months old.

Symptoms

Infected lambs are often found dead. If noted earlier they appear dull and have a high temperature.

Treatment

Early cases will respond to antibiotic treatment. Prophylactic treatment of other lambs may be appropriate.

Prevention

Silage is a common source of infection for sheep. Attention should be paid to silage quality and handling. Ensure that the pH value is below 5 (acid) and ash content below 70 ppm (minimal soil contamination). With clamp silage the surface layers are the most likely to be contaminated, and if possible they should not be fed to sheep. Cattle are less susceptible to listeriosis than sheep and it is often suggested that spoilt or dubious silage should be fed to them. However, this must still entail a small risk. Do not allow uneaten silage to lie in feeding passages. Exposure to the air will allow the pH value to rise and facilitate multiplication of *Listeria*. Big-bale silage, where the plastic wrapping has been damaged, should not be fed to sheep.

LIVER ABSCESS (LIVER NECROSIS)

This disease affects lambs aged three days or older. It is caused by the entry of bacteria via the navel soon after birth and, possibly, bacteria entering via the gut, especially in lambs which receive

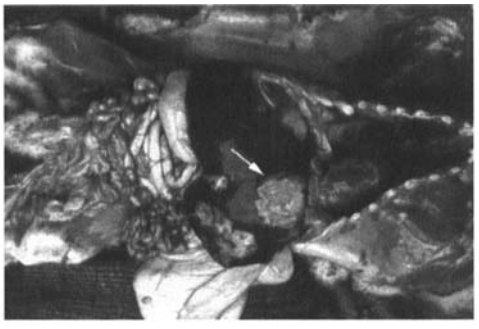


Fig. 3.20 Liver abscesses or necrotic hepatitis (arrow) caused by infection via the navel. See also colour plate section.

either late or insufficient colostrum. The blood vessels from the navel run through the liver in which the invading bacteria multiply and cause abscesses (Fig. 3.20).

Symptoms

Affected lambs first appear a little dull, but their condition quickly worsens and death follows within three days. Antibiotic treatment often provides an apparent cure but once treatment is stopped a relapse is common.

Treatment

Prolonged antibiotic therapy is required.

Prevention

The navel should be dressed as soon as possible after birth (Chapter 7) and lambing pens kept clean. Ensure that lambs get plenty of colostrum – this increases resistance to diseases such as liver abscess.

LOCKJAW

See Tetanus.

LOUPING-ILL

Louping-ill is a viral *encephalitis* (brain infection) of sheep and other animals. It is spread by the sheep tick *Ixodes ricinus*. The disease is most serious when it occurs simultaneously with

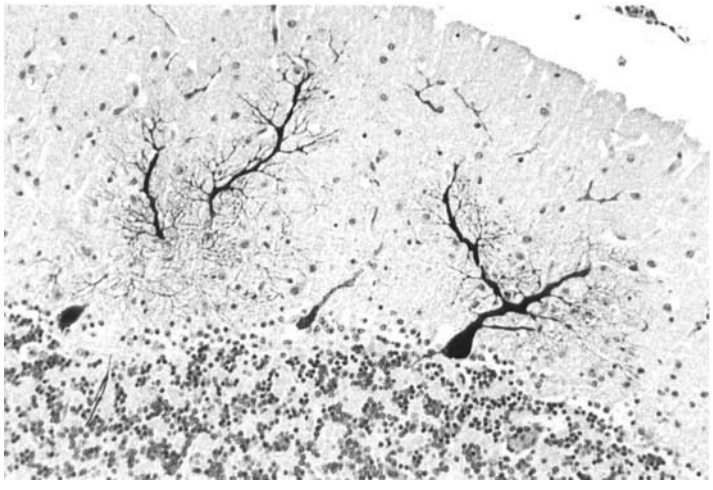


Fig. 3.21 Section of lamb's brain as seen under the microscope. Special processing reveals brown-stained louping-ill virus in the nerve cells (neurones). See also colour plate section.

Tick-borne fever. Tick-borne fever depresses the lamb's immune system, allowing the louping-ill virus to multiply unhindered.

Symptoms

Affected lambs may simply be found dead. In less acute cases symptoms progress from slight loss of balance to coma and death in one to two days. In the few animals that recover, some nervous signs may persist for months. In lambs also infected with tickborne fever, other signs such as scouring may be seen. Mortality in these lambs approaches 100%. A precise diagnosis depends on post-mortem examination of the brain (Fig. 3.21).

Treatment

Little can be done except careful nursing. Depending on the age of the lamb, stomach-tube feeding of either milk or a glucose/electrolyte fluid will be indicated (Chapter 7). In some cases humane destruction will be required.

Prevention

Vaccination is the principal method of control. Lambs born to vaccinated ewes acquire antibodies in the colostrum that will protect them certainly for their first spring. The vaccine is a single-dose product, normally given to lambs in later summer to protect them from autumn infection (Chapter 6). In endemic areas, further vaccination may be unnecessary, natural infection serving to boost

immunity. However, if the level of infection in an area is relatively low, re-vaccination at two-year intervals may be indicated.

A second approach to preventing louping ill is to avoid infestation with ticks. Problems can be avoided if grazing on tick-infested land can be avoided in the spring and autumn risk periods, but this is seldom possible. There is also evidence that ticks are becoming more active at other times of the year as a result of our increasingly warmer and wetter climate. An alternative is to use insecticide preparations. In the past, dipping has been used but this can pose mis-mothering problems where young lambs are present. The recent introduction of pour-on preparations presents an easier method of using this approach. The animals most at risk are bought-in tick-naïve stock, both ewes and lambs. These animals *must* be vaccinated one month before they encounter ticks.

LUNGWORM

Lungworm infection (caused by *Dictyocaulus filaria* and *Muellerius capillaris*) is common in sheep in the United Kingdom, but seldom produces serious disease. The most probable reason for this is that the measures taken to control **Parasitic gastroenteritis** also control lungworm. The life cycle of *Dictyocaulus* is similar to that of intestinal worms with some important differences. In the small intestine, ingested lungworm larvae penetrate the intestinal wall and make their way via the lymphatic system and the blood circulation to the lungs. They then settle in the trachea, the *bronchi* (main branches of the trachea) and the *bronchioles* (small bronchi). Here they develop into mature worms measuring up to 10 cm long. The life cycle of the worm is completed when the adult female worm lays eggs that develop into immature larvae. These larvae are coughed up and swallowed, to pass out in the faeces. The larvae mature on the ground and infect (or reinfect!) sheep as they graze. Not surprisingly the presence of these worms causes irritation and coughing. The tissue damaged by the worms is highly susceptible to secondary infection with bacteria such as *Mannheimia (Pasteurella)*. Nodules containing *Muellerius* worms are often found in sheep lungs at slaughter but these do not usually cause a problem.

Symptoms

In mild cases, the occasional cough is all that is seen. In more severe cases, the coughing is accompanied by laboured breathing and weight loss.

Treatment
Most of the anthelmintics in common use against intestinal worms are effective against lungworms.

Prevention
Strategies advocated for the control of intestinal worms are effective against lungworm (*see* **Parasitic gastroenteritis**).

MUSCULAR DYSTROPHY

See **Stiff lamb disease.**

NAVEL HERNIA

See **Umbilical hernia.**

NAVEL ILL

Navel ill is a bacterial infection of the navel which may be restricted to this region but may also be associated with further infections such as **Joint ill** (Fig. 3.18), **Liver abscess** (Fig. 3.20) or **Spinal abscess** (Fig. 3.31). A high incidence of this condition is commonly associated with bad hygiene.

Symptoms
Affected lambs appear off colour, and a close examination reveals swelling and tenderness in the navel area. The removal of any scab may result in the release of pus.

Treatment
The navel area should be cleaned. If necessary clip away any wool which has become encrusted with pus. Prolonged antibiotic therapy is required.

Prevention
Navels should be dressed immediately after birth (Chapter 7). Ensure that lambs receive plenty of colostrum. Keep lambing pens clean and ensure that bedding is fresh and dry at all times. In some lambing sheds the level of bacterial contamination is so overwhelming that it is surprising that not all lambs become infected.

NEONATAL ATAXIA

See **Swayback.**

NEPHROSIS

Nephrosis is a normally fatal degeneration of the kidney seen in lambs from 2–16 weeks of age. The cause is presently unknown, but may be associated with a bacterial toxin that is yet to be identified. The only common factor between cases appears to be that only lambs at pasture are affected, leading some people to suggest that there may be a link with *Nematodirus* worm infections (*see* **Parasitic gastroenteritis**). Normally only 1–2% of lambs are involved.

Symptoms

Symptoms vary somewhat with age but are related to acute kidney failure. Young lambs become listless and stop sucking. This quickly progresses to a drunken appearance, followed by coma and death. Some young lambs scour. The total course of the disease is normally only a few days. Older lambs commonly scour and although they can appear bright, they quickly weaken and die.

Treatment

There is no specific treatment. Supportive therapy should be given including fluids by stomach tube (Chapter 7).

Prevention

Nothing.

OPEN MOUTH

See **Jaw defects.**

ORF

Orf is a most distressing skin disease that affects both lambs and ewes. It is more correctly called *contagious* (spreading) *pustular* (pus-filled swelling in the skin) *dermatitis* (inflammation of the

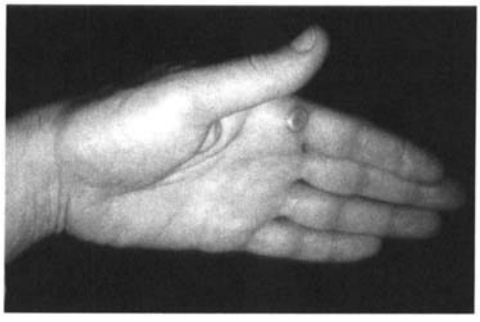


Fig. 3.22 Orf lesions on a shepherd's hand. See also colour plate section.

Fig. 3.23 Orf lesions around a lamb's mouth. See also colour plate section.

skin). Orf is caused by a virus and can affect lambs only a few days old. The disease can easily spread from sheep to man and from person to person (Fig. 3.22). This is most important in the context of the family. An orf lesion on the shepherd's finger may be little more than a painful nuisance; a lesion on a child's face may be far more distressing.

Symptoms

In lambs, the disease is normally first seen as scabs on the lips (Fig. 3.23). Close examination reveals pustules at the corners of the mouth. The affected area increases and may become further inflamed by secondary bacterial infection. The scabs may interfere with sucking and starvation is a common end result. This situation can be further compounded if the infection spreads from the lamb to the ewe's teats, making suckling a painful process for her. Mastitis often develops. In some lambs a very serious type of orf may develop in which the infection spreads into the mouth, down the throat and sometimes even further down the digestive tract.

Treatment

There is no effective treatment for orf. Antibiotic in spray or ointment form is used to control secondary bacterial infection. General nursing is most important, for starvation must be prevented. This condition is self-curing in two to four weeks. It is essential that you seek veterinary advice.

Prevention

Orf is a most contagious disease and immediate isolation of affected ewes and lambs may help to prevent its spread. Great attention must be paid to hygiene – pens and feeding equipment exposed to orf must be thoroughly disinfected before next year's lambing. Orf virus is exceptionally tough and, under dry conditions, may survive in dropped scabs for many years before causing further infections. A live vaccine is available which helps to control this condition but vaccination of the ewe appears to confer little or no protection to the lamb. The use of this vaccine tends to perpetuate the condition in the flock, albeit at a low level, so it should never be used in situations where orf is not a problem. Take professional advice if this disease occurs.

OVERSHOT JAW

See **Jaw defects.**

PARALYSIS

See **Joint ill, Spinal abscess** and **Swayback.**

PARASITIC GASTROENTERITIS

Parasitic gastroenteritis probably accounts for the greatest source of production losses in sheep farming. Chronic parasitism leads to poor growth rate in lambs, even when no clinical disease is evident. Despite the availability of anthelmintic drugs, parasitism is a common cause of death in lambs. More recently, the emergence and spread of worm resistance to some of these drugs (*see* Anthelmintic resistance p. 81) has been a very worrying development, as it is already starting to place severe restrictions on which drugs may be used effectively on some farms. This situation has arisen largely

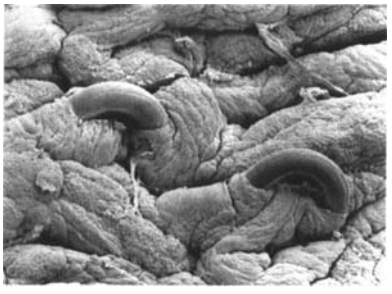


Fig. 3.24 Adult *Trichostrongylus vitrinus* burrowing under the epithelium of the small intestine.

through selection of resistant worms on farms, often through misuse or overuse of anthelmintics. The problem then spreads when other people unwittingly buy in animals carrying these resistant worms. Whatever the cause, it is vital that farmers develop a rational worm-control policy in consultation with their vet if the spread of anthelmintic resistance is to be at least slowed, otherwise many more lambs will suffer from poor growth rates or even die in future.

Roundworms and disease

Roundworms cause disease by physically attacking the lining of the gut. Much of this damage is caused by the burrowing of adult worms and emergence of developing larvae (Fig. 3.24). This damage reduces the absorption of nutrients, and also leads to protein loss into the gut. Some worms, e.g. *Haemonchus contortus,* cause further damage by sucking blood. Heavy infestation leads to disease and, in extreme cases, death, due mostly to dehydration and anaemia.

Life cycles

All roundworms, including lungworms, have essentially the same life cycle (Fig. 3.25). No other animal is involved. Development of eggs on the pasture is dependent on temperature and humidity. Ideal conditions are 18–26°C and 100% relative humidity. Infection persists over the winter as larvae and eggs on the pasture, and also as arrested larvae in the adult sheep gut. In the autumn, larvae do not fully develop in the gut. Instead they remain as larvae in the gut, only to emerge again in the spring.

The intestinal worms *Teladorsagia (Ostertagia) circumcincta, Trichostrongylus vitrinus, Cooperia curticei* and *Haemonchus contortus*

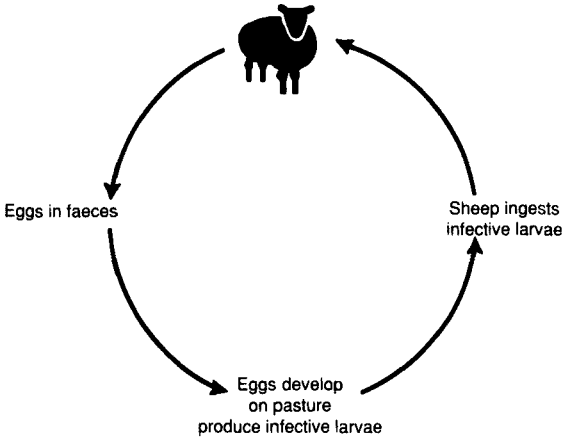


Fig. 3.25 Basic parasitic roundworm life cycle.

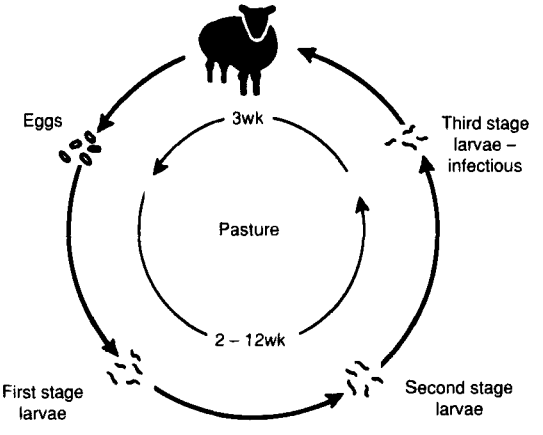


Fig. 3.26 Life cycles of the common gut roundworms, except *Nematodirus*.

have similar life cycles (Fig. 3.26). Eggs in faeces hatch to yield free-living first-stage larvae. These develop to third-stage larvae that are infective to sheep.

Nematodirus

Nematodirus battus, which can cause serious disease in lambs, has a slightly different life cycle (Fig. 3.27). Development of the infective third-stage larvae takes place within the egg and hatching depends on the experience of a cold shock followed by warmth, i.e. winter followed by spring. The effect of this unique series of events is that infection in the spring depends on contamination of the pasture the previous year. The infection is practically a lamb-

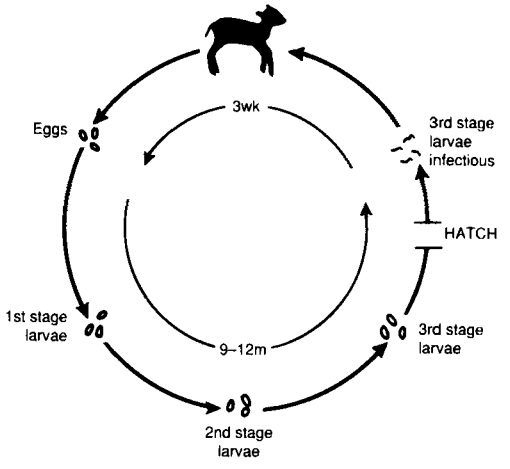


Fig. 3.27 Life cycle of *Nematodirus*, a lamb-to-lamb disease.

to-lamb affair, this year's lambs being infected by larvae derived from eggs shed by last year's lambs.

The nature of this life cycle has another important implication. As the temperature rises in the spring, all the hibernating larvae on the pasture are subject to the same climatic influence and thus tend to hatch more or less simultaneously. Lambs are thus suddenly exposed to a massive *Nematodirus*-infective load on the pasture. In an early warm spring, the 'hatch', as it is called, may occur before the lambs are grazing. The larvae will die and there will be no disease. If the spring is cold, the hatch may be delayed until the lambs are older and have acquired some age-related immunity. However, if the hatch occurs when young lambs have started to graze, i.e. at about two months old, disease can be expected. The relationship of infection to climate enables the agricultural and veterinary organisations to issue *Nematodirus* warnings when the risk is high. Inevitably this is a local warning, so take local advice.

Immunity to parasites

Adult non-lactating sheep are largely immune to roundworm infection. They remain infected but at a very low level, which has little or no deleterious effect. Adult infection with *Haemonchus* can sometimes seem to be an exception to this general immunity rule. The immunity to parasites depends on previous infection and thus lambs have practically no immunity to gastrointestinal parasites. They do however develop some age-related immunity,

and first infection later in a lamb's life is less likely to lead to disease than early infection.

This immunity in the adult can be compromised by two circumstances: first, other sources of ill health, poor nutrition and other infectious disease will lower the immunity to intestinal parasites; the second factor is lambing and lactation. From two weeks pre-lambing to six weeks afterwards, the ewe's immunity to parasites is depressed. This means that during this period the ewe can acquire more new infection and will pass more eggs out in her faeces – the so-called peri-parturient rise in faecal egg production. An additional effect of the reduction in immunity is that larvae arrested in the gut wall the previous autumn become active. They develop into mature egg-laying worms. This reduction in immunity causes no disease in the ewe herself, but it can lead to an increase in infection on the pasture, to which lambs are defenceless.

Sources of infection for lambs

There are two sources of infection for grazing lambs. First, larvae which have overwintered on the pasture from the previous year. These larvae become infective in the spring and early summer, but for practical purposes very few will remain after the end of May. The second source of infection is the ewes, where an increased egg output during the peri-parturient period, from just before until eight weeks after lambing, produces fresh pasture contamination. This egg output will be derived from worms that have overwintered in the ewe, and fresh infection acquired from the pasture in the spring.

This ewe-derived egg output onto the pasture does not pose an immediate threat to lambs. But the non-immune lambs act as multipliers. A relatively low level of infection in the lamb results in the production of large numbers of eggs in the lamb faeces. This multiplication cycle continues until July/August when pasture contamination often reaches danger levels. At this time of year lambs can be exposed to a large challenge at grazing. The result is parasitic gastroenteritis – diarrhoea and disease.

Control strategies against parasitic gastroenteritis must be aimed at preventing this dangerous multiplication of infection. The exception to this sequence of events is *Nematodirus* (see above) where lambs are faced with a massive challenge in the spring. Adults play little part in the *Nematodirus* cycle except that they do remain infected at low levels. Thus, when ewes are introduced to sheep-naïve pasture, the potential for *Nematodirus* infection in the future is present.

Symptoms

Heavy infection can lead to obvious disease with profuse scouring. Dehydration follows and this may lead to the death of the lamb. Sub-clinical infection that produces no obvious disease can have severe effects on growth rate, even if lambs are receiving regular anthelmintic treatment. The blood-sucking worm *Haemonchus* infects the abomasum and rarely produces scouring. The loss of blood leads to anaemia, with pale mucous membranes seen in the gums, conjunctivae and vulva. Lambs become weak and may develop a swelling under the jaw (bottle jaw). A diagnosis of parasitic gastroenteritis can be confirmed at post-mortem examination by counting the worms and in the live lamb by a faecal egg count (FEC) and blood samples. An FEC is meaningless within three weeks of anthelmintic treatment, unless there is a concern that anthelmintic resistance is present, in which case faecal samples taken shortly after dosing can be used to estimate how effective the anthelmintic has been. In young lambs especially, parasitic gastroenteritis is often confused with **coccidiosis.**

Treatment

Affected lambs must be treated with an effective anthelmintic as recommended by your vet. Remember that other lambs in the group are likely to be similarly infected. After treatment, lambs should be moved to safe pasture (*see* Alternate grazing below). If they must remain on heavily contaminated pasture, further treatment will be required. Steps must be taken in following years to avoid this situation. Severely affected lambs will require fluid by mouth to combat dehydration (Chapter 7).

Prevention

Prevention of parasitic gastroenteritis is highly desirable from the disease prevention and production point of view. The aim of any preventative strategy must be to avoid exposing lambs to heavily infected pasture, allowing immunity to develop naturally. From the information above, it is clear that many parasites have evolved to ensure that infective larvae come into contact with susceptible stock at just the right time. This is definitely no accident as far as the worms are concerned! Consequently, most problems tend to occur in spring-born lambs grazed intensively for the first few months of their lives. Most of the comments on prevention strategies below therefore relate to such situations rather than more extensive or early-lambing systems where the dynamics of infection (epidemiology) may be quite different. Nevertheless, whatever the

management system, waiting for lambs to scour before acting is shutting the stable door after the horse has bolted.

Alternate grazing

The success of alternate or safe grazing in the control of parasitic gastroenteritis depends on two factors: first, very few larvae survive on pasture for more than 12 months; and, second, sheep and young cattle do not generally share common parasites. The pasture grazed by cattle in the previous year can be said to be safe for sheep, and vice versa. There is one important exception to this rule – *Nematodirus*. Although *Nematodirus battus* does not usually cause disease in cattle it can survive in this host and cattle can thus perpetuate the infection on a pasture from year to year.

Many farmers cannot hope to practise an alternate or clean-grazing system but that does not mean that the concept need be abandoned. Any pasture that has been free of sheep for 12 months can be regarded as 'safe' for young lambs (remembering the exception of *Nematodirus*). But other pasture can be added to this category depending on grazing history. At one extreme, pasture grazed by last year's undosed lactating ewes and an undosed lamb is quite definitely not safe. But pasture grazed as aftermath by dry, dosed ewes can be regarded as safe.

If an alternate grazing system can be practised, lambs should be dosed in the spring to combat *Nematodirus*. Take advice on timing. It is usual to dose ewes once annually, preferably after lambing and before moving to safe pasture. In some systems, more dosing may be required. For optimum results, good growth rate, no wastage of anthelmintic and minimising the risk of anthelmintic resistance developing (*see* Anthelmintic resistance below), dosing regimes *must* be tailored to the individual farm. There is no universal plan. Take professional advice. On some lowland farms, a three-year grazing cycle can be employed, using cropping as the third type of land use. Inevitably, such a system will be more effective than simply alternating cattle and sheep on a two-year system.

Control with anthelmintics

On farms which are unable to practise alternate grazing and where sheep must graze the same permanent pasture every year, parasitic gastroenteritis may need to be controlled by anthelmintics to prevent pasture contamination reaching danger levels. However, this type of management requires particularly skilful handling

so that disease does not occur, whilst at the same time ensuring anthelmintic usage is minimised to reduce the risk of anthelmintic resistance developing.

In this situation, the peri-parturient ewe usually provides the major source of initial pasture contamination. These ewes should be dosed at lambing (alternatively, housed ewes can be dosed at housing), and then three and six weeks later. Lambs should be dosed at six weeks of age and then, depending on local circumstances, *may* also require dosing as often as every three weeks until the end of May. By this time most overwintered larvae will have died out and the ewes will be producing very few eggs.

To avoid anthelmintic resistance problems the aim should always be to reduce general pasture contamination so that the frequency of dosing can also be reduced in subsequent years rather than blindly relying on the same dosing interval using the same product year in and year out. Control by anthelmintic dosing alone requires continuous monitoring using FECs to establish infection and resistance levels, and you must consult your veterinary surgeon for advice on which products to use as well as optimal testing and dosing intervals. Clearly, under these circumstances it would be advantageous to re-examine all possibilities for using safe grazing.

Anthelmintic resistance and use of anthelmintics

Anthelmintics are most valuable drugs and great care should be taken in their use. Despite the seemingly endless variety of different commercial products available, these are actually all based on only three different groups or classes of drug – the *benzimidazoles* (white drenches), the *levamisoles* (clear drenches) and the *macrocyclic lactones* or *avermectins* (usually supplied as drenches or injectables).

Anthelmintic resistance, i.e. worms not being killed by the normal therapeutic dose, which develops to even one of the products in each class means that none of the other products containing the same drug will be effective. In this situation one has to resort to using only products containing either of the two remaining classes of drug available. However, it doesn't take a mathematical genius to realise that this is a real 'three strikes and you're out' situation should resistance to the other drugs develop. Most reports in the United Kingdom have described resistance to the benzimidazole group of anthelmintics, although recent investigations have also found some United Kingdom farms where resistance to two and

sometimes all three classes of drug is already present. The problem is also here to stay, because further studies, both here and abroad, particularly Australia, where multiple resistance has been a problem for some time, have also shown that once resistance is acquired, worm populations do not become susceptible again even after up to 15 years spent using other drug classes.

Precautions to be taken to avoid this problem include:

- Discuss the proper use of anthelmintics on your farm with your vet.
- Ensure that all stock receive the full dose. In groups of lambs this means dosing for the heaviest lamb. Weigh a few lambs to make sure.
- Check dosing equipment to ensure that the full dose is always given.
- Do not dose unnecessarily. If you are unsure whether or not animals need to be treated, or if you think that anthelmintic resistance may be present, seek veterinary advice and ask about getting FECs done on samples pooled from lambs in the group you are concerned about. Your vet will advise you on how and when to take the samples required.
- Providing there is no evidence of anthelmintic resistance, alternate the class of anthelmintic used annually on indigenous animals. Bought-in animals will require special treatment (see below). Try to alternate the drug groups on a three-year cycle. Changing from one product containing a member of a group to another product containing the same group will have no benefit.

Bought-in stock pose a real risk for importing anthelmintic-resistant worms on to the farm so it is advisable that all these animals should be dosed sequentially on arrival with a macrocyclic lactone product (ivermectin or an equivalent) followed by a levamisole product and yarded for 24 hours after treatment. After yarding, they should be quarantined on recently grazed pasture so that any eggs from resistant worms that survive the anthelmintic treatments are 'diluted' in amongst eggs shed by existing sheep on the farm. By this means benzimidazole-resistant worms, currently the commonest form of resistance in the United Kingdom, should at least be eliminated.

Anthelmintic resistance is currently a real and emerging problem in the United Kingdom. The situation is changing rapidly and this may affect future recommendations for parasite control and prevention. Always consult your vet for the latest information.

PASTEURELLOSIS (ENZOOTIC PNEUMONIA)

In recent years *Pasteurella* pneumonia seems to have become more common in lambs. The bacterium responsible, *Mannheimia (Pasteurella) haemolytica,* is the same organism that causes pneumonia in adult sheep.

Symptoms

In lambs, the disease is often acute, the lamb being found dead. Signs in sick lambs include dullness, a high fever, loss of appetite and laboured breathing.

Treatment

Prompt antibiotic treatment is indicated.

Prevention

Effective vaccines against *Pasteurella* pneumonia are available. Lambs from vaccinated ewes will acquire some protection from colostrum (Chapter 6). In problem situations, the lambs may be vaccinated early in life. The first injection (two doses are required) can be given in the first week. Pasteurellosis often seems to be precipitated by stressful situations, e.g. transport, handling or bad weather. Lambs at pasture should be provided with shelter from inclement weather, and routine tasks should be undertaken in the least stressful way possible.

PHOTOSENSITIZATION (YELLOWSES)

Photosensitization is commonly seen on some Scottish hill farms, and arises when the skin becomes excessively sensitive to sunlight. This sensitivity is related to one of two mechanisms: the first results from the ingestion of plants containing toxic substances that act directly on the skin, greatly increasing the absorption of sunlight energy; the second results from the ingestion of other plants that damage the liver. This liver damage results in a failure to break down *phylloerythrin*, a normal product of digestion in ruminants. This excess phylloerythrin acts on the skin to increase the absorption of sunlight energy. Whatever the cause, the result is tissue damage. Signs are seen on skin areas not protected by wool, notably the face and ears.

Symptoms
Initially swelling is seen, often first on the ears. The affected skin dries and cracks. Dead skin eventually drops off. The tip of the ear may even slough off.

Treatment
There is no specific treatment other than preventing exposure to sunlight by housing, which must be used in serious cases. Application of creams or the use of injectable agents is unlikely to have any noticeable effect.

Prevention
Several plants, including St John's wort, have been suggested as causes. If possible, suspicious plants should be removed, but this is not feasible on extensive hill grazing.

PINE (COBALT DEFICIENCY)

Cobalt (Co) deficiency is a common cause of ill thrift and poor growth rate in lambs. Cobalt is an essential part of vitamin B_{12}, a vitamin crucial to many mechanisms in the body. Vitamin B_{12} is synthesised by rumen bacteria and it is here that cobalt is required. Injection of cobalt elsewhere into the animal has little or no beneficial effect.

Symptoms
Signs are non-specific. Poor growth rate leading sometimes to emaciation is the main sign. Lambs may show a watery discharge from the eye. The problem of detection is similar to that seen with **Copper deficiency**. Many animals are similarly affected.

Cobalt deficiency will have debilitating effects in adult animals, but the effects are not so drastic. Poor productivity is likely. Diagnosis depends on examination of blood samples taken by your veterinary surgeon. Examination for copper deficiency and chronic **Parasitic gastroenteritis** will also be required.

Treatment
In acute cases vitamin B_{12} can be given by injection. This must be repeated monthly and other methods of supplementation are preferable.

Prevention

Free access minerals are not a very suitable method of supplying cobalt because of variable intakes. All commercial concentrate feeds and vitamin/mineral supplements will contain cobalt, and animals in receipt of such feeds should not be at risk. For home-mixed rations, mineral mixes containing as little as 680 µmol (40 mg) Co/kg will provide adequate Co intake when they are included at a rate of 25 kg/tonne, provided the concentrate forms at least 10% of the total food intake.

Unfortunately, lambs are rarely fed concentrates during high-risk periods for cobalt. For grazing lambs cobalt sulphate can be applied directly to the pasture. Take advice on this measure as local conditions can affect the usefulness of this technique. Cobalt (with selenium) is often incorporated into anthelmintics. If these agents are used monthly, deficiency will be prevented, but in many situations (e.g. hill lambs), monthly dosing is neither practical nor desirable (*see* **Parasitic gastroenteritis** – Anthelmintic resistance). Cobalt can be given orally as a drench but weekly treatment is required. Cobalt oxide pellets (bullets) are an established way of cobalt supplementation. The pellets should not be given to milk-fed lambs since an insoluble coating of calcium phosphate will form on the pellet. Care should be taken that the pellets are swallowed and not regurgitated.

A further method of cobalt supplementation, especially useful where copper deficiency is also a problem, is the Cosecure® glass bolus (Telsol Ltd, Leeds, United Kingdom). The bolus contains several minerals including cobalt. These dissolve slowly in the reticulo-rumen and release cobalt on a continuous basis, which is ideal for the rumen micro-organisms' requirements. Boluses can be given to stores and hoggs, administered at five to six months of age or in animals weighing more than 20 kg.

POISONING

This is unusual in the newborn lamb since it obtains its nourishment from the ewe and is unlikely to eat poisonous plants. There are, however, two sources of poison of which the shepherd should be aware. The first is drug overdosage: providing drugs are used as prescribed no problems should arise, but occasionally the understandable but erroneous logic that 'if a certain dose has a beneficial effect then double the dose must be better' is applied. This logic rarely applies and instead of getting increased benefit

the deleterious effects of overdosage are seen. A second possible source of poisoning is phenolic disinfectants and dips: these are extremely toxic to newborn lambs and are very rapidly absorbed through the skin.

Older grazing lambs are exposed to all the perils facing adult stock. These include many poisonous plants including ragwort, yew, ivy, privet and rhododendron. Many incidents result from the careless disposal of domestic garden clippings 'over the fence'. Most cases of chemical poisoning are man-induced. Copper and selenium toxicity are just two examples. Copper poisoning can result from excessive copper supplementation, high copper levels in concentrate feeds, the feeding of pig rations (which are high in copper) to sheep or even grazing pasture which has been treated with pig slurry. Lead is no longer used in paint and this has reduced the incidence of lead poisoning. However, in some areas (often old lead-mining areas) high levels of lead can be found in soil and streams.

Symptoms

These are enormously variable depending on the poison, but nervous signs are common, either depression or excessive excitement followed by depression.

Treatment

In most poisoning cases no specific antidote is available (but note section on **Copper poisoning**). Treatment comprises nursing and the amelioration of symptoms by use of appropriate drug therapy. With plant poisoning it is sometimes appropriate to operate on animals which are known to have eaten the poisonous plant recently. A rumenotomy is performed and the rumen contents removed. This measure is only likely to be economic with valuable animals.

Prevention

In most cases this is common sense. Poisonous plants on extensive hill grazing may be difficult to cope with.

PREMATURE BIRTH

Premature birth is not in itself a disease, although it may be a result of a disease such as enzootic abortion (Chapter 5). It may also result from poor nutrition or rough handling. It is a problem

Fig. 3.28 Premature triplets. Note poor birth coats and 'foetal' heads.

that every shepherd faces and so the principles of the treatment and care of these lambs are described here.

Symptoms

Premature lambs are small, have poorly grown coats, are physically weak, may have teeth which have yet to erupt and often have 'foetal' heads (dome-like skull with narrow jaws) (Fig. 3.28). These features, plus the history of the ewe and flock (infectious abortion, poor nutrition), should make a diagnosis easy to make.

Treatment

The premature lamb is weak – it may be unable to suck or even stand. It has problems keeping warm and is a hypothermia risk. These lambs may have breathing problems, for the lungs sometimes fail to expand fully at birth. Premature lambs are also very susceptible to infectious disease. The premature lamb should be kept, if strong enough, with its ewe under cover in a clean sheltered pen. The lamb (not the ewe) should have access to an infra red lamp for extra warmth. If not sucking adequately, the lamb should be fed three times daily by stomach tube. If too weak to be left with the ewe, the lamb should be kept in an individual box warmed by an infrared lamp (Chapter 7). Watch out for signs of other disease such as enteritis and treat promptly.

Prevention

This depends on the original cause of the premature birth. Prematurity is often a sign of a serious underlying problem – take professional advice.

PULPY KIDNEY

Pulpy kidney disease is not, as the name suggests, an infection of the kidney. It is an infection of the gut by clostridial bacteria. These bacteria produce a lethal toxin that is absorbed into the bloodstream and damages many internal organs including the heart (Fig. 3.29) and the brain. The name pulpy kidney derives from the post-mortem appearance of this organ.

Symptoms

Death is the commonest symptom. Live affected lambs show nervous signs, such as increased excitability, progressing quickly to coma and death. Diarrhoea may be seen.

Prevention

The sheep clostridial vaccines are some of the safest, cheapest and most effective vaccines available. *They must be used where possible* (Chapter 6). Lambs from vaccinated ewes acquire antibodies in the colostrum that will protect them for the first 12 weeks of life. Vaccination of these lambs can commence at eight weeks with a second dose required four to six weeks later. If a lamb is known not to have consumed colostrum it can be vaccinated in the first week of life, although protection is likely to be incomplete and the

Fig. 3.29 Fluid accumulation around the heart (arrow) as a result of pulpy kidney disease. See also colour plate section.

lamb will need to be re-vaccinated at six and twelve weeks of age to gain full protection. Clearly it is far safer and cheaper to ensure that the lamb gets adequate colostrum from vaccinated ewes in the first place. In areas of high incidence, it may also be worth re-vaccinating older lambs in the autumn, before the main risk period, especially if they were born early in the year.

Pulpy kidney is associated with the consumption of a diet that is excessively high in carbohydrate. Little can be done to prevent lambs gorging themselves with milk, but care can be taken when introducing older lambs to concentrate feed. Introduce the feed slowly to give the ruminal bacteria a chance to adapt to the new diet. This procedure will also prevent **Ruminal acidosis** and digestive upsets.

RATTLE BELLY

See **Watery mouth.**

REDFOOT

This is a distressing condition of the Scottish Blackface breed and its crosses, found most commonly in southern Scotland and northern England on heather hills. The cause is unknown but a genetic basis seems likely. Normally only 1–2% of lambs is affected.

Symptoms

The horn on one or more hooves becomes detached, revealing the sensitive tissues underneath. Secondary bacterial infection leads to severe lameness.

The condition may progress. The skin of the legs may become detached. The gums, mouth and lips, and even the eye may be affected.

Treatment

There is none. Affected lambs should be humanely destroyed.

Prevention

If the offending ram can be identified it should be culled. It would seem sensible not to keep ewe lambs from the dam of the affected lamb as flock replacements.

Fig. 3.30 Lamb that died from a twisted gut (redgut). Note bloated appearance due to intestinal blockage.

REDGUT

This term describes the post-mortem appearance of young grazing lambs that have died suddenly. The cause of death is a twisted gut leading to blockage and bleeding. The condition is associated with movement to lush pasture, which leads to excessive distension and movement of the intestines (Fig. 3.30).

Symptoms

A dead lamb. If found alive, affected lambs will appear very ll.

Treatment

In early cases, surgical treatment could be attempted, but the chances of success are slim.

Prevention

Lambs and all sheep should be introduced to any change of diet, e.g. lush pasture, gradually. Either limit the time on the lush pasture or restrict intake by strip grazing.

RIBS (FRACTURED)

See Fractures.

RICKETS

Rickets is a member of the group of diseases known as the *osteodystrophic* diseases. This term refers to abnormalities in the development of the skeleton. Such abnormalities may be related to deficiencies of protein, calcium, phosphorus, vitamin D or to calcium:phosphorus imbalance. In addition, trace-element deficiency, such as **Copper deficiency**, can interfere with bone development. In the United Kingdom, phosphorus deficiency and/or vitamin D deficiency are most commonly implicated.

Symptoms

Lameness and loss of condition are the common signs. The long leg bones, especially in the forelegs, may be bowed. Joints may be swollen. Diagnosis depends on a careful examination of the affected lambs, including a post-mortem examination to obtain bone samples for mineral-content tests. An X-ray examination may well be helpful.

Treatment

Once the severe signs noted above have been identified, a complete resolution of problems will take time. Affected animals should be given vitamin D by injection and attention paid to the diet to correct any imbalance. Only the correct dose of vitamin D should be given, for *vitamin D in excess is toxic*. **Parasitic gastroenteritis** reduces the absorption of minerals from the gut, and must be treated at the same time. If **Copper deficiency** is present this also must be treated.

Prevention

Vitamin D and phosphorus deficiencies are unlikely to occur in isolation. The occurrence of rickets in a flock suggests that the diet is inadequate in many respects. A total review is called for, including seeking professional nutritional advice.

Poor conserved forage is often very low in vitamins, including vitamin D. Vitamin supplementation may be required if poor forage has to be used. As noted above, attention should be paid to preventing parasitic gastroenteritis and copper deficiency.

ROUNDWORM INFECTION

See **Lungworm** and **Parasitic gastroenteritis.**

RUMINAL ACIDOSIS

Acidosis within the rumen, which is often fatal, is very definitely a man-made disease. The condition arises when grass-fed lambs are suddenly transferred to a cereal-based diet. Rapid fermentation of the high carbohydrate diet leads to the production of excessive acid. Acid is absorbed into the body and water is drawn from the body into the rumen.

Symptoms

In mild cases, animals look distinctly unwell and are unwilling to feed. They may scour. In severe cases lambs are found off their feet, breathing heavily and in very obvious distress.

Treatment

Severe cases are normally hopeless, and humane destruction is indicated. Mild cases can be treated by giving aluminium hydroxide (1–2 g in aqueous suspension two to three times daily) or magnesium or calcium carbonate (up to 8 g four times daily) by mouth. Supply plentiful clean water. Particularly valuable animals may benefit from antibiotic treatment and intensive intravenous fluid therapy (1–2 l glucose saline containing 10 ml 2.5% sodium bicarbonate) administered by your vet. In valuable animals that are known to have recently ingested large amounts of cereal, a rumenotomy can be performed and the cereal removed. The concentrate food must be withdrawn from all the lambs at risk, and access given to good hay only.

Prevention

This is infinitely preferable to cure. Lambs should only gradually be introduced to concentrate rations, with access to good forage. Beware of the lambs that don't eat the concentrate for a week, and then for no apparent reason gorge themselves. Remember that lambs are ruminants. This digestive system is designed to cope with relatively indigestible grass. Sudden exposure of this system to large quantities of highly digestible cereals is a recipe for disaster.

SCAD (SCALD)

Scad is a disease of the feet caused by one of the bacteria found in foot rot. The disease is restricted to the cleft between the digits and no separation of the horn occurs. This problem in young lambs is nearly always associated with wet conditions underfoot. A change of environment is just as important as treatment if further cases are to be prevented.

Symptoms

Lameness, often very severe. Examination of the foot reveals an acute inflammation between the digits that is very painful to the touch.

Treatment

Topical application of antibiotic by spray is normally very effective. Keep the lamb back until the spray has had time to dry. Consult your vet for the best product to use.

Prevention

Use more bedding if inside. If outside try to find a drier pasture for the lambs and remember to move feed and water troughs around so the ground doesn't become too poached and contaminated. This will not only speed healing in affected lambs, but will prevent the problem in other lambs.

SCOUR

See **Coccidiosis, Enteritis, Lamb dysentery** and **Parasitic gastroenteritis.**

SELENIUM DEFICIENCY

See **Stiff lamb disease.**

SHEEP SCAB

This formerly notifiable disease of sheep, once largely eradicated from the United Kingdom, has returned to provide a constant

threat to all sheep flocks. Increased sheep movement and a failure to dip correctly must be two elements contributing to the failure of recent control policies.

Sheep scab is caused by the mite *Psoroptes ovis*. This mite spends its whole life cycle on the sheep, and spreads mostly from one sheep directly to another. The life cycle of the parasite can be completed in less than three weeks, and with each mite laying up to 80 eggs it is easy to see how infection can take hold very quickly.

Symptoms

Intense irritation is the cardinal sign. Close examination of the skin reveals pustules (small fluid-filled swellings) which burst and weep fluid. This fluid encrusts in the fleece. Fleece loss can be considerable. Some infected sheep, which don't react as strongly to the mite, will show few or none of these signs. Thus an absence of symptoms does not necessarily mean an absence of infection. A precise diagnosis is made by examination of skin scrapings, when the mite is identified.

Treatment and prevention

Treatment is by means of a scab-approved dip or by injection. Prevention in the United Kingdom used to be by means of at least one compulsory annual dip. Whilst this measure did not completely eradicate the disease, it certainly contributed to its control. Compulsory dipping has ceased, and sheep scab is no longer notifiable. There is thus an increased onus on all flockmasters to watch for this dreadful disease. An often forgotten benefit of annual dipping is control of other parasites such as lice and keds. These pests are re-emerging to cause problems on farms that have ceased dipping. Dips must always be used in a plunge dip bath to be effective against scab. Using these dip chemicals in shower or jet races simply doesn't work because they are unable to penetrate the fleece sufficiently to kill all the scab mites, which can hide in all sorts of crevices in the sheep's skin. It is also important to remember that none of the pour-on or spot-on insecticidal products currently available are effective against scab although they will protect against other skin parasites such as flies, ticks (*see* **Fly strike, Tick-borne fever, Tick pyaemia** and **Louping-ill**), lice and keds.

More recently, injectable avermectin-based anthelmintic drugs have also been found to be effective against scab. Several products are now available and licensed for this purpose. Using injectables has proved particularly useful in situations where it is difficult to use dips either because of a lack of dipping equipment or because

of concerns about safe handling and disposal of dip chemicals. Injectable preparations are also particularly convenient for treating bought-in stock where the same drugs should be being used to prevent importing anthelmintic-resistant worms. However, despite their undoubted effectiveness and convenience, they still have some drawbacks when compared to dips, which need to be considered: relative treatment cost per animal; long meat withdrawal periods, nearly two months for some products, which may affect getting lambs away; limited protection from further infestation after treatment; and no effect on other ectoparasites, especially lice which can be easily confused with scab. Scab control and eradication is a complex but highly necessary business so it is always worth seeking professional advice on which product best suits your circumstances.

SLAVERS (SLAVERY MOUTH)

See **Watery mouth.**

SPINAL ABSCESS

This problem is seen in lambs aged from a few days to a few weeks. Spinal abscess has much in common with **Joint ill** and **Liver abscess.** Bacteria enter the lamb's circulation either through the navel or through the gut, especially in lambs which receive late or insufficient colostrum. In older lambs, castration or docking wounds can serve as routes of entry (Chapter 7). The bacteria lodge within the spinal column where an abscess forms. The abscess presses on the adjacent tissues and causes damage to the nerves and bones of the spine leading to paralysis. The exact symptoms seen depend on both the site and severity of the infection.

Symptoms

Most commonly the hind legs are affected. The lamb manages to move about on its forelegs, dragging the hind legs (Fig. 3.31), but it quickly deteriorates.

Treatment

Prolonged antibiotic therapy combined with careful nursing is required. Treatment often produces a temporary remission of symptoms that return when the treatment stops.

Fig. 3.31 Lamb with a spinal abscess showing hind limb paralysis

Prevention

As with all such infections, a high standard of hygiene at lambing is imperative. Lambing pens should be kept clean and dry. Navels should be dressed at birth (Chapter 7). Ensure that lambs get plenty of colostrum. Docking and castrating instruments should be kept clean. Spinal abscess can easily be confused with **Sway-back**. Take advice if in doubt.

STARVATION

See **Hypothermia.**

STIFF LAMB DISEASE (MUSCULAR DYSTROPHY, WHITE MUSCLE DISEASE)

This disease is caused by a deficiency of selenium and/or vitamin E. Lambs may be affected at any age up to six months but most commonly in the first month of life.

Symptoms

Lambs born to severely deficient ewes may be born dead or die suddenly in the first few days of life. Less badly affected lambs

appear weak. Commonly, the back legs become stiff and the lamb may eventually be unable to stand.

Treatment

Consult your veterinary surgeon, who can prescribe an injectable preparation of selenium with vitamin E. It is most important to obtain an accurate diagnosis since this condition can easily be confused with other problems such as **Swayback** and **Joint ill**.

Prevention

If stiff lamb disease is confirmed, treat all newborn lambs with selenium and vitamin E. In the future, ensure that the ewes' diet is sufficient in selenium and vitamin E. Your veterinary surgeon may advise treating the ewes with a preparation containing selenium and/or vitamin E. *Note that selenium is toxic if given in excess.*

STONES

See **Urinary calculi.**

STRIKE

See **Blowfly strike.**

SWAYBACK

Swayback, sometimes known as *enzootic ataxia* or *neonatal ataxia*, is caused by a low availability of copper in the ewe's diet that inhibits the development of the lamb's nervous system during pregnancy. This low availability may be related to an absolute deficiency of copper in the diet or to an excess of the element molybdenum. Most cases of swayback occur in areas where copper deficiency is known to be a problem or on land that has recently been improved by liming, since this procedure reduces the availability of copper to the ewe.

Symptoms

The disease takes two forms in lambs. The first is congenital swayback, when the lambs are affected at birth. In severe cases the

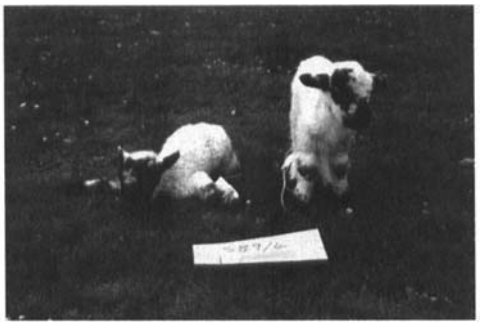


Fig. 3.32 Congenital swayback, the affected lamb on the left is unable to rise. See also colour plate section.

lambs may be unable to rise (Fig. 3.32), while in mild cases they may be merely a little unsteady on their hind legs. The second form is delayed swayback. As the name suggests, the symptoms are not seen until some time *after* birth, normally between two and six weeks, but sometimes as late as 12 weeks. Diagnosis of swayback may sometimes be easy but in many cases it is not. Other conditions that must be considered include **Spinal abscess** and **Stiff lamb disease**. Since the prevention of more cases depends on an accurate diagnosis, suspect swayback lambs should be submitted for veterinary investigation.

Treatment

Treatment of severe congenital swayback is normally hopeless, and the lamb should be humanely destroyed. The recognition of delayed swayback suggests copper deficiency in the lambs. Treatment with copper supplements (*see* **Copper deficiency** and Chapter 6) will halt the progress of the condition.

Prevention

The prevention of swayback both at the time of an outbreak and in future years depends on the administration of copper-containing compounds to the ewes and, where appropriate, to the lambs. The ewe may be treated either by injection or by oral dosing with a copper oxide capsule or a Cosecure® bolus (*see* **Copper deficiency** and Chapter 6). Copper is a very toxic substance for sheep, so consult your veterinary surgeon for both an accurate assessment of the problem and for instruction on the safe use of copper compounds.

Fig. 3.33 Lamb with tetanus. Note the stiff extended legs and the pricked ears (picture by Prof. M.J. Clarkson). See also colour plate section.

TETANUS (LOCKJAW)

Tetanus is caused by a toxin produced by the bacterium *Clostridium tetani.* Infection normally occurs via a wound, e.g. castration or docking. The use of clostridial vaccines has greatly helped to reduce the incidence of this disease.

Symptoms

These are first seen three to ten days after infection. Initially, the lamb appears stiff, is unwilling to move and muscle tremors may be observed. After 12–24 hours the limbs, neck and jaw become very stiff (Fig. 3.33). Disturbance of the lamb causes increased stiffness and muscular spasms. Convulsions, failure of the breathing muscles and death follow rapidly. Occasionally, only a mild form of tetanus may occur, there being little progress beyond the initial stiffness stage.

Treatment

Treatment of all but the mildest cases is useless. Affected lambs should be humanely destroyed for this is a most painful disease. Mild cases can be treated with antibiotics and tetanus antiserum – consult your veterinary surgeon.

Prevention

Vaccination of the ewe with clostridial vaccine effectively prevents this problem, providing the lamb gets adequate colostrum. The few cases that do arise are probably due either to incorrect

vaccination of the ewe or to failure of the lamb to take colostrum. Take care to castrate and dock lambs correctly under clean conditions. If there is any doubt about a lamb's colostrum intake, give tetanus antiserum by injection.

TICK-BORNE FEVER

All ticks are infected with the organism of tick-borne fever, *Anaplasma* (formerly *Cytoecetes*) *phagocytophila,* and all lambs in tick areas will meet the infection. The infection alone is of limited consequence, but when it occurs simultaneously with **Louping ill** or **Tick pyaemia** the effects can be devastating. Tick-borne fever depresses the lamb's immune system, allowing other infections to proceed unhindered.

Symptoms

Little is normally seen. The lamb will suffer a high temperature and will be 'off colour' for a week or more. There may be a moderate weight loss.

Treatment

This is seldom attempted as, on their own, signs are usually mild and short lived. A single injection of long-acting oxytetracycline is effective.

Prevention

Tick-borne fever cannot be prevented, but the time of infection can be delayed. Hopefully such a delay will reduce the severity of the **Tick pyaemia** that commonly follows tick-borne fever. Two complementary measures can be employed before the lambs are exposed to tick pastures: treatment with insecticide, commonly a pour-on preparation, and a double-dose injection of long-acting oxytetracycline.

TICK INFESTATION

In the United Kingdom, the sheep tick is most important because of the diseases it carries: **Tick-borne fever** and **Louping-ill.** However a heavy tick infestation will itself have deleterious effects, related to the bloodsucking activity of the parasite.

Symptoms
Affected lambs will appear weak. Loss of blood will lead to anaemia, seen as pale gums, conjunctiva or vulva. Ticks will be much in evidence.

Treatment
In heavy infestation, dipping will provide the most immediate response. Supportive treatment may be required.

Prevention
Use of a pour-on insecticide should prevent this problem.

TICK PYAEMIA

Staphylococcus aureus is a commensal bacterium of the lamb's skin that normally does no harm. But if the bacteria gain entry to the lamb's body whilst immunity is depressed by **Tick-borne fever** the results can be most serious.

Symptoms
Symptoms vary with the site in the body in which the bacteria lodge. **Joint ill** (cripples) and **Spinal abscess** are two possible sequelae.

Treatment
Intensive antibiotic treatment is required. Unfortunately, many lambs will remain 'poor doers'.

Prevention
The main problem is **Tick-borne fever**. See above for details of delaying the onset of this problem.

TREMBLING

See **Louping-ill.**

UMBILICAL HERNIA

There is a gap in the muscles of the body wall in the navel region through which the blood vessels from the placenta gain access via

Fig. 3.34 A lamb with an umbilical hernia. See also colour plate section.

the navel cord to the lamb's circulation. This gap should close very soon after birth. Occasionally it does not, and it may be big enough to allow the loose contents of the abdomen, the intestines, to find their way outside the lamb's body to form an umbilical hernia (Fig. 3.34). Once some intestines are out, others follow. The ewe often exacerbates the condition by persistently licking the herniated intestines.

Symptoms

An impending hernia may be seen as a small swelling at the navel but more commonly the problem is only first noticed when a few inches of intestine have already escaped. Sometimes these may be hidden inside the membranes of the cord. At this stage the lamb itself shows no untoward symptoms.

Treatment

Do not attempt this yourself. It is normally impossible to return the herniated intestines through the small hole and any attempt will only make matters worse. Protect the intestines from damage

and try to keep them clean. Loosely wrap the lamb's abdomen with a clean towel. Take the lamb immediately to your vet. Unless this problem is quickly corrected the lamb's condition will deteriorate at an alarming rate. Death in less than 12 hours can be expected in untreated cases. Under anaesthesia your vet can enlarge the gap in the body wall, gently replace the herniated intestines and then close the wound with sutures.

Prevention

This problem may have a genetic component and it is probably unwise to keep treated lambs as replacements. Take professional advice on prevention if more than the occasional lamb is affected.

UNDERSHOT JAW

See Jaw defects.

URINARY CALCULI (STONES)

This is another condition common in intensively fed lambs. It is relatively unusual in grass-fed lambs. Only ram lambs are affected. Precipitates initially form in the kidney, and make their way to the bladder and the urethra (the tube leading from the bladder to the tip of the penis). It is in the narrow male urethra that problems are caused. The small calculi, often called 'sand', block this tube, preventing the passage of urine.

Symptoms

These are mostly related to a full bladder and fruitless attempts to empty it. The lamb is in obvious discomfort and strains with no result. The abdomen becomes distended as the bladder enlarges. Blood, drops of urine and crystals may be seen at the prepuce. As time passes the symptoms become more acute and the lamb is clearly in great pain.

Treatment

Veterinary help is required. Either medical or surgical treatment can be attempted, but the prognosis is poor. In some cases the blockage is just behind the urethral process (the vermiform appendage) on the tip of the penis. Removal of the process can relieve the problem.

Prevention

Once more, prevention is infinitely preferable to cure.

A number of factors have been identified which predispose to urinary calculi:

- a high mineral content in the diet, especially phosphorus and magnesium;
- a low volume of concentrated urine, related to the low water content of concentrate feeds;
- a high urine pH (urinary calculi are less likely to form when the urine is acid, pH value less than 7);
- urinary calculi are more common in castrated than entire ram lambs.

With these points in mind, steps can be taken to prevent urinary calculi:

- leave ram lambs entire if possible;
- introduce lambs to concentrate diet gradually, and always provide roughage, e.g. hay, to maintain water intake;
- add 1% sodium chloride (common salt) to the diet to increase drinking;
- add ammonium chloride to the diet to acidify the urine;
- do not allow access to extra minerals;
- ensure that the calcium:phosphorus ratio in the diet is at least 2:1;
- ensure that lambs are used to drinking water from a trough before they are introduced to concentrate feed;
- clean water must always be available.

VITAMIN E DEFICIENCY

See **Stiff lamb disease.**

WATERY MOUTH (RATTLE BELLY, SLAVERS, SLAVERY MOUTH)

Watery mouth is a disease of intensive husbandry seen in lambs aged 12–72 hours. Up to 50% of all lambs can be affected.

In years gone by, watery mouth has been attributed to a host of causes, ranging from constipation to castration with rubber rings. Today, we can discount the mythology that surrounds this

disease, for we now know that watery mouth is a form of endotoxic shock. Endotoxic shock arises because large numbers of otherwise harmless coliform bacteria, commonly *E. coli*, are swallowed accidentally and are able to survive transit through the gut and enter the blood. Normally, the lamb's immune systems keep the blood sterile, but if bacteria enter the circulation in high numbers, the body's defences are overwhelmed and blood poisoning results. During the growth and death of bacteria in the blood a toxin known as endotoxin is released and causes shock, recognised by the shepherd and vet as watery mouth disease.

How do young lambs acquire this heavy bacterial load? Three factors contribute to this:

(1) When lambing inside the lamb is born into a heavily contaminated environment. Both the bedding and the ewe's fleece are rich in bacteria such as *E. coli*. When the lamb first attempts to suck, it often starts with a mouthful of fleece, not a teat. Its first suck is bacteria, not colostrum.
(2) Unlike the adult sheep, the pH of the contents of the lamb's stomach, the abomasum, is neutral, pH 7. This condition is desirable, for it allows the antibodies in colostrum to pass undamaged into the small intestine, whence they are absorbed. But it also favours bacterial survival, allowing bacteria swallowed accidentally in the lamb's search for food to pass unharmed to the small intestine.
(3) An early and adequate intake of colostrum is highly effective at preventing watery mouth, both by neutralising bacteria in the gut and by binding to the sites on the gut wall that bacteria would otherwise use to transfer into the bloodstream. But many lambs, especially twins and triplets, do not receive adequate colostrum early in life. It is not surprising that watery mouth is considerably more common in multiple lambs than in single lambs, and also in lambs out of ewes in poor condition.

In the early stages of this condition the passage of food through the gut slows down and may stop totally. The lamb ceases to suck. Gas accumulates in the abomasum and the lamb may become bloated (Figs 3.35 and 3.36). If these lambs are gently shaken, a rattling or tinkling sound will be heard, hence the name *rattle belly*. A moderate amount of gas in the stomach can be deceiving, for it gives the lambs a 'full-of-milk' appearance whereas the lamb may in fact be starving. The combination of starvation and endotoxaemia quickly kill the lamb.

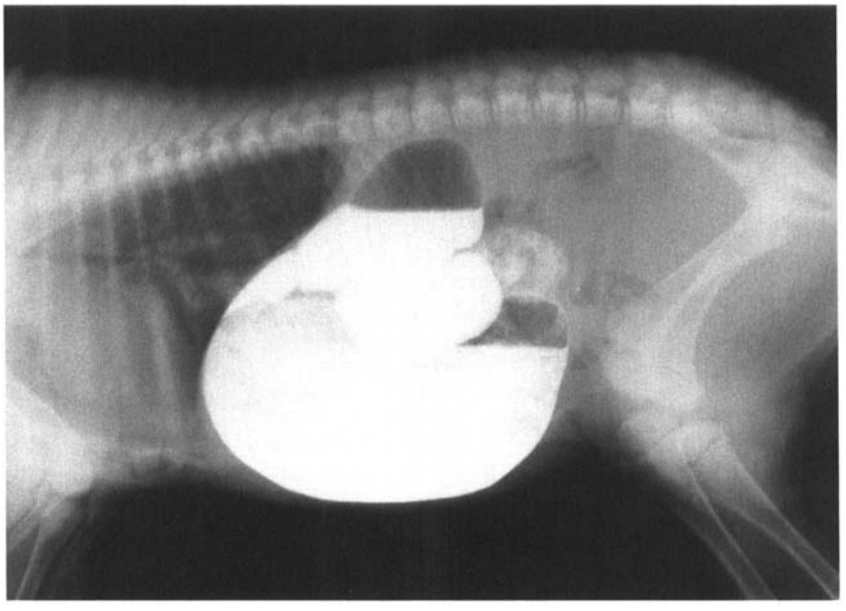


Fig. 3.35a An X-ray of a healthy lamb given a barium meal by stomach tube. The extent of the abomasum is indicated in Fig. 3.35b.

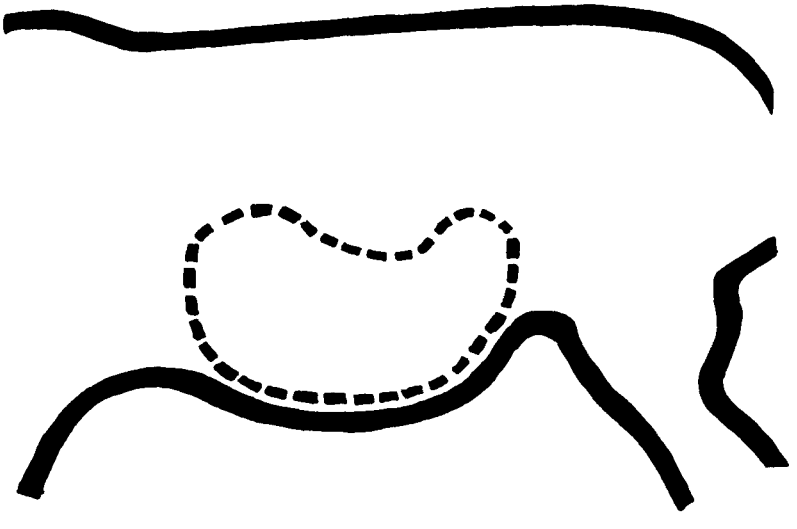


Fig. 3.35b Diagrammatic representation of abomasum shown in Fig. 3.35a.

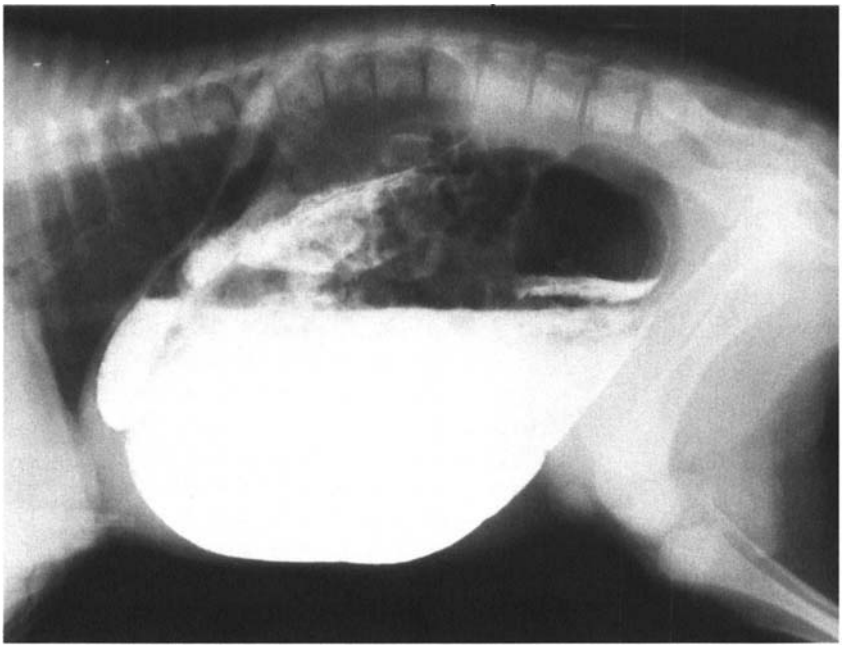


Fig. 3.36a An X-ray of a lamb with watery mouth which has been given a barium meal. The extent of the enlarged abomasum is indicated in Fig. 3.36b.

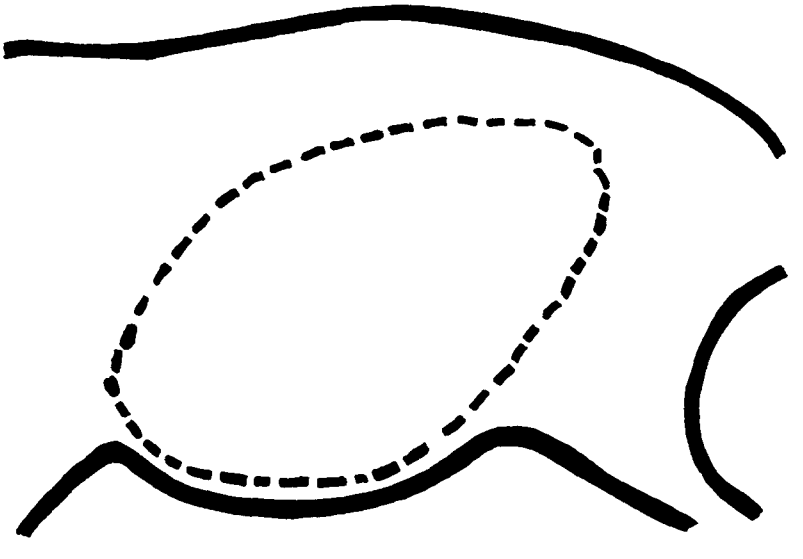


Fig. 3.36b Diagrammatic representation of abomasum shown in Fig. 3.36a

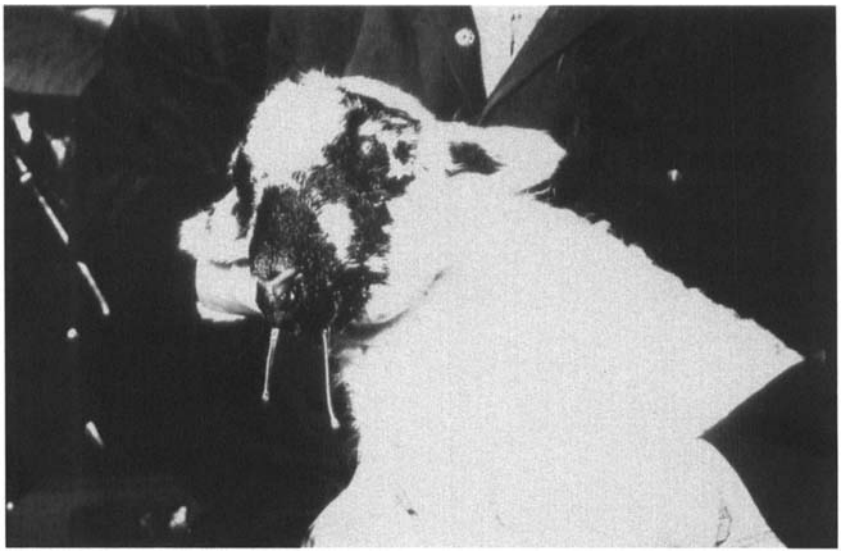


Fig. 3.37 A lamb affected by watery mouth showing dullness and the characteristic wet mouth due to excessive salivation (picture by Dr C. Hodgson).

Symptoms

Initially the lamb looks miserable and 'tucked-up'. The characteristic 'watery mouth', which is simply a wet mouth or drooling of saliva, soon appears (Fig. 3.37). The lamb ceases to suck and may become bloated. If not treated the lamb quickly deteriorates and dies.

Treatment

This should be started at the earliest possible opportunity. Inject the lamb once daily with antibiotics to control any systemic bacterial infection. Feed the lamb three times daily, by stomach tube, with 50 ml of a glucose/electrolyte solution, and give an oral antibiotic (Chapter 7) to reduce the build-up of bacteria in the gut. If the lamb is not sucking from the ewe, increase the feed volume to 100–200 ml per feed. Continue treatment until the symptoms have gone. It is not advisable to feed watery mouth lambs with milk. Consult your veterinary surgeon about which antibiotics to use and when.

Prevention

Good ewe nutrition should result in a plentiful supply of colostrum. This will help to prevent watery mouth in addition to many other problems. Ensure that all lambs, and especially twins and

Fig. 1.6 The contents of a uterus 90 days after conception. The blood vessels running from the cotyledons to the umbilical (navel cord) can clearly be seen (picture by Dr D. Buxton).

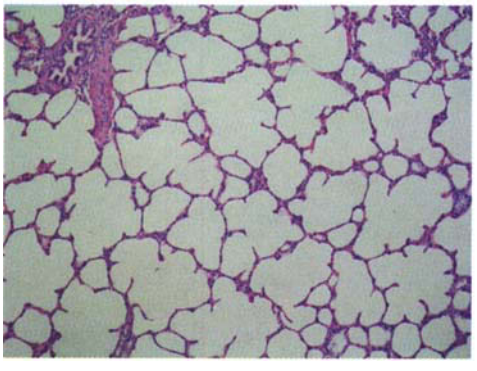


Fig. 1.7 A histological section (tissue seen under the microscope) showing lung from a healthy newborn lamb.

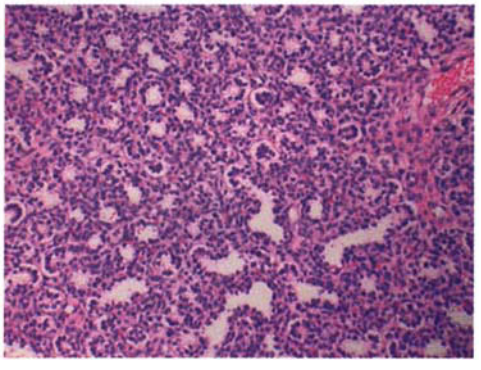


Fig. 1.8 A histological section of lung taken from a premature lamb. The lung has not expanded.

Fig. 2.2 Lambing – external appearance, normal presentation.

Fig. 2.4 Lambing – assisted delivery, note use of protective gloves.

Fig. 2.7 Snare and ropes positioned on a lamb. Snare must be behind the ears.

Fig. 3.2 Skinned lamb showing limb and joint deformities (*arthrogryposis*) caused by Border disease virus infection.

Fig. 3.3 Incorrect rubber-ring castration causing urethral obstruction and bladder distension (arrow).

Fig. 3.7 Lamb with Michel clips placed under the eye to correct entropion.

Fig. 3.8 Antibiotic eye ointment being applied to treat infection resulting from entropion.

Fig. 3.19 Intestinal damage (arrow) caused by lamb dysentery.

Fig. 3.20 Liver abscesses or necrotic hepatitis (arrow) caused by infection via the navel.

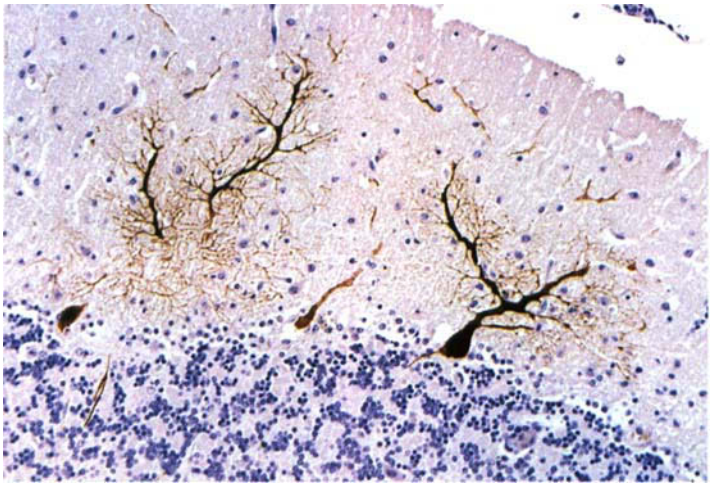


Fig. 3.21 Section of lamb's brain as seen under the microscope. Special processing reveals brown-stained louping-ill virus in the nerve cells (neurones).

Fig. 3.22 Orf lesions on a shepherd's hand.

Fig. 3.23 Orf lesions around a lamb's mouth.

Fig. 3.29 Fluid accumulation around the heart (arrow) as a result of pulpy kidney disease.

Fig. 3.32 Congenital swayback, the affected lamb on the left is unable to rise.

Fig. 3.33 Lamb with tetanus. Note the stiff extended legs and the pricked ears (picture by Prof. M.J. Clarkson).

Fig. 3.34 A lamb with an umbilical hernia.

Fig. 4.2 A ewe with a vaginal prolapse (picture by Dr M. Dagleish).

Fig. 5.1 Placenta infected with enzootic abortion of ewes. Note numerous white spots on the cotyledons, this is damage caused by the bacteria (picture by Dr D. Buxton).

Fig. 5.5 Stillborn lamb infected with *Toxoplasma*; note the mummified twin (arrow) that died as a result of infection in mid-pregnancy (picture by Dr D. Buxton).

Fig. 5.4 The most expensive litter tray in the world? (Picture by Dr D. Buxton).

Fig. 6.3 Cosecure® glass bolus containing copper, selenium and cobalt (Telsol Ltd., Denbigh).

Fig. 7.2 Taking a lamb's temperature.

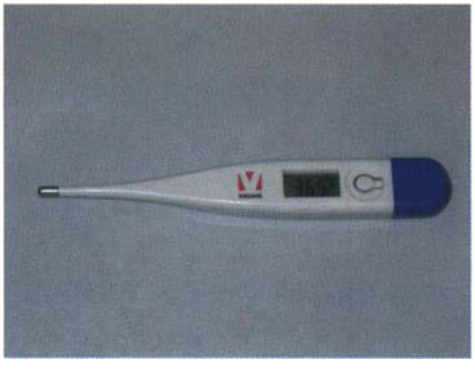


Fig. 7.3 Electronic thermometer.

Fig. 7.7 Giving a feed by stomach tube.

Fig. 7.9 Administration of medicine by mouth using a pump-action dispenser.

Fig. 7.12 Injection by the subcutaneous route.

Fig. 7.13 Injection by the intramuscular route. The injection is given into the front of the upper hind leg.

Fig. 7.14 Injection of glucose solution by the intraperitoneal route.

Fig. 7.20 Unconscious, hypothermic lamb ready for warming after being dried and given a glucose injection.

Fig. 7.27 Castration using a rubber ring. Note correct placement around the scrotal neck but below the teats (arrows) after ensuring both testicles are in the scrotum.

Fig. 7.28 Tail docking using the rubber ring.

Fig. 7.30 Dressing the navel – the whole cord and surrounding skin are immersed.

Fig. 7.34 Giving an enema using a cut-down stomach tube and syringe.

triplets, take plenty of colostrum in the first hour of life. When necessary give supplementary colostrum by stomach tube. Keep lambing pens clean – this will help to prevent watery mouth and many other infections. Do not castrate lambs with rubber rings until 12 hours of age, and preferably not until 24 hours, since the discomfort caused by this procedure reduces colostrum intake. When a serious problem does arise, all lambs may have to be treated immediately after birth with antibiotics – treatment a few hours after birth may well be too late. However, this should be regarded as an exception rather than the rule. Good hygiene and plenty of colostrum is the key.

WHITE MUSCLE DISEASE

See **Stiff lamb disease.**

WOUNDS

Most skin wounds in young lambs are of no serious consequence. Problems can arise through bacterial infection if the wound is not kept clean.

Treatment

If a wound is large, i.e. very deep or more than half an inch long, it may require stitching and you should consult your veterinary surgeon. Otherwise clip the wool surrounding the wound and bathe it with warm water containing a non-irritant disinfectant (follow the instructions on the bottle – using too strong a solution is harmful). Dry the area and apply a little antiseptic cream. If there is any doubt about the tetanus status of the lamb (ewe vaccinated? lamb sucked plenty of colostrum?) give tetanus antiserum. Check the wound over the next few days to ensure that it is healing. If necessary bathe and dress again. Do not allow fluid seeping from the wound to become encrusted on surrounding wool – this will encourage bacterial infection.

YELLOWSES

See **Photosensitization.**

4 Problems in Ewes

In this chapter we have included notes on problems common in lambing ewes. Problems not specifically associated with lambing time are not covered. Before lambing you should consult your veterinary surgeon on all the problems described below. You should discuss appropriate forms of prevention and treatment, and also draw up guidelines as to when you can safely proceed yourself and when it will be prudent to summon professional help. Such discussions form an important basis for developing a proper written Flock Health Plan (Chapter 8). References that appear elsewhere in the chapter appear in bold face.

ABDOMINAL HERNIA (RUPTURES)

This is an occasional problem that is most likely to occur in late pregnancy in the older ewe carrying twins or triplets. A weakness and splitting can develop in the muscles of the body wall either in the midline (*ventral hernia*), or at the side (*flank hernia* or 'fallen side').

Symptoms

In the case of ventral hernia, the floor of the abdomen drops almost to the ground – only the skin is retaining the abdominal contents (Fig. 4.1). The ewe will walk with great difficulty, if at

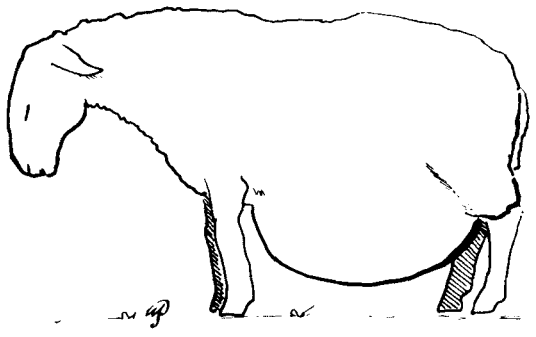


Fig. 4.1 A ewe with a ventral hernia.

all. With a flank hernia, a swelling is seen to one side of the lower abdomen but the ewe is not normally as severely incapacitated.

On very rare occasions, a ventral hernia can be confused with an excessive accumulation of fluid in the uterus – *hydrops*. This confusion is resolved by *briefly* turning the ewe on her back. In ventral hernia, the abdominal contents fall back into the ewe and the break in the body wall can be found with the hand. In hydrops this does not happen.

Treatment

There is no specific treatment for either of these conditions. You must take advice from your veterinary surgeon. The ewe is unlikely to lamb naturally, especially in the case of a ventral hernia. If the ewe is near to lambing your veterinary surgeon may be able to induce her to lamb by injection of a hormone or deliver the lambs by Caesarean section. Remember that the lambs will be premature. In severe cases, where this is not possible or when induction fails, the ewe may have to be destroyed on humane grounds.

HYPOCALCAEMIA (LAMBING SICKNESS, MILK FEVER, PARTURIENT PARESIS)

The term *hypocalcaemia* means a low blood level of calcium. This condition is not an absolute deficiency of calcium, for the ewe has considerable reserves in her bones. It is rather a disturbance of the ewe's calcium metabolism in the last month of pregnancy or the first few weeks after lambing which results in a sudden and severe lowering of the blood calcium level. This is of serious consequence because calcium is essential for the efficient functioning of all muscles including the heart. Before lambing, hypocalcaemia is

normally associated with some stress, such as being driven. Indeed stress alone, such as bad weather after shearing, can cause this problem at other times of the year. After lambing, the onset of lactation and the secretion of calcium into milk seem to precipitate this problem.

Symptoms

Initially, just muscular weakness may be seen, but more usually the ewe is first noticed when she cannot stand. The ewe appears depressed and may rest her head on the ground. Occasional muscular spasms may be noticed. These symptoms may be confused with **Hypomagnesaemia** or **Pregnancy toxaemia**. However, the hyperexcitability of hypomagnesaemia is missing and a prompt response to treatment with calcium solutions serves to differentiate hypocalcaemia from pregnancy toxaemia.

Treatment

If hypocalcaemia is suspected, a full dose of 20% calcium borogluconate solution should be injected under the skin (subcutaneous injection), at a rate of 50 ml/40 kg body weight, changing the injection site two or three times during administration. The best injection sites are usually found under the loose skin behind the shoulder or immediately in front of the inner thigh. A favourable response should be seen within an hour or so. Keep an eye on the ewe for the next few days. Relapse is not uncommon and a repeat treatment may be needed. If you do not see definite signs of recovery within an hour or so of treatment, you should question your diagnosis and, if in doubt, take professional advice. Under these circumstances, your veterinary surgeon may give additional treatments by intravenous injection. However, farmers should never attempt to give calcium, or any other drug for that matter, intravenously unless specifically instructed how to do so by their veterinary surgeon, as there is a high risk of inducing fatal infections or allergic or other reactions.

Prevention

The prevention of hypocalcaemia by dietary means seems attractive in principle, but there is little agreement between the experts on how it should be done. Some say give excess calcium so that there is plenty available to the ewe – others say restrict calcium intake to stimulate calcium release from the bones! What can be said with confidence is that both physical and nutritional stresses should be avoided before and after lambing.

HYPOMAGNESAEMIA (GRASS STAGGERS, LACTATION TETANY)

The term *hypomagnesaemia* means a low blood level of magnesium. It is an acute condition most likely to occur in the first four to six weeks after lambing, although occasionally it can occur before lambing. It can be precipitated by moving the ewe to either lush or bare pasture and also by bad weather. Magnesium is essential for the normal function of nerves and most of the symptoms seen are nervous in origin. It must therefore be differentiated from other nervous diseases such as listeriosis, cerebrocortical necrosis, and louping-ill (in tick areas) (see Chapter 3 for discussion of these conditions). Hypomagnesaemia is commonly accompanied by **Hypocalcaemia** and it is normal to treat both conditions if hypomagnesaemia is suspected.

Symptoms

Hypomagnesaemia is a much 'faster' disease than hypocalcaemia – the progression from apparent normality to death may only take an hour or so. In many situations the first thing noticed is a dead ewe. In the early stages, the affected ewe appears excitable, may walk with a stiff gait and may show nervous twitchings or spasms. As the disease progresses the ewe goes off her legs and may lie with all four legs extended in spasm. Convulsions and death follow.

The problem can be confused with either **Hypocalcaemia** or **Pregnancy toxaemia** (before lambing only). Confusion with hypocalcaemia is of no immediate importance since both conditions are treated together as a routine. Confusion with pregnancy toxaemia should be resolved by the fast progressive nature of the condition and hopefully prompt response to treatment.

Treatment

A 20% calcium borogluconate solution, also containing magnesium hypophosphite (5% w/v), should be given subcutaneously (50 ml/40 kg). Your veterinary surgeon may also recommend the subcutaneous injection of up to 75 ml of a stronger solution of magnesium sulphate (25% w/v). Under no circumstances should strong magnesium solutions be given by intravenous injection – this stops the heart and is a sure way of killing the ewe. Take advice from your veterinary surgeon about which solutions to use, when and how.

Prevention

If a sudden change of diet or pasture has precipitated cases of hypomagnesaemia, the careful reversal of the change is probably wise. In the longer term, the incidence of hypomagnesaemia can be reduced to a minimum by ensuring an adequate dietary intake, ideally in the form of a high magnesium concentrate. Provide shelter during the high-risk period and ensure that ewes in poor condition receive extra rations. In known high-risk situations, hypomagnesaemia can be prevented by either pasture treatment, administration of a magnesium bolus or 'bullet' or by adding magnesium to the water supply (Chapter 6).

MASTITIS (UDDERCLAP)

The term *mastitis* means an inflammation of the udder, normally caused by bacterial infection. The form of mastitis that occurs in early lactation is an acute disease that can easily lead to the death of the ewe if not promptly detected and treated.

Symptoms

The affected ewe is first noticed either when she does not come to the feeding trough or when she limps on a hind leg as she tries to relieve the pain in her udder. On turning the ewe, examination reveals that one side of the udder is swollen, hot and painful. The ewe is depressed and may well have a high temperature (more than 40.5°C, 105°F). The milk in the affected quarter is often thin and may contain clots of blood. Sometimes one's attention is first brought to this problem by hungry lambs, for mastitis severely depresses or stops milk production.

Treatment

Prolonged antibiotic and anti-inflammatory therapy is required. The sooner it is commenced the better are the chances of saving the ewe and the infected quarter (or should it be the udder half?).

Prevention

A number of factors are likely to increase the chances of a ewe getting mastitis. These include orf, bad hygiene in the lambing area and over-zealous sucking by the lambs. Orf has been discussed earlier (Chapter 3) and the second factor requires no further comment. Over-zealous sucking, which can lead to teat damage and infection, is most likely to occur when the ewe has insufficient

milk. Occasionally, it is bacteria from the mouth and throat of the lambs that actually initiate the infection. The hungry lambs continue to suck the empty udder and as they become more frustrated they increase their efforts. In this situation the lambs should be supplemented until the milk supply increases, or removed and fostered or reared artificially.

PNEUMONIA

The term *metritis* means inflammation of the uterus. This is usually caused by bacterial infection and is a serious condition that can quickly kill the ewe. It occurs either when the ewe has aborted and the placenta (afterbirth) has been retained or when a dead, rotten lamb has been born or when the shepherd has assisted a lambing without observing all the precautions noted in Chapter 2.

Symptoms

The first sign is often a dull ewe. A close examination reveals a discharge from the vulva. This is often brown or green in colour and foul smelling. A high temperature (more than 40.5°C, 105°F) is a common finding.

Treatment

Prolonged antibiotic therapy is required.

Prevention

Abortion and the birth of rotten lambs are beyond the shepherd's immediate control, although they are causes for long-term concern. Consult your veterinary surgeon on the best preventative measures to take in these cases. Some cases of metritis are caused by clostridial bacteria. Vaccination of the ewe with a clostridial vaccine should prevent these. When aiding a ewe during lambing, be as clean and gentle as you possibly can. To prevent infections, antibiotic pessaries can be placed in the uterus once the lamb has been delivered, but these may later be expelled with the afterbirth. An injection of long-acting antibiotic is required.

METRITIS

Pasteurella pneumonia caused by the bacterium *Mannheimia (Pasteurella) haemolytica* can occur at any time of the year, but in

some flocks it does occur more commonly around lambing. Sometimes a number of ewes are affected, but often the occurrence is sporadic.

Symptoms

Ewes may be found dead. More commonly the ewe is found obviously ill, with a high temperature and laboured breathing. Discharges may be seen from the nose and eyes.

Treatment

Antibiotic treatment is required: consult your veterinary surgeon. If only the odd case is seen, prophylactic treatment of other ewes is probably unjustified, but, if an outbreak seems likely, such treatment is worthwhile. Past flock history will be important in taking this decision.

Prevention

In flocks where *Pasteurella* pneumonia is a recurrent problem, vaccination should be considered. Such vaccination can be conveniently given in preparations combining clostridial vaccines and pneumonia vaccine. The pneumonia vaccine, like clostridial vaccine, is a dead preparation and two doses are required. The last dose (or a booster dose) should be given at least four weeks before lambing is due (Chapter 6).

Outbreaks of *Pasteurella* pneumonia are often associated with stressful conditions and handling. Care should be taken to avoid such situations around lambing. Ewes should be moved to lambing areas well before lambing is due; moving them just before lambing often seems to precipitate problems.

PREGNANCY TOXAEMIA (TWIN LAMB DISEASE)

Pregnancy toxaemia is a metabolic problem of the ewe that occurs in the last four weeks of pregnancy – never after lambing. It is most commonly seen in the ewe carrying two or more lambs but it can occur in ewes, especially hill ewes, carrying only one lamb.

This condition results from a shortage of nutritional energy. This energy shortage is related to the requirements of the growing lamb and to the nutritional state of the ewe. Not surprisingly, the condition occurs in ewes in poor condition on a low nutritional plane. But it also occurs in very fat ewes whose appetite may be depressed, and in ewes which are greedy trough feeders, but which

take little hay or silage. Stress factors such as bad weather, handling and hard driving may bring on this problem in susceptible ewes.

Symptoms

In the early stages the ewe separates from the flock. Signs of blindness may be evident. The ewe soon becomes depressed, stops feeding and may show nervous signs. These are variable but can include head pressing, unusual carriage of the head, fine tremors, teeth grinding and even convulsions. Breathing may appear to be laboured. It may be possible to detect the sweet smell of acetone on the ewe's breath. After a day or so the ewe becomes recumbent (unable to rise). Regurgitated stomach contents may be seen in the nose and a scour may develop. The ewe may become blown. Coma and death follow.

Treatment

The chances of success are not high but they are best if treatment is started at the earliest possible stage. Assume that hypocalcaemia is also present and treat accordingly with subcutaneous injection of 20% calcium borogluconate solution at a rate of 50 ml/40 kg (*see* **Hypocalcaemia**). In the case of the overfat ewe, shearing may help – this stimulates the ewe to break down her own energy reserves. If the ewe is known to be near lambing, labour can be induced. Otherwise the principle of treatment is to give the ewe energy. Offer appetising food such as molasses and give 160 ml 30% dextrose/electrolyte solution two to three times daily followed by 50 ml propylene glycol four hours later by mouth. In addition to feeding, a high standard of nursing is required. The ewe should be removed indoors to a deeply bedded pen. If she is recumbent, move her at least twice daily to prevent the development of sores and pneumonia. An early improvement with treatment is a hopeful sign; no immediate improvement or further deterioration less so. Your veterinary surgeon may supplement this regime by giving *specially formulated* glucose solutions by intravenous injection.

Prevention

The major principle involved is nutrition from before tupping until lambing. This requires proficiency in, and frequent use of, body-condition scoring (Chapter 6). Ewes should be in good, but not fat, condition at mid-pregnancy, i.e. a condition score of 3, and should receive an improving plane of nutrition as lambing approaches.

- Separate the lean ewes and give them extra rations.
- Shy feeders must be separated from the bullies. This ensures that the shy ewes get enough feed and that the bullies do not get too much.
- Ewes with either teeth or feet problems should be culled – if not, they require preferential treatment if their nutrition is not to suffer.
- When folding on turnips, feed concentrates first, as some ewes are slow to eat concentrates after turnips.
- Check that hay or silage is of good quality and is palatable – a stomach full of rubbish is no good to a ewe in late pregnancy.
- If you are feeding more than 0.5 kg (1 lb) of concentrates daily, divide the ration into two feeds.

Commercial 'high energy' feed blocks and licks are available but variable intake by the ewes often limits their usefulness and they should never be regarded as an alternative to ensuring good nutritional management throughout pregnancy. Keep the stress of procedures such as driving and dosing to a minimum.

PROLAPSED VAGINA

Prolapse of the vagina is a condition occurring in the last three weeks before lambing in which the vagina is pushed out through the lips of the vulva (Fig. 4.2). It is most common in old fat ewes but can occur in ewes of any age. The prolapse can include the urethra (the tube connecting the bladder to the vagina) and also the bladder itself. This leads to an inability to urinate, pressure in the bladder and further straining which makes the condition worse.

Fig. 4.2 A ewe with a vaginal prolapse (picture by Dr M. Dagleish). See also colour plate section.

In severe cases, the wall of the vagina may break and intestines may herniate through the hole. These extreme cases are hopeless. Summon your veterinary surgeon who can painlessly destroy the ewe and maybe salvage the lambs by Caesarean section *post mortem*.

Symptoms

The prolapse is normally first seen when the ewe is lying down. It may not be present all the time – it can pop in and out. The condition may progress no further but it often does. Eventually the vagina becomes permanently prolapsed. The ewe strains, making the condition worse.

Treatment

A number of treatments have been advocated over the years. These include tying strands of wool across the vulva (impossible in many short-woolled breeds and in shorn ewes), a number of patent restraining devices (Figs 4.3 and 4.4) and stitching (Figs 4.5 and 4.6). In all cases the prolapsed vagina will have to be replaced or *reduced* prior to treatment.

As noted above, a prolapse may block the urethra preventing urination. This increases straining. The urethral orifice is situated on the floor of the birth canal (i.e. nearest the ewe's feet) about two inches from the exterior. The full bladder can be relieved by carefully elevating the prolapsed vagina, with clean, lubricated fingers, above the floor of the birth canal for a few seconds. No force is required.

Correction and stabilisation of the prolapse is always much easier if the rear end of the ewe can be raised, so reducing the pressure from the contents of the abdomen. The prolapse should be washed using warm water containing a non-irritant disinfectant, and then gently pushed back using bent fingers. The reduced vagina can now be stabilised using one of several methods.

When using retainers (Fig. 4.3) the flat tongue is inserted into the vulva to hold the reduced vagina in place. The device is then tied to the surrounding wool using the tapes attached to the side arms. Unfortunately, these devices have a tendency to fall out unless very carefully secured. Furthermore, their presence in the vagina may cause irritation and interfere with urination, stimulating the ewe to strain even more thus eventually making the whole situation worse. Ewe trusses (Fig. 4.4) work by holding the replaced vagina in position by exerting external pressure on the perineum (the area around the vulva) thus overcoming problems

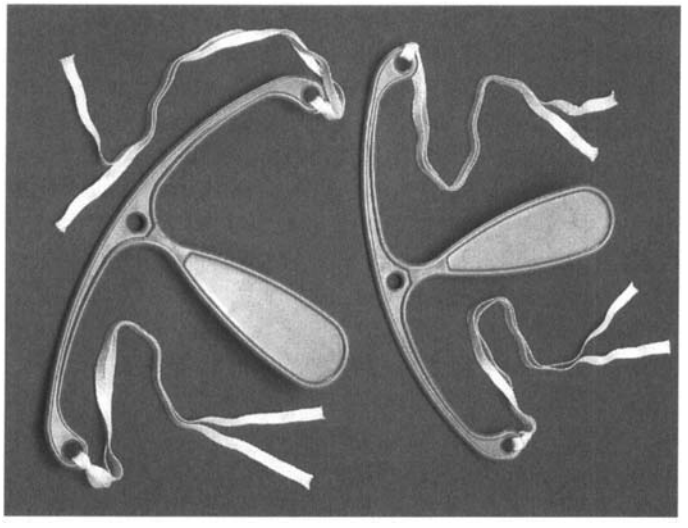


Fig. 4.3 Plastic retaining devices used to treat a prolapsed vagina (picture by Ritchey Tagg plc., Masham).

Fig. 4.4 Ewe harness and truss. The replaced vagina is held in position by plates at the right hand side (picture by Ritchey Tagg plc., Masham).

associated with straining and urinary blockage; however the harness has to be carefully fitted to be most effective. Both of the above methods are probably only effective when treating early or mild cases.

As long as the ewe can be closely watched for signs of lambing, one of the best methods is to stitch the lips of the vulva closed. You should only attempt this if you are experienced and have received detailed instruction from your veterinary surgeon. Use nylon tape and a large sharp needle specifically designed for the

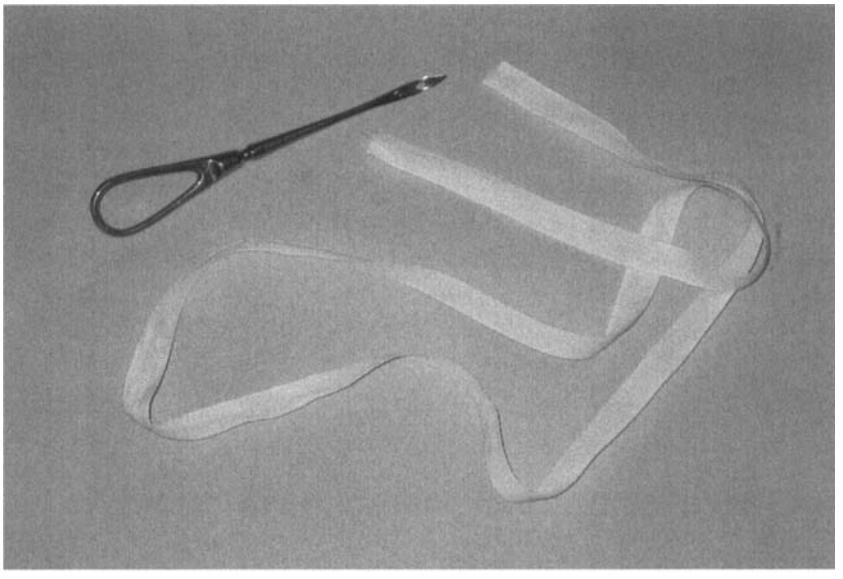


Fig. 4.5 Needle and tape used in the treatment of a vaginal or uterine prolapse.

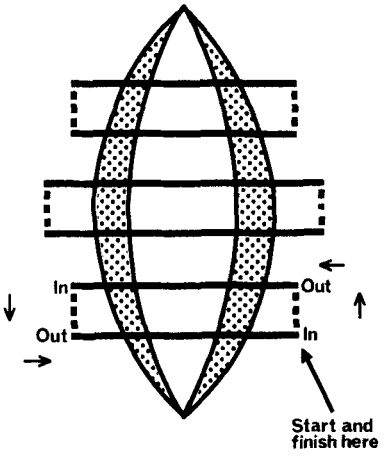


Fig. 4.6 Stitching of the vulva after a prolapse (*Management at Lambing*, 1983).

job (Fig. 4.5). Three stitches are usually inserted across the vulva as shown in Fig. 4.6. The needle should not be passed through the lining of the vulva as this will cause straining – instead go in and out of the skin at the edge of the vulva. In some cases it may be advisable to apply a truss in addition to the stitches. Once the ewe has started to lamb remove the sutures. If you don't, serious tearing will result.

Remember: *do not* attempt this procedure unless you are very experienced.

More difficult cases, where the prolapsed vagina is very swollen or infected, where the vagina cannot be properly replaced or the prolapse recurs despite treatment, will definitely require veterinary attention. Your veterinary surgeon may have to give an epidural anaesthetic to stop the ewe from straining and allow the prolapse to be repaired properly. All ewes treated for vaginal prolapse should be given antibiotics by injection and either her number noted or a permanent mark applied. She will almost certainly prolapse again in her next pregnancy and should be culled after weaning.

Prevention

The cause or causes of this problem are not known. It has been attributed to sloping ground (unlikely), over-fatness, excessive bulky foods (turnips) and relaxation of the tissues in the vaginal area after many lambings. Prolapse is more likely to occur if the ewe is fed either poor-quality roughage or excessive concentrates. Both these factors depress digestion and increase the pressure in the abdomen. The problem may also be exacerbated by housing ewes in pens where there is insufficient trough space, leading to ewes barging one another and pushing in at feeding time. Feed only good-quality roughage and divide the daily concentrate ration into two feeds. Ewes in late pregnancy should always be handled gently. Recent investigations have suggested that prolapse of the vagina is most common when nutritional control of the flock is poor. A combination of regular monitoring of condition score, good roughage, adequate but not excessive concentrate feeding and improved housing would seem the best approach to preventing this problem.

PROLAPSED UTERUS

Prolapse of the uterus occurs immediately or soon after lambing. The whole uterus passes through the vagina and vulva and hangs from the ewe. The inverted uterus can be severely damaged if prompt action is not taken.

Symptoms

One look is normally enough.

Treatment

If you are not very experienced summon professional help immediately. A good job must be done first time. If a ewe prolapses for a second time the outlook is grim. Whilst waiting for your veterinary surgeon, keep the ewe still and wrap the uterus in a clean towel.

As with a vaginal prolapse, correction of uterine prolapse is much easier if the ewe's hindquarters are raised. Clean the surface, i.e. the inside of the uterus, with warm water containing a non-irritant disinfectant. Remove pieces of dirt. If the placenta is still attached to the wall of the uterus this can be removed if it comes away easily – if not, leave well alone. Lubricate the uterus with lambing lubricant and with the whole clenched fist push it back into the correct position. Suture the lips of the vulva as described for **Vaginal prolapse** and apply a truss. The truss and sutures can be removed after ten days. Give antibiotics by injection and keep a close eye on the ewe.

If the uterus cannot be replaced easily, i.e. within five to ten minutes of starting, stop and seek professional help. An epidural anaesthetic administered by your vet will be required to do the job properly and persevering will only cause further serious damage to the ewe.

We repeat: *do not* attempt this procedure unless you have received full instruction from your veterinary surgeon.

Prevention

As for **Vaginal prolapse**, it would seem wise to cull affected ewes after weaning.

5 Abortion in Ewes

In the last thirty years, abortion in ewes, especially infectious abortion, has become increasingly important in the sheep industry of the United Kingdom. The annual cost probably exceeds £50 million. This cost is not divided equally between the nation's sheep farmers. Some have no problem; others have serious problems that can cost thousands of pounds in just one year. According to recent economic surveys, each lamb lost due to abortion can cost the farmer around £90 as result of lost productivity. Table 5.1 shows the more important causes of abortion. The major infectious causes are enzootic abortion of ewes (EAE) and toxoplasmosis (Table 5.2).

Table 5.1 Common causes of abortion in ewes.

Infectious	**Non-infectious**
Enzootic abortion of ewes	Pregnancy toxaemia
Toxoplasmosis	Rough handling
Salmonellosis	Transport
Campylobacteriosis	Other stress
Listeriosis	
Border disease	

Table 5.2 Abortion: a summary of the common infectious causes.

	Enzootic abortion of ewes	**Toxoplasmosis**	**Campylobacteriosis**	**Salmonellosis (not *S. abortus ovis*)**	**Listeriosis**	**Border disease**
Cause	*Chlamydia* (small bacteria)	Protozoa	Bacteria	Bacteria	Bacteria	Virus
Species affected	Sheep (also man)	Many	Sheep and other animals	Many	Many	Sheep and cattle
Source of infection	Aborting ewes	Infected cat faeces	Aborting ewes, carrier ewe, rodents, birds?	Contaminated food or water. Cattle	Poor silage	Congenital. Carrier ewe
Abortion	Last 2 weeks Fresh. Alive or dead	Alive or dead May be mummified	Last 7 weeks. Foetus may be swollen	Last 6 weeks	Alive or dead	Alive or dead
Ewe effects at abortion	None	None	None	Varies with species None to death	May be metritis	None
Immunity	Will not abort again May retain infection	Life-long	Life-long	Good to species involved	Probably good	Good except congenital infection
Vaccination	See text	Live vaccine	Farm vaccine can be made	Depends on species involved	None in UK	None
Culling policy	Few abortions – cull Many abortions – keep	Keep	Keep	Keep	Keep	Cull carrier ewes
Replacement policy	EAE-free stock	None	Graze with flock before tupping	None	None	Mix with ewes and lambs up to 2 months pre-tupping

NON-INFECTIOUS ABORTION

In ewes, 1% but certainly not more than 2%, may be expected to abort each year due to non-infectious causes such as stress of handling or transport or pregnancy toxaemia. However, even if a non-infectious cause is suspected, and even if the laboratory fails to demonstrate any infection, it must be assumed that such abortions are infectious. Every case of abortion must be treated as outlined below. Only at the end of lambing will you be able to say that only 1% of ewes aborted and that all the laboratory findings were negative.

INFECTIOUS ABORTION

Enzootic abortion of ewes (EAE) (chlamydial abortion)

The cause

Enzootic abortion of ewes is caused by a bacterial organism called *Chlamydophila abortus* (formerly called *Chlamydia psittaci*). The organism principally infects the placenta, interfering with the passage of nutrients and oxygen from the ewe to the lamb (Fig. 5.1). The infection also disturbs the production of placental hormones.

The disease

Infection can result in the premature (normally 10–14 days) birth of a fresh, dead lamb, the premature birth of a weak, live lamb or

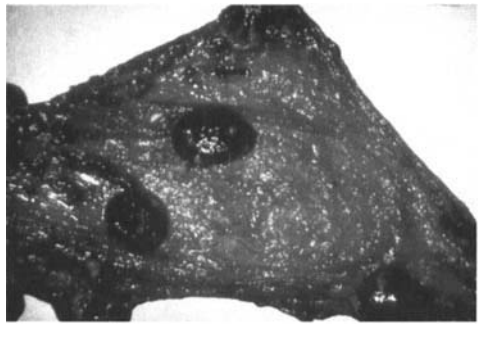


Fig. 5.1 Placenta infected with enzootic abortion of ewes. Note numerous white spots on the cotyledons, this is damage caused by the bacteria (picture by Dr D. Buxton). See also colour plate section.

the near-term birth of a weak, live lamb. Thus some cases of infection are not immediately apparent.

The principal source of infection is the aborting ewe. The foetus, placenta and uterine discharges are rich in infective organisms that may be ingested by clean ewes. These freshly infected ewes do not usually abort. They harbour the infection without showing symptoms until the next lambing, when they in turn abort, serving as a source of infection for further clean ewes.

This is the normal sequence of events – infection one lambing, abortion the next. However, if a clean ewe is infected some time before lambing, say more than five weeks, she may abort in that pregnancy. Such a situation is only likely to arise if lambing is unduly protracted, or if a farm has two flocks, one lambing early and one lambing late. Infectious abortion in the early flock could cause abortion in the late flock, either directly or indirectly, if the late-flock ewes had access to the early-lambing ewes or if staff accidentally carried infection between the two flocks.

If a ewe has aborted once she is very unlikely to abort again. But future lambings (lamb, placenta and discharges) may be infected. She may still serve as source of infection for clean ewes.

Typical flock history of EAE infection

- **Year 1:** clean flock with no history of EAE buys in infected replacement females;
- **Year 2:** some of replacement females abort, spreading infection to the rest of the flock;
- **Year 3:** an abortion storm, up to 30% of ewes abort, all ages;
- **Year 4** and subsequently: 5–10% of ewes abort, mostly younger ewes.

The losses in the third year are catastrophic, and this is followed by an annual loss that will make a considerable dent in flock profits. EAE can also cause metritis in the ewe (Chapter 4). Live lambs born to infected ewes or lambs fostered onto these ewes are likely to become infected, and should not be retained as replacements.

Action after an abortion

Action is based on the knowledge that the aborted ewe is a source of infection for other ewes – discharges, placenta and foetus or lamb. Although you may suspect EAE you cannot be sure that other infection such as salmonellosis is not present. You must assume that the aborted ewe is a danger for other ewes and people by taking the precautions listed below:

- Isolate and mark the aborted ewe. She can shed infection for two weeks after aborting and the bacteria can survive in the environment for a further six weeks, so it would be wise to isolate her for at least eight weeks after the event.
- Keep other ewes away from abortion sites.
- Seek veterinary assistance and send samples (lamb or foetus and placenta) to laboratory for examination. Until proved otherwise, assume that the abortion is caused by EAE and salmonellosis.
- Mark any live lambs from aborting ewes.
- If further ewes abort, treat as above and send further samples to the laboratory. Do not assume that all abortions have the same cause.
- If enzootic abortion of ewes is confirmed, your veterinary surgeon may advise treating remaining pregnant ewes with long-acting oxytetracycline. This does not eliminate the infection but it can delay abortion, and thus increase the viability of lambs from infected ewes. Discuss the potential cost benefit of this treatment with your veterinary surgeon before proceeding.

Future flock policy

If only a few ewes have aborted, and these ewes have been identified and isolated, there is a very good argument for culling with the hope that the infection can be eliminated. However, if many ewes have aborted it is inevitable that the infection has been widely spread through the flock, and culling is probably pointless. Live attenuated and inactivated vaccines against *Chlamydophila abortus* are both available. Both types of vaccine give good protection after a single dose and immunity appears to be maintained for two to four years after administration, depending on the product used. Ideally the ewes should be vaccinated with either type of vaccine four to six weeks before mating to ensure they develop good immunity before they become pregnant. Live attenuated vaccines should not be given *during* pregnancy, as there is a very small risk that they may cause animals to abort. Inactivated vaccines can be given after about one month into pregnancy and, like oxytetracycline injections, may help to reduce abortion incidence in pregnant ewes in the face of an outbreak. Ask your vet for advice on which product most suits your particular circumstances.

Management at lambing can also help to reduce the spread of infection. The general direction of infection spread is from older ewes to younger ewes. It thus follows that if ewes are segregated on the basis of age during lambing, and if possible for three weeks after, the spread of infection will be greatly reduced.

Elimination of infection

This is a highly desirable aim but very difficult to achieve. In spite of the measures mentioned above, it is likely that infection will persist, albeit at low levels. The ultimate solution would be to cull the whole flock and restock with clean animals from EAE-tested flocks. This is unlikely to be a financially viable option, and there is always the nagging doubt of infection persisting on the farm, e.g. in housing, and infecting the clean stock.

A second option that may be possible on some farms is the 'two flock option', where the original flock is retained, and possibly vaccinated, but clean replacements (from tested flocks) are maintained as a separate flock. As the years go by the original infected flock is progressively culled, and the new clean flock becomes 'the flock'. With a little flexibility the overlap can be limited to two years.

Great efforts must be made to keep the clean flock clean: lamb it first. Do not buy in lambs for adoption purposes – they may be infected.

Prevention

Having enzootic abortion of ewes in a flock is a highly undesirable state of affairs. It is easily avoided, but very few sheep farmers seem to be interested in this – until they have found the infection in their flocks! Two methods are available: maintain a closed flock, or buy in replacements only from EAE-tested flocks.

The first option, a closed flock, is highly desirable from many disease points of view. 'A sheep's worst enemy is another sheep' may be something of an exaggeration but 'a sheep's worst enemy is another sheep of origin unknown' is most certainly not (Fig. 5.2). It is no coincidence that enzootic abortion of ewes is thankfully uncommon in self-replacing hill flocks.

If a closed flock is not possible, then only buy clean replacements. This may involve a change of traditional buying policy but the potential rewards are enormous. Ask your vet for further information on accreditation schemes for EAE. As mentioned above, don't buy in lambs for fostering. They may well be carrying enzootic abortion of ewes.

Human infection

Note the comments under Preventing problems in people – zoonotic infections (p. 140), especially in *pregnant women*, who may be particularly susceptible to infection, with tragic consequences for both themselves and the unborn child they are carrying.

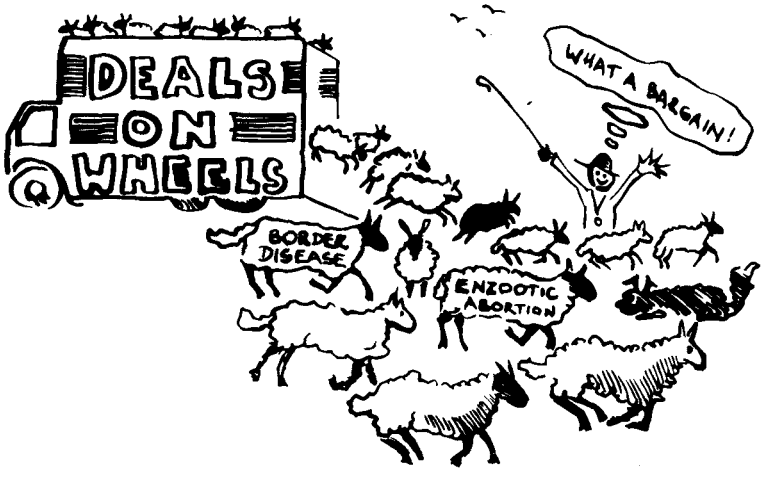


Fig. 5.2 The new replacements – asset or liability?

Toxoplasmosis

The cause

Together with enzootic abortion of ewes, toxoplasmosis is the other most common cause of infectious abortion. But that is about all that toxoplasmosis has in common with enzootic abortion. In practically every other respect it is entirely different – save the end result of abortion and financial loss.

Toxoplasmosis is caused by a protozoan parasite, *Toxoplasma gondii*, related to the organism that causes coccidiosis in lambs. The organism infects the placenta, where it interferes with the passage of nutrients and oxygen to the foetus. The infection also gains access to the foetus itself.

The disease

The source of infection for sheep, and indeed other animals, including man, is the domestic cat (Fig. 5.3). When a non-immune cat, normally a young cat, ingests an infected mouse or infected uncooked meat it develops toxoplasmosis in its gut. About a week after infection the cat commences to pass oocysts (eggs) in its faeces. This stage only lasts about a week, after which the cat becomes immune and is unlikely to pass any more oocysts for several years. It is these oocysts in cat faeces that infect sheep (and people). At peak oocyst production, 50 g of infected cat faeces may contain as many as ten million oocysts. If, in a hypothetical situation, this was evenly dispersed throughout ten tonnes of ewe

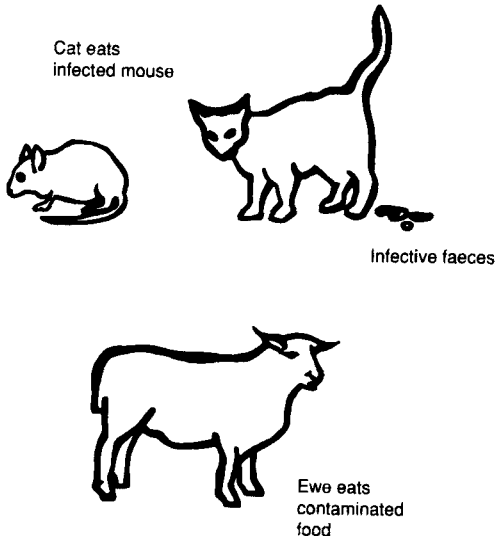


Fig. 5.3 Infection of ewes by *Toxoplasma* oocysts (eggs).

concentrate feed, then each kilogram of feed could contain 5–25 sheep-infective doses.

This sequence of events contains two elements of importance in preventing disease in sheep. First, it is mainly the young, uninfected cat that poses a threat. Older, immune cats are extremely useful for controlling vermin on the farm and are unlikely to pose a problem unless they are suffering from ill health. It would therefore seem prudent to neuter the farm queens to control the numbers of young cats on the farm. Secondly, efforts must be taken to avoid contamination of sheep food, bedding and water with cat faeces. Straw and hayricks are favoured nesting sites for pregnant queens, and an open grain store makes an excellent defecation site – a sort of giant litter tray (Fig. 5.4)!

There are two further important points:

(1) Infection of the ewe at any time, including when she is not pregnant, leads to long-term immunity, which probably prevents abortion if further infections occur in subsequent pregnancies.
(2) There is no transmission of infection from ewe to ewe, or from ram to ewe. Toxoplasmosis is an infection of the farm, not the flock.

What are the effects of infection? Infection early in pregnancy can lead to foetal death, re-absorption and apparent barrenness.

Fig. 5.4 The most expensive litter tray in the world? (Picture by Dr D. Buxton). See also colour plate section.

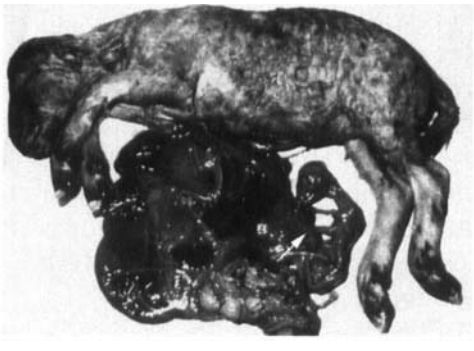


Fig. 5.5 Stillborn lamb infected with *Toxoplasma*; note the mummified twin (arrow) that died as a result of infection in mid-pregnancy (picture by Dr D. Buxton). See also colour plate section.

Infection in mid-pregnancy can lead to foetal death and abortion although a dead and often mummified foetus can be carried to term, especially if a littermate survives or is stillborn (Fig. 5.5). Infection in late pregnancy can lead to the birth of weak lambs or practically no ill effects at all. When a non-immune flock meets toxoplasmosis for the first time, however, the effects can be catastrophic, with 30% or more of ewes being barren or aborting. In subsequent years, mostly non-immune replacement ewes will be affected.

Action in an outbreak

There are no precautions specific to toxoplasmosis, but until confirmation of the cause of the abortion you must assume that it is enzootic abortion of ewes. Therefore, follow the action already outlined for this disease (p. 127).

Future flock policy

Since ewes which have been infected are currently thought to be immune for life, they pose little direct threat to other ewes and can probably be retained if required. This point emphasises the need for accurate diagnosis. If the ewes have aborted with enzootic abortion they should quite definitely be culled.

Prevention

Neutering of female cats and avoiding contamination of feed and bedding for pregnant ewes have already been mentioned.

A live vaccine is available and is dramatically effective in reducing losses from toxoplasmosis. The vaccine can be given to females aged five months and older, and should only be used in non-pregnant ewes. The vaccine should not be given in the three weeks preceding tupping. Immunity after vaccination lasts at least two years, but on farms with a toxoplasmosis problem natural infection should boost this to a life-long immunity. Thus on many farms vaccination of replacement females will be all that is required. For safe and effective use this vaccine should be administered carefully, under veterinary instruction, and in strict accordance with the manufacturer's instructions. The vaccine is difficult to manufacture and only available under prescription via your veterinary surgeon so you should contact him or her well in advance of anticipated use to check availability.

Decoquinate added to concentrate feed and occasionally used to control coccidiosis in lambs (Chapter 3) has also been found useful in the prevention of losses from toxoplasmosis. However, the drug is most effective if it is already being fed to susceptible ewes at the time they encounter infection, rather than after infection is established.

The only cost-free preventative policy is to try and encourage infection in young stock before their first pregnancy. In this respect homebred replacements probably have the advantage. In the first six months (breeding as ewe lambs) or 18 months (breeding as gimmers) of life they will meet toxoplasma infection, and harmlessly acquire immunity. The replacement ewe lamb or gimmer

bred on a hill farm, where toxoplasmosis is unusual, is unlikely to have met the infection.

All that remains is to try and encourage infection in non-pregnant stock: graze the flock near buildings occupied by cats, and allow the flock access to buildings contaminated by cats. This is fine in theory but seldom seems to work in practice.

Salmonellosis

The cause

Abortion can be caused by a variety of types of *Salmonella* bacteria. This group of bacteria can be divided into two classes: *Salmonella abortus ovis* and other salmonellae. Abortion due to *Salmonella abortus ovis* is now rare in the United Kingdom and mostly confined to southwest England. Readers should be wary when consulting older texts on the subject of salmonella abortion. These accounts may well refer only to *Salmonella abortus ovis* disease, which differs in many important respects from other *Salmonella* infections.

Abortion due to *Salmonella abortus ovis*

As the name suggests, the sheep is the important species involved. *Salmonella abortus ovis* causes abortion in the last six weeks of pregnancy. The ewes show minimal effects and become immune for life, although they may well remain carriers of the infection. These ewes thus serve as a source of infection for clean stock when they abort, and for the remainder of their lives in the flock. Buying in a carrier ewe may well introduce the disease to a hitherto clean flock. This infection tends to become endemic within a flock, but use of a vaccine specially made under veterinary licence can help to protect replacement ewes.

Disease caused by other salmonellae

A variety of *Salmonella* bacteria can cause abortion. The list includes *Salmonella dublin* and *Salmonella typhimurium* that also causes disease in man, and many other exotic types including *Salmonella montevideo.*

Infection is by mouth, and up to 20% of the flock may abort. The source of infection varies and includes other stock, e.g. calves, contaminated feed or water, sewage and wild birds. Symptoms in affected ewes vary with the type of *Salmonella* involved. *Salmonella montevideo* produces no symptoms save abortion, *Salmonella dublin* produces scour and fever and *Salmonella typhimurium* causes

severe illness, including death. In some *Salmonella typhimurium* outbreaks dead ewes, not abortion, is the first sign. Some salmonellae can cause serious disease in man. Shepherds and their families are at special risk (see Preventing problems in people – zoonotic infections, p. 140).

Action in an outbreak

Aborting ewes are a threat to other sheep and to man. All the precautions outlined for enzootic abortion p. 127 should be followed, especially isolation of affected ewes. Every abortion should be regarded as being caused by enzootic abortion and salmonellosis, i.e. a serious threat to sheep and people, until proved otherwise. If *Salmonella* is demonstrated to be the cause of abortion, your veterinary surgeon may advise antibiotic therapy for the whole flock. Ewes that develop other problems, such as septicaemia, scour or metritis, will also require special nursing, possibly including more intensive antibiotic and fluid therapy. Always be aware that such animals pose a high infection risk and be scrupulous about hygiene after handling them.

Future flock policy

In many cases *Salmonella* abortion is a one-off event and serious problems do not occur in the future. Culling of aborting ewes is seldom advised. *Salmonella* vaccines are available, but their potential usefulness depends on the type involved. Your veterinary surgeon will be able to advise.

Prevention

Most sources of salmonellae will be unknown until an outbreak, and little can be done to eliminate them. Infected calves are a known source and, if salmonellosis occurs in calves on a sheep farm, every effort must be made to avoid cross-infection. Ideally, staff tending sheep should have no contact with infected calves. Sheep should have no access to contaminated buildings.

Wild birds can be another potential source of infection. The most likely contact point is outside feeding troughs. It makes sense to clean these regularly, to upturn them after the sheep have fed and to move the troughs daily.

Campylobacteriosis

The cause

Campylobacteriosis (formerly known as vibriosis, a much more pronounceable name!) is caused by two species of the bacteria

Campylobacter, Campylobacter foetus and *Campylobacter jejuni.* This latter organism can cause disease in man. In contrast to cattle, campylobacteriosis in sheep is not a venereal disease. It cannot be passed from the ram to the ewe.

The disease

Infection is by mouth and infection after three months of pregnancy causes abortion within one to four weeks. Infection before this time or when the ewe is not pregnant causes no serious disease, and confers life-long immunity. The source of infection may be a bought-in carrier ewe, but in some outbreaks birds or rodents may be responsible.

The aborting ewe is a rich source of infection. The foetus, placenta and discharges are heavily contaminated. Other ewes that pick up the infection in late pregnancy may produce stillborn lambs but some will produce weak live lambs. The aborted ewe is solidly immune and will not abort again.

Action in an outbreak

Apply the same measures as for enzootic abortion (p. 127). Don't forget that the infection might cause disease in people. Your veterinary surgeon may advise antibiotic therapy for the remaining pregnant ewes, although this often provides little beneficial effect once an outbreak has occurred.

Future flock policy

Fortunately, campylobacteriosis tends to be a one-season affair, serious problems not occurring in future years. Aborted ewes should be retained.

Prevention

The threat of the infected bought-in ewe has already been mentioned. Breeding your own replacements avoids this risk.

Listeriosis

The cause

Two types of *Listeria* bacteria cause disease in sheep, *Listeria monocytogenes* and *Listeria ivanovii.* These are ubiquitous organisms found in the soil and elsewhere, though normally in small numbers. The incidence of listeriosis has increased considerably in recent years due to the increased feeding of silage to sheep. There is no doubt that poor silage is the major source of infection for sheep. Well-fermented silage, with a pH value below 5, does not

permit the multiplication of *Listeria* bacteria, but poor silage that is less acid does.

Listeria infection does not only cause abortion in sheep. It also causes encephalitis in adult sheep – circling disease – and serious septicaemia or encephalitis in lambs (Chapter 3).

The disease

Abortion occurs a few weeks after infection with the production of dead or weak lambs. In the absence of ewes affected by the encephalitic form of listeriosis, abortion is the first sign seen. Although the products of abortion are contaminated, it is not generally thought that sheep-to-sheep transmission is of great importance. Heavily contaminated food would appear to be much more important. The incidence of *Listeria* abortion in a flock is normally low – around the 1% but occasionally 10% of ewes may abort.

Action in an outbreak

Proceed as for enzootic abortion (p. 127). If listeriosis is suspected, the silage should be examined. However, do not be surprised if the results of analysis are satisfactory. The likely culprit was the bale of silage that was consumed three weeks ago!

Future flock policy

The ubiquitous nature of the organism means that culling of aborted ewes is pointless.

Prevention

Attention should be paid to silage quality and handling. Ensure that pH value is below 5 (acid) and ash content below 70 ppm (minimal soil contamination). With clamp silage, the surface layers are the most likely to be contaminated and if possible they should not be fed to sheep. Cattle are less susceptible to listeriosis than sheep and it is often suggested that spoilt or dubious silage should be fed to them. This must still entail a small risk. Do not allow uneaten silage to lie in feeding passages. Exposure to the air will allow the pH value to rise and facilitate multiplication of *Listeria*. Big-bale silage from damaged bags should not be fed to sheep.

Border disease

The cause

Border disease is caused by a virus closely related to the virus causing bovine virus diarrhoea (BVD) in cattle. In fact, sheep can acquire infection from cattle and vice versa. As the name suggests,

the disease was first identified in the Welsh Border counties, but now it is found throughout the United Kingdom and elsewhere.

The disease

In non-pregnant stock, infection is a bit like German measles in humans, causing very mild disease leading to lifelong immunity. In pregnant ewes, however, infection can lead to various problems including foetal death, re-absorption and apparent barrenness, abortion or the birth of weak lambs. Some live lambs show the typical 'hairy shaker' syndrome – excessive shaking and a hairy coat or limb deformities (Chapter 3). Hairy shakers are often but not always seen in flock outbreaks.

The source of infection is a bought-in carrier ewe or ram. It is vital to understand the way in which such an animal became infected. If infection occurs in late pregnancy, the foetus reacts from an immunological point of view like an adult – it mounts an immune response producing antibodies. These antibodies eliminate the virus. The foetus may be stillborn, born weak, show the hairy shaker syndrome or be apparently normal, but it will not be infected. If infection occurs in early pregnancy, however, the foetus mounts no immune response. Such a foetus may not survive, but if it does it will be born with no antibodies and, of great importance, be persistently infected with virus – a symptomless carrier that can pass infection on to others.

Action in an outbreak

There may be no signs at abortion that the cause is obviously Border disease. Therefore it must be assumed that the abortion is caused by enzootic abortion of ewes and salmonellosis, and all the precautions noted for enzootic abortion observed (p. 127).

Future flock policy

There are two possible approaches. The first is to eliminate the disease and the second is to live with it. To eliminate the disease, the carrier animals responsible for infecting the breeding flock must be identified. Blood sampling of all stock will be required. This approach may be possible in a small flock or in a larger flock where groups of suspect animals, e.g. recently bought store lambs or replacements, can be identified. Remember that persistently infected lambs may be born in the same period as abortions occur so the entire lamb crop will also either require blood sampling or fattening for slaughter. Never select breeding replacements from these lambs unless they can be demonstrated to be free from infection.

If the elimination approach is not possible every effort must be made to encourage infection when the ewes are not pregnant, up to two months before mating. Ewes and lambs must be run together, ideally under close confinement. Border disease is not a particularly contagious disease, and extensive grazing conditions would be unlikely to serve this purpose. Housing at night might be an option.

Prevention

The bought-in carrier animal is the problem. The closed flock is at much reduced risk. In open flocks every effort should be made to ensure that replacements come from Border-disease-free flocks. The closed flock is not, however, totally safe. A purchased carrier ram is a potential risk. Newly acquired rams should be isolated on arrival at the farm, and blood tested to ensure freedom from Border disease virus. The practice of borrowing or swapping rams for short periods at mating without knowing whether they are carrying the virus creates a major risk for spreading the disease.

Other infectious causes of abortion

Any infection in pregnancy causing fever and malaise, even if for only a few days, can cause abortion. One of the best known examples is tick-borne fever. Ewes bred in tick country encounter the disease as lambs and gain life-long immunity, but if tick-borne fever-naïve pregnant ewes from a tick-free area are moved to a tick area they will become infected, and some will abort. Prevention is common sense – don't introduce naïve ewes to a tick area.

The organism *Coxiella burnetii* is carried without symptoms by many sheep but occasionally it causes abortion. This organism causes Q fever in man and hence the importance once again of following hygienic procedures at lambing.

Brucella abortus, more commonly associated with cattle, can cause abortion in sheep. With the eradication of this disease from the United Kingdom, problems in sheep have hopefully disappeared.

Mouldy hay can occasionally cause abortion. The mould produces toxins that cause the abortion.

Preventing problems in people – zoonotic infections

A glance at Table 5.2 shows that many infectious causes of abortion can cause disease in people (zoonotic infection). As always, the very young and very old are at increased risk. But, just as the pregnant sheep suffers serious consequences when meeting these infections (but little disease when not pregnant), so also can preg-

nant women. The pregnant uterus is readily colonised by many of these infections. The message is, therefore, very simple: *pregnant women have no place in lambing situations and should keep well away.*

To avoid risk to lambing personnel remember that until proved otherwise, all abortions are caused by enzootic abortion and salmonellosis. Aborted ewes are thus a potential danger to people and to other sheep. Observe these common-sense precautions:

- Always use disposable gloves, especially when handling the products of abortion.
- Wash hands thoroughly before eating, drinking or smoking.
- If there is a pregnant woman in the household, wash your boots in disinfectant on leaving the lambing shed, discard outer clothing before entering the house and load the washing machine yourself!
- Isolate all aborted sheep.
- Treat all placentae and foetuses not submitted for laboratory investigation as potentially infectious clinical waste and incinerate or arrange for special collection.

Preventing infectious abortion

Infectious abortion is a dismal subject, miserable to write about and equally miserable to read about. From a veterinary point of view there is seldom a magic answer to the problem. Keeping the flock clean must be the aim. Some problems we cannot prevent, e.g. infected wild birds, but most potential problems can be prevented.

With many infections (e.g. enzootic abortion), the bought-in infected ewe is the culprit. Ideally, breed your own replacements. If this is not possible buy from known enzootic-abortion-tested flocks. Buying at big sales may be an enjoyable social occasion but it is a lottery, a bit like playing poker with a blindfold (Fig. 5.2). Most flocks purchase rams and here the risk is Border disease. Rams *must* be blood-tested.

Prevention of Problems

Some problems cannot be foreseen and must be treated as and when they arise. Most problems, however, can be prevented and in this chapter we have attempted to summarise preventative measures which are applicable to most flocks. We also outline how problems at lambing can be accurately assessed and a prevention programme tailored to the individual farm. Many flock owners will be aware that the recent trend towards organic production places severe constraints on the use of many of the chemical treatments, drugs and vaccines discussed in both this and previous chapters. Nevertheless, in many instances, effective disease prevention, treatment and control still rely on the use of these products. How to avoid and manage problems that may arise under organic circumstances is discussed at the end of the chapter.

PREVENTION OF PROBLEMS IN EWES

For further details of the specific problems mentioned in parentheses below, see Chapters 3 and 4 (specific conditions in bold face).

Do's and don't's

Do:

- condition-score ewes regularly through pregnancy and give extra feeding to lean ewes. In lowland flocks, aim for a condition

score of 3–3½ at tupping, 2½–3 at mid-pregnancy and 3 at lambing. For the hill flock, the scores might be 2½–3, 2½ and 2½–3 (**pregnancy toxaemia** and practically all lamb problems);
- feed the daily concentrate ration in two feeds (**pregnancy toxaemia, prolapses**);
- ensure the ration is properly balanced for minerals and trace elements (**hypocalcaemia, hypomagnesaemia, copper deficiency** or **toxicity**);
- vaccinate your ewes against the clostridial diseases (**metritis** in ewes, **lamb dysentery, pulpy kidney** and **tetanus** in lambs);
- observe all the warnings given in Chapter 2 when assisting a lambing (**metritis,** physical injury);
- give long-acting antibiotics to ewes after an assisted lambing (**metritis**).

Do not:

- impose any sudden change in nutrition (**pregnancy toxaemia**);
- feed poor quality roughage (**pregnancy toxaemia, prolapses**);
- stress ewes in late pregnancy or after lambing (**hypocalcaemia, pregnancy toxaemia**);
- let hungry lambs butt an empty udder (**mastitis**).

PREVENTION OF PROBLEMS IN LAMBS

For further details of the specific problems mentioned in parentheses below see Chapters 1, 3 and 4 (specific conditions in bold face).

Do's and don't's

Do:

- condition-score ewes regularly through pregnancy and give extra feeding to lean ewes. In lowland flocks aim for a condition score of 3–3½ at tupping, 2½–3 at mid-pregnancy and 3 at lambing. For the hill flock, the appropriate scores might be 2½–3, 2½ and 2½–3 (stillbirth, **prematurity,** low birth weight, poor body energy reserves, low colostrum production in the ewe leading to starvation and little resistance to infectious disease in the lamb);
- vaccinate ewes against clostridial disease and ensure that lambs suck plenty of colostrum (**lamb dysentery, pulpy kidney, tetanus**);
- provide shelter if lambing outside (**hypothermia**);
- ensure adequate assistance during lambing – tired bad-tempered shepherds make mistakes;

- detect hypothermia in the early stages (temperature check) and treat quickly;
- dry lambs after birth if the ewe fails to do so, especially small twins and triplets (**hypothermia**);
- dress navels as soon as possible after birth (**joint ill, liver abscess, navel ill, spinal abscess**);
- clean lambing pens after every ewe (*all* infectious diseases);
- ensure that lambs get plenty of colostrum within a few hours of birth – give by stomach tube if necessary (**hypothermia**, *all* infectious diseases). Consider penning lambing ewes *before* they lamb rather than 30 minutes after lambing, when the lambs are starting to suck;
- detect and treat entropion as early as possible;
- detect hungry lambs – temperature check, and supplement by stomach tube (**hypothermia**).

Do not:

- feed weak lambs by bottle (**inhalation pneumonia**);
- castrate lambs with rubber rings before 12 hours of age – this reduces colostrum intake and makes watery mouth more likely;
- turn out lambs that are hungry (temperature check) – they will become hypothermic;
- keep lambs on wet bedding or sodden pasture (**scald**).

Preventing lamb problems

All sheep farmers and shepherds recognise the triplet or small twin lamb as a poor risk, less likely to survive than the fit single. However, our approach to these problem lambs too often seems to be one of passive pessimism – wait and see what happens. When it is clear that something is amiss, the resuscitation brigade is called for, often to no avail. We need an active approach to these lambs aimed at preventing problems.

First spot the lambs. The list includes:

- all triplets;
- twins out of thin ewe;
- twins out of ewe lambs;
- lambs that appear weak at birth;
- premature lambs, e.g. resulting from abortion.

What do these lambs need in the first few hours of life? The first requirement is drying – if the ewe has not completed this task *you* must. A towel is infinitely more effective than a handful of straw! Secondly, food. Ideally use stored ewe colostrum but if that is not

available use cow colostrum or a substitute. There is a slight risk of anaemia with cow colostrum, but cow colostrum has saved many more lambs than it has killed. Give about a 150 ml feed by stomach tube. The aim of this first feed is to give the lamb the strength to get to its feet and to suck. Feeding by stomach tube *encourages* sucking and not the reverse, as is sometimes thought. By three or four hours of age the lambs should be lying with the ewe, contented and full, not struggling around the pen still trying to find the teat.

Assuming this happy state has been established the lamb's future depends on a continual supply of milk. Supplementation may be required. When supplementing healthy lambs the bottle can prove useful, giving some idea of the deficit. Remember to feed all the lambs, not just the one that is obviously hungry.

ASSESSMENT OF LOSSES

There is a tradition in sheep farming that lambs are never counted until after lambing. This tradition is based on the idea that 'if you never had it, you can't have lost it'. In the days before the advent of clostridial vaccines and antibiotics many lamb losses could not be prevented and this tradition is understandable, but it has no place in modern sheep farming. It is *essential* that the flockmaster knows how many ewes and lambs have died, why they have died and, equally important, what factors predisposed to the deaths. You *must* keep records.

Before lambing, discuss plans for lamb and ewe death recording with your veterinary surgeon, who will be largely responsible for the interpretation of your records. Time and effort will be needlessly wasted if you do not involve the vet at the planning stage. You, however, will have to do the bulk of the work.

The first question to be answered is 'Do I have a lamb or a ewe mortality problem?'. To answer this question, simple records need to be kept to enable a flock-performance survey to be completed (Table 6.1). There must be no exceptions to this recording – all deaths need to be recorded. All lambing staff must understand the aims of the exercise: the shepherd should not be deterred from recording losses by fear of recriminations from the boss!

The results of the recording exercise can then be examined in the cool light of day. The figures below (Tables 6.2 & 6.3) give our interpretation of lamb and ewe losses as calculated at one week after the end of lambing, i.e. once all lambs are through the

Table 6.1 Flock lambing-performance record.

Ewes lambing		.....
Ewes barren		.....
Lambs born (dead and alive)	singles	.....
	twins	.....
	triplets	.....
	total	
Lambs dead within 7 days of birth (including stillbirths)	singles	.....
	twins	.....
	triplets	.....
	total	
Ewes dying		.....

By calculation

$$\text{lambing (\%)} = \frac{\text{lambs born}}{\text{ewes lambing}} \times 100$$

Lamb mortality in first 7 days (%)

$$\text{singles} = \frac{\text{dead singles}}{\text{singles born}} \times 100$$

$$\text{twins} = \frac{\text{dead twins}}{\text{twins born}} \times 100$$

$$\text{triplets} = \frac{\text{dead triplets}}{\text{triplets born}} \times 100$$

$$\text{Total} = \frac{\text{dead lambs}}{\text{lambs born}} \times 100$$

Ewe mortality (%)

$$\frac{\text{ewes dying}}{\text{ewes lambing}} \times 100$$

neonatal period. Further assessments should be made at weaning to look for problems in growing lambs.

If examination of the figures suggests that losses can be reduced, further recording may be necessary to pinpoint the areas of management requiring improvement (Tables 6.4 and 6.5).

Blank lamb and ewe records can be duplicated onto loose sheets or, more conveniently, can be made up as a computer template for

Table 6.2 Lamb losses (percentage of all lambs born).

Percentage (%)	Comment
0	Impossible.
1	You are deceiving yourself.
5	The best mean figure the authors can achieve.
10	A good figure for the average commercial flock. Room for some improvement.
15	Average. Aim for a reduction to 10%.
20	Too high. Improvements in the correct area will yield gratifying results.
25 (or more)	Much too high. Either improve or get out of sheep farming.

Table 6.3 Ewe losses (percentage of all ewes lambing).

Percentage (%)	Comment
0–1	Good.
2	Average. Pinpoint the major problems and attempt to solve them.
3 (or more)	You have a problem. Detailed investigation is required.

Table 6.4 Lamb death record.

Date ..... Time .....

Weather in last 12 hours (especially if outside)

.....

Type single/twin/triplet

Age at death stillborn/0–5/5–12/12–24/24–48 hours
3–5/5–7 days

Assisted birth Yes/No

Weight .....kg

If stillborn fresh/decomposed

Fate of other lambs (if a twin or triplet) .....

Symptoms .....

Ewe age ..... years

Ewe condition score .....

Ewe disease .....

Evidence of abortion Yes/No

Table 6.5 Ewe death record.

Time of death	before lambing/at lambing/after lambing ..... days
Age ..... years	
Condition score	
Assisted at lambing	Yes/No
Lambs born	
Symptoms	

printing out as required. The information gained from these records is itself most useful, but its value will be enhanced if post-mortem examinations are also performed to establish the actual cause of any losses. Discuss this with your veterinary surgeon.

At the end of lambing, pass your records to your vet for interpretation. The information gained from the records together with the results of post-mortem examinations will enable the vet to pinpoint the causes of death and important predisposing factors in most cases. A few examples may help to show how this can be done.

Example 1: lamb
Stillborn, single, 6.0 kg, birth assisted, fresh carcass.
Ewe: 2 years old, condition score 3, no disease.
Post mortem: lungs not inflated, no other findings.
Probable cause of death: parturient stillbirth.
Predisposing factors: big lamb, maiden ewe, assistance too late?

Example 2: lamb
Died at 48 hours of age, twin, 3.5 kg, hypothermic, other twin also hypothermic.
Ewe: 4 years old, condition score 1½, no disease.
Post mortem: empty stomach and intestines, fat reserves exhausted, no other findings.
Probable cause of death: hypothermia due to starvation.
Predisposing factors: thin ewe, little milk, poor nutrition during pregnancy.

Example 3: lamb
Destroyed at 6 days of age, twin, 4.5 kg, off back legs for last 2 days, other twin healthy.
Ewe: 3 years old, condition score 3, no disease.
Post mortem: abscess pressing on spinal cord.
Disease: spinal abscess.
Predisposing factors: dirty pen? navel dressed?

Example 4: ewe
Died 3 days after assisted lambing, 3 years old, condition score 3, foul-smelling discharge from vulva.
Cause of death: metritis.
Predisposing factors: poor hygiene at lambing, long-acting antibiotic given?

Example 5: ewe
Died 5 days after lambing triplets, 5 years old, condition score 2, high temperature, one side of udder swollen and painful.
Cause of death: mastitis.
Predisposing factors: poor nutrition during pregnancy, insufficient milk for three lambs.

As an illustration of how recording at lambing can help to improve flock performance we have presented in Table 6.6 a summary of the lamb death situation in one commercial flock. The mortality rate in this flock was too high (18%). The major cause of loss was hypothermia due to starvation. Poor ewe nutrition, reflected in low condition scores, was the important predisposing factor. Not surprisingly, the mortality rate in triplets was very high (28%). Other significant causes of death were infections (probably related to a low colostrum intake), parturient stillbirths and foetal stillbirths, probably related to poor nutrition.

The following changes in management were recommended:

- improve ewe nutrition: introduce regular condition scoring and draw out lean ewes for extra feeding;
- consider ultrasonic scanning for the identification of twin-and-triplet-bearing ewes;
- upgrade the standard of hygiene at lambing – lambing pens, navel dressing and assisted lambings;
- send the shepherd and other farm staff for training on how to prevent and treat hypothermia;
- improve triplet management, especially nutrition.

Summary

Most lamb and ewe losses are preventable and this should be your aim. Remember that ewe and lamb losses represent only one part of the true loss. For each lamb that dies another 'just makes it' and suffers a severe check to its growth and development. For each ewe that dies another may be successfully treated but performance in lactation is likely to be poor and the lambs held back. Conditions such as mastitis may result in premature culling. Lamb performance recording, the correct interpretation of the findings and the imple-

Table 6.6 Summary of the lamb death information gained from one commercial flock.

Flock performance		
Ewes lambing	416	
Total lambs born	818	
Lambing percentage	197%	
Lamb mortality		
Singles	8	(10% of all singles born)
Twins	79	(15% of all twins born)
Triplets	56	(28% of all triplets born)
Not known	3	
Total	146	(18% of all lambs born)
Causes of lamb death		
Stillbirth – foetal	13 lambs	(9%)
Stillbirth – parturient	13 lambs	(9%)
Hypothermia – exposure	19 lambs	(13%)
Hypothermia – starvation	59 lambs	(40%)
Infectious disease	28 lambs	(19%)
Other problems	5 lambs	(4%)
No diagnosis	9 lambs	(6%)
All causes	146 lambs	(100%)
Predisposing factor		
Conditions scores of the ewes which lost lambs		
Condition score 1	78 ewes	
Condition score 2	15 ewes	
Condition score 3	4 ewes	
Not recorded	24 ewes	

mentation of appropriate improvements are likely to have dual benefit: losses will be reduced and the productivity of the whole flock will be increased.

EWE BODY-CONDITION SCORING

Throughout this chapter, and elsewhere, we have stressed the importance of ewe nutrition and body condition. In this section we outline how ewe body condition can be objectively assessed using the body-condition scoring technique. An objective system for assessing body condition is needed for two reasons:

(1) definitions of ewe condition such as 'poor, lean, fat, moderate, fit and good' vary from individual to individual;
(2) the individual's definition of these descriptions tends to vary from one year to another depending on the general nutritional state of the flock; the definition of 'fit' at lambing in a good year is unlikely to be the same as 'fit' in a poor year.

Ewes are scored on a scale of 0–5 using half scores when needed to improve accuracy. The score is related to the degree of fatness in the lumbar region of the back, behind the rib cage (Fig. 6.1).

The score is assessed in four stages (Fig. 6.2):

(1) the degree of prominence of the spinous processes of the lumbar vertebrae;
(2) the prominence and degree of fat cover over the ends of the transverse processes;
(3) the degree of muscle and fat cover beneath the transverse processes as judged by the ease with which the fingers may be passed under these bones;
(4) the fullness of the eye muscle and fat in the angle between the spinous and transverse processes.

Once you have completed your examination, score the ewe according to the scale shown in Table 6.7, using half scores when needed.

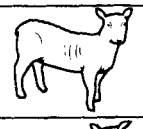
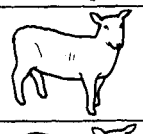
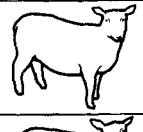
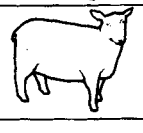
Score		Description	
1		Spine sharp, back muscle shallow, no fat	Lean
2		Spine sharp, back muscle full, no fat	
3		Spine can be felt, back muscle full, some fat cover	Good condition
4		Spine barely felt, muscle very full, thick fat cover	Fat
5		Spine impossible to feel, very thick fat cover, fat deposits over tail and rump	

Fig. 6.1 Ewe body-condition scoring (see text for details).

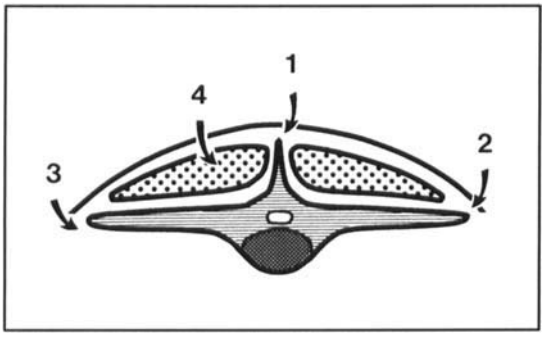


Fig. 6.2 Ewe body-condition scoring. A cross-section through the lumbar spine [Russel (1984) *In Practice* **6**(3)].

Table 6.7 Body-condition scoring of the ewe.

Score (out of 5)	Description
0	Extremely emaciated and on the point of death. It is not possible to detect any muscular or fatty tissue between the skin and the bone.
1	Spinous processes are prominent and sharp; transverse processes also sharp, the fingers pass easily under the ends, and it is possible to feel between each process; loin muscles are shallow with no fat cover.
2	Spinous processes still prominent, but smooth; individual processes can be felt only as fine corrugations; transverse processes are smooth and rounded and it is possible to pass fingers under the ends with a little pressure; loin muscles are of moderate depth, but have little fat cover.
3	Spinous processes have only a small elevation, are smooth and rounded; individual bones can be felt only with pressure; transverse processes are smooth and well covered, and firm pressure is required to feel over the ends; loin muscles are full, and have a moderate degree of fat cover.
4	Spinous processes can just be detected with pressure as a hard line; ends of transverse processes cannot be felt; loin muscles are full and have a thick covering of fat.
5	Spinous processes cannot be detected even with firm pressure – there is a depression between the layers of fat in the position where the spinous processes would normally be felt; transverse processes cannot be detected; loin muscles are very full with very thick fat cover.

With a little practice you will be able to score ewes quite quickly. Regular use of this technique will enable you to rationalise the nutrition of your ewes and will ensure that extra food is given to the ewes that need it.

VACCINATION

The days are long gone when sheep farmers could afford to vaccinate their ewes against everything, 'just in case'. Expenditure on vaccination must be justified in the light of previous experience. Organic regulations also discourage the use of vaccines (or other preventative treatments involving chemicals or drugs) unless good evidence for the presence of disease can be established (*see* Prevention of problems in organic management systems p. 164).

In terms of economics and welfare, the only exception to this state of affairs is vaccination against the clostridial diseases, such as lamb dysentery, pulpy kidney and tetanus. These are horrific diseases that can easily be prevented by using cheap, safe and effective vaccines that have been tried and trusted for many years. The latest multivalent (multi-component) preparations provide protection against up to ten different common forms of clostridial disease in a single vaccine. A relaxation in vaccination policy by some sheep farmers in recent years has resulted in an unacceptable increased incidence of these diseases. Problems have also arisen because organic production regulations require that organic farmers must demonstrate the presence of clostridial disease before vaccination is permitted. However, in our opinion, since clostridial bacteria reside in the soil and in sheep faeces, i.e. they are always present wherever sheep are, failure to use these vaccines where problems are suspected, let alone demonstrated, could be considered tantamount to negligence.

When using any vaccine it is essential to study the instructions supplied. Recommendations do change with experience and vaccine development. If you are in any doubt about whether, when or how you should be using these vaccines seek veterinary advice immediately.

Clostridial vaccines

Clostridial vaccines are presented as multi-component (multivalent), seven-, eight- or ten-in-one, vaccines covering a variety of combinations of diseases. These diseases include lamb dysentery, struck,

pulpy kidney, braxy, blackleg, tetanus, black disease, bacillary haemoglobinuria, post-parturient gangrene (metritis), malignant oedema and abomasitis. The widest-spectrum vaccines include protection against all these diseases, but other products are restricted, e.g. four-in-one vaccines against braxy, blackleg, pulpy kidney and tetanus or single-component (univalent) vaccines against individual diseases, e.g. tetanus. All these products are dead vaccines and thus *two* doses are required initially to confer protection. One dose confers little or no protection.

Two forms of protection are acquired from clostridial vaccination: first, the ewe or ram is protected from the diseases affecting principally adult animals, e.g. black disease; second, through the colostrum, the newborn lamb is protected from killers such as lamb dysentery, pulpy kidney and tetanus. This immunity in the lamb lasts about three months. Thereafter the lamb itself must be vaccinated if protection is to be continued.

Ewes

Unvaccinated ewes must initially receive two doses of vaccine separated by four to six weeks. To ensure colostral protection for newborn lambs, ewes should receive a booster dose approximately one month before lambing is due to start. Ewes are normally revaccinated annually before lambing, but experience of autumn or winter disease in ewes may indicate twice-yearly boosting.

Lambs

Lambs from unvaccinated ewes, or lambs from vaccinated ewes requiring additional protection where there is a known problem, may be vaccinated from one to two weeks of age depending on the product used (seek veterinary advice). Lambs fed sufficient colostrum from vaccinated ewes should be protected against the diseases covered in the ewe vaccine for the first two to three months of life. Vaccination of these lambs can begin at two months of age. All lambs must initially receive two doses of vaccine four to six weeks apart for full protection. Lambs retained as replacements will require annual or twice-yearly boosting, as for ewes, commencing 12 months after the last lamb dose.

Erysipelothrix vaccine

Erysipelothrix infection causes joint ill in lambs and post-dipping lameness in older sheep (Chapter 3). The vaccine is a dead preparation and thus two doses are required, three weeks apart. Lambs may be vaccinated from eight weeks of age.

If the major infection problem occurs in young lambs then pregnant ewes will require vaccination, the second or booster dose being given three weeks before lambing is due to start. Immunity contained in the colostrum should protect the lambs.

If the major infectious problem occurs later in life (e.g. at dipping), the lambs and ewes will require vaccination. The second or booster dose should be given at least two weeks before the risk period.

Escherichia coli vaccine

This dead vaccine is specifically formulated for the prevention of enteritis in lambs caused by *E. coli* (Chapter 3). Ewes are given two doses at least two weeks apart, the second dose being given one month before lambing is due. Immunity is passed to the lambs via the colostrum. In subsequent years only a single booster is needed one month before lambing.

Foot-rot vaccine

Foot rot is an uncommon problem in young lambs, but it can be a severe problem in ewes. Disease in ewes has two significant consequences: pain and distress for the ewe; and poor nutrition that will affect foetal development and colostrum production. From all points of view this is a disease to control, and if possible eradicate. Vaccination alone is unlikely to be successful in controlling foot rot, but in conjunction with other measures, such as foot bathing and the culling of chronically infected ewes, control is possible. In closed flocks control should be followed by eradication.

Foot-rot vaccine contains multiple strains of inactivated *Dichelobacter nodosus*, the bacteria responsible for causing the problem. The dosage regime requires a single primary injection followed by booster injections timed to precede risk times, generally when conditions are wet underfoot.

Take note of the instructions accompanying the vaccine. This product also contains oil which helps to boost the immune response but may also cause a lump to appear at the injection site. Such reactions may be thought unsightly, particularly in shorn animals, and could cause problems if you intend to show ewes or rams shortly after vaccination. The oil also causes severe reactions in humans if self-injection occurs. Immediate medical attention at a hospital accident/emergency department is required.

Louping-ill vaccine

Use of louping-ill vaccine is restricted to tick areas where the disease is endemic. The vaccine is a dead preparation suspended in an oil emulsion. Only one dose is required. Sheep must be vaccinated at least one month before exposure to infection. Lambs from vaccinated ewes will be protected for the spring risk period by colostral immunity, but they will require vaccination in late summer to protect them from autumn challenge. Tick-naïve sheep must be vaccinated one month before introduction to tick pasture.

Revaccination at two yearly intervals is recommended, but this may be unnecessary in endemic areas where stock is repeatedly subject to natural challenge.

As with other oil-based vaccines, accidental self-injection can have serious consequences and urgent attention at the nearest hospital accident/emergency department is required.

Orf vaccine

Orf vaccine is live orf virus so this product should never be used on orf-free farms. Orf is a skin disease and the vaccine is used to create the disease at a skin site that will not unduly inconvenience the sheep. The infection is followed by a degree of immunity lasting a few months. The vaccine is applied by scratching the skin with a special applicator carrying a drop of vaccine. Localised active orf is the result.

The resulting scabs eventually fall to the ground and contain live orf virus. If maintained in a dry environment (e.g. a sheep house), these scabs can remain infective to other sheep for many months, or even years. However, the virus has little resistance to the elements, especially water, and will soon perish if deposited on pasture.

This persistence of virus in dry scabs has serious implications for the use of orf vaccine. If orf is a problem in both nursing ewes and young lambs, and the ewes are maintained outside, the ewes may be vaccinated not less than eight weeks before lambing. However, if ewes are housed, pre-lambing vaccination may be contraindicated due to the persistence of infection in dry scabs. No immunity passes from the ewe to the lamb in colostrum, and thus lambs should be vaccinated soon after birth, after the birth coat has dried.

If orf is only a problem in the lambs, vaccination of ewes may be unnecessary. The lambs should be vaccinated three to four weeks before the expected risk period.

The site of vaccination is chosen to minimise the risk of spread to other stock. In pregnant ewes, either the base of the tail or behind the shoulder is chosen. The latter site carries a lower risk of secondary bacterial infection. In young lambs, the axilla (armpit) is the best site, whereas in older lambs the inside of the thigh is chosen.

Follow the instructions supplied with the vaccine carefully. If the vaccine does not take, i.e. no active infection occurs, it will have no beneficial effect whatsoever. The pattern of orf infection and the apparent efficacy of orf vaccine seem to vary from farm to farm, even from year to year. Whether vaccination is practised at all, and the precise regime to follow, will depend very much on local conditions and previous experience.

Pasteurella vaccine

Dead *Pasteurella* vaccines are available alone or combined with clostridial vaccines. *Pasteurella* bacteria cause both pneumonia and septicaemia in sheep (Chapters 3 and 4), but the vaccines are aimed principally against pneumonia. Being dead vaccines, two doses are required, about one month apart. The second, or booster, dose should precede any risk period by at least two to three weeks.

On farms with a low incidence of *Pasteurella* pneumonia, annual boosting at least one month before lambing should suffice. However, if experience dictates, boosting at six-monthly intervals may be required.

Some immunity is transferred to the lamb in colostrum, but this wanes in three to four weeks, so this is the age at which vaccination of lambs can start. On some farms, however, serious disease in lambs can occur about this time. In these circumstances it is sometimes advised that initial vaccination of lambs should start in the first few days of life.

Salmonella vaccine

Salmonella vaccination is not routinely practised in sheep, but may be indicated where abortion due to salmonellosis has occurred or it is known that *Salmonella* infection is present in other animals, e.g. cattle on the same farm.

The usefulness of these vaccines depends on the type of *Salmonella* involved. Take professional advice before considering using them. Salmonella vaccines are dead vaccines and two doses at least two weeks apart are required. This factor severely limits the usefulness of these products when faced by an outbreak. First, considerable spread of infection will have occurred *before* a diagnosis is made, and, second, no useful immunity will be gained from vaccination until three to four weeks after the first dose.

VITAMIN SUPPLEMENTATION

Vitamin supplementation is only of benefit when a deficiency exists. Supplementation of ewes or lambs suffering no deficiency is a waste of money. The B vitamins, and vitamins K and C are synthesised in the rumen and no supplementation is normally required. Lack of vitamin B_1 (thiamine) causes cerebrocortical necrosis (CCN) (Chapter 3): in this case, however, the condition is caused by an enzyme imbalance rather than by a straightforward deficiency, so supplementing animals to prevent disease is not the answer. In contrast, the fat-soluble vitamins A, D and E *must* be supplied in the diet. Deficiency in summer, when fresh herbage is available, is rare, but when stock is dependent on preserved forage in the winter problems can arise.

Ewes

Good hay and well-preserved silage should be adequate in vitamins A, D and E, but poorly conserved forage is often deficient in these fat-soluble vitamins. Not surprisingly, vitamin deficiency often manifests itself in the spring following a bad summer. Bought-in concentrates and home mixes with a vitamin/mineral supplement added should be adequate in vitamins A, D and E, but often these feeds are only fed in late pregnancy. When past experience indicates a potential deficiency of these vitamins, or when it is known that preserved forage quality is poor, a combined vitamins A, D and E injection should be given to ewes at mid-pregnancy.

Lambs

Lambs from deficient ewes will have low body reserves of vitamins A, D and E, and will receive a less than adequate supply in colostrum and milk. The most likely problem encountered will be stiff lamb disease (Chapter 3), which may be caused by vitamin E deficiency, selenium deficiency or both. A deficiency of vitamin A will lead to high susceptibility to infectious disease and a deficiency of vitamin D will retard skeletal development.

When experience suggests a potential problem with a vitamin deficiency, lambs should be injected with a combined A, D and E preparation soon after birth. This should protect them until grazing of fresh herbage ensures an adequate supply. In cases of stiff lamb disease, it is vital that a thorough investigation is conducted to determine the exact cause: vitamin E deficiency, selenium deficiency or both. Vitamin supplementation will have minimal benefit if selenium deficiency is the main problem, and vice versa.

MINERAL SUPPLEMENTATION

Magnesium

Magnesium deficiency is a problem of ewes only, leading to hypomagnesaemia (grass staggers) (Chapter 4), which commonly occurs at turnout onto lush pasture. Extra magnesium must be supplied in the diet. A high-magnesium concentrate will serve the purpose, but this may be economically undesirable when plentiful grass is available. Calcined magnesite may be spread on the pasture to raise the magnesium content of the sward. The practicality and efficacy of this method will vary considerably from farm to farm. Take advice from your agricultural adviser.

Free-access minerals, such as powder or blocks, are sometimes used in an attempt to prevent magnesium deficiency. Unfortunately, ewes vary enormously in their appetite for these products, and results are often variable. Magnesium can also be delivered in the drinking water, using automatic dispensers that deliver measured quantities into water troughs. This method provides much more reliable free-access delivery than feed blocks and is extremely effective under housed conditions where sheep have to drink from troughs; however there may be practical problems with treating water supplies outside. Water intake may also be reduced at pasture as much of the animal's water requirements will be provided for by the lush grass (i.e. exactly the situation where staggers is likely to occur!).

Probably the surest method to prevent magnesium deficiency is to use a magnesium 'bullet' or bolus. Magnesium boluses are moulded metal cylinders composed of a magnesium alloy. They are administered by means of a special 'bailing' gun which deposits the bolus over the back of the ewe's tongue. Boluses should only be given to animals that are big enough to swallow them otherwise damage to the back of the mouth or throat may occur leading to choking or infection. After administration, the bullet lies in the reticulo-rumen and releases magnesium over a period of three weeks or sometimes longer.

Copper

Copper deficiency can be a problem in both ewes and lambs (Chapters 3 and 4). Sometimes supplementation of ewes seems to resolve any problem in lambs, but in some circumstances supplementation of both ewes and lambs is required.

The toxicity of copper to sheep has already been outlined (Chapter 3), and great care must be taken with copper products. *Do not*

use these products unless you have hard evidence of deficiency, i.e. blood and tissue samples taken by your veterinary surgeon or cases of swayback confirmed by post-mortem examination. Never use more than one form of copper supplementation. Take extra care if ewes are to be housed for any period, since the availability of copper in conserved forages considerably exceeds that of fresh grass. Note also that some breeds (e.g. Suffolk and Texel) are particularly susceptible to copper poisoning.

There are three types of copper supplement available: injections, copper-oxide needles and a glass bolus which also contains cobalt and selenium (*see* Glass bolus p. 163).

Copper injections

Ewes are generally injected around mid-pregnancy. The precise injection method varies with the product – read the instructions.

Lambs will acquire some copper in the ewe's milk. Thus injection of lambs is normally contraindicated until at least six weeks of age.

Copper-oxide needles

Copper-oxide needles are an alternative form of oral copper supplementation. The animal is dosed with a gelatine capsule (or capsules) containing copper-oxide needles. The capsules dissolve and the needles lodge in the wall of the abomasum whence copper is slowly released. One treatment normally provides adequate copper for a whole year. Ewes should ideally be dosed at mid-pregnancy but in many circumstances dosing as early as tupping will be adequate to prevent swayback. Make sure the capsule is swallowed!

Cobalt

Cobalt is required in the rumen to facilitate the manufacture of vitamin B_{12} by the resident microflora. There is no effective storage of cobalt in the body, and ideally a constant supply should be provided. In cobalt-deficient areas, dietary cobalt can be supplemented by:

- weekly oral dosing with a cobalt solution;
- monthly dosing with a trace-element-enriched anthelmintic containing cobalt and selenium;
- administering cobalt-oxide pellets (or bullets), or Cosecure® glass boluses (*see* Glass bolus, p. 163), which also contain copper and selenium;
- treatment of pasture with cobalt sulphate.

Oral dosing

Cobalt can be given orally on a weekly or monthly basis either alone or in a supplemented anthelmintic. This method has obvious limitations. On extensive grazings it will be undesirable to gather the lambs so frequently. On some lowland farms, weekly dosing with cobalt solution may well be feasible, and will probably be the cheapest way of preventing deficiency. To avoid anthelmintic-resistance problems, anthelmintics should only be given when required to control parasitic gastroenteritis (Chapter 3). Extra anthelmintic doses should never be given just to satisfy a lamb's cobalt or selenium requirements.

Pasture treatment

Dressing the pasture with a cobalt solution can increase dietary cobalt in herbage. The effectiveness of this measure can vary considerably depending on local conditions. Take advice from your agricultural adviser. This measure is normally impracticable in extensive hill grazings.

Iodine

Iodine deficiency (Chapter 3) is relatively uncommon, and no specific agents are available for its prevention. Bought-in concentrate feeds and home mixes which incorporate a vitamin/mineral supplement should be adequate sources. If additional supplementation is required, iodine salts must be given orally. Consult your vet about this.

Selenium

Selenium deficiency in ewes, with or without vitamin E deficiency, leads to stiff lamb disease (Chapter 3). This can easily be avoided by supplementing the ewes. Bought-in concentrate feeds and home-mixed feeds that incorporate a vitamin/mineral supplement should be adequate sources of selenium, but often these are fed too late in pregnancy to prevent problems, especially in the early-lambing ewes.

Two long-acting preparations are currently available: selenium injections and the Cosecure® glass bolus that also contains copper and cobalt (*see* p. 163). Selenium is available in injectable form either alone or with vitamin E. To protect newborn lambs, the injection should be given to ewes after three months of pregnancy. In high-risk situations it may be advisable to inject newborn lambs soon after birth with a similar preparation.

Excess selenium is *highly toxic* to sheep. Fatalities have occurred when ewes have inadvertently been given excessive doses. Take care; a double dose does not have double benefit.

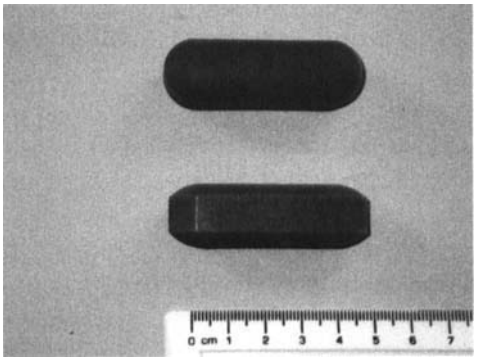


Fig. 6.3 Cosecure® glass bolus containing copper, selenium and cobalt (Telsol Ltd., Denbigh). See also colour plate section.

Combined preparations

Glass bolus

Some years ago, a glass bolus incorporating cobalt, selenium and copper was introduced under the trade mark Cosecure® (Fig. 6.3). The bolus is given by mouth, coming to rest in the reticulo-rumen. Here it is designed slowly to release adequate but safe quantities of the three essential trace elements. The ewe bolus is best administered just before tupping and boluses can be given to lambs from five to six months of age or weighing more than 20 kg. The device should provide adequate supplementation for a whole season.

As has been noted, both copper and selenium are potentially toxic and no other trace element supplementation should be given, i.e. injections or copper-oxide needles.

Vitamin E/selenium injection

When stiff lamb disease has been shown to be related to deficiencies of both vitamin E and selenium, this preparation is appropriate. Ewes should be injected after three months of pregnancy. In high-risk situations, a similar preparation can be given to newborn lambs. However, this must not be regarded as a substitute for supplementing the ewes.

Combined vitamin injections

There is a multitude of combined vitamin injections on the market. The only ones generally of use to the sheep farmer are those containing vitamins A, D and E. Where past experience has indicated that a deficiency of these vitamins is likely, and especially if the quality of preserved forage is poor, ewes should receive a supplementary injection at or just after mid-pregnancy.

Mineral blocks, powders and water supplements

Free-access blocks and powders are commonly used, but are an unreliable way of mineral supplementation. Some ewes devour these products avidly whilst others never touch them. Adding mineral supplements to water provides more reliable delivery to all ewes providing access can be restricted to water supplies that have been treated.

Irrespective of the delivery method, the high iron content of some of these mixtures may have adverse effects on the absorption of other trace elements. Recent work has also shown that excessive mineral consumption by pregnant ewes may also adversely affect subsequent colostral antibody absorption in their lambs, a situation that appears to be linked to excess availability of iodine and, to a lesser extent, zinc during pregnancy. Under no circumstances should blocks, powders or water supplements designed for cattle be given to sheep. The copper content of these products may prove dangerous.

Vitamin/mineral drenches

A number of vitamin/mineral oral preparations are available. These supplements generally give only short-term relief of any deficiency and repeated dosing will be required to confer adequate long-term supplementation. This considerably reduces the practical usefulness of these products.

PREVENTION OF PROBLEMS IN ORGANIC MANAGEMENT SYSTEMS

Organic standards

Organic farms more than doubled in number in the last five years and organic farming now accounts for somewhere 3%–5% of the total United Kingdom agricultural land area. Grant aid schemes are available to assist with organic conversion and this, along with perceived financial, ethical and environmental benefits of producing a more 'natural' product using sustainable methods, means that many more flock owners are considering converting to organic production.

The rules which govern organic production (and processing) are part of internationally agreed standards or regulations covering all EU countries, although each country has its own bodies to enforce the rules. In the United Kingdom this role is taken by the United Kingdom Register of Organic Food Standards (UKROFS),

http://www.defra.gov.uk/farm/organic/, which monitors the activities of approximately 15 organic certification bodies, including the Soil Association and Organic Farmers and Growers. Some organic certification bodies demand more stringent standards than UKROFS requires but they cannot be more lenient. Inspectors from the certification body visit member farms at least annually and some farms may be re-inspected by representatives of UKROFS.

Organic regulations are designed to develop production systems in which animals, crops and soil are integrated to produce a sustainable whole. Livestock standards emphasise the importance of positive animal health, proper control of disease and high welfare standards. All highly commendable ideals which should be the aspiration of every self-respecting flock owner!

Within an organic framework, disease prevention is based on the following principles (UKROFS 2002):

- the selection of appropriate breeds of animals for the enterprise concerned;
- the application of animal husbandry practices appropriate to the requirements of each species, encouraging strong resistance to disease or infections;
- the use of high-quality feed, together with regular exercise and access to pasture, thus boosting the natural immunological defence of the animal;
- avoidance of overstocking to minimise any animal health problems;
- the production of a written animal-health plan (flock-health plan), preferably working in partnership with a veterinary surgeon.

Again, so far so good, especially the last point which is insisted upon by some of the accreditation bodies and is now, in any case, also a requirement for all farmers under the Welfare Codes (Chapter 8). Flock-health plans drafted in consultation with your vet are vital for ensuring proper disease control and animal care in the run up to lambing and beyond (Chapters 3, 4 and 5).

The regulations also state that: 'where, in spite of the implementation of organic principles, an animal becomes sick or injured, it *must* be treated immediately'. However, in keeping with the organic ideal of minimising potentially harmful residues in both food and the environment, they also make it clear that many conventional chemicals, drugs and vaccines described throughout this book either cannot be used on organic farms or require special authorisation before restricted use is permitted.

For example:

- herbal and homeopathic products are to be used 'in preference to' conventional authorised products, providing the former products are effective for the species and condition to be treated;
- authorised products must be used under veterinary supervision;
- veterinary medicinal products are not to be used in the prevention of disease – however, where disease cannot be prevented by management alone and there is an identifiable risk to animal welfare, strategic use of such products (other than antibiotics) will be permitted;
- vaccination is permitted but only where there is a known risk of disease;
- growth promoters or hormone treatments, including reproductive hormones for synchronised breeding, are not permitted;
- the use of organophosphate products, found in many scab-approved dips (*see* Chapter 3), is prohibited;
- records must be maintained of the use of all medicines;
- twice the legal withdrawal period (i.e. the period between the last administration of a drug and the point at which meat or milk from that animal can be declared safe for human consumption) is to be applied for all authorised medicines;
- treatment with more than three courses of authorised medicines in one year will result in removal of organic status for the individual animal or its produce (although this does not apply to justified use of vaccines or parasite treatments).

Again, within these requirements there are a number of good things, particularly closer supervision and recording of drug use, which should ensure that these valuable resources are always used to their best advantage. At a practical level, however, some of the other requirements are perhaps more controversial.

For instance:

- *The preferred use of herbal or homeopathic remedies* when in many cases there is still little or no sound evidence for the efficacy of many of these treatments;
- *The use of organophosphate products is prohibited* at a time when sheep scab is a major welfare problem in the United Kingdom (Chapter 3);
- *Twice the withdrawal period is to be applied for all authorised medicines* despite existing safety data for many veterinary products (Chapter 8), which show minimal residue levels at the end of legally defined periods. Extending withdrawal periods causes major problems, particularly when trying to get lambs away,

and this may discourage some from giving vital treatments in the hope that 'things may improve by themselves' – something that is definitely not in the animal's best interests!;

- *Treatment with more than three courses of authorised medicines in one year will result in removal of an animal's organic status.* Whilst this is understandable given organic requirements, any rules which potentially discourage giving vital treatments could give cause for concern.

Perhaps the biggest problem relating to these requirements, however, is that, in almost every instance, the farmer and his vet have to demonstrate the presence of specific diseases before conventional treatment and prevention measures can be introduced. On the face of it, with mounting concerns over antibiotic and anthelmintic resistance (Chapter 3) as well as concerns over drug residues in milk and meat, this reactive and targeted approach appears extremely sensible. But, in terms of lamb and ewe care, this approach also has major implications for anticipating, and responding rapidly to, many of the conditions discussed in Chapters 3 to 6, particularly clostridial diseases, infectious abortion and parasitic gastroenteritis, some or all of which will be found on almost every sheep farm in the United Kingdom. Under these circumstances, considerable losses and welfare problems may occur on organic sheep farms

Organic conversion and management

Before undertaking conversion, which entails removing existing preventative treatments, it is vital that you have a thorough knowledge of all health problems and health risks that exist in your flock. The health implications of what you are about to undertake need to be fully and carefully discussed with your vet *before* any application is made. Any specific risks that are identified then need to be brought to the attention of the accreditation body *during* the application process, so they can be taken into account when drafting the procedures required for conversion. Always remember that significant management changes may be required to offset these risks, e.g. reduced stocking, less intensive pasture management, moving to a more 'closed' breeding flock etc., and that ultimately organic conversion may not be a practical or economic option for your particular enterprise.

Throughout the conversion period and beyond, you must develop an increased awareness of disease. Without the protection afforded by vaccinations or other conventional preventative treatments, such as anthelmintics or antibiotics, large numbers of animals

may succumb rapidly to disease. This is particularly true of young lambs, which, for a variety of reasons, are often particularly susceptible to infections (Chapter 1). Increased disease-susceptibility means that the highest possible standards of husbandry, care and hygiene will be required at lambing, making good use of the techniques described in Chapters 2 and 7 to ensure that all lambs get the best possible start in life.

Should problems occur during lambing, the importance of accurate record keeping for assessing losses becomes particularly apparent (pp. 148–9), because you *must* be pro-active in identifying the underlying causes. This will mean maintaining close dialogue with your vet and, if so advised, being prepared to submit all samples necessary to obtain an accurate diagnosis. Never assume anything, you may not get a second chance if you get it wrong. In some instances, proper investigation may also require extensive (and in some cases expensive) laboratory testing. However, to do otherwise could run the risk of incurring much bigger expenses associated with a major disease outbreak.

Once a diagnosis has been made, you will need to discuss the appropriate course of action with your vet before obtaining permission to implement the recommended measures with your organic accreditation body. All of this can take time, effort and money so hopefully, in the meantime, you won't also have lost too many animals.

In summary, the key elements for successful organic health management are as follows:

- *health plans:* discuss what is required carefully with your vet before, during and after organic conversion;
- *increased disease awareness:* expect problems to occur, particularly if conventional preventative treatments such as vaccinations and anthelmintic drugs have been withdrawn;
- *act as soon as any problems become evident:* any delays could mean the difference between effective control and catastrophe;
- *make sure any problem is thoroughly investigated:* this includes calling in the vet and may involve submitting samples and tissues for laboratory testing to establish an accurate diagnosis;
- *once a diagnosis has been reached, seek advice from your vet and contact your certifying body on how to proceed:* particularly if conventional treatments have been recommended.

Organic conversion should never be seen as a means of deriving economic benefits at the expense of animal health, to do so only leads to disaster!

7 Techniques for Treating Newborn Lambs

DIAGNOSIS OF PROBLEMS

The diagnosis of conditions in newborn lambs depends on knowledge of the problems likely to occur (Chapter 3), a careful examination of the lamb and the ewe (see below) and a consideration of the disease history of the whole flock. Some problems require no more than examination of the lamb, e.g. umbilical hernia, while others require a detailed investigation by your veterinary surgeon, and quite probably submission of samples to a veterinary laboratory, e.g. swayback. If at all in doubt take professional advice – a stitch in time commonly saves more than nine.

Detection of sick lambs

The early detection of sickness in lambs contributes much to the success of treatment. It does, however, present a problem. Behaviour, appearance and response to a stimulus such as the presence of the shepherd vary considerably from lamb to lamb depending on age and type (single, twin etc.). There is no such animal as a 'normal' lamb with which to compare the potentially sick lamb. Experience helps, for this subject is just as much an art as a science. The only useful advice for the novice is: if in doubt, examine the lamb as described below. In the end this will save time and lambs. Whenever you see a lamb curled up in the corner of a pen ask yourself: 'Is it sleeping off the effects of its last feed or is it sick?'.

Table 7.1 Problems in newborn lambs according to age at which they may first be seen.

Birth

Atresia ani, Border disease, cleft palate, entropion, fractured ribs, jaw defects, joint defects, prematurity, umbilical hernia

0–5 hours

Congenital swayback, daft lamb disease, fractures, hypothermia (exposure)

5–36 hours

Castration (incorrect), enteritis, hypothermia (starvation), inhalation pneumonia, stiff lamb disease, watery mouth

36 hours

Eye infection, joint ill, lamb dysentery, liver necrosis, navel ill, scad, spinal abscess, tetanus

The number of conditions to be considered increases as the lamb gets older, i.e. for a four-hour-old lamb only conditions in the first two categories need be considered, but for a two-day-old lamb all the conditions are possible.

Examination of the sick lamb

The diagnosis of a problem in a sick newborn lamb depends on a careful examination. The temptation to jump at the apparently obvious symptom should be avoided as something of equal importance may be missed. Always follow the routine outlined below.

Before physically examining the lamb ask yourself the following questions:

- How old is it? Many problems are age related (Table 7.1);
- Was its birth assisted or protracted? It may have suffered severe hypoxia (high susceptibility to hypothermia), or it may have been injured (fractured ribs);
- Is the ewe thin or diseased? The lamb will have had little colostrum and may be starving;
- Have there been any other lambs lost due to abortion? Enzootic abortion, toxoplasmosis, Border disease and other infectious causes of abortion can lead to the birth of other lambs that are alive but weak;
- Is the lamb very big? Birth problems likely;
- Is the lamb very small? May be premature and susceptible to hypothermia;

Table 7.2 Conditions in which some abnormality of walking ability *may be* the first sign of disease.

Castration (incorrect)	Scad
Daft lamb disease	Spinal abscess
Joint defects	Stiff lamb disease
Joint ill	Swayback
Limb fracture	

- Is the lamb weak *and* unable to stand? Suspect a systemic or 'whole lamb' problem, such as hypothermia;
- Is the lamb strong *but* unable to stand? Suspect a problem affecting nerves or muscle such as swayback (Table 7.2);
- Is the lamb unable to use both its hind legs? Consider swayback, spinal abscess or stiff lamb disease (Table 7.2);
- Is the lamb lame on one leg? Consider fracture, joint ill or scad (Table 7.2);
- Is breathing fast and/or heavy? Think of fractured ribs, pneumonia or prematurity (lungs poorly expanded);
- Is the lamb's abdomen empty and tucked up? starvation;
- Is the lamb's abdomen swollen or bloated? watery mouth or red gut;
- Has the lamb a poor birth coat? prematurity or Border disease.

Now examine the lamb (Fig. 7.1 and Table 7.3).

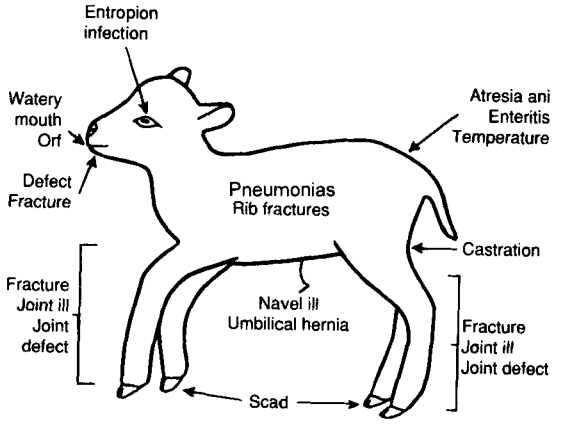


Fig. 7.1 Examination of the sick newborn lamb.

Table 7.3 Examining the sick lamb.

Area	Finding	Possible problem
Anal area	Is the anus present or absent?	Atresia ani
	Is the lamb scouring?	Enteritis; lamb dysentery
	What is the lamb's temperature?	See Table 7.4
	Has the lamb been castrated correctly? (rubber ring)	
Trunk	Is the navel swollen?	Navel ill
	Can you see intestines at the navel?	Umbilical hernia
	Are there any skin wounds?	
Head	Is there excessive saliva around the mouth?	Watery mouth
	Is the lower jaw normal?	Under- or overshot; fractures
	Are there pustules or scabs on the lips or head?	Orf
	Is the bottom eyelid(s) turned in?	Entropion
	Is the eye(s) inflamed?	Eye infection
Legs	Are the joints fully extended?	Joint defects
	Are any joints swollen?	Joint ill
	Are there any other swellings?	Fractures
	Is the cleft between the claws inflamed?	Scad

Table 7.4 Interpretation of a lamb's temperature.

Temperature	Interpretation
More than 40°C (104°F)	Fever – infection; if in a warmer, overheating (hyperthermia)
39–40°C (102–104°F)	Normal
37–39°C (99–102°F)	Moderate hypothermia
Less than 37°C (99°F)	Severe hypothermia

Taking the lamb's temperature

There are two types of thermometer available for recording a lamb's rectal temperature. They are basically used in the same way (Fig. 7.2). Sit with the lamb on your lap, gently insert the thermometer/probe into the rectum to a depth of about $1^1/_2$ inches (4 cm), allow time for the thermometer to warm up (normally about 30 seconds) and finally read the temperature.

Fig. 7.2 Taking a lamb's temperature. See also colour plate section.

Mercury clinical thermometer

This is an inexpensive glass thermometer commonly used in both veterinary and human medicine. It is easy to break and even easier to lose! It is made in such a way that it 'holds' the lamb's temperature after it has been removed from the rectum, unlike a normal room thermometer which goes up and down depending on the temperature of the environment. This means that the thermometer has to be re-set or zeroed before the next lamb's temperature is taken. This is easy to do by means of a flick of the wrist once you have got the knack – get your vet to show you how. To read the thermometer you need good light – an inconvenience when working in the poorly lit sheep house at night. A special type of clinical thermometer, the sub-normal thermometer, is very useful when working with hypothermic lambs. This instrument reads to a much lower temperature than does the normal thermometer.

Electronic digital thermometer

As an alternative to mercury thermometers, a battery-powered digital electronic thermometer is also available (Fig. 7.3). After insertion, it usually takes a few seconds for the correct temperature to register, at which point the LCD display stops flashing and an audible 'beep' is usually heard. In poor light the display can only be read with the aid of a torch, although some more expensive versions may also incorporate a back-lit display. Most models switch themselves off automatically and the batteries last a long time although it can still be extremely inconvenient when they run out in the middle of a field! However, they are generally more robust and accurate than their glass counterparts.

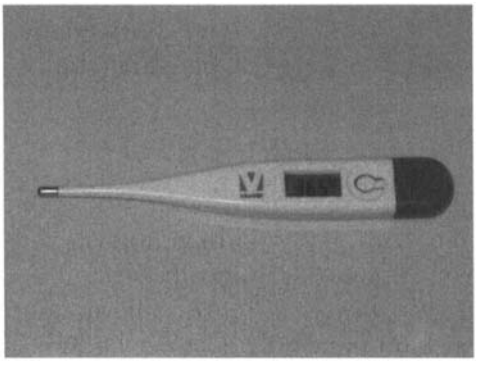


Fig. 7.3 Electronic thermometer. See also colour plate section.

Note that a low temperature (hypothermia) does not necessarily mean that infection is absent. An infection such as joint ill may lead to starvation – net result a low temperature. It should also be noted that infections in lambs aged less than 24 hours rarely produce a fever (high temperature).

FEEDING THE NEWBORN LAMB

In general, a stomach tube should always be used when feeding newborn lambs. A bottle and teat (a normal baby bottle is ideal but make the hole in the teat a bit bigger) is suitable for feeding the strong orphan lamb but can be lethal when feeding the weaker newborn lamb. Milk can easily enter the trachea (windpipe) and lead to inhalation pneumonia (Chapter 3). However, it should be noted that it is dangerous to feed semiconscious or unconscious lambs (normally hypothermic) with a stomach tube. In these lambs the tube can be passed easily into the trachea and the lamb drowned. Even if the feed is correctly placed absorption of nutrients is very slow and the food may even be regurgitated and inhaled. If a lamb can lie in sternal recumbency (on its front), and hold up its head it is safe to feed it by stomach tube. If not, proceed as outlined in the hypothermia section in Chapter 3.

The equipment

Clean, lamb stomach tubes and 60 ml feeding syringes are required (Fig. 7.4). Unlike normal syringes for hypodermic needles, feeding syringes have a special wide-bore, conical-shaped (catheter) tip that attaches to a collar on the tube. Syringes and tubes should be

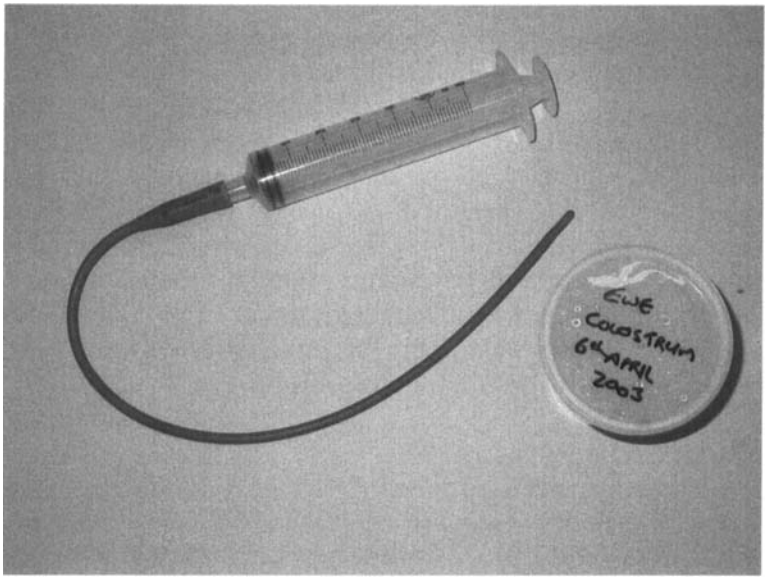


Fig. 7.4 A lamb stomach tube and 60 ml feeding syringe.

rinsed after each lamb and sterilised at least once daily by immersion in a hypochlorite/detergent solution. This cleaning routine is most important and applies equally to all other feeding equipment. Dirty feeding equipment quickly becomes contaminated with bacteria, and disease will be passed from lamb to lamb.

The feed

Ewe colostrum

This is the best food for the newborn lamb. When supplies are limited it should be restricted to the first one or two feeds. If possible, accumulate a store of ewe colostrum by milking ewes with a plentiful supply, e.g. ewes with single lambs. This can be stored in the deep freeze in small containers such as yoghurt pots or screw-topped plastic jars. Screw-topped plastic jars are ideal as they can be immersed in a bucket of warm water for fast defrosting. Whatever the container, do not defrost frozen colostrum by boiling in a saucepan or heating in a microwave oven, as this destroys the protective antibodies.

Cow colostrum

The best substitute for ewe colostrum is cow colostrum. This can be obtained from a dairy farmer, for whom it is a waste product,

and stored in the deep freeze as already described. Cow colostrum does not, however, contain the same protective antibodies found in ewe colostrum. From the point of view of clostridial disease this problem may be overcome by vaccinating a cow with clostridial vaccine before she calves. Consult your veterinary surgeon about this before lambing. Very occasionally, problems occur in newborn lambs that have been fed cow colostrum. A severe anaemia (shortage of red blood cells) develops, characterised by weakness, shortage of breath and pale gums. If this occurs consult your veterinary surgeon who may be able to save the lamb by transfusing blood from a ewe to the anaemic lamb. Do not feed the suspect cow colostrum to any more lambs.

Milk replacer

This is an acceptable food for the lamb aged more than 24 hours but should not be regarded as a substitute for colostrum.

Glucose/electrolyte solution

This solution is used for feeding lambs that have enteritis or watery mouth. In an emergency it can be used to feed any hungry lamb. Use one of the proprietary calf scour mixtures, but add powdered glucose to bring the concentration of glucose in the feeding solution to 10%, i.e. 100 grams per litre. Glucose supplementation is not necessary in lambs aged three weeks or older.

Colostrum substitutes

Recently a number of colostrum 'substitutes' have come onto the market, some of cow and others of sheep origin. It would seem likely that those of sheep origin would be more efficacious, but currently we have no objective information upon which to base any judgement. It should be noted that even a half-feed, i.e. 20 ml/kg, of colostrum obtained from another ewe or ewe colostrum preserved in the deep freeze is likely to be more effective than any substitute. This half-feed should be complemented by a half-feed of some other food such as cow colostrum or milk substitute, to ensure adequate energy intake.

Feeding routine

If a lamb is not sucking from a ewe it should be fed at least three times daily, e.g. 7 a.m., 3 p.m. and 11 p.m., at the dose rates shown in Table 7.5.

If it is practical, feed lambs more often. The quantity per feed should be reduced proportionally.

Table 7.5 Feeding volumes for lambs.

Size of Lamb	Approximate Weight (kg)	Volume of Feed (ml/feed)
Large (average single)	5	200
Medium (average twin)	3.5	150
Small (average triplet)	2.5	100

Fig. 7.5 A comfortable position for feeding a lamb by stomach tube.

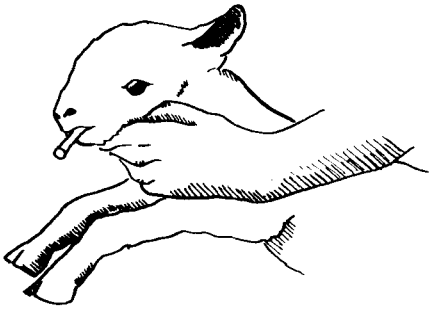


Fig. 7.6 The stomach tube in place.

Using the stomach tube

(1) Sit or stand comfortably with the lamb's weight supported in your lap (Fig. 7.5) or on your thigh.
(2) Gently introduce a clean stomach tube (with no syringe attached) via the side of the mouth (Fig. 7.6). No force is

Fig. 7.7 Giving a feed by stomach tube. See also colour plate section.

required. In a large lamb all but 2–5 cm of the tube can be introduced easily. If the lamb shows signs of discomfort or starts coughing withdraw the tube and start again.

(3) Once the tube is in place, observe the lamb. It should show no signs of distress and will probably chew the tube. This lack of discomfort proves that the tube is in the stomach.

(4) Attach a syringe of colostrum to the end of the tube (Fig. 7.7). Empty the syringe slowly, taking about 20 seconds. Remove the empty syringe and attach a full one. Repeat this process until the full feed has been given.

(5) Finally, remove both syringe and tube as a single unit and give the lamb freedom to move its head or cough if it so desires.

(6) Wash and disinfect the tube and syringe.

ADMINISTRATION OF DRUGS

Principles

Drugs are given for a variety of purposes by a variety of routes. Each time a drug is used, four requirements must be satisfied:

(1) the drug must reach the site or sites in the body at which its action is required;

(2) the concentration of the drug at these sites must be high enough to achieve the desired result;

(3) the drug must be given over a period long enough to achieve the desired effect;

(4) toxic (poisonous) side effects, which all drugs have to a greater or lesser degree, must be avoided.

To achieve these aims, the route of administration, frequency of administration and dose rates are specified for each drug

and, unless your vet specifically advises otherwise, these *must* be adhered to.

Routes of administration

The routes of administration commonly used in sheep are: topical, oral and parenteral (by injection). For farmers and shepherds, parenteral administration means giving drugs by one of three routes: subcutaneously (under the skin), intramuscularly (into the muscle) and intraperitoneally (into the abdominal cavity).

Under certain circumstances, drugs may also be given by other routes, e.g. intravenously (into the blood circulation via a vein) or epidurally (into the spine). However, administration of drugs by these additional routes requires specialist knowledge, is generally difficult to do and may be extremely dangerous for the animal. They will not be discussed further and should only be attempted by your veterinary surgeon.

Topical application (eye)

The topical route is used when only a local action is required, such as on a wound or in the eye. Only preparations specifically intended for the eye should be used on this organ (Figs 3.8, p. 52, and 7.8).

Great care must be taken when applying eye ointments. The eye should not be touched by the fingers or by the ointment tube. Hold the lamb firmly (Fig. 7.8). Open the eye by drawing the eyelids apart with the fingers. Apply ointment to the open eye from a distance of about half an inch and allow the eyelids to close.

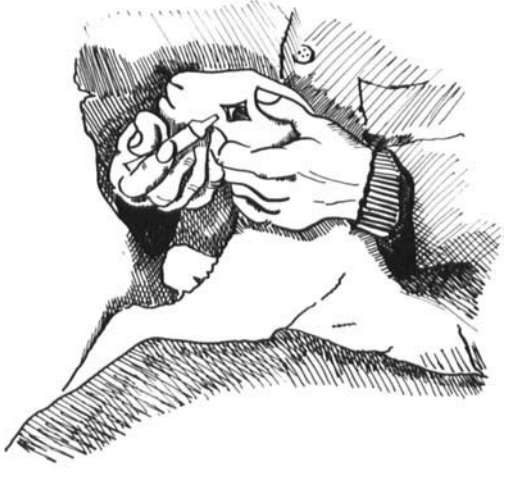


Fig. 7.8 Administration of eye ointment. Note: the tube is not touching the eye.

Oral dosing

The oral route is generally employed when a drug is required to be active within the gut, e.g. antibiotic preparations for the treatment of enteritis. In human medicine, many drugs are taken orally as pills, tablets and capsules which are absorbed from the gut into the body system where their effects are required. In sheep, when we want a systemic effect rather than a local gut effect, we generally give drugs by injection. Drugs designed for oral use should never be given by any other route.

Drugs for oral dosing are often supplied in convenient pump dispensers which deliver a pre-set volume of medicine (Fig. 7.9). If not, a 2 or 5 ml plastic syringe should be used (Fig. 7.10). This should be placed gently over the lamb's tongue to ensure swallowing. Do not use an adult sheep drenching gun. Oral preparations should never be given to lambs that are not fully conscious or are unable to swallow. In these lambs the drug, normally in liquid form, may either dribble out of the mouth or enter the windpipe and cause inhalation pneumonia (Chapter 3).

Injections

Drugs are given by injection when the effect is required within the body system, e.g. an antibiotic for the treatment of joint ill or calcium solution for the treatment of hypocalcaemia in the ewe. The type of injection used depends on the drug in question and on the speed and duration of action required.

Equipment

Sterile plastic disposable syringes and disposable needles are generally used nowadays. These disposable items are neither designed

Fig. 7.9 Administration of medicine by mouth using a pump-action dispenser. See also colour plate section.

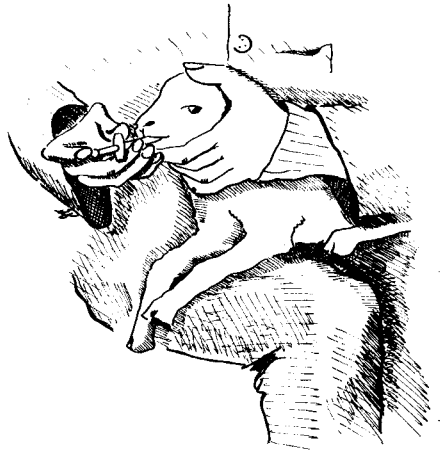


Fig. 7.10 Administration of medicine by mouth using a syringe.

nor intended for repeated use and ideally should be used for one injection only.

When a syringe is used for the injection of antibiotic it may be used for one day, but after this it should either be discarded or cleaned and sterilised by boiling before re-use. If you are re-using disposable needles for the injection of antibiotics, they should be discarded after about six injections and always at the end of the day. These needles quickly become blunt and barbed (Fig. 7.11), and further use will cause unnecessary pain and permanent damage to tissues. Nowadays, most routine vaccinations are given using automatic dosing guns using dedicated needles which should be replaced before use and changed after every 20 to 25 animals.

When injecting non-antibiotic solutions, such as glucose, it is absolutely essential to use a new needle each time and either a new syringe or one that has been sterilised since the last injection. Solutions such as glucose encourage the growth of bacteria and the repeated use of dirty equipment will result in serious, if not fatal, infections.

Subcutaneous (SC) injection

An injection under the skin (subcutaneous injection) is employed either when a comparatively slow release of the drug is required or when the volume involved is too great for administration by the intramuscular route. This route is used for the administration of vaccinations, most antibiotics, and for giving calcium and magnesium solutions.

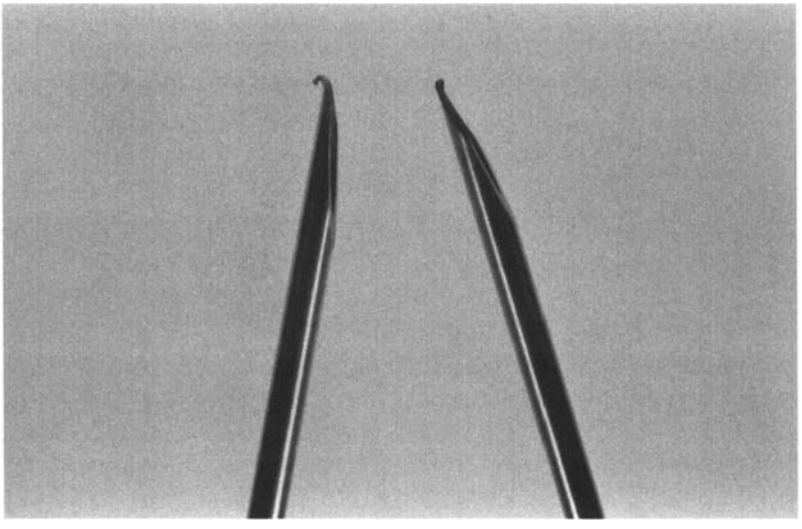


Fig. 7.11 The blunted points of two hypodermic needles which have been used repeatedly.

Fig. 7.12 Injection by the subcutaneous route. See also colour plate section.

In the lamb, the scruff of the neck is the easiest site to use. Use either a 2 or 5 ml syringe with a 19 gauge × 1 inch needle. Pinch and raise a fold of skin and insert the needle into the fold holding the syringe at an angle of about 30° to the lamb's body (Fig. 7.12). Once the needle is in position, pull back on the syringe plunger slightly to check that the needle is properly placed under the skin and that you haven't accidentally penetrated the muscle or a blood vessel. There should be no resistance on pulling the plunger and little or no air or blood should enter the syringe. Once you are happy with the position, inject the solution and withdraw the syringe.

Fig. 7.13 Injection by the intramuscular route. The injection is given into the front of the upper hind leg. See also colour plate section.

Intramuscular (IM) injection

The intramuscular route (injection into a muscle) is commonly used in sheep. Absorption from this site is quite rapid – high concentrations of the drug will be found in the bloodstream within an hour or so of injection – while the injected drug retained within the muscle acts as a reservoir, continually releasing more drug. The effective duration of action of drugs given by this route varies from 12 hours to two or three days. Intramuscular injections can be painful, so large volumes of drug cannot be given by this route. Practically, the maximum volume for a lamb is 2 ml and for a ewe 10 ml.

In the lamb, the best site to use is the front of the upper hind leg – the muscle known as the *quadriceps femoris* (Fig. 7.13). Use a 2 ml syringe and a 19 gauge × 1 inch needle. Pinch the muscle mass between the thumb and index finger and insert the needle along the length of the muscle, almost parallel to the leg. As with subcutaneous injections, pull back on the plunger slightly to make sure you haven't accidentally penetrated a blood vessel. Inject the solution and withdraw. This injection site is initially more difficult to identify than the muscles in the back of the leg, but it is a much more reliable site for drug absorption and there is little risk of nerve damage. Many drugs for which intramuscular injection is prescribed can be given safely and effectively by the subcutaneous route. Subcutaneous injections are easier and less painful for the lamb. However, take advice from your veterinary surgeon because some injectable compounds must only be given by the intramuscular route.

Table 7.6 Glucose dosages for lambs.

Lamb Size	Approximate Weight (kg)	Glucose Dose (ml or 20% solution)
Large (average single)	5	50
Medium (average twin)	3.5	35
Small (average triplet)	2.5	25

Intraperitoneal (IP) injection

A rapid effect is also achieved by injection into the peritoneal (abdominal) cavity – intraperitoneal injection. Practically the only indication for the use of this route in lambs is the injection of glucose solution to starving hypothermic lambs that have hypoglycaemia (low blood sugar level).

You will need:

- sterile 50 ml syringes;
- new 19 gauge × 1 inch disposable needles;
- 20% or 40% glucose (dextrose) solution (500 ml bottles);
- electric kettle;
- antiseptic foot-rot spray.

The dose of glucose to be given to a lamb depends on its size (Table 7.6). The solution for injection should be prepared immediately before use. If using 20% glucose solution, simply withdraw the required dose and warm to blood heat under a hot tap. If using 40% glucose solution, withdraw one-half of the required dose from the bottle and dilute this with an equal volume of recently boiled water from a kettle. Shake the syringe and ensure that the solution is at blood heat. If recently boiled water is used, the mixture should be at the right temperature automatically.

To perform the injection:

(1) Hold the lamb by the front legs as shown in Fig. 7.14.
(2) Prepare the injection site (1.25 cm (half inch) to the side and 2.5 cm (1 inch) behind navel) by spraying with foot-rot spray.
(3) Fully insert the needle (with syringe attached) at the injection site with the needle tip aimed towards the lamb's rump (at an angle of about 45°).

Fig. 7.14 Injection of glucose solution by the intraperitoneal route. See also colour plate section.

(4) Empty syringe and carefully withdraw. (The lamb may urinate during this procedure – this is not because the injection has gone into the bladder.)
(5) Dispose of needle and boil syringe before re-use.

These notes are for guidance only. You must obtain professional instruction in this technique before using it yourself. Your veterinary surgeon may advise a precautionary subcutaneous injection of long-acting antibiotic at the same time as the glucose injection. Never administer an intraperitoneal injection to any lamb suffering a disorder of the gut, e.g. enteritis or watery mouth.

Using, recording and disposal of medicines

In the United Kingdom, the supply of veterinary medicines is controlled by law and you should obtain them only from your vet, a registered distributor, e.g. agricultural merchant or a pharmacy. Medicines from unauthorised sources may not be safe or effective. *Never* be tempted to use human medicines, veterinary medicines that have been prescribed for use in other animal species or any other chemicals. It is illegal and dangerous to use such 'unlicensed' products unless they have been specifically prescribed by your vet.

In the United Kingdom, supply of veterinary medicines is regulated by the Veterinary Medicines Directorate (VMD). The latest information on animal medicines including codes of practice on the responsible use of animal medicines on the farm can be obtained from their website: http://www.vmd.gov.uk. The National Office of Animal Health (NOAH) represents the United Kingdom animal medicines industry. NOAH aims to provide safe, effective, quality medicines for the treatment and welfare of all animals. Their website, http://www.noah.co.uk also provides access to a wealth of medicine-related information, including links to relevant legislation and other publications.

Medicine development and manufacturing

Before they can be sold, veterinary medicines undergo strict testing for efficacy, safety and quality. Efficacy means checking that they will do what the manufacturer claims. Safety means ensuring that they will not be unduly toxic to the animal, harmful to the environment or, in the case of food animals, harmful to the consumer as a result of drug residues in the milk or meat. Quality means ensuring that each batch of medicine is manufactured to the same consistently high standard.

One reason animal medicines are so expensive, is that these testing procedures are incredibly stringent, usually involving large numbers of clinical trials which cost the manufacturers many thousands of pounds before products ever reach the pharmacy shelf. In Europe, should a new product fail any one of the strict criteria laid down under EU legislation then the relevant local licensing or regulatory body, in the United Kingdom it is the Veterinary Medicines Directorate (VMD), will not license the sale of the product. It is then a case of a big bill and back to the drawing board for the manufacturer! If a manufacturer wishes to sell its product worldwide then this testing process may have to be repeated several times to satisfy different regulatory authorities in different parts of the world. An expensive business; however, from the farmer and consumer point of view, we end up with medicines which, *providing they are used properly*, will be safe and should do what they claim to be able to do.

It is worth noting that such compulsory testing is not required for many products that are not classed as medicines, e.g. many mineral supplements, drenches or feed blocks and certain colostrum substitutes, so always be wary of any extravagant claims that may be made on their behalf, particularly in terms of disease prevention or control.

Medicine storage

When using any new drug or vaccine for the first time, carefully read the label or data sheet, which is usually found in the box, to find out exactly how the product should be stored and administered. Veterinary drugs and vaccines can be surprisingly fragile and there is little point in administering medicines that have not been stored properly. Every farm should have a dedicated medicine cabinet which is lockable, clean and dry and located in an area that is not subject to temperature extremes or direct sunlight. Avoid the common scenario of leaving bottles of antibiotics, syringes and needles etc. lying around the lambing shed where they may be found by other animals or by children. Remember, some antibiotics and hormone preparations as well as many vaccines require refrigerated storage otherwise they may go off, sometimes within a matter of hours at room temperature. Others may be supplied in a dried (*lyophilised*) form for storage and may require reconstituting by adding *sterile – not* tap – water immediately before use. Once reconstituted, such products usually have a very limited shelf-life, even in the refrigerator.

Using medicines

If you are in any doubt about how and when to administer any medicine, check with your vet before you go anywhere near animals with it. Always complete treatment courses as advised, even if the animal seems to improve rapidly after initial administrations. Remember short-acting antibiotics may have to be given daily for several days and vaccines may have to be given on more than one occasion to give full protection (Chapter 6).

Always give the correct dose based on the animal's size. Simply guessing an animal's weight is notoriously inaccurate and under-dosing, either by accident or by design is considered one of the main reasons for developing antibiotic or anthelmintic resistance (Chapter 3). Always weigh the animal wherever possible beforehand.

Check the data sheet for any information under contra-indications or warnings which will give you an idea of any known adverse effects that may occur after dosing. These instructions also give information on situations when the medicine should not be administered, e.g. some medicines may be unsafe for use in pregnant or milking ewes – a major consideration around lambing! Many medicines and vaccines may also be harmful if accidentally injected into the operator. Again, the datasheet will give important instructions on what to do should an accident occur.

If you suspect an adverse reaction has occurred in your animals, yourself or the environment whilst using a medicine, then contact your veterinary surgeon who will notify the VMD. The VMD, along with the manufacturer, will investigate the problem as part of the Suspected Adverse Reaction Surveillance Scheme (SARSS). All medicines have a batch number printed on the side of the bottle or box which should ideally be recorded in the medicines book (see below). This is important so that similar problems occurring on different farms can be linked during any investigations.

Pay close attention to the medicine's withdrawal period. Random drug-residue testing is routinely carried out on meat and milk samples under EU and United Kingdom legislation and a test failure could lead to prosecution. Withdrawal periods for specific products may change from time to time as new data becomes available so always check the latest situation by consulting either your vet or the relevant section on the NOAH website. Organic producers should remember that their withdrawal period will be at least twice the legal requirement (Chapter 6). If in doubt, consult your organic accreditation body.

The expiry date of a drug is self explanatory. If a medicine is even one day past its sell by date, dispose of it – don't be tempted to use it.

Medicine records

Farmers have a legal obligation to keep records of the administration of all medicines, including in-feed medication. Such records must be kept for at least three years and can be inspected at any time. It is a legal requirement to keep the following information as a minimum:

- name of the veterinary medicine;
- identity of animal/group treated;
- number treated;
- date treatment finished;
- date withdrawal period ended;
- total quantity of medicine used;
- name of person who administered the veterinary medicine.

Additional useful information includes:

- date of use;
- batch number (see above);
- expiry date.

NOAH, in association with the Animal Health Distributors Association (AHDA), publishes blank animal medicines record books that comply with these requirements. Copies may be purchased via the NOAH website.

Disposal of medicines, syringes and needles

Unused or out-of-date medicines must be disposed of carefully, otherwise they may pose a significant risk to the environment. Never put them in with domestic rubbish or pour them down the drain, sink or toilet. Needles pose an obvious injury hazard and must always be placed in a sharps-safe container immediately after use. After disposing of the needle it is also a good idea to cut the nozzles off used syringes using sharp scissors to prevent them from being useful in the wrong hands. Your vet should be able to supply you with proper sealed plastic containers for used bottles, syringes and needles which can be collected or delivered for disposal by incineration.

WARMING HYPOTHERMIC LAMBS

If a lamb's temperature is less than 37°C (99°F) it needs to be warmed actively. Infrared lamps are not advised because the rate of warming cannot be controlled, there is a serious risk of skin burns and overheating (*hyperthermia*) can easily occur.

The ideal way to warm hypothermic lambs is in air at 35–37°C (95–99°F); this temperature should not be exceeded. This warm environment may be obtained by making a bale warmer (Figs 7.15 and 7.16), or by using a commercial lamb-warming box (Fig. 7.17). The bale warmer is cheap but bulky, has a very slight fire risk and poor temperature control. The more expensive commercial lamb-warming box is compact, avoids all risk of fire, has automatic temperature control and can be subdivided into several compartments. Another option is to construct a wooden box yourself based on the bale-warmer concept (Fig. 7.18). The dimensions of such a box should not be less than 1.5 metres square and 1 metre high, otherwise there is a serious risk of overheating.

Heating for bale or box warmers should be provided by means of a domestic fan-heater with 1 kW, 2 kW and 3 kW output settings. Whichever type of warmer is employed, it should stand on a layer of paper sacks to provide insulation. An ordinary household thermometer should be placed near the lamb to be absolutely sure that the correct temperature is being maintained.

Fig. 7.15 A lamb warmer constructed from bales.

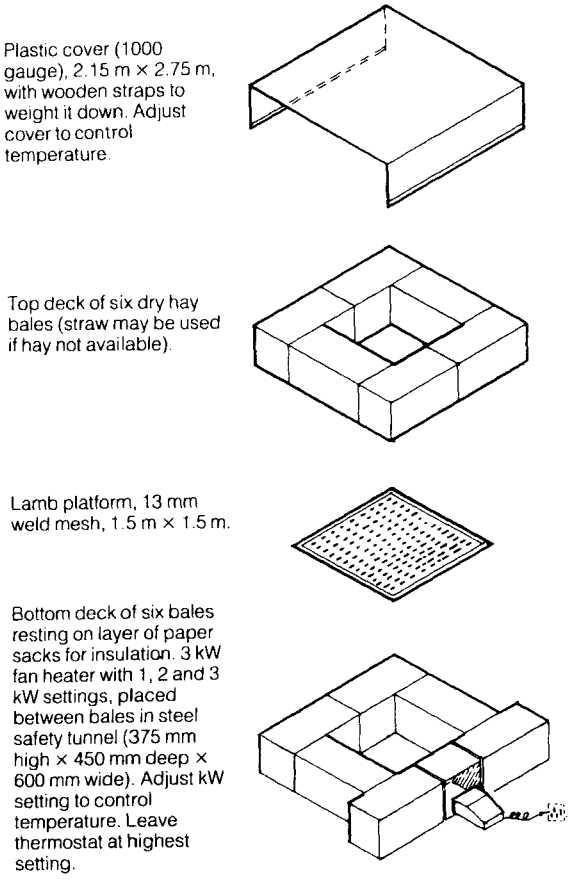


Fig. 7.16 Plans for making a bale warmer (*Management at Lambing*, 1983).

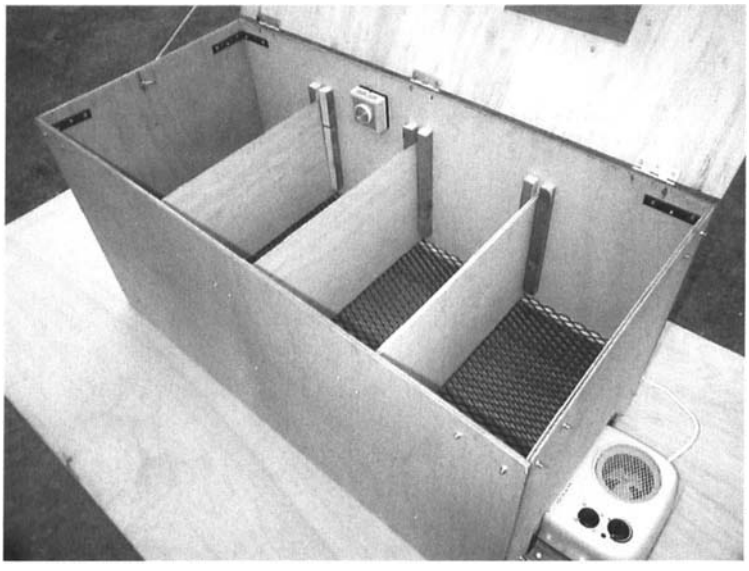


Fig. 7.17 A commercial lamb warmer fitted with integral heater, fan and thermostat (picture by Shearwell Data Ltd). The solid partitions between the compartments in this model allow several lambs to be warmed without risking cross-transmission of disease.

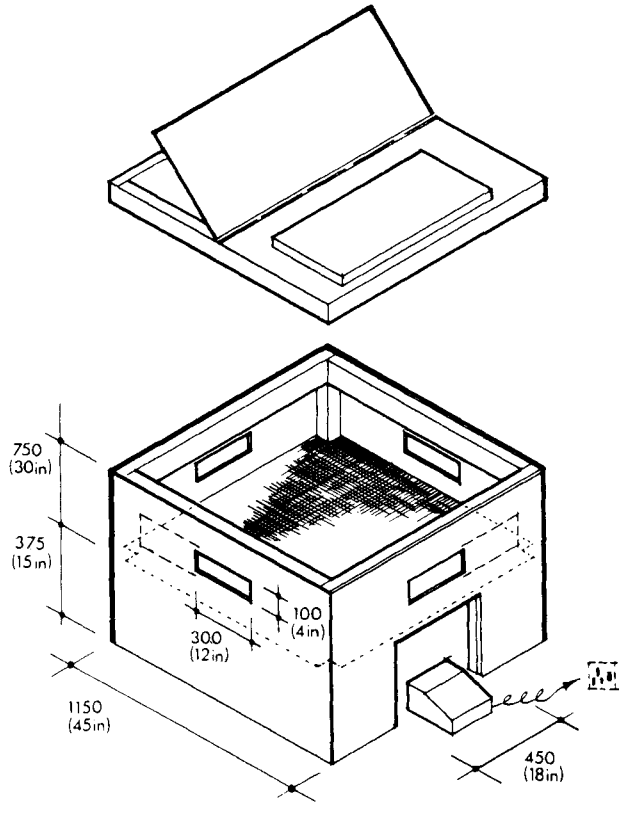


Fig. 7.18 Plans for making a wooden lamb warmer. The lid has a transparent inspection window, the false floor is constructed using 13 mm weldmesh, and each of the four vents is fitted with a sliding adjustable cover used to control temperature (*Management at Lambing*, 1983).

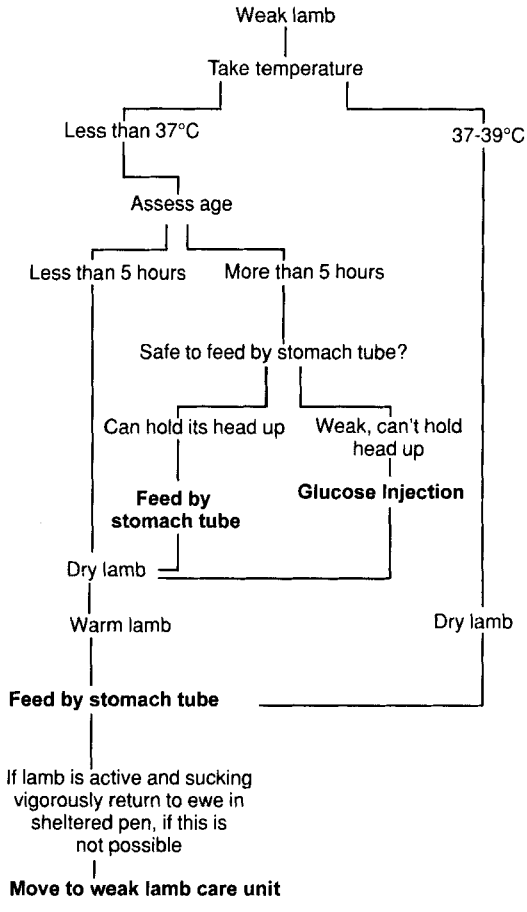


Fig. 7.19 Flow chart for the correct treatment of hypothermic lambs (refer to the text for guidance on how to perform the procedures shown in bold type).

The lamb must be dried before it is warmed. The easiest way to do this is with a towel. If a wet lamb is placed in warm air it may lose more heat than it gains, due to the evaporation of water from its coat. The net result is that the lamb gets colder.

To warm a lamb, dry it and carry out any other appropriate treatments, following the flow chart shown in Fig. 7.19, then place it in the top chamber of the warmer (Fig. 7.20). Check the lamb's temperature at half-hour intervals, and when it exceeds 37°C (99°F) remove the lamb from the warmer. The lamb will soon raise its temperature to normal by means of its own body heat. Feed the lamb by stomach tube (see above).

Most lambs can now be returned to their ewes, ideally in a small sheltered pen. Take care that the lamb is well fed and does

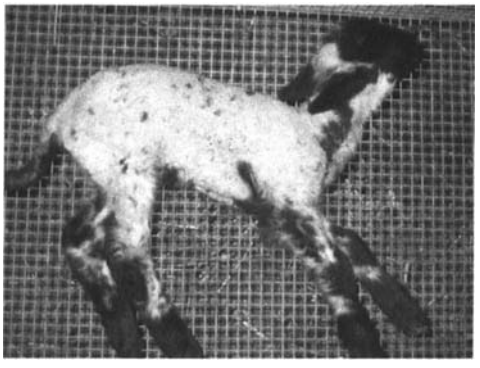


Fig. 7.20 Unconscious, hypothermic lamb ready for warming after being dried and given a glucose injection. See also colour plate section.

not become hypothermic again. One practical tip: when dealing with twins or triplets remove all the lambs from the ewe while the hypothermic one is being treated and then after treatment return them to her together. This avoids rejection problems.

A few lambs will still be too weak after warming to be returned to their ewes. They may be unable to stand and suck. These lambs should be treated as described in the next section. We have summarised all the procedures for the treatment of hypothermic lambs in Fig. 7.19.

CARE OF THE WEAK LAMB

On occasion, the shepherd has to care for a very weak lamb which cannot be left with its ewe. There are many causes of weakness, including premature birth, high litter size (e.g. quads) and postnatal disease, such as hypothermia or enteritis.

The weak lamb has four basic requirements:

(1) treatment of any disease present;
(2) warmth;
(3) food;
(4) protection from infection.

To satisfy these requirements:

- treat any disease present;
- house the lamb in an individual cardboard box or similar container under an infrared lamp (suspended about four feet above the lamb to avoid the risk of fire or burns) (Fig.7.21);

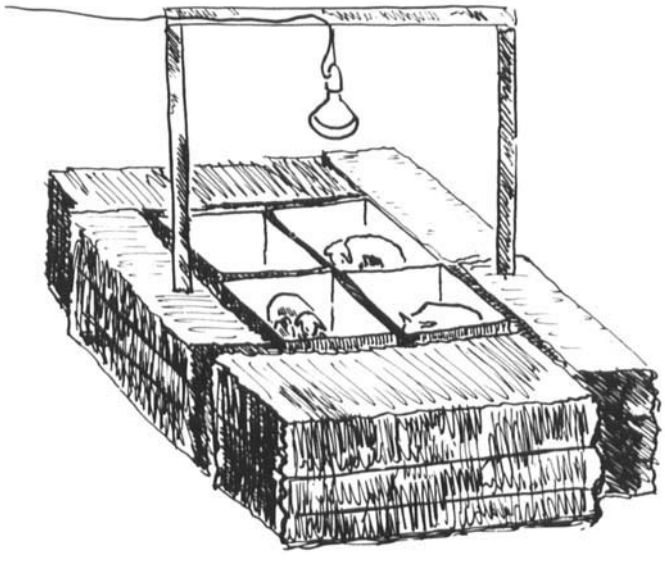


Fig. 7.21 Unit used to house very weak lambs. The infrared lamp is suspended about four feet above the lambs.

- feed the lamb at least three times daily by stomach tube (see above); colostrum should be given for the first day, subsequently milk replacer can be used;
- administer oral antibiotic twice daily – consult your veterinary surgeon about this;
- maintain the lamb in this system until it is stronger and free of disease, then either foster to a ewe or rear artificially.

ARTIFICIAL REARING

In most flocks there will be spare lambs that cannot be fostered and these will need to be reared artificially.

All too frequently these lambs are kept in a small, dark, damp shed and are fed at irregular intervals from a filthy washing-up-liquid bottle, fitted with a perished teat. Bacteria multiply in both the bedding and feeding equipment and the end result is a group of poor, sick lambs. This situation can be easily and profitably avoided by adhering to the principles contained in the following guidelines.

Management in the first three days

Ideally, leave the 'spare' lamb with the ewe for the first 24 hours, and supplement the whole litter by stomach tube. Ensure that all

the lambs receive plenty of colostrum. At about 24 hours of age, lift the lamb – preferably the strongest – and transfer it to an individual cardboard box warmed by an infrared lamp (see above). Feed the lamb milk replacer by bottle three times daily. Allow the lamb 50 ml/kg each feed. Give oral antibiotic twice daily (consult your veterinary surgeon about this). At 72 hours of age, transfer the lamb to the artificial rearing pen provided that it is strong, is sucking well and is showing no signs of disease. Never introduce a sick lamb to the rearing pen – it will probably infect the others. All lambs, irrespective of source or age, which are destined for artificial rearing, should undergo this 48-hour quarantine period before being introduced to the artificial rearing pen.

Management in the rearing pen

Housing

Lambs should be reared in groups of up to twelve. Ideally, site the rearing pen in a clean building or covered yard. During the training period (see below) the rearing pen should be restricted in size, but once all the lambs are sucking well give them plenty of space – the more the better (Fig. 7.22). Move the feeding equipment daily to prevent a build-up of dung in one area. In covered yards

Fig. 7.22 Lambs housed in an indoor, purpose-built, artificial rearing unit. It would be almost impossible to achieve this level of hygiene on most commercial farms, but this is what we should be aiming for!

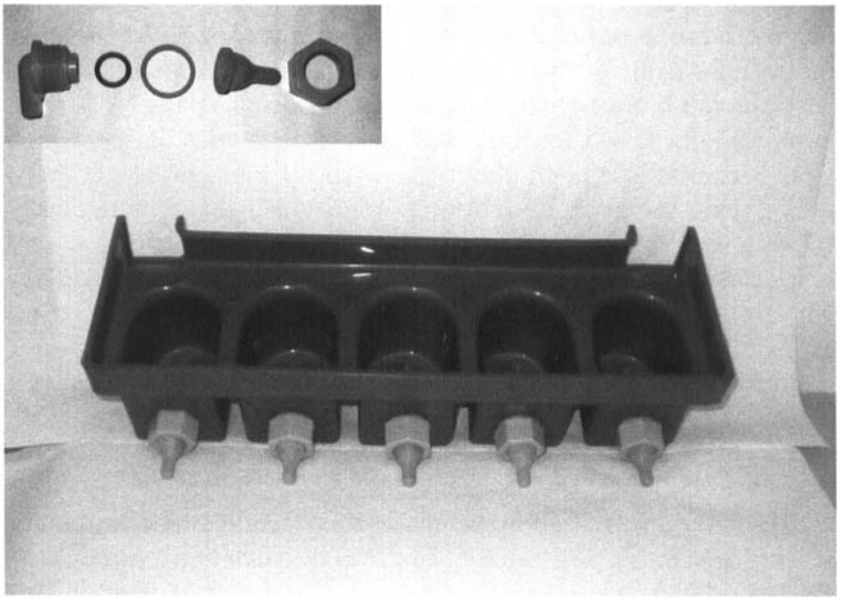


Fig. 7.23 A feeding trough for artificial rearing. The unit is hooked over a gate or fence at the right height for the size of lambs. The teats can be dismantled easily (inset) to allow thorough cleaning.

with open sides provide straw bales arranged to form a cross. This ensures that the lambs can always find shelter from draughts. Move these bales twice weekly. Do not use infrared lamps, as they encourage the lambs to huddle in one spot on badly soiled bedding.

Feeding

Equipment & feed

Use a lamb feeder (Fig. 7.23). The lamb will quickly become self-feeding, and the use of cold milk prevents short-term overfeeding.

Use a good-quality ewe milk replacer. These are usually made up by mixing 200 g of milk powder with water to produce one litre of milk. Check that the measure used to dispense the powder gives the correct amount. If too little powder is used the lambs may starve; if too much, the lambs may become dehydrated and may also scour.

Training

To train lambs to use a feeder:

- introduce lambs to the lamb feeder when they are expecting their next feed, i.e. hungry but *not* starving;
- ensure that there is milk in the teat;

Table 7.7 Milk requirements for lambs based on age.

Age of Lamb (days)	Volume of Milk to Feed (ml/day)
4–5	500–750
6–12	750–1000
13 and older	1500–2000

- gently hold the lamb on the teat and encourage it to suck; squeezing the teat may help to give the lamb the right idea;
- repeat this procedure every few hours until you are sure that the lamb is sucking for itself;
- if a lamb refuses to suck much milk, feed it by stomach tube – do not let it starve;
- while training, keep the milk warm to encourage sucking;
- once training is complete, feed the milk cold to discourage overfeeding.

Milk requirements

Individual lamb requirements vary considerably. Table 7.7 gives advisable volumes to feed.

Adjust the amount of milk so that there is always a little left over at the end of feeding time. This will ensure that the slower feeders get their full requirements. If the milk is restricted, these weaker lambs will be in danger of starvation.

Hygiene

All feeding equipment must be rinsed, washed and sterilised each day. Use a hypochlorite/detergent solution.

Solid food

After about one week in the rearing pen, introduce fresh hay and lamb pellets. Replace these feeds daily even if they have not been touched.

Water

Always provide clean, fresh water.

Weaning

If the cost of milk replacer were not a consideration, the determination of the best time for weaning would be a simple matter.

One could safely suggest that lambs should not be weaned until they had reached a body weight of 15 kg. In the real world, where cost is a significant factor, it is inevitable that most lambs will be weaned at lower weights. Care must be taken, however, not to wean lambs too early, otherwise a serious check in growth and intestinal problems will result. The following guidelines should help to prevent most problems:

- Do not wean before 30 days of age.
- Do not wean at a body weight of less than 10 kg.
- Ensure that lambs are taking solid food before weaning.
- Wean abruptly. Do not progressively reduce the milk allocation to a group of lambs. The big, strong lambs that are ready for weaning will continue to get milk, but the smaller lambs that are not ready for weaning will be weaned willy-nilly.
- Assess readiness for weaning by relating present body weight to birth weight. A big single lamb, weighing 6 kg at birth, may need to be taken to 15 kg, whereas a small triplet, weighing only 2 kg at birth, could be safely weaned at 10 kg.

Health

The relatively close confinement of lambs in an artificial rearing system inevitably increases the risk of infectious diseases such as enteritis and eye infections. The incidence of these problems can be reduced by following these guidelines:

- Give oral antibiotics for the first three days of life (take advice from your veterinary surgeon and remember that this may not be possible under organic management).
- All lambs must undergo 48 hours of quarantine before introduction into the system.
- Never introduce a sick lamb to a system.
- Watch the lambs closely, and isolate and treat any sick lamb.
- Clean and sterilise the feeding equipment daily.
- Give the lambs plenty of space and fresh air while preventing draughts.
- Avoid the use of infrared lamps.

Urinary calculi

Urinary calculi can be a serious problem in ram lambs after weaning. Calculi are small stones that collect in the bladder and eventually block the urethra, the tube connecting the bladder to the penis. The bladder eventually ruptures and the lamb dies. Urinary calculi are a most painful condition for the lamb. If you suspect

this problem – straining but little or no urine passed and tenderness of the lower abdomen – you must call your veterinary surgeon at once. See Chapter 3 for measures to avoid this problem.

FOSTERING

In most flocks, successful fostering is preferable to artificial rearing. It is, however, a far from foolproof technique and very high mortality rates are often recorded in fostered lambs. Guidelines are presented below which should help prevent some of these losses.

The lamb

Only strong, healthy lambs should be fostered. Inevitably, lambs to be fostered will face problems, and if attempts are made with either weak or sick lambs, failure can be expected.

The lamb is likely to come from one of two sources: a ewe which has too many lambs, e.g. triplets, or a poor ewe with twins; or out of the initial stages of an artificial rearing system (see above). If the lamb comes from a ewe with too many lambs, choose the strongest – not the weakest. If it comes from an artificial rearing system, take a lamb that has only been fed by stomach tube and has not become bottle orientated. Whatever the source, the lamb must have received plenty of colostrum. During the fostering process ensure that the lamb never goes hungry. Hungry lambs soon become too weak to suck and are likely to be injured by the ewe.

The ewe

Only use a ewe as a foster mother if she is in good condition, has plenty of milk, is not likely to have lost her lambs as a result of infectious abortion and is otherwise free of disease. If infectious abortion is suspected as a cause of still birth or neonatal death, the ewe should be isolated and appropriate samples collected for laboratory testing. It is also better to avoid both very young and very old ewes.

Techniques

Four techniques are outlined:

(1) rubbing-on at birth;
(2) late rubbing-on;
(3) lamb adopters; and
(4) skinning.

In our experience the rubbing-on techniques are the simplest and most effective.

Rubbing-on at birth

The success of this technique depends on speedy action after a ewe has had either a stillborn lamb or a single (check for the presence of another lamb by feeling the ewe's abdomen). The procedure is outlined below:

(1) Do not allow the ewe to rise to her feet after lambing.
(2) Rub the foster-lamb in the birth fluids, paying special attention to the anal region and the head.
(3) Tie the lamb's front legs gently together, so that it behaves like a newborn lamb and does not run around the pen.
(4) Place the foster-lamb plus the ewe's own lamb (if there is one) in front of the ewe and release her.
(5) Watch carefully from a distance but leave well alone.
(6) After an hour release the lamb's tied legs.
(7) For the next few days keep the ewe and lambs in a small pen. Check that the lambs are feeding and that the ewe is accepting them.

Late rubbing-on

On occasion, it may not be possible to follow the procedure outlined above. Within about six hours of lambing, a variation of the rubbing-on technique can be effective, especially if the placenta (afterbirth) has been retrieved.

(1) Place the ewe's own lamb and the foster-lamb in a *clean* plastic dustbin.
(2) Throw the placenta on top of the lambs. If you have managed to save any birth fluids add these as well.
(3) Leave the lambs for an hour to 'mix'.
(4) Cut the placenta into halves and tie one half round each lamb's neck.
(5) Place the dustbin in the ewe's pen but *do not* release the lambs.
(6) After 30 minutes release the lambs.
(7) Watch carefully for signs of rejection and ensure that neither of the lambs goes hungry.

Lamb adopters

A variety of adopters can be purchased ready-made (Fig. 7.24), and plans for DIY models are also available (Fig.7.25). All these

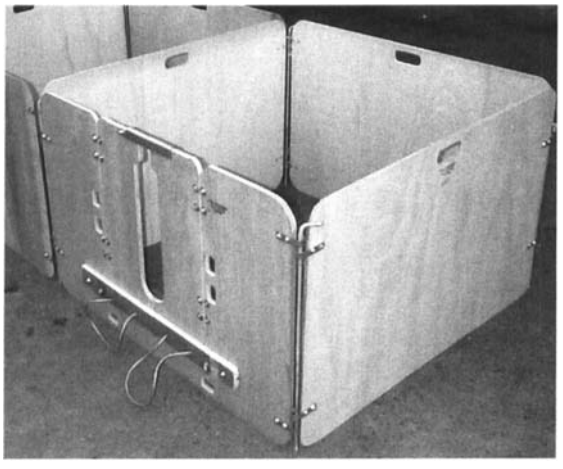


Fig. 7.24 A ready-made fostering pen. Modular construction allows quick and easy assembling where required (picture by Shearwell Data Ltd).

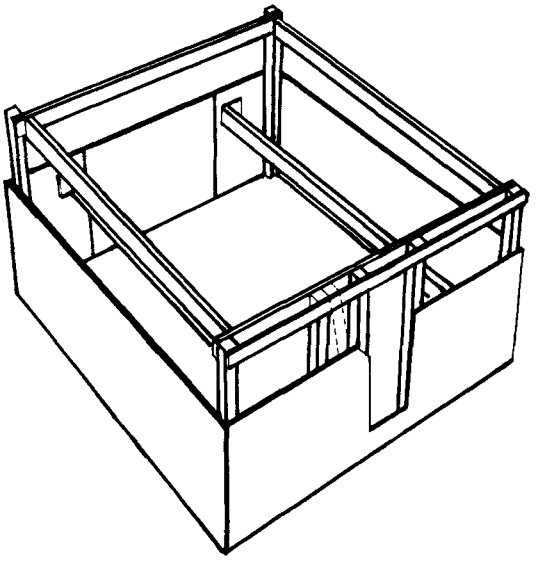


Fig. 7.25 A DIY wooden fostering pen. Note the internal rails which provide a safe lying area for the lambs (*Management at Lambing*, 1983).

devices comprise a small pen, measuring about four feet square, fitted with a yoke in one side for restraining the ewe. The lambs have the freedom of the pen and can suck when the ewe stands. Rails are commonly fitted in the pen to enable the lambs to lie at the sides without danger of being crushed (Fig. 7.25).

The following procedure is followed:

(1) Place the ewe in the pen and secure her head.
(2) Put the lambs in the pen when they are due for their next feed, i.e. hungry but not starving.
(3) Leave for 48 hours. Check that the lambs are feeding. If they are not, encourage them to suck, but if this fails, feed them by stomach tube. Do not let them starve.
(4) After 48 hours release the ewe from the yoke and watch carefully for signs of rejection, e.g. refusal to suckle, butting.
(5) If the ewe rejects the foster lambs, give up. Further efforts are likely to be fruitless.
(6) If the lambs have been accepted, release the ewe with her lambs into a small pen where you can watch them closely for the next few days.

This technique is most likely to be effective when the fostering process is commenced soon after lambing. It may be preferable to remove the ewe's own lamb (if she has one) and replace it with a pair of matched foster lambs.

Skinning

Some shepherds swear by this technique, others consider it a waste of time. It should not be used if you suspect that the ewe's own lamb may have died from an infectious disease such as enteritis. The procedure is as follows:

(1) Skin the dead lamb.
(2) Fit the skin to the foster lamb.
(3) Put the ewe and foster lamb in a small pen.
(4) Keep a close watch for signs of rejection and ensure that the lamb sucks. Remove the skin after two days.
(5) If all is well after three days, move the ewe and lamb to a small yard.
(6) If the ewe rejects the lamb, give up.

Summary

Whichever fostering technique you use, remember these four basic rules:

(1) Do not use weak or sick lambs.
(2) Do not use a ewe with insufficient milk.
(3) Do not let the lamb(s) starve.
(4) If at first you don't succeed, give up!

CASTRATION

Three techniques are used: the rubber ring in the first week of life; the bloodless method at about four to six weeks of age; and the open or knife method. Of the three, the rubber ring, followed by the bloodless method are probably most commonly used by shepherds in the United Kingdom. Open castration is occasionally performed in older lambs but if performed badly can result in infection as well as chronic, severe pain. For safety and welfare reasons, it is advisable that this technique should really only be performed under special circumstances by a veterinary surgeon. None of these techniques should be used, under any circumstances, without prior practical instruction. Incorrect or ill-timed use of the rubber-ring method of castration can cause problems (Chapter 3, Faulty castration and Watery mouth). Notes on the correct use of this technique are given below.

Castration in the first 12 hours of life makes lambs more susceptible to watery mouth, probably by reducing colostrum intake. Leave castration until at least this age, and in the case of weak twins and all triplets until 24–48 hours, when you are sure that the lambs have had plenty of colostrum and are sucking well.

Why castrate?

At around five months of age, the uncastrated ram lamb matures sexually and can become a considerable nuisance in the flock. If lambs are sent to slaughter before this age castration is not necessary – some would say it is undesirable as the entire lamb grows faster and produces a leaner carcass. All sheep farmers should question whether castration is necessary in their lambs. If it isn't – don't do it.

Precautions

Whichever technique is used for castration, ensure that the scrotum contains testicles and testicles only. Any swelling of the scrotum suggests a hernia and possibly prolapsed intestines. Castration of such a lamb would likely prove fatal.

Castration and similar procedures should always be conducted in clean, dry conditions.

The law

(1) No person under 17 years of age may castrate a lamb.
(2) Only a veterinary surgeon may castrate a lamb older than three months.

(3) Rubber rings may only be used in the first week of life. Use of the rubber ring after seven days of age is a criminal offence.

Rubber-ring castration

The technique for rubber-ring castration follows:

(1) Check that both testicles have descended into the scrotum and that the lamb does not have a scrotal hernia – intestines in the scrotum (Fig. 7.26). A hernia can be felt as a soft mass within the scrotum. If in doubt mark the lamb and take professional advice. Castration would kill the lamb.
(2) Place a clean, new ring well over the elastrator points, open the points by pressing the handles together, and with the points aimed towards the lamb, position the ring above the testicles but below the teats (Figs 7.26a and 7.27). If the ring is placed too high it may interfere with the urethra, the tube connecting the bladder to the penis. This prevents urination and will lead to the death of the lamb.
(3) Release the pressure on the elastrator handles and check that both testicles are still within the scrotum.

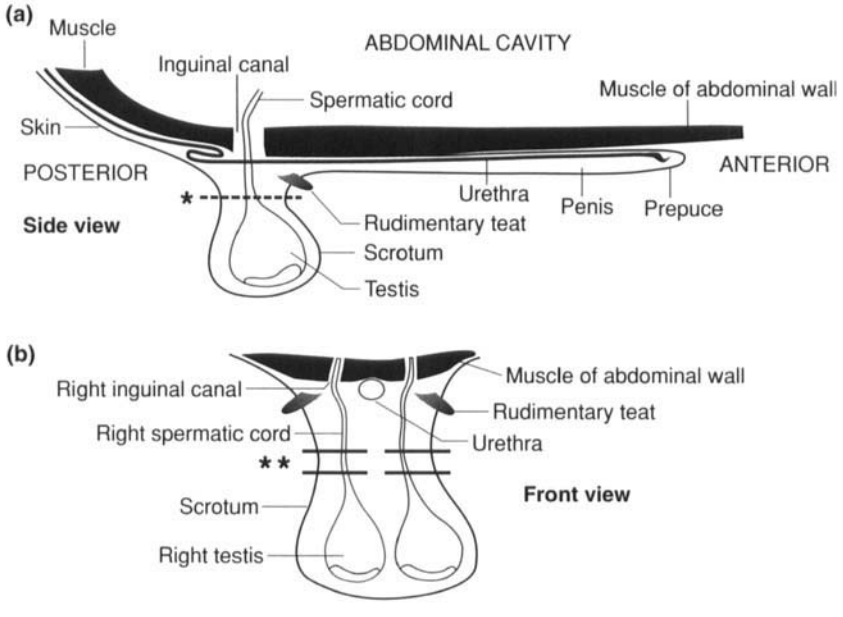


Fig. 7.26 Diagram showing male lamb scrotal anatomy along with correct positions for (a) placing rubber ring* and (b) bloodless castration** equipment. Bloodless castration equipment should never be placed across the entire width of the scrotal neck (diagram by Mr M. Graham).

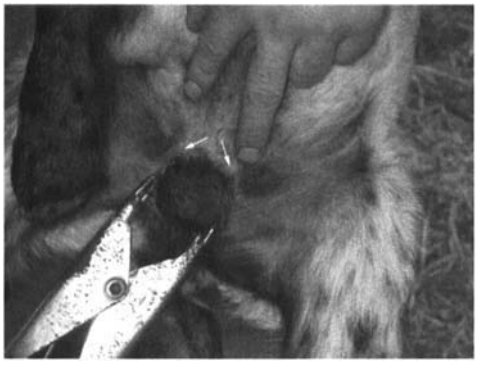


Fig. 7.27 Castration using a rubber ring. Note correct placement around the scrotal neck but below the teats (arrows) after ensuring both testicles are in the scrotum. See also colour plate section.

(4) Remove the elastrator.
(5) Check again that there are two testicles below the ring and two teats above it.
(6) If the ring has been wrongly placed, it must be removed. Insert a blunt instrument, such as a teaspoon handle, under the ring and cut through the ring down onto the handle. This avoids any risk of cutting the skin.
(7) Check all castrated lambs a few hours later to ensure that they are mothered-up correctly and that none is showing signs of discomfort. If in doubt check the position of the ring again.

The rubber ring is also used for docking the tail to avoid the danger of excessive faecal soiling and fly strike (Fig. 7.28). Short docking is unlawful and the unhealed wound that can result can increase the chance of fly strike. Sufficient tail must be left to cover the vulva in the ewe lamb and the anus in the ram lamb.

Fig. 7.28 Tail docking using the rubber ring. See also colour plate section.

Bloodless castration

Bloodless castration is performed using precisely engineered surgical instruments such as a Burdizzo emasculator or Ritchey Nipper (Fig. 7.29). It is essential that these instruments are well maintained and handled with care otherwise the jaws may become misaligned or damaged causing unnecessary pain and injury to the lamb. When the jaws are closed over the neck of the scrotum the blood vessels which run with the spermatic cord are crushed depriving the testicles of their blood supply. The testicles therefore eventually shrivel up and die. The scrotal skin above the testicles is bruised but remains intact so that the testicular remnants are retained within the closed scrotal sac ensuring that infection cannot enter.

With the lamb securely restrained, each side of the neck of the scrotum must be emasculated separately by applying the device at two points approximately 1 cm apart along the spermatic cord (Fig. 7.26b). To avoid damaging the penis or urethra the jaws must be applied well below the body wall and well above the testes. The jaws must *never* be placed across the whole width of

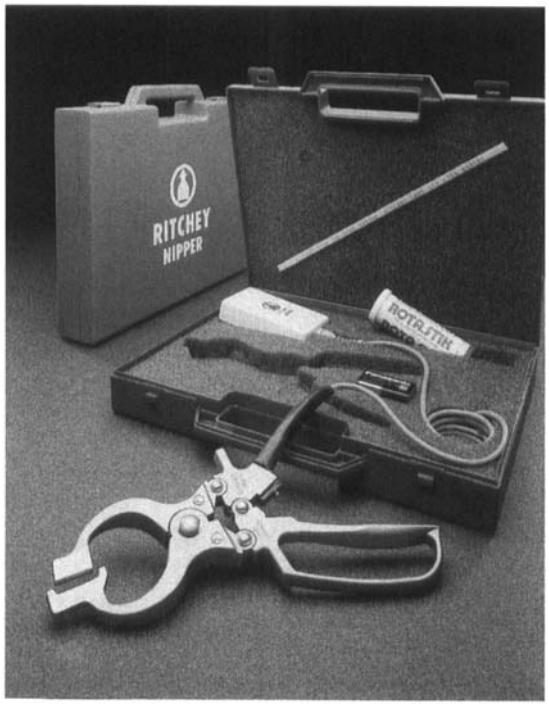


Fig. 7.29 Bloodless castration equipment designed for use in lambs (picture by Ritchey Tagg plc., Masham).

the scrotal neck in a single crush. Doing this blocks the blood supply to the entire scrotum causing great pain. The damaged scrotum also eventually detaches leaving an infected, open wound.

As with rubber-ring castration, bloodless castration requires a high degree of skill and care if unnecessary pain and suffering is to be avoided. Lambs should be checked afterwards for mismothering and signs of excessive pain or swelling of the scrotal tissue. Poor technique may also lead to lambs not being properly castrated and they should all be checked again after several weeks to make sure the procedure has been effective, as evidenced by the presence of a shrivelled-up scrotum.

Bloodless castrators are specifically designed for using on soft scrotal tissues; they should not be used for tail docking because crushing tail bones damages the jaws of the equipment.

Future castration policy

There can be no doubt that castration and docking by any means is painful for the lamb and techniques for castration and tail docking in the United Kingdom are under constant review. An ideal solution to this problem would be to use some form of local anaesthesia, although there is currently some doubt as to whether a practical, safe and economic technique for use on-farm can be found. However, tests using prototype equipment have been found to be extremely effective under experimental conditions and it remains to be seen whether these will become more widely adopted in future.

NAVEL DRESSING

The bacteria that cause joint ill, liver abscess, navel ill and spinal abscess commonly gain entry into the lamb through the wet navel cord (umbilicus) soon after birth, although the infections only become clinically evident a few days later. The incidence of these infections can be considerably reduced by keeping lambing pens clean and by dressing navels as soon as possible after birth.

The whole navel should be dipped in tincture of iodine (*see* Lambing equipment checklist, p. 231, for the recipe or buy ready formulated). To ensure complete coverage, the jar containing the solution should be pressed against the lamb's belly and the lamb quickly upturned (Fig. 7.30). This solution contains two antiseptics – iodine and alcohol – and in addition the alcohol helps to dry the cord. Spraying the cord with an aerosol antiseptic or antibiotic

Fig. 7.30 Dressing the navel – the whole cord and surrounding skin are immersed. See also colour plate section.

Fig. 7.31 Plastic navel clips may be applied after dipping (picture by Ritchey Tagg plc., Masham).

preparation is unlikely to be as effective as this technique. It is sometimes suggested that the navel should be dressed again in the first day of life. In situations where extra protection is required, the navel can also be tied off or clamped using tape or commercially available plastic clips (Fig. 7.31) after dipping.

EAR TAGGING AND ELECTRONIC IDENTIFICATION

Identification is now compulsory within the EU, largely as a result of the concerns over animal traceability in relation to food safety, infectious disease controls and subsidy payments. From a flock health point of view, the ability to record which lambs came from which ewe after weaning is also advantageous.

Fig. 7.32 Electronic identification rumen boluses for cattle and sheep (picture by Shearwell Data Ltd).

In young lambs, ear tagging is still the most widely used method usually with the metal Ketchum-type or plastic tags. Ear tagging is a painful procedure so ideally, as with castration and tail docking, it should only be performed once the ewe–lamb bond is well established and you are sure the lamb has consumed plenty of colostrum. The minimum number of tags possible should be inserted using the correct applicator for the tag.

Tags should be inserted approximately halfway along the length of the rear edge of the ear at a point just behind the obvious ridge of cartilage that runs up the middle of the ear from the base to the tip. When placed properly, the tags should hang from the back leaving sufficient room for ear growth without interference. If you are unsure about how to place tags, seek advice from more experienced shepherds or your vet. Tagging should always be done under clean, dry conditions and before the flies are active to minimise risks of infection or strike (Chapter 3).

Even when placed properly, tags are still prone to falling out, so recent research has focussed on developing alternative identification methods. These include electronic rumen boluses (Fig. 7.32) which look similar to mineral-supplement boluses (Chapter 6) and can be administered orally to older lambs, and electronic chips which can be injected subcutaneously. Each bolus or chip has a unique

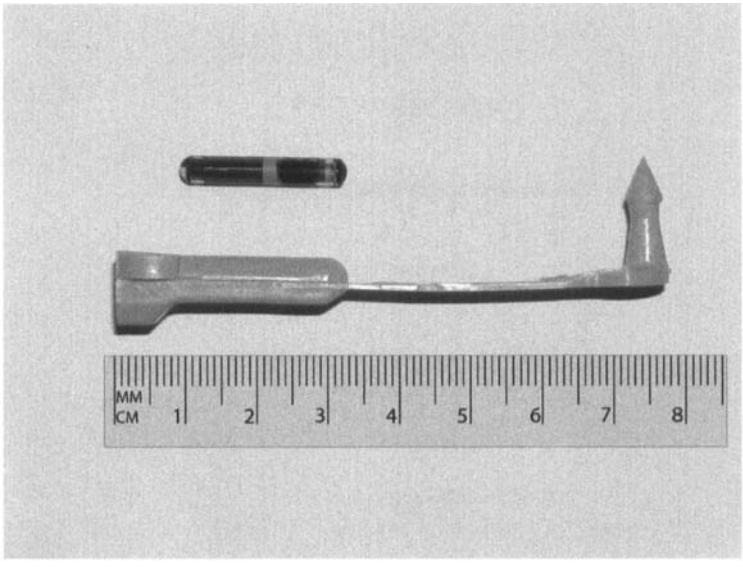


Fig. 7.33 Plastic ear tag and the electronic microchip it contains (picture by Shearwell Data Ltd).

code which can be detected and read using a portable scanner. As with mineral-supplement boluses, identification boluses need to be carefully administered using the correct size for the age of lamb otherwise injury may occur. They should not be used without proper training.

Electronic chips have the advantage that they can be safely administered to any age of animal, however they occasionally move around under the skin making detection difficult. Although more expensive and less visible than tags, these methods are more secure, making them popular with various authorities as identification requirements become more stringent. With the correct detection and handling equipment, they can also make the shepherd's life much easier when it comes to sorting out large groups of animals. Ear tags containing electronic chips are also available (Fig. 7.33). These are extremely easy to read, however, as with conventional tags, they can occasionally be lost or tampered with.

GIVING AN ENEMA

An enema may be indicated in the treatment of constipation or watery mouth. This is easily performed using a 20 ml syringe and

Fig. 7.34 Giving an enema using a cut-down stomach tube and syringe. See also colour plate section.

a cut-down stomach tube. Draw about 15 ml of warm soapy water (washing-up liquid in water) into the syringe and insert the tube about 5 cm (2 inches) into the rectum (Fig. 7.34). Inject the solution over about five seconds. In many cases faeces will be passed within 5–10 minutes.

8 Welfare at Lambing

It is the prime responsibility of everyone, sheep farmer, shepherd and veterinary surgeon, to ensure the welfare of their stock at lambing, as at all other times. There are two very good reasons for this: for moral and ethical reasons anyone who can knowingly cause distress or suffering to a ewe or lamb has no place on a sheep farm; secondly, and this will be obvious to most in sheep farming, unhealthy sheep do not thrive. They certainly don't make a profit.

To the novice the detection of ill health and even pain in sheep can present a problem. The sheep rarely makes an obvious response to pain or ill health. It adopts the dumb approach. There may be good biological reasons for this, but for the shepherd or the sheep farmer it presents problems.

Changes in behaviour are often the first signs of trouble. To detect one oddly behaving ewe in a flock of 600 sheep requires patience and keen, unhurried observation. This shepherding skill is only learnt in the field, not in the lecture room. Early detection is the key to solving many problems, not only for the individual animal concerned. A problem in one ewe (e.g. blowfly strike) may foretell a potential problem for the other 599 ewes. Swift preventative action may be called for.

WELFARE CODES

The Department for the Environment and Rural Affairs (DEFRA) (and corresponding authorities in Scotland and Wales) publish *Codes of Recommendations for the Welfare of Livestock*. These codes are not law as such but they occupy a similar place in legal practice to that occupied by the *Highway Code*. Failure to observe code recommendations could be used as evidence to establish the guilt of anyone accused of causing suffering to animals. By law, all stockmen must have access to these codes. The latest edition was published in August 2000 replacing the previous edition published in 1990. The new edition contains entire sections devoted to pregnancy and lambing as well as artificial rearing of lambs. Copies are available free of charge from DEFRA publications or online at http://www.defra.gov.uk/animalh/welfare/farmed/sheep/.

Below we have summarised aspects of the code that are of special relevance to the topics covered in this book. Numbers in parentheses refer to paragraph numbers in the code itself. Our additional comments are shown in *italics*. These abbreviated notes should not be seen as a substitute for studying the code in full.

Health

(20) Stockmen should be experienced and competent in the prevention and treatment of foot rot, the techniques of lambing, injection and oral dosing, tail docking and castration of lambs. It is particularly important that shepherds have competence in the skills required at lambing time.

(21) A written health and welfare programme for all animals (including pregnant ewes, lambs and breeding replacements) should be prepared for each flock. This should cover the yearly production cycle. It should be developed with appropriate veterinary and technical advice, and reviewed and updated annually. The programme should include sufficient records (*including lambing records*) to assess the basic output of the flock and should address, as a minimum, vaccination policy and timing and control of external and internal parasites and foot care.

(25) The health and welfare of animals depends upon regular supervision. Shepherds should carry out inspections of the flock at intervals appropriate to the circumstances in which sheep are kept and pay particular attention to signs of injury,

distress, illness or infestation so that these conditions can be recognised and dealt with promptly. The frequency of inspection will depend on factors which affect sheep welfare at any particular time, such as housing, lambing, fly strike and adverse winter weather conditions.

(32) Where external parasites, such as those causing scab or fly strike, ticks or lice are likely to occur, sheep should be protected by dipping or by the use of an effective preventive chemical agent. Where sheep are clinically infected with such external parasites, effective treatment must be given without delay.

(33) Internal parasites should be controlled by grazing management and/or anthelmintic treatment administered at appropriate times based upon the life cycle of the parasite. Advice on appropriate timing, and steps to avoid the development of anthelmintic-resistant worms, should be sought from a veterinary surgeon or specialist adviser.

Casualties

(34) Injured, ailing or distressed sheep should be identified and treated without delay. Where the shepherd is able to identify the cause of ill health, he or she should take immediate remedial action. When in doubt, veterinary advice should be obtained as soon as possible.

(35) Provision should be made for the segregation and care of seriously sick and injured animals. Unfit sheep should be removed from flocks.

(36) If an unfit sheep does not respond to treatment, it should be culled or humanely killed on farm. It is an offence to cause, or to allow, unnecessary pain or unnecessary distress by leaving a sheep to suffer.

(37) In an emergency, it may be necessary to kill an animal immediately to prevent suffering. In such cases the animal should be destroyed in a humane manner and, where possible, by a person experienced and/or trained both in the techniques and the equipment used for killing sheep.

Dosing and vaccination

(40) Special care should be taken to ensure that all equipment used in dosing, vaccination and treatment is maintained to a satisfactory standard. Equipment used for any injection technique

should be frequently cleansed and sterilised to avoid infections at the site of injection. Disposable needles should be used whenever possible. Needles and dosing gun nozzles should be of a suitable size for the age of the sheep. Hazardous objects such as needles should be disposed of safely in accordance with current legislation.

Management

Castration

(58) Farmers and shepherds should consider carefully whether castrating within a particular flock is necessary. Castration is unlikely to be necessary where lambs will be finished and sent to slaughter before reaching sexual maturity. Account should be taken not only of the pain and distress caused by castration but also the stress imposed by gathering and handling, and the potential risk of infection. Castration should not be performed until the ewe–lamb bond has become established. Castration must be carried out only in strict accordance with the law (*see* section on relevant legislation p. 220) by a competent and trained operator.

Tail docking

(62) Farmers and shepherds should consider carefully whether tail docking within a particular flock is necessary. Tail docking may be carried out only if failure to do so would lead to subsequent welfare problems because of dirty tails and potential fly strike. If it is considered that both tail docking and castration are necessary, thought should be given to performing both operations at once to minimise disruption and the potential for mis-mothering and distress. Tail docking must be carried out in strict accordance with the law (*see* section on relevant legislation p. 220).

Pregnancy and lambing

(72) The nutritional management of pregnant ewes is particularly important. Both condition scoring and ultra-sound scanning, to determine the numbers of foetuses present, will be of benefit in assessing dietary needs.

(73) Pregnant and nursing ewes should receive sufficient food to ensure the development of healthy lambs and to maintain the health and bodily condition of the ewe.

(75) Heavily pregnant ewes should be handled with care to avoid distress and injury that may result in premature lambing.

(76) Severe damage and suffering can be caused through inexperience when assisting a ewe in lambing difficulties. Shepherds should therefore be experienced and competent before having responsibility for a flock at lambing time. Where necessary, they should receive proper training in lambing techniques.

(77) Stockmen should pay particular attention to cleanliness and hygiene. Every effort should be made to prevent the build-up and spread of infection by ensuring the lambing pens are provided with adequate clean bedding and are regularly cleansed and disinfected. It is particularly important to ensure that dead lambs and afterbirth are removed and disposed of by incineration without delay. Lambing pens, sufficient in size and number (*i.e. 1 pen per 8 ewes or 1 pen per 4 ewes where synchronised mating is practised*) should be easily accessible on a dry, well-drained site. Each pen should be provided with a hay rack, feed trough and water bucket. If the pens are outside, the tops should be covered.

There is a potential health risk to pregnant women from aborting ewes, ewes at risk of abortion, dead lambs and afterbirths. Pregnant women should stay away from sheep at lambing time.

(78) There may be times when even a proficient shepherd experiences difficulty in delivering a lamb single handed. In such cases, assistance should be called immediately.

(79) Any ewe with a prolapse should be treated immediately using an appropriate technique and, where necessary, veterinary advice should be sought.

(82) Stockmen should be trained in resuscitation techniques and survival aids such as feeding by stomach tube and use of a warmer box.

(83) It is vital that every newly born lamb receives colostrum from its dam, or from another source, as soon as possible and in any case within three hours of birth. Adequate supplies of colostrum should always be stored for emergencies.

(85) Where lambing takes place out of doors some form of (*natural or artificial*) shelter or windbreak should be available.

(86) The problems of mis-mothering, which occur particularly during gathering, handling, transport or dipping of ewes and lambs, should be reduced by keeping group size to a minimum. Careful marking of lambs and mothers may also be beneficial, using non-toxic colour markers.

(87) Wherever possible, young lambs should never be sold at market unless they are with their mothers. Arrangements should be made for direct transfer of orphan lambs between farms rather than through markets to minimise disease risks. It is illegal to transport and offer for sale at market lambs with an unhealed navel.

United Kingdom sheep movements, including lambs, will be subject to restrictions imposed in the wake of the 2001 foot and mouth disease outbreak.

Artificial Rearing

(88) Artificial rearing requires close attention to detail and high standards of supervision and stockmanship to be successful. *It is essential that, where possible, the lambs should be allowed to suck the ewe for at least the first 12 hours of life.*

(89) All lambs should receive an adequate amount of suitable liquid food, such as ewe milk replacer, at regular intervals each day for at least the first four weeks of life.

(90) From the second week of life, lambs should also have access to palatable and nutritious solid food (including grass) and always have access to fresh, clean water.

(91) Where automatic feeding equipment is provided lambs should be trained in its use to ensure an adequate intake of food. The equipment should be checked daily to see that it is working properly.

(92) Troughs should be kept clean and any stale food removed. Equipment and utensils used for liquid feeding should be thoroughly cleansed at regular and frequent intervals and should be effectively sterilised.

(93) A dry bed and adequate draught-free ventilation should be provided at all times. Where necessary, arrangements should be made to provide safe supplementary heating for very young lambs.

(95) Suitable accommodation should be available for sick or injured lambs. This should be separate from other livestock.

(96) Until weaning, housed lambs should be kept in small groups to facilitate inspection and limit the spread of disease.

(97) Where young lambs are being reared at pasture without their mother, care should be taken to ensure that they have adequate shelter.

Housing

Buildings and equipment

(107) Floors should be designed, constructed and maintained so as to avoid discomfort, distress or injury to the sheep. Regular maintenance is essential. Solid floors should be well drained and provided with some form of dry bedding. Newly born and young lambs should not be put on slatted floors unless suitable bedding is provided.

(110) Water bowls and troughs should be constructed and sited so as to avoid fouling and to minimise the risk of water freezing in cold weather. They should be kept thoroughly clean and should be checked at least once daily and more frequently in extreme conditions to ensure that they are in working order.

(111) Troughs should be designed and installed in a way that will ensure small lambs cannot get into them and drown.

(112) For sheep given concentrate feed, when all animals are fed together, it is important to have adequate trough space to avoid competition and aggression. In normal practice, approximately 30 cm of trough space is needed for hill ewes and approximately 45 cm for the larger lowland ewes. Excessive competition is detrimental to sheep welfare. *Overcrowding may lead to increased incidence of prolapses.*

(113) When feeding hay and silage *ad libitum*, trough space should normally be 10–12 cm per ewe, dependent upon size. Racks and troughs should be positioned and designed to avoid injury, discomfort and damage to sheep.

Safe feed-trough design is particularly important for housed lambs who, like children, love exploring and appear to have an unrivalled ability for getting themselves trapped in all sorts of awkward areas! Broken limbs, crush injuries or

worse have become more common in recent years, largely due to increased popularity of feeding big bale silage or hay that occasionally topples over inside the feeder.

Lighting

(114) The law requires that fixed or portable lighting be available so that sheep kept in buildings can be thoroughly inspected at any time.

(115) Throughout the hours of daylight the level of indoor lighting, natural or artificial, should be such that all housed sheep can be seen clearly.

Space allowances

(116) The space allowance and group size for housed sheep should be determined according to age, size and class of livestock.

Space requirements for different ages and types of stock are given in the code and will not be reproduced here.

Hazards

(127) Young lambs should be protected as far as possible from hazards such as open drains and predators.

RELEVANT UNITED KINGDOM LEGISLATION

(1) Section 1 (1) of the Agricultural (Miscellaneous Provisions) Act 1968 states that it is an offence to cause unnecessary pain or unnecessary distress to livestock on agricultural land. A breach of a code of provision (*i.e. the Welfare Codes*) can be used in evidence as tending to establish the guilt of anyone accused of causing the offence of causing unnecessary pain or distress under the Act [Section 3(4)].

(2) The Welfare of Farmed Animals (England) Regulations 2000 (S.I. 2000 No. 1870) (and equivalent legislation under review in Scotland) provides that any person who employs or engages a person to attend to animals shall ensure that the person attending to the animals is acquainted with the provisions of all relevant statutory welfare codes relating to the animals attended to; has access to a copy of those codes while he is attending to the animals and has received instruction and

guidance on these codes. Owners and keepers of animals shall take all reasonable steps to ensure the welfare of animals under their care and ensure that the animals are not caused any unnecessary pain, suffering or injury.

(3) Under the Protection of Animal Acts 1911 to 1988 (in Scotland, the Protection of Animals (Scotland) Acts 1912 to 1988), it is an offence to tail dock or castrate lambs which have reached the age of three months without the use of an anaesthetic. Furthermore the use of a rubber ring or other device to restrict the flow of blood to the tail or scrotum is only permitted without an anaesthetic if the device is applied during the first week of life. Under the Veterinary Surgeons Act 1966, as amended, only a veterinary surgeon or veterinary practitioner may castrate a ram which has reached the age of three months or dehorn or disbud a sheep, except the trimming of the insensitive tip of an ingrowing horn which, if left untreated, could cause pain or distress.

(4) The Welfare of Livestock (Prohibited Operations) Regulations 1982 (SI 1982 No. 1884 as amended by SI 1987 No. 114) prohibit tooth grinding, freeze dagging and short-tail docking unless sufficient tail is retained to cover the vulva in the case of female sheep and the anus in the case of male sheep.

Sections 20, 76 and 82 of the Welfare Codes, as well as The Welfare of Farmed Animals (England) Regulations 2000, emphasise the importance of competence acquired through proper training. Lack of training leads to needless suffering, lost profit and, in some unfortunate cases, prosecution.

All sheep farmers should note sections 112 and 113 of the Welfare Codes. All too often great care is given to ration calculation and formulation, but too little attention to feeding arrangements. The result is underfed ewes, mostly carrying twins or triplets. A ewe heavily pregnant with triplets may be carrying 20 kg (44 lb) of extra weight. She simply can't fight at the trough for her food.

All should also note the excerpts from the Welfare of Livestock (Prohibited Operations) and the Protection of Animal Acts which specifically cover tail docking and castration. This is the law, not a recommendation. To do otherwise is a criminal offence.

Causing suffering to animals is often thought of as an active offence. In the sheep world it is normally a negative offence – not

taking action when it is required. Not feeding sheep is the most commonly reported offence.

PROBLEMS IN LAMBS

Generally, welfare problems in lambs reflect a lack of prompt attention. Eye problems such as entropion are, sadly, a common example. The problem is present at birth but goes unnoticed. Only when infection and copious tears are evident one or two days later is action taken. The lamb has had to endure two days of needless suffering.

Feet are a continual source of problems for sheep. If God had blessed sheep with two legs instead of four, approximately 5% of all sheep would be off their feet, never to rise again. But sheep have four feet and struggle on despite obvious pain and discomfort. All foot problems must be treated thoroughly and promptly. Tomorrow won't do. In closed flocks it should be possible to eradicate foot rot, to the benefit both of sheep's feet and shepherd's back!

Tetanus, lamb dysentery and the other clostridial diseases should be history, and not part of contemporary sheep farming, even under organic management systems (Chapter 6). If these diseases occur, either the situation has been allowed to get out of control, vaccination has been missed, or the lambs have had insufficient or no colostrum. Again the problem is omission.

Incorrect castration is a problem related to training, or rather the lack of it. Checking for correct placement of the rubber ring is very simple, two teats above the ring and two testicles below, providing the operator has been correctly instructed. It is the sheep farmer's responsibility to ensure that this instruction is given.

Every lamb problem in Chapter 3 is a welfare problem, but prompt action will reduce pain and suffering to a minimum. Problems as diverse as fractures and faecal spoiling must cause untold misery. Both respond gratifyingly to appropriate treatment.

PROBLEMS IN EWES

Problems in ewes start before lambing, with pregnancy toxaemia. Medical treatment is far from perfect but much can be done from a nursing viewpoint. These ewes must be regularly turned, their legs massaged and joints moved.

Problems during lambing itself mostly stem from unduly prolonged attempts to deliver the lambs. Note the 'ten-minute' rule in Chapter 2. Extended, haphazard attempts may be successful eventually, but the chance of ewe and lambs being alive in two days time is low.

Mastitis and metritis are the two major infectious problems post lambing. Keen observation and early detection are vital if treatment is to be successful. Affected ewes are clearly unwell and must be rescued from their plight at the earliest opportunity. Don't forget that one injection is rarely enough, even using long-acting antibiotic preparations. Ewes must be watched carefully after treatment, and a repeat injection or veterinary examination may be required two to three days later if the situation hasn't improved significantly.

HUMANE DESTRUCTION

It will sometimes be evident that a problem in a lamb or ewe is hopeless, and that death will be the eventual outcome. In other cases, veterinary treatment may be theoretically possible, but totally uneconomic. In either of these circumstances the animal must be quickly and humanely destroyed. To abandon the animal, mumbling 'I've done all I can', is totally unacceptable.

In an ideal world, personnel specifically trained to do the job, such as veterinary surgeons or slaughter men, would destroy all casualty animals. Unfortunately, economic and practical constraints often mean that this is not possible and so the responsibility for performing this unpleasant task falls to the farmer.

Lethal injection

In the case of lambs, an overdose of anaesthetic (barbiturate) administered by your vet is the best method. Talk to your vet to see if a mutually acceptable arrangement can be made, but be aware that the vet will have to charge for this service. Lambs destroyed by this method must be safely stored until the carcase can be incinerated or sent to a knackery for rendering (*see* p. 228). Barbiturates make the carcase lethal to any human or animal, e.g. your sheep dog, that consumes it.

Blunt trauma followed by bleeding out

If anaesthetic drugs are not an option, very young lambs (less than 10 kg in weight) can be held up by the back legs and despatched

with a swift, sharp blow to the back of the head using a blunt object such as a heavy piece of wood or short section of pipe. As an alternative, you can deliver the blow by holding the lamb by the back legs and swinging it hard against a wall or other hard surface. If you are in any doubt about whether the blow has been effective repeat it immediately, only much harder. This technique requires a swift and sure touch but, if done properly, it renders the animal unconscious instantly. Death of the unconscious animal should then be ensured by cutting the throat from ear to ear. The cut should be made with a long sharp knife and should penetrate all the way to the neck bones (*vertebrae*) so that the blood vessels supplying the brain are severed. Such methods are obviously not for the faint hearted and should only be undertaken by experienced and competent people.

Firearms

For larger lambs and adult animals, firearms are indicated, usually a shotgun (e.g. 28 bore or .410) capable of delivering the required weight of shot or a humane killer or rifle (e.g. .22) which delivers a free bullet.

Used correctly, a shotgun is much safer than a free-bullet weapon, as shot disperses inside the skull, reducing the risk of injury to bystanders. In young or polled animals the shotgun should be aimed at a point on the midline of the brow as shown in Figure 8.1. The direction of shot should be down the spine into the body. For older animals and ewes with horns an alternative aiming position at the back of the head is required (Fig. 8.2) as shot may not penetrate the thicker skull bones at the front. In

Figure 8.1 Aiming position for a shotgun in young or polled animals or a free-bullet weapon in adult animals.

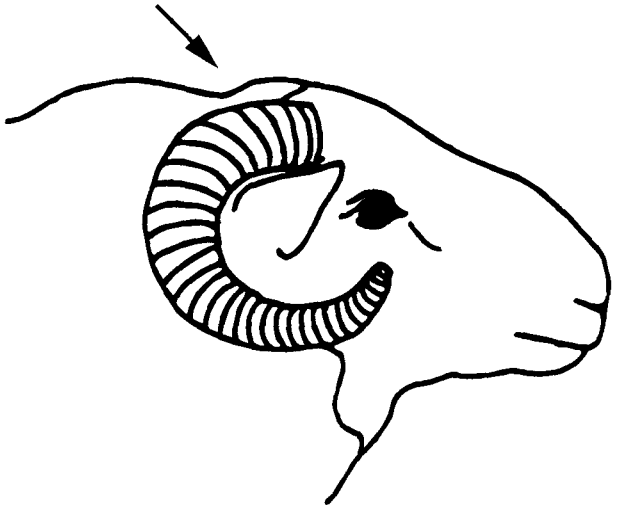


Figure 8.2 Aiming position for using a shotgun or captive bolt in older or horned animals (Humane Slaughter Association).

both instances the gun should be held approximately 8–10 cm from the head. Remember that, at this close range, shotgun pellets will cause severe mutilation which may be distressing to anyone observing the procedure.

Free-bullet weapons are extremely dangerous and must be used *only by very experienced operators.* Operators must be aware of the risks of ricochet and must always ensure that any observers stand directly behind them when the operator is firing. *These are* ***not*** *suitable weapons for killing young lambs because of the high risk of the bullet passing through the carcase.* Used in older lambs or adult animals, free bullets should be aimed as shown in Figure 8.1 and held approximately 1–3 cm from the head. Align the animal and aim carefully to ensure that the bullet passes down through the neck. Shooting in the back of the head (Fig. 8.2) is not recommended as the bullet will exit through the base of the skull.

On no account whatsoever must anyone hold an animal whilst it is being shot using ***any*** *weapon.* Use straw bales if additional restraint or positioning is needed and never shoot an animal in a confined space or over a concrete floor. Be patient when aiming and always have another cartridge immediately to hand should it be needed.

Needless to say these techniques require training and skill and are recommended only for those who are experienced at handling firearms and hold relevant firearms certificates.

Captive bolt followed by bleeding out

A captive-bolt pistol (Fig. 8.4), as used in most abattoirs, is probably the safest weapon for stunning livestock and, currently, you don't need to hold a Firearms Certificate to own one in the United Kingdom (see below). Captive bolts work by using a blank cartridge to fire a fixed rod, the bolt, through the skull and into the brain. Sheep may be stunned with a captive-bolt pistol loaded with the appropriate-sized cartridge (e.g. 1 grain for newborn lambs, 1.25 grain for older lambs and 2.5 grain for adult sheep). For young and polled animals, the pistol is placed on top of the head at a point just behind the brow aiming directly downwards (Fig. 8.3). For older animals with horns, the position is slightly further back, as for a shotgun (Fig. 8.2), aiming towards the base of the tongue. In both instances, the weapon is held gently against the head before firing. Remember, the bolt may exit through the base of the skull so keep this area clear and never hold the animal otherwise you may lose a finger or worse!

Unlike shot or a free bullet, the bolt only stuns the animal. It *must* then be killed by bleeding out or pithing. *Under no circumstances must stunned animals be left without being bled or pithed as they may regain consciousness.*

Bleeding out is done by cutting the animal's throat from ear to ear ensuring that all the neck vessels are severed. To speed the process up, a knife may also be inserted into the chest to sever the major vessels as they leave the heart.

Pithing involves inserting a rod into the hole made by the bolt and moving it around rapidly inside the skull to destroy the rest of

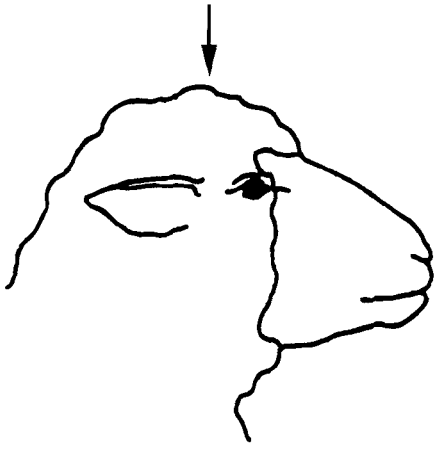


Figure 8.3 Aiming position for using a captive bolt in young or polled animals (Humane Slaughter Association).

Figure 8.4 'Cash' captive bolt pistol with cartridges used to propel the bolt.

the brain and top of the spinal cord. Flexible metal or plastic pithing rods are commercially available and are usually used for bigger animals such as cattle, but for sheep a short solid rod such as a 20 cm long Phillips-head screwdriver will do the job equally well. During and after pithing, animals may kick violently due to involuntary nerve reflexes known as 'spinal shock'. In lambs, spinal shock can last for several minutes and may be distressing to watch, however, the reaction is an involuntary response to the destruction of brain tissue and does not mean that the animal is alive.

After bleeding, leave the animal for approximately five minutes or, after pithing, until spinal shock subsides, and check for any signs of life such as breathing or blinking when you touch the front of the eye. To be fully effective, captive bolt pistols must always be properly maintained by regular cleaning; any build-up of soot or dirt can cause the bolt to jam.

Since February 1998, captive-bolt equipment is no longer subject to United Kingdom firearms legislation and is therefore easier to obtain. However, when using captive-bolt equipment for the routine culling of livestock in the United Kingdom, 'in the course of furtherance of a business', it is necessary for the operator to hold a current slaughter licence [The Welfare of Animals (Slaughter or Killing) Regulations 1995]. Further details on how to obtain a

slaughter licence can be obtained from the Meat Hygiene Service (MHS), Tel. 01904 455501, http://www.foodstandards.gov.uk/enforcement/mhservice/.

Further information on humane killing of livestock, including details of training courses, legislative requirements and excellent guidance notes and videos, can be obtained from the Humane Slaughter Association:

Humane Slaughter Association
The Old School
Brewhouse Hill
Wheathampstead
Herts.
AL4 8AN
Tel. 01582 831919
http://www.hsa.org.uk/

Carcase disposal

All stock, including lambs, that die or are killed on farm in the United Kingdom must be properly disposed of in accordance with the law (The Animal By-Products Order 2003, and the Specified Risk Material Order Regulations 2000 and subsequent amendments). Current options include collection or delivery to a knackery, licensed incinerator or hunt kennels or disposal on-farm.

Disposal by delivery or collection is probably the safest option from a pollution or disease-control point of view, but obviously costs money. Recent implementation of strict environmental protection measures mean that on-farm disposal is now largely restricted to incineration using equipment that complies with Local Authority, Environmental Protection Agency and DEFRA requirements. Disposal by on-farm burial or open burning is now prohibited, except in specially defined remote areas or during notifiable-disease outbreaks, e.g. foot and mouth disease. Seek advice from your Local Authority, Environmental Health Agency or Divisional Veterinary Office on how these new rules affect you.

SHEPHERD WELFARE

It is in the interest of the sheep, the sheep farmer and the shepherd that employers give shepherd welfare a high priority. A tired shepherd makes mistakes, and misses the vital early signs of disease. Unfortunately this is becoming all too common under today's harsh

economic circumstances which have led to ever-reducing labour inputs on most farms. Problems caused by insufficient labour are detrimental to stock, and also to the farmer's pocket. The employment of extra labour at lambing is always worthwhile considering. But if relatively inexperienced staff are employed (e.g. students), they must have adequate supervision. They do not have 'the eye'.

Glossary

Abomasum The functional stomach in the newborn lamb. The fourth stomach in the adult sheep.
Abortion The premature birth of weak or dead lambs (normally associated with disease).
Abscess A localised collection of pus in any part of the body, e.g. liver abscess.
Antibiotic A substance which either kills or arrests the multiplication of bacteria.
Antibodies Substances produced within the body which counteract infection.
Antiserum A solution for injection which contains a high concentration of antibodies against a particular infection.
Ataxia Muscular incoordination. Inability to co-ordinate voluntary movement.
Atresia Absence of a normal opening in the body, e.g. the anus.
Bacteria Free-living micro-organisms, some of which can cause disease.
Bloat An excessive amount of gas in part of the digestive tract.
Bolus A large pill.
Caesarean section A surgical operation performed under either general or local anaesthesia by which the lamb is delivered through the abdominal wall.
Carbohydrate A sugar or starch, e.g. glucose.
Caruncles Button-like structures on the inner wall of the uterus through which oxygen and nutrients are passed to the foetus via the placenta.

Cerebrocortical necrosis (CCN) A nervous disease of ruminants caused by a deficiency of vitamin B_1 (thiamine).
Colostrum The first milk produced by the ewe, very rich in antibodies.
Commensal bacteria Bacteria which normally does the host no harm.
Congenital abnormality A defect present at birth.
Cotyledons The parts of the placenta which make contact with the uterine caruncles and serve to transfer nutrients and oxygen to the foetus.
Cull Removal of a ewe that is unfit for future breeding from a flock.
Dag Clip excess wool from the area around the vulva and anus.
Egg The unfertilised female germ cell which develops in the ovary.
Elastrator Device used for the application of rubber rings used for either castration or docking.
Embryo The early developmental stages of the fertilised egg.
Enzootic An animal disease which occurs commonly in a particular geographical area.
Ewe lamb A female sheep aged one year; a hogg.
Fat A tissue found throughout the body that is an important source of energy.
Foetal stillbirth Death of a lamb before the beginning of the birth process.
Foetus The developing lamb in the uterus. Description normally used from about five weeks after conception.
Gimmer A female sheep aged two years.
Hernia The protrusion of an organ, often intestines, through the body wall, e.g. umbilical hernia.
Hogg A female sheep aged one year, a ewe lamb.
Hypoxia A shortage of oxygen.
Immunity The acquisition of resistance to infectious disease by either vaccination or previous infection.
Immunisation The acquisition of immunity by means of vaccination.
Larva An immature roundworm. Plural: larvae.
Litter size The number of lambs carried by a ewe through one pregnancy.
Meconium The faeces which collect in the foetal bowel before birth; the foetal dung.
Microflora The small organisms which populate the reticulo-rumen – bacteria and protozoa.
Necrosis The death of part or parts of an organ.
Nephrosis A non-inflammatory degeneration of the kidney.
Notifiable disease A disease which, if suspected, must be reported to the authorities. Failure to do so is a criminal offence.
Oesophagus The flexible tube connecting the mouth to the stomach; the gullet.

Oocyst The fertilised infective egg of a protozoan parasite, e.g. *Coccidia, Toxoplasma.*
Osteodystrophy Defective bone formation.
Ovum An egg.
Ovary The female reproductive organ which produces eggs and also female sex hormones.
Oviduct The tube which transports the egg from the ovary to the uterus. Fertilisation takes place in this tube.
Ovulation The shedding of the egg or eggs from the ovary.
Parturient stillbirth Death of a lamb during the birth process.
Pessary A large tablet for local use in the vagina or uterus.
Placenta The foetal membranes and cotyledons; the afterbirth. The placenta carries oxygen and nutrients from the uterine wall to the foetus via the umbilical cord.
Pneumonia Infection of the lungs.
Prematurity The birth of a lamb before the normal length of pregnancy is complete (less than 140 days after conception).
Prolapse The displacement of an organ through a natural orifice, e.g. prolapse of the uterus through the vagina.
Proteins Nutrients essential to growth and normal development.
Protozoa Single-celled microscopic organisms, e.g. *Coccidia, Toxoplasma.*
Reticulo-rumen The first and second ruminant stomachs, rudimentary in the newborn lamb.
Roundworm A parasitic worm of the class Nematoda; includes intestinal worms and lungworms.
Rumen The second and largest ruminant stomach, but rudimentary in newborn lambs.
Septicaemia A disease of the whole body caused by the presence of bacteria and their poisonous products in the blood.
Stillbirth The birth of a dead lamb.
Strike Attack on animal's skin by maggots derived from fly eggs, e.g. blowfly strike (myiasis).
Toxaemia A condition in which the blood contains harmful products.
Trachea The windpipe.
Vaccine A preparation which induces immunity to a disease in an animal without causing the disease, often given by injection.
Virus A micro-organism, much smaller than a bacterium, which causes disease. A virus is able to multiply only within living tissue.
Vitamin An organic nutrient essential in very small quantities for health and development.
Zoonotic disease Disease that affects both animals and humans.

Index

Lambing Equipment Checklist

EQUIPMENT

Lamb/baby feeding bottles and teats
Cardboard boxes (for housing weak lambs)
Electric kettle
Ewe trusses
Hypodermic needles (19 gauge × 1 inch)
Infrared lamps
Lamb feeder (artificial rearing)
Lamb warmer
Lambing snare
Lambing ropes
Needle and tape for treating prolapses
Plastic dustbin (fostering)
Rectal thermometer
Syringes (2, 5 and 50 ml)
Stomach tubes
Thermometer for lamb warmer

SUNDRIES

Arm-length disposable gloves
Disinfectant: non-irritant, e.g. Savlon®
Disinfectant: hypochlorite/detergent

Disinfectant: general purpose
Frozen colostrum (ewe/cow)
Lamb milk replacer
Lambing lubricant
Polythene bags
Soap
Stock marker (spray or crayon)

DRUGS (AFTER CONSULTATION WITH YOUR VETERINARY SURGEON)

Antibiotic for use in the eye
Antibiotic for injection
Antibiotic for oral use
Antiseptic cream, e.g. Savlon®
Antiseptic foot-rot spray
Calcium solution for injection
Glucose (dextrose) solution for injection
Glucose (powdered)
Glucose/electrolyte preparation (for lambs with enteritis or watery mouth)
Liquid paraffin
Magnesium solution for injection
Tetanus antiserum
Tincture of iodine (25 g iodine, 25 g potassium iodide and 25 ml freshly boiled and cooled distilled water, made up to 1000 ml with 90% alcohol)

Useful Internet Addresses

DEFRA. United Kingdom Government Department for the Environment, Food and Rural Affairs:
http://www.defra.gov.uk

DEFRA information page on organic farming including links to latest UKROFs standards and various organic certification bodies:
http://www.defra.gov.uk/farm/organic/

Humane Slaughter Association:
http://www.hsa.org.uk

Lantra SSC. United Kingdom sector skills council, licensed by government to promote training and business development for environmental and land-based enterprises:
http://www.lantra.co.uk

Meat Hygiene Service:
http://www.foodstandards.gov.uk/enforcement/mhservice/

Moredun Foundation. Charity dedicated to promoting sheep welfare and disease research:
http://foundation.mri.sari.ac.uk

National Sheep Association:
http://www.nationalsheep.org.uk/

National Office for Animal Health (NOAH). United Kingdom animal medicines industry association:
http://www.noah.co.uk/

Sheep Veterinary Society. Specialist division of the British Veterinary Association:
http://svs.mri.sari.ac.uk

The Veterinary Medicines Directorate (VMD). Regulatory body for veterinary medicines in the United Kingdom:
http://www.vmd.gov.uk