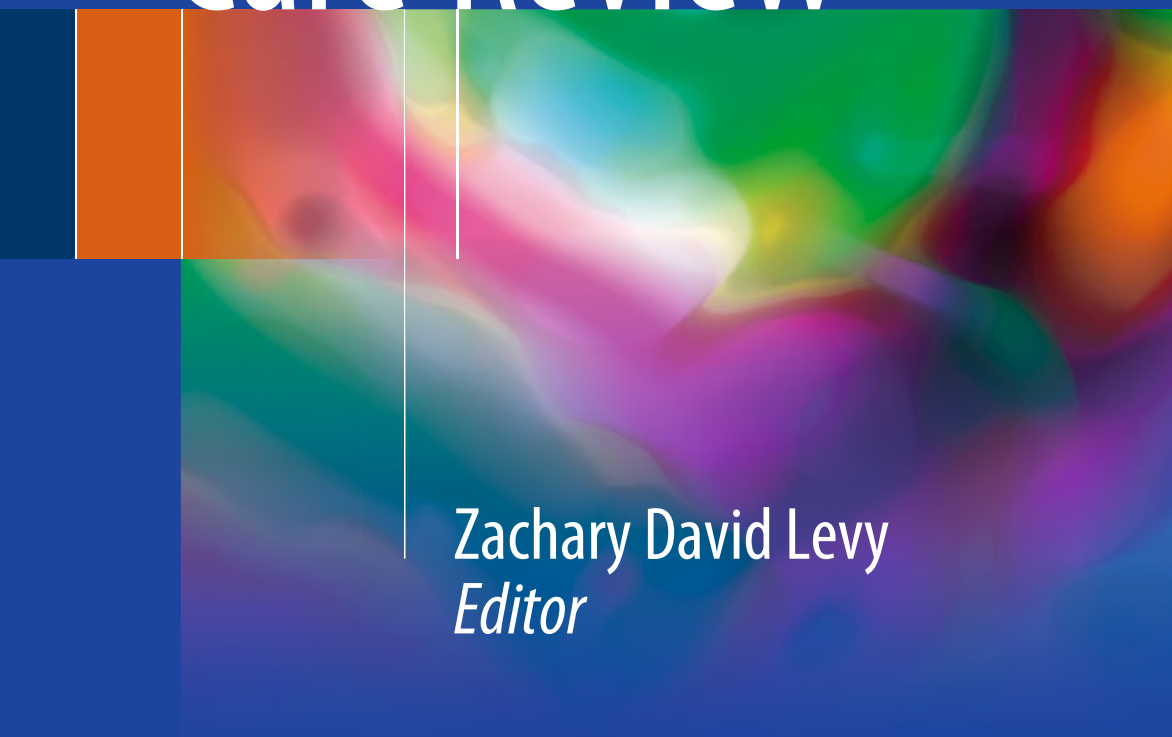
Absolute Neurocritical Care Review



Zachary David Levy
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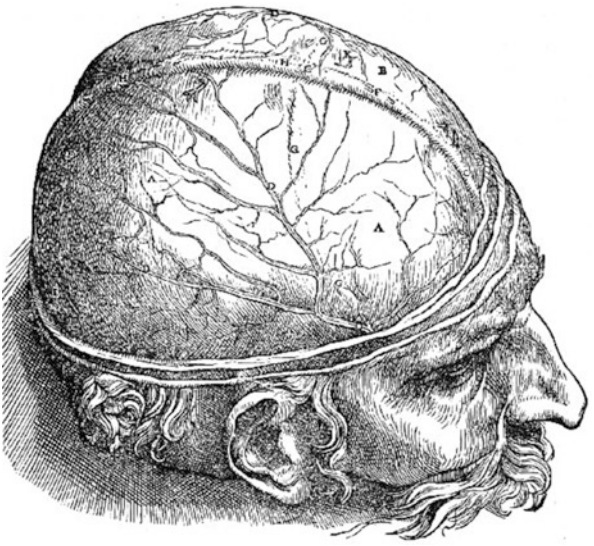

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Absolute Neurocritical Care Review

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For Anna, moya oatpooska, ochen ochen i navsegda

and

For Elijah, my greatest gift, and my gift to the world

*

Dedicated to the memory of the great men
who came before me—Alain Levy, David Levy,
Jack Schwartzman, Isidore Schwartzman, and
Jack Weinberger

Preface

This book is intended to closely approximate the tone, scope and format of the United Council for Neurologic Subspecialties (UCNS) Neurocritical Care certifying examination. Each practice test is exactly half the length of the actual certifying exam. Readers may utilize this book any way that they see fit; however, if the desire is to recreate the real-life testing experience as closely as possible, each test should be taken in one sitting, with limited interruption (bathroom breaks only), over a maximum of 2 h.

The content is split evenly between neurological disease states and general critical care, and the individual subjects are drawn directly from the core curriculum as defined by the UCNS. Broadly, those subjects are as follows: cerebrovascular disease, neurotrauma, seizures, neuromuscular diseases, demyelinating diseases, neuroendocrine derangements, neuro-oncology, encephalopathies, coma, brain death (including organ donation and end-of-life care), perioperative neurosurgical care, the physiology and pathology of cardiovascular/renal/pulmonary/gastrointestinal illnesses, infectious disease, hematologic disorders, transplant medicine, general trauma and burns, invasive monitoring, clinical scoring systems, administrative issues (including resource allocation and performance improvement), and the ethical and legal aspects of critical care medicine.

Please note that the UCNS did not officially advise on the development of this book. Candidates are encouraged to visit www.ucns.org for more information.

Hempstead, NY, USA — Zachary David Levy, MD, FACEP

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Exam 1 Questions

Wherever the art of medicine is loved, there is also a love of humanity.

Hippocrates of Kos
(ca 460 BC–ca 370 BC)

1. Which of the following is the most common form of incomplete spinal cord injury?

   A. Central cord syndrome
   B. Cauda equina syndrome
   C. Anterior spinal cord syndrome
   D. Posterior spinal cord syndrome
   E. Brown-Sequard lesion

2. A 64-year-old male with a history of chronic alcohol abuse and congestive heart failure is currently recovering from excision of a large right shoulder lesion suspicious for melanoma. Postoperatively, he is experiencing bleeding and oozing from his surgical site that has persisted despite suture repair and direct pressure for an extended period of time. His labs are drawn, and are as follows: platelets 141 × 10^3/mL, INR 1.2, fibrinogen 90 mg/dL. Which of the following blood products should be administered next?

   A. Fresh frozen plasma
   B. Cryoprecipitate
   C. Prothrombin complex concentrate
   D. Recombinant activated factor VII
   E. Aminocaproic acid

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3. A 75-year-old, 90 kg male with a history of peripheral vascular disease, coronary artery disease, and epilepsy following a recent cerebral infarction presents to the emergency department after having three witnessed seizures at home. He was intubated at the scene by the paramedics, and received 8 mg of intravenous lorazepam and 1 g of phenytoin. While you are evaluating him, he has another generalized tonic-clonic seizure, and the nurse asks if you would like to initiate a continuous propofol infusion. His blood pressure is 94/42 mmHg, and he is having numerous premature ventricular contractions (PVCs) on the electrocardiographic monitor. He has no history of platelet or liver dysfunction. Which of the following should be performed next?

   A. Complete the phenytoin load to attain 20 mg/kg, then start propofol infusion
   B. Complete the phenytoin load to attain 20 mg/kg only
   C. Administer valproate, 30 mg/kg over 10 min, as well as midazolam 0.2 mg/kg
   D. Start immediate midazolam infusion at 2 mg/kg/h
   E. Give a 1 L normal saline bolus, and start a norepinephrine infusion to normalize blood pressure

4. A 38-year-old male is brought to the emergency department after a motor vehicle accident. He is found to have significant ecchymoses on his chest and face, with multiple apparent rib fractures. He is in mild respiratory distress, with an oxygen saturation of 89% on room air, and hypotensive, with a systolic blood pressure of 88 mmHg. He has absent breath sounds on the right side. There is currently a delay in obtain a bedside portable chest x-ray. Which of the following should be performed next?

   A. 28-French chest tube placement
   B. 16-French chest tube placement
   C. Obtain computed tomography (CT) of the chest
   D. Administer 30 cc/kg crystalloid
   E. Obtain urgent cardiothoracic surgery consult

5. Stress ulcer prophylaxis is often undertaken to prevent clinically important upper gastrointestinal (GI) bleeding. Which of the following factors puts patients at highest risk for such bleeding episodes?

   A. Respiratory failure
   B. History of alcohol abuse
   C. NPO status
   D. Diverticulitis
   E. All of the above

6. In an intact heart, the Frank-Starling mechanism describes contractility increases in responses to:

   A. Decreased preload
   B. Increased afterload
   C. Decreased left ventricular end-diastolic pressure

D. Increased left ventricular end-diastolic volume
E. Increased pulmonary vascular resistance

7. A 68-year-old female with a history of hyperlipidemia, hypothyroidism, and gastric cancer on total parenteral nutrition is currently in the ICU following a small traumatic subdural hemorrhage. On hospital day 5, the patient begins to spike fevers that persist despite broad spectrum antibiotic coverage with vancomycin and piperacillin-tazobactam. She is otherwise hemodynamically stable. The lab calls you to notify you that multiple sets of blood cultures display budding yeast forms and pseudohyphae. Which of the following should be administered next?

   A. Fluconazole
   B. Posaconazole
   C. Anidulafungin
   D. Caspofungin
   E. Amphotericin B

8. A 56-year-old male with a past medical history of hypertension, hyperlipidemia, and morbid obesity is currently intubated in the ICU following a left middle cerebral artery infarct. The respiratory therapist alerts you the fact that the patient has become markedly dysynchronous with the ventilator, including breath holding episodes, breath stacking, and resisting ventilator-delivered breaths. A variety of pressure- and volume-regulated ventilator modes have been attempted without improvement, as well as boluses of both fentanyl and midazolam. The most recent arterial blood gas is as follows: pH 7.19, $PaCO_2$ 78 mmHg, PaO_2 61 mmHg. The patient is now hypotensive to 91/66 mmHg with sinus tachycardia at 117 beats/min. A recent bedside chest x-ray shows no consolidation or pneumothorax. Which of the following should be performed next?

   A. Prone the patient
   B. Administer nitric oxide at 10 parts per million
   C. Administer 10 mg of cisatracurium
   D. Administer a mixture of 60% helium/40% oxygen
   E. Administer a continuous infusion of phenobarbital

9. Compared to lactulose for the treatment of hepatic encephalopathy, polyethylene glycol (PEG) has been shown to:

   A. Decrease in-hospital mortality
   B. More rapidly improve symptoms
   C. Increase the rate of gastrointestinal complications
   D. Increase the incidence of major electrolyte abnormalities
   E. None of the above

10. Which of the following neurologic insults is the least likely to cause central (non-infectious) fever in the ICU?

   A. Intracranial neoplasm
   B. Intraventricular hemorrhage

C. Normal pressure hydrocephalus
D. Subarachnoid hemorrhage
E. Traumatic brain injury

11. A 57-year-old male with a history of epilepsy and medication noncompliance is admitted to a small community hospital after a brief tonic-clonic seizure. A non-contrast head CT on admission is normal. On the second hospital day, the patient begins to complain of severe substernal chest pressure, and an urgent bedside EKG shows evidence of an acute inferior myocardial infarction (MI). The nearest percutaneous coronary intervention (PCI) capable center is approximately 150 min away by the fastest transport method available. Which of the following is the most appropriate next step in this patient's care?

A. Arrange for transport to the closest PCI center with anticipated balloon time within 30 min of arrival
B. Prepare to administer fibrinolytic therapy
C. Consult cardiothoracic surgery for possible coronary artery bypass grafting (CABG)
D. Place the patient on a continuous nitroglycerine infusion and administer aspirin, clopidogrel, and heparin
E. Await serum cardiac biomarkers and repeat EKG in 1 h

12. A 62-year-old male with unknown past medical history who recently immigrated from El Salvador is currently in the stroke unit after suffering from an acute left middle cerebral artery infarction. The patient is aphasic; his wife states that he been in his usual state of health lately, and denies any recent weakness, dizziness, chest pain, cough, shortness of breath, or fevers. On reviewing this patient's belongings, the nurse discovers a bottle of isoniazid, as well as paperwork demonstrating a positive quantiferon gold test performed at a local clinic approximately 3 weeks ago. He does not appear to be on any other medications. A bedside portable chest x-ray is performed, which preliminarily appears normal. Which of the following should be performed next?

A. Move the patient to a negative pressure isolation room, continue isoniazid
B. Isolate the patient, continue isoniazid, add rifampin
C. Isolate the patient, continue isoniazid, add rifampin and pyrazinamide
D. Isolate the patient, continue isoniazid, add rifampin, pyrazinamide and ethambutol
E. None of the above

13. A 56-year-old, 70 kg female patient in oliguric renal failure would be expected to have a daily urine output of:

A. No more than 50 mL
B. No more than 400 mL
C. No more than 800 mL
D. Less than 70 mL/h
E. Less than 35 mL/h

14. A 37-year-old female with a history of epilepsy is admitted to the ICU with status epilepticus. She required several doses of lorazepam in the emergency department in addition to fosphenytoin, intubation, and a continuous propofol infusion. There was concern for aspiration in the prehospital setting. Approximately 3 days after being admitted to the hospital, her respiratory status has worsened; she is increasingly hypoxic, and her chest x-ray demonstrates diffuse bilateral interstitial infiltrates. The patient is afebrile with minimal secretions. Her most recent arterial blood gas is as follows: pH 7.21, PaO_2 107 mmHg, PCO_2 55 mmHg, 100% FiO_2, and a positive end-expiratory pressure (PEEP) of 8 cm H_2O. According to the Berlin criteria, how would you categorize this patient's acute respiratory distress syndrome (ARDS)?

    A. Acute lung injury (ALI)
    B. Mild ARDS
    C. Moderate ARDS
    D. Severe ARDS
    E. None of the above

15. An 80-year-old male presents to the emergency department with multiple episodes of bright red blood per rectum. He is on aspirin and clopidogrel for a history of coronary artery disease and a previous transient ischemic attack. He underwent aortic graft surgery for repair of an abdominal aortic aneurysm 2 years ago. A complete blood count and coagulation profile are all within normal limits. His vital signs are as follows: blood pressure 102/58 mmHg, heart rate 98 beats/min, respiratory rate 18 breaths/min, oxygen saturation 98% on room air, and temperature 98.3 °F. Which of the following is the next best step in the care of this patient?

    A. Transfuse platelets, fresh frozen plasma, and recombinant factor VIIa
    B. Consult gastroenterology for emergent upper endoscopy
    C. Consult gastroenterology for emergent colonoscopy
    D. CT angiogram of the abdomen and pelvis
    E. Expectant management with fluids and blood transfusions

16. A thrombus in which of the following veins would not be considered a deep vein thrombosis (DVT)?

    A. Popliteal vein
    B. Soleal vein
    C. Femoral vein
    D. Gastrocnemius vein
    E. Greater saphenous vein

17. After partial resection of the pituitary stalk, secretion of which of the following hormones will be most affected?

    A. Oxytocin
    B. Adrenocorticotrophic hormone

C. Melanocyte-stimulating hormone
D. Thyroid-stimulating hormone
E. All will be equally affected

18. A 58-year-old female with a history of hypertension, rheumatoid arthritis, metastatic ovarian cancer, and bilateral deep venous thrombosis status post recent inferior vena cava filter placement presents to the emergency department with right flank pain. She states the pain began approximately 1 h ago when bending down to pick something off the floor, and that it is constant and severe in nature. She denies dysuria or hematuria. Her vital signs are as follows: blood pressure 108/62 mmHg, heart rate 121 beats/min, respiratory rate 20 breaths/min, oxygen saturation 99% on room air, and temperature 99.6 °F. A CT scan of the abdomen is obtained (see Image 1). Which of the following is the next best step in this patient's management?

A. Administer vancomycin and cefepime, and draw two sets of blood cultures
B. Urgent vascular surgery consult
C. Immediately place the patient on her left side
D. Rapid sequence intubation with mechanical ventilation
E. Perform bedside diagnostic peritoneal lavage

Image 1 CT scan of the abdomen

19. Which of the following antiepileptic medications undergoes both hepatic metabolism and renal elimination?

A. Phenytoin
B. Levetiracetam
C. Valproate
D. Pentobarbital
E. Lacosamide

20. A 65-year-old male is brought to the emergency department by his family with several months of progressive behavioral changes and lethargy. On exam, he appears confused, and is minimally verbal. An MRI of the brain is performed, demonstrating a large homogenously enhancing lesion with a dural tail in the right frontal lobe with significant surrounding edema. The patient undergoes a right frontal craniotomy with gross total resection of the lesion. Surgical pathology is consistent with a World Health Organization (WHO) grade I lesion. All of the following are true regarding this patient's pathology except:

    A. This is the most common primary brain tumor in adults
    B. This lesion is more common in men versus women (2:1 ratio)
    C. This lesion often expresses progesterone and estrogen receptors
    D. Risk factors for the development of this lesion include ionizing radiation exposure
    E. Greater than 90% of these lesions are supratentorial

21. A 69-year-old male with a history of hypertension, diabetes, and a recent left middle cerebral artery infarct is found to have a significant left internal carotid artery stenosis on further work-up. Which of the following represents the threshold amount of carotid stenosis to recommend this patient be evaluated for carotid endarterectomy?

    A. >10%
    B. >40%
    C. >70%
    D. >90%
    E. >99%

22. "Massive" pulmonary embolism (PE) is best described as PE in the presence of:

    A. Any single mean arterial pressure (MAP) less than 65 mmHg
    B. Heart rate greater than 100 beats/min regardless of blood pressure
    C. Systolic pressure less than 90 mmHg for greater than 15 min
    D. Abnormal bowing of the interventricular septum on bedside echocardiography
    E. Any single elevated serum troponin

23. A 51-year-old male has been admitted to the ICU for a traumatic brain injury. The patient received a kidney transplant 3 years ago, and is on immunosuppression with mycophenolate mofetil and cyclosporine. On hospital day 3, the patient suffers a generalized tonic-clonic seizure which abates after administration of lorazepam, and you are now considering future seizure prophylaxis. Which of the following medications is not expected to interfere with this patient's serum cyclosporine levels?

    A. Fosphenytoin
    B. Carbamazepine
    C. Phenobarbital
    D. Levetiracetam
    E. All of the above

24. According to the three column theory of spinal cord stability, the spinal cord can be divided into three segments that each contribute to cord stability in a different manner. All of the following are true regarding the three column theory except:

    A. The anterior column consists of the anterior vertebral body, anterior annulus fibrosus, and anterior longitudinal ligament
    B. The middle column includes the posterior longitudinal ligament, posterior annulus fibrosus, and posterior wall of the vertebral body
    C. The posterior column comprises the pedicles, the facet joints, and the supraspinous ligaments
    D. All three columns must be disrupted for the spine to be considered unstable
    E. Spinal trauma is classified as minor or major depending on the ability of the injury to cause instability

25. A 22-year-old female was admitted to the psychiatry service after presenting with 10 days of bizarre and disinhibited behavior, as well as auditory and visual hallucinations. While on the psychiatry service, she had a prolonged generalized tonic-clonic seizure requiring intubation and transfer to the ICU. Lumbar puncture was performed, and N-Methyl-D-aspartate (NMDA) receptor antibodies were positive in the spinal fluid. All of the following are accepted first-line treatments for this patient except:

    A. Intravenous immunoglobulin (IVIG)
    B. Tumor resection, if applicable
    C. Corticosteroids
    D. Plasma exchange
    E. Rituximab

26. A 54-year-old male is currently recovering from transphenoidal resection of a pituitary mass. A serum cortisol level is drawn the next morning. A value below which cutoff is associated with a significant risk of long-term hypothalamic-pituitary-adrenal (HPA) dysfunction?

    A. 1 μg/dL
    B. 15 μg/dL
    C. 75 μg/dL
    D. 300 μg/dL
    E. 600 μg/dL

27. A 71-year-old female in the ICU with an acute-on-chronic subdural hemorrhage develops acute kidney injury, and requires hemodialysis. Upon consultation with the nephrology service, the decision is made to initiate continuous renal replacement therapy (CRRT). Which of the following is an advantage of CRRT compared to intermittent hemodialysis?

    A. CRRT has a lower overall cost of disposables
    B. CRRT is easier to implement without the use of anticoagulation
    C. Rapid adjustments can be made to accommodate evolving patient needs

D. CRRT is more widely available
E. Nursing staff may be more familiar with the CRRT modality

28. An irregular group of breaths followed by apneic periods of variable duration in a patient with a lesion in the pneumotaxic center of the upper medulla would be classified as which of the following?

A. Cheyne-Stokes respiration
B. Central neurogenic hyperventilation
C. Cluster breathing
D. Kussmaul respirations
E. Apneustic breathing

29. Which of the following echocardiography findings is most consistent with Takotsubo cardiomyopathy?

A. Apical ballooning
B. Bowing of the ventricular septum into the left ventricle
C. Hypoechoic area surrounding the pericardium
D. Enlargement of the left ventricular outflow tract
E. Hyperdynamic left ventricle

30. A 27-year-old female with no prior medical history at 37 weeks gestation presents with hypertension and a dull frontal headache, and is admitted for the management of preeclampsia. A continuous magnesium infusion is started. Which of the following additional medications would be contraindicated in the treatment of this patient's blood pressure?

A. Labetalol
B. Hydralazine
C. Hydrochlorothiazide
D. Captopril
E. Nicardipine

31. A 28-year-old 50 kg female is currently hospitalized with a myasthenic crisis. While you are evaluating her, you note her to be mildly tachypneic with some accessory muscle use. Her oxygen saturation is 97% on room air. You obtain the following respiratory parameters: vital capacity 890 mL, peak inspiratory pressure 44 cm H_2O, peak expiratory pressure 61 cm H_2O. Which of the following is the next best step in management?

A. Intubate the patient
B. Place the patient on noninvasive positive pressure ventilation
C. Place the patient on 4 L supplemental oxygen
D. Check the patient's rapid shallow breathing index
E. Check the patient's carbon dioxide level

32. A 62-year-old male with a history of cirrhosis, ascites, and prior spontaneous bacterial peritonitis is admitted to the ICU with worsening encephalopathy. Despite home therapy with rifaximin and lactulose, his mental status has been

declining steadily, and he requires intubation for airway protection. A non-contrast head CT demonstrates mild diffuse cerebral edema. All of the following are reasonable strategies to reduce this patient's cerebral edema except:

A. Elevate the head of the bed 30°
B. Intravenous mannitol
C. Intravenous hypertonic saline
D. Intravenous dexamethasone
E. Induced hypothermia

33. Which of the following would lead you to incorrectly conclude that a patient with no prior medical history, based on their hemoglobin A1c, was actually a diabetic?

A. Surrepitious alcohol abuse
B. Severely elevated triglycerides
C. Recent blood transfusion
D. Erythropoietin administration
E. Hemolytic anemia

34. A 77-year-old male from the nursing home has been admitted to the ICU for lethargy. The patient weighted 58 kg on admission, and the serum sodium was noted to be 177 mEq/L. About how much would you expect 1 L of 0.225% sodium chloride to reduce the serum sodium**?**

A. 1.6 mEq/L
B. 4.6 mEq/L
C. 8.6 mEq/L
D. 16.6 mEq/L
E. 32.6 mEq/L

35. A 52-year-female is admitted to the ICU after an anterior cervical discectomy and fusion surgery. On day 5 of her hospital stay, the patient was found to have a proximal deep venous thrombosis (DVT) in her left leg. Treatment was initiated with a continuous heparin infusion with target aPTT 1.5–2 times baseline. Her platelet count this morning was $130 \times 10^3/\mu L$; it was $280 \times 10^3/\mu L$ on admission. Her 4T score was 6, and a heparin PF4 immunoassay is pending. What is the next best step in this patient's management?

A. Discontinue unfractionated heparin infusion, initiate argatroban infusion
B. Discontinue unfractionated heparin infusion, initiate warfarin therapy
C. Discontinue unfractionated heparin infusion, initiate low-molecular weight heparin therapy
D. Continue unfractionated heparin infusion while awaiting PF4 immunoassay result
E. Continue unfractionated heparin infusion, initiate argatroban infusion

36. Which of the following vasculitidies may present with central nervous system involvement?

    A. Wegner's granulomatosis
    B. Polyarteritis nodosa
    C. Churg-Strauss syndrome
    D. Behcet's syndrome
    E. All of the above

37. Which of the following describes correctly the radiologic findings in a developmental venous anomaly of the brain?

    A. MRI shows medullary veins converging on a dilated transcerebral vein with a characteristic "sunburst" pattern on enhanced T1 weighted images
    B. Cerebral angiography shows a faint blush with an associated venous channel in the late arterial or early capillary phases
    C. Cerebral angiography is normal, as these lesions are "angiographically occult" with minimal blood flow
    D. MRI shows a "popcorn" pattern of variable image intensities in T1 and T2-weighted images consistent with evolving blood products
    E. CT scan without contrast shows flow voids demonstrating enlarged tangled vessels with curvilinear or speckled calcification

38. Which of the following definitions accurately describes renal "loss" based on the RIFLE (Risk, Injury, Failure, Loss, End-stage) classification scheme for acute kidney injury?

    A. Tripling of serum creatinine
    B. Serum creatinine $\geq$4 mg/dL
    C. Urine output <0.3 mL/kg/h × 24 h or anuria × 12 h
    D. Renal failure >4 weeks
    E. Urine output <0.5 mL/kg/h × 12 h

39. A 27-year-old female with a history of chronic migraines presents to the emergency department with new onset weakness in her right leg over the past several days. A non-contrast CT of the head is performed, demonstrating evidence of a large left frontal lesion. Which of the following will conclusively differentiate Marburg variant multiple sclerosis (MVMS) from an acute neoplastic process?

    A. Contrast-enhanced CT scan
    B. Contrast-enhanced MRI
    C. Positron emission tomography
    D. Craniotomy and biopsy
    E. Diffusion tensor imaging

40. A 52-year-old male is currently intubated in the ICU after suffering an aneurysm-related subarachnoid hemorrhage (SAH). He is intubated and on mechanical ventilation; his height is 72 in. and he weighs 320 kg. He is placed on assist-control, rate of 16, tidal volume 650 cc, positive end-expiratory pressure (PEEP) of 5, and FiO_2 40%. Post-intubation chest x-ray shows an opacity in the right lower lobe. On the second ICU day, his FiO_2 requirements have increased to 80% to maintain an O_2 saturation of >90%, and his CXR now shows bilateral alveolar opacities. His plateau pressure is 30. He is on piperacillin-tazobactam for antibiotic coverage, with a negative endotracheal aspirate gram stain. Which of the following should be performed next?

    A. Prone the patient
    B. Decrease the tidal volume to 500 and increase PEEP to 8
    C. Add vancomycin and azithromycin
    D. Start inhaled nitric oxide therapy
    E. Place the patient on extracorporeal membrane oxygenation (ECMO)

41. Which of the following is the definition of Mallory-Weiss syndrome?

    A. Linear mucosal lacerations of the esophagus at the gastroesophageal junction
    B. Full thickness tears of the esophagus due to retching at the gastroesophageal junction
    C. Esophageal variceal bleeding at the gastroesophageal junction
    D. Esophageal metaplasia at the gastroesophageal junction due to chronic exposure to acid reflux
    E. Peptic ulcer disease resulting in gastrointestinal bleeding

42. A 19-year-old male with no significant past medical history presents to the emergency department with fever, confusion, and lethargy. The parents report that he had been complaining of headaches and nausea for several days before decompensating prior to arriving at the hospital. They also report that he has spent the last 6 weeks at an outdoor summer camp, and had not been ill recently otherwise. A lumbar puncture is performed, and while awaiting the results, the patient is started on ceftriaxone, vancomycin and acyclovir. Several hours later, the laboratory calls you urgently to report the presence of motile amebae in the cerebrospinal fluid (CSF) sample that was sent. Which of the following should be administered next?

    A. Mebendazole
    B. Miltefosine
    C. Doripenem
    D. Fidamoxicin
    E. Rifampin

43. A 71-year-old male with a history of peripheral vascular disease and hypertension is currently hospitalized while recovering from a transient ischemic attack when he begins to complain of several hours of severe generalized abdominal

pain. Surprisingly, his abdominal exam is relatively benign considering how uncomfortable he appears. His lab work is notable for a white blood cell count of 26.6×10^9/L with 17% bands, along with a lactate of 11.6 mmol/L. Which of the following is the gold standard for the diagnosis of the most likely etiology?

A. Duplex ultrasound
B. Flexible endoscopy and tissue biopsy
C. Contrast-enhanced MRI
D. CT arteriography
E. Plain abdominal radiography

44. Which of the following is true regarding the use of nimodipine in critically ill patients?

A. It is widely used for antihypertensive purposes
B. It has been proven to be equally effective versus magnesium in the treatment of preeclampsia
C. It may be used to attempt to preserve cochlear nerve function following schwannoma surgery
D. It is used as a continuous intravenous infusion for the prevention of delayed cerebral ischemia (DCI)
E. None of the above

45. A 21-year-old man presents to the emergency department with 1 day of abdominal pain, nausea and vomiting. His past medical history was unremarkable up until a few months ago, when he started to develop transient weakness in his extremities, and has been hospitalized twice since then with generalized tonic-clonic seizures. He has one sibling, who has also experienced similar episodes. His vital signs are as follows: temperature 36.6 °C, blood pressure 136/66 mmHg, pulse rate 96 beats/min, respiratory rate 14 breaths/minute. His abdomen is distended on exam, and a CT scan of the abdomen and pelvis demonstrates distended loops of bowel without any overt mechanical obstruction. Blood work demonstrates a normal leukocyte count with a markedly elevated serum lactate. All of the following are true about the patient's condition except:

A. This patient would be unlikely to pass this condition on to his children
B. The majority of cases are caused by mutations in the MT-TL1 gene
C. Half of all cases appear to be due to spontaneous mutations, without prior family history
D. The patient's condition is uniformly progressive and fatal
E. The disease is frequently misdiagnosed, due to both rarity and heterogeneous presentations

46. A 50-year-old male with a 100 pack-year smoking history presents to the emergency department with shortness of breath. He was diagnosed with primary lung adenocarcinoma 1 week ago. Computed tomography (CT) imaging of the chest shows extrinsic compression of the trachea by a left lung mass. The

patient is able to speak in full sentences, though becomes short of breath while doing so. He is afebrile, with the following vital signs: heart rate 99 beats/min, blood pressure 140/90 mmHg, respiratory rate 20 breaths/min, and oxygen saturation of 97% on 2 L nasal cannula. On exam, there is intermittent inspiratory wheezing auscultated on the neck with otherwise clear lung fields. What is the best immediate treatment to alleviate the patient's symptoms?

A. Racemic epinephrine
B. Helium-oxygen mixture
C. Intravenous corticosteroids
D. Surgical intervention of the lung mass
E. Inhaled bronchodilators

47. A 64-year-old male with a history of congestive heart failure is currently admitted to the hospital for work-up of a suspected transient ischemic attack. He is also complaining of urinary frequency and dysuria, and his urinalysis indicates the presence of a urinary tract infection on admission. Approximately 24 h later, urine cultures indicate the presence of *Escherichia coli* with the following minimum inhibitory concentration (MIC) susceptibilities (see Table 1 below). According to the susceptibility chart alone, which of the following antibiotics is most likely to result in eradication of this patient's infection?

A. Ceftriaxone
B. Cefepime
C. Cefoxitin
D. Piperacillin/tazobactam
E. None of the above

Table 1 MIC susceptibilities

Ampicillin	R > 16
Ceftriaxone	S < 1
Cefepime	S < 4
Cefoxitin	S < 8
Piperacillin/tazobactam	S < 16

48. An excess of all of the following may result in severe metabolic alkalosis except:

A. Vomiting
B. Nasogastric suctioning
C. Diuretic use
D. Mineralocorticoid administration
E. Blood loss

49. In the setting of traumatic brain injury (TBI), pretreatment with which of the following agents has been proven prevent elevation of intracranial pressure (ICP) associated with endotracheal intubation?

    A. Lidocaine
    B. Fentanyl
    C. Succinylcholine
    D. Etomidate
    E. None of the above

50. A 61-year-old male is currently admitted to the ICU following 18 months of progressive gait dysfunction, memory loss, and intermittent episodes of urinary incontinence. A non-contrast head CT performed on admission demonstrates moderate hydrocephalus, and a lumbar drain trial is being performed. 5 cc/h of spinal fluid is being drained. 48 h after lumbar drain insertion, the patient is being evaluated by the physical therapy and neurocognitive teams, who report no significant change from their initial evaluations on admission. Which of the following should be performed next?

    A. Continue lumbar drainage at current rate for an additional 72 h, reassess
    B. Increase drainage rate to 10 cc/h, continue for an additional 48 h, reassess
    C. Discontinue lumbar drain, schedule the patient for ventriculoperitoneal (VP) shunt placement, reassess the patient 3 months post-operatively
    D. Discontinue lumbar drain, as the patient is not a candidate for a VP shunt
    E. Discontinue lumbar drain and repeat lumbar drain trial in 3 months

51. All of the following brain metastases are at a high risk for intracranial hemorrhage except:

    A. Melanoma
    B. Renal cell carcinoma
    C. Choriocarcinoma
    D. Thyroid carcinoma
    E. Breast carcinoma

52. A 61-year-old female with a history of heparin-induced thrombocytopenia (HIT), polycythemia vera, and multiple prior thrombotic events including bilateral pulmonary emboli, is currently being evaluated for 4 weeks of chronic daily headaches. She is currently on daily aspirin and rivaroxaban for maintenance therapy. Her hemoglobin is 16.1 g/dL and her hematocrit is 48%. A CT venogram of the head is performed, demonstrating an acute superior sagittal sinus thrombus. Which of the following should be administered at this time?

    A. Fondaparinux
    B. Low molecular weight heparin

C. Unfractionated heparin infusion
D. Apixaban
E. Eptifibatide

53. During endotracheal intubation, in the absence of a view of the vocal cords, optimal bougie technique involves:

A. Using the upturned end to put pressure on the valecula and lift the epiglottis
B. Inserting the bougie at the corner of the mouth and sweeping the tongue out of the way
C. Blindly inserting the bougie into the mouth advancing until resistance is felt
D. Sliding the bougie under the visualized epiglottis and feeling for the tracheal rings
E. Advancing the bougie under ultrasound guidance with the probe on the trachea

54. A 44-year-old female with a history of metastatic breast cancer is currently being treated in the ICU for leptomeningeal disease, and her prognosis is grave. The patient asks that you do not discuss any aspect of her care with her family, as she does not believe they are emotionally equipped to handle the news, and you promise to uphold her wish. Your promise aligns with which of the following ethical principles?

A. Beneficence
B. Non-maleficence
C. Autonomy
D. Fidelity
E. Justice

55. Which of the following has been associated with a decreased risk of ventriculitis in patients with indwelling ventriculostomy catheters?

A. Cerebrospinal fluid (CSF) surveillance daily
B. CSF surveillance every third day
C. Catheter exchange every 5 days
D. Silver-impregnated catheters
E. Insertion site antibiotic wafers

56. A 62-year-old male with a history of myasthenia gravis is currently being evaluated for aspiration pneumonia in the setting of a myasthenic crisis, with evidence of a developing empyema on chest x-ray. Which of the following would be appropriate empiric antibiotic coverage in this setting?

A. Cefepime and azithromycin
B. Levofloxacin
C. Piperacillin-tazobactam and ciprofloxacin
D. Clindamycin and moxifloxacin
E. Ampicillin-sulbactam

57. A 23-year-old female presents to the emergency department with headache, lethargy and confusion. A non-contrast head CT demonstrates diffuse subarachnoid hemorrhage, and the patient subsequently undergoes clipping of an anterior choroidal artery aneurysm. Despite treatment, the patient continues to decline in the ICU, and her neurologic status is poor. The family decides (based on prior discussion with the patient) to withdraw life-sustaining treatment and undergo donation after cardiac death (DCD). You will be accompanying the patient to the operating room. Which of the following medications would not be reasonable to bring with you?

    A. Glycopyrrolate
    B. Cisatracurium
    C. Morphine
    D. Lorazepam
    E. It is inappropriate to administer any medications that may hasten death in patients undergoing DCD

58. Which of the following cranial nerve (CN) reflex sequences is correct?

    A. Oculocephalic reflex: sensory input from CN VIII, motor output from CN III/IV/VI
    B. Corneal reflex: sensory input from CN VII, motor output from CN V
    C. Gag reflex: sensory input from CN X, motor output from CN IX
    D. Pupillary light reflex: sensory input from CN III, motor output from CN II
    E. All of the above are correct

59. A 35-year-old male with severe traumatic brain injury (TBI) and isolated traumatic subarachnoid hemorrhage experiences a sudden neurologic deterioration on post-injury day 2. An emergent non-contrast head CT demonstrates no significant changes from admission imaging. The patient is afebrile and normotensive; standard mechanical ventilation with volume assist control is being performed at 6 mL/kg, a rate of 12 breaths/min, and a positive end-expiratory pressure (PEEP) of 5 cm H_2O. A recent arterial blood gas shows a PaO_2 of 120 mmHg and $PaCO_2$ of 40 mmHg with a pH of 7.37. Continuous EEG shows no epileptiform activity. Which of the following is the most likely cause of this patient's deterioration?

    A. Ventilator associated pneumonia
    B. Myocardial dysfunction from the subarachnoid hemorrhage
    C. Hypercapnea-induced increase in cerebral blood volume
    D. Severe metabolic acidosis with respiratory compensation
    E. Cerebral vasospasm

60. Which of the following is the most common hereditary stroke disorder?

    A. Hereditary hemorrhagic telangiectasia (HHT)
    B. Mitochondrial encephalopathy, lactic acidosis, and stroke-like episodes (MELAS)
    C. Cerebral autosomal-dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL)
    D. Giant cell arteritis (GCA)
    E. Moyamoya disease

61. Which of the following is true regarding amyotrophic lateral sclerosis (ALS)?

    A. The average age of onset is in the sixth through seventh decades of life
    B. The average life expectancy from time of diagnosis is 10 years
    C. Riluzole increases life expectancy by 3–5 years, on average
    D. Approximately 50% of cases are hereditary
    E. Positive pressure ventilation plays no role in disease management

62. Which of the following patientsintracranial pressure (ICP) waveform with intracerebral hemorrhage (ICH) is at highest risk for the development of late/long-term seizure activity?

    A. An 83-year-old male with a noncortical 8 mL hemorrhage
    B. A 44-year-old female with a cortical 12 mL hemorrhage
    C. A 68-year-old male with a cortical 21 mL hemorrhage
    D. A 50-year-old female with a noncortical 5 mL hemorrhage who seizes twice within the first 3 days of ictus
    E. All of the above are equally likely

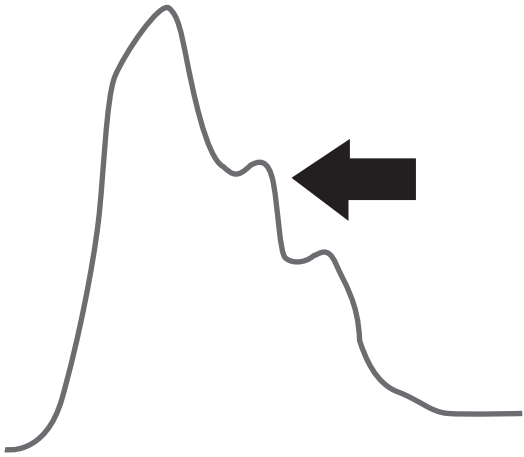
63. Which of the following has been prospectively demonstrated regarding very early (<4 days) versus late (>10 days) tracheostomy for patients unlikely to be weaned from mechanical ventilation?

    A. Decreased 30-day mortality
    B. Decreased 2-year mortality
    C. Decreased ICU length-of-stay
    D. Decreased rate of tracheostomy-related complications
    E. None of the above

64. In the intracranial pressure (ICP) waveform shown (see Image 2), which of the following is represented by the black arrow?

    A. Arterial pulsation
    B. Intracranial compliance
    C. Aortic valve closure
    D. Pulmonic valve closure
    E. None of the above

Image 2 ICP waveform tracing



65. Which of the following patients with cerebellar hemorrhage has the best chances of a good functional outcome?

    A. A patient with a GCS of 9, no ventricular compression, moderate intraventricular extension but CSF visible in the fourth ventricle
    B. A patient with a GCS of 13, a totally compressed fourth ventricle, and no intraventricular extension
    C. A patient with a GCS of 11 and a noncompressed fourth ventricle completely casted with hematoma
    D. A patient with a GCS of 12, a partially compressed fourth ventricle, and no intraventricular extension
    E. A patient with a GCS of 7 and a compressed fourth ventricle that is completely casted

66. What is the maximum amount of time that hyperventilation-induced hypocarbia may be expected to last before the PCO_2 begins to normalize?

    A. 2 h
    B. 4 h
    C. 6 h
    D. 8 h
    E. 24 h

67. A 52-year-old female presents to the emergency department with a severe, sudden onset headache concerning for subarachnoid hemorrhage that started 3 days ago. A non-contrast head CT is unremarkable. Which of the following MRI sequences may be most useful in this scenario?

    A. T1 weighted images
    B. T2 weighted images
    C. Gradient echo
    D. Apparent diffusion coefficient mapping
    E. Diffusion-weighted imaging

68. A 29-year-old, 84 kg male is in the ICU recovering from Guillain-Barre syndrome. He is currently intubated and undergoing a spontaneous breathing trial at a continuous positive airway pressure of 5 cm H_2O with 30% inspired oxygen. His respirations are currently 20 breaths/min with an average tidal volume of 500 mL. He has not had any apneic episodes. What is this patient's rapid shallow breathing index?

    A. 40
    B. 80
    C. 105
    D. 0.04
    E. 0.08

69. All of the following are true regarding Herpes simplex encephalitis (HSE) except:

    A. The majority of asymptomatic adults are seropositive for Herpex simplex virus
    B. There are no seasonal variations of disease incidence
    C. Generalized seizure activity is common
    D. It is the most common sporadic viral encephalitis in the Western world
    E. Patients who are immunocompromised are more prone to developing HSE

70. A 50-year-old female presents to the emergency department after a fall at home. On further questioning, she endorses several months of worsening back pain and progressive paraplegia, as well as the recent onset of urinary retention. An MRI of the spine reveals an enhancing intradural extramedullary spinal cord lesion extending from the T1-T4 spinal cord level with spinal cord compression. Emergency surgical resection is performed. Which of the following is the least likely pathology of this patient's lesion?

    A. Paraganglioma
    B. Ependymoma
    C. Schwannoma
    D. Neurofibroma
    E. Meningioma

71. A 70 year-old female is intubated 5 days after hospital admission for hypoxemic respiratory failure after a witnessed aspiration event. Prior to admission, the patient lived in a nursing home, and recently was treated for left leg cellulitis with a short course of intravenous antibiotics. Her medications include metoprolol, metformin, glyburide, atorvastatin, and baby aspirin. Three days after intubation, the patient is noted to have a temperature of 102.5 °F, a blood pressure of 70/50 mmHg, a white blood cell count of 20.0×10^9/L, with purulent secretions suctioned from the endotracheal tube. You decide to initiate antibiotic therapy. Which of the following is the best antibiotic regimen to initiate at this time?

    A. Ceftriaxone and ertapenem
    B. Imipenem, levofloxacin and vancomycin
    C. Meropenem, cefepime, and piperacillin-tazobactam
    D. Cefepime and daptomycin
    E. Ceftriaxone and azithromycin

72. In patients suffering from severe traumatic brain injury (TBI) with cerebral contusions, the addition of which of the following medications has been shown to cause harm in human studies?

    A. Progesterone
    B. Haloperidol
    C. Corticosteroids
    D. Furosemide
    E. Mannitol

73. Assuming the peripheral white blood cell (WBC) count is normal, approximately how many WBCs should be expected from a suspected traumatic spinal tap in which 15,000 red blood cells (RBCs) are seen?

    A. 20–30
    B. 100–150
    C. 200–300
    D. 500–750
    E. 1000–1500

74. A 79-year-old male with a history of hypertension and hyperlipidemia presents to the emergency department with acute atraumatic bilateral lower extremity weakness over the past hour. He denies any recent illness and denies any prior difficulty with ambulation or urination. He is also complaining of severe low back pain. On exam, he has profound symmetric weakness of the bilateral lower extremities with intact vibratory sense and proprioception. He has not undergone any recent surgical procedures. Which of the following is the most likely cause of this patient's pathology?

    A. Anterior spinal artery infarction
    B. Guillain-Barré syndrome
    C. Transverse myelitis
    D. Spinal epidural abscess
    E. Spinal cord neoplasm with mass effect on the cord

75. Which of the following are accepted indications for veno-venous extracorporeal membrane oxygenation (ECMO) lung support in adults with hypoxemic respiratory failure?

    A. $PaO_2/FiO_2 < 150$ mmHg on $FiO_2 > 0.9$ and Murray Score of 1
    B. $PaO_2/FiO_2 < 100$ mmHg on FiO_2 0.7 and Murray Score of 3
    C. $PaO_2/FiO_2 < 200$ mmHg on FiO_2 0.9 and Murray Score of 2
    D. $PaO_2/FiO_2 < 100$ mmHg on $FiO_2 > 0.9$ and Murray Score of 3
    E. Oxygenation index of 29 on FiO_2 0.8 and Murray Score of 3

76. A 56-year-old female presents to the emergency department with new onset severe headache, visual disturbance and diplopia. Her past medical history is remarkable only for hypertension, but she is noted to be relatively hypotensive on arrival. On examination, she has a bitemporal hemianopsia, partial right

sided ptosis and limited right eye movements. Which of the following statements is true regarding the most likely diagnosis?

A. The underlying lesion is most likely a posterior communicating artery aneurysm
B. This is a common presentation for the underlying lesion
C. This presentation is more common in men than women
D. Hormonal dysfunction is commonly seen
E. Headache is infrequently reported

77. Which of the following is true regarding primary brainstem hemorrhage?

A. They nearly always carry a very poor prognosis
B. Hypertension is not a risk factor
C. Arteriovenous malformations (AVMs) are a frequent cause
D. The prognosis is better if an underlying cavernous malformation is responsible
E. Patients usually present with a GCS <5

78. A 55-year-old male with no past medical history presents to the emergency department with worsening dyspnea and cough for the last week. He has also been experiencing low grade fevers and diffuse arthralgias. On examination, he is in severe distress, with a respiratory rate of 30 breaths/min and an oxygen saturation of 86% on room air. Computed tomography (CT) of the chest shows diffuse ground glass opacities. The patient improves briefly with non-invasive positive pressure ventilation, but eventually requires intubation. An urgent bronchoscopy is performed, which yields progressively bloody bronchoalveolar lavage specimens. Considering the most likely diagnosis, which of the following conditions is least likely responsible for this patient's presentation?

A. Microscopic polyangiitis
B. Granulomatosis with polyangiitis
C. Churg-Strauss syndrome
D. Goodpasture's syndrome
E. Osler-Weber-Rendu disease

79. A 51-year-old female is admitted to the ICU with a Hunt-Hess 3 subarachnoid hemorrhage secondary to a basilar tip aneurysm. She had experienced approximately 3 h of headache, nausea and vomiting prior to presenting to the hospital. 18 h after admission, she experiences a sudden deterioration and is intubated for airway protection. A non-contrast CT of the head is ordered. Which of the following would be the least likely explanation of the patient's decline in mental status?

A. Rebleed
B. Hydrocephalus
C. Seizure
D. Cerebral vasospasm
E. All of the above are reasonable explanations

80. A 35-year-old male is currently in the ICU with a small traumatic subarachnoid hemorrhage when he begins to complain of severe epigastric abdominal pain. Laboratory evaluation demonstrates an elevated lipase, ten times the upper limit of normal, along with elevated total and direct bilirubin levels. Ultrasound demonstrates gallbladder sludge and a severely dilated common bile duct. The next most appropriate course of action is:

    A. Endoscopic retrograde cholangiopancreatography (ERCP)
    B. Laparoscopic cholecystectomy
    C. Percutaneous cholecystectomy
    D. Broad spectrum antibiotics and NPO status
    E. Transjugular intrahepatic portosystemic shunt (TIPS) procedure

81. A 63-year-old female with a history of atrial fibrillation and recent acute ischemic infarct is recovering in the ICU following the placement of a percutaneous left atrial appendage filter. Approximately 12 h post-procedure, the patient begins to complain of chest pain and shortness of breath. The most recent blood pressure is 88/45 mmHg, and an EKG is notable only for generalized low voltage without any acute ST segment abnormalities. Which of the following should be performed next?

    A. Portable chest x-ray
    B. CT angiogram of the chest, abdomen, and pelvis
    C. Ventilation-perfusion scan of the chest
    D. Bedside echocardiography
    E. Serum cardiac enzymes

82. Osborne J waves are EKG abnormalities that may be present in all of the following except:

    A. Hypothermia
    B. Hypercalcemia
    C. Hypernatremia
    D. Subarachnoid hemorrhage
    E. Idiopathic ventricular fibrillation

83. A 44-year-old female is currently hospitalized with a right subcortical intracranial hemorrhage. On MRI, the bleed appears isointense on T1 sequences and dark on T2 sequences. Based on this information, how old would you estimate the bleed to be?

    A. 2 h
    B. 24 h
    C. 96 h
    D. 7 days
    E. 21 days

84. An ambulance is en route to your ED with a 32-year-old male bull-rider who was thrown off and kicked in the chest by the bull he was riding. Per report, he was initially unconscious with a thready pulse and rapid respirations; an 18

gauge IV was placed and fluids were started. Approximately 7 min prior to arrival to the ED, he became pulseless, and CPR was started in the ambulance. On arrival, chest compressions are in progress. As he is transferred to the trauma bay stretcher, he is noted to still be unresponsive, pulseless and apneic. The cardiac monitor shows narrow complex tachycardia. Compressions are restarted. Which statement is true regarding emergent thoracotomy in this patient?

A. ED thoracotomy has an extremely low likelihood of providing benefit to this patient
B. ED thoracotomy is not indicated in trauma patients presenting with cardiac arrest
C. ED thoracotomy should only be performed if standard protocol-driven resuscitation fails
D. Patients with cardiac arrest following blunt chest trauma have better outcomes with ED thoracotomy that do those following penetrating chest trauma
E. None of the above

85. An 80-year-old male with a history of benign prostatic hypertrophy (BPH) and coronary artery disease (CAD) is currently in the ICU in decompensated heart failure, and you decide to place a foley to closely monitor urine output. After three failed attempts by two different nurses, the staff inform you that they are unable to pass a 16 Fr Foley catheter. Which of the following should be performed next?

A. Attempt to place a 22 Fr Foley catheter
B. Attempt to place a 16 Fr coude catheter
C. Attempt to place a 14 Fr suprapubic catheter
D. Attempt to place a 16 Fr catheter again following uretheral lidocaine instillation
E. Defer foley placement

86. A 55 year-old male is admitted to the ICU with septic shock and evidence of a right lower lobe opacity on portable chest x-ray. The patient is initiated on broad spectrum empiric antibiotics for pneumonia, intravenous fluids, and vasopressors. Bedside ultrasonography of the lung is performed (see Image 3). Which of the following should be performed next?

A. Continue current therapy
B. Initiate diuresis with furosemide or torsemide
C. Postural drainage three times daily
D. Tube thoracostomy
E. Paracentesis

Image 3 Bedside lung ultrasonography

87. Which of the following is the reference standard for the diagnosis of cerebral arteriovenous malformations?

    A. Conventional CT of the brain
    B. Conventional MRI of the brain
    C. CT angiography
    D. MR angiography
    E. Conventional cerebral angiography

88. A 65-year-old male presents to the emergency room after being found on the ground. His past medical history is remarkable for hypertension and hyperthyroidism. His family is unsure what medications he takes. On examination, he has a lid lag, tremor, aphasia, and dense right hemiparesis. He undergoes a noncontrast head CT and CT angiogram as part of a stroke work-up, which reveals a left holohemispheric acute subdural hematoma. After scan, he becomes more lethargic, requiring intubation. He is taken to the operating room emergently for a craniotomy for evacuation of the subdural hematoma. He undergoes uncomplicated surgery and is extubated postoperatively. A few hours after surgery, he develops sudden confusion, diarrhea, tachycardia, and is febrile to 41 °C. Which of the following may have contributed to this patient's condition?

    A. Subdural evacuation
    B. Initial physical trauma
    C. Irregular home medication use
    D. CT angiography
    E. All of the above

89. Slowing of neuronal activity as seen on electroencephalography (EEG) is evident when cerebral blood flow drops below which of the following values?

    A. 65 mL/100 g/min
    B. 40 mL/100 g/min
    C. 20 mL/100 g/min

D. 10 mL/100 g/min
E. 6 mL/100 g/min

90. Which factor is not predictive of the need for intubation and mechanical ventilation in a patient with Guillain-Barre syndrome?

A. Presence of facial palsy
B. Difficulty lifting the head off of the bed
C. Duration of time from onset of symptoms to presentation
D. Inability to stand
E. Ineffective cough

91. Patients with severe traumatic brain injury and critically elevated intracranial pressure (ICP > 25 mmHg) with accompanying respiratory failure and persistent life-threatening hypoxia can be managed by all of the following methods except:

A. Airway pressure release ventilation (APRV)
B. Aggressive recruitment maneuvers
C. Veno-venous extracorporeal membrane oxygenation (ECMO)
D. Inhaled nitric oxide
E. Prone positioning

92. A 23-year-old female presents to the emergency department with altered mental status at work for several hours. CT of the head without contrast reveals a left-sided intraparenchymal hemorrhage with significant intraventricular extension, and a CT angiogram reveals a 5 mm left anterior choroidal aneurysm. The patient undergoes a decompressive craniectomy, external ventricular drain (EVD) placement, and eventual surgical clipping of her aneurysm. Two days postoperatively, a follow-up conventional angiogram reveals no residual aneurysm. Repeat non-contrast head CT shows a stable left tempoparietal lobe hemorrhage with increased surrounding hypoattenuation, concerning for increased edema versus developing ischemia. There is persistent diffuse intraventricular hemorrhage (IVH) and ventriculomegaly. The decision is made to proceed with intrathecal tPA. Which of the following statements regarding intrathecal tPA is true?

A. There is longstanding evidence that use of intrathecal tPA in IVH is both safe and feasible
B. There is no evidence that intrathecal tPA improves outcomes in patients with significant intraventricular hemorrhage
C. After administration of intrathecal tPA, the EVD is usually clamped for 8 h to allow circulation of the drug around the clot
D. The usual dose is for IVH clot lysis is 0.9 mg/kg
E. Intrathecal tPA is currently the standard of care for the treatment of significant IVH

93. A 43-year-old female currently hospitalized with a systemic lupus erythematous (SLE) flare has had progressive dyspnea and hemoptysis for the last 5 days. She has had low grade fevers, but no chest pain. On examination, she is in moderate respiratory distress, with an oxygen saturation of 88% on room air. Her lungs have diffuse inspiratory crackles, and chest x-ray from earlier today reveals bilateral opacities. The patient's respiratory status continues to deterio-

rate, and she is intubated and transferred to the ICU. Which of the following should be performed next?

A. Computed tomography angiography (CTA) of the chest
B. Bronchoscopy with bronchoalveolar lavage
C. Bedside echocardiogram
D. Tracheal aspirate and culture
E. Serial measurement of pulmonary plateau pressures

94. A 27-year-old male presents to the emergency department complaining of acute onset headache and vomiting over the past 3 h. He has severe neck pain on exam and complains of nausea, but is otherwise neurologically intact. A non-contrast CT of the head is performed, demonstrating thin, diffuse subarachnoid hemorrhage without ventricular involvement. What would be the correct way to characterize this patient's Hunt-Hess and modified Fisher scores?

A. Hunt-Hess 1, modified Fisher 1
B. Hunt-Hess 1, modified Fisher 2
C. Hunt-Hess 2, modified Fisher 1
D. Hunt-Hess 2, modified Fisher 2
E. Hunt-Hess 3, modified Fisher 1

95. A 65-year-old male unrestrained driver is being evaluated after being involved in a rollover motor vehicle accident. Vital signs are as follows: heart rate 102 beats/min, blood pressure 190/100 mmHg, respiratory rate 26 breaths/min, oxygen saturation 98% (on 5L venturi mask). You notice that on inspiration, his left chest rises while his lower right chest collapses, and vice-versa on expiration. A bedside chest x-ray is performed (see Image 4). What is the most appropriate initial step in management?

A. IV analgesia
B. Right-sided chest tube placement
C. Endotracheal intubation
D. Chest wall binding
E. Thoracotomy

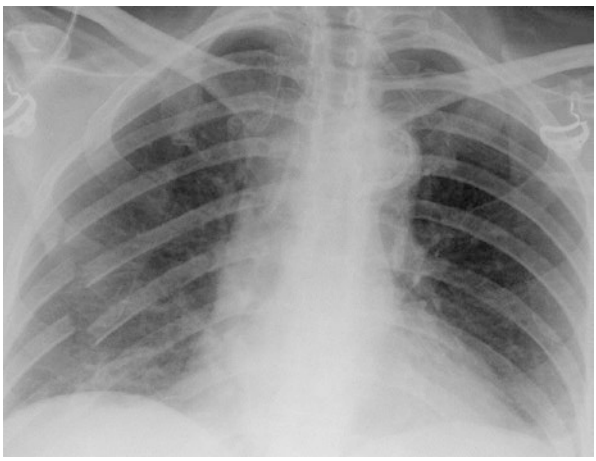


Image 4 X-ray of the chest

96. A 25-year-old female with known myasthenia gravis presents complaining of a sore throat and difficulty swallowing. Physical examination reveals severe tonsillitis, and a rapid strep test is positive. The patient is started on oral penicillin. Two days later, she returns complaining of shortness of breath and worsening difficulty swallowing. Her repeat exam demonstrates a fever of 39 °C, a peritonsillar abscess, and a negative inspiratory force (NIF) of 18. She has no bulbar weakness, no significant airway obstruction, and her voice is normal. The abscess is drained, and she is admitted to the ICU for close monitoring of respiratory status and consideration of BiPAP initiation. Her latest arterial blood gas shows no evidence of hypercarbia. What changes in her medical management would be appropriate at this time?

    A. Broaden antibiotic coverage to piperacillin-tazobactam
    B. Proceed with endotracheal intubation
    C. Administer systemic corticosteroids
    D. Administer azathioprine
    E. Initiate plasma exchange

97. An 80-year-old male with history of Parkinsonism and episodes of agitation requiring daily haloperidol presents to the emergency department during a heat wave with confusion, diaphoresis, tachypnea at 25/min and fever to 40 °C. Which of the following can be used to distinguish neuroleptic malignant syndrome from malignant hyperthermia in this patient?

    A. Testing for hallucinations and checking ionized calcium
    B. Testing muscular tone and checking creatine phosphokinase
    C. Testing orientation and checking arterial PCO_2
    D. Testing judgment and checking thyroid stimulating hormone
    E. Testing deep tendon reflexes and checking serotonin level

98. A 59-year-old female with a history of hypertension, type 2 diabetes, and prior renal transplant on immunosuppressive therapy presents to the emergency department with fever and altered mental status. A contrast-enhanced head CT demonstrates a large rim-enhancing lesion with a thick capsule and a hypodense center. Which of the following is the most likely causative organism?

    A. *Streptococcus pneumoniae*
    B. *Staphylococcus aureus*
    C. *Staphylococcus epidermidis*
    D. Group B strep
    E. *Aspergillus fumigatus*

99. You are currently in the planning stages of a new dedicated stroke unit at your hospital when the subject of capital budget items is raised. Which of the following represents a capital budget item?

    A. A dedicated MRI machine for the unit
    B. Salaries for new stroke nursing staff

C. Utility bills for the planned unit
D. Healthcare benefits for the new employees
E. Cost of intravenous supplies

100. A 69-year-old female presents to the emergency department with approximately 15 h of lethargy, dysarthria, and right sided weakness. She has an NIH Stroke Scale of 28 on admission, and a large hypodensity is present in the left middle cerebral artery territory on a non-contrast head CT. She is 5′4″, and you calculate her predicted body weight as 55 kg. She is intubated for airway protection, with the following ventilator settings: volume control, tidal volume 480 mL, 100% FiO_2, a positive end expiratory pressure (PEEP) of 10 cmH_2O, and a rate of 14. Her venous blood gas shows a CO_2 of 32 mmHg, and her bedside oxygen saturation is 100%. To prevent the development of acute respiratory distress syndrome (ARDS), the most significant change you can make to her ventilator would be:

A. Reduce her fraction of inspired oxygen to 0.4
B. Reduce her PEEP to 5 cm H_2O
C. Reduce her tidal volume to 360 mL
D. Increase her minute ventilation by 50%
E. Add inhaled nitric oxide to the ventilator circuit

Exam 1 Answers

Teach thy tongue to say 'I do not know', and thou shalt progress.

Moses Maimonides
(1135–1204)

1. **The correct answer is A.** Central cord syndrome is the most common form of incomplete spinal cord injury, and is usually the result of hyperextension of the cervical spine. It is seen more often in older patients, and result in weakness more pronounced in the upper extremities as compared to the lower extremities [1].
2. **The correct answer is B.** This patient presents with postoperative oozing and a markedly low fibrinogen, likely secondary to chronic alcohol abuse (fibrinogen is synthesized in the liver). Of all the answer choices, cryoprecipitate is the most appropriate option, as it contains large amounts of fibrinogen, von Willebrand factor, and factor VII. Fresh frozen plasma also contains fibrinogen, although in smaller quantities, and would require a much larger transfusion volume in order to replete this patient's fibrinogen appropriately (which may be deleterious in this patient with congestive heart failure). Additionally, this patient's INR is not likely contributing to his ongoing bleeding, so the additional factors present in plasma would be unnecessary.
3. **The correct answer is C.** This patient is in convulsive status epilepticus after having received a significant load of lorazepam but incomplete load of phenytoin. While completion of the phenytoin load is usually a judicious step, this patient has cardiovascular instability as evidence by his hypotension and frequent PVCs, and so continued phenytoin or high dose midazolam is relatively contraindicated. Blood pressure correction with fluid repletion is certainly reasonable, but eradication of his status epilepticus is paramount, and fast escalation in hemodynamic augmentation may lead to flash pulmonary edema or cardiac ischemia in this frail vasculopathic patient.
4. **The correct answer is A.** Given the presentation, this patient likely has a traumatic hemothorax, and requires large bore tube thoracostomy. 16-French is too small, as it will be more likely to clot off (compared to a 28-French tube). Surgical intervention may be necessary if there is immediate bloody drainage of >20 mL/kg or 1500 mL. The patient's airway and respiratory compromise should be addressed first before continuing the assessment and resuscitation..
5. **The correct answer is A.** Overall, respiratory failure and coagulopathy are the two risk factors most convincingly linked to stress ulceration and upper GI bleeding. Some studies suggest that enteral feeding may reduce clinically important bleeding, but there is insufficient evidence to recommend this practice across patient populations [2].
6. **The correct answer is D.** The Frank-Starling mechanism describes increases in cardiac contractility and stroke volume as a result of increases in left-ventricular end-diastolic volume (i.e., an increase in preload). Increased volume (up to a point) results in more forceful contraction by optimizing actin-myosin cross-bridging.

7. **The correct answer is A.** Total parenteral nutrition is an independent risk factor for the development of fungemia, particularly with *Candida albicans*. Frontline therapy includes 400 mg of fluconazole daily for 14 days after the first negative blood culture is obtained, and this has been shown to be as effective as amphotericin B in this setting (with far fewer side effects). The echinocandins (anidulafungin or caspofungin) are more effective against azole-resistant strains such as *Candida glabrata* and *Candida krusei* [3].
8. **The correct answer is C.** This patient has significant patient-ventilator dyssynchrony with signs of worsening respiratory failure and hemodynamic instability despite different modes of ventilation and multiple sedative agents. It is appropriate in this situation to paralyze the patient, at least temporarily, in order to restore patient-ventilator synchrony and improve the arterial blood gas. Once the patient improves, different ventilation strategies and sedatives can be explored, as well as whether or not the patient is ready for extubation.
9. **The correct answer is B.** The HELP study was a randomized trial comparing lactulose to PEG for the treatment of hepatic encephalopathy. Patients in the PEG group had better objective improvement of their encephalopathy, and over a shorter period of time. Adverse events were not reported to be significantly different in either group [4].
10. **The correct answer is C.** Central fever is a relatively common occurrence in ICU patients with neurologic insults. Central fever is more likely to present in younger patients, and to develop within the first few days after ICU admission. Conditions commonly associated with central fever include intraventricular and subarachnoid hemorrhage, intracranial neoplasms, and traumatic brain injury. Normal pressure hydrocephalus is not a typical cause of central fever [5].
11. **The correct answer is B.** Per the American Heart Association and the American College of Cardiology, PCI is the treatment of choice in the setting of acute MI with a first medical contact (FMC)-to-device time goal of less than 120 min. If this is expected to take significantly longer than 120 min, fibrinolytic therapy should be administered, provided there are no contraindications [6]. CABG is not an appropriate first-line treatment for an acute MI, nor is simply awaiting serum biomarkers and repeating the EKG at a later time. Nitroglycerine is relatively contraindicated in patients with inferior MIs due to the high rate of right ventricular infarct in these patients, who subsequently become preload dependent in order to maintain adequate systemic pressures.
12. **The correct answer is E.** This patient presents with a positive quantiferon gold test, no infectious symptoms per his family, a normal chest x-ray, and on isoniazid monotherapy as an outpatient. This is consistent with the treatment of latent tuberculosis (TB). These patients do not require negative pressure isolation (they are not contagious), nor do they require the escalation of care reserved for active TB infections.
13. **The correct answer is B.** In adults, oliguric renal failure is defined as urine output less than 400 mL in a 24 h period. The 0.5 mL/kg/h formula is used for children, while the 1 mL/kg/h formula is used for infants. Less than 50 mL in 24 h generally defined anuria.

14. **The correct answer is C.** The Berlin severity categories are based on the PaO_2/FiO_2 ratio on a positive end-expiratory pressure (PEEP) of ≥5. Mild ARDS is defined by a PaO_2/FiO_2 ratio >200 but <300; moderate is defined by a PaO_2/FiO_2 ratio >100 but <100; and severe ARDS is defined by a PaO_2/FiO_2 ratio <100. This patient's PaO_2/FiO_2 ratio is 107 (PaO_2 107 divided by 1.0 for 100% FiO_2). Acute lung injury is an outdated term from the older American European Consensus Conference (AECC) on ARDS and is no longer used [7].
15. **The correct answer is D.** Given this patient's history of aortic graft surgery in the setting of bright red blood per rectum, an aorto-enteric fistula must be considered, as treatment would be dramatically different than other causes of gastrointestinal bleeding. Only after this entity is ruled out might you consider GI consultation or expectant management. Given the patient is on antiplatelet agents, platelet transfusion might be reasonable, but FFP and factor VIIa have no role in the setting of otherwise normal blood work.
16. **The correct answer is E.** The femoral, popliteal, soleal and gastrocnemius veins are all considered deep veins, and a thrombus in any of these vessels would be appropriately called a deep venous thrombosis (DVT). Isolated saphenous and gastrocnemius thromboses are considered to be at a lower risk for progression and embolism, and may not require anticoagulation, but they are still considered to be DVTs. The greater and lesser saphenous veins, on the other hand, are superficial, and not part of the deep venous system.
17. **The correct answer is A.** The axons of posterior pituitary neurons are contained in the pituitary stalk. Destruction of the stalk leads to atropy and loss of neuron function, thus affecting secretion of the posterior pituitary hormones oxytocin and vasopressin. The anterior pituitary does not have a major direct arterial blood supply; it is receives blood flow from a dense capillary network. A resection of the stalk would deprive the anterior pituitary from blood flow from the median eminence, but it would continue to receive arterial input from the inferior hypophyseal artery. If the peripheral blood concentration of hypothalamic hormones is high enough, the anterior pituitary will continue to respond to them.
18. **The correct answer is B.** This patient's scan shows evidence of an intramural IVC hematoma, a laterally displaced and collapsed IVC filter, and contrast extravasation, consistent with IVC rupture likely secondary to filter placement. This patient needs urgent vascular surgery and interventional radiology consultations, in addition to blood product administration as needed. Left sided positioning may be necessary to relieve pressure on the IVC in pregnant patients, but will be of no benefit in this scenario.
19. **The correct answer is E.** Among antiepileptic medications, only phenobarbital and lacosamide are both metabolized by the liver and eliminated through the kidneys. Phenytoin, valproate and pentobarbital undergo hepatic metabolism, while levetiracetam is eliminated via the kidneys.
20. **The correct answer is B.** Meningiomas are the most common primary brain tumor in adults accounting for 1/3 of all primary brain tumors. Some meningiomas express progesterone/estrogen receptors. Meningiomas are far more

common in women, at approximately a 2:1 ratio. Ionizing radiation has been identified as an environmental risk factor. The great majority of meningiomas are located in supratentorial space [8].

21. **The correct answer is C.** According to the landmark NASCET trial data, carotid endarterectomy is clearly beneficial in symptomatic patients when the amount of stenosis exceeds 70%. Patients with 50–69% stenosis may be considered for treatment as well, although the risk/benefit analysis is more equivocal [9].
22. **The correct answer is C.** The American Heart Association guidelines on the management of massive PE define "massive" as PE in the presence of systolic pressures less than 90 mmHg for greater than 15 min, or requiring inotropic support, not due to a cause other than PE (such as hypovolemia, arrhythmia, etc.) [10].
23. **The correct answer is D.** Medications used often in the ICU setting can affect the metabolism of cyclosporine. Phenobarbital, phenytoin, carbamazepine, and modafinil increase the metabolism of cyclosporine and lead to a decrease in serum concentration. Levetiracetam does not affect serum cyclosporine levels.
24. **The correct answer is D.** In the three column theory, the anterior column is made up of the anterior vertebral body, anterior annulus fibrosus, and anterior longitudinal ligament. The middle column includes the posterior longitudinal ligament, posterior annulus fibrosus, and posterior wall of the vertebral body. Finally, the posterior column includes the posterior longitudinal ligament, posterior annulus fibrosus, and posterior wall of the vertebral body. In general, the spine is considered unstable if at least two columns are injured [11].
25. **The correct answer is E**. Rituximab (usually combined with cyclophosphamide) is considered a second line treatment for anti-NMDA encephalitis, and should be considered when there is no response to first line therapy (which includes IVIG, corticosteroids, plasma exchange, and tumor resection, if applicable) [12].
26. **The correct answer is B.** Resection of pituitary adenomas is associated with a risk of long-term HPA axis dysfunction. A morning serum cortisol level below 15 μg/dL the next day after surgery is associated with a significantly increased risk of requiring long-term glucocorticoid therapy [13].
27. **The correct answer is C.** Advantages of CRRT over intermittent hemodialysis includes a greater hemodynamic tolerability, and the ability to rapidly adjust the prescription to evolving patient needs. Disadvantages of CRRT include the higher cost of disposables, greater logistic complexity, and the difficulty of administering this type of dialysis without anticoagulation. Intermittent hemodialysis is more available and likely more familiar to nursing staff.
28. **The correct answer is C.** Many patients with acute neurologic injury will have an abnormal pattern at some point during their hospitalization. This patient has cluster breathing, which was defined in 1982 by Plum and Posner as irregular clusters of breaths followed by apneic periods of variable duration. This typically results from a lesion in the pneumotaxic center in the

upper medulla or lower pons [14]. Cheyne-Stokes respiration is a regular crescendo-decrescendo breathing pattern followed by a period of apnea. Central neurogenic hyperventilation would be sustained hyperventilation, with associated significant respiratory alkalosis. Kussmaul breathing is a deep and labored breathing pattern often secondary to metabolic acidosis, particularly diabetic ketoacidosis or renal failure. Apneustic breathing is sustained deep inspiration lasting for a few seconds followed by rapid exhalation and a brief post expiratory pause.

29. **The correct answer is A.** Apical ballooning is a characteristic feature of Takotsubo cardiomyopathy, which takes its name, tako tsubo (literally "octopus pot" in Japanese) from the abnormal appearance of the left ventricle. Bowing of the septum may be seen in cases of pulmonary embolism and right heart strain. A hypoechoic area surrounding the pericardium usually denotes an effusion. Enlargement of the outflow tract is seen in patients with ascending aortic aneurysms and bicuspid aortic valves. Contrary to the diminished systolic function seen in Takotsuo cardiomyopathy, a hyperdynamic left ventricle is defined as an ejection fraction >70%.
30. **The correct answer is D.** The use of angiotensin converting enzymes (ACE) inhibitors is contraindicated in pregnancy. Specifically, administration of ACE inhibitors during the third trimester is associated with a significantly increased risk of fetal renal abnormalities.
31. **The correct answer is E.** The 20/30/40 rule is traditionally used to evaluate for need for intubation in patients with Guillain Barre syndrome (GBS) and myasthenia gravis (vital capacity >20 mL/kg, peak inspiratory pressure >30 cm H_2O, peak expiratory pressure >40 cm H_2O). While this is still a good guideline for patients with GBS, there is evidence to suggest that myasthenic patients who do not have hypercarbia may be trialed on noninvasive positive pressure ventilation first, and that this may be associated with improved in-hospital outcomes [15]. Therefore, it makes sense to check this patient's CO_2 before deciding whether to intubate her, particularly with normal oxygenation and only mild respiratory distress. The rapid shallow breathing index is one parameter used to determine extubation readiness in patients who are already intubated.
32. **The correct answer is D.** Simple head elevation is an easy maneuver that promotes venous drainage in order to reduce intracranial pressure (ICP). Mannitol and hypertonic saline also have established roles in treating cerebral edema and reducing ICP. Hypothermia, while controversial, has been shown to reduce levels of inflammatory mediators and subsequently reduce ICP. Use of hypothermia may be limited by coagulopathy and cardiac arrhythmias. Dexamethasone has no proven benefit in treating ICP in this setting and may predispose to infectious and metabolic complications [16].
33. **The correct answer is A.** One must be careful when using a hemoglobin A1c alone to diagnose diabetes. Several factors may cause an elevated A1c, including alcohol abuse (interferes with assay), chronic kidney disease (decreased erythropoiesis), and prior splenectomy (increased red cell lifespan), in which case one might erroneously conclude a patient is diabetic. On the other hand,

the A1c may be low in patients with severe hypertriglyceridemia (interferes with assay), recent blood transfusion, prior erythropoietin administration, or hemolytic anemia (decreased red cell lifespan), in which case one might erroneously conclude a patient is not a diabetic.

34. **The correct answer is B.** To calculate the estimate change in serum sodium from the infusion of 1 L of any replacement fluid, the following formula can be used: change in serum Na = (replacement fluid Na − serum Na)/(total body water + 1). Total body water (TBW) usually accounts for 60% of lean body weight for men and 50% in women. The proportion of TBW decreases with age, becoming 50% in elderly men and 45% in elderly women. Therefore, in this patient, total body water can be calculated as 50% of his weight (58 kg) which is equal to 29 L. A liter of 0.225% sodium chloride solution contains 1/4 of the amount of sodium in normal saline (i.e. 154/4 = 38.5 mmol/L). The change in serum sodium as calculated from the formula will be (38.5 − 177)/(29 + 1), which equals −4.6 mEq/L.
35. **The correct answer is A.** HIT is a serious medical condition, and needs to be treated as soon as possible once diagnosed. Although laboratory tests have not yet confirmed the presence of HIT, the suspicion of HIT is high based on her 4T score. The patient should therefore be initiated on a direct thrombin inhibitor (such as argatroban) for treatment of suspected HIT while awaiting further testing. Fondaparinux is an acceptable alternative. Warfarin therapy can be initiated after 5 days of treatment, with overlap therapy, and when platelet count is above $150 \times 10^3/\mu L$. Switching to enoxaparin therapy is not an option because of cross-reactivity between heparin antibodies and low-molecular weight heparin.
36. **The correct answer is E.** The vasculitidies are a broad class of diseases that involve the inflammatory destruction of both arterial and venous blood vessels. All of the disease listed may present with central nervous system involvement.
37. **The correct answer is A.** Developmental venous anomalies are usually not demonstrated in non-enhanced CT scans, but the enlarged veins are identified after administration of contrast. MRI shows medullary veins converging on the dilated transcerebral vein and a characteristic "sunburst" pattern is seen on enhanced T1 weighted images. Cerebral angiographic findings are pathognomonic, with a "caput medusa" appearance of the radially arranged small medullary veins found during the late capillary or venous phase. Capillary telangiectasias appear as low signal intensity "black dots" on T1 and T2 weighted imaging, but are not diagnostic of these lesions. With cerebral angiography, telangiectasias can be identified in the late arterial/early capillary phase as a faint blush with an associated venous channel. Cavernous malformations have minimal blood flow and thus may not be seen on angiography, often referred to as being "angiographically occult." Characteristic findings on T1 and T2-weighted images include a "popcorn" pattern of variable image intensities consistent with evolving blood products. A dark hemosiderin ring on T2 or gradient echo sequences at the periphery of the lesion is suggestive of remote hemorrhage.

38. **The correct answer is D.** The RIFLE classification scheme for acute kidney injury includes separate criteria for creatinine and urine output. Renal failure is defined as an increase in serum creatinine threefold, a GFR decrease by 75% or serum creatinine ≥4 mg/dL; a urine output <0.3 mL/kg/h × 24 h or anuria × 12 h. Renal loss is defined as persistent acute renal failure or complete loss of kidney function >4 weeks.
39. **The correct answer is D.** MVMS is an acute, rapidly progressive form of MS that usually presents in younger patients, and may be fatal within months from the time of diagnosis. When MVMS presents as a large, single brain lesion, it may be indistinguishable from a neoplastic process on conventional imaging. In these cases, craniotomy and biopsy is required to make the definitive diagnosis.
40. **The correct answer is B.** This patient is likely developing ARDS secondary to an acute aspiration related to his SAH. He would benefit most from low tidal volume ventilation, one of the few intervention proven to decrease mortality in ARDS. His ideal body weight is 80 kg; decreasing his tidal volume to 6 cc/kg yields a tidal volume of 500. Additionally, his PEEP needs to be increased in an attempt to decrease his FiO_2 requirements. If the patient does not improve with these initial measures, PEEP could be further increased and proning could be considered.
41. **The correct answer is A.** Mallory-Weiss tears are mucosal or submucosal lacerations that occur at the gastroesophageal junction, and usually extend distally into a hiatal hernia. Patients generally present with initial nonbloody vomiting followed by hematemesis. Although approximately 50% of patients hospitalized with upper GI bleeding from a Mallory-Weiss tear receive blood transfusions, the hematemesis is often mild and self-limited in patients who do not seek medical care. Occasionally, patients with continued active bleeding require endoscopic therapy and repair [17].
42. **The correct answer is B.** Primary amebic meningoencephalitis by *Naegleria fowlerii* occurs after the parasite gains access to the central nervous system via the cribiform plate, typically after an individual goes swimming in a freshwater lake. Several days of a vague prodrome (including headaches, nausea and vomiting) eventually lead to confusion, coma, and within 1–2 weeks, death for the majority of individuals. Miltefosine, an antiparasitic agent originally approved for the treatment of leishmaniasis, is currently stockpiled by the Center for Disease Control (CDC) for the emergent treatment of suspected or confirmed *Naegleria* meningoencephalitis.
43. **The correct answer is B.** This vasculopathic patient presents with severe abdominal pain out of proportion to exam and a significantly elevated serum lactate, which is the classic description of ischemic colitis. Although CT arteriography is highly sensitive and often the first investigation performed in the emergency department, flexible endoscopy with tissue biopsies remains the diagnostic gold standard [18].
44. **The correct answer is C.** Nimodipine, initially developed as an antihypertensive, is rarely used for this purpose. Instead, it is primarily used to prevent DCI

in the setting of subarachnoid hemorrhage, administered enterally every 4 h. It was previously studied in the setting of preeclampsia, but proved inferior to magnesium [19]. It has also been used to preserve facial and cochlear nerve function following schwannoma surgery, with mixed results in several studies [20].

45. **The correct answer is C.** Mitochondrial encephalopathy, lactic acidosis, and stroke-like episodes (MELAS) is a rare mitochondrial disorder characterized by headaches, muscle weakness, seizures, vomiting, and altered mental status. The majority of cases are caused by mutations in the MT-TL1 gene, and there is usually a family history of similar symptoms (though rare spontaneous cases are reported in the literature). Like other mitochondrial cytopathies, the inheritance pattern is maternal. Unfortunately, there is no cure, and the disease is both progressive and fatal. Because MELAS is so rare, and the clinical presentation is so varied, it is often misdiagnosed.
46. **The correct answer is B.** The patient has a partial central airway obstruction secondary to the compressive tumor. Although he is hemodynamically stable and is able to maintain his airway at this time, the patient should admitted to an intensive care unit for aggressive monitoring as decompensation can happen quickly and unpredictably. Racemic epinephrine works both by stimulating alpha adrenergic receptors, resulting in mucosal vasoconstriction and by stimulating beta adrenergic receptors, resulting in relaxation of the bronchial smooth muscle. Racemic epinephrine has been proven to be most beneficial in treating laryngotracheobronchitis (croup) in the pediatric population, as well as laryngeal edema. Heliox is a 70:30 mixture of helium and oxygen, and is effective in reducing the work of breathing by decreasing airway resistance to turbulent flow generated across an airway obstruction. It has been used in post extubation laryngeal edema, tracheal stenosis, extrinsic compression, and acute severe asthma attacks [21]. Corticosteroids work by reducing airway edema, but this patient does not have any suggestion of airway edema; he has an airway obstruction secondary to mass effect. Also, they take several hours to take effect, and therefore steroid administration is not the most appropriate for the immediate relief of symptoms. The patient has lung adenocarcinoma that involves a mediastinal structure, and is unlikely to be a candidate for resection. Also, regardless of the resectability of this patient's mass, surgery is not an immediate solution to the patient's symptoms. Inhaled $ß_2$ agonists will not provide relief, as the patient has a central airway obstruction.
47. **The correct answer is E.** MICs are used to report the sensitivity of an organism to various antimicrobial agents. Each agent has its own reference cutoff to determine whether the organism will be reported as sensitive, intermediate, or resistant to that agent. MICs cutoffs are not meant to be used to compare antimicrobial agents, and the absolute MIC does not take into account several other factors such as pharmacodynamics and the site of infection. Based only on a chart of antibiotic susceptibilities, none of the antibiotics listed can be considered "most likely" to be effective.

48. **The correct answer is E.** Vomiting, nasogastric suction, diuretic use, or mineralocorticoid excess may all result in the development of metabolic alkalosis. Blood loss, on the other hand, may result in a metabolic acidosis if it is significant enough to impair oxygen delivery.
49. **The correct answer is E.** When intubating a patient with TBI, the primary goals are to avoid causing or worsening secondary brain injury. As such, avoidance of hypoxia, hypotension, spikes in blood pressure, and elevated ICP are important. Lidocaine has often been used as pretreatment for the purposes of preventing ICP spikes during intubation; however, no direct evidence supports this approach in the setting of traumatic brain injury, nor is there evidence of any significant effect on patient outcomes [22].
50. **The correct answer is D.** Treatment for normal pressure hydrocephalus may include a lumbar drain trial, which involves lumbar drain placement and spinal fluid drainage for approximately 2–3 days. This is followed by physical therapy and neuropsychiatric testing to determine if there is any improvement in the patient's clinical status compared to baseline. This patient did not benefit from lumbar drain placement; therefore, the correct answer is to discontinue the drain. The patient is unlikely to benefit from additional drainage, or from a repeat trial in 3 months.
51. **The correct answer is E.** It has long been recognized that brain metastases from certain malignancies are at a higher risk of bleeding episodes [23]. These include melanoma, renal cell carcinoma, choriocarcinoma, and thyroid carcinoma. Breast metastases are not considered high-risk lesions.
52. **The correct answer is A.** This patient presents with a cerebral venous sinus thrombosis in the face of antiplatelet and anticoagulation therapy, likely the result of her polycythemia vera. Given the history of HIT, it would be inappropriate to give this patient low molecular weight or unfractionated heparin; fonaparinux is an appropriate alternative. Apixaban and eptifibatide are not used in this setting.
53. **The correct answer is C.** Bougie-guided intubation may be necessary in the absence of an adequate view of the vocal cords. The upturned end is slid under the epiglottis, feeling for the tracheal rings and eventual resistance when the bougie hits the carina. The laryngoscope blade can then be removed, and an endotracheal tube can be advanced along the bougie into the trachea.
54. **The correct answer is D.** Autonomy involves a respect for a patient's wishes regarding their care, while the distinct (but closely related) principle of fidelity involves the concept that physicians and nurses will stay true to their promises and agreements. Beneficence refers to acts of compassion or healing, while non-maleficence refers to avoiding acts which may cause a patient harm. Justice refers to the fair and equal distribution of healthcare resources.
55. **The correct answer is D.** Many interventions have been studied in an attempt to reduce rates of iatrogenic ventriculitis. Routine CSF surveillance has not been demonstrated to be effective, either on a daily or 3-day interval basis. Similarly, routine catheter exchange has also failed to show benefit. Insertion site antibiotic wafers have been used in the setting of indwelling vascular

catheters, but not ventriculostomy catheters. There is evidence that both antibiotic-coated and silver-coated catheters may reduce rates of ventriculitis [24], along with bundled protocols regarding catheter insertion and maintenance.

56. **The correct answer is E.** Treatment of aspiration pneumonia should include coverage of anaerobes and typical oral flora. Certain antibiotics, including aminoglycosides, fluoroquinolones, erythromycin, and tetracycline can aggravate weakness in myasthenic crisis, and should be avoided. Cefepime and azithromycin may be an effective regimen for community acquired pneumonia, but probably do not provide adequate anaerobic coverage.
57. **The correct answer is B.** Following withdrawal of life support, it is appropriate to administer any medications you would otherwise administer to a patient for purposes of palliation. This includes pre-extubation glycopyrrolate to dry secretions, as well as benzodiazepines or opiates titrated to patient comfort (or surrogates of possible discomfort, such as significant hypertension or tachycardia). These drugs should never be administered solely for the purposes of hastening death and facilitating organ transplantation. Accordingly, paralytics serve no purpose other than inducing respiratory arrest, and may mask signs of patient discomfort.
58. **The correct answer is A.** The oculocephalic reflex involves sensory input from CN VIII and motor output from CN III/IV/VI. The corneal reflex involves sensory input from CN V and motor output from CN VII. The gag reflex involves sensory input from CN IX and motor output from CN X. Finally, the pupillary light reflex involves sensory input from CN II and motor output from CN III.
59. **The correct answer is E.** Up to one third of patients with traumatic subarachnoid hemorrhage may develop post-injury cerebral vasospasm. Unlike aneurysmal subarachnoid hemorrhage, TBI-induced cerebral vasospasm often occurs earlier, and can be seen as early as post-injury day 2 [25].
60. **The correct answer is C.** There are numerous hereditary disorders that predispose patients to developing strokes, particularly at younger ages than typical atherosclerotic or embolic processes. The most common of these is CADASIL, in which a defect in the NOTCH3 gene causes abnormal protein build-up in vascular smooth muscle cells. HHT, MELAS, Moyamoya, and GCA are less common hereditary stroke disorders [26].
61. **The correct answer is A.** ALS is a chronic disease characterized by motor neuron degeneration that affects patients in the sixth and seventh decade of life, on average. Unfortunately, most patient will die within 5 years of diagnosis. The majority of cases are sporadic, not hereditary. Disease management is largely supportive, including positive pressure ventilation and the use of riluzole (which may delay ventilator dependence and prolong survival by 2–3 months [27]).
62. **The correct answer is C.** The CAVE score may predict which ICH patients are at risk for the development of late seizures. Patients get 1 point for each of the following: age >65, hemorrhage volume >10 mL, cortical location, and

seizure activity in the first 7 days following ictus. A higher score denotes a progressively higher risk of developing late seizures [28].

63. **The correct answer is E.** The TracMan study was a large, prospective, randomized, multicenter trial of very early (<4 days) versus late (>10 days, if still indicated) tracheostomy among ICU patients identified by the treating physician as likely to require >7 days of mechanical ventilation. The study did not demonstrate any significant differences in 30-day or 2-year mortality, nor were there any differences in ICU length-of-stay or the rate of tracheostomy-related complications [29]. It is noteworthy, however, that a recent Cochrane review using a much broader and more liberal definition of early vs. late tracheostomy (<10 days versus >10 days) found moderate quality evidence for a mortality benefit in the former group [30].
64. **The correct answer is B.** A normal ICP waveform has three peaks of descending amplitude. The first represents arterial pulsation, the second represents intracranial compliance, and the third represents aortic valve closure. Pulmonic valve closure is not indicated in the waveform.
65. **The correct answer is A.** A study by Kirollos developed a risk-stratification schema for cerebellar hemorrhages based on the appearance of the fourth ventricle. Grade I patients had a fourth ventricle that was midline, non-compressed, and contained visible CSF. These patients uniformly had good long-term outcomes. Grade II patients had fourth ventricles that were partially compressed or displaced, with intermediate prognoses depending on further details of their presentation. In the published protocol those with GCS > 13 were monitored, and with worsening GCS were either given an EVD (if they had hydrocephalus) or decompression (if no hydrocephalus or persistent poor GCS after EVD placement). Grade III patients had either complete obliteration of the fourth ventricle or partial obliteration with compression of the pons and prepontine cistern, and had the worst prognoses with 38% good outcomes if GCS > 8 and 17% chance of good outcome with GCS < 8. Patient A is the only patient described with a Grade I ventricle and therefore has the best prognosis [31].
66. **The correct answer is E.** Induced hyperventilation results in hypocarbia that may last anywhere up to 24 h before PCO_2 levels normalize. This phenomenon is a result of extensive bicarbonate buffering, as the brain attempts to return the intracellular and extracellular pH back to baseline levels [32].
67. **The correct answer is C.** Noncontrast head CT is the initial test of choice for the evaluation of acute subarachnoid hemorrhage, but becomes less sensitive over time, particularly several days out from the ictus. In this setting, evidence of hemorrhage may still be seen on MRI gradient echo sequences.
68. **The correct answer is A.** The rapid shallow breathing index (RSBI) is one parameter used to determine extubation readiness. In general, a cutoff of less than 105 is used to identify patients who are more likely to be extubated successfully. The formula is f/Vt, or respiratory rate divided by tidal volume. In this case, the RSBI is 40 (20/0.5 L).
69. **The correct answer is E.** Although immunocompromised patients may present with more atypical and aggressive variants of the disease, HSE is not more

common in these patients, and it is not considered an opportunistic infection. All of the other answer choices are correct [33].

70. **The correct answer is B.** The most common intradural extramedullary tumors include meningiomas, schwannoma, and neurofibromas. Paragangliomas may also occur, though are less common. Intradural extramedullary ependymomas are very rare, existing in only a handful of case reports [34].
71. **The correct answer is B.** Healthcare associated infections are almost routine in today's critical care units, and the increasing rates of multi-drug resistant (MDR) organisms is taking a toll on our clinical and economic systems. Ventilator associated pneumonia (VAP) is a subtype of healthcare associated infection, and is defined by the diagnosis of clinical pneumonia 48–72 h after intubation. Duration of mechanical ventilation, antibiotic use history, geography, co-morbidities, and the epidemiology of the ICU population all determine the etiology of a nosocomial pneumonia. Aerobic gram negative bacilli are the most common pathogens causing VAP. These include *Klebsiella*, *Escherichia coli*, *Pseudomonas*, *Acinetobacter*, *Stenotrophomonas*, *Enterobacter*, *Citrobacter*, *Proteus*, and *Serratia* species. *Pseudomonas* is the most prevalent pathogen recovered in VAP. With the emergence of MDR organisms, *Methicillin resistant Staphylococcus aureus* (MRSA) is also an important etiology of VAP, as well as anaerobes such as *Bacteroides* species. Community acquired pathogens, including *Streptococcus* and *Haemophilus* species are less likely to cause VAP. The antibiotic regimen that should be initiated depends on the suspicion that a patient harbors MDR pathogens. Usually, if a patient is hospitalized for more than 5 days, the possibility of MDR pathogens is high, particularly if a patient has been on intravenous antibiotic therapy recently. The first line treatment would include an antipseudomonal cephalosporin *or* an antipseudomonal carbapenem *or* an antipseudomonal penicillin with Beta lactamase inhibitor, *plus* an antipseudomonal fluoroquinolone *or* aminoglycoside, *plus* an anti-MRSA agent [35]. Azithromycin should be considered for atypical coverage if Legionella is high on the differential and in severely ill patients. If an MDR pathogen is not suspected, a third-generation cephalosporin *or* respiratory fluoroquinolone *or* non-antipseudomonal carbapenem should be considered. Daptomycin is not appropriate to use for pulmonary infections, as it is inactivated by surfactant.
72. **The correct answer is C.** Data from the CRASH TBI trial clearly demonstrated harm with the use of corticosteroids after blunt TBI [36]. The PROTECT III trial was stopped early for futility, but no harm was detected in patients receiving progesterone [37]. Furosemide and mannitol are common therapies for the management of intracranial pressure.
73. **The correct answer is A.** Assuming the peripheral WBC is normal, one would expect a ratio of RBC:WBC between 500:1 and 750:1. Therefore, if a suspected traumatic tap results in 15,000 RBCs in the sample, one should expect approximately 20–30 WBCs to be present as well.
74. **The correct answer is A.** An anterior spinal artery infarction usually presents as sudden onset severe low back pain with bilateral lower extremity weakness

and preserved proprioception and vibratory sense. The other answer choices listed usually have a more insidious onset, or are preceded by an infectious process (i.e. Guillain-Barré syndrome and transverse myelitis). Spontaneous spinal epidural abscess is rare, and is usually the result of recent surgery/manipulation, intravenous drug use, or systemic infection.

75. **The correct answer is D.** Extracorporeal Life Support Organization (ELSO) guidelines suggest that consideration for ECMO support be given to adult patients with predicted mortality exceeding 50% (i.e. PaO_2/FiO_2 <150 mm Hg on a FiO_2 >0.9 and Murray Score of 2 or 3) [38].
76. **The correct answer is C.** This patient has pituitary apoplexy. Though a subarachnoid hemorrhage from a right posterior communicating aneurysm may give similar findings, it would not give the patient bitemporal hemianopsia. Pituitary apoplexy is a rare neurosurgical and endocrine emergency and is more commonly seen in men than women. Though the patient in this vignette may have central adrenal insufficiency, clinical hormonal deficiency is uncommon. Headache is the most common symptom [39].
77. **The correct answer is D.** In a large case series examining patients with primary brainstem hemorrhage, individuals with underlying cavernous malformations had a 95% chance of having a good functional outcome (mRS $\leq$ 2 at 3 month follow-up), as opposed to patients with hypertensive hemorrhages (who had only a 38% chance of a good functional outcome). Each group formed roughly 40% of the population. AVM was an infrequent cause, accounting for only 4% of cases. The mean GCS at presentation was 13, although a wide range was noted [40].
78. **The correct answer is E.** This patient has diffuse alveolar hemorrhage, characterized by diffuse ground glass opacities on chest CT coupled with progressively bloody bronchoalveolar lavage specimens. Autoimmune processes and vasculitides are high on the differential diagnosis. Osler-Weber-Rendu, also known as hereditary hemorrhagic telangiectasis, may present with pulmonary arteriovenous malformations, but these typically present with dyspnea and cyanosis, not DAH [41].
79. **The correct answer is D.** This patient has experienced an aneurismal subarachnoid hemorrhage, and is within the first 24 h of symptom onset. Rebleed, hydrocephalus and seizures are all reasonable explanations for her decline. The risk of vasospasm, on the other hand, generally does not occur until at least 3 days after ictus, peaks around 7 days, and fades around day 14. Hyperacute vasospasm has been described in both animal models and case series of intraoperative aneurysm rupture, but this occurs within minutes of ictus, not 18 h later [42].
80. **The correct answer is A.** The patient presents with likely gallstone pancreatitis and biliary obstruction. Although somewhat controversial, patients with severe pancreatitis and overt biliary obstruction may benefit from early ERCP. Conservative approaches may be more appropriate for patients with milder disease. Once resolution of this initial attack is achieved, it may then be appropriate to perform a cholecystectomy to prevent recurrent attacks [43].

81. **The correct answer is D.** The most common overall complication of percutaneous left atrial appendage filter placement is the development of a pericardial effusion, which usually occurs in the first 24 h after the procedure. Shortness of breath, hypotension, and low voltage on the EKG are suggestive of the diagnosis, with echocardiography being the simplest and most effective diagnostic modality.
82. **The correct answer is C.** J waves are seen on EKG as positive deflections at the J point, and are classically associated with severe hypothermia. However, J waves may be present in a number of other conditions. These include hypercalcemia, significant neurologic injuries (including subarachnoid hemorrhage), and cases of idiopathic ventricular fibrillation. Hypernatremia is not associated with J wave formation.
83. **The correct answer is B.** The simplified mnemonic "iddy biddy baby doodoo" is often used when estimating the age of bleeding as seen on MRI T1 and T2 sequences. Isointense on T1 and dark on T2 (iddy) is usually 7 h to 3 days old. Bright on T1 and dark on T2 (biddy) is usually 3–7 days old. Bright on both T1 and T2 (baby) is usually 7 days to 3 weeks. Dark on both T1 and T2 (doodoo) is usually >3 weeks old. Hyperacute bleeds (<7 h) are isointense on T1 and bright on T2.
84. **The correct answer is A.** The cornerstone of management for patients with trauma-related cardiopulmonary arrest is emergent thoracotomy performed in the ED. The goal is to rapidly identify and intervene on intrathoracic hemorrhage. However, the procedure has the highest outcome yield in patients with penetrating trauma with onset of cardiac arrest in the ED. Patients presenting to the hospital already in cardiopulmonary arrest, particularly following blunt thoracic trauma, have a very low likelihood of survival, with or without emergent thoracotomy. The likelihood of favorable neurologic outcomes in this patient population is even more dismal. A systematic review of the literature performed by Eastern Society for the Surgery of Trauma (EAST) for their Clinical Practice Guidelines revealed 1.4% hospital survival and 0.1% survival neurologically intact after emergent thoracotomy for patients with blunt trauma presenting to the hospital without signs of life [44].
85. **The correct answer is B.** Difficulty passing a foley catheter is common in patients with a history of BPH. Coude tip catheters are specifically designed to allow the catheter to more easily pass the enlarged prostate. Repeatedly attempting to pass the same catheter, or a larger non-coude catheter, would be less likely to succeed, and would expose the patient to an increased risk of urethral trauma. Suprapubic catheterization is reserved for long term use, and in emergent cases of urinary retention recalcitrant to other remedies.
86. **The correct answer is D.** This patient has a complicated parapneumonic pleural effusion seen as multiple fibrinous septations within the anechoic pleural effusion, and requires placement of a chest tube for drainage. Point-of-care ultrasound (POCUS) allows the distinction between effusion and lung consolidation, and is more accurate at detecting pleural effusion in comparison with bedside chest X-rays. Sensitivity of chest x-ray decreases in more supine

positioning, while POCUS can detect effusions as small as 20 mL. Although definitive distinction between transudative and exudative pleural effusion requires thoracentesis, POCUS can suggest the nature of pleural effusion. The effusion can appear as anechoic (black), complex non-septated (black with white strands), complex septated (black with white septae), or homogeneously echogenic (white). In general, the presence of a complex pleural effusion suggests exudative effusion, whereas an anechogenic effusion is likely transudative; however, clinical correlation is warranted since exudative effusions may be anechoic, while longstanding transudative effusion may appear as complex non-septated [45]. Continuing only medical therapy with antibiotics or diuresis would not be appropriate, since this complex pleural effusion requires drainage.

87. **The correct answer is E.** Conventional cerebral angiography with catheter is considered the reference standard for the diagnosis of arteriovenous malformations. However, non-invasive vascular imaging (such as CT or MR angiography) is appropriate as an initial screening tool, or in cases where conventional angiography is unavailable.
88. **The correct answer is E.** This patient has a history of hyperthyroidism, and is now exhibiting symptoms consistent with thyroid storm. Surgery, trauma, irregular use of antithyroid medication, or iodine load (in the form of contrast material) may all be precipitating factors.
89. **The correct answer is C.** Cerebral blood flow is normal at 50 mL/100 g/min. Once it drops below 20 mL/100 g/min, slowing is evident on EEG, and the EEG may be isoelectric below 15 mL/100 g/min. Neuronal cell death will occur when CBF drops below 6 mL/100 g/min.
90. **The correct answer is A.** In a retrospective study analyzing 43 different clinical variables in GBS patients, the only ones which were found to have independent predictive value for need for mechanical ventilation were: inability to stand, inability to lift the head off the bed, inability to lift the elbows off the bed, duration from symptom onset to presentation <7 days, ineffective cough, and elevated liver enzymes. Other studies have also found bulbar dysfunction to be a predictor of need for intubation [46].
91. **The correct answer is E.** Case reports have demonstrated the feasibility of APRV in patients with increased ICP. Recruitment maneuvers improve alveolar ventilation, improve compliance, and may lessen ICP when effective. Veno-venous ECMO can be performed without the use of anticoagulation, and is therefore considered a possibility as a rescue technique in severe TBI. Nitric oxide does not increase ICP, and may improve ventilation/perfusion matching in severe lung injury. Prone positioning may lead to a significant increases in ICP and a critical decrease in CPP, making it the least safe option in a patient with elevated ICP [47].
92. **The correct answer is A.** There have been multiple cases series and reports over the past 20 years demonstrating the safety and feasibility of intrathecal tPA for the treatment of IVH. The CLEAR-III trial, a large randomized multicenter prospective trial evaluating the effect of intrathecal tPA on outcomes in

IVH, has already finished enrolling patients, and results are pending. After administration of tPA, the EVD is usually clamped for 1 h to allow the drug to circulate (not 8 h). 0.9 mg/kg is the intravenous tPA dose given for acute ischemic stroke, not IVH. Finally, although preliminary results are promising, tPA cannot be described as the current standard of care [48, 49].

93. **The correct answer is B.** In an SLE patient with hemoptysis, worsening hypoxemia, and bilateral infiltrates on chest x-ray, it is important to rule out diffuse alveolar hemorrhage (DAH). DAH affects the majority of the alveolar capillary surface, and is a medical emergency that often leads to acute respiratory failure. Progressively bloody return is seen on bronchoalveolar lavage. It is imperative that DAH is differentiated from other causes of hemoptysis in SLE patients, such as acute lupus pneumonitis, and bronchoscopy with bronchoalveolar lavage is the only way to confirm this. CT pulmonary angiography would be ideal for diagnosing pulmonary embolism, but hemoptysis with diffuse bilateral infiltrates makes DAH more likely. Echocardiogram may help diagnose heart failure, which may present with diffuse infiltrates and pink, frothy sputum, but it would not help rule out DAH.
94. **The correct answer is C.** The Hunt-Hess scoring system classifies the severity of subarachnoid hemorrhage based on the clinical exam, from 1 (least severe) to 5 (most severe). Hunt-Hess 1 is defined by either no symptoms, or mild headache/neck pain; Hunt-Hess 2 is defined by severe headache/neck pain, with or without cranial nerve palsies, but no other neurologic deficit; Hunt-Hess 3 is defined drowsiness/confusion, with mild focal deficits; Hunt-Hess 4 is defined by stupor, with moderate to severe hemiparesis; and Hunt-Hess 5 is defined by coma and decerebrate posturing. The modified Fisher scale, on the other hand, is based entirely on the thickness of subarachnoid blood and the presence or absence of blood in the lateral ventricles. The modified Fisher score is as follows: modified Fisher 0, no subarachnoid blood or IVH; modified Fisher 1, thin (<1 mm) subarachnoid blood, no IVH; modified Fisher 2, thick subarachnoid blood, no IVH; modified Fisher 3, thin subarachnoid blood with IVH; and modified Fisher 4, thick subarachnoid blood with IVH [50].
95. **The correct answer is A.** The chest x-ray shows multiple right sided rib fracture, with three consecutive ribs fractured in two placed, known as "flail chest". Primary management includes analgesia and incentive spirometry to prevent atelectasis and pneumonia. There is no role for chest wall binding or thoracotomy, and the need for intubation is rare.
96. **The correct answer is E.** As evidenced by her significantly decreased NIF, this patient is having a myasthenic crisis, likely exacerbated by infection, and requires emergent therapy (plasmapheresis or IVIG) to decrease her chances of requiring intubation. Given her absence of bulbar weakness, she does not require intubation, but may benefit from BiPAP if she develops ongoing respiratory insufficiency. Broadening her antibiotic coverage is unnecessary; group A strep has not demonstrated significant penicillin resistance and the reason for failure is likely inadequate source control of her abscess, which has now

been remedied. Corticosteroids may be helpful for symptom control for strep throat and for longer-term myasthenia control, but does not directly address the most immediately life-threatening issue. Azathioprine may be useful in chronic disease management, but is not the best choice for this acute, life-threatening decompensation.

97. **The correct answer is B.** Neuroleptic malignant syndrome and malignant hyperthermia may both present with fever, diaphoresis, confusion, and tachypnea. Muscular rigidity and an elevation in serum creatine phosphokinase make neuroleptic malignant syndrome the more likely diagnosis.
98. **The correct answer is E.** Although bacterial infections, particularly *Streptococcus pneumoniae*, are common causes of cerebral abscesses overall, fungal pathogens account for the overwhelming majority of cases in patients who have received solid organ transplants. These include primarily aspergillus and candida species [51].
99. **The correct answer is A.** Capital budgeting covers investment in fixed assets. This may include machinery, technology, building space, or safety upgrades. Salaries, benefits, and ongoing utilities and supplies are not capital budget items.
100. **The correct answer is C.** Even brief exposures to excessive tidal volumes have been shown to be related to the development of ventilator associated lung injury and ARDS; this patient is currently hypocarbic, and is receiving >8 cc/mL tidal volume. While it would certainly be reasonable to examine , whether her fraction of inspired oxygen or PEEP should be titrated down, the most important first step would be to adjust her tidal volume appropriately [52].

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Exam 2 Questions

One of the first duties of the physician is to educate the masses not to take medicine.

William Osler
(1849–1919)

1. A 54-year-old male presents to the emergency department with altered mental status and lethargy after being found down by his family. He is ultimately intubated for airway protection, and is now in the ICU. A non-contrast head CT is performed (see Image 1). Occlusion of which of the following vessels could explain this patient's clinical presentation and CT findings?

   A. Artery of Adamkiewicz
   B. Artery of Drummond
   C. Artery of Heubner
   D. Artery of Percheron
   E. Artery of Samson

2. A 62-year-old, 100 kg male is admitted to the ICU with multifocal pneumonia, acute respiratory distress syndrome (ARDS), and ventilator-dependent respiratory failure. Escalating ventilator support has been required to maintain an oxygen saturation > 88%, with current ventilator settings as follows: pressure control, FiO_2 1.0, rate 14 breaths/min, positive inspiratory pressure 34 cm H_2O, positive end expiratory pressure (PEEP) 16 cm H_2O, inspiratory time 1.1 s. A recent arterial blood gas sample shows pH 7.29, $PaCO_2$ 44 mmHg, PaO_2 66 mmHg. What additional interventions can be performed at this time that will confer an evidence-based mortality benefit?

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Image 1 CT scan of the head

A. Begin inhaled nitric oxide at 20 ppm
B. Place a gastric manometer to target positive transpulmonary pressures
C. Place a pulmonary artery catheter to measure the wedge pressure
D. Initiate prone positioning
E. All of the above can be expected to confer a mortality benefit

3. A large bore nasogastric tube may be indicated for which of the following?

A. Refractory nausea and vomiting
B. Providing enteral nutrition to a septic patient
C. Decompressing a high grade bowel obstruction
D. Prophylaxis against swallowing a large volume of blood with a posterior nosebleed
E. All of the above

4. A 60-year-old male presents with weakness in right upper and lower extremities and worsening difficulty with walking for the last 48 h. Upon further questioning, he admits having similar symptoms 4 months ago that improved over few weeks with residual mild difficulty walking. He endorses intermittent urinary urgency. On exam, the patient demonstrates right hemiparesis (4/5 strength), a sensory level at T4 level bilaterally, and hyperreflexia in bilateral lower extremities. An MRI of the thoracic spine shows cord edema from T2 to T10 with T2/FLAIR hyperintensity and subtle gadolinium enhancement. There are multiple T2 flow voids on the dorsal surface of the spinal cord. What diagnostic test will most likely confirm diagnosis?

A. Lumbar puncture with CSF analysis
B. Conventional spinal cord angiography
C. MR spectroscopy of the spinal cord
D. Laminectomy and operative intervention
E. Paraspinal thoracic soft tissue ultrasound

5. A 51-year-old female with a recent subarachnoid hemorrhage (SAH) and recently removed external ventricular drain (EVD) is currently in the ICU with a cerebrospinal fluid (CSF) leak from her EVD site, fevers, and altered mental status. The patient is initiated on vancomycin and meropenem, and CSF cultures have been sent from a recently placed lumbar drain. Which of the following indicates the proper time to check a vancomycin trough along with an acceptable therapeutic level?

   A. Before the second dose; 10–15 μm/mL
   B. Before the third dose; 10–15 μm/mL
   C. Before the third dose; 15–20 μm/mL
   D. Before the fourth dose; 15–20 μm/mL
   E. before the fourth dose; 25–30 μm/mL

6. The bicaudate index is commonly used in the evaluation of which of the following disease states?

   A. Hydrocephalus
   B. Herniation
   C. Hemorrhagic mass effect
   D. Intracranial hypertension
   E. Intracranial hypotension

7. A 55-year-old female is admitted to the ICU after having been rescued from a house fire. She was found unconscious in her bedroom by firefighters. On arrival to the ED, she had dermal burns to her forehead and cheeks, her mouth and nose were covered in soot, and she had singed nasal hairs. She was intubated for airway control. Her vital signs are as follows: blood pressure 110/40 mmHg, heart rate 110 beats/min, oxygen saturation 98% (on 100% oxygen). You bolus crystalloids, plavce a subclavian central line, and send blood work from the central line. Her serum lactate level is 9 mmol/L, with the following venous blood gas: pH 7.22, pCO_2 32 mmHg, pO_2 77 mmHg, $ScvO_2$ 90%. What is the most likely mechanism of her acid-base derangement?

   A. Global tissue hypoperfusion
   B. Dysfunctional oxygen utilization
   C. Decreased metabolic demand
   D. Hemoconcentration
   E. All of the above

8. A 68-year-old male with a history of hypertension is being evaluated in the ED for right-sided weakness and slurred speech. A non-contrast head CT is performed, demonstrating a left-sided intracranial hemorrhage with the largest dimensions

measured at 1.5 cm × 2.0 cm. More than 50% of the hemorrhage is seen on ten cuts and less than 25% of the hemorrhage seen on two additional cuts, with a slice thickness of 0.5 cm. What is the approximate volume of this patient's bleed?

A. 7.5 cc
B. 15 cc
C. 30 cc
D. 60 cc
E. 120 cc

9. Which of the following dietary alterations may be beneficial in the treatment of super refractory status epilepticus?

A. Low protein, high carbohydrate
B. Low fat, high protein
C. Low fat, low protein
D. High fat, low carbohydrate
E. High fat, high carbohydrate

10. An anxious appearing 45-year-old male with no past medical history presents complaining of 2 days of mild dyspnea. He has had approximately 10 days of rhinorrhea and nonproductive cough, which have improved but not resolved. Review of systems is positive for paresthesias in both of his hands and feet; he states these began yesterday and are worse today. He has not had any fevers. His oxygen saturation on room air is 97%. On exam, he is not tachypneic, and his lungs are clear. Sensation is grossly intact in all extremities, although he does note subjective paresthesias. His motor exam is unremarkable. An EKG, chest x-ray, and two sets of cardiac enzymes are negative. What is the most appropriate next step?

A. Admit for serial exams and further work-up
B. Attempt a trial of intravenous benzodiazepines and reassess
C. Reassurance and discharge with outpatient follow-up
D. Observation in order to obtain a stress echocardiogram
E. Discharge with a trial of antibiotics for atypical pneumonia

11. All of the following are part of the most recent guidelines from the Society of Critical Care Medicine regarding the definition and diagnosis of sepsis and septic shock except:

A. Elimination of the term "severe sepsis"
B. Septic shock defined by serum lactate >2 mmol/L despite adequate resuscitation
C. Septic shock defined by hypotension requiring vasopressors to maintain mean arterial pressure (MAP) ≥65 mmHg
D. Use of the quick Sepsis-Related Organ Failure Assessment (qSOFA) score
E. Use of the Acute Physiology and Chronic Health Evaluation (APACHE) IV score

12. Regarding spontaneous cerebellar hemorrhage, assuming rebleed does not occur, over what time period are patients most likely to experience clinical deterioration?

A. 1–2 h
B. 12–24 h
C. 3–5 days
D. 1–2 weeks
E. Patients with spontaneous cerebellar bleeding do not deteriorate in the absence of rebleeding

13. An 84-year-old female with a history of Parkinson's dementia, chronic constipation, recurrent small bowel obstructions, peptic ulcer disease, and coronary artery disease is currently hospitalized for the treatment of community acquired pneumonia. She is receiving intravenous levofloxacin and has been tolerating a regular diet. On day 3, she begins complaining of severe abdominal pain, and a contrast-enhanced CT of the abdomen is obtained (see Image 2). Which of the following should be performed next?

Image 2 Contrast-enhanced CT of the abdomen

A. Discontinue diet, place a nasogastric tube to low intermittent wall suction
B. Surgical consultation for exploratory laparotomy
C. Interventional radiology consultation for percutaneous drainage
D. Discontinue levofloxacin, send stool sample for *Clostridium difficile* toxin assay
E. Gastroenterology consult for emergent upper endoscopy

14. According to Brain Trauma Foundation guidelines, which of the following range of values would be reasonable jugular venous oxygen saturation ($SjVO_2$) targets?

A. 75–90%
B. 50–75%
C. 35–50%
D. 20–35%
E. 15–20%

15. A 62-year-old female with myasthenia gravis maintained on low-dose prednisone presents with dysuria and urgency. She is started on a 5-day course of ciprofloxacin by her primary care physician. She returns 3 days later complaining of generalized weakness, although her urinary symptoms have resolved. Physical exam reveals mild to moderate ptosis without bulbar weakness and a negative inspiratory force (NIF) of 41. She is afebrile, and has no flank or suprapubic tenderness. What is the most appropriate next step in this patient's management?

    A. Increase oral prednisone dose
    B. Discontinue ciprofloxacin
    C. Admit to the hospital for plasmapharesis
    D. Admit to the hospital for intravenous immunoglobulin
    E. Add azathioprine

16. A 35-year-old male with no past medical history presents with a thunderclap headache and vertigo in the absence of focal neurologic symptoms. He does not report a history of easy bruising or bleeding. On exam, his blood pressure is 126/85 mmHg and he is neurologically intact. Head CT demonstrates a 2 mm medullary hemorrhage; platelet count and coagulation studies are unremarkable. The patient is admitted for monitoring and further workup. Angiography is performed and no vascular malformation is identified. The patient's exam remains nonfocal, and his vertigo improves. What is the most appropriate next step?

    A. Reassurance and discharge home
    B. Discharge home with 6-week follow-up angiography
    C. Begin oral antihypertensive therapy and discharge home
    D. Obtain an MRI of the neuroaxis
    E. Consult hematology service for a coagulopathy work-up

17. Which of the following statements is true regarding posterior reversible encephalopathy syndrome (PRES) associated with immunosuppression therapy?

    A. The severity of symptoms is directly correlated with supratherapeutic drug levels
    B. The risk is highest during the initial month of therapy
    C. Patients who develop PRES on calcineurin inhibitors (CNIs) have a contraindication to all CNI use in the future
    D. Discontinuation of immunosuppressive therapy is the first intervention to manage PRES
    E. None of the above

18. A 26-year-old male with no prior medical history presents with confusion, vomiting, and severe, diffuse myalgias approximately 1 day after starting a strenuous new workout routine. He is afebrile. A non-contrast head CT is performed, and is unremarkable. Which of the following findings would be expected on urinalysis?

A. Dipstick positive for blood and microscopic analysis with no red cells
B. Dipstick negative for blood and microscopic analysis with >50 red cells
C. Dipstick positive for blood and microscopic analysis with >50 red cells
D. Dipstick negative for blood and microscopic analysis with no red cells
E. The patient will not be able to provide a urine sample

19. Which of the following is the most common cause of intraventricular hemorrhage?

A. Intraventricular tumor
B. Intraventricular aneurysm
C. Intraventricular vascular malformation
D. Intraventricular trauma
E. Extension of parenchymal hemorrhage

20. A 28-year-old man is brought to the ED via ambulance after sustaining multiple gun-shot wounds to the abdomen. The patient has two 18-guage IVs and has received 1 L of lactated Ringer's (LR) solution en route. On arrival, his heart rate is 130 beats/min, blood pressure 74/40 mmHg, respiratory rate 30 breaths/min, and his oxygen saturation is 99% on 2 L via nasal cannula. His eyes are open, he is moaning in pain, and moving his arms spontaneously. A second liter of LR is bolused. His focused abdominal sonographic exam shows free intraperitoneal fluid in Morrison's pouch. Which of the following should be performed next?

A. Bolus an additional 2 L of LR
B. Administer 4 units packed red cells (PRBC), 2 units fresh frozen plasma (FFP), and 1 unit of single-donor platelets
C. Administer 4 units PRBC, FFP to a target international normalized ratio (INR) of <1.7, and platelets to target count $>100 \times 10^3/\mu L$
D. Administer 4 units PRBC, administer FFP to target INR <1.7, and platelets to target count $>50 \times 10^3/\mu L$
E. Allow permissive hypotension

21. A 74-year-old male is currently intubated in the ICU following the development of a spontaneous intracerebral hemorrhage. His hospital course has been complicated by the development of pyelonephritis and septic shock, and you are having trouble weaning him off the ventilator after nearly 2 weeks in the ICU. You decide to perform the peroneal nerve test in order to evaluate for the presence of critical illness polyneuropathy (CIP). Which of the following is true?

A. The peroneal nerve test is a poorly sensitive screening test for the presence of CIP
B. The test is considered positive if peroneal nerve testing is abnormal in both legs
C. The test cannot be performed at the bedside
D. Patients with an abnormal peroneal nerve test require a complete nerve conduction study in order to objectively diagnose CIP
E. An abnormal peroneal nerve test should be repeated in 24 h, and if positive, confirms the diagnosis of CIP

22. A 58-year-old female is admitted to the ICU with a Hunt-Hess 3, modified Fisher 3 subarachnoid hemorrhage (SAH). She is intubated, and requiring 100% FiO_2 to maintain a PaO_2 of 100 mmHg. She is also hypertensive despite a continuous nicardipine infusion, and hyperglycemic at 277 mg/dL. Which scoring system will most succinctly identify this patient's risk factors for early mortality beyond her acute neurologic injury?

    A. The Hunt-Hess and modified Fisher scores are sufficient
    B. The Acute Physiology and Chronic Health Evaluation (APACHE) score
    C. The Medical Early Warning Signs (MEWS) score
    D. The Therapeutic Intensity Score (TIS)
    E. The Physiologic Derangement Score (PDS)

23. Which of the following is most commonly seen in patients with cerebral autosomal-dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL)?

    A. Migraines by age 30
    B. Temporal lobe epilepsy
    C. Dementia by age 40
    D. Severe mood disturbances
    E. All of the above

24. All of the following are commonly affected in Toxoplasmosis except:

    A. Pituitary gland
    B. Brainstem
    C. Basal ganglia
    D. Meninges
    E. Corticomedullary junction

25. Which of the following is not a known risk factor for nontraumatic subarachnoid hemorrhage (SAH)?

    A. Hypertension
    B. Cigarette smoking
    C. Excessive alcohol consumption
    D. History of peripheral vascular disease
    E. All of the above are risk factors

26. A 76-year-old female was recently discharged from the hospital after suffering an ischemic right middle cerebral artery infarct. She is weak on her left side, but able to walk unassisted. She requires help completing her activities of daily life (ADLs), and has moderate dysarthria. What is this patient's modified Rankin score?

    A. 1
    B. 2
    C. 3

D. 4
E. 5

27. Which of the following medications is not a direct thrombin inhibitor (DTI)?

A. Lepirudin
B. Bivalirudin
C. Argatroban
D. Dabigatran
E. Rivaroxaban

28. Steep increases in intracranial pressure lasting for 5–10 min are best described as:

A. Lundberg A waves
B. Lundberg B waves
C. Lundberg C waves
D. Lundberg D waves
E. Lundberg E waves

29. Aerophobia is most commonly seen in which of the following disease states?

A. Malignant hyperthermia
B. Seratonin syndrome
C. Leptomeningeal carcinomatosis
D. Meningococcal meningitis
E. Rabies encephalitis

30. A 61-year-old male with a history of degenerative disc disease and coronary artery disease is recovering postoperatively from a C3-C6 anterior cervical discectomy and fusion. Approximately 12 h after his procedure, he develops acute quadriparesis, and a stat CT of the cervical spine demonstrates a spinal epidural hematoma. He returns to the operating room for hematoma evacuation, and is transferred back to the ICU for further monitoring. The patient is now weakly antigravity in the proximal upper extremities and is 1/5 in the bilateral lower extremities. You perform a rapid bedside ultrasound of the lower extremities, and it is negative for deep vein thrombosis (DVT). Which of the following statements is correct?

A. An inferior vena cava (IVC) filter should be placed at this time, but no systemic anticoagulation
B. An IVC filter should be placed at this time, and the patient should be started on prophylactic enoxaparin this evening
C. No IVC filter should be placed at this time, and no systemic anticoagulation should be initiated
D. No IVC filter should be placed at this time, and the patient should be started on prophylactic enoxaparin this evening
E. Any of the above are reasonable options

31. Regarding acute ischemic infarcts due to emboli in the setting of non-valvular atrial fibrillation, approximately what percentage of emboli originate in the left atrial appendage?

    A. 10%
    B. 25%
    C. 50%
    D. 75%
    E. 90%

32. Which of the following is the earliest sign of intra-abdominal hypertension (abdominal compartment syndrome)?

    A. Fever
    B. Rapidly expanding abdominal girth
    C. Oliguric kidney injury
    D. Altered mental status
    E. Complete bowel obstruction

33. Which of the following may indicate occult pelvic fracture in a 22-year-old male patient with multisystem trauma following a motor vehicle accident?

    A. Instability with downward pressure
    B. Scrotal swelling
    C. Blood at the meatus
    D. Contrast extravasation on CT scan
    E. All of the above

34. A 48-year-old female with hepatitis C and alcoholic cirrhosis is admitted to the ICU with worsening mental status. On admission, her renal function is normal; however, over the next several days, her creatinine increases fourfold despite daily albumin administration, foley catheter drainage, and no ultrasonographic evidence of obstructive uropathy or parenchymal renal disease. All potentially nephrotoxic agents have been avoided. Her vital signs are within normal limits and she is without obvious signs of infection. Serum potassium and bicarbonate levels are within normal limits. The next best . step in management is:

    A. Administer dopamine
    B. Administer octreotide, midodrine and albumin
    C. Consult radiology for possible transjugular intraheptic portosystemic shunt (TIPS) procedure
    D. Initiate hemodialysis
    E. Diurese the patient

35. Hollow viscous injury as a result of blunt abdominal trauma is most likely to occur at which of the following anatomic locations?

    A. Points of fixed bowel
    B. Freely mobile portions of bowel

C. More caudal portions of bowel
D. More rostral portions of bowel
E. Centrally located portions of bowel

36. Which of the following is true regarding acute disseminated encephalomyelitis (ADEM)?

A. Although it can affect patients of all ages, it is most commonly seen in the elderly population
B. Symptoms may develop several weeks after a bacterial infection
C. Unlike multiple sclerosis, patients with ADEM suffer a single symptomatic episode, followed by either death (approximately 50% of cases) or complete recovery
D. Unlike multiple sclerosis, ADEM rarely causes impairment in consciousness
E. First-line therapy consists of either intravenous immunoglobulin (IVIg) or plasmapharesis, with high-dose intravenous corticosteroids reserved for refractory cases

37. Approximately what percentage of brain abscesses arise via hematogenous spread from other sources?

A. 1%
B. 5%
C. 33%
D. 66%
E. 90%

38. A 31-year-old male with a history of HIV and recurrent *Pneumocystis* pneumonia on dapsone prophylaxis is brought to the ED after a generalized tonic-clonic seizure at home. The patient's wife reports he has been fatigued for 1 week, followed by several hours of confusion that preceded his seizure. He is afebrile. A non-contrast head CT performed on admission does not show any overt lesions, and the results of a lumbar puncture are pending. Which of the following should be performed next?

A. Repeat the head CT with IV contrast administration
B. Empirically treat for both bacterial and viral meningitis
C. Arrange for 24-h video electroencephalography (vEEG)
D. Obtain an arterial blood gas
E. Place the patient on a continuous magnesium infusion

39. A 65-year-old male remains severely encephalopathic in the ICU 1 week after suffering a spontaneous intraparenchymal and intraventricular hemorrhage, likely related to chronic hypertensive microangiopathy. The nurse is reporting him as "stuporous", with a Richmond Agitation Sedation Scale (RASS) score of −3, the neurosurgical resident scores him Glasgow Coma Scale (GCS) 7T, the physician assistant finds him "very drowsy", while the neurology resident

prefers the term "lethargic". Which score best helps you to succinctly reconcile these statements into a more unequivocal assessment of his current level of consciousness?

A. The GCS score reliably conveys this information; his score is less than 8, so he is comatose
B. The RASS suffices to assess his level consciousness
C. A combination of the FOUR score, his attention span, and which stimulus leads to arousal
D. Assessing his orientation to person, place, self, and recent events
E. All of the above provide equivalent information

40. Which of the following is the most common side effect of the anti-rejection medication tacrolimus?

A. Mood instability
B. Akinetic mutism
C. Fine hand tremor
D. Posterior reversible encephalopathy syndrome (PRES)
E. Chronic demyelinating sensorimotor neuropathy

41. A 39-year-old female presents to the ICU post-operatively following resection of a large right frontal mass. A preliminary pathology report indicates the presence of anaplastic cells, and no other masses or lesions have been identified elsewhere. Which of the following therapies would not be a reasonable future treatment option for this patient?

A. Bevacizumab
B. Temozolomide
C. Gemcitabine
D. Resection of recurrent lesions
E. Stereotactic radiosurgery

42. A 71-year-old female with a history of COPD requiring home oxygen use is admitted to the ICU after a mechanical fall that resulted in a subdural hematoma. The patient required intubation in the field for a Glasgow Coma Scale (GCS) score of 4. Three days after admission, the patient is sent for a computed tomography (CT) scan of the chest due to increasing secretions noted during endotracheal tube suctioning, as well as an increasing oxygen requirement. All of the following elements of the history are risk factors for the development of a ventilator-associated pneumonia (VAP) except:

A. Age >60
B. History of COPD
C. Transport out of the ICU for a diagnostic procedure
D. Need for reintubation
E. Female gender

43. A 36-year-old male presents to the emergency department with a first-time seizure, and has a second episode while being evaluated in the hospital. A noncontrast head CT demonstrates a suspicious hyperdensity, and the lesion takes on a "popcorn" appearance on follow-up MRI. Which of the following is a risk factor for developing the most likely pathology?

    A. Cigarette smoking
    B. Prior whole brain radiation for a pediatric brain tumor
    C. Prior episode of Varicella zoster encephalitis
    D. Prior severe closed head injury
    E. Cocaine abuse

44. A 60-year-old female with a history of generalized anxiety disorder and severe alcohol abuse with multiple prior hospitalizations for delerium tremens has just been admitted to the ICU for confusion, tremor, and agitation. She normally consumes approximately 3 L of red wine per day. Her serum alcohol level is 181 mg/dL on arrival. A serum level above which of the following cutoffs should effectively prevent this patient from experiencing alcohol withdrawal seizures?

    A. 50 mg/dL
    B. 100 mg/dL
    C. 175 mg/dL
    D. 275 mg/dL
    E. None of the above

45. Approximately what percentage of patients suffering from aneurysmal subarachnoid hemorrhage will go on to develop delayed (occurring weeks to months later) hydrocephalus?

    A. 1%
    B. 5%
    C. 10%
    D. 25%
    E. 33%

46. A 49-year-old female who is HIV-positive is currently in the ICU following an aneurysmal subarachnoid hemorrhage complicated by stress-induced cardiomyopathy. The patient exhibits persist hypotension, and you decided to place a right internal jugular central venous catheter. During the procedure, you accidentally suffer a needlestick injury, and promptly report the incident to your supervisor. What is your approximate risk of contracting HIV as a result of this incident?

    A. 0.3%
    B. 3%
    C. 33%
    D. 66%
    E. 99%

47. All of the following are true regarding primary angiitis of the central nervous system except:

    A. The etiology is unknown
    B. It is more commonly seen in women
    C. It is an uncommon disease
    D. The most common presenting symptom is headache
    E. It affects the small and medium sized arteries of the brain

48. You are taking care of a patient with an aneurismal subarachnoid hemorrhage complicated by septic shock secondary to multifocal pneumonia. She is recovering from her infection, but now appears to be fluid overloaded due to the saline boluses given at the time that she was hypotensive, and her serum creatinine has doubled in the last 24 h. Which of the following is true regarding furosemide use in this patient?

    A. Furosemide may ameliorate ischemic damage in acute kidney injury by reducing the energy requirements of cells within the loop of Henle, and can be used as a prophylactic agent at the time of imaging procedures with contrast
    B. Randomized clinical trials have shown that furosemide can be used as a prophylactic agent for acute kidney injury perioperatively
    C. The use of furosemide may aid in the management of hypokalemia and hypocalcemia
    D. Furosemide facilitates diuresis and improves kidney recovery among patients requiring dialysis for acute kidney injury
    E. Furosemide can be used to facilitate mechanical ventilation in volume-overloaded patients

49. Which of the following regarding the treatment of pancreatitis is correct?

    A. Aggressive fluid resuscitation is important in the early stages of acute pancreatitis
    B. Prophylactic antibiotics play an essential part in reducing complications in severe pancreatitis
    C. H2 blockers or proton pump inhibitors are recommended for reducing the course and severity of disease
    D. Nasogastric suction is recommended as part of routine management
    E. All of the above

50. A 71-year-old male is currently intubated in the ICU following an aneurysmal subarachnoid hemorrhage. His hospital course has been complicated by aspiration pneumonia and persistent fevers despite acetaminophen administration and appropriate antibiotic therapy. You decide to use a water-circulating surface cooling system to control the patient's fever, but he begins to shiver uncontrollably. Which of the following is the next best step?

    A. Discontinue water-circulating surface cooling
    B. Initiate surface counterwarming
    C. Administer buspar and magnesium

D. Administer magnesium and meperidine
E. Administer meperidine and propofol

51. A 59-year-old female with a history of diabetes, hypertension, and atrial fibrillation was recently hospitalized for an acute ischemic infarct, and was subsequently discharged to a rehabilitation facility. She presents to the emergency department 1 week later with fevers and cough productive of foul smelling sputum. There is no prior history of tuberculosis exposure, and she recently had a negative PPD screen. Computed tomography (CT) of the chest is performed (see Image 3). Which of the following should be performed next?

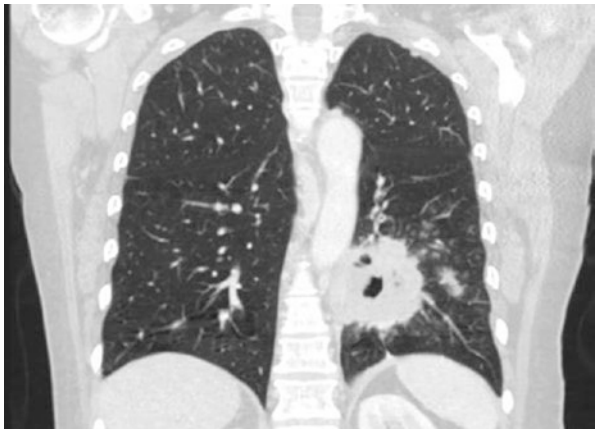


Image 3 CT scan of the chest

A. Administer clindamycin
B. Refer for urgent bronchoscopy
C. Place the patient on airborne isolation
D. Start systemic anticoagulation with an continuous heparin infusion
E. Refer for image-guided transthoracic biopsy

52. Which of the following may put patients at a greater risk of postoperative chemical (not bacterial) meningitis?

A. Surgical manipulation of the sinuses
B. Surgical manipulation of the spine
C. Presence of CSF rhinorrhea
D. Occurrence in the immediate postoperative period
E. New focal neurologic deficits

53. A 34-year-old female presents to the ED with headache, nausea and vomiting. A non-contrast head CT is performed, demonstrating thick, diffuse subarachnoid blood in the basilar cisterns with extension into the Sylvian fissures bilaterally. The patient is neurologically intact. Conventional angiography is

performed, and does not reveal the presence of any underlying vascular lesions. Magnetic resonance imaging of the neuroaxis is also unremarkable. Which of the following are the best next steps in this patient's management?

A. Discharge home, repeat angiography in 1 year
B. Transfer out of the ICU, observe for 3 days, discharge home, repeat angiography in 3 months
C. Transfer out of the ICU, observe for 14 days, discharge home, repeat angiography in 6 months
D. Observe in the ICU, repeat angiography in 7 days, discharge home if negative
E. Observe in the ICU, discharge home in 7 days, repeat angiography in 9 months

54. A 45-year-old male is admitted to the ICU after a witnessed seizure. He was intubated in the field without complications. Head imaging on arrival showed a temporal lobe mass that was successfully resected. The patient passed a weaning trial, and was extubated on the fourth postoperative day. Thirty minutes after extubation, the patient became aphonic. He is also noted to be dyspneic, with a respiratory rate of 40 breaths/min and a heart rate of 108 beats/min. What is the next best step in alleviating the patient's symptoms?

A. Reintubate the patient
B. Initiate noninvasive positive pressure ventilation with frequent reassessment
C. Administer supplemental oxygen via nasal cannula
D. Refer for urgent bronchoscopy
E. Administer racemic epinephrine and inhaled bronchodilators

55. A 65-year-old 100 kg female is currently intubated in the ICU following a left spontaneous intracerebral hemorrhage (ICH) complicated by convulsive status epilepticus. Continuous electroencephalography (EEG) at day 2 demonstrated gross seizure control. She is on a continuous propofol infusion and phenytoin 150 mg every 8 h, and is receiving continuous feeding for 18 h per day via nasogastric tube (NGT). The patient has had daily fevers for the past several days despite a negative bacteriological workup. On day 3, the patient has three consecutive 2-min convulsions in the right upper extremity with definite corroboration on EEG, followed by lateralizing epileptiform discharges spreading from the left parietal area. Which of the following should be performed next?

A. Discontinue tube feeds, taper off propofol, and assess for extubation readiness
B. Increase propofol infusion, and increase phenytoin to 200 mg every 8 h
C. Give 4 mg of lorazepam and replace phenytoin with valproate
D. Start midazolam infusion at 2 mg/kg/h until lateralizing epileptiform discharges abate
E. Rush the patient to the operating room for clot evacuation

56. Under which value should blood pressure be controlled in the first 24 h following tPA administration in the setting of an acute ischemic infarct?

    A. 165/110
    B. 165/105
    C. 185/110
    D. 180/105
    E. 220/110

57. A 55-year-old male presents to the emergency department from his nursing home for increased lethargy. His past medical history is notable for hypothyroidism, atrial fibrillation, and recent hospitalization for traumatic brain injury sustained during a car accident. His medications include amantadine, levothyroxine and amiodarone. On examination, he has a blood pressure of 90/50 mmHg, heart rate of 52 beats/min, and a temperature of 95.5 °F. He has a healed tracheostomy scar, his gastrostomy site is erythematous, and there is a purulent collection around the tube. He does not open his eyes to deep noxious stimulation. At baseline, he is reported to be awake spontaneously and able to mouth words. Which of the following is least likely to be necessary at this time?

    A. Insulin infusion
    B. Corticosteroids
    C. Rewarming
    D. Intravenous fluids
    E. Mechanical ventilation

58. Which of the following is true regarding the difference between SvO_2 and $ScvO_2$?

    A. SvO_2 is measured from the superior vena cava, while $ScvO_2$ is measured from the pulmonary artery
    B. $ScvO_2$ is normally higher than SvO_2 because of brain oxygen extraction
    C. Obtaining $ScvO_2$ is more invasive than obtaining SvO_2
    D. Obtaining $ScvO_2$ poses more risk to the patient than obtaining SvO_2
    E. None of the above

59. You are caring for an 81-year-old female who has experienced a prolonged ICU course after experiencing a fall with resultant subdural hematoma and dens fracture. She remains in a hard collar and has been unable to tolerate weaning from the ventilator. She is now beginning to develop worsening infiltrates on her chest x-ray, intermittent fevers, and anasarca. In the course of your daily rounds, you begin to notice scleral icterus and gradual increases in bilirubin and transaminases; her albumin is currently 1.4 g/dL. The patient winces in pain when her upper abdomen is palpated. Bedside ultrasound demonstrates a distended gallbladder with a thickened wall and a large amount of surrounding pericholecystic fluid, but no gallstones. The common bile duct is unremarkable. What is the next best treatment option for this patient?

A. Expectant management with antibiotics
B. Percutaneous cholecystectomy
C. Laparoscopic cholecystectomy
D. Endoscopic retrograde cholangiopancreatography (ERCP)
E. Magnetic resonance cholangiopancreatography (MRCP)

60. Which of the following is true regarding CT perfusion (CTP) for the evaluation of delayed cerebral ischemia (DCI) and cerebral vasospasm in the setting of aneurysmal subarachnoid hemorrhage (aSAH)?

A. A mean transit time (MTT) >4.0 s is pathognomonic for cerebral vasospasm
B. The combination of CT angiography (CTA) and CTP is superior to conventional angiography for the diagnosis of cerebral vasospasm
C. CTP offers no added benefit when combined with CTA in the evaluation of DCI
D. CTP cannot be accurately interpreted without concurrent real-time transcranial doppler (TCD) ultrasonography
E. None of the above

61. Which of the following correctly lists the incidence of primary brain tumor in adults from most common to least common?

A. Meningiomas, gliomas, pituitary tumors, CNS lymphoma
B. Gliomas, meningiomas, pituitary tumors, CNS lymphoma
C. CNS lymphoma, meningiomas, gliomas, pituitary tumors
D. CNS lymphoma, gliomas, meningiomas, pituitary tumors
E. Pituitary tumors, gliomas, CNS lymphoma, meningiomas

62. You are taking care of a patient with hepatic encephalopathy who also needs renal replacement therapy for acute kidney injury. Continuous renal replacement therapy is unavailable in your institution, and intermittent hemodialysis is suggested by the nephrologist. Which of the following is not a reasonable dialysis prescription to decrease the risk of secondary brain injury?

A. Using a dialyzer membrane with larger surface area
B. Using a lower blood flow rate
C. Using a lower rate of ultrafiltration
D. Using a cooler dialysate temperature
E. Using a lower rate of urea removal

63. Which of the following therapies is least helpful in the treatment of status asthmaticus requiring mechanical ventilatory support?

A. Inhaled helium
B. Inhaled anesthetics
C. Inhaled nitric oxide
D. Bronchoscopy
E. Intravenous magnesium

64. A 60-year-old male with diabetes melitus and no other significant medical history is currently intubated in the ICU secondary to status epilepticus and a left temporal lobe neoplasm. Overnight, the nurse notices the patient is experiencing a regular crescendo-decrescendo tidal volume pattern, interspersed with periods of apnea. His oxygen saturation remains normal during these episodes. Which of the following diagnostic tests should be performed next?

    A. Magnetic resonance imaging (MRI) of the brain
    B. Arterial blood gas
    C. Venous blood gas
    D. Bedside echocardiogram
    E. Computed tomography (CT) of the chest

65. A 31-year-old female with a history of Lennox-Gastaut syndrome is currently intubated in the ICU for the treatment of status epilepticus. Her current antiepileptic regimen includes valproic acid (VPA), levetiracetam, and a continuous propofol infusion. The most recent serum ammonia level was 104 mcg/dL, and you decide to initiate levocarnitine therapy. Which of the following statements is correct?

    A. Long-term therapy, but not acute VPA overdose, is associated with depleted carnitine levels
    B. Levocarnitine should be co-administered with VPA in status epilepticus, even in the absence of hyperammonemia
    C. The oral and intravenous forms have roughly equivalent bioavailability
    D. There are no randomized trials evaluating the efficacy of levocarnitine in VPA-induced hyperammonemia
    E. All of the above are correct

66. A 34-year-old obese male is currently in the ICU following a motor vehicle accident and multiple orthopedic injuries. He is currently on low molecular weight heparin for DVT prophylaxis, dosed at 30 mg every 12 h. Which of the following would be the appropriate range of anti-Xa serum values in order to ensure proper thromboprophylaxis?

    A. <0.1 IU/mL
    B. 0.1–0.2 IU/mL
    C. 0.2–0.5 IU/mL
    D. 0.5–1.2 IU/mL
    E. 1.2–2.0 IU/mL

67. A 39-year-old female is currently intubated in the ICU following a motor vehicle accident with multiple long bone fractures and a small traumatic subarachnoid hemorrhage. A urine drug screen was performed on arrival which was positive for the presence of amphetamines, though the patient's family is adamant that the patient has no history of substance abuse. Which of the following medical conditions would most likely explain this test result?

A. Hyperlipidemia
B. Restless leg syndrome
C. Depression
D. Hypothyroidism
E. Infertility

68. A 34-year-old female is currently in the ICU with an acute left superior cerebellar artery thrombus. She was attending a yoga class when she experienced profound, sudden onset vertigo. She has no past medical history and her only medication is an estrogen-containing oral contraceptive. A recent outpatient echocardiogram and lipid profile were unremarkable. Which of the following is most likely to be discovered on further work-up?

A. Elevated serum homocysteine
B. Abnormal factor V variant
C. Positive platelet seratonin release assay
D. History of recent international airline travel
E. All of the above are equally likely

69. A 23-year-old female is admitted to the ICU for treatment of suspected herpes simplex (HSV) encephalitis. She had been complaining of "flu-like" symptoms for the approximately 4 days, along with vomiting and severe headaches. She is initiated on empiric acyclovir treatment, 10 mg/kg three times a day. Her laboratory work on admission is unremarkable. What intervention can be done in order to reduce the risk of acyclovir induced nephrotoxicity?

A. No intervention needed, as the risk of nephrotoxicity at this dosage is minimal
B. Reduce the dose to 5 mg/kg IV three times a day
C. Administer crystalloids before and after each dose
D. Switch from intravenous to oral acyclovir
E. No intervention has been proven to decrease the risk of acyclovir nephrotoxicity

70. A 69-year-old female with a history of chronic kidney disease is currently being evaluated for a suspected intracranial mass seen on non-contrast head CT, and you are considering ordering a contrast-enhanced MRI. Below which of the following glomerular filtration rate (GFR) cutoffs, in general, would the administration of gadolinium be considered too dangerous to proceed?

A. 10 mL/min/1.73 m^2
B. 15 mL/min/1.73 m^2
C. 30 mL/min/1.73 m^2
D. 45 mL/min/1.73 m^2
E. 60 mL/min/1.73 m^2

71. Which of the following is true regarding the use of statins to improve functional outcomes in the setting of aneurysmal subarachnoid hemorrhage? (aSAH)

A. Improved functional outcomes have been demonstrated in a dose-dependent fashion
B. Improved functional outcomes demonstrated with a fixed benefit across a range of doses from 10 mg to 40 mg daily
C. Improved functional outcomes have been demonstrated when used in conjunction with oral nimodipine
D. Improved functional outcomes have not been demonstrated
E. The efficacy of statins in aSAH has not been prospectively studied

72. All of the following elements help differentiate myoclonic status epilepticus from Lance-Adams syndrome except:

A. Presence of coma
B. Occurrence after cardiac arrest
C. Long term prognosis
D. Intention myoclonus
E. All of the above

73. A 40-year-old female with a history of tuberculosis and significant hemoptysis is currently being evaluated in the ICU for bronchial artery embolization. All of the following are potential complications of this procedure except:

A. Transverse myelitis
B. Bronchoesophageal fistula
C. Pulmonary embolism
D. Dysphagia
E. Chest pain

74. A 64-year-old female is currently in the ICU following a motor vehicle accident in which she suffered several broken ribs, a right-sided femur fracture, and a small right-sided subdural hemorrhage. She subsequently develops severe acute respiratory distress syndrome (ARDS) and requires mechanical ventilation. She is currently on airway pressure release ventilation (APRV) with the following settings: T_{high} 5.4 s, T_{low} 0.8 s, P_{high} 30, P_{low} 0, FiO_2 70%. Her last arterial blood gas is as follows: pH 7.27, $PaCO_2$ 48, PaO_2 67. Which of the following measures would not potentially improve this patient's hypoxemia?

A. Increase the mean airway pressure
B. Increase T_{low}
C. Increase the fraction of inspired oxygen
D. Initiate inhaled nitric oxide therapy at 10 parts per million
E. Prone the patient

75. A 45-year-old right-handed female who presented with headaches was found to have an unruptured arteriovenous malformation (AVM) on imaging. The AVM is located in the left frontal lobe and measures <3 cm. Subsequent cerebral angiography revealed no associated aneurysms, and the AVM drains into the superficial veins. Which of the following is the best treatment for this patient?

A. Craniotomy and surgical removal
B. Medical management alone
C. Endovascular treatment with complete obliteration of AVM by embolization
D. Stereotactic radiotherapy alone
E. Combination of craniotomy and stereotactic radiotherapy

76. A 45-year-old male with a history of HIV presents to the emergency department with headaches that have worsened over the past 2 weeks, and the patient is ultimately diagnosed with cryptococcal meningitis. His baseline serum creatinine is 1.1 mg/dL. The patient is initiated on amphotericin B and flucytosine for treatment. On day 2 of therapy, his serum creatinine increases to 1.5 mg/dL. Which of the following is the next best step in this patient's management?

A. Reduce the dose of amphotericin B
B. Discontinue flucytocine
C. Administer normal saline boluses with each dose of amphotericin B
D. Increase the administration rate of amphotericin B
E. Decrease the administration rate of flucytocine

77. Which of the following lab abnormalities is most commonly seen in patients with aneurysmal subarachnoid hemorrhage?

A. Hyponatremia
B. Hypercalcemia
C. Hypophosphatemia
D. Hyperglycemia
E. Hypochloremia

78. Perflutren lipid microspheres may be used to aid in the diagnosis of which of the following disease processes?

A. Left ventricular thrombus
B. Middle cerebral artery thrombus
C. Basilar artery thrombus
D. Popliteal deep venous thrombus
E. Cerebral venous thrombus

79. A 67-year-old female presents to the emergency department for several months of worsening headaches and pulsatile tinnitus in her right ear. Her past medical history is remarkable only for mild osteoarthritis, and she does not report any history of trauma. She is neurologically intact. A vascular abnormality is found on further imaging. Which of the following statements is true regarding the most likely diagnosis?

A. Pulsatile tinnitus results from drainage into the transverse or sigmoid sinus
B. The Barrow classification system divides lesions into Types A, B, C and D
C. Lesions may be treated surgically or via sterotactic radiosurgery, but not endovascularly

D. Lesions do not recur after treatment
E. Common findings include vision loss and the presence of an orbital bruit

80. Approximately what percentage of patients suffering from spontaneous intracerebral hemorrhage (ICH) will go on to develop epilepsy over the subsequent 24 months?

A. 1%
B. 5%
C. 10%
D. 25%
E. 50%

81. Which of the following is the drug of choice for empiric treatment of a suspected candida infection of a cerebrospinal fluid (CSF) shunt?

A. Anidulafungin
B. Amphotericin B
C. Fluconazole
D. Flucytocine
E. All of the above are reasonable options

82. If all of the following patients arrived in the emergency department and were triaged simultaneously, which one should be treated first?

A. 56-year-old male who took his apixaban this morning after awakening with left arm weakness
B. 43-year-old female with back pain and worsening lower extremity weakness for 1 month
C. 85-year-old male with known brain cancer and focal right leg seizure activity
D. 64-year-old female with 30 min of facial droop and slurred speech
E. 70-year-old female with 8 h of dizziness

83. A 60-year-old male with a history of metastatic lung cancer and recent gamma knife radiosurgery for an isolated cerebral metastatic lesion presents to the emergency department with several complaints, including a cough productive of rust-colored sputum, increased early morning headaches, urinary hesitancy, weakness in the bilateral lower extremities, and several days of subjective fever and chills. His vital signs are as follows: blood pressure 171/88 mmHg, heart rate 64 beats/min, respirations 14/min, saturation 93% on room air, and temperature of 99.9 °F. He is awake, alert, and in no acute distress. His serum white blood cell count is 24.9×10^9/L. Obtaining which of the following is most urgent at this time?

A. Non-contrast CT of the head
B. Contrast enhanced CT of the chest, abdomen, and pelvis
C. MRI of the lumbar spine
D. Blood and sputum cultures
E. A manual differential of the patient's white blood cell count

84. A 55-year-old female is currently in the ICU following evacuation of a subdural hematoma suffered after a fall from standing. It is now day 7, and her hematoma has not reaccumulated. She has had a fluctuating mental status and transient aphasia for the last several days, which prompts continuous electroencephalography (EEG) monitoring, revealing left frontal and parietal periodic lateralized epileptiform discharges (PLEDs) that accelerate to 2.5 Hz, but never spread or vary in amplitude. Some of these rhythmic accelerations are prompted by noxious stimulation, but there is no superimposed fast activity. She is on levetiracetam at 1.5 g twice a day and valproate (VPA) 400 mg three times a day (last serum VPA level 80 μg/mL). You are considering her EEG pattern to be responsible for her fluctuating mental status, and have given the patient 1 mg of midazolam to see if this would improve her mental status, but her respiratory rate plummets and she nearly required intubation. Which of the following should be considered next?

    A. Continue current regimen; her EEG pattern reflects fixed brain injury from her fall
    B. Increase the dose of both her valproate and levetiracetam
    C. Obtain single photon emission computerized tomography (SPECT) to assess if her PLEDs coincide with foci of hypermetabolism or hyperperfusion
    D. Obtain CT perfusion imaging to assess if her PLEDs coincide with foci of hypermetabolism or hyperperfusion
    E. Discontinue both VPA and levetiracetam, as guidelines do not recommend long term antiepileptic medications following subdural hemorrhage

85. A 19-year-old 70 kg male with a traumatic hemothorax secondary to a penetrating chest injury undergoes left-sided tube thoracostomy. 550 mL of blood is initially drained from the pleural space, and over the subsequent 2 h, his chest drain output is recorded as 500 mL (first hour) and 450 mL (second hour). What is the next appropriate step in management?

    A. Continue chest tube drainage with close monitoring of vital signs and serial hemoglobin and hematocrit values
    B. CT of the chest with IV contrast
    C. Conventional angiography
    D. Thoracotomy
    E. Placement of a second left-sided thoracostomy tube

86. A 26-year-old female with a history of depression and schizoaffective disorder is brought to the hospital by her parents after noticing significant confusion and difficulty ambulating for the last few days. She has been maintained on sertraline for many years, with risperidone recently added for worsening depression. Her vital signs are as follows: blood pressure 166/80 mmHg, heart rate 117 beats/min, temperature 100.5 °F, respiratory rate 18 breaths/min, oxygen saturation 99% on room air. Physical exam is remarkable for lower and upper extremity rigidity and hyperreflexia. She is alert and oriented to person and place, but is unsure of the date or time. She cannot ambulate unassisted. Her blood work is

notable for a mild leukocytosis and a markedly elevated serum creatine kinase. A non-contrast head CT is unremarkable, and lumbar puncture yields normal cerebrospinal fluid. Which of the following should be administered next?

A. Vancomycin, ceftriaxone, and acyclovir
B. Dantrolene
C. Cyproheptidine
D. Urgent hemodialysis
E. Intravenous fluids and sedation with benzodiazepines as needed

87. According to guidelines from the American College of Surgeons, which of the following criteria should be met when administering blood products as part of a massive transfusion protocol (MTP)?

A. Administer 2 L of crystalloid after activating the MTP but prior to giving blood products
B. Administer 2 L of colloid after activating the MTP but prior to giving blood products
C. Transfuse one single donor apheresis or random donor platelet pool for every 10 units of RBCs
D. Transfuse universal RBCs and plasma in either 1:1 or 1:2 ratio
E. Transfuse RBCs, plasma, platelets and cryoprecipitate in a 1:1:1:1 ratio

88. Patients admitted to the ICU with severe traumatic brain injury (TBI) and cerebral contusions who are comatose should routinely have which of the following monitoring devices applied based on current guidelines?

A. Brain tissue oxygen monitor
B. Cerebral microdialysis catheter
C. Jugular venous oxygen saturation monitor
D. Pulmonary artery catheter
E. Continuous video electroencephalography

89. In a patient with bright red blood per rectum and hemodynamic compromise:

A. A lower GI bleed is always assumed to be the source, and colonoscopic evaluation is the initial study of choice
B. Up to 10% may have may have an upper GI bleeding source, and upper endoscopy may be the first endoscopic evaluation
C. Surgical intervention should be sought immediately
D. A transjugular intrahepatic portosystemic shunt (TIPS) procedure is the initial treatment of choice
E. Internal hemorrhoids remain an important diagnostic consideration

90. An 84-year-old male has been terminally extubated in the ICU following a ruptured left middle cerebral artery aneurysm with a subsequent devastated neurologic exam. Approximately 10 min after extubation, asystole is noted on the monitor, and you are called to examine the patient. Which of the following represents the official time of death?

A. The approximate time the aneurysm ruptured
B. The time the patient was terminally extubated
C. The time asystole was noted on the cardiac monitor
D. The time the physician completes the death exam
E. Any of the above may be used

91. According to current guidelines, patients who have sustained acute spinal cord injury should have all of the following interventions performed except:

A. Systolic blood pressure maintained above 90 mmHg
B. Mean arterial pressure maintained between 85 and 90 mmHg for 7 days post-injury
C. Targeted temperature management with core body temperature of 33 °C for 3 days post-injury
D. Early surgical decompression for central cord syndrome
E. Management in an intensive care unit

92. Which of the following intracranial vessels is most readily assessed via Transcranial Doppler (TCD) ultrasonography?

A. The anterior cerebral artery (ACA)
B. The middle cerebral artery (MCA)
C. The posterior cerebral artery (PCA)
D. The posterior inferior cerebellar artery (PICA)
E. The basilar artery

93. A 45-year-old male with an ASIA A classification injury at the C5 level remains vasopressor-dependent 5 days after injury and 3 days after operative decompression and fixation. Which of the following adjunctive therapies has been shown to increase the likelihood of successfully weaning this patient off of pressors?

A. Scheduled pseudoephedrine administered orally
B. Administration of scheduled doses of 0.25 mg atropine IV every 6 h
C. Volume loading to achieve a central venous pressure (CVP) of >14 cm H_2O
D. Administration of oral nitrates to reduce left ventricular afterload and improve cardiac unloading
E. Administration of amantadine 100 mg orally twice daily to antagonize NMDA receptors in the central nervous system

94. The American Heart Association recommends that an ambulance bypass the closest hospital in favor of a regional stroke center in which of the following situations?

A. The patients requests they be taken 45 min further, because their primary care doctor works at that location
B. The regional stroke center is 15 min away, and the patient has a dense left hemiparesis that began 90 min ago
C. The regional stroke center is 40 min away, and the patient has slurred speech and a facial droop that began 15 min ago

D. The patient is complaining of right arm weakness that has been ongoing for the last 3 days
E. The patient goes into cardiac arrest en route to the hospital

95. A 51-year-old male recently involved in a low-speed rear-end motor vehicle collision (MVC) is currently being evaluated for the presence of a cervical spine injury. The patient self-extricated and was ambulatory at the scene. He is neurologically intact. On exam, he complains of midline cervical tenderness, but is able to range his neck 45° to the left and right. According to the Canadian C-spine Rules, which of the following clinical features necessitates further imaging of the neck?

A. Age >50
B. MVC
C. Midline neck tenderness
D. Male gender
E. The patient does not require further imaging

96. Which of the following has the highest sensitivity for diagnosing myasthenia gravis?

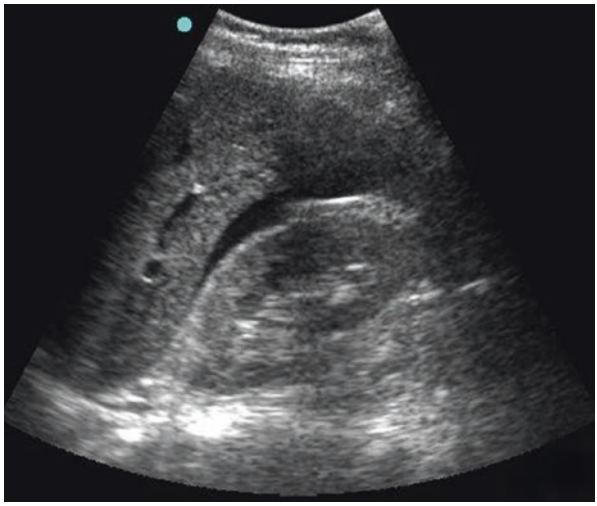
A. Ice pack test
B. Tensilon test
C. AChR antibodies
D. MuSK antibodies
E. Electromyography

97. A 61-year-old female with a history of chronic alcoholism has recently been diagnosed with osmotic demyelination syndrome following overly aggressive correction of chronic hyponatremia. She is currently intubated and quadriparetic. Approximately what percentage of patients in this scenario will make a complete recovery from their illness?

A. 0%
B. 1%
C. 5%
D. 10%
E. 33%

98. You are evaluating a 52-year-old construction worker who fell 20 ft to the ground from scaffolding. En route to the hospital, the patient received 1 L of lactated Ringer's (LR). Two 18-gauge IVs are in place and an additional 2 L LR are being bolused in the trauma bay. His vital signs are as follows: heart rate 120 beats/min, blood pressure 88/40 mmHg, respiratory rate 20 breaths/min, oxygen saturation 100% (room air). His Glasgow Coma Score (GCS) is 14 and he has bruising across his upper back and abdomen. The trauma resident performs a focused sonographic exam (see Image 4). Based on the clinical context, what is the diagnosis?

Image 4 Ultrasound of the abdomen



A. Ascites
B. Hemoperitoneum
C. Renal laceration
D. Hemothorax
E. Pneumothorax

99. Which of the following EEG patterns is uniquely associated with anti-N-Methyl-D-aspartate (NMDA) encephalitis?

A. Extreme delta brush
B. Frontal intermittent rhythmic delta activity (FIRDA)
C. Burst suppression
D. Generalized periodic epileptiform discharges (GPEDs)
E. Periodic sharp wave complexes (PSWCs)

100. Which of the following is associated with central diabetes insipidus?

A. Anorexia nervosa
B. Wolfram syndrome
C. Septo-optic dysplasia
D. Decreased thirst
E. All of the above

Exam 2 Answers

..so for me, the practice of medicine has become the pursuit of a rare element which may appear at any time, at any place, at a glance. It can be most embarrassing. Mutual recognition is likely to flare up at a moment's notice. The relationship between physician and patient, if it were literally followed, would give us a world of extraordinary fertility of the imagination, which we can hardly afford. There's no use trying to multiply cases; it is there, it is magnificent, it fills my thoughts, it reaches to the farthest limits of our lives.

William Carlos Williams
(1883–1963)

1. **The correct answer is D**. This patient's CT scan demonstrates bilateral thalamic infarcts. The artery of Percheron is an anatomic variant in which a single vessel arises from the posterior cerebral artery to feed the bilateral thalamic and midbrain structures, and an occlusion of this vessel would explain this patient's presentation. The artery of Adamkiewicz is a large anterior medullary artery that supplies blood to the thoracolumbar spinal cord, and an occlusion here can result in an anterior cord syndrome. The artery of Drummond is a colonic vessel that connects the superior and inferior mesenteric arteries, and provides collateral blood flow. The recurrent artery of Heubner is a branch of the anterior cerebral artery that supplies blood to the caudate and internal capsule, and an occlusion here may result in contralateral hemiparesis. Finally, the artery of Samson is a uterine vessel of little clinical significance.
2. **The correct answer is D.** The PROSEVA trial demonstrated that patients with ARDS and severe hypoxemia (PaO_2:FiO_2 ratio of <150 mmHg, with an FiO_2 >0.6 and PEEP >5 cm water) may benefit from prone positioning, with an unadjusted 28-day mortality of 16% vs. 32.8% in the standard care group. None of the other intervention listed has been shown to confer a mortality benefit in this setting [1].
3. **The correct answer is C.** Enteral nutrition can be accomplished with smaller, more comfortable tubes. Decompression is more likely to require a large bore tube to achieve appropriate and effective suction. Nasogastric tubes are not routinely placed in the management of epistaxis.
4. **The correct answer is B.** This patient has stepwise neurological decline with a lesion localized to thoracic spinal cord. Given the finding of spinal cord edema and flow voids in the thecal sac, a diagnosis of spinal AVM (aka Foix-Alajouanine syndrome) is likely, which has led to venous congestion and potentially a venous infarction of the thoracic spinal cord. Spinal angiography will likely confirm diagnosis, and will potentially be therapeutic with embolization of the feeding vessel [2].
5. **The correct answer is D.** Vancomycin trough levels should be checked approximately 30 min prior to the fourth dose. Therapeutic levels are generally in the 10–20 μ/mL range, with higher levels usually reserved for more severe infections. Levels exceeding 25 μ/mL are rarely (if ever) recommended, and may put patients at an increased risk of vancomycin toxicity.

6. **The correct answer is A.** The bicaudate index is defined as the diameter of the brain divided by the width of the frontal horns at the level of the caudate nuclei. It is usually used as a measure of hydrocephalus.
7. **The correct answer is B.** This patient's history (prolonged downtime in the setting of a fire in a closed space) and physical findings (soot around mouth and nose) indicate inhalation injury. Patients with inhalational injury from structure fires are at high risk of carbon monoxide (CO) and cyanide exposure (CN), which is evident in this case. Both CO and CN impair cellular utilization of oxygen, resulting in end-organ dysfunction and lactic acidosis. Elevated venous oxygen content reflects decreased oxygen utilization, and is characteristic of these conditions.
8. **The correct answer is A.** Intracranial hemorrhage volume can be measured using the formula A × B × C/2 (approximating the volume of an ellipsoid), where A and B are the largest perpendicular dimensions of the hemorrhage, and C is the number of slices on which the bleed is visible (assuming a slice thickness of 1.0 cm). C is also modified by the percent of hemorrhage seen on each slice, with >50% counting as one full slice, 25–50% counting as 0.5 slices, and <25% not counting at all. This patient has a bleed measuring approximately 1.5 × 2.0 cm, with ten slices that each count as a full slice and two slices that should not be factored in. Additionally, slice thickness here is 0.5 cm, making the calculation: 1.5 × 2.0 × (10/2)/2, or 7.5 cc [3]. Note that often times, a simplified (and less accurate) version of this formula is utilized which equally counts all slices on which a hemorrhage is visible, in which case the measured volume would be 9 cc.
9. **The correct answer is D.** The ketogenic diet may be beneficial in cases of super-refractory status epilepticus, based on the observation that mimicking the fasting state has proven beneficial in certain cases of childhood epilepsy [4]. As such, the diet is high in fat, low in carbohydrates, and contains sufficient dietary protein.
10. **The correct answer is A.** This patient's history of progressive paresthesias after a viral infection is suspicious for Guillain-Barre syndrome, and he should be admitted for close monitoring of his respiratory status. 80% of such patients have associated paresthesias which may portend significant muscular involvement. Given his absence of sputum production, fevers, or hypoxia, and his negative chest x-ray, pneumonia is unlikely. Benzodiazepines may be dangerous in this scenario; although anxiety-induced hyperventilation may cause similar paresthesias, he is not tachypneic on exam, and life-threatening causes of his presentation have not been adequately addressed. Likewise, reassurance and discharge is premature given the classic history for Guillain-Barre syndrome.
11. **The correct answer is E.** The most recent guidelines for the definition and diagnosis of sepsis and septic shock were released in 2016. These include several changes, most notably: elimination of the term "severe sepsis", defining septic shock by either lactate >2 mmol/L despite resuscitation or use of vasopressure to

maintain a MAP ≥65 mmHg, and the use of the qSOFA score (requiring at least two of the three elements) as a measure of organ dysfunction [5].

12. **The correct answer is B.** In contrast to patients with supratentorial hemorrhage, the tight posterior fossa may lead to rapid deterioration secondary to brainstem compression or hydrocephalus. This usually occurs in the first 12–24 h.
13. **The correct answer is B.** This patient's CT demonstrates pneumoperitoneum, concerning for ruptured viscus. Rapid surgical consultation for possible exploratory laparotomy is mandatory, along with broad spectrum antibiotic administration.
14. **The correct answer is B.** A normal $SjVO_2$ is in the 50–75% range. While there is no compelling data from randomized controlled trials to dictate saturation targets in traumatic brain injury, it is reasonable to avoid prolonged desaturation (<50%), as this may indicate imminent or ongoing ischemia. There is no evidence to support targeting supratherapeutic values (75–90%).
15. **The correct answer is B.** This patient's infectious symptoms have resolved, and she is already beyond the recommended 3-day course of antibiotics for an uncomplicated UTI. Several antibiotics, most notably fluoroquinolones and aminoglycosides, have been implicated in myasthenic exacerbations. Injection anesthetics, IV magnesium, and rarely phenytoin and gabapentin have also been described as causes. Consequently, discontinuing this patient's antibiotic would be prudent as it is no longer needed and likely the cause of her exacerbation.
16. **The correct answer is D.** Cavernous angiomas are a well-described cause of medullary hemorrhage. They are often not identified on angiography due the absence of large feeding arteries and draining veins, but can be seen on gradient echo sequences. While hypertension may cause medullary hemorrhage, this patient is young, does not have known hypertension, and is not hypertensive at presentation, making hypertension an unlikely cause. Follow-up angiography may be performed after MRI, depending on institution and physician preference. There is nothing to suggest this patient has a rare platelet disorder or coagulopathy, and so this should not be performed before obtaining an MRI.
17. **The correct answer is B.** Most cases of PRES associated with immunosuppressive therapy present during the first month after initiation of therapy. PRES can occur at therapeutic and supratherapeutic levels of the immunosuppressant, and symptom severity is not associated with drug levels. However, if PRES occurs in the setting of a supratherapeutic drug level, reducing the dose may be a viable option for certain patient populations before considering discontinuing the medication. If needed, patients can be safely switched from mycophenolate to tacrolimus and vice versa [6].
18. **The correct answer is A.** This presentation is highly suggestive of rhabdomyolysis after a recent strenuous workout routine. Patients will classically produce a brown urine sample that is dipstick-positive for blood without red cells seen on microscopic analysis. This is due to the inability of the dipstick to

differentiate myoglobin from hemoglobin. Although rhabdomyolysis may progress to renal failure in severe cases, patients generally do not present with anuria.

19. **The correct answer is E.** Intraventricular hemorrhage without involvement of the parenchyma is relatively uncommon, and may be related to the presence of an aneurysm, vascular malformation, or tumor contiguous with the ventricles. Far more common is intraventricular hemorrhage as a result of extension of a parenchymal lesion [7].
20. **The correct answer is B.** This patient has penetrating abdominal trauma with evidence of intraperitoneal hemorrhage and signs/symptoms of shock. Based on the ABC score, a retrospectively-derived and prospectively validated prediction tool, he is likely to require massive transfusion [8]. While the optimal ratio of PRBC:FFP:platelets is still unclear, professional society guidelines advocate the achievement of a 2:1 PRBC to FFP ratio with 1 unit of platelets transfused for each 4–6 units of PRBC.
21. **The correct answer is D.** Peroneal nerve testing is a highly sensitive bedside screening assessment for the presence of CIP. The test is considered positive if there is an abnormal finding in either leg. Patients with a positive peroneal nerve test must still undergo a complete nerve conduction study in order to be objectively diagnosed with CIP [9].
22. **The correct answer is E.** The clinical elements most closely linked to early mortality after SAH are the A-a gradient, significant hyper- or hypotension, metabolic acidosis, and hyperglycemia. These elements, collectively, are known as the SAH Physiologic Derangement Score, which ranges from 0 to 8 points [10].
23. **The correct answer is A.** CADASIL most commonly presents as migraines between the third and fourth decade of life, followed by the onset of transient ischemic attacks and discrete infarcts in the fifth to sixth decade of life. Multi-infarct dementia of variable severity ensues. A smaller subset of patients may also present with epilepsy and mood disturbances [11].
24. **The correct answer is B.** *Toxoplasma gondii* commonly causes encephalitis in immunocompromised patients, but not meningitis. Therefore CSF cell count, protein, and glucose in toxoplasmosis may be unremarkable
25. **The correct answer is D.** Hypertension, cigarette smoking, and excessive alcohol intake are all established risk factors for subarachnoid hemorrhage [12]. A history of peripheral vascular disease may intuitively seem like a risk factor, but it has not been established by epidemiological research.
26. **The correct answer is C.** The modified Rankin score is the most frequently used measure to describe the extent of a patient's disability after suffering from a stroke. The scale is as follows: 0, asymptomatic; 1, symptomatic, but no disability; 2, slight disability preventing one from completely resuming all prior activities, but able to care for self; 3, can walk unassisted, but requires help with ADLs; 4, can neither walk unassisted nor care for ADLs; and 5, bedridden/incontinent/requiring constant nursing care.

27. **The correct answer is E.** Direct thrombin inhibitors (DTIs) include both the bivalent hirudin derivatives (bivalirudin, lepirudin) as well as the univalent DTIs (argatroban, dabigatran). Rivaroxaban, on the other hand, is a factor Xa inhibitor. Other medications in this class include apixaban and edoxaban.
28. **The correct answer is A.** Lundberg A waves represent steep increases in intracranial pressure lasting for 5–10 min. Lundberg B waves represent modest increases in intracranial pressure lasting 30 s to several minutes. Lundberg C waves represent small increases in intracranial pressure lasting 7–15 s. Lundberg D and E waves do not exist.
29. **The correct answer is E.** Aerophobia (and more notoriously, hydrophobia) are common symptoms of rabies encephalitis, along with myoclonic jerking, altered mental status, and coma. The disease is fatal in a majority of patients, though there are an increasing number of survivors reported in the literature [13].
30. **The correct answer is C.** According to guidelines from the American College of Chest Physicians, IVC filter placement is only recommended for patients with evidence of proximal DVT and contraindication to systemic anticoagulation [14]. This patient has no evidence of DVT, and so despite his higher risk of developing DVT secondary to an acute spinal cord injury, no IVC filter should be placed. Additionally, this patient has just returned from evacuation of a life threatening spinal epidural hematoma, and so it would not be appropriate to initiate DVT chemoprophylaxis at this time.
31. **The correct answer is E.** Approximately 90% of emboli in the setting of nonvalvular atrial fibrillation originate in the left atrial appendage. This has led to a variety of methods to "seal off" the left atrial appendage, which may be particularly beneficial among patients who cannot tolerate or are not compliant with oral anticoagulation. The Food and Drug Administration (FDA) has recently approved percutaneous left atrial appendage filter placement for this purpose, based in part from data from the PROTECT AF trial [15].
32. **The correct answer is C.** Abdominal compartment syndrome is often an unrecognized cause of organ dysfunction in critically ill patients, due to the inaccuracy of the clinical examination in detecting intra-abdominal hypertension. Oliguric kidney injury may be the earliest sign, where compression of the renal veins leads to increasing venous resistance and lowering of the glomerular filtration rate [16].
33. **The correct answer is E.** Pelvic fractures may account for significant and often occult bleeding in patients following traumatic injuries. Scrotal swelling, blood at the meatus, and instability with "rocking" of the pelvis may indicate the presence of the fracture, and contrast extravasation on pelvis CT may represent ongoing bleeding.
34. **The correct answer is B.** This patient's presentation is consistent with hepatorenal syndrome. In general, this syndrome is characterized as functional renal failure in the setting of liver failure, without obvious underlying renal disease. Ruling out overt shock, sepsis, underlying sources of infection, or use of nephrotoxic agents is vital to establishing the diagnosis. Once confirmed,

treatment is designed to promote splanchnic vasoconstriction and renal vasodilation, and raise systemic arterial pressure to increase renal perfusion. Of the options listed, octreotide, midodrine, and albumin are the best options to achieve this goal [17].

35. **The correct answer is A.** Significant abdominal trauma and rapid deceleration are thought to create shearing forces between the relatively fixed and mobile portion of the GI tract. Natural points of fixation include the ligament of Treitz, either end of the sigmoid colon, and the ileocecal junction, and these are particularly vulnerable to injury [18].
36. **The correct answer is B.** Acute disseminated encephalomyelitis (ADEM) is an autoimmune disease typically seen in younger patients. Although it often follows a viral illness by 1–3 weeks, it may be seen following bacterial infections as well. Unlike multiple sclerosis, patients generally suffer a single episode, although recurrent forms exist as well. Mortality rates are low, with the majority of patients experiencing complete recovery after several months. Patients may present with fever, confusion, seizures, and coma. First-line therapy consists of intravenous corticosteroids, with intravenous immunoglobulin (IVIg) or plasmapharesis used for severe cases.
37. **The correct answer is C.** Approximately one third of brain abscesses arise via hematogenous spread from remote sites. The most common cause, however, is via contiguous spread of infected structures., accounting for one half of all cases [19].
38. **The correct answer is D.** Fatigue, altered mental status, and seizure activity in a patient on dapsone should immediately raise suspicion for methemoglobinemia. Dapsone use may result in oxidation of the heme molecule, converting Fe^{2+} to Fe^{3+}. Methemoglobin is less able to release oxygen at the tissue level, resulting in functional hypoxia, and symptoms may range from lethargy and confusion to coma and seizure activity. Arterial methemoglobin levels should be obtained, and the sample should be examined for the characteristic "chocolate" brown discoloration of the blood [20]. The possibility of methemoglobinemia can be rapidly assessed before exploring the possibility of a CNS infection.
39. **The correct answer is C.** Communication is key in the ICU, especially with multi-disciplinary care teams. The terms drowsy, lethargic, encephalopathic, stuporous, and comatose are usually not precisely used, and can be equivocal. Noting which stimulus (auditory, tactile, repeated vigorous tactile, noxious) led arousal is more useful, in addition to eye tracking and attention span. Aphasic or intubated patients with eye opening apraxia who are localizing to painful stimuli score 7 on the GCS, but are definitely not comatose, as they have cortically mediated responses.
40. **The correct answer is C.** Tacrolimus, a calcineurin inhibitor, is one of the most widely used immunosuppressive medications in transplant recipients. A wide array of neurologic side effects have been reported, including all of the listed answer choices. The most common side effect, however, is fine tremor, which may resolve on dose reduction or discontinuation of the medication.

41. **The correct answer is C.** A number of treatment options exist for patients with high grade gliomas (WHO class III or IV), including surgical resection, stereotactic radiosurgery, traditional chemotherapeutic agents (such as carmustine), and in particular the angiogenesis inhibitor bevacizumab and the alkylating agent temozolomide. Gemcitabine, on the other hand, is a nucleoside analog most commonly used for breast and lung cancer, and plays no role in the treatment of a high grade glioma.
42. **The correct answer is E.** Several risk factors have been identified for the development of ventilator-associated pneumonia. These include male gender, underlying lung disease, head trauma, need for reintubation, or need for transportation outside of the ICU for diagnostic procedure [21]. Female gender is not a risk factor.
43. **The correct answer is B.** This description of this patient's lesion is consistent with a cavernous hemangioma, or cavernoma. A history of prior whole brain radiation is a risk factor for the development of cavernomas later in life [22].
44. **The correct answer is E.** There is no reliable serum alcohol cutoff that will ensure a patient will not experience alcohol withdrawal seizures. Furthermore, patients with a history of chronic and severe alcohol abuse may go into withdrawal at serum levels which would be otherwise incapacitating to average individuals.
45. **The correct answer is A.** Delayed hydrocephalus is an uncommon complication of subarachnoid hemorrhage, occurring in just over 1% of patients, the majority of whom will develop hydrocephalus within 1 year of hospital discharge. In one study, factors significantly associated with the development of delayed hydrocephalus included requiring a temporary ventriculostomy during initial hospitalization, microsurgical clipping, and discharge to a rehabilitation facility [23].
46. **The correct answer is A.** The overall risk of contracting HIV as a result of a needlestick injury in an HIV-positive patient is approximately 0.3%. A high plasma viral load in the source patient is associated with an increased risk of transmission [24].
47. **The correct answer is B.** The etiology of primary angiitis is unknown, and it is an uncommon disease overall, with an annual incidence of 2.4 cases per 1,000,000 person-years. A 2:1 male predominance is seen. Headache is the most common presenting symptom, seen in about 60% of cases [25].
48. **The correct answer is E.** The use of loop diuretics can exacerbate hypokalemia and hypocalcemia. It has been proposed that loop diuretics could ameliorate ischemic damage in acute kidney injury (AKI) by reducing energy requirements of cells within the loop of Henle. However, diuretics can also induce hypovolemia, which can lead to or worsen prerenal AKI. Some small trials have reported higher risks of AKI when used as a prophylactic agent at the time of imaging and surgical procedures. Overall, the use of furosemide to facilitate diuresis does not appear to improve kidney recovery among patients who require dialysis for AKI; however, it may facilitate mechanical ventilation in volume-overloaded patients.

49. **The correct answer is A.** Aggressive fluid resuscitation is essential in the treatment of acute pancreatitis, along with meticulous ongoing management of fluid and electrolyte needs. The routine use of antibiotics, acid reducers, or nasogastric suction is discouraged, as these therapies do not have any proven benefit [26].
50. **The correct answer is B.** Water-circulating surface cooling can be an effective therapy to combat central and persistent hyperthermia. Shivering is commonly encountered in this setting, and must be controlled. Surface counterwarming is a relatively simple non-pharmacologic approach that can be tried initially. Medications may be administered as well, including buspar, meperidine, magnesium, and sedative medications. However, it would be imprudent to institute multiple medical therapies without a trial of surface counterwarming first.
51. **The correct answer is A.** The CT scan shows a cavitary lung lesion in the left lower lobe. A cavity in the lung is a gas filled space within a consolidation, mass or nodule. The differential for a cavitary lesion is broad, and can be divided into infectious and non-infectious processes. The clinical history and presentation is of utmost importance in deciding the next best step. The most common organisms that can cause cavities or abscesses in the lung include anaerobes, mycobacteria, MRSA, fungi, *Klebsiella*, and *Nocardia*. Given the history of a recent stroke, fevers, and purulent sputum, this patient is most likely aspirating, resulting in an anaerobic infectious cause of the cavitary lung lesion. Therefore, antibiotics covering for aspiration organisms should be given, such as clindamycin or piperacillin-tazobactam. Tuberculosis must be strongly considered in anyone with an infectious cavitary lung lesion, but this patient has no risk factors, is PPD negative, and is acutely ill, which is more suggestive of an acute bacterial process. Bronchoscopy would not be needed if the patient improves on antibiotics. This patient's finding is not consistent with a pulmonary infarct, and intravenous heparin is not needed. There is no role for image guided lung biopsy at this point, as the most likely cause is infectious. If the cavity does not improve after a sufficient period of time, further evaluation can be performed [27].
52. **The correct answer is D.** Chemical (sterile) meningitis is a postoperative complication that may be difficult to distinguish from bacterial meningitis. Operative and postoperative factors linked to bacterial meningitis include sinus or spine manipulation, CSF rhinorrhea or otorrhea, or the presence of new seizures or focal neurologic deficits. Chemical meningitis is more likely to be present in the immediate postoperative period [28].
53. **The correct answer is D.** The work-up for patients with subarachnoid hemorrhage without detectable aneurysm on conventional angiography varies, but generally includes repeat angiography at 1–2 weeks and magnetic resonance imaging of the neuroaxis if suspicion for a vascular cause is high. It is arguable that this may be unnecessary in patients with a classic perimesencephalic pattern of subarachnoid blood, and that those patients have an excellent prognosis without further imaging, but perimesencephalic bleeding should not, by definition, significantly extend into the bilateral Sylvian fissures (as it does in this

patient). Therefore, this patient likely requires repeat angiography, and waiting 3, 6 or 12 months to do so is too long; answers A, B, C, and E are incorrect [29].

54. **The correct answer is A.** The patient has an upper airway obstruction after extubation, most likely secondary to laryngeal edema. Aphonia indicates a complete obstruction with impending respiratory failure, and thus, the patient needs immediate re-intubation. Inhaled bronchodilators, racemic epinephrine, and helium-oxygen mixtures may provide some relief, but can only be used in patients who do not require immediate control of the airway. If there was prior clinical suspicion for laryngeal edema, the use of intravenous methylprednisolone 12 h prior to extubation has been shown to reduce failure rates [30].
55. **The correct answer is C.** While discontinuing feeds and tapering the propofol would indeed address the issue of phenytoin absorption and allow for a better neurologic assessment, the patient is still seizing, and still has a high risk of deterioration from hematoma expansion or increase in perihematomal edema. Increasing the phenytoin will still lead to erratic absorption given the continuous feeds; additionally, it may be the etiology of her fevers. It is likely more judicious to switch from phenytoin to a different agent, such as valproate. Recurrent seizure activity should always prompt a dose of benzodiazepine to prevent recurrence. Adding a midazolam infusion to her current regimen may result in prolonged mechanical ventilation, especially considering her LPDs may simply be markers of her ICH. Clot evacuation can be considered in extreme cases, but not before addressing her ongoing seizure activity.
56. **The correct answer is D.** There is evidence that excessive hypertension may contribute to the hemorrhagic complications of tPA administration. Prior to tPA administration, the blood pressure needs to be controlled <185/110 mmHg. Once tPA has been administered, the blood pressure needs to be maintained <180/105 for at least 24 h.
57. **The correct answer is A.** This patient presents with myxedema coma. These patients are usually hypoglycemic; therefore, an insulin infusion would likely be unnecessary. Corticosteroids may treat concurrent adrenal insufficiency, and hypothermia should be treated with rewarming. This patient is comatose, and may require mechanical intubation to protect his airway.
58. **The correct answer is E.** SvO_2 is measured from the pulmonary artery, while $ScvO_2$ is measured from the superior vena cava. As such, SvO_2 measurements are more invasive, and inherently pose more risk to the patient. $ScvO_2$ is usually (though not always) lower than SvO_2 due to high oxygen extraction by the cerebral circulation.
59. **The correct answer is B.** The clinical presentation suggests acalculous cholecystitis. Critical illness and neurologic deficits are frequently associated with this diagnosis, and it confers considerably higher morbidity and mortality than its calculous counterpart. While surgical options may be considered, this patient's overall critical illness and poor healing potential (i.e. very low serum albumin) make her a poor surgical candidate. Therefore, percutaneous cholecystostomy is the best treatment option for this patient.

60. **The correct answer is E.** There are a number of imaging studies that may be useful in the evaluation of DCI and cerebral vasospasm, including multimodality CT (non-contrast, angiography, and perfusion imaging). Mean transit times >6.4 are highly sensitive for predicting angiographic vasospasm, and may be used in conjunction with vessel appearance on CT angiography. However, conventional digital subtraction angiography (DSA) remains the gold standard [31].
61. **The correct answer is B.** In adult patients, gliomas account for the majority of primary brain tumors (approximately 50%). The next most common are meningiomas (30–40%), followed by pituitary tumors (10–20%) and primary CNS lymphoma (<5%).
62. **The correct answer is A.** In order to prevent rapid shifts in fluid and solute concentrations during intermittent hemodialysis, the dialysis prescription should include a dialyzer membrane with a small surface area, a low blood flow rate and dialysate flow rate, a high dialysate sodium concentrate, a low bicarbonate concentrate, a cooler dialysate temperature, a low rate of urea removal and a low rate of ultrafiltration.
63. **The correct answer is C.** The lower density of helium/oxygen mixtures reduces frictional resistance and promotes laminar gas glow, which reduces overall airway resistance. Isoflurane and sevoflurance both have bronchodilatory properties, and may help reduce auto-PEEP. In refractory cases of status asthmaticus with mucoid impaction, bronchoscopy and mucolytic therapy may lower airway pressures and improve gas exchange. Intravenous magnesium is a standard frontline therapy for status asthmaticus. Nitric oxide, on the other hand, is a pulmonary vasodilator, and is of little benefit in primary airway disease.
64. **The correct answer is D.** A regular crescendo-decrescendo tidal volume breathing pattern with alternating periods of apnea is typical of Cheyne-Stokes respiration. This is highly suggestive of low cardiac output and cardiac dysfunction, and is found in up to 33% of patients with heart failure and a reduced ejection fraction [32].
65. **The correct answer is D.** VPA-induced hyperammonemia is thought to be, in part, related to carnitine depletion, which is a co-factor in VPA metabolism. Depleted carnitine levels may be seen both in the setting of long-term use and acute overdose. Although there are no prospective randomized trials evaluating levocarnitine in VPA-induced hyperammonemia, numerous case reports have reported it to be both a safe and effective therapy. The oral bioavailability is poor compared to the intravenous route, and may not be tolerated due to it's foul odor and tendency to cause gastrointestinal upset [33].
66. **The correct answer is C.** Anti-Xa assays may be used to monitor the activity of both unfractionated heparin (UH) and low molecular weight heparin (LMWH). Different therapeutic reference ranges have been established for each agent, depending on whether or not the intention is thromboprophylaxis or treatment. Anti-Xa levels for thromboprophylaxis should be 0.1–0.4 IU/mL and 0.2–0.5 IU/mL for UH and LMWH, respectively. Treatment levels for UH and LMWH should be 0.3–0.7 IU/mL and 0.5–1.2 IU/mL, respectively.

67. **The correct answer is C.** Both bupropion and trazodone have been known to result in false-positive drug screens for amphetamine. None of the other implied answer choices (including statins, dopamine agonists, levothyroxine, or hormone replacements) are known to cross-react with the amphetime urine screen [34].
68. **The correct answer is A.** Of the choices listed, only hyperhomocysteinemia is likely to result in the formation of an arterial thrombus in this scenario. Oral contraceptive use may be a contributing factor in this case. The other answer choices refer to factor V Leiden, heparin induced thrombocytopenia (HIT), and deep venous thrombosis (DVT). DVT and factor V Leiden are conditions involving venous (not arterial) thrombosis. HIT does not occur in the outpatient setting in the absence of heparin exposure.
69. **The correct answer is C.** Administration of acyclovir is associated with nephrotoxicity due to intra-tubular precipitation of crystals, and may be prevented simply via administration of intravenous fluids. Since the patient has been complaining of vomiting for the past several days, she is likely dehydrated and at an increased risk of acute kidney injury. However, the acyclovir dose should only be reduced empirically in patients with known renal insufficiency, as reducing the dose may lead to therapeutic failure. Acyclovir should be administered intravenously during the initial treatment of HSV encephalitis, and therefore switching to oral therapy is not an option at this time.
70. **The correct answer is C.** Patients with impaired kidney function who receive gadolinium are at risk of nephrogenic systemic fibrosis (NSF), a severe and potentially life-threatening disorder involving fibrosis of both the skin and internal organs. Although NSF has been reported in patients with a GFR less than 60 mL/min/1.73 m^2, the risk is greatest when gadolinium is administered to patients with a GFR less than 30 mL/min/1.73 m^2.
71. **The correct answer is D.** The STASH trial was a randomized, double-blind, placebo-controlled, multicenter study evaluating the use of simvastatin to improve functional outcomes after aSAH. A favorable outcome was defined by a modified Rankin score of 0–2 at 6 months. There were no significant differences between the control and placebo groups in this study [35].
72. **The correct answer is B.** Lance-Adams syndrome is a rare form of intention myoclonus usually seen after resuscitated cardiac arrest. Myoclonic status epilepticus may also be seen after cardiac arrest; however, patients are comatose, and with poor long-term outcomes. On the other hand, patients with Lance-Adams are awake, and may regain much or all of their prior cognitive functioning [36].
73. **The correct answer is C.** Chest pain and dysphagia are common after bronchial artery embolization, and generally self limited. More serious complications often arise from unintentional, non-targeted embolization. For example, transverse myelitis may result from spinal cord ischemia secondary to anterior spinal artery infarction. Bronchoesophageal fistula, though rare, may develop after bronchial wall ischemia and proximity to the esophagus. Pulmonary embolism would not be an expected complication, as the catheter is not inserted in the venous system [37].

74. **The correct answer is B.** In airway pressure release ventilation, the primary determinants of oxygenation are the mean airway pressure and the fraction of inspired oxygen. Thus, increasing either of these parameters may improve this patient's hypoxemia. Increasing T_{low} would actually decrease the patient's mean airway pressure by increasing the time spent at the lower set pressure. Both prone positioning and nitric oxide have been shown to improve hypoxemia in severe ARDS, though prone positioning has been linked to improved outcomes and nitric oxide has not.
75. **The correct answer is B.** The ARUBA trial evaluated the benefit of preventive eradication of unruptured brain AVMs. This trial compared the risk of death and symptomatic stroke in patients with unruptured brain AVMs who are allocated to medical management with interventional therapy (i.e. neurosurgery, embolization, or stereotactic radiotherapy, alone or in combination) or medical management alone. The trial found that medical management alone is superior to medical management with interventional therapy for the prevention of death and stroke [38].
76. **The correct answer is C.** Administration of crystalloid before and after amphotericin B reduces the risk of nephrotoxicity. Reducing the dose of amphotericin B and discontinuing flucytocine can have a detrimental effect on treatment of cryptococcal meningitis, and should not be tried before the much simpler addition of normal saline boluses. Changing the rate of administration of either drug is not expected to have any beneficial effect.
77. **The correct answer is A.** Hyponatremia is commonly encountered in patients with aneurysmal subarachnoid hemorrhage, with salt wasting often preceding the onset of cerebral vasospasm and delayed cerebral ischemia. For this reason, subarachnoid patients often require the careful initiation of hypertonic saline solutions, enteral salt supplementation, and medications such as fludrocortisone, to maintain a neutral-to-mildly hypernatremic salt balance.
78. **The correct answer is A.** Perflutren lipid microspheres are an ultrasound contrast agent. They are usually injected through a peripheral IV, with an echocardiogram probe placed on the heart. As the contrast material reaches the heart, the left ventricular chamber becomes opacified, the endocardium becomes easier to visualize, and the presence of a left ventricular thrombus may be detected (though transesophageal echocardiogram is more sensitive.) Perflutren lipid microspheres are not used in the diagnosis of cerebral venous thrombus, cerebral arterial thrombus, or deep venous thrombus.
79. **The correct answer is A.** Dural arteriovenous fistulae (AVF) may present with pulsatile tinnitus, particularly if they drain into the transverse or sigmoid sinus. The Barrow classification system is used to describe cavernous carotid fistulae (CCF), not dural AVF. CCF may present with vision loss and the presence of an orbital bruit. Dural AVF may be treated surgically, endovascularly, or via stereotactic radiosurgery. They may also recur after treatment.
80. **The correct answer is C.** The development of both early- and late-seizures has been described as a potential consequence of stroke, with the risk for developing epilepsy appearing to be higher among patients suffering from hemorrhagic infarcts. Although the incidence of late seizures varies based on

a number of factors, by 2 years, approximately 10% of ICH patients will develop epilepsy. Risk factors for the development of late seizures may include the development of early seizures, younger age at presentation, ICH volume, and cortical involvement [39].

81. **The correct answer is A.** Echinocandins, including anidulafungin, are the treatment of choice for empiric coverage of presumed candida infections, except for the central nervous system, eye, and urinary tract. Echinocandins do not penetrate the CSF. Amphotericin B formulations are currently considered treatment of choice for empiric coverage in this scenario; fluconazole is reserved for step-down therapy once the diagnosis has been confirmed and the patient is improving. Flucytocine may be added to amphotericin B therapy at clinician discretion [40].
82. **The correct answer is D.** The goal behind triage is to address the patients who are sickest first. When multiple patients are critically ill, one should evaluate and treat them in a way that does the most good for the most people. In this case, the patient who is most likely to require immediate intervention is the patient who may be having an acute ischemic stroke and is within the tPA window.
83. **The correct answer is C.** This patient is presenting with several symptoms that may be concerning for progression of his underlying disease (in addition to the potential for a superimposed infectious process). However, the possibility of spinal cord compression from a metastatic lesion is what most requires urgent investigation. These lesions may be rapidly progressive, and of the answer choices listed, the diagnosis of cord compression is the most time sensitive.
84. **The correct answer is D.** Even if EEG criteria are not met for seizures, this patient's PLEDs seem to be on the ictal-interictal continuum, and are potentially responsible for her fluctuating mental status. When benzodiazepine trial is inconclusive or unable to be performed, metabolic imaging is the next best way to confirm that the ictal signature coincides with hypermetabolism. Both CT perfusion and SPECT imaging can be used for this purpose, although CT perfusion is faster and more easily obtained in a critically ill patient.
85. **The correct answer is D.** Once a chest tube is placed for traumatic hemothorax, the output should be monitored closely. Though individual trauma center thresholds may differ, per ATLS guidelines, initial chest tube blood output of $\geq$1.5 L (or 20 mL/kg) or continued blood drainage of $\geq$3 mL/kg/h are indications for urgent thoracotomy in order to rapidly identify and intervene on the source of hemorrhage [41].
86. **The correct answer is E.** The cornerstone in the management of both serotonin syndrome and neuroleptic malignant syndrome is adequate fluid resuscitation and control of psychomotor agitation with sedatives as needed. Differentiating neuroleptic malignant syndrome from seratonin syndrome can be difficult, and the administration of "antidotes" for either of these conditions should not precede standard conservative treatment.
87. **The correct answer is D.** The American College of Surgeons makes several recommendations regarding the development and implementation of MTPs. These include resuscitation with only blood products once the MTP has been activated, transfusion of RBCs and plasma in either a 1:1 or 1:2 ratio, giving one

single donor apheresis or random donor platelet pool for every 4 units of PRBCs administered, and having one cooler of blood products delivered every 15 min until the MTP is terminated. There are no recommendations given regarding fixed administration of cryoprecipitate in ratio with other blood products.

88. **The correct answer is E.** Of the monitoring choices listed, many hold promise for management of blunt TBI but have yet to be borne out in high-quality clinical trials. However, a significant percentage of comatose ICU patients may have non-convulsive status epilepticus (particularly those with severe neurologic injuries), which necessitates the use of continuous video EEG monitoring.
89. **The correct answer is B.** While hematochezia often implies a lower GI source of bleeding, a brisk upper GI bleed may be found up to 10% of the time as the source of bleeding. Therefore, especially in cases of hemodynamic instability, an upper endoscopy may be undertaken first in an effort to identify and control the bleeding. Surgical intervention is usually sought after more conservative medical and endoscopic therapies have failed. TIPS procedure may be appropriate in cases of established variceal bleeding [42].
90. **The correct answer is D.** The time of death is the time that a physician or licensed provider examines the patient and declares them to have expired. This may occur long after asystole and physical death have occurred, particularly if the provider is delayed in performing their exam.
91. **The correct answer is C.** Current recommendations do not include induced hypothermia; ongoing clinical trials aim to answer this clinical question. Maintenance of MAP between 85 and 90 mmHg, SBP targeted >90 mmHg, early decompression and admission to an ICU are all supported by Level III recommendations [43].
92. **The correct answer is B.** The MCA is the most readily accessible intracranial vessel, owing to the temporal window. Additionally, the MCA receives the majority of blood flow from the ipsilateral carotid artery, making it a useful surrogate of hemispheric blood flow. The PCA, PICA, and basilar are not assessed via TCD ultrasonography.
93. **The correct answer is A.** Pseudoephedrine has been shown to be an effective adjunctive therapy for the treatment of refractory hypotension secondary to spinal cord injury. Atropine at doses below 0.5 mg can cause worsening of bradycardia. Amantadine does not affect hemodynamics in spinal cord injury patients. Central venous pressures have fallen out of favor as measures of intravascular volume status [44].
94. **The correct answer is B.** The American Heart Association's 2013 policy statement recommends that policies be developed to allow ambulances to bypass non-stroke centers when patients have stroke symptoms that started within 6–8 h, and when that diversion will take no more than 15–20 min [45].
95. **The correct answer is E.** Contrary to popular belief, the Canadian C-spine Rules do not recommend neck imaging simply for the presence of midline neck tenderness. No further imaging is recommended if the following criteria are met: Age <65, no extremity paresthesias, and no "dangerous" mechanism (defined as a fall >3 ft, axial load injury, high speed/rollover MVC/ejection,

bicycle collision or motorized recreational vehicle). Next, the patient must have at least one low risk feature (defined as sitting position in the ED, ambulatory at any time, delayed onset neck pain, lack of midline tenderness, or simple rear-end MVC). Finally, the patient must be able to rotate their neck at least 45° to the left and right [46].

96. **The correct answer is E.** Single-fiber EMG offers the best sensitivity at approximately 95%. The ice-pack test has limited sensitivity. The tensilon test is 80–90% sensitive, as is most helpful when there is clear ptosis or ophthalmoparesis. The AChR antibody is present in about 85% of those with generalized disease; of the remaining 15%, approximately 40–50% will be MuSK-positive. Of note, almost all patients with both myasthenia and a thymoma are AChR-Ab positive [47].
97. **The correct answer is E.** Although osmotic demyelination syndromes, such as pontine and extrapontine myelinolysis, are often thought to carry universally poor prognoses, this is a bit of a misconception. In one study of chronic alcoholics suffering from osmotic demyelination, nearly one third went on to make a complete recovery from their illness [48].
98. **The correct answer is B.** The focused assessment with sonography in trauma (FAST) is an integral component of the rapid assessment of the patient with thoraco-abdominal trauma. FAST provides the ability to rapidly identify hemothorax, hemoperitoneum, hemopericardium and pneumothorax. This ultrasound image of the right upper quadrant demonstrates fluid within the hepatorenal recess (Morrison's pouch). While ascites and fresh blood are indistinguishable on ultrasound, in the setting of thoraco-abdominal trauma, one must assume that peritoneal free fluid represents blood.
99. **The correct answer is A.** Extreme delta brush is an unusual EEG waveform uniquely associated with anti-NMDA encephalitis, and resembles waveforms seen in premature infants. It is characterized by rhythmic delta activity with bursts of 20–30 Hz beta activity superimposed on each delta wave [49]. All of the other answer choices may be seen in a variety of conditions.
100. **The correct answer is E.** Anorexia nervosa is associated with subnormal or erratic vasopressin release. Wolfram syndrome is also known as DIDMOAD (diabetes insipidus, diabetes mellitus, optic atrophy and deafness). It is an autosomal recessive illness with incomplete penetrance, and is also associated with cognitive and psychiatric disorders. Septo-optic dysplasia and other congenital cerebral midline abnormalities have been associated with both anterior and posterior pituitary dysfunction.

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Exam 3 Questions

The capacity of man himself is only revealed when, under stress and responsibility, he breaks through his educational shell, and he may then be a splendid surprise to himself no less than to his teachers.

Harvey Cushing
(1869–1939)

1. Which of the following is true regarding the Barrow classification system for carotid cavernous fistulae?

   A. Type A shunts are indirect shunts between branches of the internal carotid artery (ICA) and cavernous sinus
   B. Type B shunts are direct shunts between the ICA and cavernous sinus
   C. Type C shunts are indirect shunts between branches of the external carotid artery (ECA) and cavernous sinus
   D. Type D shunts are high-flow shunts
   E. All of the above

2. A 80-year-old male with an intracranial neoplasm presents to the emergency department with weight loss, drowsiness, and tachypnea for 1 month. On examination, his respiratory rate is 28 breaths/minute with a normal oxygen saturation. His lungs are clear to auscultation. An arterial blood gas reveals the following: pH 7.60, PCO_2 14 mmHg, PaO_2 115 mmHg. A chest x-ray, bedside echocardiogram, and EKG are all unremarkable. No other pulmonary, metabolic, or pharmacologic etiologies for the breathing pattern are found. What is the most likely diagnosis?

   A. Central neurogenic hyperventilation
   B. Cheyne-Stokes respirations
   C. Apneustic breathing
   D. Ataxic breathing
   E. Cluster breathing

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3. A 48-year-old female is admitted to the ICU with a Hunt-Hess 2 modified Fisher 2 subarachnoid hemorrhage (SAH). She remains intact neuro-cognitively, but has transcranial doppler (TCD) mean flow velocities up to 150 cm/s, and a serum platelet count twice her baseline. You are worried about vasospasm and impending delayed cerebral ischemia. Which of the following should be performed next?

   A. An additional 100 mL/h of normal saline should be given on top of maintenance fluids
   B. CT perfusion scan to assess for any ongoing hypoperfusion
   C. Evaluate volume status with hemodynamic monitoring and give fluid boluses accordingly
   D. Induce hypertension to a systolic pressure of 160 mmHg
   E. Conventional angiography

4. A 25-year-old male is currently in the ICU with an anoxic brain injury after diving into shallow waters and suffering a high cervical cord transection. Two weeks after his injury, he remains comatose, has diffuse loss of gray-white differentiation on noncontrast head CT, and exhibits myoclonic status epilepticus. The family is devastated by his poor prognosis, and distraught by his uncontrollable shaking. What is your rationale behind your decision about starting an antiepileptic regimen?

   A. Phenytoin and propofol will be used, and escalated until eradication of his myoclonus to assess his underlying brain damage
   B. Levetiracetam and lacosamide will be used, and escalated until eradication of his myoclonus to assess his underlying brain damage
   C. If EEG reveals dyssynchronous spikes on a severely slow background, myoclonus invariably portends death or a vegetative state, and midazolam should only be used for palliative purposes
   D. Regardless of EEG or clinical exam, half of patients in myoclonic status epilepticus will have a good neurologic recovery by 90 days
   E. Regardless of EEG or clinical exam, myoclonic status epilepticus is always ominous, not amenable to treatment. and should lead to immediate withdrawal of life-support

5. An 18-year-old female presents to the emergency department with several months of progressive left-sided hearing loss and tinnitus. An MRI of the brain is performed, demonstrating bilateral enhancing dumbbell shaped lesions extending from the auditory canal to the cerebellopontine angle. Which of the following genetic disorders is associated with this finding?

   A. Von Hippel-Lindau syndrome
   B. Neurofibromatosis type II
   C. Tuberous sclerosis
   D. Schwannomatosis
   E. Alport syndrome

6. A 23-year-old female is brought to the emergency department by her boyfriend with difficulty breathing. She cannot provide her history, but her boyfriend states that she has asthma, although he is unsure of her medications. On physical exam the woman is noted to have nasal flaring, is diaphoretic, cannot lie flat, and is breathing at a rate of 40 breaths/minute. She is given short acting $ß_2$ agonist treatments with no obvious relief of her symptoms. Serial arterial blood gases are done and show a pCO_2 that has increased from 25 to 40. What is the next best step in the patient's management?

   A. Continue short-acting $ß_2$ agonist treatment, as her pCO_2 is normalizing, and continue observation in the emergency department
   B. Intubate the patient and admit to the ICU
   C. Administer intravenous corticosteroids and admit to the general medical ward
   D. Place the patient on non-invasive positive pressure ventilation and admit to the general medical ward
   E. Administer a long-acting $ß_2$ agonist agent and admit to the general medical ward

7. Cerebellar hypoplasia without displacement through the foramen magnum is best described as a:

   A. Chiari I malformation
   B. Chiari II malformation
   C. Chiari III malformation
   D. Chiari IV malformation
   E. Chiari V malformation

8. A 77-year-old female with a history of hypertension, atrial fibrillation, and diabetes mellitus has recently been taken off of warfarin due to frequent falls and gait instability. She has not had any prior significant bleeding or ischemic events. A recent echocardiogram demonstrates moderate aortic regurgitation with grossly preserved systolic and diastolic function. Which of the following elements is not a stroke risk factor in this patient?

   A. Age
   B. Female gender
   C. Hypertension
   D. Diabetes mellitus
   E. Aortic regurgitation

9. Which of the following is the most effective measure to prevent aspiration in an intubated patient?

   A. Elevation of the head of the bed
   B. Subglottic drainage
   C. Gastric volume monitoring
   D. Nasogastric tube placement
   E. Percutaneous endoscopic gastrotomy

10. Which of the following is a unique feature of Comprehensive Stroke Centers?

    A. Dedicated stroke unit availability
    B. 24/7 ability to administer tPA
    C. 24/7 interventional neuroradiology availability
    D. 24/7 CT angiography availability
    E. Ambulance receiving capability

11. Which of the following segments of the internal carotid artery is farthest from its origin?

    A. Ophthalmic segment
    B. Petrous segment
    C. Cavernous segment
    D. Clinoid segment
    E. Lacerum segment

12. A 44-year-old male is intubated secondary to a high-grade subarachnoid hemorrhage, and is admitted to the ICU. On the sixth postoperative day, he develops worsening hypoxemia and bilateral interstitial infiltrates on his chest x-ray, consistent with acute respiratory distress syndrome (ARDS). Which of the following interventions has not been demonstrated to improve outcomes in ARDS in a prospective randomized trial?

    A. Prone positioning
    B. Lung-protective ventilation
    C. Extracorporeal membrane oxygenation (ECMO)
    D. Neuromuscular blocking agents
    E. High-frequency oscillatory ventilation (HFOV)

13. A 56-year-old female is currently intubated in the ICU following a left basal ganglia hemorrhage. The nurse reports the patient is having copious thick secretions, and you are considering initiating inhaled N-acetylcysteine therapy. What element of the patient's past medical history may serve as a relative contraindication to this treatment?

    A. Amiodarine-induced pulmonary fibrosis
    B. Newly diagnosed metastatic adenocarcinoma of the lung
    C. Recent course of outpatient antibiotics for community-acquired pneumonia
    D. Poorly controlled asthma
    E. All of the above

14. An 18-year-old female is currently being evaluated for amenorrhea. In addition, she endorses fatigue, cold intolerance, polyuria and dizziness upon standing. On examination, she is thin but appears well hydrated. Blood pressure and heart rate when supine are 90/60 mmHg and 80 beats/minute, respectively. When standing, they are 60/40 mmHg and 120 beats/minute, respectively. Pubic and axillary hair growth is sparse. Eye examination reveals an asymmetric

bitemporal hemianopsia. Imaging reveals a cystic, calcified suprasellar mass. Which of the following statements is true regarding the most likely diagnosis?

A. Medical management is the mainstay of treatment
B. Recovery of pituitary function is common
C. This patient likely has the papillary subtype of this neoplasm
D. This neoplasm has a bimodal age distribution
E. This neoplasm arises from modified glial cells that reside in the infundibular neurohypophysis

15. A 55-year-old female presents to the emergency department after collapsing at home. The patient was arguing with her husband before she suddenly became unresponsive. The patient is intubated, and a non-contrast head CT is performed (see Image 1). The patient then undergoes conventional angiography, revealing occlusion of the proximal bilateral middle cerebral and anterior cerebral arteries with extensive collateral vessels noted. All of the following are true regarding the most likely diagnosis except:

A. The disease can be either congenital or acquired
B. Patients may suffer recurrent infarcts, or remain completely asymptomatic
C. There are no effective surgical interventions available
D. It is more commonly seen in women than in men
E. Patients may initially present with persistent headaches

Image 1 CT scan of the head

16. Which of the following may be used to treat a patient in the acute phase of thyroid storm?

    A. Propylthiouracil
    B. Lugol's solution
    C. Propranolol
    D. Methimazole
    E. All of the above

17. Diabetes insipidus (DI) can be caused by disorders in which of the following anatomic locations?

    A. Hypothalamic osmoreceptors
    B. Supraoptic nuclei
    C. Paraventricular nuclei
    D. Supraopticohypophyseal tract
    E. All of the above

18. A 51-year-old female with a history of cirrhosis and chronic alcohol abuse presents to the ED with altered mental status for the past 12 h, and you suspect hepatic encephalopathy. The serum ammonia level is most likely above which of the following cutoffs?

    A. 75 μmol/L
    B. 90 μmol/L
    C. 150 μmol/L
    D. 200 μmol/L
    E. None of the above

19. A 68-year-old female with nonvalvular atrial fibrillation and unknown anticoagulant use is transferred by helicopter from an outside hospital with a 2.5 × 2 × 2 cm spontaneous cerebellar hemorrhage. Her preintubation GCS was 10 and she was electively intubated for transfer. Her family arrives shortly after and is requesting information regarding her prognosis. Which of the following is the most accurate estimate of her chances of survival?

    A. <1%
    B. 10%
    C. 25%
    D. 75%
    E. >99%

20. The Stewart-Hamilton equation for estimating cardiac output via thermodilution is dependent on all of the following variables except:

    A. Volume of injected substance
    B. Temperature of injected substance
    C. Temperature of the patient's blood
    D. Change in blood temperature over time
    E. Change in blood volume over time

21. Which of the following is not a form of dysautonomia?

    A. Postural orthostatic tachycardia syndrome (POTS)
    B. Multiple system atrophy
    C. Neurocardiogenic syncope
    D. Precordial catch syndrome
    E. Diabetic autonomic neuropathy

22. A 70-year-old female presents with a Hunt-Hess 3 subarachnoid hemorrhage (SAH) and undergoes craniotomy and surgical clipping for a ruptured aneurysm, in addition to ventriculostomy placement. Her postoperative head CT reveals significant retraction injuries, and mild cortical hemorrhage along the ventriculostomy tract. Which of the following is the most appropriate prophylactic antiepileptic regimen?

    A. Phenytoin × 14 days
    B. Phenobarbital × 3 days
    C. Levetiracetam × 7 days
    D. Valproate × 14 days
    E. No antiepileptic prophylaxis is required at this time

23. Which of the following correctly lists the various types of astrocytomas in ascending WHO grade (i.e., from least aggressive to most aggressive)?

    A. Fibrillary astrocytoma, pilocytic astrocytoma, anaplastic astrocytoma, glioblastoma mulitforme
    B. Pleomorphic xanthoastrocytoma, fibrillary astrocytoma, anaplastic astrocytoma, glioblastoma multiforme
    C. Anaplastic astrocytoma, fibrillary astrocytoma, subependymoma, glioblastoma multiforme
    D. Glioblastoma multiforme, subependymal giant cell astrocytoma, anaplastic astrocytoma, fibrillary astrocytoma
    E. Glioblastoma multiforme, fibrillary astrocytoma, pleomorphic xanthoastrocytoma, anaplastic astrocytoma

24. A 29-year-old female presents to the ED after a suspected intentional drug overdose, and is intubated for airway protection. On exam, the patient has fixed, dilated pupils, and no brainstem reflexes whatsoever. Which of the following substances may be responsible for this patient's exam?

    A. 3,4-Methylenedioxymethamphetamine (MDMA)
    B. Amitryptiline
    C. Clonidine
    D. Phencyclidine
    E. Synthetic cathinone

25. A 73-year-female with a history of gait instability, frequent falls, and a recent subdural hematoma evacuation presents to the emergency room with fevers, lethargy and headaches for several days. A CT scan of the brain is performed, revealing vasogenic edema and a questionable area of hypodensity adjacent to

the surgical site. An MRI is currently pending. What is the most appropriate empiric antibiotic coverage at this time?

A. Cefazolin and vancomycin
B. Ceftriaxone, vancomycin and ampicillin
C. Cefepime, vancomycin and metronidazole
D. Imepenem and vancomycin
E. Doripenem and clindamycin

26. All of the following signs and symptoms may herald the onset of eclampsia in a pregnant patient except:

A. Nystagmus
B. Nausea
C. Vomiting
D. Headache
E. Cortical blindness

27. A 64-year-old male with a history of hypertension and chronic kidney disease is currently in the ICU with septic shock secondary to pyelonephritis. A central line is placed for hypotension and significant pressor requirements. A post-procedure chest x-ray is performed (see Image 2), and blood drawn from the line shows partial pressure of oxygen of 40 mmHg. The patient has a normal oxygen saturation on room air. Where is the tip of the catheter located?

A. Aortic arch
B. Right atrium
C. Left subclavian artery
D. Left atrium
E. Aberrant superior vena cava

Image 2 X-ray of the chest

28. A 56-year-old male was at work when he noticed weakness and paresthesias in his right leg. His co-worker called 911, which had just started a new mobile stroke unit program. Which of the following has been demonstrated as a benefit of mobile stroke units?

    A. Decreases symptom onset to tPA time
    B. Allows patients to receive tPA without the need for a CT scan
    C. Allows for earlier identification of seizure activity and other stroke mimics
    D. Allows for patients to be treated at home without hospitalization
    E. Provides stroke care for rural areas that are long distances from the nearest hospital

29. Which of the following is the most common cause of a false negative apnea test (i.e., a test that incorrectly concludes that brain death has not occurred)?

    A. Hyperdynamic precordium
    B. Electromagnetic interference
    C. Ictal activity
    D. Physician inattentiveness
    E. Severe hypocarbia

30. Which of the following is the gold standard for the diagnosis of cerebral venous sinus thrombosis?

    A. CT venography
    B. CT angiography
    C. MR venography
    D. Conventional angiography
    E. Transcranial doppler

31. Which of the following statements regarding scoring systems in subarachnoid hemorrhage is false?

    A. The Hunt-Hess scoring system is used to predict overall mortality
    B. The Fisher and modified Fisher scores are used to predict the risk of cerebral vasospasm
    C. The World Federation of Neurologic Surgeons (WFNS) grade is based on the Glasgow Coma Scale (GCS) and the presence or absence of focal deficits
    D. The HAIR score is based on the Hunt-Hess grade, aneurysm size, presence of intraventricular hemorrhage, and whether or not the patient experiences re-bleed
    E. All of the above are true

32. A 40-year-old male has recently been diagnosed with a right frontal arteriovenous malformation (AVM) after an MRI was performed for the evaluation of recurrent headaches. Which of the following is the estimated risk of intracranial hemorrhage due to this lesion?

    A. 5% per lifetime
    B. 20% per lifetime
    C. <1% per lifetime
    D. 10% per year
    E. 2% per year

33. Which of the following is not an element of the quick Sepsis Related Organ Failure Assessment (qSOFA) score?

    A. Renal failure (creatinine >2.0 mg/dL)
    B. Altered mental status (Glasgow Coma Scale <15)
    C. Hypotension (systolic pressure <100 mmHg)
    D. Tachypnea (respiratory rate >22 breaths/minute)
    E. All of the above are elements of the qSOFA score

34. A 54-year-old male with a history of appendiceal cancer on cisplatin is currently in the ICU following a fall and a traumatic subdural hemorrhage. On admission, his serum potassium is noted to be 2.6 mEq/L. You administer a total of 100 mEq of intravenous potassium over the next several hours. On repeat serum testing in the morning, the patient's potassium is now 2.7 mEq/L. Which of the following is most likely to reveal the cause of the patient's hypokalemia?

    A. Check serum calcium
    B. Check serum magnesium
    C. Ask the nurse if the patient has been experiencing diarrhea overnight
    D. Ask the nurse if the patient has been experiencing vomiting overnight
    E. Assess for the presence of a pancreatic fistula

35. A 45-year-old female with a history of epilepsy presents to the emergency department with altered mental status requiring intubation; a continuous electroencephalogram (EEG) reveals severe diffuse background slowing with continuous generalized periodic discharges (GPDs) of variable triphasic morphology. You suspect that she is in non-convulsive status epilepticus (NCSE). Which of the following should be considered at this time?

    A. Hepatic impairment must be ruled out
    B. Renal impairment must be ruled out
    C. Major electrolyte abnormalities must be ruled out
    D. Benzodiazepines should be administered to see if the background becomes faster and more reactive
    E. All of the above

36. A 54-year-old male with a history of severe paroxysmal hypertension is currently being evaluated for the presence of a pheochromocytoma. Which of the following is the most sensitive initial diagnostic test in this setting?

    A. Plasma free metanephrines
    B. Plasma catecholamines
    C. Urine catecholamines
    D. Urine vanillymandelic acid
    E. Any of the above are equally sensitive

37. Which of the following medications requires a change in drug dosing during renal replacement therapy?

    A. Amphotericin B
    B. Vancomycin

C. Ceftriaxone
D. Erythromycin
E. Norepinephrine

38. A 58-year-old female presents to the emergency department with dry cough, fever and rapidly progressive dyspnea over 1 week. She has a history of rheumatoid arthritis (RA) and is maintained on weekly methotrexate and daily prednisone (which was increased to 30 mg starting 1 month ago for an acute flare). She takes no other medications. Her vital signs are as follows: blood pressure 100/70 mmHg, heart rate 110 beats per minute, respirations 20 per minute, and temperature 38.0 °C. In the ED she develops progressive hypoxemia with oxygen saturation 92% on 100% nonrebreather, and is increasingly diaphoretic. She is emergently intubated, and a chest x-ray post intubation shows extensive bilateral lung opacities. Which of the following should be administered at this time?

A. Ceftriaxone and azithromycin
B. Vancomycin and piperacillin-tazobactam
C. Vancomycin, cefepime, and fluconazole
D. Ceftriaxone, levofloxacin, and trimethoprim-sulfamethoxazole
E. Tigecycline only

39. A 45-year-old male with a history of diabetes mellitus and hypertension presents to the emergency room after a generalized tonic-clonic seizure that lasts approximately 2 min. His home medications include amlodipine, lisinopril, metformin, and glimepiride. He reports that he has been suffering from a "cold" and severe headaches for the past 4 days. A non-contrast CT of the brain is unremarkable. His admission laboratory values are as follows: sodium 132 mEq/L, potassium 3.1 mEq/L, carbon dioxide 18 mEq/L, blood urea nitrogen (BUN) 18 mg/dL, and serum creatinine 1.1 mg/dL. A lumbar puncture is performed, and the patient is initiated on empiric antiviral therapy for suspected viral encephalitis. His medications on admission include: acyclovir 700 mg IV every 8 h, phenytoin 100 mg three times a day, lisinopril 10 mg daily, insulin glargine 20 IU units at bedtime, insulin sliding scale three times a day before meals, heparin 5000 IU every 8 h, and acetaminophen 325 mg every 4 h as needed for fever. On day 3 after admission, the patient's laboratory values are as follows: sodium 136 mEq/L, potassium 3.2 mEq/L, carbon dioxide 18 mEq/L, blood urea nitrogen (BUN) 70 mg/dL, and serum creatinine 2.3 mg/dL. Which of the following is most likely responsible for this patient's acute kidney injury?

A. Phenytoin
B. Acyclovir
C. Acetaminophen
D. Lisinopril
E. Amlodipine

40. All of the following must be met in order to clear the cervical spine after trauma per NEXUS criteria except:

    A. No posterior midline tenderness
    B. No evidence of intoxication
    C. No focal neurological deficit
    D. No painful distracting injuries
    E. Age less than 65

41. A 66-year-old male with a history of longstanding medical noncompliance, currently taking no medications, is brought to the hospital by his family members for several weeks of progressive confusion and generalized weakness. The physical exam is most striking for the appearance of a diffuse, fine, white crystalline substance on the patient's skin. Which of the following lab abnormalities should be expected?

    A. Elevated blood urea nitrogen (BUN)
    B. Elevated serum albumin
    C. Large numbers of schistocytes on the peripheral smear
    D. Markedly decreased serum potassium
    E. Severe metabolic alkalosis

42. A 44-year-old male presents to the emergency department with a severe headache and neck pain. He is found to have a small ruptured aneurysm of the anterior communicating artery, and is deemed to be a candidate for both surgical and endovascular treatment. The patient is neurologically intact, and his family asks for your recommendation regarding treatment. Which of the following responses would be most appropriate?

    A. This patient should undergo surgical clipping of his aneurysm
    B. This patient should undergo endovascular coiling of his aneurysm
    C. In this patient population, both approaches are expected to have similar clinical outcomes
    D. This patient should undergo observation and medical management only at this time, and delayed treatment can be discussed at a later date
    E. This patient should undergo observation and medical management only at this time, with no treatment at a later date

43. Which of the following is the optimal prophylactic antibiotic to administer prior to external ventricular drain placement (EVD) in a patient with no known drug allergies and no prior medical history?

    A. Ceftriaxone 1 g
    B. Vancomycin 1 g
    C. Clindamycin 300 mg
    D. Cefazolin 1 g
    E. Piperacillin/tazobactam 3.375 g

44. Patients with acute cervical spinal cord injury who require endotracheal intubation should preferentially have their airway managed through which of the following techniques?

    A. Fiberoptic oral bronchoscopic intubation
    B. Retrograde wire intubation
    C. Bougie-assisted direct laryngoscopy
    D. Video-assisted direct laryngoscopy
    E. Standard direct laryngoscopy

45. Which of the following patients would most benefit from a trial of non-invasive positive pressure ventilation (NIPPV)?

    A. A 40-year-old male with hypoxemic respiratory failure due to pneumonia with an oxygen saturation of 90% on non-rebreather, tachypnea, and a blood pressure of 88/60 mmHg
    B. A 50-year-old female with an acute myocardial infarction, hypotension, and respiratory distress secondary to flash pulmonary edema
    C. A 67-year-old male with chronic obstructive pulmonary disease (COPD) with wheezing and hypercarbic respiratory failure
    D. A 75-year-old female with an acute hemorrhagic stroke, obtundation, and hypercarbic respiratory failure
    E. A 60-year-old male with alcohol intoxication, recurrent vomiting, and respiratory distress due to aspiration pneumonia

46. You are currently evaluating a 44-year-old female with a history of neurosarcoidosis who has previously maintained on corticosteroid therapy, but has now been slowly decompensating over the last several weeks. All of the following may be treatment options at this time except:

    A. Cyclosporine
    B. Methotrexate
    C. Azothioprine
    D. Whole-brain radiation therapy
    E. Folinic acid, fluorouracil, and oxaliplatin (FOLFOX)

47. A 55-year-old male is admitted to the hospital for fatigue and progressive difficulty breathing. He has a history of advanced alcoholic cirrhosis, but is currently not on any therapy due to noncompliance. He has no history of tobacco use and denies fever, cough or chest pain. He is afebrile, with vital signs as follows: pulse rate 100 beats/minute, respiratory rate 32 breaths/minute, blood pressure 96/42 mmHg, O_2 saturation of 95% on 2 L/min via nasal cannula. Physical exam reveals stigmata of liver failure but no frank ascites. A chest x-ray is performed, showing a large right pleural effusion. An esophagogastroduodenoscopy (EGD) reveals esophageal and gastric varices. Therapeutic thoracentesis returns 3 L of clear light yellow fluid with the following analysis: total protein 2.0 g/dL, albumin 1.0 g/dL, lactate dehydrogenase (LDH) 100 IU/L,

glucose 130 mg/dL. His serum protein is 5.5 g/dL, serum albumin is 2.9 g/dL, and serum LDH is 270 IU/L. What type of pleural effusion is present?

A. Transudative
B. Exudative
C. Infectious
D. Mixed
E. Indeterminate

48. A 55-year-old male on warfarin for a mechanical mitral valve develops acute onset right facial pain which is described as severe burning. Shortly after, he also develops vertigo, nausea, and vomiting. On exam, his blood pressure is 160/84. His neurologic exam demonstrates horizontal nystagmus, intact motor function, decreased pain and temperature sensation in the right face, left arm and left leg, and moderate right arm ataxia. Your medical student accompanies the patient to the CT scanner, and returns excited to have identified a 1 cm intraparenchymal hemorrhage; however, he is unable to describe the location. What is the most likely location and most appropriate management?

A. Right cerebellum; reversal of anticoagulation and medical management of intracranial (ICP) crises
B. Right cerebellum; reversal of anticoagulation and surgical decompression
C. Right medulla; reversal of anticoagulation and medical management of ICP crises
D. Right medulla; reversal of anticoagulation and surgical decompression
E. Right medulla; maintenance of anticoagulation is this is likely hemorrhagic conversion of an embolic infarct

49. Which of the following statements is true regarding the CRASH-2 trial and the use of tranexamic acid (TXA) in the setting of acute trauma?

A. Decreased mortality due to bleeding events in the TXA group, but no difference in overall mortality
B. Significant increase in vascular occlusion events in the TXA group
C. No difference in need for surgery or transfusion between the two groups
D. Decreased overall mortality in the placebo group
E. The number needed to treat (NNT) is about 67

50. A 79-year-old 50 kg female is currently in the ICU with cardiogenic shock and hypoxemic respiratory failure secondary to massive pulmonary edema. A foley catheter was placed on admission, and strict intakes and outputs are being monitored. According to the RIFLE (Risk, Injury, Failure, Loss, End-stage) criteria, a 24 h urine output below what threshold would qualify as renal failure?

A. 150 cc
B. 250 cc
C. 300 cc
D. 500 cc
E. 625 cc

51. A 48-year-old woman with a history of hypertension and allogeneic renal transplant presents to the emergency department with tonic-clonic seizures. In reviewing patient's medical history, you discover that she has been on a stable regimen of tacrolimus 1 mg twice daily, mycophenolate mofetil 500 mg orally twice daily, and prednisone 5 mg daily. The patient is also on hydrochlorothiazide 25 mg daily for management of her hypertension, as well as fluconazole 100 mg daily for treatment of candida esophagitis started approximately 10 days ago. Her blood pressure on arrival is 138/66 mmHg, and the patient's husband states that she has been compliant with her home medication regimen. Which of the following is the most likely explanation for this patient's seizures?

    A. Occult cerebral neoplasm
    B. Fluconazole-induced lowering of the seizure threshold
    C. Supratherapeutic tacrolimus level
    D. Adverse reaction to mycophenolate mofetil
    E. Hypertensive emergency

52. A 38-year-old female presents to the ED with generalized weakness of the limbs and oropharyngeal muscles, and a decreased negative inspiratory force (NIF). She is diffusely weak on exam, worse distally, and is nearly areflexic. A presumptive diagnosis of Guillain-Barre syndrome (GBS) is made, and she is admitted to the ICU for monitoring of her respiratory status. Unfortunately, she continues to deteriorate, and requires intubation 2 h after admission. Disease-modifying therapy is being considered, and your resident wants to know whether plasma exchange or intravenous immunoglobulin (IVIG) would be more beneficial for this patient. Which of the following statements is true?

    A. Glucocorticoids should be trialed prior to initiation of either therapy
    B. IVIG is preferred for campylobacter-associated GBS
    C. The American Academy of Neurology (AAN) does not recommend plasma exchange for ambulatory patients
    D. IVIG would be as effective as plasma exchange in this patient
    E. Plasma exchange must be started within 7 days of symptom onset to be beneficial

53. A 34-year-old 90 kg male firefighter is admitted to the burn unit following circumferential second and third degree burns to his bilateral lower extremities, abdomen, and chest. He is intubated and mechanically ventilated, and you are called to the bedside because his ventilator is alarming. It displays a peak inspiratory pressure of 48 cm H_2O. You perform an inspiratory pause maneuver, and it displays a plateau pressure of 42 cm H_2O. The current ventilator settings are: tidal volume 600 mL, respiratory rate 18/minute, positive end-expiratory pressure (PEEP) 5 cm H_2O, oxygen fraction 0.6. His heart rate is 120 beats/minute, blood pressure 93/50 mmHg, respiratory rate 30 breaths/minute, oxygen saturation 95%. He is fully awake and appears extremely

agitated, with diminished breath sounds bilaterally. What is the next most appropriate intervention?

A. Initiate lung-protective ventilation strategy, starting with 6 mL/kg ideal body weight
B. Perform urgent escharotomy
C. Perform bilateral needle thoracostomy
D. Begin continuous cisatricurium infusion
E. Extubate the patient

54. A 45-year-old male patient with a history of epilepsy due to intracranial metastasis is admitted to the ICU for status epilepticus. The patient is currently on three antiepileptic medications, a propofol infusion, and is on video EEG which demonstrates a burst suppression pattern. It has now been 5 days, and you are concerned that the patient may be experiencing propofol infusion syndrome (PRIS). The following clinical or laboratory features are consistent with PRIS except:

A. Tachycardia
B. Decreasing serum bicarbonate
C. Increasing serum creatinine
D. Hyperlipidemia
E. All of the above

55. In the intracranial pressure (ICP) waveform shown (see Image 3), which of the following is indicated by the waveform morphology?

A. Impaired brain compliance
B. Intravascular volume depletion
C. Normal intracerebral pressure
D. Intracranial hypotension
E. None of the above

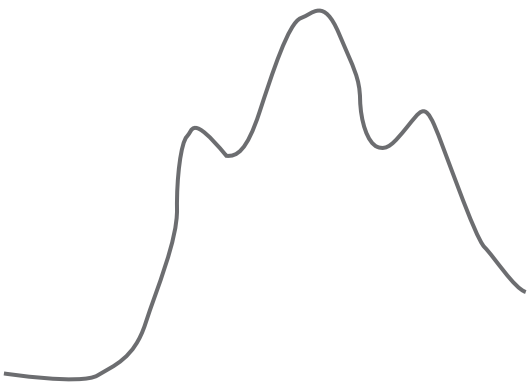

Image 3 ICP waveform tracing

56. A 77-year-old male presents to the emergency department after a fall from a ladder. Paramedics report that the patient was initially speaking to them after the incident, but was confused, with 2 mm equal reactive pupils. On exam, the patient now has nonreactive, midpoint pupils, with abnormal extension of the upper extremities to painful stimulation. The plantar reflex is upgoing bilaterally. His vital signs are as follows: temperature 37.8 °C, blood pressure 191/103 mmHg, pulse rate 48 beats/minute, respiratory rate 28 breaths/minute. Which herniation syndrome is most likely present?

    A. Central
    B. Upward
    C. Uncal
    D. Medullary
    E. Tonsillar

57. A 71-year-old female is currently intubated in the ICU following a large ischemic right middle cerebral artery infarct. The patient begins to experience intractable hiccups while on the ventilator, which are intermittently triggering unwanted ventilator breaths. All of the following may be used in this patient's condition except:

    A. Erythromycin
    B. Metoclopramide
    C. Baclofen
    D. Chlorpromazine
    E. Haloperidol

58. A 69-year-old male with a history of benign prostatic hyperplasia and a chronic indwelling foley catheter is currently intubated in the ICU after a severe traumatic subdural hemorrhage. On the seventh hospital day, the patient develops a high fever; urine cultures indicate the presence of extended-spectrum ß-lactamse (ESBL)-producing enterobacteriaceae. Which of the following would be reasonable empiric treatment options at this time?

    A. Ceftriaxone
    B. Cefotaxime
    C. Aztreonam
    D. Doripenem
    E. All of the above

59. Which of the following pairs of paraneoplastic syndromes and autoantibody targets is correct?

    A. Myasthenia gravis: voltage-gated calcium channels
    B. Lambert-Eaton syndrome: muscle-specific tyrosine kinase (MuSK) receptors
    C. Autoimmune autonomic neuropathy: ganglionic acetylcholine receptors
    D. Isaacs syndrome: acetylcholine receptors
    E. Inflammatory myopathy: N-methyl D-aspartate (NMDA) receptors

60. A 61-year-old male currently hospitalized following a transient ischemic attack (TIA) is complaining of hives and pruritus following the administration of ceftriaxone. You later discover the patient had a documented cephalosporin allergy. Which of the following is true regarding these types of medical errors?

    A. The majority of physicians report covering up a mistake at some point in their careers
    B. 75% of nurses reported knowing about a medication error and not saying anything about it
    C. Tens of thousands of deaths each year can be attributed to preventable errors
    D. 66% of patients will experience a medical error in a given year
    E. A single person can often be identified as the cause of a medical error

61. Which of the following antibiotics cannot be administered via the intraventricular route?

    A. Ceftriaxone
    B. Gentamicin
    C. Vancomycin
    D. Amikacin
    E. Polymyxin B

62. Which of the following is true regarding cerebral blood flow (CBF), cerebral blood volume (CBV), and mean transit time (MTT) in CT perfusion imaging?

    A. CBV = CBF × MTT
    B. CBV = CBF + MTT
    C. MTT = CBF + CBV
    D. MTT = CBF × CBV
    E. CBF = MTT × CBV

63. Which of the following is true regarding the Confusion Assessment Method for the ICU (CAM-ICU) scoring system?

    A. It can be used in patients with a full range of Richmond Agitation and Sedation Scale (RASS) scores, from +4 to −5
    B. It involves the use of the Letters Inattention Test
    C. It does not take into account disorganized thinking
    D. It is graded on a scale of +4 to −5
    E. It was originally designed to be used only in the setting of acute stroke

64. Hypertensive emergency is best defined as end-organ dysfunction in the setting of a systolic blood pressure of at least:

    A. 120 mmHg
    B. 140 mmHg
    C. 160 mmHg
    D. 180 mmHg
    E. 200 mmHg

65. Which of the following statements regarding renal replacement therapy is incorrect?

    A. In the critically ill patient, renal replacement therapy should be initiated early
    B. The time-honored criteria for initiation of renal replacement therapy in patients with chronic renal failure are appropriate to use in critically ill patients
    C. There is no compelling evidence that continuous renal replacement therapy (CRRT) is superior to intermittent hemodialysis
    D. The slow and steady clearance of continuous renal replacement therapy allows lower average serum urea levels than intermittent therapies and avoids dangerous peaks of solute increase
    E. In dialysis, water is removed through the process of ultrafiltration, whereas unwanted solutes are removed by the process of diffusion

66. A 40-year-old female presents with sudden onset severe headache, maximal in intensity at onset, accompanied by photophobia, nausea, and vomiting. Her medical history is notable for depression, for which she was recently started on sertraline. Her examination is notable for a blood pressure of 160/90 mmHg, but otherwise normal physical and neurologic examination. Neuroimaging reveals superficial subarachnoid blood in bilateral posterior frontal convexities and multiple areas of vessel narrowing in branches of the posterior and anterior cerebral arteries, with no other vascular abnormalities. Laboratory data, including erythrocyte sedimentation rate and c-reactive protein, are all within normal limits. Which of the following is true regarding this patient's most likely diagnosis?

    A. This entity is more common in males
    B. Headaches may be treated with sumatriptan
    C. Glucocorticoids are the mainstay of treatment
    D. Most patients have complete resolution of their symptoms and radiographic findings
    E. All of the above

67. A 45-year-old female is currently intubated in the ICU following an acute asthma exacerbation. She was hospitalized for her asthma several weeks ago and was treated with ceftriaxone for a superimposed pneumonia at that time. She is sedated and paralyzed, and receiving both intravenous steroids and inhaled albuterol. On admission, her chest x-ray is clear, and laboratory values are within normal limits. On hospital day 3, her temperature increases to 38.3 °C, she has new leukocytosis, and the nurse notices increased thick secretions. A new hazy right lower lobe opacity is seen on repeat chest x-ray. According to Infectious Disease Society of America (IDSA) guidelines, which of the following is the ideal way to diagnose ventilator-associated pneumonia in this patient?

    A. Bronchoscopy with protected specimen brush culture
    B. Bronchoalveolar lavage with quantitative culture

C. Endotracheal aspirate and culture
D. Serum procalcitonin level
E. Serum C reactive protein level

68. Regarding transcranial doppler (TCD) ultrasonography, the Lindegaard ratio refers to:

A. Mean middle cerebral artery (MCA) velocity divided by ipsilateral anterior cerebral artery (ACA) velocity
B. Mean MCA velocity divided by ipsilateral internal carotid artery (ICA) velocity
C. Mean MCA velocity divided by contralateral MCA velocity
D. Mean ACA velocity divided by contralateral ACA velocity
E. Mean ACA velocity divided by ipsilateral ICA velocity

69. Which of the following statements regarding neoplastic meningitis is true?

A. It is referred to as carcinomatous meningitis when it occurs in the setting of a hematologic malignancy
B. Melanoma is the most commonly encountered cause of leptomeningeal disease
C. Cranial nerve palsies are common findings
D. CSF sampling may be necessary up to four times in order to ensure the presence of malignant cells
E. Carcinomas of unknown primary constitute approximately 25% of cases

70. Which of the following calcium channel blockers is not available as a titratable continuous infusion?

A. Clevidipine
B. Nimodipine
C. Nicardipine
D. Diltiazem
E. All of the above are available as a continuous infusion

71. A 41-year-old male is currently intubated and mechanically ventilated in the ICU while recovering from severe community-acquired pneumonia, and you have decided to extubate the patient. The set tidal volume is 500 mL, and you deflate the cuff on the endotracheal tube. An expiratory tidal volume below which cutoff is least likely to result in post-extubation stridor?

A. 500 mL
B. 475 mL
C. 400 mL
D. 300 mL
E. 200 mL

72. Which of the following infectious pathogens is least likely to trigger an episode of Guillain-Barre syndrome?

A. *Campylobacter jejuni*
B. *Mycoplasma pneumoniae*
C. Cytomegalovirus (CMV)

D. Epstein-Barr virus (EBV)
E. Respiratory syncitial virus (RSV)

73. Regarding continuous electroencephalography (cEEG), relative alpha variability may be used to predict the onset of which of the following?

A. Nonconvulsive status epilepticus
B. Alpha coma
C. Hypoactive delerium
D. Cerebral salt wasting
E. Cerebral vasospasm

74. A 65-year-old female presents to the emergent department with progressive weakness and increasing dyspnea. She has had nasal congestion, a sore throat, and a mild cough for the last several days. On further questioning, she reports exhaustion with routine chores such as combing her hair, as well as blurry vision that is worse at the end of the day. She has had a 10 lb weight loss in the last month, and is having difficulty chewing her food while eating meals. She is febrile to 39 °C, tachypneic, and has audible secretions. Her oxygen saturation is noted to be 88% on room air, and an arterial blood gas shows the following: pH 7.32, PO_2 70 mmHg, PCO_2 75 mmHg. A chest x-ray shows a left lower lobe opacity and a small left pleural effusion. Which of the following should be performed next?

A. Intubate the patient
B. Initiate noninvasive positive pressure ventilation
C. Check her negative inspiratory force (NIF) and vital capacity
D. Perform diagnostic thoracentesis
E. Arrange for plasmapharesis

75. All of the following are proposed mechanisms of benefit in the use of neuromuscular blocking agents in the care of adults with severe acute respiratory distress syndrome (ARDS) except:

A. Reduction in oxygenation consumption
B. Reduction in breath stacking
C. Decrease in delivered alveolar pressure
D. Improvement in patient-ventilator synchrony
E. Improved matching of target and delivered tidal volumes

76. Which of the following is correct regarding deep venous thrombosis (DVT) prophylaxis for patients admitted to the hospital after acute spinal cord injuries?

A. Begin prophylaxis with unfractionated subcutaneous heparin within 24 h of injury
B. Begin prophylaxis with low molecular weight heparin within 72 h of injury
C. Begin prophylaxis with unfractionated subcutaneous heparin within 7 days of injury
D. Withhold prophylactic anticoagulation from time of injury until surgery is complete
E. Consider placing an IVC filter in the majority of acute SCI patients at time of surgery

77. A 72-year-old female presents who has been hospitalized for community-acquired pneumonia begins to complain of severe midsternal chest pressure. A bedside EKG is performed, demonstrating 2–3 mm of ST elevation in the inferior leads. In addition to activating the cardiac catheterization lab, you prepare to administer aspirin and a loading dose of clopidogrel. Which of the following is true regarding a 600 mg loading dose of clopidogrel as compared to a 300 mg loading dose?

    A. Lower risk of adverse cardiac events, higher risk of major bleeding events
    B. Lower risk of adverse cardiac events, no difference in bleeding risk
    C. No difference in adverse cardiac events, higher risk of major bleeding events
    D. No difference in adverse cardiac events, no difference in bleeding risk
    E. Studies have not previously compared the two loading doses

78. Approximately what percentage of patients with spontaneous subarachnoid hemorrhage will have normal cerebral angiography?

    A. 1%
    B. 5%
    C. 20%
    D. 50%
    E. 75%

79. An 84-year-old male is currently receiving empiric antibiotic treatment for suspected iatrogenic ventriculitis. Immediately after the first dose of antibiotics are administered, the patient develops a confluent, intensely pruritic erythematous rash on the face, neck, and upper torso. The patient remains hemodynamically stable, and his symptoms resolve within a few hours with conservative management. Which of the following antibiotics is most likely responsible for this patient's symptoms?

    A. Ceftriaxone
    B. Metronidazole
    C. Piperacillin/tazobactam
    D. Meropenem
    E. Vancomycin

80. A 54-year-old 70 kg male with a history of atrial fibrillation is currently in the ICU following an acute ischemic infarct with endovascular clot retrieval. He is currently poorly rate controlled, with a heart rate fluctuating between 130 and 160 beats/minute. His last blood pressure was 102/44 mmHg. You decide to initiate an amiodarone bolus and continuous infusion. Assuming the patient does not receive any repeat bolus dosing, approximately how much amiodarone will this patient require in the next 24 h?

    A. 150 mg
    B. 300 mg
    C. 625 mg

D. 750 mg
E. 1050 mg

81. A 60-year-old female with systolic heart failure is intubated and mechanically ventilated for septic shock due to aspiration pneumonia. You decide to increase positive end-expiratory pressure (PEEP) to improve alveolar recruitment and oxygenation. Which of the following effects should be expected?

A. Increase in venous return
B. Decrease in urine output
C. Increase in left ventricular afterload
D. Decrease in right ventricular afterload
E. Decrease in functional residual capacity (FRC)

82. Which of the following is the diagnostic test of choice to confirm compartment syndrome?

A. Manometry
B. Compression/duplex ultrasonography
C. Contrast-enhanced CT
D. Contrast-enhanced MRI
E. Conventional angiography

83. Which of the following classic pairs of EKG leads and cardiac territories is correct?

A. II, III, aVF—anterior
B. V3, V4—inferior
C. V1, V2—septal
D. I, aVL—inferior
E. V5, V6—inferior

84. A 62-year-old male with a history of COPD, atrial fibrillation on warfarin, and hypertension presents to the emergency department for acute onset of headache, nausea, vomiting, and gait instability. A head CT demonstrates a 3.4 cm cerebellar hemorrhage without intraventricular extension. Laboratory studies demonstrate an INR of 2.5. The patient is given vitamin K and 4-factor prothrombin complex concentrate (PCC) and admitted to the ICU for frequent neurologic checks. Six hours later, he develops progressive lethargy, although he is still arousable and protecting his airway. A stat repeat head CT shows no rebleed, but compression of the fourth ventricle associated with moderate hydrocephalus. His INR is currently normal. According to guidelines from the American Stroke Association (ASA) and American Heart Association (AHA), what treatment is currently indicated?

A. 250 cc infusion of 3% saline
B. 1 g/kg mannitol infusion
C. Suboccipital craniotomy and decompression
D. Lumbar puncture
E. External ventricular drain (EVD) placement

85. A 47-year-old female who has just undergone cervicothoracic spine surgery has been admitted to your ICU. The surgeon signs out an estimated blood loss of 750 mL, along with several episodes of hypotension during the surgery. The patient has a history of chronic kidney disease, and you are following the serum creatinine closely. Which of the following statements regarding the use of creatinine as a marker for acute kidney injury (AKI) is correct?

    A. Serum creatinine is a predictable marker for renal failure in the first 2–4 h of injury
    B. The absolute level of serum creatinine always reflects the severity of the underlying kidney damage
    C. The rate of increase in serum creatinine is related to baseline kidney function
    D. Serum creatinine is an accurate marker for structural renal damage
    E. The use of serum creatinine to assess the severity of AKI is unaffected by patient nutrition or medication effects

86. A "lung point sign" on bedside ultrasonography is highly specific for which of the following?

    A. Pulmonary edema
    B. Pleural effusion
    C. Atelectasis
    D. Pneumothorax
    E. Empyema

87. Which of the following may be used to control shivering in patients undergoing targeted temperature management (TTM)?

    A. Buspirone
    B. Fentanyl
    C. Dexmedetomidine
    D. Cisatracurium
    E. All of the above

88. A 70-year-old male with a new diagnosis of lung cancer is admitted to the neurology service for new onset right-sided weakness. During the initial work up, he starts to have significant hemoptysis. Computed tomography (CT) of the chest without contrast shows multiple bilateral lung masses. The patient's oxygen saturation drops to 88% on room air as he continues to cough up bright red blood, and he is eventually intubated and transferred to the ICU. Bronchoscopy is performed, and shows blood coming from the right lower lobe, with the left lung being completely clear. How should this patient be positioned?

    A. Left side down
    B. Right side down
    C. Alternating left and right side down every 4 h
    D. Prone position
    E. Fowler's position

89. Which of the following is true regarding flail chest injuries?

    A. The most common cause of death is secondary to hemothorax
    B. The mortality rate for this injury may be as high as 25%
    C. Early operative intervention has been shown to reduce morbidity and mortality
    D. The high risk of secondary infection usually dictates the use of prophylactic antibiotics
    E. None of the above

90. A 33-year-old male with a history of bicuspid aortic valve and childhood asthma is currently in the ICU following elective clipping of an incidentally discovered middle cerebral artery (MCA) aneurysm. The patient begins to complain of sharp substernal chest pain radiating to his shoulder blades that is severe in intensity, associated with diaphoresis and lightheadedness. Which of the following is the most likely diagnosis?

    A. Acute myocardial infarction
    B. Valve failure and severe aortic regurgitation
    C. Myocardial papillary muscle rupture
    D. Endocarditis with secondary valvular stenosis
    E. Aortic dissection

91. Which of the following is not a defining feature of thrombotic thrombocytopenic purpura (TTP)?

    A. Low platelet count
    B. Fever
    C. Presence of schistocytes
    D. Elevated international normalized ratio (INR)
    E. Hallucinations

92. You are a spectator at a high school football game when lightning strikes one of the goalposts. A 34-year-old male standing approximately 10 ft away immediately collapses, and you rush to render aid. He is apneic, pulseless, and unresponsive. Which of the following is true regarding his condition?

    A. He is most likely in asystole
    B. He is most likely in pulseless electrical activity
    C. His chances of resuscitation, even with immediate aid, are poor
    D. His chances of neurologic recovery, even with immediate resuscitation, are poor
    E. CPR should be withheld while awaiting the nearest defibrillator

93. Which of the following antiepileptic medications may result in a markedly increased international normalized ratio (INR) when used in conjunction with warfarin?

    A. Valproic acid
    B. Phenytoin
    C. Levetiracetam
    D. Zonisamide
    E. Phenobarbital

94. Which of the following is the preferred diagnostic modality in a patient with abdominal pain, hemodynamic instability, and suspected hollow viscous injury following blunt abdominal trauma?

    A. Exploratory laparotomy
    B. Bedside focused assessment with sonography in trauma (FAST) exam
    C. Contrast-enhanced CT scan
    D. Diagnostic peritoneal lavage
    E. Plain radiography with specific attention to the presence of free air

95. A 50-year-old male with a history of metastatic renal cell carcinoma presents to the emergency department with exertional dyspnea. There is no edema of the lower extremities on exam, and the lung fields are grossly clear. Vital signs are unremarkable except for an oxygen saturation of 93% on room air. A complete blood count, metabolic profile, and cardiac enzymes are all within normal limits. A bedside echocardiogram is unremarkable. A computed tomography (CT) angiogram of the chest is performed (see Image 4). Which of the following should be performed next?

    A. Cardiothoracic surgery consult
    B. Anticoagulation with intravenous heparin infusion
    C. Administration of systemic thrombolytics
    D. Endobronchial ultrasound with transbronchial needle aspiration
    E. Noncontrast CT of the head

Image 4 CT angiogram of the chest

96. Which of the following is the mechanism of action of the anticonvulsant levetiracetam?

    A. Calcium channel inhibition
    B. Sodium channel inhibition
    C. GABA potentiation
    D. NMDA inhibition
    E. Potassium channel modulation

97. A 73-year-old female is currently in the ICU following a craniotomy and clipping of a left middle cerebral artery aneurysm. The patient presented with an atraumatic subarachnoid hemorrhage, and an external ventricular drain (EVD) was placed in the emergency department. The patient's postoperative course has been uneventful, and the EVD has now been clamped for the last 12 h. The patient is now complaining of a severe headache, with intracranial pressure (ICP) readings fluctuating between 25 and 40. The neurologic exam us otherwise unremarkable. Laboratory findings from this morning indicate a serum sodium of 144 mEq/L and a serum osmolarity of 310 mOsm/kg. Which of the following should be performed next?

    A. Administer mannitol
    B. Administer hypertonic saline
    C. Urgent non-contrasted computed tomography (CT) of the head
    D. Send cerebrospinal fluid for culture and gram stain
    E. Open the EVD

98. A 62-year-old female with a history of hypertension and coronary artery disease is currently recovering from a cardiac catheterization and stent placement in the left main coronary artery. On post-catheterization day 2, the patient begins to complain of right groin pain at the catheterization puncture site. Vital signs are unremarkable. Mild ecchymosis is present without overt hematoma, and distal pulses are in tact. Which of the following should be performed next?

    A. Venous duplex ultrasonography of the right lower extremity
    B. Arterial duplex ultrasonography of the right lower extremity
    C. CT of the pelvis with special attention to the retroperitoneum
    D. Urgent return to the cardiac catheterization suite
    E. Bedside echocardiography

99. A 71-year-old male is currently intubated in the ICU while being treated for status epilepticus. He has been receiving subcutaneous enoxaparin for deep vein thrombosis (DVT) prophylaxis. On day 6 of his ICU stay, his platelet count has dropped from $220 \times 10^3/\mu L$ (on admission) to $44 \times 10^3/\mu L$. He has

also developed a DVT in his right lower extremity despite enoxaparin therapy. There is high suspicion that the patient may be suffering from heparin-induced thrombocytopenia (HIT), with no reasonable alternative explanation for the patient's low platelet count. According to the 4T score, all of the following elements of his history place him at a high risk of testing positive for HIT except:

A. Age >65 years old
B. Timing of platelet fall
C. Degree of platelet fall
D. Development of DVT despite prophylaxis
E. No reasonable alternative to explain the patient's thrombocytopenia

100. A 75 year-old male with Hodgkin's lymphoma on chemotherapy presents to the emergency department with cough, fever and right sided chest pain for 3 days. A contrast-enhanced chest CT is performed (see Image 5). He is started on broad spectrum antibiotics, but shows no clinical improvement over the next several weeks with persistent fever and elevated white count. What is the next best step in this patient's management?

A. Open surgical drainage
B. Continue antibiotics and monitor for clinical improvement
C. Insert a pigtail catheter
D. Perform thoracentesis
E. Chest physiotherapy

Image 5 Contrast-enhanced CT of the chest

Exam 3 Answers

Then fail not most carefully to peruse the books of the Greek, Arabian, and Latin physicians, not despising the Talmudists and Cabalists; and by frequent anatomies, get thee the perfect knowledge of that other world, called the microcosm, which is man.

Francois Rabelais
(1494–1553)

1. **The correct answer is C.** The Barrow classification system breaks carotid cavernous fistulae down into four subtypes. Type A shunts are direct communications between the ICA and the cavernous sinus. Types B, C, and D are indirect shunts involving branches of the ICA, ECA, and both ICA/ECA, respectively. Type A lesions are high flow, while Types B, C and D lesions are low flow. Type D lesions account for the majority of cases.
2. **The correct answer is A.** This patient has central neurogenic hyperventilation (CNH), which is a rare condition that results in hyperventilation persisting in sleep and resulting in low $PaCO_2$, high PaO_2, and a high pH in the absence of any pharmacologic or metabolic conditions. It has been hypothesized that CNH results from uninhibited stimulation of both the inspiratory and expiratory centers in the pons and medulla. Cheyne-Stokes respiration is a more regular crescendo-decrescendo breathing followed by periods apnea. Apneustic breathing is a sustained deep inspiration lasting few seconds followed by rapid exhalation and a brief post expiratory pause. Ataxic breathing is another rare breathing pattern consisting of erratic rate and depth of breathing, interspersed with episodes of apnea. Ataxic breathing is one of the few true localizing breathing patterns, and should always raise the suspicion of a medullary infarct. Cluster breathing consists of irregular clusters of breaths followed by apneic periods of variable duration.
3. **The correct answer is C.** A significant number of patients with TCD elevation will never develop ischemia, even in the absence of any intervention. Given the lack of clinical symptoms, aggressive fluid resuscitation and blood pressure augmentation may harm this patient. Instead, volume repletion as needed based on hemodynamic monitoring is preferred. Conventional angiography is traditionally reserved for significant delayed ischemic neurologic deficits with intention to treat vasospasm intra-arterially.
4. **The correct answer is C.** Myoclonic status is associated with a broad range of brain injuries, including anoxic brain injury, toxic-metabolic encephalopathies, and exacerbations of certain epilepsy syndromes. The clinical presentation and significance of frequent myoclonic jerks differs greatly by etiology. Controversies persist about prognostic significance and management of myoclonic status epilepticus following anoxic brain injury, but recent data suggest that in the era of therapeutic hypothermia, postanoxic myoclonic status epilepticus may not be as ominous a sign as previously thought [1]. Valproate and benzodiazepines are the most successful agents for myoclonic status. In the context of anoxia, when myoclonus represents

the erratic last sparks of disseminated neuronal populations, benzodiazepines will mask the behavioral correlate with no impact on recovery; this may serve an appropriately palliative purpose (primarily for the benefit of the family).

5. **The correct answer is B.** The clinical scenario is suspicious for bilateral vestibular schwanommas, which is associated with neurofibromatosis type II. Von Hippel-Lindau syndrome in the nervous system presents as hemangioblastomas, primarily involving the cerebellum, retina, and spinal cord. Those affected with tuberous sclerosis are at risk for cortical tubers, subependymal nodules, and subependymal giant cell astrocytomas (SEGAs). Schwannomatosis is a rare condition associated with noncutaneous schwannomas involving spinal, peripheral, and cranial nerves in the absence of vestibular nerve involvement. Alport syndrome is a rare form of inherited collagen dysfunction resulting in hearing loss and renal failure.
6. **The correct answer is B.** This patient is in status asthmaticus and severe respiratory distress. These patients will often present hypocapnic secondary to hyperventilation. "Normalization" of the pCO_2 is an ominous sign, and portends impending respiratory failure. Therefore, this patient should be intubated immediately and admitted to the ICU.
7. **The correct answer is D.** Chiari malformations can be broadly described as follows: I—displacement of the cerebellar tonsils through the foramen magnum; II—displacement of the medulla and vermis through the foramen magnum, usually in conjunction with a myelomeningocele; III—similar to II with an associated with an occipital encephalocele; IV—cerebellar hypoplasia without herniation through the foramen magnum; and V—absent cerebellum with herniation of the occipital lobe through the foramen magnum (controversial) [2].
8. **The correct answer is E.** The CHA_2DS_2-VASc is used to estimate the annual stroke risk in patients with atrial fibrillation [3]. Each of the following elements is worth 1 point: congestive heart failure, hypertension, diabetes mellitus, vascular disease, age 65–74 years, or female gender. Additionally, age ≥75 or prior stroke/TIA are worth 2 points. Based on a maximum score of 9 points, the annual stroke risk is as follows (from 0 to 9 points, respectively): 0%, 1.3%, 2.2%, 3.2%, 4.0%, 6.7%, 9.8%, 9.6%, 12.5%, and 15.2%.
9. **The correct answer is A.** Raising the head of the bed 30–45° is the most effective measure to prevent aspiration in an intubated patient. In one randomized trial, a markedly significant decrease in suspected and confirmed cases of healthcare-associated pneumonia was seen in patients in the semirecumbent position (8% versus 34% incidence of clinically suspected, and 5% versus 23% of microbiologically confirmed cases). The trial was actually terminated early due to overt benefit in the treatment group [4]. There are also specialized endotracheal tubes that allow for continuous or intermittent aspiration of subglottic secretions, with randomized controlled studies showing a reduction in ventilator-associated pneumonia (VAP) rates [5]. However, these devices have not been universally adopted, may be cost-prohibitive, and are not as effective

as simple head elevation. There is no correlation with aspiration or VAP rates and measurement of gastric volume residuals, and monitoring gastric volume may also lead to a reduction in nutritional intake.

10. **The correct answer is C.** Comprehensive Stroke Centers are the highest level of care available for certification. Stroke Center certification is managed by The Joint Commission most commonly, but can also be managed by state regulations and several other certifying bodies. Acute Stroke Ready Hospitals have the ability to perform rapid neuroimaging, maintain a 60-min door-to-needle time, and have access to neurosurgical services within 3 h or by transfer. Primary Stroke Centers have the ability to perform rapid neuroimaging, maintain a 60-min door-to-needle time, have access to neurosurgical services within 2 h or by transfer, and have a stroke unit available. Comprehensive Stroke Centers have the ability to perform rapid neuroimaging, maintain a 60-min door-to-needle time, have access to neurosurgical and interventional services at all times (with a call schedule), have a stroke unit available, and have a neurocritical care unit.
11. **The correct answer is A.** The most common classification system for the internal carotid artery divides it into the following segments, in order from proximal to distal: C1 (cervical), C2 (petrous/horizontal), C3 (lacerum), C4 (cavernous), C5 (clinoid), C6 (ophthalmic), and C7 (communicating/terminal) [6].
12. **The correct answer is E.** A number of landmark trials have been performed evaluating potential therapies in ARDS. The most notable of these was the ARDSNet trial comparing lower tidal volumes versus traditional tidal volumes, and established lung-protective ventilation as the standard of care in ARDS [7]. Other evidence-based interventions include prone positioning (the PROSEVA trial)[8], the selective use of neuromuscular blocking agents (the ACURASYS trial) [9], and ECMO (the CESAR trial). The use of HFOV early in ARDS was actually associated with poorer outcomes in a trial by Ferguson et al. [10].
13. **The correct answer is D.** One must be cautious when administering inhaled N-acetylcysteine in patients with poorly controlled asthma, as the drug itself may trigger bronchospasm in sensitive individuals. None of the other answer choices are contraindications to its use, and in fact, N-acetylcysteine is sometimes used as maintenance therapy in cases of idiopathic pulmonary fibrosis.
14. **The correct answer is D.** This patient has a craniopharyngioma. Though a histologically benign tumor, craniopharyngiomas infiltrate adjacent structures and cause significant morbidity and mortality. The mainstay of treatment is surgical resection. Craniopharyngiomas have a bimodal age distribution, with one peaks among children aged 5–14 and the other peak in adults aged 50–75. There are two types of craniopharyngioma: the adamantinous type is most common in children, and the papillary type is most common in adults. The most common presentations include hypopituitarism and visual deficits. Most patients suffer from chronic partial or complete hypopituitarism with approximately 80% requiring hormone substitution. Craniopharyngiomas arise from epithelial remnants of Rathke's pouch [11].

15. **The correct answer is C.** This patient's presentation and angiography findings are highly suggestive of moyamoya disease. Moyamoya is characterized by occlusions of the bilateral internal carotid arteries and proximal anterior and middle cerebral arteries. It may be congenital, or may be secondary to a variety of other conditions such as sickle cell disease and Down syndrome. Patients may suffer from recurrent headaches, ischemic insults, or remain completely asymptomatic. Women are more commonly affected than men. Surgical treatment is often recommended, particularly superficial temporal artery to middle cerebral artery (STA-MCA) bypass.
16. **The correct answer is E.** Thyroid storm management typically consists of a beta-blocker to treat adrenergic tone, a thionamide to block new hormone synthesis, and an iodine solution to block the release of thyroid hormone. Cooling blankets may also be used to correct pyrexia.
17. **The correct answer is E.** Central DI can arise from pathology in a number of different brain regions. This includes hypothalamic osmoreceptors, supraoptic or paraventricular nuclei, and/or the superior portion of the supraopticohypophyseal tract.
18. **The correct answer is E.** The evaluation of serum ammonia in patients with hepatic encephalopathy remains somewhat controversial. Although patients usually present with elevated serum ammonia levels, there has been no cutoff that is consistently associated with symptomatic patients, nor is there a clear association between an increased serum ammonia level and a more severe degree of encephalopathy [12].
19. **The correct answer is D.** According to the ICH score, this patient receives 1 point for a GCS between 5 and 12, 0 points for her age (<80), 0 points for hemorrhage volume (<30 cc), and 1 point for infratentorial origin. The total score is 2 points, which corresponds to an in-hospital mortality of about 26% [13].
20. **The correct answer is E.** The Stewart-Hamilton equation for estimating cardiac output via thermodilution follows a relatively simple formula. A thermistor measures blood temperature change following a small bolus of cold injectate. Cardiac output is inversely proportional to the rate of change over time (i.e. impaired cardiac output is indicated by a longer, slower temperate change as measured by the thermistor). The formula is as follows: $Q = V \times (Tb - Ti)K1 \times K2/Tb(t)dt$, where Q is cardiac output, V is injectate volume, Tb is blood temperature, Ti is injectate temperature, K1 and K2 are density, dead space, and heat corrections, and Tb(t)dt is the change in blood temperature over time.
21. **The correct answer is D.** POTS, multiple system atrophy, neurocardiogenic syncope, and diabetic autonomic neuropathy are all forms of dysautonomia. Precordial catch syndrome, or "Texidor's twinge", is a benign chest pain syndrome seen primarily in teenagers and young adults.
22. **The correct answer is C.** Phenytoin for 2 weeks has been associated with poorer cognitive and functional outcomes after SAH. Prophylaxis is still required for a shorter period, especially in an elderly female patient after

craniotomy with visible injury on neuroimaging. Levetiracetam has become the preferred first line agent for this purpose.

23. **The correct answer is B.** WHO grade I astrocytomas include pilocytic astrocytoma, pleomorphic xanthoastrocytoma, subependymal giant cell astrocytoma, and subependymoma. WHO grade II astrocytomas include fibrillary astrocytoma and mixed oligoastrocytoma. WHO grade III and IV respectively include anaplastic astrocytoma and glioblastoma multiforme (GBM).
24. **The correct answer is B.** Tricyclic antidepressants are notorious for their ability to produce an exam mimicking complete brain death in the setting of an acute overdose, a state which may reverse over time with appropriate care [14]. Overdoses of phencyclidine and synthetic cathinone (colloquially known as "bath salts") usually result in a severely agitated state, while overdoses of MDMA or clonidine may present as lethargy, stupor, or even coma—but not to the point where all brainstem reflexes are abolished. Interestingly, an MDMA overdose may also result in states of severe agitation, hallucinations, or even frank seratonin syndrome.
25. **The correct answer is C.** Patients with history of a recent neurosurgical procedure and suspected postoperative infection should be provided with empiric coverage for nosocomial pathogens such as *Pseudomonas aeruginosa* and MRSA. Additionally, anerobic coverage should be included for empiric treatment of brain abscesses. Of the choices listed, only cefepime, vancomycin and metronidazole provide appropriate anaerobic and nosocomial coverage.
26. **The correct answer is A.** Preeclampsia and eclampsia are two of the most common hypertensive disorders of pregnancy. In preeclamptic pregnant patients, seizure activity may be preceded by headache, nausea, vomiting, and in some cases, cortical blindness. Nystagmus is not usually reported.
27. **The correct answer is E.** A left-sided superior vena (LSVC) cava is an anatomic variant present in 0.3–0.5% of healthy subjects and 1.3–4.5% of those with congenital heart defects. In the majority of cases, the persistent LSVC connects to the right atrium via the coronary sinus; however, in a subset of patients (as in this patient), the LSVC connects to the left atrium. The partial pressure of oxygen from the catheter blood sample rules out an arterial source [15].
28. **The correct answer is A.** Mobile stroke units are a relatively new innovation that are still being evaluated for their generalizability. They are ambulances equipped with CT scanners and staffed by prehospital providers, CT techs, nurses who can provide tPA, and vascular neurologists. Thus far, these units have been deployed in large cities, not in rural areas. Patients seen in these mobile units are more likely to receive tPA closer to symptom onset, and are more likely to be transported to Primary Stroke Centers or Comprehensive Stroke Centers [16].
29. **The correct answer is A.** A hyperdynamic precordium causes movement of the chest wall that may be mistaken for respiration, and this is a common cause of false negative apnea testing. Electromagnetic interference may

prevent a determination of brain death in regards to EEG testing. Ictal activity requires functioning neurons, and by definition, precludes brain death. Physician inattentiveness may result in a false positive apnea test, as patient respirations may go unnoticed. Severe hypocarbia should be addressed and corrected before performing apnea testing in the first place, as it may also result in false positive testing.

30. **The correct answer is D.** Although cerebral venous sinus thrombosis is usually diagnosed via CT or MR venography, conventional angiography remains the diagnostic gold standard [17]. Transcranial doppler is primarily used to measure flow velocities in the proximal anterior and middle cerebral arteries, particularly in the setting of suspected vasospasm.
31. **The correct answer is D.** The HAIR score is used to stratify the risk of 30-day mortality in subarachnoid hemorrhage. The components of the HAIR score are as follows: Hunt-Hess grade (H), patient age (A), presence of intraventricular hemorrhage (I), and whether or not the patient experiences re-bleed (R). Aneurysm size is not a consideration [18].
32. **The correct answer is E.** The risk of hemorrhage in an unruptured AVM is about 2–4% per year, and AVMs with concurrent arterial aneurysms are at a higher risk for rupture [19]. Exclusive deep venous drainage and deep brain location may also be risk factors, along with hemorrhage as the initial presenting symptom.
33. **The correct answer is A.** The elements of the qSOFA score are altered mental status, hypotension, and tachypnea. Each element is worth 1 point; a score of 2 or 3 is associated with an increased risk of in-hospital mortality and increased ICU length-of-stay in patients admitted with an infectious illness [20].
34. **The correct answer is B.** The most common cause of recalcitrant hypokalemia is concurrent hypomagnesemia. This is especially true of patients on cisplatin therapy, who may have significant ongoing renal losses of both potassium and magnesium. Any patient who has hypokalemia that persists despite intravenous replacement should have a serum magnesium level checked first. Diarrhea and vomiting would be less likely to cause the degree of refractory hypokalemia seen here. Pancreatic fistulae are rare causes of hypokalemia.
35. **The correct answer is E.** Triphasic wave encephalopathy (TWE) is a relatively nonspecific indicator of a wide range of metabolic, toxic and structural abnormalities. Differentiating which pattern represents a fixed encephalopathy versus a reversible super-imposed condition is challenging. Hepatic, renal, and electrolyte abnormalities should be considered. Benzodiazepine trial is reasonable as well.
36. **The correct answer is A.** Plasma free metanephrine level is the most sensitive (99%) initial diagnostic test when working a patient up for pheochromocytoma, followed by urinary catecholamines (86%), plasma catecholamines (84%), and urinary vanillymandelic acid (64%) [21].
37. **The correct answer is B.** Amphotericin B, ceftriaxone, and erythromycin do not require a change in drug dosing during renal replacement therapy.

Vancomycin, however, requires dosing adjustments during both continuous renal replacement therapy and intermittent hemodialysis. Catecholamines, such as norepinephrine, can be initiated at normal doses and titrated to effect.

38. **The correct answer is D.** This patient has severe community acquired pneumonia in the setting of immunosuppression as a result of her recent RA flare and ongoing prednisone use. For patients with severe community acquired pneumonia requiring ICU admission, Infectious Disease Society of America guidelines recommend use of a antipneumococcal ß-lactam (i.e. ceftriaxone, cefotaxime, ampicillin-sulbactam) plus azithromycin or a respiratory fluoroquinolone (moxifloxacin, gemifloxacin, or levofloxacin) [22]. In addition, this patient has been on a significant dose of glucocorticoid (greater than 20 mg of prednisone for 1 month or longer) in addition to receiving methotrexate weekly for RA, which also puts her at risk for *Pneumocystis* (PCP) infection. As she has not been on prophylaxis for PCP, she should also be empirically treated with trimethoprim-sulfamethoxazole**.**
39. **The correct answer is B.** Administration of acyclovir is associated with nephrotoxicity due to intra-tubular precipitation of crystals, and usually occurs during the initial 72 h of treatment. Lisinopril can cause acute kidney injury as well; however, in this case lisinopril is a home medication, and is less likely to be the culprit. Renal toxicity is not a common adverse effect associated with administration of phenytoin, amlodipine, or acetaminophen.
40. **The correct answer is E.** All of the following are correct regarding the NEXUS criteria for cervical spine clearance, with the exception of an age requirement [23]. This is in contrast to the Canadian cervical spine rule [24], although both are used in clinical practice.
41. **The correct answer is A.** This patient is suffering from uremic encephalopathy, with characteristic uremic frost as a result of crystalline urea deposits on the skin. The serum BUN is usually markedly elevated, often times exceeding 200 mg/dL [25].
42. **The correct answer is B.** Although this is still a somewhat contentious subject, there is evidence to suggest that, among younger patients with low clinical grade bleeds as a result of aneurysms in the anterior or posterior circulation, an endovascular approach may provide better outcomes versus a traditional surgical approach. The surgical approach may be better suited to aneurysms of the middle cerebral artery, which are surgically easier to access versus aneurysms in the anterior or posterior circulation [26].
43. **The correct answer is D.** Cefazolin provides the narrowest coverage against likely organisms (i.e. *Staphylococcus aureus* and coagulase negative staphylococci), and is recommended for perioperative prophylaxis of certain neurosurgical procedures, including EVD placement. Ceftriaxone is incorrect because it provides much broader coverage compared to cefazolin, and is not the recommended agent according to Infectious Disease Society of America guidelines. Piperacillin/tazobactam is incorrect for similar reasons. Vancomycin and clindamycin are reserved for patients with beta-lactam allergies [27].

44. **The correct answer is A.** Fiberoptic oral intubation is preferred for cervical spine stability when compared to direct laryngoscopy, which requires extension of the cervical spine in many cases. Retrograde wire intubation is time-consuming and generally reserved as a rescue technique only.
45. **The correct answer is C.** NIPPV is most suited for acute exacerbations of COPD and congestive heart failure; however, it is contraindicated in cases of hemodynamic instability, acute myocardial infarction, and altered mental status. A combination of alcohol intoxication and recurrent vomiting would likely put a patient on NIPPV at risk of further aspiration events.
46. **The correct answer is E.** Corticosteroids are frontline therapy for the treatment of neurosarcoid. When patients fail steroid therapy, a number of second-line treatments may be explored, including cyclosporine, methotrexate, azothioprine, and even radiation therapy in certain cases. FOLFOX is a chemotherapy regimen used in colorectal cancers, and has no role in the treatment of neurosarcoid.
47. **The correct answer is A.** Light's criteria favoring transudative effusion are as follows: pleural fluid protein to serum protein <0.5, pleural fluid LDH to serum LDH <0.6, or pleural fluid LDH <2/3rd upper limit of normal for serum level. In this case, the fluid sample indicates this is likely a transudative effusion.
48. **The correct answer is C.** This patient has ipsilateral ataxia and facial sensory findings with contralateral arm and leg sensory findings, classic for Wallenberg syndrome. The ataxia in this case is due to compression of the ipsilateral cerebellar peduncle, and not direct involvement of the cerebellum. Ipsilateral Horner's syndrome is also often present. Despite the risk from his mechanical mitral valve, this patient's anticoagulation must be temporarily held, as expansion and rebleeding in the confined space of the brainstem would likely be catastrophic. Surgical decompression and/or clot extraction is often not recommended for brainstem hemorrhages, and this patient's lack of evidence of increased ICP makes the possible benefits of such a high-risk surgery even smaller.
49. **The correct answer is E.** The CRASH-2 trial was a randomized, placebo-controlled multicenter trial evaluating the safety and efficacy of tranexamic acid (load of 1 g over 10 min, followed by 1 g over 8 h infusion) in adult trauma patients at risk of severe hemorrhage (or in hemorrhagic shock) if administered within 8 h of presentation. Overall mortality was decreased in the TXA group, particularly in regards to bleeding as a cause of death. There was no statistically significant difference in thrombotic adverse events between the two groups, nor was there a difference in need for surgical intervention or blood product administration. The number needed to treat (NNT) was 67 (1.5% absolute risk reduction) [28].
50. **The correct answer is A.** According to RIFLE criteria, a 24 h urine output of <0.3 cc/kg (or alternatively, anuria × 12 h) qualifies as renal failure. Therefore, in this 50 kg patient, that would equate to a threshold of 150 cc/24 h (50 kg × 0.3).

51. **The correct answer is C.** Fluconazole inhibits the metabolism of tacrolimus, and it is recommended to reduce the dose of tacrolimus by 50% empirically when fluconazole therapy is initiated. Otherwise, tacrolimus levels may become supratherapeutic, which puts the patient at risk for developing seizures.
52. **The correct answer is D.** Although it has never been compared to placebo, IVIG has been demonstrated to be as effective as plasma exchange for GBS. Plasma exchange is most effective when started within 7 days, but may be effective in multiple outcome measures including degree of disability and need for mechanical ventilation even when given up to 30 days after symptom onset. Glucocorticoids are not recommended for Guillain-Barre management. The AAN recommends plasma exchange, but not IVIG, for ambulatory patients presenting within 2 weeks of symptom onset [29, 30].
53. **The correct answer is B.** This patient has sustained circumferential burns to his chest and abdomen, rendering the skin tight and inelastic (eschar formation). The result is thoraco-abdominal compartment syndrome. This is manifested as reduced respiratory system compliance (elevated plateau pressure) and hypotension from impaired venous return. The treatment of this condition is urgent escharotomy, wherein the eschar is incised (usually longitudinally, in multiple locations on the thoracoabdominal wall) down to underlying intact, flexible fatty tissue.
54. **The correct answer is A.** Propofol infusion syndrome is a rare complication of propofol infusion associated with high doses and prolonged usage. Risk factors include young age, critical illness, high fat and low carbohydrate intake, concomitant catecholamine infusion, and steroid therapy. Findings include bradycardia and cardiovascular collapse, severe metabolic acidosis, rhabdomyolysis, hyperlipidemia, renal failure, and hepatomegaly.
55. **The correct answer is A.** A normal ICP waveform has a descending triphasic morphology. In the waveform shown, the second peak is higher than the first, a general indicator of intracranial hypertension and impaired brain compliance.
56. **The correct answer is A.** Central herniation involves bilateral temporal and thalamic herniation through the tentorial notch. Early confusion and small, reactive pupils (the diencephalic stage) may progress to unresponsiveness, fixed and midpoint pupils, decerebrate posturing, and increased muscle tone (the mesencephalic stage).
57. **The correct answer is A.** There are a number of medications that may be used to treat intractable hiccups, with chlorpromazine being the most commonly used agent. A number of other medications, including baclofen, metoclopramide, haloperidol, and a variety of anticonvulsants (including gabapentin, phenytoin, and valproic acid), have been used with varying degrees of success. Erythromycin, which is most often used to augment gut motility rather than as an antibiotic, is not a treatment for hiccups.
58. **The correct answer is D.** ESBL-producing organisms display resistance to third generation cephalosporins (such as ceftriaxone and cefotaxime) and

monobactams (such as aztreonam). Carbapenems (such as doripenem, meropenem, and imipenem) are reasonable empiric treatment options [31].

59. **The correct answer is C.** Autoimmune autonomic neuropathy is caused by antibodies against ganglionic acetylcholine receptors. Most cases of myasthenia Gravis are attributable to autoantibodies against either the acetylcholine receptor or MuSK receptors, while Lambert-Eaton myasthenic syndrome is caused by antibodies against voltage-gated calcium channel. Isaacs syndrome is due to antibodies against the voltage-gated potassium channel complex.
60. **The correct answer is C.** "To Err is Human", the 1999 report by the Institute of Medicine, reported famously that 44,000–98,000 deaths in the United States each year could be attributed to preventable medical errors. This has led to multiple other publications on the lack of reporting of medical errors, prompting concerns that this number was actually lower than reality. It also led to the Institute for Healthcare Improvement (IHI) launching the 100,000 lives campaign that sparked patient safety initiatives in over 3000 hospitals around the country. According to the IHI, the majority of errors can be traced back to systemic issues rather than a single person.
61. **The correct answer is A.** Occasionally, severe infections of the central nervous system require intraventricular antibiotic instillation, particularly after surgical procedures or secondary to infected shunt catheters. Gentamicin, vancomycin, amikacin, and polymyxin B have all been used for this purpose. Cephalosporins and penicillin, on the other hand, are neurotoxic agents, and cannot be given via the intraventricular route.
62. **The correct answer is A.** CBV is defined as the MTT multiplied by the CBF, and is usually measured in mL/100 g. Normal CBV is approximately 2.6 ± 0.8 mL/100 g in grey matter and 1.3 ± 0.4 mL/100 g in white matter [32].
63. **The correct answer is B.** The CAM-ICU scoring system is a delirium monitoring tool, and is graded dichotomously (delirium is present or absent). It excludes patients with a RASS score of -4 or -5, and involves the use of the Letters Inattention Test, as well as evaluations of disorganized thinking and level of consciousness. It was originally designed with input from geriatricians and neuropsychologists, but can be used in patients of any age group.
64. **The correct answer is D.** Although somewhat controversial, "hypertensive emergency" is generally defined as hypertensive crisis (systolic pressure >180 mmHg or diastolic pressure >110 mmHg) plus end-organ dysfunction. The more murkily defined "hypertensive urgency" is sometimes used in the setting of hypertensive crisis without end-organ dysfunction [33].
65. **The correct answer is B.** Renal replacement therapy should be initiated early in the critically ill patient as it is dangerous to wait for complications to appear before intervening. Criteria for initiation of renal replacement therapy for chronic renal failure may be inappropriate in critically ill patients. Current evidence does not support the view that continuous renal replacement therapy is superior to peritoneal dialysis and conventional intermittent hemodialysis [34]. Continuous renal replacement therapies allow lower average serum urea levels compared to intermittent therapies and avoids dangerous peaks of solute

increase. The removal of unwanted solvent or water is done through the process called ultrafiltration, whereas removal of unwanted solutes is achieved through the process of diffusion.

66. **The correct answer is D.** This patient most likely has reversible cerebral vasoconstriction syndrome, possibly precipitated by recent sertraline use. This entity is more common in women. Sumatriptan is relatively contraindicated, as triptans may potentially exacerbate vasoconstriction. Supportive therapy is the mainstay of treatment. Glucocorticoids have not been proven to be beneficial in this setting. Most patients have complete resolution of symptoms and radiographic findings with basic supportive care [35].
67. **The correct answer is C.** This patient has ventilator-associated pneumonia, which is defined as a pneumonia occurring >48 h after endotracheal intubation. IDSA guidelines recommend that noninvasive sampling with semiquantitative culture be used to diagnose ventilator associated pneumonia, rather than invasive sampling methods. Invasive sampling methods include bronchoscopic techniques such as bronchoalveolar lavage (BAL), protected specimen brush (PSB), and blind bronchial sampling (ie, mini-BAL). Noninvasive respiratory sampling refers to endotracheal aspiration. There is no evidence that invasive microbiological sampling with quantitative cultures improves clinical outcomes compared with noninvasive sampling with either quantitative or semiquantitative cultures. Additionally, noninvasive sampling can be done more rapidly than invasive sampling, with fewer complications and utilizing fewer resources [36].
68. **The correct answer is B.** The Lindegaard ratio refers to the mean MCA velocity divided by the ipsilateral ICA velocity. It is used to distinguish increased velocity as a result of hyperemia from increased velocity as a result of cerebral vasospasm, i.e., markedly increased MCA velocity in the face of low or normal ICA velocity is less likely to be explained by hyperemia alone. Broadly speaking, hyperemia is more likely with a Lindegaard ratio <3 [37].
69. **The correct answer is C.** Neoplastic meningitis is best described as carcinomatous meningitis in the setting of a solid tumor, versus leukemic or lymphomatous meningitis in the case of hematologic malignancies. Although melanoma is more *likely* to spread to the leptomeninges, the higher incidence of breast cancer makes it the most common overall cause. CSF sampling is the diagnostic test of choice, though a second sampling may be necessary in order to ensure the presence of malignant cells. Obtaining a third and fourth sample is less likely to be of diagnostic value. Leptomeningeal disease in the setting of unknown primary is uncommon, accounting for <10% of cases. Cranial nerve palsies are common complaints, particularly CN III, VI and VI.
70. **The correct answer is B.** Nimodipine, while used frequently in neurocritical care settings for the prevention of delayed cerebral ischemia following subarachnoid hemorrhage, is not available as a continuous infusion. Clevidipine and nicardipine infusions are used primarily as antihypertensives, while diltiazem is used primarily for rate control in the setting of paroxysmal atrial fibrillation.

71. **The correct answer is C.** The cuff leak test involves deflating the endotracheal balloon, followed by measuring the volume of air that escapes from the otherwise-closed ventilator circuit. It is intended to be a surrogate measure of laryngeal edema. The maneuver is far from perfect when it comes to predicting which patients will and will not be successfully extubated, and several confounding variables may exist (such as the presence of crusted secretions around the endotracheal tube). However, a number of studies have repeatedly demonstrated a high negative predictive value for post-extubation stridor when the cuff leak exceeds 100 mL [38].
72. **The correct answer is E.** A number of different infections may precede an episode of Guillain-Barre syndrome, with *Campylobacter jejuni* being the most common cause overall (approximately 30% of cases), followed by CMV, EBV, and *Mycoplasma pneumoniae*. RSV-related illnesses are not generally recognized as preceding events [39].
73. **The correct answer is E.** cEEG has been studied extensively in the setting of subarachnoid hemorrhage, particularly in regards to predicting the onset of vasospasm and delayed cerebral ischemia. In one study, relative alpha variability was shown to precede the onset of angiographically-proven vasospasm by up to 3 days [40].
74. **The correct answer is A.** This patient has many of the cardinal symptoms of myasthenia gravis, including weakness that is worse at the end of the day, difficulty chewing her food, and visual changes. Patients often report blurry vision before frank diplopia sets in. She now has both hypoxemic and hypercarbic respiratory failure, likely secondary to an upper respiratory infection, and is having difficulty clearing secretions. She requires urgent intubation and control of her airway before any other definitive treatments can be initiated.
75. **The correct answer is A.** Short term reductions in oxygen consumption with the use of neuromuscular blocking agents has been suggested as a potential benefit in septic shock, not ARDS. In ARDS, the proposed benefits of neuromuscular blocking agents are (1) improvement in patient-ventilator synchrony, (2) matching of target and delivered tidal volumes, (3) decrease in delivered alveolar pressure, and (4) reduced breath stacking [41].
76. **The correct answer is B.** Low molecular weight heparin should be initiated within 72 h post-injury, and a dose should be held prior to surgical intervention and resumed within 24 h post-surgery. Unfractionated heparin is not the preferred method of prophylactic anticoagulation in acute spinal cord injury [42].
77. **The correct answer is B.** A recent meta-analysis has indicated a slightly lower risk of adverse cardiac events with the 600 mg loading dose of clopidogrel compared to the 300 mg dose, without an increased risk of major bleeding events [43]. Both doses are commonly used in practice.
78. **The correct answer is C.** About 20% of patients with spontaneous subarachnoid hemorrhage will have normal cerebral angiography. This is more common in patients with a classic perimesencephalic pattern of bleeding. In general, patients with angiogram-negative subarachnoid hemorrhage have excellent long-term outcomes.

79. **The correct answer is E.** The description of a rapidly progressive confluent erythematous rash on the face, neck and torso that quickly resolves with conservative management is typical of "red man syndrome", a mast-cell mediated response that is not a true allergic reaction. Vancomycin is the causative agent, and this syndrome can be prevented by administering the vancomycin over a longer period of time.
80. **The correct answer is E.** Amiodarone bolus and infusion for rate control in atrial fibrillation is usually not weight based. Patients receive a 150 mg bolus, followed by an infusion at 1 mg/min during the first 6 h, and then 0.5 mg/min for the next 18 h. So, in the first 24 h, a patient will usually receive 150 + (60 × 6) + (30 × 18) = 1050 mg.
81. **The correct answer is B.** Introduction of PEEP increases end-expiratory intrathoracic pressure, which impedes venous return and may cause a reduction in cardiac output. A decrease in urine output caused by PEEP has been attributed to multiple factors, such as decreases in cardiac output and renal blood flow, reduced intravascular volume, activation of sympathetic and renin-angiotensin-aldosterone-antidiuretic hormone systems, and suppression of atrial natriuretic peptide. Addition of PEEP decreases left-ventricular afterload by increasing intrathoracic pressure, thereby reducing transmural left ventricular pressure and afterload. Elevated intrathoracic pressures due to PEEP may also lead to compression of alveolar blood vessels and a rise in right ventricular afterload due to an increase in pulmonary vascular resistance. PEEP also leads to increased alveolar recruitment and opening of dependent lung units, leading to an increase in FRC.
82. **The correct answer is A.** Compartment syndrome is often a clinical diagnosis, and when the pre-test probability is high enough, intervention is often sought prior to confirmatory testing. However, if further testing is required, measuring compartment pressures directly is the confirmatory test of choice.
83. **The correct answer is C.** There are several basic injury patterns to know when evaluating an EKG for evidence of ischemia and infarction, and these correspond with so-called contiguous leads. The correct patterns are as follows: I, aVL—lateral; II, III, aVF—inferior; V1, V2—septal; V3, V4—anterior; V5, V6—lateral.
84. **The correct answer is C.** Currently guidelines from the ASA and AHA recommend surgical clot removal in this circumstance. While EVD placement may not put patients at a high risk of upwards herniation as previously feared, it is still not recommended as the preferred option. Lumbar puncture, mannitol, or hypertonic saline will not be curative in this case [44].
85. **The correct answer is C.** The use of serum creatinine to assess the severity of AKI is limited by medication effects, patient nutrition, and other alterations produced by non-renal disease states. The absolute level of creatinine does not always reflect the severity of underlying kidney damage. Rises in serum creatinine occur 12–24 h following tissue injury, and therefore do not detect early stage AKI. The time to reach a 50% increase in serum creatinine is directly related to baseline kidney function, and ranges from 4 h with

normal function to >24 h with stage 4 chronic renal failure. Creatinine is a functional measure of renal function, but not a very good marker for structural renal damage.

86. **The correct answer is D.** The 'lung-point sign' occurs at the border of a pneumothorax. It is due to sliding lung intermittently coming into contact with the chest wall during inspiration. It can allow for estimation of the size of a pneumothorax, and also guide management. If a lack of lung sliding is visualized anteriorly, the probe can progressively be moved to more lateral and posterior positions on the chest wall searching for the location of the lung-point. The more lateral or posterior the 'lung-point sign' is identified, the larger the pneumothorax. Therefore, if the 'lung-point sign' is seen in an anterior location on the chest wall and the patient is stable, the sonographer can be assured that the pneumothorax is relatively small. Although the specificity is high, the sensitivity of the 'lung-point sign' is relatively low (reported at 66%) and is not seen in cases of total lung collapse [45].
87. **The correct answer is E.** A number of agents may be used to prevent shivering in patients undergoing TTM. These include opiates, buspirone, magnesium, propofol, acetaminophen, and dexmedetomidine, along with non-pharmacologic approaches such as skin counterwarming. In extreme cases, it may even be necessary to paralyze patients with agents such as cisatracurium or vecuronium in order to ensure shivering does not prohibit ideal cooling.
88. **The correct answer is B.** This patient is having significant hemoptysis, most likely a result of his pulmonary malignancy. There is no universal consensus on the definition massive hemoptysis. Some define it as more than 500 mL in a 24-h period, or more than 100 mL/h. Others define it as any amount that leads to abnormal gas exchange. Semantics aside, massive hemoptysis can be fatal, more the result of asphyxiation rather than blood loss. The initial steps in management include correctly positioning the patient, establishing a secure airway, ensuring adequate gas exchange and cardiovascular function, and controlling bleeding. In this case, bronchoscopy identified bleeding from the right lower lobe. Therefore, the patient should be placed on his right side, with the presumed bleeding source in the dependent position, since spillage may impair gas exchange in the healthy lung.
89. **The correct answer is B.** Mortality in flail chest may be as high as 25%, and the most common cause of death is secondary to pneumonia. However, there is no validated role for prophylactic antibiotics, nor is early operative intervention beneficial [46].
90. **The correct answer is E.** Bicuspid aortic valve is the most common congenital heart defect, and a significant percentage of patients will have concurrent thoracic aortic aneurysms which may be prone to rupture at a relatively young age [47]. Sharp or tearing chest pain radiating to the back in a patient with a known bicuspid valve should immediately prompt concern for aortic dissection, which includes CT angiography of the chest if the patient is hemodynamically stable.

91. **The correct answer is D.** The classic diagnostic features of TTP are thrombocytopenia (with or without purpura), fever, altered mental status (which may range from mild confusion to frank hallucinations), hemolytic anemia (including the presence of schistocytes on the peripheral smear), and fever. It is rare, however, for a patient with TTP to present with all five elements of the "pentad". The INR is usually normal, which may help to differentiate TTP from disseminated intravascular coagulation (DIC).
92. **The correct answer is A.** This man is victim of ground transmission of high-voltage electrical energy from a lightning strike to a nearby grounded object. Patients with cardiopulmonary arrest from lightning strike usually have asystole as the initial presenting rhythm, though ventricular fibrillation can be a secondary rhythm [48]. These patients are typically able to be resuscitated quickly and with a high degree of success, and CPR according to standard protocols should be initiated immediately.
93. **The correct answer is A.** The majority of antiepileptic medications increase warfarin metabolism and may result in an unwanted decrease in the serum INR. The notable exception is valproic acid, which competes with warfarin for albumin binding and may result in a rapid increase in the serum INR, particularly in the setting of a valproic acid loading dose [49].
94. **The correct answer is A.** Although the FAST exam is useful in the initial evaluation of a patient with blunt abdominal trauma, hemodynamic instability and suspected hollow viscous injury mandate immediate surgical exploration without delay. Contrast-enhanced CT may take too long in this setting, and peritoneal lavage is rarely performed since the widespread use of bedside sonography.
95. **The correct answer is E.** The CT angiogram shows bilateral pulmonary emboli. Given that this patient is hemodynamically stable and not in extremis, and has a history of a malignancy with a high predilection for metastatic brain lesions (which tend to bleed easily), a noncontrast head CT should first be performed before administering systemic anticoagulation. If the head CT is unremarkable, the next step would be a continuous heparin infusion. The patient is not ill enough to warrant systemic thrombolytics or cardiothoracic surgery consult at this time (i.e. there is no evidence of right heart strain or hemodynamic compromise).
96. **The correct answer is A.** Levetiracetam's mechanism of action is not entirely understood, but it is thought to exert its effects in part through presynaptic calcium channel inhibition. Sodium channel inhibition is the mechanism by which a number of antiepileptic medications act, including phenytoin, valproate, and carbamazepine. The benzodiazepines, including lorazepam and alprazolam, operate via potentiation of GABA at the GABA receptor. Felbamate operates via NMDA receptor inhibition. Finally, retigabine is a novel anticonvulsant medication that operates by activating voltage gated potassium channels.
97. **The correct answer is E.** This patient is experiencing severe headaches and elevated ICP readings in the setting of a recently clamped EVD. Of the

choices listed, the next best step is to open the drain and monitor for clinical improvement. If the patient quickly improves, she may end up requiring a ventriculoperitoneal shunt, although another clamp trial may be attempted.

98. **The correct answer is B.** Pseudoaneurysm formation is an uncommon complication of cardiac catheterization. Treatment ranges from conservative management for small pseudoaneurysms to percutaneous thrombin injection and vessel stenting for more significant lesions. Ultrasonographic evaluation of the femoral artery is usually the initial test of choice. Iatrogenic retroperitoneal hemorrhage can be ruled out with a pelvic CT, but generally presents as back and flank pain with or without signs of hemodynamic compromise and anemia.
99. **The correct answer is A.** The 4T score is used to rule-out the possibility of HIT in patients who have developed thrombocytopenia. The elements of the 4T score are timing of platelet count fall, platelet count fall relative to baseline, occurrence of thrombotic events, and the existence of an alternative explanation for the patient's thrombocytopenia. Patients are stratified into low-, intermediate-, or high-risk, based on their history, with patients in the low-risk group not requiring further laboratory testing for HIT. Patient age is not a factor in the 4T score.
100. **The correct answer is C.** This patient has a large lung abscess that is seen as an area of hypodensity surrounded by lung parenchyma. It may be difficult to differentiate lung abscess from a loculated empyema; however contrast enhanced chest CT often helps to make that distinction. Pyogenic lung abscesses are treated successfully with prolonged antibiotic therapy in 80–85% of cases, though there may be situations in which drainage may be necessary. These include very large abscess, persistent sepsis syndrome, generalized debility, and risk of rupture. Percutaneous or endobronchial drainage may be performed depending on the location of the abscess and the available expertise. The biggest concerns for percutaneous drainage with a large bore chest tube may be contamination of the pleural space leading to empyema, hemothorax, pneumothorax, and formation of a broncho-pleural fistula. Hence, percutaneous insertion of a small bore pigtail catheter is the next best step in this case. With poor clinical response, drug resistance should be suspected, and hence continuing antibiotics without any other intervention is not appropriate. The patient has small parapneumonic pleural effusion, and there is no role for thoracentesis. Percutaneous drainage is often favored over surgical management, when feasible [50].

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Exam 4 Questions

Rough work, iconoclasm, but the only way to get at truth.

Oliver Wendell Holmes Sr.
(1809–1894)

1. A 73-year-old male with a history of hypertension and hyperlipidemia is currently in the stroke unit after suffering a right middle cerebral artery infarct. His symptoms started 2 h prior to arrival at the hospital, and tPA was administered. The patient is plegic on the left side and with mild dysarthria, but is otherwise neurologically intact. His labwork is within normal limits. Which of the following describes the optimal deep venous thrombosis (DVT) prophylaxis regimen for this patient?

   A. Wait 6 h post tPA, then administer unfractionated heparin (UFH) along with intermittent pneumatic compression (IPC)
   B. Wait 24 h post tPA, then administer UFH along with IPC
   C. Wait 6 h post tPA, then administer low molecular weight heparin (LMWH) along with IPC
   D. Wait 24 h post tPA, then administer LMWH along with IPC
   E. IPC only for the first 72 h, then LMWH or UFH after obtaining follow-up imaging

2. All of the following causes of acute encephalitis have the matching characteristic radiological features except:

   A. Autoimmune limbic encephalitis: T2/FLAIR hyperintensity in the mesial temporal lobes
   B. Cytomegalovirus: T2/FLAIR hyperintensity in the subependymal white matter
   C. JC virus: T2/FLAIR hyperintensity in the parieto-occipital lobes and corpus callosum
   D. Herpes simplex virus type 1: restricted diffusion in frontal/temporal lobes and insular cortex
   E. Varicella zoster: T2/FLAIR hyperintensity in the brainstem

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3. Which of the following categorizations is most accurate regarding acute respiratory distress syndrome (ARDS) in the setting of subarachnoid hemorrhage (SAH)?

   A. Non-neurogenic, non-cardiogenic
   B. Neurogenic, non-cardiogenic
   C. Neurogenic, cardiogenic
   D. Non-neurogenic, cardiogenic
   E. None of the above accurately reflect ARDS in SAH

4. A 52-year-old female is admitted to the ICU with a Hunt-Hess 1, modified Fisher 2 subarachnoid hemorrhage. Her past medical history is significant for hypertension, diabetes mellitus, and chronic renal insufficiency. She undergoes craniotomy for surgical clipping of an anterior cerebral artery aneurysm, and does not experience any additional complications. Two weeks later, she begins complaining of left calf pain, and a lower extremity sonogram demonstrated a proximal deep venous thrombosis (DVT). The patient weighs 60 kg. Her laboratory values are as follows: sodium 142 mEq/L, potassium 3.4 mEq/L, carbon dioxide 18 mEq/L, blood urea nitrogen (BUN) 70 mg/dL, and serum creatinine 2.5 mg/dL. What would be the optimal treatment for this patient's proximal DVT?

   A. Unfractionated heparin infusion for at least 5 days concomitantly with warfarin therapy
   B. Low molecular weight heparin 60 mg twice a day for at least 5 days concomitantly with warfarin therapy
   C. Fondaparinux 7.5 mg daily for 5 days followed by warfarin therapy
   D. Apixaban 10 mg twice daily for 7 days followed by 5 mg twice daily
   E. Rivaroxaban 15 mg twice daily for 21 days followed by 20 mg once daily

5. All of the following are currently implicated in uremic encephalopathy except:

   A. Derangements in cerebral metabolism
   B. Alterations in the blood-brain barrier
   C. Accumulation of circulating toxins
   D. Imbalance of endogenous neurotransmitters
   E. Recurrent lobar hemorrhages

6. A 70-year-old female is hospitalized with a recent ischemic infarct. As part of stroke core measures, you obtain a hemoglobin A1c of 10.0. What is an approximate estimation of this patient's average blood glucose level over the last several months?

   A. 70 mg/dL
   B. 100 mg/dL
   C. 130 mg/dL
   D. 190 mg/dL
   E. 240 mg/dL

7. A 28-year-old female with no known past medical history is in the ICU in status epilepticus, with anti-N-methyl D-aspartate (NMDA) receptor antibodies isolated in the cerebrospinal fluid. Which of the following is most likely to identify the root cause of her illness?

   A. Transvaginal ultrasound
   B. Contrast-enhanced CT of the chest
   C. Contrast-enhanced CT of the brain
   D. Virtual colonography
   E. Thorough examination of the skin, particularly in sun-exposed areas

8. A 17-year-old male with no significant past medical history collapses during a high school football game, and goes into cardiac arrest. He did not have any complaints earlier in the day. The patient is brought to a nearby hospital, where is he resuscitated, intubated, and transferred to the ICU for further management. The patient is currently undergoing therapeutic hypothermia, and a work-up is underway to determine the cause of his sudden collapse. Which of the following is the most likely diagnosis?

   A. Rupture of a previously undiagnosed cerebral aneurysm
   B. Hypertrophic cardiomyopathy
   C. Commotio cordis
   D. Severe hyponatremia and cerebral edema
   E. Brugada syndrome

9. A 31-year-old female at 38 weeks gestation is currently hospitalized for the treatment of preeclampsia. Due to her medical condition, her obstetrician is currently considering induced labor. At which point will this patient no longer be at risk for developing frank seizure activity as a result of her condition?

   A. 48 h postpartum
   B. 1 week after delivery
   C. 2 weeks after delivery
   D. 4 weeks after delivery
   E. 6 weeks after delivery

10. A 38-year-old male with no prior medical history presents to the emergency department with fever and severe headaches for several days. A CT scan of the brain is unremarkable, and the results of a lumbar puncture are pending. What is the most appropriate empiric antimicrobial regimen at this time?

    A. Cefazolin and vancomycin
    B. Ceftriaxone and vancomycin
    C. Ceftriaxone, vancomycin and ampicillin
    D. Piperacillin/tazobactam and vancomycin
    E. Meropenem and vancomycin

11. The majority of intramedullary spinal cord neoplasms are:

    A. Astrocytomas
    B. Meningiomas
    C. Metastatic lesions
    D. Ependymomas
    E. Hemangioblastomas

12. Which of the following derived parameter formulas is correct?

    A. Cardiac index = cardiac output x body surface area
    B. Stroke volume = cardiac output/heart rate
    C. Systemic vascular resistance = 80 × (mean arterial pressure/cardiac output)
    D. Pulmonary vascular resistance = 80 × (mean pulmonary artery pressure/cardiac output)
    E. All of the above are correct

13. A 23-year-old female marathon runner is currently in the ICU after suffering from heat stroke following an outdoor run on a particularly hot summer day. She was initially delirious in the emergency department, but progressed to coma and respiratory failure requiring mechanical ventilation. Her oral temperature is 42.1 °C. Which of the following would be most effective in reducing this patient's severe hyperthermia?

    A. Regularly scheduled alternating acetaminophen and ibuprofen
    B. Spraying room temperature water on the patient, followed by fanning
    C. Ice water immersion
    D. Dantrolene sodium, 2.5 mg/kg
    E. Application of ice packs to the groin and axilla

14. Hyperinsulinemia-euglycemia (HIE) therapy may be useful for toxicity related to which of the following?

    A. Tricyclic antidepressants
    B. Calcium channel blockers
    C. Aspirin
    D. Digoxin
    E. Lithium

15. A 71-year-old female with a history of alcohol abuse is currently intubated in the ICU following a catastrophic spontaneous left basal ganglia hemorrhage with resultant herniation. You have just declared her brain dead. The patient's family agrees to make her an organ donor, and the organ donation coordinator requests you initiate levothyroxine therapy. Which of the following benefits would be expected with this treatment?

    A. Increase the number of solid organs available for transplant
    B. Eliminate the need for hepatic biopsy prior to liver transplant
    C. Eliminate the need for cardiac catheterization prior to heart transplant

D. Eliminate the need for bronchoscopy prior to lung transplant
E. Reduce the need for supplementation of sodium, potassium, calcium, and magnesium

16. Which of the following is not an element of the Full Outline of Unresponsiveness (FOUR) score?

A. Eye opening
B. Respiratory function
C. Brainstem reflexes
D. Motor response
E. Verbal response

17. A 23-year-old female is currently in the ICU with status asthmaticus. She was initially on noninvasive positive pressure ventilation, with an arterial blood gas (ABG) as follows: pH 7.13, pCO_2 60 mmHg, PaO_2 is 61 mmHg, HCO_3 24 mmol/L, and oxygen saturation of 90%. She is given continuous inhaled albuterol, intravenous steroids, and magnesium sulfate. She subsequently becomes more lethargic and is intubated, with settings as follows: volume assist-control, rate of 12 breaths/min, tidal volume of 500 cc, PEEP of 5 cm H_2O, and FiO_2 of 50%. Peak airway pressure is 50 cm H_2O and plateau pressure is 15 cm H_2O. A stat portable chest x-ray shows hyperinflation with no pneumothorax. A repeat ABG after 30 min of invasive ventilation shows the following: pH of 7.24, pCO_2 49 mmHg, PaO_2 71 mmHg, HCO_3 is 25 mmol/L. Which of the following should be performed next?

A. Increase rate to 16
B. Increase tidal volume to 600 cc
C. Initiate bicarbonate infusion
D. Switch to pressure assist-control
E. Maintain current settings

18. Which of the following mechanisms is implicated in super-refractory status epilepticus?

A. Influx of proinflammatory molecules
B. Upregulation of NMDA receptors
C. Upregulation of molecular transport molecules
D. Downregulation of GABA receptors
E. All of the above

19. A 85-year-old male with a history nephrolithiasis, mild dementia, and alcohol abuse presented to the emergency department after a fall from standing, and was found to a right holohemispheric subdural hematoma. His clot was evacuated successfully, in spite of his oozing diathesis in the operating room (INR on arrival was 1.4 with a platelet count of $88 \times 10^3/\mu L$). His serum transaminases are twice the normal value, and he has had refractory chronic hyponatremia. He has had three convulsions during this week of hospitalization, in spite of

levetiracetam therapy at 1.5 g twice a day. Over the past 24 h, he has had a marked increase in agitation. He has also just had a 5-s run of non-sustained ventricular tachycardia, and his systolic blood pressure is now 85 mmHg. You are considering discontinuing his levetiracetam and starting a new agent. Which of the following would be the best choice in this scenario?

A. Carbamazepine
B. Phenytoin
C. Valproate
D. Lacosamide
E. Topiramate

20. A 65-year-old male with a history of COPD on rescue albuterol and ipratropium is diagnosed with myasthenia gravis, and started on an acetylcholinesterase inhibitor. He returns several days later complaining of increased salivation and worsening bronchial secretions in the absence of fevers, purulent sputum, or increasing dyspnea. These symptoms are not relieved by use of his albuterol. On exam, he has slightly decreased air movement throughout both lung fields without any clear wheezing, no focal rales, and a normal inspiratory to expiratory ratio. Which treatment option is most likely to be beneficial?

A. Increase frequency of short-acting ß$_2$ agonist use
B. Add a standing long-acting inhaled ß$_2$ agonist
C. Add glycopyrrolate as needed
D. Add inhaled corticosteroids
E. Add oral systemic corticosteroids

21. Regarding states of impaired consciousness, which of the following statements regarding arousal and awareness is correct?

A. Coma: intact arousal, but impaired awareness
B. Minimally conscious state: impaired arousal and impaired awareness
C. Persistent vegetative state: intact arousal, but impaired awareness
D. Locked-in state: intact arousal, but impaired awareness
E. All of the above are correct

22. A 62-year-old female is currently in the ICU following craniotomy for clipping of a cerebral aneurysm. Postoperatively, she is noted to have an oxygen saturation of 92% on 50% non-rebreather face mask, and her respiratory rate is 32 breaths/min. She denies chest pain. Her blood pressure is 96/72 mmHg and heart rate is 120 beats/min. Nimodipine has been held according to blood pressure parameters. A portable chest x-ray shows hazy opacities bilaterally, and bedside echocardiogram shows decreased left ventricular systolic function with apical, septal, lateral, anterior, anteroseptal and inferolateral wall akinesis, along with apical ballooning. Which of the following should be performed next?

A. Intubate the patient and begin mechanical ventilation
B. Call urgent cardiology consult for cardiac catheterization

C. Start noninvasive positive airway pressure ventilation
D. Administer broad spectrum antibiotics
E. Administer albuterol and systemic corticosteroids

23. Which of the following is the most common etiology of acute spinal cord ischemia and infarction?

A. Atherosclerotic disease
B. Rupture of an abdominal aortic aneurysm
C. Degenerative spine disease
D. Cardioembolic events
E. Systemic hypotension in the setting of other disease processes

24. A 62-year-old female with a history of coronary artery disease has just been admitted to the ICU with a left-sided spontaneous basal ganglia hemorrhage. The patient takes 325 mg of aspirin daily at home, and you are considering platelet transfusion. Which of the following has been demonstrated regarding platelet transfusion in this setting?

A. Improved chances of survival to hospital discharge
B. Decreased hospital length-of-stay
C. Improved chances of survival at 3 months
D. Improved modified Rankin scale at 3 months
E. None of the above

25. Which of the following therapies has been shown to decrease the incidence of delayed cerebral ischemia (DCI) in the setting of subarachnoid hemorrhage (SAH)?

A. Atorvastatin
B. Magnesium
C. Methylprednisolone
D. Nicardipine
E. None of the above

26. A 70-year-old male with a history of diabetes, hypertension, and cigarette smoking (one pack per day for the last 40 years) is currently in the ICU with a COPD exacerbation. This is his third exacerbation this year, and was discharged from the hospital only 3 weeks prior. On your examination, he is alert, his breathing is labored, and he has rales at the right lung base. His vital signs are as follows: blood pressure 90/60 mmHg, heart rate 120 beats per minute, respirations 28 per minute, and temperature 38.3 °C. His oxygen saturation on 50% face mask is 93%, and his most recent PCO_2 is 55 mmHg. Labs are notable for the following: white blood cell count 14.4×10^9/L with 90% neutrophils, blood urea nitrogen (BUN) 30 mg/dL, serum creatinine 1.2 mg/dL, and glucose 240 mg/dL. Ketones are negative. He is currently on noninvasive positive pressure ventilation at 10/5 cm H_2O and 50% FiO_2, and broad spectrum antibiotics have been administered. An hour later, the nurse pages you because his heart

rate is now 140 beats per minute and irregular, blood pressure is 85 systolic, oxygen saturation is 85%, and he is minimally responsive. You now hear bilateral rales, most prominently in the right lung base, and scattered wheezes. Which of the following should be performed next?

A. Increase inspiratory pressure to 15 and FiO_2 to 100%
B. Start a continuous diltiazem infusion and give intravenous furosemide
C. Start a continuous phenylephrine infusion targeting a mean arterial pressure (MAP) > 65
D. Give 125 mg of solumedrol and administer albuterol via nebulizer
E. Intubate the patient and initiate mechanical ventilation

27. A 57-year-old male with a history of epilepsy is currently in the stroke unit following a large right middle cerebral artery infarction. A nasogastric tube has been inserted, and 24 h continuous enteral feeds have been initiated. The patient is currently on 100 mg of phenytoin every 8 h for seizure prophylaxis. Which of the following measures should be taken to prevent the patient from developing subtherapeutic phenytoin levels?

A. Change to 18 h tube feeds, and only administer phenytoin at night
B. Change to 18 h tube feeds, and only administer phenytoin twice daily
C. Switch from standard to hydrolyzed tube feeds
D. Switch from standard to glycemic control tube feeds
E. Hold tube feeds for 2 h before and after phenytoin administration

28. A 37-year-old female presents to the emergency department with approximately 2 weeks of progressively worsening clumsiness and drastic mood swings. Her past medical history is significant only for Crohn's disease, for which she takes both natalizumab and infliximab. A contrast-enhanced CT scan of her head is performed, revealing hypodense, non-enhancing lesions in the cortical white matter of the frontal and parietal lobes. Despite treatment, the patient expires 1 month later. Which of the following is true regarding the most likely diagnosis?

A. The diagnosis may be confirmed via CSF analysis
B. The pathologic process spares oligodendrocytes
C. It is a prion-based disease
D. The condition is universally fatal despite treatment
E. All of the above

29. A 58-year-old female presents to the emergency department with dry cough, fever and rapidly progressive dyspnea over 1 week. She has a history of rheumatoid arthritis (RA) and is maintained on weekly methotrexate and daily prednisone (which was increased to 30 mg starting 1 month ago for an acute flare). She takes no other medications. Her vital signs are as follows: blood pressure 100/70 mmHg, heart rate 110 beats/min, respiratory rate 20 breaths/min, and temperature 38.0 °C. In the ED she develops progressive hypoxemia with oxygen saturation 92% on 100% nonrebreather, and is increasingly

diaphoretic. She is emergently intubated, and a chest x-ray post intubation shows extensive bilateral lung opacities. Which of the following should be administered at this time?

A. Ceftriaxone and azithromycin
B. Vancomycin and piperacillin-tazobactam
C. Vancomycin, cefepime, and fluconzole
D. Ceftriaxone, levofloxacin, and trimethoprim-sulfamethoxazole
E. Tigecycline only

30. A 45-year-old woman undergoes uncomplicated transsphenoidal resection of a pituitary macroadenoma. She appears well hydrated and is not complaining of excessive thirst. Post-operatively, she is noted to have increased urine output. Serum sodium is 137 mEq/L, and serum osmolarity is 275 mOsm/kg. What is the most likely cause of her polyuria?

A. Syndrome of inappropriate antidiuretic hormone
B. Diabetes insipidus
C. Cerebral salt wasting
D. Fluid mobilization
E. All of the above are equally likely

31. A 36-year-old female with a recent lumbar puncture to rule out subarachnoid hemorrhage is now complaining of a severe headache unlike anything she has experienced previously. She reports her headache is worse when standing, and better upon lying flat. She is otherwise neurologically intact. All of the following medications may be beneficial in this scenario except:

A. Acetaminophen
B. Ibuprofen
C. Caffeine
D. Aminophylline
E. Methylprednisolone

32. Which of the following is the most common overall cause of acute myocardial infarction?

A. Coronary dissection
B. Plaque rupture
C. Imbalance between oxygen demand and supply across a fixed obstruction
D. Coronary vasospasm
E. Ischemia related to hypotension and decreased perfusion

33. A 78-year-old male is in the ICU recovering from sepsis and pneumonia. He was just recently extubated after 2 days of mechanical ventilation and sedation with a fentanyl infusion. Over the ensuing days, he develops worsening abdominal distention, poor bowel sounds, and no stool output. CT scan reveals significant colonic distention, but no mass or obstruction. Records demonstrate a normal routine colonoscopy performed 6 weeks ago. You have

appropriately hydrated the patient, corrected any electrolyte abnormalities, placed a rectal tube, withheld all opiates, and given intravenous erythromycin, but to no avail. Abdominal x-rays continue to demonstrate marked cecal dilatation greater than 12 cm in diameter. What is the next best appropriate therapy for this patient?

A. Neostigmine
B. Naloxone
C. Metoclopramide
D. Surgical consultation for hemicolectomy
E. Endoscopic percutaneous cecostomy tube placement

34. Which of the following is the most common cerebral vascular malformation in the general population?

A. AV malformation
B. Dural AV fistula
C. Developmental venous anomaly
D. Cavernous malformation
E. Vein of Galen malformation

35. A 49-year-old female with a history of acute lymphoblastic leukemia and recent subcutaneous cerebrospinal fluid (CSF) reservoir placement presents to the emergency department with fever, chills, and increased confusion for the past 3 days. Her CSF reservoir was last accessed 1 week ago. A thorough work-up reveals no other obvious infectious source, and there is concern for CSF reservoir-associated meningitis. Which of the following is the most likely causative organism?

A. Coagulase-negative staphylococci
B. *Propionobacterium acnes*
C. Methicillin-resistant *Staphylococcus aureus*
D. *Klebsiella pneumoniae*
E. *Neisseria meningitidis*

36. A 47-year-old woman presents to the emergency department with headache, nausea, and vomiting. Non-contrast head CT is performed, revealing subarachnoid blood in the right Sylvian fissure, and conventional angiography reveals the presents of a large right-sided MCA aneurysm. The patient undergoes successful surgical clipping of her aneurysm, and is being observed in the ICU. On admission, the patient's serum sodium was 142 mEq/L and the hematocrit was 37%; by the seventh post-operative day, the serum sodium is 127 mEq/L and the hematocrit is 44%. Bedside ultrasonography demonstrates an IVC diameter of approximately 0.9 cm. Which of the following interventions would be least reasonable at this time?

A. Fludrocortisone, 0.2 mg twice a day
B. 2% hypertonic saline, infused peripherally
C. 3% hypertonic saline, infused centrally

D. Sodium chloride oral tablets
E. 1500 mL daily fluid restriction

37. Which of the following is true regarding central (non-infectious) fever?

A. Less common in subarachnoid hemorrhage
B. More common versus infectious fever
C. Earlier onset versus infectious fever
D. Easier to confirm versus infectious fever
E. All of the above

38. Flaccid paralysis is most commonly associated with which of the following forms of encephalitis?

A. West Nile
B. Varicella zoster
C. Rabies
D. Herpes simplex
E. Epstein-Barr

39. Which of the following would not be considered appropriate therapy for heparin-induced thrombocytopenia (HIT)?

A. Discontinuation of heparin products alone
B. Danaparoid
C. Fondaparinux
D. Argatroban
E. All of the above are acceptable treatment options

40. A 45-year-old male with severe blunt traumatic brain injury (TBI) from a motor vehicle collision suffered a ventricular fibrillation cardiac arrest at the time of injury with return of spontaneous circulation (ROSC) in the field after endotracheal intubation and one dose of epinephrine. On arrival to the emergency department, no regional wall motion abnormalities were noted on surface echocardiography and no ST segment changes were seen on the presenting EKG. Head CT revealed cerebral contusions but no extra-axial mass lesions. The patient is now in the ICU and found to be comatose without sedation. Mild therapeutic hypothermia to 33° is being considered in the management of this post-arrest patient. Which of the following statements is true?

A. Mild therapeutic hypothermia is contraindicated due to the risk of induced epilepsy
B. Mild therapeutic hypothermia is contraindicated with any intracranial pathology on CT imaging
C. Mild therapeutic hypothermia does not induce a clinically significant coagulopathy
D. Patients who have sustained ROSC after an arrest associated with TBI do not benefit from therapeutic hypothermia
E. Endovascular cooling is superior to surface cooling in young patients with ROSC

41. A 35-year-old male is in the intensive care unit following resection of a large right-sided meningioma. He is currently intubated and sedated on a continuous fentanyl infusion. The nurse calls you to the bedside due to concerns over "unusual ventilator waveforms". Upon arrival, you note the following (see Image 1). What is the best way to describe this phenomenon?

    A. Reverse triggering
    B. Double triggering
    C. Breath stacking
    D. Missed triggering
    E. None of the above; normal ventilator waveforms are present

Image 1 Ventilator waveforms

42. A 19-year-old male with no prior medical history presents to the emergency department unresponsive after a suspected heroin overdose. Several escalating doses of naloxone are administered before he regains consciousness. Shortly afterwards, the patient begins to experience severe respiratory distress, and is intubated due to hypoxemic respiratory failure before being transferred to the ICU. He is otherwise hemodynamically stable. Copious frothy secretions are evident in the endotracheal tube on your evaluation. Which of the following is the most likely explanation for this patient's condition?

    A. Catecholamine-induced lung injury
    B. Multiple wall motion abnormalities in the left ventricle

C. Diffuse alveolar hemorrhage
D. Direct pulmonary toxicity of the reversal agent
E. Global systolic dysfunction

43. A 92-year-old female is in the intensive care unit following a large right-sided subdural hemorrhage. The patient's neurological status is poor, and the family has decided to forego invasive therapy and opt for comfort measures only. As you prepare to extubate the patient, you note that the patient is breathing irregularly, alternating randomly and rapidly between deep breaths and shallow breaths with variable intervals between respirations. What would be the best way to describe this breathing pattern?

A. Cheyne-Stokes respiration
B. Central hyperventilation
C. Apneustic respirations
D. Ataxic respiration
E. Decerebrate respiration

44. The constellation of cerebellar ataxia, oculomotor nerve palsy, and tremor are consistent with which of the following syndromes?

A. Weber syndrome
B. Benedikt syndrome
C. Claude's syndrome
D. Wallenberg's syndrome
E. Dejerine syndrome

45. Common causes of upper gastrointestinal (GI) bleeding including all of the following except:

A. Gastric ulcer
B. Duodenal ulcer
C. Esophageal varices
D. Esophagitis
E. All of the above are equally likely to be causes of upper GI bleeding

46. An 81-year-old male with a coronary artery disease and hyperlipidemia is currently intubated in the ICU after suffering from a frontal intraparenchymal hemorrhage. He was hospitalized 11 days ago, and the family is deciding whether or not to proceed with tracheostomy and percutaneous gastrostomy tube placement. His international normalized ratio (INR) is 1.6 this morning; it was 1.2 on admission. He has never been on warfarin therapy, and has no known underlying coagulopathy. He is currently afebrile and normotensive. Which of the following is the most likely etiology of the patient's elevated INR?

A. Surreptitious warfarin administration
B. Malnutrition
C. Disseminated intravascular coagulopathy (DIC)
D. Prophylactic heparin administration
E. Hepatic dysfunction with impaired factor synthesis

47. Which of the following is the most common presenting neurologic sign of neurosarcoidosis?

    A. Hydrocephalus
    B. Seizures
    C. Limb weakness
    D. Facial nerve weakness
    E. Urinary incontinence

48. Regarding the clotting cascade, which of the following factors is not part of the intrinsic pathway?

    A. Factor VII
    B. Factor VIII
    C. Factor IX
    D. Factor XI
    E. Factor XII

49. A 45-year-old male presents with several years of progressively worsening headaches and memory loss. He recently had a transient episode of right-sided weakness. He denies fever, weight loss, or rash. On neurological examination, he scores a 20 on the mini-mental status exam, and has a right pronator drift. An MRI of the brain reveals several small cortical, subcortical, and callosal infarcts. Lipid profile, HbA1c, echocardiography and holter monitoring are all within normal limits. An extensive work-up is undertaken, and no infectious or systemic etiology is identified. Which of the following diagnostic results is least likely in this patient?

    A. Elevated c-reactive protein (CRP)
    B. Normal erythrocyte sedimentation rate (ESR)
    C. Beading seen on conventional angiography
    D. Lymphocytic pleocytosis in the spinal fluid
    E. Foreign body giant cells on brain biopsy

50. Which of the following is a reasonable partial thromboplastin time (PTT) target for a patient on a heparin infusion who is being treated for an acute pulmonary embolus (PE)?

    A. 10 s
    B. 30 s
    C. 60 s
    D. 100 s
    E. 140 s

51. A 41-year-old female presents to the emergency room with severe headache. Her workup reveals diffuse subarachnoid hemorrhage, and she is immediately transferred to the ICU for further management. Her laboratory values are as follows: sodium 142 mEq/L, potassium 3.1 mEq/L, carbon dioxide 18 mEq/L, blood urea nitrogen (BUN) 32 mg/dL, and serum creatinine of 0.7 mg/dL.

She weighs 73 kg. What is the most appropriate deep vein thrombosis (DVT) prophylaxis for the patient at this time?

A. Intermittent pneumatic compression device alone
B. Intermittent pneumatic compression device plus enoxaparin 40 mg daily
C. Intermittent pneumatic compression device plus unfractionated heparin 5000 IU twice a day
D. Enoxaparin 40 mg daily alone
E. Unfractionated heparin 5000 IU twice a day alone

52. A 57-year-old male with a history of emphysema is currently hospitalized for community-acquired pneumonia. On the third hospital day, the patient begins to experience bright red blood per rectum. He does not take any antiplatelet medications and is currently on prophylactic low molecular weight heparin, 40 mg daily. Which of the following is the most likely etiology of this patient's bleeding?

A. Diverticular disease
B. Inflammatory bowel disease
C. Irritable bowel syndrome
D. Hemorrhoids
E. Anal fissures

53. Regarding apnea testing for the determination of brain death, which of the following statements is true?

A. Apnea testing should be initially performed with the patient disconnected from the ventilator and without the presence of supplemental oxygen
B. Apnea testing should be initially performed with the patient connected to the ventilator and a positive end-expiratory pressure (PEEP) of 10 cm H_2O.
C. Once apnea testing is initiated, it should not be aborted until 10 min have elapsed, even in the face of hemodynamic instability
D. Apnea testing is considered positive if there are no respiratory movements and the patient's PCO_2 is >50 mmHg or >10 mmHg over baseline
E. Repeat testing can be performed and extended longer than 10 min, if necessary

54. A 54-year-old female with a history of Goodpasture syndrome and end-stage renal disease status-post live donor renal transplant presents to the ED due to concern by her transplant nephrologist for renal failure. Her creatinine is 2.84 mg/dL (double her baseline), and her white blood cell count is 31.5×10^9/L with 35% bands. An ultrasound of the transplanted kidney demonstrates moderate hydronephrosis, and her urine culture is growing gram negative rods with >100,000 colony-forming units. Which element of this patient's history is normal in a post-transplant patient?

A. Doubling of baseline creatinine
B. Presence of hydronephrosis

C. Presence of 35% bands
D. White count of 31.5×10^9/L
E. Urine culture with >100k g negative rods

55. Which of the following is not an expected complication of cerebellar hemorrhage?

A. Respiratory insufficiency
B. Herniation
C. Communicating hydrocephalus
D. Intraventricular extension
E. Brainstem compression

56. A 71-year-old male with a history of cirrhosis and recurrent right-sided pleural effusions presents to the emergency department with low grade fever, worsening shortness of breath, and non-productive cough. Chest x-ray shows reaccumulation of his previously drained right pleural effusion. Bedside ultrasound demonstrates a moderate uncomplicated pleural effusion. A thoracentesis is performed, showing a pH of 7.30 and 700 cells/μL with 90% polymorphonuclear cells. Pleural fluid lactate dehydrogenase (LDH) is 350 U/L (normal range 140–280 U/L). Gram stain and culture of the pleural fluid is negative. What is the next best step in this patient's management?

A. Administer spironolactone and reassess
B. Insert a tunneled pleural catheter
C. Refer for transjugular intraheptic portosystemic shunt (TIPS)
D. Refer for liver transplantation
E. Administer broad spectrum antibiotics

57. A 55-year-old male is admitted to the ICU with a Hunt-Hess 2, modified Fisher 4 subarachnoid hemorrhage (SAH). His transcranial dopplers have remained unremarkable. Additionally, there is no evidence of cerebral salt wasting, increased intracranial pressure, or self-generated hypertension. However, on post-bleed day 10, the patient develops a right pronator drift and intermittent paraphasic errors right before his first ventriculostomy clamp trial. You are worried about ongoing delayed cerebral ischemia. Which of the following should be performed next?

A. Start intravenous fluids at 250 mL/h and induce hypertension to a systolic blood pressure of 200 mmHg
B. Order urgent perfusion imaging followed by conventional angiography with intention to treat
C. Give albumin around the clock for neuroprotection and volume repletion
D. Infuse magnesium as a neuroprotective agent and vasodilator
E. Lower the ventriculostomy to 0 cm H_2O and inject intrathecal nicardipine

58. A 20-year-old male presents to the ED after a surfing injury in which a wave knocked him over in relatively shallow water, causing him to land head first on the shore in a position of neck hyper-flexion and rotation. Immediately after the injury, he felt a stinging pain in his left arm and hand. Currently, he reports left hand paresthesias and midline posterior neck pain. Plain radiography of the cervical spine is obtained (see Image 2). Which of the following statements about this injury is correct?

    A. This is an unstable injury typically associated with spinal cord injury
    B. This is a stable injury not typically associated with spinal cord injury
    C. This is an unstable injury not typically associated with spinal cord injury
    D. This is a stable injury typically associated with spinal cord injury
    E. There is no apparent injury on the image shown

Image 2 X-ray of the cervical spine

59. Which of the following anticoagulants lacks an effective reversal agent?

    A. Dabigatran
    B. Warfarin
    C. Apixaban
    D. Low molecular weight heparin
    E. Unfractionated heparin

60. In polytrauma patients with signs of shock, packed red blood cells (PRBC) should be transfused to what general hemoglobin target?

    A. >7 g/dL
    B. >8 g/dL
    C. >9 g/dL
    D. >10 g/dL
    E. None of the above

61. A 39-year-old male with a history of chronic alcohol abuse is currently in the ICU with delerium tremens. Over the past several months, the patient's hospital presentations have become increasingly severe, requiring greater doses of benzodiazepines to treat his withdrawal. The metabolic explanation for this worsening pattern of presentations is most likely due to:

    A. GABA hyperactivity
    B. Glutamate hyperactivity
    C. Thiamine underactivity
    D. Dopamine hyperactivity
    E. Seratonin hyperactivity

62. Which of the following antibiotics is least likely to exacerbate a myasthenic crisis?

    A. Vancomycin
    B. Ciprofloxacin
    C. Gentamicin
    D. Telithromycin
    E. Erythromycin

63. A 58-year-old male with a history of COPD is admitted to the ICU with septic shock secondary to community acquired pneumonia. Noninvasive positive pressure ventilation is started, but he continues to decline, and requires intubation. He is started on empiric antibiotics, intravenous steroids, and bronchodilators for pneumonia and a concurrent COPD exacerbation. After intubation, the patient is sedated, and his ventilator settings are as follows: tidal volume 550 cc, respiratory rate 20 breaths/min, FiO_2 50%. The peak pressures are 45 cm H_2O. Six hours later, the patient becomes agitated, and the airway pressures rise to 65 cm H_2O. He develops tachycardia at 130 beats/min and is now requiring an continuous norepinephrine infusion. Chest x-ray is performed (see Image 3). Which of the following should be performed next?

    A. Tube thoracostomy
    B. Immediate withdrawal of the endotracheal tube 4 cm, followed by repeat chest x-ray
    C. Refer for urgent bronchscopy
    D. Replace the endotracheal tube via tube exchanger
    E. Computed tomography (CT) of the chest

Image 3 X-ray of the chest

64. Which of the following is true regarding the World Federation of Neurological Surgeons (WFNS) grading scale for subarachnoid hemorrhage?

    A. Grade 1: GCS 13–15, no motor deficit
    B. Grade 2: GCS 12–13, no motor deficit
    C. Grade 3: GCS 12–13, with motor deficit
    D. Grade 4: GCS 7–12, with or without motor deficit
    E. Grade 5: GCS 3, with or without motor deficit

65. A 41-year-old 80 kg male is brought to the ED after being rescued from a structure fire; his wife (who sustained minor injuries) thinks that he fell asleep on the sofa with a lit cigarette. He has sustained full-thickness burns to both arms, his chest, his abdomen, and around to his entire back. He has no other apparent injuries. He was intubated en route. How much isotonic crystalloid should you administer in the first 8 h of resuscitation?

    A. 6 L
    B. 9 L
    C. 12 L
    D. 15 L
    E. 18 L

66. A 25-year-old male who passed out at a local rave is brought to the hospital by his friends, who report that he was dancing for the last 4 h and was binge drinking at the concert. Vital signs are as follows: 80/40 mmHg, heart rate 155 beats/min, temperature 104.7 °F, respiratory rate 20 breaths/min, oxygen saturation 98% on room air. Physical exam reveals a somnolent-appearing disheveled adult male, drenched in sweat, warm to touch, flailing his harms without purposeful movement. His finger stick glucose level is 122, and his EKG is remarkable only for sinus tachycardia. You initiate aggressive cooling, and draw labs. His blood work is remarkable for a markedly elevated creatine kinase, a serum

creatinine of 2.6 mg/dL, and a sodium of 117 mEq/L. The most appropriate next step in his management is:

A. Continuous renal replacement therapy
B. Intermittent hemodialysis
C. Fluid restriction
D. Normal saline
E. Hypertonic saline

67. A 35-year-old 80 kg male with no past medical history presents to the ED after suffering an unprovoked seizure at home. He remains unconscious on your initial evaluation, and is now having a second generalized tonic-clonic seizure in front of you despite already receiving 4 mg of intravenous lorazepam and a fosphenytoin loading dose of 20 mg/kg, of which 50% has been administered so far. Which of the following should be performed next?

A. Give 2 mg of lorazepam now, and be prepared to give another 2 mg after 1 min
B. Intubate the patient with rocuronium and etomidate
C. Complete the fosphenytoin load and get a stat electroencephalogram (EEG)
D. Begin a continuous propofol infusion
E. Obtain a stat CT of the head to determine the etiology of the patient's seizures

68. What is a reasonable target international normalized ratio (INR) that should be attained during the reversal of warfarin coagulopathy for a patient who presents with a traumatic subarachnoid hemorrhage and an INR of 3.1?

A. <1.0
B. <1.5
C. <1.9
D. <2.4
E. No reversal is required unless repeat imaging shows a worsening bleed

69. Which of the following is the most appropriate initial action when evaluating a patient with a confirmed colonic perforation?

A. Expectant management with fluids, antibiotics, and pain control
B. Urgent colonoscopy to try and identify the source of the perforation
C. Bedside placement of a rectal tube for colonic decompression
D. Bedside placement of a nasogastric tube for gastric decompression
E. Surgical consultation for exploration and repair of the injury

70. A 70-year-old male is on mechanical ventilation for 5 days for acute hypoxemic respiratory failure secondary to severe community acquired pneumonia, renal failure, and septic shock. He also has underlying systolic heart failure with a left ventricular ejection fraction of 30% on transthoracic echocardiogram. He has recovered from his critical illness, and seems to be ready for extubation

during a trial of pressure support ventilation. He is afebrile, with the following vital signs: heart rate 70 beats/min, blood pressure is 120/70 mmHg, respiratory rate 16 breaths/min, tidal volume 450 cc, oxygen saturation 97% on FiO_2 of 0.4, pressure support of 5 cm H_2O and PEEP of 5 cm H_2O. What strategy will be most effective to prevent failure of weaning and avoid re-intubation?

A. Give supplemental oxygen via nasal cannula and titrate to an oxygen saturation >85%
B. Start non-invasive positive pressure ventilation for 24 h post-extubation
C. Maintain a mean arterial pressure of at least 85 mmHg
D. Implement frequent chest physiotherapy
E. Administer inhaled mucolytics round-the-clock for 48 h post-extubation

71. In adults with penetrating thoracic spinal cord injuries, the proper type and dose of steroids to administer is:

A. Methylprednisolone 1000 mg IV daily for 5 days
B. Methylprednisolone 30 mg/kg IV bolus once
C. Hydrocortisone 300 mg IV daily divided twice daily
D. Prednisone 60 mg PO daily for 5 days
E. None of the above

72. A 65-year-old male is brought to the emergency department after suffering a cardiac arrest at the county courthouse. He is currently exhibiting pulseless electrical activity. Per police report, he went from a normal mental status, to a tonic-clonic seizure, to being unresponsive, all in a matter of minutes. They also report that he appeared to ingest a capsule containing an unknown substance just prior to collapsing. The patient received epinephrine, bicarbonate, and calcium chloride prior to arrival. Upon arrival to the hospital, he is promptly intubated, placed on 100% oxygen, and chest compressions continue. A right femoral vein triple-lumen catheter is placed, with the following lab results: lactate >20 mmol/L, pH 6.80, pO_2 480 mmHg, pCO_2 95 mmHg. Ultrasound examination confirms appropriate placement of the central line. The next most appropriate step in this patient's management is:

A. Repeat the venous blood gas from a different anatomic site
B. Send an arterial blood gas
C. Administer fompizole, 15 mg/kg
D. Administer hydroxycobalamin, 5 mg
E. Administer 20% lipid emulsion, 100 mL

73. A 61-year-old female presents to the emergency department with weakness, lethargy, nausea, and vomiting. Her serum sodium on presentation is 160 mEq/L, and she weighs 60 kg. What is the approximate free water deficit?

A. 1.1 L
B. 4.2 L
C. 8.4 L

D. 16.8 L
E. Insufficient information to calculate

74. A 42-year-old female is currently in the ICU after suffering an aneurysmal subarachnoid hemorrhage. An external ventricular drain (EVD) was placed on admission to monitor her intracranial pressure, and to facilitate cerebral spinal fluid (CSF) drainage. On post-bleed day 10, she develops a fever, and is diagnosed with ventriculitis. Which of the following should be administered empirically while awaiting CSF cultures?

A. Ceftriaxone and vancomycin
B. Ceftriaxone, vancomycin, and ampicillin
C. Cefepime and vancomycin
D. Cefazolin and vancomycin
E. Ertapenem and vancomycin

75. A 55-year-old male is in the intensive care unit following cardiac arrest and severe anoxic brain injury. The decision is made to perform somatosensory evoked potentials (SSEPs) for prognostic purposes. Which of the following is **true**?

A. N9 waveform represents activity through the brachial plexus
B. N13 waveform represents activity through the dorsal horns of the spinal cord
C. N20 waveform represents activity through the thalamocortical radiations
D. All of the above
E. None of the above

76. A 64-year-old female with a history of allogeneic renal transplant on immunosuppressive medication is currently being worked-up for presumed aseptic meningitis. Which of the following would be most likely to predispose the patient to developing this condition?

A. Cyclosporine
B. Muromonab
C. Mycophenolate
D. Tacrolimus
E. All of the above

77. Which of the following statements about acute respiratory distress syndrome (ARDS) is correct?

A. Overall mortality has plateaued over the past 20 years
B. Patients are likely to have physical and cognitive impairment for up to 5 years after recovering from their illness
C. Patients are likely to require supplemental oxygen therapy for up to 3 years after recovering from their illness
D. Patients with ARDS secondary to trauma have a higher mortality at 90 days compared to infectious etiologies
E. All of the above are correct

78. The Monro-Kelly doctrine describes the relationship between all of the following variables except:

    A. Brain tissue oxygen levels
    B. Intracranial volume
    C. Blood
    D. Cerebrospinal fluid
    E. Brain parenchyma

79. A 34-year-old female with bipolar disorder recently underwent transphenoidal resection of a pituitary tumor. You are now evaluating her after nursing staff have noted significantly increased urine output for the last several hours. All of the following are consistent with central diabetes insipidus except:

    A. History of recent and longstanding lithium use
    B. Serum sodium >145 mEq/L and urine specific gravity <1.003
    C. Elevated urine output >30 mL/kg/day
    D. Polydipsia and nocturia
    E. All of the above are consistent with central diabetes insipidus

80. A 51-year-old male is admitted for an acute ischemic infarct, and a screening EKG is performed on admission. There are no prior EKGs available for comparison, although the patient states his doctor told him he has a "right bundle block". Which of the following findings would support this diagnosis?

    A. Dominant S wave in V1
    B. Slurred S wave in V6 and I
    C. Broad, monophasic R wave in V5 and V6
    D. QRS duration of <120 ms
    E. Short PR interval and presence of a delta wave

81. All of the following define complicated diverticulitis except:

    A. Abscess formation
    B. Gross hematochezia
    C. Fistula formation
    D. Colonic stricture
    E. Colonic perforation

82. According to the Centers for Disease Control and Prevention (CDC), which of the following trauma patients requires tetanus booster vaccination?

    A. A 27-year-old male with a mangled right lower extremity following an automobile accident who received a tetanus booster 6 months prior
    B. A 55-year-old female with a traumatic fingertip amputation who received a tetanus booster 18 months prior
    C. A 41-year-old male with a deep scalp laceration who received a tetanus booster 4 years prior
    D. A 38-year-old female with clean, superficial abrasions of her left flank who received a tetanus booster 11 years prior
    E. None of the above

83. Which of the following statements regarding diagnostic testing in Guillain-Barre syndrome (GBS) is false?

    A. Nerve conduction studies and electromyography, when available, are recommended as part of the diagnostic workup
    B. Lumbar puncture (LP) should be performed to confirm the diagnosis
    C. Specific CSF immunologic markers are not helpful in diagnosing GBS
    D. Typical CSF results include a normal cell count and significantly elevated protein
    E. CSF protein levels may be normal when tested within 1 week of symptom onset

84. Which of the following has been shown to effectively reduce the incidence of kidney injury due to contrast-induced nephropathy?

    A. Low dose dopamine
    B. Theophylline
    C. N-acetylcysteine
    D. Normal saline
    E. None of the above

85. A 53-year-old morbidly obese male with a history of COPD is currently intubated in the ICU due to respiratory failure secondary to community acquired pneumonia. The patient abruptly becomes hypotensive to 68/42 mmHg, with diffuse expiratory wheezes noted in all lung fields. A stat portable chest x-ray confirms appropriate endotracheal tube placement with no visible pneumothorax. After an end-expiratory hold maneuver, the intrinsic positive end-expiratory pressure (iPEEP) is measured as 21 cm H_2O. Which of the following should be performed next?

    A. Administer continuous nebulized albuterol treatments over 1 h and reassess
    B. Administer 125 mg intravenous methylprednisolone
    C. Initiate a norepinephrine infusion and titrate to a mean arterial pressure (MAP) >65 mmHg
    D. Decrease the set inspiratory time
    E. Disconnect the patient from the ventilator

86. A 31-year-old male presents to the emergency department after being assaulted with a lead pipe. He is missing his right maxillary central incisor, and there is a 1 cm gap when he attempts to clench his teeth. A non-contrast maxillofacial CT with reconstruction is obtained (see Image 4). Which of the following is the next best step in management?

    A. Discharge with supportive care including ibuprofen, ice, and outpatient oral maxillofacial surgery (OMFS) follow-up in 1 week
    B. Immediate manual reduction by putting pressure on the molar teeth and moving the dislocated mandible posteriorly and inferiorly
    C. Dental consult for replacement of the dislodged maxillary tooth
    D. Send routine lab work and prepare the patient for operative intervention
    E. Administer prophylactic antibiotics to prevent complications of sinus involvement

Image 4 CT reconstruction of the skull

87. All of the following regarding respiratory quotient are true except:
    A. It is represented by oxygen consumption divided by carbon dioxide elimination
    B. The respiratory quotient for carbohydrate-based meals is approximately 1
    C. The respiratory quotient for lipid-based meals is approximately 0.7
    D. It is calculated independently of age, gender, or body mass index
    E. All of the above

88. A 66-year-old alcoholic with a history liver cirrhosis presents with multiple episodes of hematemesis. You are appropriately resuscitating the patient, and are awaiting the arrival of the gastroenterologist to perform an urgent upper endoscopy. An important adjunctive medical therapy that has a proven mortality benefit in this patient population with active bleeding is:

    A. Ceftriaxone to prevent infectious complications
    B. Octreotide to promote splanchnic vasoconstriction
    C. Propranolol to reduce portal venous pressure
    D. Lactulose to prevent ammonia-related hepatic encephalopathy
    E. All of the above

89. A 37-year-old male is brought to the ED via ambulance following a high-speed motorcycle crash. He has ecchymoses around both eyes, and obvious deformities to the left upper extremity and right lower extremity. He is protecting his airway. On sternal rub, he does not opens his eyes, moans, and reaches for your hand with his right upper extremity. An 18-guage peripheral IV, cervical collar, and back board were established prior to arrival. Which of the following is the best approach regarding intubating this patient?

    A. Awake fiberoptic nasotracheal intubation
    B. Cricothyroidotomy
    C. Rapid sequence orotracheal intubation
    D. Sedation-only orotracheal intubation
    E. This patient does not require intubation

90. Which of the following has been shown to predict extubation failure in neurocritical care patients?

    A. The rapid shallow breathing index (RSBI)
    B. The motor component of the Full Outline of UnResponsiveness (FOUR) score
    C. The brainstem component of the FOUR score
    D. The minute ventilation
    E. None of the above

91. A 54-year-old male is hospitalized for treatment of *Clostridium difficile* colitis. He is currently receiving oral metronidazole and intravenous fluids, and his hospital course has been uneventful so far. On day 3 of his hospital stay, he develops altered mental status, hypernatremia, and increasing abdominal pain. A CT of the abdomen is obtained, demonstrating haustral distortion and pericolonic fat stranding. His serum white blood cell count has risen from 18.8×10^9/L on admission to 22.3×10^9/L today. Which of the following is not a reasonable treatment option at this time?

    A. Addition of oral vancomycin
    B. Placement of a nasogastric tube
    C. Withholding of opiate and anticholinergic medications
    D. Prone positioning
    E. Subtotal colectomy

92. A CD4 count below which cutoff places AIDS patients at a significantly increased risk of cerebral toxoplasmosis?

    A. 50 cells/μL
    B. 100 cells/μL
    C. 200 cells/μL
    D. 500 cells/μL
    E. 1000 cells/μL

93. Which of the following is not a metric that is evaluated by the Joint Commission when determining whether a hospital can become a Primary Stroke Center?

    A. Median door-to-needle time for tPA administration
    B. Median door-to-CT time for acute stroke symptoms
    C. Percentage of patients admitted with an acute stroke to a dedicated stroke unit
    D. Percentage of patients admitted with an acute stroke who have a neurosurgical evaluation
    E. The location of the closest hospital

94. The use of renal replacement therapy (RRT) in patients with acute brain injury can contribute to increase in intracranial pressures (ICP). While the exact mechanism for this is still unknown, postulated mechanisms for increased ICP with RRT include all of the following except:

    A. The slow removal of urea from the brain compared to plasma creates an osmotic gradient resulting in cerebral edema
    B. An osmotic gradient between brain and plasma develops during rapid dialysis because of newly formed cerebral osmoles

C. The rapid infusion of bicarbonate in high doses during hemodialysis can cause a paradoxical intracellular acidosis, leading to compensatory production of intracellular osmoles and water movement into the brain
D. Episodes of intradialytic hypotension may trigger reflexive surges in intracranial pressure
E. All of the above are correct

95. Which of the following best describes the characteristics of a patient in a persistent vegetative state?

A. Arousal, lack of awareness, intact sleep/wake cycles
B. Arousal, lack of awareness, lack of sleep/wake cycles
C. Lack of arousal, aware, intact sleep/wake cycles
D. Lack of arousal, aware, lack of sleep/wake cycles
E. Lack of arousal, lack of awareness, intact sleep/wake cycles

96. Which of the following medications may result in seizure activity in an acute overdose?

A. Clonidine
B. Meperidine
C. Baclofen
D. Dextroamphetamine
E. All of the above

97. A 53-year-old male with known congestive heart failure was recently admitted to the hospital for an right middle cerebral artery stroke. His wife has noticed that he appears to stop breathing at times during the night. His body mass index (BMI) is 35 kg/m^2, with a neck circumference of 17 in. Which of the following would be the gold standard in diagnosing this patient's condition?

A. Overnight pulse oximetry
B. Arterial blood gas
C. Echocardiogram
D. Overnight polysomnography
E. Non-contrast computed tomography (CT) of the chest

98. A 39-year-old male is currently hospitalized after presenting to the emergency department with fever, altered mental status, thrombocytopenia, and acute renal failure. Which of the following findings would be the most compelling evidence that the underlying pathology is not thrombotic thrombocytopenic purpura (TTP)?

A. Absence of schistocytes on the peripheral smear
B. Waxing and waning altered mental status
C. Creatinine less than double the patient's baseline
D. Platelet count greater than $50 \times 10^3/\mu L$
E. Recent upper respiratory infection

99. A 70-year-old female was admitted to the ICU after a left middle cerebral artery stroke. She received tissue plasminogen activator on arrival to the emergency department, and has been improving since admission. She passed her dysphagia screen on the fourth hospital day, and has been eating a normal diabetic diet. On the sixth hospital day, the patient started to cough after drinking her breakfast tea and was in respiratory distress. Her vitals at the time of the episode were: blood pressure 160/99 mmHg, heart rate 130 beats/min, temperature 97.9 °F, respiratory rate 40 breaths/min, oxygen saturation 83% on non-rebreather mask. Within 15 min, the patient's respiratory rate decreased to 25, and her saturation increased to 93% on the non-rebreather mask. An emergent chest x-ray did not show any lobar collapse. What is next best step in the patient's management?

    A. Initiate broad spectrum antibiotics
    B. Administer intravenous corticosteroids
    C. Refer for emergent bronchoscopy
    D. Aggressive pulmonary toilet
    E. Intubate the patient and initiate mechanical ventilation

100. Which of the following is the most common initial presentation of Sheehan's syndrome (postpartum hypopituitarism)?

    A. Agalactorrhea
    B. Worst headache of the patient's life
    C. Coma
    D. Seizures
    E. Hair loss and weight gain

Exam 4 Answers

The world is, of course, nothing but our conception of it.

Anton Chekhov
(1860–1904)

1. **The correct answer is D.** There is strong evidence to recommend the use of LMWH over UFH for DVT prophylaxis in the setting of acute ischemic stroke, except in cases where LMWH is contraindicated (i.e. renal failure). Additionally, although the half-life of tPA is only several minutes, current guidelines recommend waiting at least 24 h after tPA administration before initiating chemoprophylaxis. IPC should be used concurrently [1].
2. **The correct answer is E.** Varicella encephalitis can present with multifocal infarcts secondary to vasculitic processes, with associated signal abnormalities in the cortical-white matter junction or cerebellum. Varicella-induced vasculitis may also result in cerebral aneurysms, carotid dissections, and in certain cases, may even cause peripheral vascular disease [2].
3. **The correct answer is B.** There are many theories regarding the development in ARDS in the setting of SAH. One of the most prominent is "blast theory", in which the initial catecholamine surge in SAH results in a shift of blood from the systemic to the low resistance pulmonary circulation, resulting in both endothelial injury and capillary hydrostatic edema. This is most accurately categorized as neurogenic and non-cardiogenic. Classic pulmonary edema is non-neurogenic and cardiogenic, while heart failure secondary to stress cardiomyopathy or infarction secondary to SAH would be both neurogenic and cardiogenic [3].
4. **The correct answer is A.** This patient's renal impairment precludes her from receiving apixaban, rivaroxaban, or fondaparinux. Low molecular weight heparin needs to be dose-adjusted in the setting of renal impairment, meaning that full dose therapy (60 mg twice a day) would not be appropriate.
5. **The correct answer is E.** The pathophysiology of uremic encephalopathy is complex and poorly understood. Many factors are believed to be involved, including the presence of circulating toxins, a disrupted blood-brain barrier, altered cerebral metabolism, and neurotransmitter dysfunction. Uremic encephalopathy occurs in most patients in the absence of overt cerebral hemorrhage.
6. **The correct answer is E.** As a rule of thumb, the average glucose can be roughly estimated by the formula (serum A1c × 29) − 47, assuming the A1c is accurate (i.e. no condition that significantly increases or decreases red cell lifespan). In this case, the answer is (10 × 29) − 47, or 236 mg/dL.
7. **The correct answer is A.** Anta-NMDA encephalitis is a paraneoplastic phenomenon associated with a number of malignancies, the most common (by far) being a teratoma of the ovaries. Malignancies of the lung, brain, colon and

skin are much less likely to be the causative agent in this case, particularly in a young patient with no prior medical history.

8. **The correct answer is B.** The most common cause of sudden collapse and cardiac arrest in previously young, healthy individuals is hypertrophic cardiomyopathy. A subset of these patient may be prone to lethal arrhythmias such as ventricular fibrillation, particularly during rigorous exercise. Several of the other answer choices listed may also cause sudden cardiac arrest in a previously healthy young individual, but are far less common. These include aneurysm rupture, commotio cordis (unlikely without an impact to the chest), and Brugada syndrome. Severe hyponatremia is also unlikely to manifest as collapse without any preceding symptoms.
9. **The correct answer is E.** Although most patients with preeclampsia will be medically managed with relatively few complications, a subset will go on to develop eclampsia (tonic-clonic seizure activity). Even after the definitive therapy for preeclampsia (delivery of the fetus and placenta), patients continue to be at risk of late postpartum eclampsia. Cases have been reported up until about 6 weeks postpartum.
10. **The correct answer is B.** Ceftriaxone and vancomycin provide the narrowest coverage for all suspected organisms based on this patient's age group (i.e. *Nisseria meningitidis* and *Streptococcus pneumoniae*). Cefazolin is not able to penetrate the cerebral spinal fluid for treatment of meningitis. Ampicillin is only recommended for patients <1 month old and >50 years old. Piperacillin/tazobactam and meropenem would technically be sufficient, but both provide much broader coverage than needed for the empiric treatment of community acquired meningitis [4].
11. **The correct answer is D.** The majority of intramedullary spinal cord lesions are gliomas, and of these, ependymomas (65%) and astrocytomas (35%) are most common. Hemangioblastomas also occur, though less commonly, and intramedullar metastatic lesions are rare. Meningiomas are not intramedullary [5].
12. **The correct answer is B.** The formula for stroke volume is correct as shown. Cardiac index = cardiac output/body surface area. Systemic vascular resistance = 80 × (mean arterial pressure − right atrial pressure)/cardiac output. Pulmonary vascular resistance = 80 × (mean arterial pressure − pulmonary artery occlusion pressure)/cardiac output.
13. **The correct answer is C.** Although impractical, ice water immersion is the most effective means of rapidly correcting this patient's heat stroke and hyperthermia, followed by intravenous chilled saline, evaporative cooling, and ice pack application. Ibuprofen and acetaminophen are of no use in this scenario. Dantrolene, although primarily used for malignant hyperthermia related to anesthetic use, has also been described for use in life-threatening exertional heat illnesses [6].
14. **The correct answer is B.** HIE therapy has been used as rescue therapy in patients suffering from both calcium channel blocker (CCB) and beta blocker (BB) toxicity. Doses are typically several orders of magnitude larger than

those used for diabetic ketoacidosis, ranging from 1 to 10 units/kg/h in conjunction with a continuous dextrose infusion. The mechanism action involves improved myocardial glucose uptake and increase inotropy, which counteracts the cardiovascular collapse seen in CCB and BB overdose [7].

15. **The correct answer is A.** Use of levothyroxine in brain-dead patients significantly decreases vasopressor requirements compared to standard care. As a result, levothyroxine use (along with aggressive blood product resuscitation) is associated with a significantly increased number of solid organs transplanted per donor [8].
16. **The correct answer is E.** The FOUR score is a mental status scoring system that may be used in placed of the more traditional Glasgow Coma Scale (GCS). Although the FOUR score is more complicated than the GCS, there is evidence of better inter-rater reliability. The elements of the FOUR score are as follows: eye opening (open and tracking, 4 points; open and not tracking, 3 points; closed but open to voice, 2 points; closed but open to pain, 1 point; will not open, 0 points), motor function (thumbs up/fist/peace sign, 4 points; localizing, 3 points; flexion posturing, 2 points; extensor posturing, 1 point; no response, 0 points), respiratory function (not intubated, 4 points; not intubated by Cheyne-Stokes, 3 points; not intubated but irregular, 2 points; intubated but overbreathing, 1 point; intubated and not overbreathing, 0 points), and brainstem function (pupil/corneal reflexes present, 4 points; one pupil fixed/dilated, 3 points; either pupil/corneal reflex absent, 2 points; both absent, 1 point; no cough reflex, 0 points).
17. **The correct answer is E.** One of the main goals of mechanical ventilation in status asthmaticus is to prevent worsening of dynamic hyperinflation and its consequences (such as barotrauma and hypotension). Minute ventilation is the most important determinant of dynamic hyperinflation in status asthmaticus; hence increasing tidal volume or respiratory rate would increase minute ventilation, and may worsen dynamic hyperinflation. In addition, increasing respiratory rate may shorten expiratory time and lead to worsening auto-PEEP. A certain degree of hypercarbia is tolerated unless patients have any compelling contraindications, such as raised intracranial pressure or hyperkalemia. In most cases, with continued bronchodilator therapy, airway resistance improves and dynamic hyperinflation is reversed. Addition of a bicarbonate drip at pH of 7.24 is unwarranted, and may lead to post-hypercapnic metabolic alkalosis. Switching to a pressure limited mode of ventilation may correct high peak airway pressure; however high airway pressures with normal plateau pressures in status asthamticus is due to airway narrowing, and does not lead to alveolar over distension and barotrauma. In addition, use of pressure control ventilation in status asthmaticus may lead to dangerously low tidal volume delivery that may reduce alveolar ventilation.
18. **The correct answer is E.** There are numerous mechanisms for refractory seizure activity when status epilepticus is prolonged. These include an upgregulation of transport molecules which clear medications like phenytoin and phenobarbital, an upregulation of excitotoxic NMDA receptors, a

downregulation of suppressive GABA receptors, and an influx of numerous proinflammatory molecules which may alter blood-brain barrier permeability.

19. **The correct answer is D.** Carbamazepine and oxcarbazepine can worsen his seizure disorder by exacerbating his chronic hyponatremia. Phenytoin and fosphenytoin can induce cardiovascular instability. Valproate, which can be helpful as a mood stabilizer, will worsen his platelet dysfunction and can tip him over into severe hepatic failure. Topiramate is contraindicated in patients with both cognitive impairment and nephrolithiasis.
20. **The correct answer is C.** The absence of fevers, purulence, wheezing, and a normal I:E ratio make a COPD exacerbation very unlikely. Salivation and increased bronchial secretions are a well-described muscarinic receptor mediated side effect of acetylcholinesterase inhibitors, and can be managed with glycopyrrolate, which affects primarily the muscarinic receptors while still preserving the desired nicotinic effects of acetylcholinesterase inhibitors.
21. **The correct answer is C.** Consciousness consists of arousal, the state of being awake and able to respond to stimuli, and awareness, which imbues stimuli with context and meaning through cortical processes. Coma is the absence of both. Minimally conscious states involve normal arousal, but impaired awareness (though it may be present to some small extent.) Persistent vegetative states, on the other hand, involve normal arousal with absent awareness. The locked-in syndrome is characterized by intact arousal and awareness, but an inability to move other than blinking and vertical eye movements.
22. **The correct answer is C.** This patient has Takotsubo cardiomyopathy, which is a transient stress-related cardiac syndrome characterized by left ventricular apical akinesis and impaired systolic function. Noninvasive positive pressure ventilation is effective in treating pulmonary edema in this setting, and has been shown to decrease intubation rates. The echo findings are characteristic of this type of cardiomyopathy and do not fit the distribution of a particular vessel, making cardiac catheterization unnecessary.
23. **The correct answer is A.** Atherosclerotic disease accounts for a plurality of spinal cord ischemia. Aortic pathology and degenerative disease also account for a significant number of cases. Spinal cord ischemia and infarction secondary to systemic hypotension or a cardioembolic source is relatively less common [9].
24. **The correct answer is E.** The PATCH study was a prospective randomized trial evaluating platelet transfusion versus standard care in patients with spontaneous cerebral hemorrhage who were also on antiplatelet therapy. The study found that patients in the transfusion group had poorer outcomes at 3 months (both mortality and modified Rankin) compared to standard therapy, along with a higher rate of adverse events during their hospital stay [10].
25. **The correct answer is E.** Numerous interventions have been trialed to prevent DCI in the setting of SAH, but the majority of them have failed to provide meaningful benefit. These include statins, corticosteroids, magnesium, and

nicardipine (in contrast to the calcium channel blocker nimodipine, which is used extensively for this purpose).

26. **The correct answer is E.** The patient has severe community acquired pneumonia and several risk factors for ICU admission. Noninvasive positive pressure ventilation may be used to successfully treat patients with respiratory failure from a COPD exacerbation provided they are hemodynamically stable, alert, and able to protect their airway. While there are several possible reasons for his clinical deterioration including hypercapnea and primary cardiac pathology, he is now hemodynamically unstable and minimally responsive, and requires urgent intubation and mechanical ventilation.
27. **The correct answer is E.** Concomitant enteral tube feeds have long been recognized as a source of subtherapeutic phenytoin levels, though the mechanism remains somewhat unclear. There is no evidence that any one tube feed formulation may reduce this risk. However, the effect may be mitigated by holding tube feeds before and after each dose of phenytoin [11]. Although transitioning to 18 h feeds and only administering phenytoin at night would also achieve this purpose, it would likely still result in subtherapeutic phenytoin levels as a result of decreased administration.
28. **The correct answer is A.** Progressive multifocal leukoencephalopathy (PML) is a rare demyelinating disease usually seen in patients with immunosuppression, including those with AIDS or individuals taking immunosuppressive medications. It is caused by the JC virus. The diagnosis is suggested by characteristic multifocal frontal and parietal subcortical white matter findings on CT or MRI, in addition to the identification of the JC virus in the CSF. Brain biopsy may also be diagnostic. The condition is fatal in up to 50% of individuals, and survivors may be left severely disabled.
29. **The correct answer is D.** This patient has severe community acquired pneumonia in the setting of immunosuppression as a result of her recent RA flare and ongoing prednisone use. For patients with severe community acquired pneumonia requiring ICU admission, Infectious Disease Society of America guidelines recommend use of a antipneumococcal ß-lactam (i.e. ceftriaxone, cefotaxime, ampicillin-sulbactam) plus azithromycin or a respiratory fluoroquinolone (moxifloxacin, gemifloxacin, or levofloxacin) [12]. In addition, this patient has been on a significant dose of glucocorticoid (greater than 20 mg of prednisone for 1 month or longer) in addition to receiving methotrexate weekly for RA, which also puts her at risk for *Pneumocystis* (PCP) infection. As she has not been on prophylaxis for PCP, she should also be empirically treated with trimethoprim-sulfamethoxazole**.**
30. **The correct answer is D.** This patient is euvolemic and eunatremic with a normal serum osmolarity. Therefore, simple postoperative fluid mobilization is the most likely culprit.
31. **The correct answer is E.** Post-dural puncture headache is a relatively common complaint. Although blood patch administration is often sought for relief, conservative measures should be trialed first. These include supine positioning, fluid administration, use of oral analgesics, and, if necessary, use of

methylxanthine derivatives such as caffeine and aminophylline. Steroids have not been shown to be beneficial in this setting [13].

32. **The correct answer is B.** Plaque rupture is the most common cause of acute myocardial infarction overall, where thrombogenic material is exposed to the coronary circulation. The other causes mentioned may also result in acute myocardial infarction, but are far less likely [14].
33. **The correct answer is A.** This presentation is consistent with Ogilvie's syndrome, also known as colonic pseudoobstruction. If untreated, severe dilatation can lead to perforation. In this case, pro-motility agents (erythromycin) and cessation of all opiates have already proven ineffective. Surgical treatments have a high rate of complication for this entity, and should only be attempted after all medical therapies have been exhausted. Percutaneous cecostomy has been described, but it is also somewhat invasive, and without a proven record of success. Neostigmine is a cholinesterase inhibitor, increasing post synaptic concentrations of acetylcholine and boosting colonic motor function. Small controlled trials have shown success using neostigmine for colonic pseudoobstruction, but it must be administered carefully. Side effects can include severe bradycardia with cardiovascular collapse, as well as severe bronchospasm. Neostigmine is also contraindicated if there is evidence of mechanical obstruction [15].
34. **The correct answer is C.** Developmental venous anomalies are by far the most common malformation of the choices listed. The majority of these anomalies are asymptomatic, and generally require no treatment.
35. **The correct answer is A.** A CSF reservoir (also known as an Ommaya) may be placed for a number of reasons, most commonly for chemotherapeutic or palliative purposes in oncology patients. They allow for easy access to the CSF for both sampling and intrathecal medication administration. Ommaya related infections involve coagulase-negative staphylococci in about half of cases. The next most common organism is *Propionobacterium acnes*, which is seen in approximately one quarter of cases [16].
36. **The correct answer is E.** The patient here is experiencing cerebral salt wasting (CSW). Although it can be difficult to differentiate CSW from the syndrome of inappropriate anti-diuretic hormone (SIADH), there are a few important distinctions. Patients with CSW tend to be hypovolemic, whereas patients with SIADH may either be euvolemic or hypervolemic. Both conditions may demonstrate decreased serum sodium, decreased serum osmolarity, and increased urinary sodium. In this case, decreased IVC diameter and an increasing serum hematocrit make CSW more likely. In addition to volume replacement, reasonable options include hypertonic saline, mineralocorticoids, and enteral sodium supplements. Unlike SIADH, fluid restriction in this setting would be harmful.
37. **The correct answer is C.** Although the majority of fevers in the ICU are infectious in origin, a significant minority may be non-infectious, particularly among patients with subarachnoid hemorrhage. The onset tends to be earlier versus infectious fever, usually within the first 72 h. Central fever

may be difficult to confirm in many cases, as it is usually a diagnosis of exclusion [17].

38. **The correct answer is A.** Of the choices listed, flaccid paralysis is most commonly associated with encephalitis secondary to West Nile virus. Fever, altered mental status, and gastrointestinal complaints are also common in these patients. Among those who survive their illness, motor weakness may be permanent [18].
39. **The correct answer is A.** HIT is the result of the formation of antibodies to circulating platelets. The development of HIT, somewhat paradoxically, is linked to increase risk of thrombotic adverse events. Therefore, the discontinuation of heparin products alone is insufficient. Danaparoid, fondaparinux, or argatroban are all acceptable treatment options.
40. **The correct answer is C.** In a sub-study of the landmark targeted temperature management by Nielsen and colleagues, it was demonstrated that in 171 consecutively enrolled patients, there was no evidence to support the assumption that a target temperature of 33° was associated with either impaired hemostasis or an increase in bleeding events. There is no evidence to support the superiority of one method of cooling over the other [19].
41. **The correct answer is B.** The waveforms below indicate double triggering, a form of ventilator asynchrony in which patient-initiated breaths can be seen immediately following ventilator-initiated breaths. Double triggering may be due to patient demand exceeding ventilator inspiratory time, or inadequate set tidal volumes. Reverse triggering refers to diaphragmatic contraction stimulated by ventilator insufflation in a ventilator-initiated breath. Breath stacking refers to dynamic hyperinflation due to incomplete exhalation, and is often seen in patients with a history of chronic obstructive pulmonary disease (COPD). Missed triggering refers to patient respiratory efforts that are not sensed by the ventilator.
42. **The correct answer is A.** Paroxysmal pulmonary edema is a long-recognized complication of naloxone-mediated μ-opioid antagonism. Massive catecholamine surges are thought to result in increased pulmonary hydrostatic pressures and abnormal capillary permeability [20]. Direct cardiac dysfunction may also be a contributing factor in certain cases, but is less likely in this otherwise healthy 19-year-old with no hemodynamic compromise.
43. **The correct answer is D.** Ataxic respiration is characterized by a random, shifting pattern of both deep and shallow breathing with irregular intervals between breaths. It usually precedes agonal respirations and apnea, and indicates medullary dysfunction. Cheyne-Stokes respirations, on the other hand, have a progressive, oscillating pattern of hyperventilation and relative apnea. Central hyperventilation is characterized by rapid, regular deep breaths, with resultant hypocarbia and respiratory alkalosis. Lesions are localized to the midbrain and pons. Apneustic respiration is characterized by pauses of up to several seconds at the end of both inspiration and expiration, and usually indicates pontine injury.

44. **The correct answer is B.** Benedikt syndrome is characterized by cerebellar ataxia, oculomotor nerve palsy, and tremor, with lesions located in the median tegmentum. Both Weber's syndrome and Claude's syndrome describe oculomotor nerve palsy and contralateral hemiparesis secondary to midbrain infarcts, with the latter also involving contralateral hemiplegia of the face and tongue. Wallenberg's syndrome, resulting from a lateral medullary injury, describes ataxia and loss of pain and temperature sensation on the ipsilateral face and contralateral limbs. Dejerine syndrome usually consists of ipsilateral tongue weakness and contralateral limb weakness following a medial medullary injury.
45. **The correct answer is D.** While esophagitis can occasionally lead to GI bleeding, it is most commonly associated chest pain and/or dysphagia. The other options listed are far more common causes of bleeding.
46. **The correct answer is B.** Malnutrition is one of the most common causes of an elevated INR in ICU patients. This is particularly true for those who are not on warfarin therapy and have no symptoms of systemic illness which may result in the development of DIC. Synthetic hepatic dysfunction is also possible, but less likely, particularly given a normal INR on admission. Heparin use may cause an elevated INR at very high doses, but should not be a factor at prophylactic doses. In cases such as these, vitamin K administration will usually correct the coagulopathy.
47. **The correct answer is D.** Sarcoidosis is a disease of systemic granuloma formation, with a small subset of patients experiencing prominent CNS involvement (termed neurosarcoidosis). In this setting, facial nerve involvement is the most common presenting symptom. All of the other answer choices (seizures, limb weakness, hydrocephalus, and cauda equina syndrome causing urinary incontinence) may be present as well. Biopsy is required for definitive diagnosis, although the diagnosis may be suggested by a combination of imaging studies and laboratory testing (including hypercalcemia and elevated CSF angiotensin-converting enzyme.)
48. **The correct answer is A.** The clotting cascade includes both intrinsic and extrinsic pathways. The intrinsic pathway involves the activation of the following factors (in this order): factor XII, factor XI, factor IX (along with factor VIII). The extrinsic pathway involves the conversion of factor VII to VIIa, which then aids in the conversion of factor X to Xa (along with tissue factor).
49. **The correct answer is A.** This patient likely has primary angiitis of the central nervous system. ESR and CRP are typically normal. Beading of the medium and small vessels may be seen on angiography. CSF analysis usually reveals a lymphocytic pleocytosis, elevated protein, and normal glucose. The classic histopathologic finding is granulomatous segmental vasculitis with Langerhans or foreign body giant cells on brain biopsy.
50. **The correct answer is C.** A heparin infusion is often the first line of therapy for treatment of an acute PE. The PTT must be monitored closely, with a therapeutic goal usually in the 60–80 s range. Lower ranges may result in

inadequate anticoagulation, while higher ranges may expose the patient to an unacceptably high bleeding risk.

51. **The correct answer is A.** This patient has newly discovered diffuse subarachnoid hemorrhage, and requires DVT prophylaxis that will not increase her risk of bleeding complications. Intermittent pneumatic compression alone is appropriate until the source of her bleeding is controlled. If a source is not identified after a thorough work-up (i.e. conventional angiography and MR imaging of the neuroaxis), chemoprophylaxis can be initiated after her hemorrhage is stable on repeat imaging [1].
52. **The correct answer is A.** Any of the answer choices are possible etiologies for acute lower GI bleeding. However, the most common cause overall is diverticular disease, followed by hemorrhoids and inflammatory bowel disease, and less often, malignancy [21].
53. **The correct answer is E.** Apnea testing should be performed with the patient disconnected from the ventilator and while administering supplemental oxygen down the endotracheal tube to prevent hypoxia. A eucapneic (35–45 mmHg) baseline blood gas should be obtained, although higher levels of $PaCO_2$ may be acceptable in patients with chronic hypercapnia. The patient should be closely observed for any signs of respiration, including both chest and abdominal excursions. The test is considered positive (i.e., the patient is truly apneic) if no respirations are detected and a repeat blood gas demonstrates a $PaCO_2$ $\geq$60 mmHg or $\geq$20 over baseline). Repeat testing may be necessary, and may be extended beyond 10 min if the patient remains hemodynamically stable.
54. **The correct answer is B.** Of all the findings listed, the presence of hydronephrosis on ultrasound may not necessarily be pathologic. A denervated ureter is transplanted along with the donor kidney, resulting in diminished ureter tone. This, coupled with the increased urine production of the solitary kidney, may result in hydronephrosis that may be a stable finding over time. Comparison to prior imaging is crucial.
55. **The correct answer is C.** Hemorrhage into the cerebellum, due to the narrow confines of the posterior fossa, creates a high risk of brainstem compression resulting in respiratory insufficiency and, if progressive, herniation. Intraventricular extension is also a well-described complication. The hydrocephalus caused by cerebellar herniation is usually noncommunicating due to obstruction of the fourth ventricle, either by direct compression or via clot formation as a result of intraventricular extension.
56. **The correct answer is E.** The patient has neutrophilic pleocytosis in the pleural fluid, along with low pleural fluid pH and LDH greater than 2/3rd of upper limit of normal, consistent with exudative pleural effusion due to pleural infection. Positive Gram stain, pleural fluid pH <7.2, pleural LDH >1000 U/L, pleural glucose <40 mg/dL, or frank pus on gross examination are indications for insertion of a chest tube for control of pleural infection in addition to systemic antibiotics. Patients having rapidly re-accumulating pleural effusion due to advanced liver dysfunction despite optimal diuretic management can be

offered TIPS to reduce portal venous pressure. Insertion of a tunneled pleural catheter is usually performed for symptom relief in rapidly re-accumulating pleural effusions in conditions such as malignancy as an alternative or additive procedure to pleurodesis. Use of tunneled pleural catheters in the management of hepatic hydrothorax is controversial due to high incidence of complications; infection being the most prominent.

57. **The correct answer is B.** Overly aggressive volume repletion and induced hypertension can be deleterious. Instead, gentle escalation in hemodynamic augmentation and urgent confirmation of ischemia can identify whether or not the patient requires intra-arterial therapy. Albumin and magnesium once held promise as treatment options for delayed cerebral ischemia, but this has not borne out in randomized clinical trials. Intraventricular calcium channel blockade is usually reserved for distal vasospasm, and may be considered after perfusion imaging and conventional angiography.
58. **The correct answer is B.** The cervical x-ray demonstrates unilateral facet dislocation involving C4 on C5, which is characterized by subluxation of the upper vertebrae by a distance of <50% of the anterior-posterior diameter of the vertebral body. The mechanism is usually hyperflexion accompanied by rotation, resulting in disruption the posterior ligament complex. This represents a stable cervical injury, because the subluxed vertebra is "locked" in place by the remaining intact ligaments. It is not commonly associated with spinal cord injury [22].
59. **The correct answer is C.** Of the choices listed, the only medication lacking a specific reversal agent is apixaban. Dabigatran had previously lacked a reversal agent before the introduction of idarucizumab, a monoclonal antibody which rapidly binds the drug.
60. **The correct answer is E.** In the setting of hemorrhagic shock, blood product transfusion is not titrated to any one specific hemoglobin concentration. Rather, blood products are titrated to hemodynamic parameters and stability.
61. **The correct answer is B.** Repetitive episodes of GABA stimulation with exogenous sedatives (alcohol, benzodiazepines, barbiturates, etc.) leads to both down-regulation of GABA receptors and glutamate hyperactivity, resulting in more severe subsequent episodes of withdrawal and contributing to treatment recalcitrance. This is referred to as the "kindling phenomenon".
62. **The correct answer is A.** Although case reports exist for the majority of antibiotics used in clinical practice regarding exacerbating underlying myasthenia gravis, there are a number of agents which are notorious for doing so. These include the fluoroquinolones (the most common culprits), aminoglycosides, and macrolides [23]. Vancomycin is less likely to be problematic in myasthenic patients.
63. **The correct answer is A.** This patient has a tension pneumothorax, evidenced by a "blackout" of the entire left lung and shift of the mediastinal structures to the right, along with hypotension now requiring pressors. This patient requires immediate tube thoracostomy or needle decompression on the left side of the chest.

64. **The correct answer is D.** The WFNS grading scale for subarachnoid hemorrhage is as follows: Grade 1, GCS 15, no motor deficit; Grade 2, GCS 13–14, no motor deficit; Grade 3, GCS 13–14, with motor deficit; Grade 4, GCS 7–12, with or without motor deficit; Grade 5, GCS 3–6, with or without motor deficit.
65. **The correct answer is B.** Major burns induce fluid loss to the external environment, capillary leak, and vasodilation, resulting in both absolute and relative hypovolemia. As such, the cornerstone of early burn management is volume resuscitation with isotonic crystalloid (typically lactated ringer's solution). Fluid resuscitation requirements (over the first 24 h of resuscitation) can be estimated by first determining the actual body weight and the total body surface area (TBSA) burned. The TBSA burned can be estimated in adults using the "rule of 9s"—in this case, the patient has sustained approximately 54% TBSA burns (each arm is 9%, the front and back of the torso are each 18%). The volume of fluid required is indexed to weight and TBSA burned using the Parkland formula, where the patient is given 4 mL per kg per %TBSA burned. Half of the calculated volume is given in the first 8 h of resuscitation, and half in the subsequent 16 h. It is to be emphasized that these indexed formulas only provide an estimation of volume resuscitation requirements, and fluid resuscitation, as it progresses, should be titrated to clinical response and diagnostic markers [24].
66. **The correct answer is E.** This patient is presenting with hyperthermia, rhabdomyolysis, acute kidney injury, and hyponatremia, most likely from sympathomimetic drug exposure and psychomotor agitation due to 3,4-Methylenedioxymethamphetamine (MDMA) abuse. MDMA-induced SIADH may cause severe hyponatremia, and in this case, requires treatment with hypertonic saline. Fluid restriction would be inappropriate in this setting, and normal saline may worsen his hyponatremia.
67. **The correct answer is A.** This patient is in convulsive status epilepticus, and 0.1 mg/kg of lorazepam should be considered first line therapy (this patient has only received 0.05 mg/kg thus far). Rushing to intubate the patient without controlling his seizures may be premature, as seizure abatement may result in a rapid improvement in his mental status (although if intubation is required, a propofol infusion would be an excellent choice). Paralysis with rocuronium will mask this patient's seizures post-intubation, and is a poor choice in this setting. Leaving a convulsing patient to reassess later is never acceptable, nor is moving an actively convulsing patient to CT scan without controlling their seizure activity first.
68. **The correct answer is B.** Patients on oral vitamin K antagonists with traumatic subarachnoid hemorrhage are at significant risk of deterioration, rebleeding, and death. Resuscitative targeting of an INR <1.5 is appropriate to reduce this risk.
69. **The correct answer is E.** While resuscitation and antibiotics would be important, immediate surgical consultation is necessary. Identification and repair of the perforation is required to prevent further complications, such as abscess, obstruction, or fistula formation.

70. **The correct answer is B.** The patient in this vignette is severely ill, with a high APACHE II score and hypoxemic respiratory failure due to pneumonia. He also has underlying cardiac failure with reduced left ventricular function. Although he has clinically improved, he has several risk factors for weaning failure, such as age >65, severe illness, and cardiac failure. Early use of non-invasive ventilation (NIV) as opposed to supplemental oxygen alone has shown to avert respiratory failure after extubation and decrease ICU mortality in patients at increased risk [25]. However, NIV does not seem to be beneficial in avoiding re-intubation when it is instituted in extubated patients once they have already developed signs of respiratory failure. In this situation, NIV has been shown to delay re-intubation and hence is associated with poorer outcomes. There is no evidence to support higher mean arterial blood pressure of 85 mmHg, oxygen saturation above 85%, inhaled mucolytics, or frequent chest physiotherapy in patients after discontinuation of mechanical ventilation to avoid re-intubation.
71. **The correct answer is E.** Steroids are not currently recommended for the treatment of traumatic spinal cord injuries. Therefore, none of the therapeutic regimens listed would be appropriate [26].
72. **The correct answer is D.** This patient's blood gas demonstrates "arterialization" of the venous sample in the setting of an intentional drug ingestion and subsequent cardiac arrest, classic for cyanide toxicity. Cyanide acts as a cellular asphyxiant by poisoning the cytochromes involved in oxidative phosphorylation, and results in the body's inability to utilize oxygen, overwhelming circulatory collapse, and severe lactic acidosis. The oxygen-rich venous blood that is drawn from a cyanide-poisoned patient is often described as having a cherry-red color. Treatment of suspected cyanide poisoning involves the administration of the antidote, hydroxycobalamin.
73. **The correct answer is B.** The free water deficit (in L) for an adult female is as follows: $(0.5 \times \text{weight in kg}) \times [(\text{serum sodium}/140) - 1]$. For adult males, the initial multiplier is 0.6. In this case: $(0.5 \times 60) \times [(160/140) - 1] = \sim 4.2$ L.
74. **The correct answer is C.** Cefepime and vancomycin represent broad spectrum coverage that includes noscomial pathogens such as *Pseudomonas aeruginosa* and MRSA. Ceftriaxone, vancomycin and ampicillin is the regimen of choice for community acquired meningitis in patients >50 years old. The other choices are incorrect because the beta-lactam in these answers lacks coverage for *Pseudomonas*.
75. **The correct answer is D.** Somatosensory evoked potentials (SSEPs) have been used in order to provide some objective measure of neuronal functioning, and by extension, prognosis for recovery in patients with anoxic brain injury. The value of SSEPs in the setting of therapeutic hypothermia is less certain. Activity in response to median nerve stimulation is measured from the brachial plexus, dorsal horns, and thalamocortical radiations with N9, N13 and N20 waveforms, respectively.
76. **The correct answer is B.** Muromonab is an anti-CD3 monoclonal antibody, and the most commonly encountered adverse reactions are aseptic meningitis

and a flu-like illness. Cyclosporine and tacrolimus are calcineurin inhibitors; both are associated with fine motor tremor, seizures, and a number of other neurologic adverse events. Mycophenolate commonly causes headaches.

77. **The correct answer is B.** The mortality from ARDS appears to be decreasing, from 35% in 1996 to 26% in 2005 [27]. Likely causes included better supportive care and improved ventilatory strategies. Patients with trauma-related ARDS have a lower mortality at 90 days [28]. In most survivors of ARDS, lung volumes and spirometry will normalize by 6 months, and supplemental oxygen is rarely required. However, survivors of ARDS may continue to experience exercise limitation and cognitive impairment up to 5 years after their illness [29].
78. **The correct answer is A.** The Monro-Kelly doctrine states that intracranial volume is fixed, and is comprised of three components blood, cerebrospinal fluid, and brain tissue. Any increase in one of those components is accompanied by a decrease in one or both of the other two.
79. **The correct answer is A.** Central diabetes insipidus may be encountered in patients after they have undergone pituitary surgery. Patients usually present with an elevated sodium level, elevated urine output, and low urine specific gravity. Patients also typically have nocturia and polydipsia. Disruption of antidiuretic hormone secretion after pituitary surgery is often partial and temporary, and normal osmoregulation typically returns after 3–5 days. Nephrogenic diabetes insipidus occurs most commonly secondary to acute kidney injury from contrast nephropathy, or may be related to use of certain medications such as lithium, aminoglycosides, or amphotericin B.
80. **The correct answer is B.** The EKG findings indicating the presence of a right bundle branch block include a QRS duration >120 ms, an RSR' pattern in leads V1 and V2, and the presence of a slurred S wave in V6 and I. A dominant S wave in V1 and a broad, monophasic R wave in V5 and V6 indicate a left bundle branch block. A short PR interval and delta wave are seen in Wolf-Parkinson-White pre-excitation syndrome.
81. **The correct answer is B.** The majority of cases of diverticulitis are uncomplicated. Complicated diverticulitis refers to cases of abscess formation, fistulization, stricture, and perforation. Gross hematochezia can be seen in simple diverticulosis and is one of the most common causes of lower GI bleeding [21].
82. **The correct answer is D.** According to the most recent CDC guidelines, patients with clean, minor wounds should receive a tetanus booster if it has been greater than 10 years since the last tetanus toxoid vaccine dose. Patients with deeper or contaminated wounds should receive a tetanus booster if it has been greater than 5 years since the last tetanus toxoid vaccine.
83. **The correct answer is C.** The GQ1b antibody is present in up to 90% of patients with the Miller-Fischer variant of Guillain-Barre syndrome. Other antibodies may be present in GBS as well, frequently with low sensitivity, which limits their clinical utility. Given the possible side effects of treatment, GBS should be confirmed by LP and neuroelectrophysiologic studies when

possible. Typical LP findings include elevated protein with normal cell counts, although cell counts may be slightly elevated in a subset of patients. One third to one half of patients presenting early may not have the typical CSF protein elevation [30].

84. **The correct answer is D.** In patients receiving radiocontrast agents, saline infusion is helpful in attenuating kidney injury. Low-dose dopamine is no more effective than placebo in prevention of renal dysfunction in ICU patients. Other agents such as theophylline and n-acetylcysteine (NAC) have also failed to show consistent benefits [31].
85. **The correct answer is E.** Often times, in instances of hemodynamic instability and dynamic hyperinflation, the first maneuver is simply to disconnect the patient from the ventilator and allow them to exhale fully. This may result in rapid correction of the hypotension, after which the other therapies listed may be considered.
86. **The correct answer is D.** The CT scan demonstrates mildly displaced bilateral parasymphyseal mandibular fractures extending between the bilateral canines and first premolar teeth. Operative intervention is indicated. The mandible is not dislocated, and therefore attempted manual reduction is not appropriate. The sinuses are not involved in this patient's injury. Replacement of the missing tooth for cosmetic reasons may be considered after the primary injury is repaired.
87. **The correct answer is A.** Respiratory quotient is defined as the ratio of carbon dioxide elimination to oxygen consumption. It is calculated independently of age, gender, or body mass index. For example, carbohydrate metabolism can be described by: $C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$; the respiratory quotient is therefore 1 ($6CO_2/6O_2$). Alternatively, because lipids contain fewer oxygen atoms relative to carbon and hydrogen atoms, lipid metabolism will result in a respiratory quotient closer to 0.7.
88. **The correct answer is A.** Patients with liver cirrhosis have a suppressed immune response, and higher rates of gut bacterial translocation. Prophylactic antibiotics have been proven to prevent infectious complications, reduce rates of re-bleeding, and improve overall mortality. Octreotide has favorable effects on splanchnic vasoconstriction and is often used in this setting, but without any proven mortality benefit. Propranolol may improve portal venous pressures, but use is limited due to side effects and a high number of non-responders. The use of lactulose is an important adjunct in cirrhotic patients, but does not reduce mortality in the setting of an active bleed [32].
89. **The correct answer is C.** This multi-system trauma patient with a Glasgow Coma Score (GCS) of 6 requires intubation, and rapid sequence intubation (RSI) is the preferred technique of airway management in major trauma [33]. RSI produces quick induction and neuromuscular blockade to facilitate rapid placement of a definitive orotracheal airway. This reduces the likelihood of aspiration, which is particularly important in trauma patients who most likely have not fasted prior to intubation.

90. **The correct answer is E.** Traditional weaning parameters, such as the RSBI, may not be accurate in predicting extubation failure in neurocritical care patients, likely due to the fact that extubation failure in neurocritical care patients is less likely the result of intrinsic lung pathology. Elements of the FOUR score, such as the motor and brainstem components, have also failed to prove particularly useful in this regard [34].
91. **The correct answer is E.** Toxic megacolon is a potentially life-threatening complication of *C. difficile* colitis. Symptoms of toxic megacolon include colonic distension, fever, tachycardia, altered mental status, electrolyte abnormalities, and hypotension. Front line treatment is usually conservative, consisting of bowel decompression, broadening antibiotic coverage, withholding medications that could worsen colonic distension, and repositioning and/or proning the patient. For patients that do not respond to conservative therapy, subtotal colectomy and end ileostomy may then be considered [35].
92. **The correct answer is C.** Toxoplasmosis is the most common cause of neurologic deterioration among patients with HIV and AIDS. Patients are at highest risk of reactivation of latent toxoplasmosis when CD4 counts drop below 200 cells/μL. A CD4 count greater than 500 cells/μL would be considered normal.
93. **The correct answer is D.** When evaluating whether a hospital will be certified as a Primary Stroke Center, the Joint Commission evaluates ongoing metrics based on best-practice goals. There is no current recommendation that all acute stroke patients receive a neurosurgical evaluation [36].
94. **The correct answer is E.** All of the choices listed represent the postulated mechanisms for the development of increased ICP during RRT. The answer choices describe the reverse urea hypothesis, idiogenic osmole hypothesis, rapid infusion of bicarbonate hypothesis, and intradialytic hypotension hypothesis, respectively. Another mechanism postulated is that the dialysate temperature may increase body temperature and worsen intracranial hypotension. The exact mechanisms for this phenomenon has not yet been elucidated.
95. **The correct answer is A.** Persistent vegetative states are marked by arousal without discernible awareness. These patients generally have preserved sleep/wake cycles [37].
96. **The correct answer is E.** Seizure activity may result from a toxic ingestion of a variety of substances. This paradoxically include medications that are central nervous system depressants and more traditionally associated with sedative properties at standard doses, including clonidine, meperidine, and baclofen.
97. **The correct answer is D.** The patient has multiple reasons for his abnormal sleeping pattern. His gender, obesity, and neck circumference (>17 in.) places him at a higher risk for obstructive sleep apnea (OSA). In fact, roughly two-thirds of people with a BMI >30 kg/m^2 have OSA. He also has an acute ischemic infarct which can lead to central sleep apneas, such as Cheyne-Stokes, cluster breathing, or central neurogenic hyperventilation, to name a few. Polysomnography is the gold standard diagnostic test for sleep related

breathing disorders. Apnea, by convention, is reduction of airflow to less than 90% for more than 10 s. For central apneas, there is no respiratory effort. With obstructive apneas, a central drive is still present, with some resultant respiratory effort [38]. Overnight oximetry may show episodic desaturations in oxygen, depending on the sleep disorder, but it would not differentiate central from obstructive apneas. Arterial blood gasses also may show hypocapnia if there is hyperventilation or hypoxemia, but it would not be as useful as a sleep study.

98. **The correct answer is A.** TTP is a form of microangiopathic hemolytic anemia caused by a lack of circulating ADAMTS13, which results in large, uncleaved masses of Von Willebrand factor triggering systemic platelet plugs and coagulation. These tangled nets of intravascular thrombi sever circulating red cells, resulting in the presence of schistocytes on the peripheral smear. The absence of schistocytes effectively rules out the diagnosis of TTP.
99. **The correct answer is D.** Aggressive pulmonary toilet is the most effective measure that will improve the patient's respiratory status. She is alert, awake, and hemodynamically stable, with rapid improvement in her oxygen saturation. Her head should be elevated up to 45°, and bronchodilators can be used for bronchospasm. Noninvasive ventilation should be avoided as this is a relative contraindication in an aspiration event, especially with an improving patient. The course of an aspiration pneumonitis can be divided into two stages. The first is categorized by coughing and bronchospasm that occur immediately after the aspiration event. The second is categorized by an inflammatory reaction that can occur within 6 h. If the patient continues to worsen and her respiratory status declines leading to mechanical ventilation, antibiotics should be considered at that time given the risk of persistent oropharyngeal aspiration [39]. There is no indication for steroids. The patient's chest x-ray does not show any evidence of lobar collapse or an aspirated foreign body, and the aspiration involved liquids, meaning bronchoscopy would be of little value.
100. **The correct answer is A.** Women may be more susceptible to pituitary necrosis due to the enlargement of the pituitary that occurs during pregnancy, making the gland more susceptible to ischemic injury in the setting of postpartum hemorrhage and hypovolemic shock. Agalactorrhea is the most common initial complaint, although many patients may go several years without complaint until they experience symptoms of frank hypopituitarism. Dramatic presentations including severe headache, coma, and seizures are rare [40].

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Exam 5 Questions

I finally saw that the blood, forced by the action of the left ventricle into the arteries, was distributed to the body at large, and its several parts, in the same manner as it is sent through the lungs, impelled by the right ventricle into the pulmonary artery, and that it then passed through the veins and along the vena cava, and so round to the left ventricle in the manner already indicated. Which motion we may be allowed to call circular, in the same way as Aristotle says that the air and the rain emulate the circular motion of the superior bodies; for the moist earth, warmed by the sun, evaporates; the vapours drawn upwards are condensed, and descending in the form of rain, moisten the earth again; and by this arrangement are generations of living things produced.

William Harvey
(1578–1657)

1. A 26-year-old female with no past medical history at 37 weeks gestation presents to the emergency department complaining of headache and nausea. Her blood pressure is 166/80 mmHg on arrival, and she is subsequently diagnosed with preeclampsia and admitted to the ICU for further management. A continuous magnesium infusion is initiated. Several hours later, you note the patient has absent deep tendon reflexes, mild tachypnea, and has had no urine output since admission. After discontinuing the infusion, which of the following should be administered next?

   A. Furosemide
   B. Potassium chloride
   C. Calcium gluconate
   D. Pyridostigmine
   E. Methylprednisolone

2. A 44-year-old male is in the ICU recovering from resection of a falcine meningioma. Postoperatively, his neurological status has not returned to preoperative baseline, and you are concerned that the patient may be suffering from

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supplementary motor area (SMA) syndrome. What set of clinical findings would be most consistent with this diagnosis?

A. Incontinence, gait instability, confusion
B. Hemiparesis, mutism
C. Internuclear ophthalmoplegia looking one direction, conjugate gaze palsy looking the other direction
D. Weakness in the bilateral upper extremities with preserved lower extremity strength
E. Ataxia, nystagmus, confusion

3. According to current guidelines, all of the following are clinical prerequisites before pronouncing a patient brain dead except:

A. Establishing a proximal and irreversible cause of coma
B. Ruling out the presence of neuromuscular blocking agents
C. Ruling out the presence of severe electrolyte abnormalities
D. Ensuring that the patient has a core temperate >36.0 °C
E. Ensuring that the patient has mean arterial pressure (MAP) >60 mmHg

4. A 55-year-old 65 kg female was admitted to the ICU 5 days ago for management of intracerebral hemorrhage. On day 2 of her hospital stay, the patient is initiated on unfractionated heparin, 5000 units every 8 h for deep vein thrombosis (DVT) prophylaxis. Her platelet count on admission was $320 \times 10^3/\mu L$, and today it is $180 \times 10^3/\mu L$. Her 4T score is 3. What is the next best step in this patient's management?

A. Continue unfractionated heparin, send screening heparin PF4 immunoassay
B. Switch to low molecular weight heparin, send screening heparin PF4 immunoassay
C. Switch to low molecular weight heparin, do not send screening heparin PF4 immunoassay
D. Switch to an argatroban infusion, send screening heparin PF4 immunoassay
E. Continue unfractionated heparin, do not send screening heparin PF4 immunoassay

5. A 21-year-old male with a history of sickle cell disease and a remote right basal ganglia hemorrhage presents to the ED with a 1 week history of worsening mid-sternal chest pain. He reports a cough productive of purulent sputum for the past several days, along with night sweats, palpitations, and exertional dyspnea. A portable chest x-ray demonstrates a new left lower lobe infiltrate, and a bedside EKG reveals trace new ST depression in the precordial leads. The patient has an oxygen saturation of 88% on room air and a serum hemoglobin of 10.1 g/dL. You are evaluating the patient for exchange transfusion. On which elements of the patients presentation is the presumptive diagnosis of acute chest syndrome based?

A. New infiltrate on chest x-ray plus sputum production
B. Sputum production plus hypoxia

C. Hypoxia plus new EKG changes
D. EKG changes plus worsening midsternal chest pain
E. Worsening midsternal chest pain plus palpitations

6. Which of the following statements regarding MRI imaging of the pituitary gland is true?

A. The anterior pituitary is usually isodense compared to the cortex on T1 and T2 sequences
B. The normal pituitary gland enhances after gadolinium administration
C. Macroadenomas generally enhance strongly but heterogeneously on T1 post-contrast imaging
D. It is usually included on contrast-enhanced coronal images
E. All of the above

7. Which of the following is the correct characterization of cerebral vasospasm versus delayed cerebral ischemia (DCI) in the setting of subarachnoid hemorrhage (SAH)?

A. Vasospasm is a radiographic diagnosis, while DCI is a clinical diagnosis
B. DCI is a radiographic diagnosis, while vasospasm is a clinical diagnosis
C. Vasospasm is an early SAH complication, while DCI is a late complication
D. DCI is an early SAH complication, while vasospasm is a late complication
E. DCI and vasospasm are usually clinically insignificant

8. Compared to a continuous midazolam infusion, patients on a continuous dexmedetomidine infusion are least likely to develop which of the following?

A. Bradycardia
B. Hypotension
C. Hypoventilation
D. Hypothermia
E. Delerium

9. A 74-year-old female with a history of paroxysmal atrial fibrillation on no anticoagulation presents to the emergency department after falling at home. She is evaluated by an emergency department physician, and a stroke alert is paged overhead. A CT scan of the head is obtained before you have an opportunity to evaluate the patient (see Image 1). Based on the CT findings, what deficits would you expect in this patient?

A. Unilateral leg weakness and abulia
B. Hemiparesis and dysarthria
C. Quadriparesis with intact upward gaze
D. Dysmetria and dysdiadochokinesia
E. Weakness in the upper extremities greater than the lower extremities

Image 1 Noncontrast CT scan of the head

10. The effect of addition of positive end-expiratory pressure (PEEP) in a patient on mechanical ventilation includes all of the following except:

    A. Increase in functional residual capacity (FRC)
    B. Decrease in $PaCO_2$
    C. Increase in lung compliance
    D. Decrease in intrinsic PEEP
    E. Decrease in venous return

11. An 76-year-old female with a history of atrial fibrillation is currently in the ICU following an aneurysmal subarachnoid hemorrhage. The patient is poorly rate controlled, with a heart rate varying rapidly between 100 and 150 beats/minute. The patient has been borderline hypotensive, with systolic pressures around 90 mmHg, and you have been unsuccessfully attempting to manage her atrial fibrillation with intermittent digoxin due to concerns over her blood pressure. Which of the following antiarrhythmic medications would be least likely to cause significant hypotension at this time?

    A. Esmolol
    B. Metoprolol
    C. Diltiazem
    D. Amiodarone
    E. Flecainide

12. An occlusion at the C7 segment of the internal carotid artery is most likely to threaten which of the following vessels?

    A. Anterior choroidal artery
    B. Superior hypophyseal artery
    C. Meningohypophyseal artery
    D. Ophthalmic artery
    E. Vidian artery

13. For which of the following patients with a pituitary mass is medical management preferred over surgical management?

    A. A 25-year-old female with a large pituitary mass found on work-up for headache without visual symptoms who is planning on becoming pregnant soon
    B. A 35-year-old male found to have a large pituitary mass while being worked up for galactorrhea and bitemporal hemianopsia
    C. A 40-year-old obese female with moon facies and striae and a large pituitary mass
    D. A 45-year-old male with enlargement of his hands and feet and a large pituitary mass
    E. All above the above should be treated surgically

14. Which of the following is not a potential complication of inferior vena cava (IVC) filter placement?

    A. Vegetation formation and septic emboli
    B. Filter migration to the heart
    C. Increased risk of lower extremity deep vein thrombosis (DVT)
    D. Filter fracture
    E. Perforation of the IVC

15. A 26-year-old female is brought to the ED after being involved in a high-speed motor vehicle collision. She was an unrestrained driver, with reported airbag deployment and significant intrusion into the vehicle. She complains of severe neck pain and exhibits complete paralysis of the bilateral upper and lower extremities. Which of the following would be expected?

    A. Hypotension and bradycardia
    B. Hypertension and bradycardia
    C. Hypotension and tachycardia
    D. Hypertension and tachycardia
    E. Hypotension and complete heart block

16. A 27-year-old male is currently in the ICU in status epilepticus secondary to autoimmune encephalitis, and continues to have hourly seizures over the first 24 h despite the administration of three different antiepileptic medications with a concurrent propofol infusion. All of the following may be therapeutic options at this time except:

    A. Midazolam infusion
    B. Pentobarbital infusion

C. Ketamine infusion
D. Therapeutic hypothermia
E. Corpus callosotomy

17. A 54-year-old woman with a past medical history significant for hypertension and hyperlipidemia presents to the emergency department with intermittent shaking of the left upper extremity for the past week. She is treated with lorazepam and levetiracitam for presumed focal seizures with resolution of symptoms. Computed tomography (CT) of the brain reveals an ill-defined hypodense lesion in the right frontal region, with extensive surrounding vasogenic edema and compression of the right frontal horn. She undergoes a right frontal craniotomy with gross total resection of the lesion and is subsequently admitted to the ICU. Surgical pathology demonstrates a WHO grade IV glioblastoma, positive for the isocitrate dehydrogenase 1 (IDH1) mutation. All of the following are true regarding this patient except:

A. Median overall survival is 12–15 months
B. Ionizing radiation exposure is a risk factor for the development of this malignancy
C. The IDH mutation is a negative prognostic factor
D. The mainstay of initial treatment is maximal surgical resection, radiation, and chemotherapy
E. All of the above are correct

18. Which of the following is a risk factor for superior vena cava perforation during central venous catheter placement?

A. Left-sided catheter placement
B. Use of vasoactive agents
C. Use of a pressure transducer
D. Use of antibiotic-coated catheters
E. Femoral site placement

19. A 55-year-old female presents to the emergency department after family members complain that she has been “not quite right” at home. The patient’s husband reports that she spends most of the day sleeping, then stays awake all night watching television. She has also been increasingly forgetful, and has been having a difficult time paying attention to daily tasks for more than a few minutes. The patient has a history of cirrhosis, hypertension, and hyperlipidemia. On exam, she is alert and oriented, without focal neurologic deficit. She has moderate ascites, and no asterixis is present. According to the West Haven criteria, how would you grade this patient’s hepatic encephalopathy?

A. Grade 0
B. Grade 1
C. Grade 2
D. Grade 3
E. Grade 4

20. Which of the following electrolyte abnormalities would be expected in a patient on fludrocortisone therapy?

    A. Hypokalemia
    B. Hyponatremia
    C. Hypocalcemia
    D. Hypophosphatemia
    E. Hypomagnesemia

21. A 29-year-old male suffers a penetrating injury to the mid-thoracic spinal region, resulting in left-sided motor paralysis distal to the level of the injury with right-sided loss of nociception. Which of the following best describes the location of the injury?

    A. Injury to the left half of the spinal cord
    B. Injury to the right half of the spinal cord
    C. Injury to the anterior portion of the spinal cord
    D. Injury to the posterior portion of the spinal cord
    E. Injury to the central portion of the spinal cord

22. Which of the following findings is least likely to indicate a poor prognosis in post-arrest anoxic ischemic brain injury?

    A. Absence of pupillary response in a hypothermic patient on day 5
    B. Elevated neuron-specific enolase (NSE) in a hypothermic patient on day 1
    C. Myoclonic status epilepticus in a normothermic patient on day 1
    D. Myoclonic status epilepticus in a normothermic patient on day 3
    E. Absence of any brainstem function in a normothermic patient on day 7

23. A 57-year-old female presents to the emergency department with evidence of an acute ischemic stroke in a left middle cerebral artery (MCA) distribution. Her initial non-contrast head CT is normal, and tissue plasminogen activator (tPA) is administered. Approximately 4 h later, her neurological status has acutely worsened, and repeat imaging demonstrates a large left-sided intraparenchymal hemorrhage. Which of the following medications and/or blood products would be the most effective evidence-based treatment to reduce mortality in this scenario?

    A. Aminocaproic acid
    B. Cryoprecipitate
    C. Fresh frozen plasma
    D. Prothrombin complex concentrate
    E. None of the above

24. A 47-year-old female is currently intubated in the ICU after suffering a right basal ganglia hemorrhage with intraventricular extension. On the fourth hospital day, the patient becomes febrile, with purulent secretions noted by the nursing staff. An EKG obtained on admission is remarkable only for a corrected QT

interval of 524 ms. Which of the following antibiotics is most likely to put the patient at risk of developing torsades de pointes?

A. Clarithromycin
B. Azithromycin
C. Vancomycin
D. Ciprofloxacin
E. Piperacillin/tazobactam

25. A 67-year-old male with emphysema and multiple recent hospitalizations for pneumonia is currently intubated in the ICU with acute respiratory failure, and subsequently develops ventilator-associated pneumonia (VAP). Respiratory cultures preliminarily demonstrate gram positive cocci in clusters. The patient is currently receiving cefepime and ciprofloxacin. Which of the following should be added to his antibiotic regimen?

A. Linezolid
B. Daptomycin
C. Tigecycline
D. Nafcillin
E. Cefazolin

26. Which of the following medications has the highest blood-brain barrier reflection coefficient (i.e., is most excluded by the blood-brain barrier)?

A. Sodium chloride
B. Mannitol
C. Glycerol
D. Urea
E. The reflection coefficients are equivalent

27. Which of the following confers the greatest risk regarding the development of an abdominal aortic aneurysm?

A. Tobacco use
B. Hypertension
C. Hyperlipidemia
D. Advanced age
E. Family history

28. A 28-year-old female presents with several weeks of progressive binocular diplopia that is worse in the evenings. She does not have any evidence of bulbar weakness, and her negative inspiratory force (NIF) is normal. She denies any recent infectious symptoms. Which of the following is correct?

A. Because she does not have bulbar weakness or respiratory symptoms, myasthenia gravis is unlikely
B. She has an 85% chance of progression to involvement of other muscle groups

C. She is at high risk of rapid decompensation and should be admitted while the results of antibody testing are pending
D. Because of her age, myasthenia gravis is an unlikely diagnosis, and an alternate explanation for her symptoms should be sought
E. She should be started on glucocorticoids and discharged with outpatient follow-up

29. All of the following pairs of ligament/bony attachment are correct except:

A. Apical ligament: from the tip of the dens of C2 to the anterior margin of the foramen magnum
B. Interspinous ligament: between the spinous processes along their adjacent borders
C. Anterior atlanto-occipital membrane: from the upper border of the anterior arch of the atlas to the outer margin of the foramen magnum
D. Cruciform ligament: from the posterior dens of C2 in articulation at the atlanto-axial joint
E. Alar ligament: between the laminae of adjacent vertebrae

30. Regarding hemorrhagic transformation of acute ischemic infarcts, which of the following would accurately categorize a hemorrhage occupying 25% of the infarct zone with resultant mass effect?

A. Type 1 hemorrhagic infarct (H1)
B. Type 2 hemorrhagic infarct (H2)
C. Type 1 parenchymal hemorrhage (PH1)
D. Type 2 parenchymal hemorrhage (PH2)
E. None of the above

31. A 21-year-old male is admitted to the ICU with a subdural hemorrhage after a physical altercation with another individual. He is currently under observation to determine the need for definitive surgical management. A rapid HIV test was performed on admission due to high-risk behavior noted in the social history, and was positive. His CD4 count is currently 365 cells/mm^3. What is the optimal strategy for managing this patient's HIV at this time?

A. Initiate antiretroviral treatment as soon as possible
B. Send for viral load testing to determine the optimal initial regimen
C. Defer initiation of antiretroviral treatment until after discharge
D. Treatment is unnecessary at this time, based on the CD4 count
E. Repeat the rapid serum HIV test

32. A 65-year-old patient is currently hospitalized with a lower gastrointestinal bleed when they begin to complain of severe generalized abdominal pain. Earlier that same day, the patient underwent colonoscopy with the subsequent removal of several polyps. The patient is uncomfortable and writhing in pain. Vital signs are as follows: blood pressure 98/60 mmHg, heart rate 112 beats/minute, respiratory rate 20 breaths/minute, saturation 98% on room air, and

temperature is 99.8 °F. The patient's abdomen is diffusely tender and firm. Intravenous fluids and pain medication are being delivered. The next best test to order in evaluating this patient is:

A. Arterial blood gas
B. CT abdomen and pelvis with oral and intravenous contrast
C. Upright chest x-ray
D. Bedside sonographic (FAST) exam
E. Contrast-enhanced swallow evaluation

33. Which of the following clinical features makes a diagnosis of Guillain-Barre syndrome unlikely?

A. Hyperreflexia
B. An antecedent gastrointestinal illness
C. Involvement of facial muscles
D. Symmetric involvement of distal muscle groups
E. Subacute onset over days to weeks

34. Which of the following patients would be classified as being in status epilepticus?

A. A 26-year-old male with a generalized tonic-clonic seizure for 2 min, followed by a post-ictal period of 30 min
B. A 52-year-old female with three focal motor seizures lasting 4 min each over the course of 45 min
C. A 19-year-old male with a generalized tonic clonic seizure for 30 s, followed by a 5 min post-ictal period and a second generalized tonic clonic seizure for 30 s
D. A 38-year-old female with a continuous focal motor seizure for 25 min
E. A 16-year-old female with an absence seizure for 3 min, followed by a return to baseline

35. A 54-year-old female is currently intubated in the ICU following a left middle cerebral artery infarct and significant post-infarct edema. The patient is status post left hemicraniectomy, and is currently receiving standing mannitol for osmotherapy every 6 h. Her neurologic exam remains poor. Her current intracranial pressure is 28 mmHg, with the most recent labwork as follows: serum osmolarity 328 mOsm/kg, serum sodium 159 mEq/L, blood urea nitrogen (BUN) 21 mg/dL, serum creatinine 1.1 mg/dL, and glucose 180 mg/dL. Which of the following is true regarding mannitol therapy at this time?

A. Mannitol is contraindicated due to the current serum osmolarity
B. Mannitol is contraindicated due to the current osmolar gap
C. Mannitol is contraindicated due to the current serum creatinine
D. Mannitol may be administered according to the current serum osmolarity
E. Mannitol may be administered according to the current osmolar gap

36. Which of the following is a value-added activity for a potential tPA patient?

    A. Redrawing a hemolyzed blood sample
    B. Delaying care to confirm up-to-date insurance information at triage
    C. Waiting for tPA to be delivered from the central pharmacy
    D. Confirming the "last known normal" time
    E. Remaining in the hospital an additional day while durable medical equipment is delivered home

37. A 24-year-old 80 kg male is brought to the ED after being stabbed in the upper back. His vital signs are as follows: heart rate 110 beats/minute, blood pressure 108/63 mmHg, oxygen saturation 94% on 30% oxygen by venturi mask. Two 18-guage IVs are placed and a fluid bolus is started. A portable chest x-ray is obtained (see Image 2). Which of the following should be performed next?

    A. Insertion of "pigtail" catheter into the right pleural space
    B. Insertion of "pigtail" catheter into the left pleural space
    C. Insertion of "pigtail" catheter into the pericardium
    D. Insertion of large-bore chest tube into left pleural space
    E. Insertion of large-bore chest tube into right pleural space

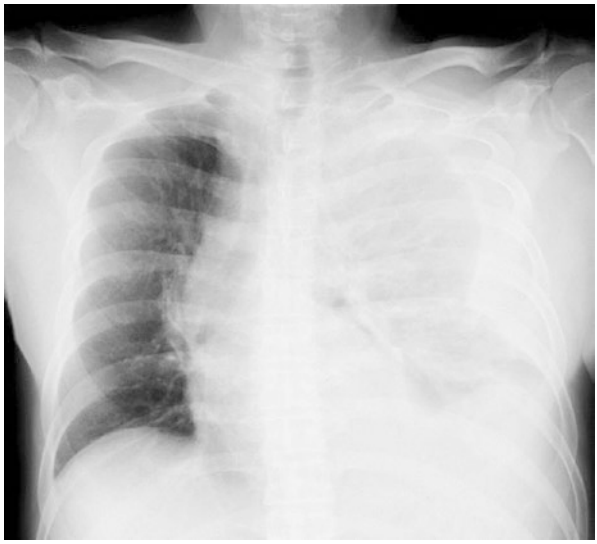

Image 2 X-ray of the chest

38. Which of the following is true regarding gabapentin?

    A. Structurally related to gamma-aminobutyric acid (GABA)
    B. Acts on cerebral GABA A receptors
    C. Acts on cerebral GABA B receptors
    D. Does not affect voltage-gated calcium channels
    E. All of the above

39. A 54-year-old female is in the ICU following clot evacuation of a traumatic intracerebral hemorrhage, complicated by an intraoperative seizure. On postoperative day 3, the patient has a second generalized tonic clonic seizure lasting approximately 4 min, and seizure activity is terminated following administration of intravenous lorazepam. She is currently on oral phenytoin, 100 mg three times a day. Her serum albumin is 2 g/dL, and her most recent phenytoin level is 7 mg/L. Her serum creatinine is normal. Which of the following statements is most accurate?

    A. Her phenytoin level is subtherapeutic; she should be bolused with phenytoin, followed by an increase in maintenance dosing.
    B. Her phenytoin level is subtherapeutic; phenytoin should be discontinued, and a different agent should be started.
    C. Her phenytoin level is therapeutic; a second agent should be started.
    D. Her phenytoin level is therapeutic; her current regimen should be maintained.
    E. Phenytoin is not appropriate monotherapy for seizure control.

40. A 41-year-old female is currently in the ICU following the resection of multiple large uterine fibroids complicated by significant intraoperative blood loss, and you have decided to transfuse two units of packed red cells. The patient's husband is asking about the risk of various adverse events associated with the transfusion. Although the overall risk is low, which of the following is most likely to occur?

    A. Contracting HIV
    B. Contracting hepatitis B
    C. Contracting hepatitis C
    D. Fatal hemolytic reaction
    E. All of the above are equally likely

41. Which of the following is not a potential cause of neurologic deterioration following intracranial tumor resection?

    A. Seizures
    B. Hemorrhage at the surgical site
    C. Cerebral vasospasm
    D. Cerebral edema
    E. All of the above are potential causes

42. A 61-year-old male with a history of emphysema and chronic renal insufficiency is brought to the emergency department as a witnessed an out-of-hospital cardiac arrest. After two cycles of epinephrine and chest compressions, you note return of spontaneous circulation, with a pulse rate of 51 beats/minute and a systolic blood pressure of 74 mmHg. You obtain a stat 12 lead EKG (see Image 3). Which of the following is the most important next step?

    A. Administration of sodium bicarbonate
    B. Administration of calcium gluconate

C. Initiation of therapeutic hypothermia
D. Urgent consult for cardiac catheterization
E. Obtain non-contrast head CT

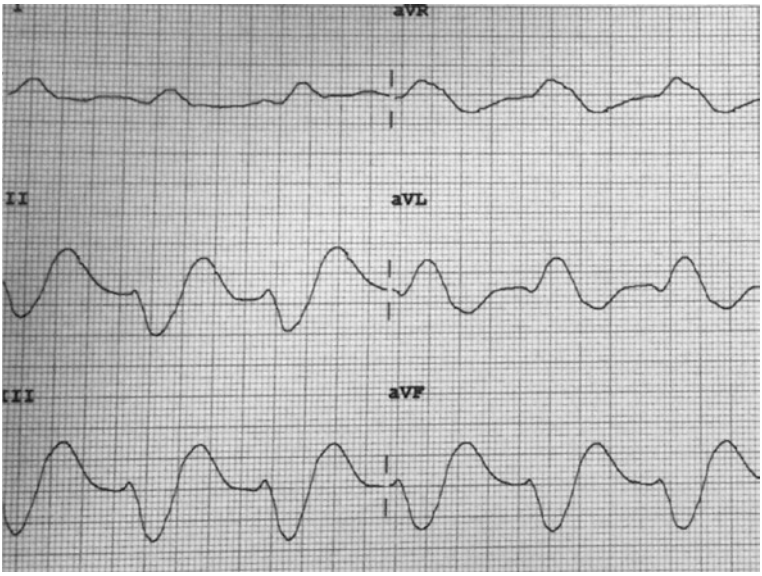

Image 3 EKG tracing

43. An 87-year-old male with a history of obstructive uropathy and a chronic indwelling foley catheter is currently in the stroke unit following a transient ischemic attack at home. On the second hospital day, the patient develops fever and lethargy, and the work-up strongly suggests a urinary source of infection. Which of the following is the most likely causative pathogen in this setting?

A. *Staphylococcus epidermidis*
B. *Staphylococcus saprophyticus*
C. *Staphylococcus aureus*
D. Extended-spectrum beta-lactamase (ESBL) producing *Enterobacter cloacae*
E. *Escherichia coli*

44. A 41-year-old female presents to the emergency department with post-coital headache, nausea and vomiting. A non-contrast head CT is performed, demonstrating thick blood in the suprasellar cistern with bilateral ventricular extension. She is currently complaining of a severe headache, but is otherwise awake, alert and neurologically intact. She is transferred to the ICU for further

management. Which of the following diagnostic tests is least likely to be utilized during her ICU stay?

A. Diffusion tensor imaging
B. Transcranial ultrasound
C. Conventional angiography
D. CT perfusion imaging
E. Continuous EEG

45. In the majority of cases, amyotrophic lateral sclerosis initially presents with:

A. Limb weakness
B. Bulbar weakness
C. Trunk weakness
D. Diaphragmatic dysfunction
E. Bladder dysfunction

46. Leukoaraiosis is a risk factor for the development of which of the following?

A. Seizures following meningioma resection
B. Hemorrhage following alteplase administration
C. Infection following ventricular drain placement
D. Intracranial hypertension following traumatic brain injury
E. Coma following intravenous immunoglobulin administration

47. Which of the following conditions may result in secondary normal pressure hydrocephalus?

A. Subarachnoid hemorrhage
B. Traumatic brain injury
C. Meningitis
D. Neoplasm
E. All of the above

48. Which of the following best describes multiple system atrophy (formerly Shy-Drager syndrome)?

A. Parkinsonism plus dysautonomia
B. Anterograde amnesia plus dysdiadochokinesia
C. Frontotemporal dementia plus dysphagia
D. Temporal lobe epilepsy plus dystonia
E. Visual hallucinations and agitation plus dysthymia

49. Which of the following is the most common cause of acute liver failure in the United States?

A. Acute viral hepatitis
B. Alcoholic hepatitis
C. Acetaminophen toxicity
D. Fatty liver of pregnancy
E. Wilson's disease

50. A 60-year-old female with history of chronic pain, hyperthyroidism, and depression presents to the emergency department with confusion, diaphoresis, and fever to 42 °C. She has been taking prochlorperazine for several days due to a gastrointestinal illness in order to keep down the citalopram she takes for depression. What elements of the physical exam will allow you to differentiate neuroleptic malignant syndrome from serotonin syndrome?

    A. Hyperreflexia and myoclonus suggests neuroleptic malignant syndrome
    B. Altered mental status suggests neuroleptic malignant syndrome
    C. Rigidity and stupor suggests serotonin syndrome
    D. Diarrhea and shivering suggests serotonin syndrome
    E. None of the above will differentiate the two conditions

51. Which of the following is the most common adverse effect of chlorpropamide when used to treat central diabetes insipidus (DI)?

    A. Hypernatremia
    B. Hypoglycemia
    C. Hypermagnesemia
    D. Hyperlipidemia
    E. Hyperammonemia

52. All of the following may result in rhabdomyolysis except:

    A. Vigorous exercise
    B. Arterial thrombosis
    C. Status epilepticus
    D. Crush injury
    E. All of the above may lead to the development of rhabdomyolysis

53. A 62-year-old male is currently intubated in the ICU for hypoxemic respiratory failure from bilateral community acquired pneumonia. He is 5′4″ tall and weighs 90 kg. He is initiated on mechanical ventilation with volume assist-control, with the following settings: tidal volume 550 cc, positive end-expiratory pressure (PEEP) of 5 cm H_2O, FiO_2 60%, and respiratory rate of 20 breaths/minute. The most recent ABG is as follows: pH 7.32, pCO_2 45 mmHg, PaO_2 70 mmHg, HCO_3 26 mmol/L, saturation 93%. Chest x-ray shows diffuse bilateral patchy opacities without any cardiomegaly, and the patient is initiated on broad spectrum antibiotics. Bedside echocardiography shows no evidence of fluid overload, and no evidence of impaired systolic or diastolic function. The next step in ventilator management is:

    A. Increase rate to 24 breaths/minute
    B. Increase PEEP to 10 cm H_2O
    C. Decrease tidal volume to 360 cc
    D. Increase FiO_2 to 80%
    E. Continue with current settings

54. A lower GI bleed is best defined as any loss of blood that originates from:

    A. The rectum and anal verge
    B. The descending colon, distal to the splenic flexure
    C. Distal to the ileocecal valve
    D. Distal to the jejunum
    E. Distal to the ligament of Treitz

55. Upwards herniation is most accurately described as:

    A. Transtentorial
    B. Subfalcine
    C. Uncal
    D. Central
    E. Tonsillar

56. Regarding pulmonary artery catheterization, which of the following is true?

    A. The tip of the catheter should come to rest in West zone 2
    B. The balloon should be inflated with approximately 10 cc of air
    C. Average healthy wedge pressures are between 25 and 35 mmHg
    D. Thermodilution operates according to Hering-Breuer mechanics
    E. None of the above

57. Which of the following is the most accurate description of critical illness polyneuropathy (CIP)?

    A. Asymmetric muscle weakness with cranial nerve sparing
    B. Asymmetric muscle weakness with cranial nerve involvement
    C. Symmetric muscle weakness with cranial nerve sparing
    D. Symmetric muscle weakness with cranial nerve involvement
    E. Isolated weakness of multiple cranial nerves

58. A 37-year-old 100 kg female with no documented history of diabetes is currently in the ICU following a thalamic intraparenchymal hemorrhage with bilateral ventricular extension. She is currently intubated and sedated, with an external ventricular drain (EVD) in place. Her blood work comes back with the following pertinent results: hemoglobin A1c 11.1%, glucose 446 mg/dL, carbon dioxide 14 mmol/L, anion gap 21 mmol/L, pH 7.18, moderate acetone. Which of the following is the most appropriate insulin regimen at this time?

    A. Bolus of 14 units, continuous infusion of 10 units/h
    B. Bolus of 10 units, continuous infusion of 14 units/h
    C. No bolus, continuous infusion of 14 units/h
    D. No bolus, continuous infusion of 10 units/h
    E. No bolus, pre-meal sliding scale with correction and basal insulin at night

59. According to the Spetzler-Martin grading system, which of the following areas of the brain, if injured, will result in a disabling neurological deficit, and hence are considered “eloquent”?

    A. Insula, cerebral peduncles, deep cerebellar nuclei
    B. Anterior frontal lobe, anterior temporal lobe, fornix

C. Internal capsule, brainstem, deep cerebellar nuclei
D. Sensorimotor, language and visual cortex, cerebellar cortex
E. Nondominant parietal cortex, visual association areas, auditory area

60. Which of the following is the most common location for large-bowel volvulus?

A. Cecum
B. Splenic flexure
C. Descending colon
D. Sigmoid colon
E. Transverse colon

61. A 51-year-old male with a recent left middle cerebral artery infarct requires intubation secondary to an aspiration event. You ask the patient to open his mouth, and note that you see the hard and soft palate, but not the uvula. What is this patient's Mallampati grade?

A. Class I
B. Class II
C. Class III
D. Class IV
E. Class V

62. A 53-year-old male with a history of coronary artery disease, hypertension, and diastolic heart failure is transferred to the ICU following an emergent laparotomy and repair of a perforated duodenal ulcer. He was extubated by anesthesia in the operating room prior to being brought to the recovery room. As the evening progresses, the patient becomes increasingly short of breath, with rales auscultated in all lung fields. A portable chest x-ray is performed, and is consistent with acute pulmonary edema. Despite intravenous furosemide and supplemental oxygen, the patient's symptoms do not improve, and his blood gas now begins to show a mild respiratory acidosis. He remains awake, alert, and appropriate, albeit in moderate respiratory distress. Which statement is most accurate regarding respiratory support for this patient?

A. The patient should be immediately intubated for airway protection and impending clinical decline
B. A continuous nitroglycerine infusion will prevent this patient from requiring mechanical ventilation
C. A continuous furosemide infusion will prevent this patient from requiring mechanical ventilation
D. Noninvasive positive pressure ventilation in contraindicated due to the risk of gastric insufflation and breakdown of his surgical repair
E. Noninvasive ventilation is the best first modality to treat this patient's respiratory failure

63. A 26-year-old male is currently intubated in the ICU with inhalational burns after an explosion in an illicit basement methamphetamine laboratory. He was found unresponsive on the floor, and has numerous facial burns. Which of the following is true regarding this patient's injuries?

    A. Inhalation injury is the most common cause of death in burn patients
    B. The combination of facial burns and being found in an enclosed space has a high degree of false positivity in identifying patients with inhalational burns
    C. Because of significant secretion and debris burden created by inhalational burns, therapeutic bronchoscopy should be the first line technique to aid in airway and bronchial clearance
    D. It is unlikely that he has significant lower respiratory tract burns
    E. There is a significant possibility that he will be extubated within 24 h of arrival

64. A 17-year-old male presents to the emergency department complaining of several hours of fever and blurry vision. His past medical history is unremarkable, save for an upper respiratory infection (URI) approximately 2 weeks ago. He has no sick contacts. His vital signs are as follows: temperature 38.4 °C, blood pressure 118/86 mmHg, pulse rate 102 beats/minute, respiratory rate 18 breaths/minute. On exam, the patient is lethargic, and you appreciate a drift in the right upper extremity. A MRI of the head is performed, demonstrating scattered subcortical areas of high signal intensity on T2-weighted imaging. Following treatment, the patient makes a full recovery over the course of several weeks, and is eventually discharged from the hospital. At 1 year follow-up, the patient remains asymptomatic, and does not have any residual deficits. What is the most likely diagnosis?

    A. Acute fulminant multiple sclerosis
    B. Tumefactive multiple sclerosis
    C. Progressive multifocal leukoencephalopathy
    D. Multiphasic disseminated encephalomyelitis
    E. Acute disseminated encephalomyelitis

65. Which of the following is the most appropriate course of action for a hypotensive trauma patient with fluid noted in Morrison's pouch on bedside ultrasonography?

    A. Diagnostic peritoneal lavage
    B. Urgent CT scan of the chest, abdomen, and pelvis with IV contrast
    C. Urgent laparotomy
    D. Urgent thoracostomy
    E. Admit to the ICU for serial examinations

66. Prone positioning is absolutely contraindicated in which of the following scenarios?

    A. A 63-year-old male with ascending cholangitis and complete heart block status post recent pacemaker placement
    B. A 24-year-old female at 28 weeks gestation with severe H1N1 influenza pneumonia and respiratory failure

C. A 36-year-old male with respiratory failure following a motor vehicle accident and blunt chest trauma status post anterior tube thoracostomy
D. A 55-year-old female with metastatic breast cancer and respiratory failure secondary to community-acquired pneumonia
E. A 72-year-old female with an acute intracerebral hemorrhage and papilledema who develops respiratory failure secondary to aspiration and lethargy

67. A 55-year-old male presents with a 2.5 cm rostral pontine hemorrhage. His GCS is currently 3, and he is intubated for airway protection. Which of the following is the most appropriate management of his hemorrhage?

A. Medical management only
B. Lumbar drain placement
C. External ventricular drain placement, followed by surgical decompression
D. Suboccipital decompressive craniotomy alone
E. All of the above are reasonable options

68. Which of the following is true regarding the diagnosis of neuromyelitis optica (Devic's disease)?

A. Patients must meet two absolute criteria and two supportive criteria
B. Patients must meet two absolute criteria and four supportive criteria
C. Patients must meet four absolute criteria and two supportive criteria
D. Patients must meet four absolute criteria and four supportive criteria
E. No consensus currently exists on objective diagnostic criteria

69. An 85-year-old male is taken to the emergency department after he was found on the ground outside his home. He is lethargic, and his examination is notable for aphasia and right hemiparesis. He is intubated and a CT scan is obtained, which shows a large left frontoparietal hematoma. His examination rapidly deteriorates, and he is noted to have fixed pupils, absent corneal responses, absent cough and gag reflexes, and no movement in any limb with noxious stimulation. He does not breath above the ventilator set rate. He is noted to have markedly increased dilute urine output. What is the most likely cause of his polyuria?

A. Syndrome of inappropriate antidiuretic hormone (SIADH)
B. Diabetes insipidus
C. Cerebral salt wasting
D. Fluid mobilization
E. All of the above are equally likely

70. Which of the following modalities may be used to detect elevated intracranial pressure (ICP)?

A. Transcranial doppler
B. Carotid doppler
C. Optic ultrasound
D. Transesophageal echocardiography
E. None of the above

71. Optimal passive oxygenation during endotracheal intubation involves which of the following?

    A. A nonrebreather at 15 L/min
    B. A nonrebreather at 6 L/min
    C. A nasal cannula at 15 L/min
    D. A nasal cannula at 6 L/min
    E. Bilevel positive airway pressure (BiPAP) at 100% FiO_2

72. A 79-year-old male is currently hospitalized while recovering from a myasthenia gravis exacerbation. His hospital course has been complicated by hyperactive delierium, and he has been receiving standing quetiapine to manage his symptoms. On exam, his eyes are closed; he opens his eyes briefly to voice, but does not make eye contact, and will occasionally mutter incomprehensibly to himself. How would you classify this patient's Richmond Agitation and Sedation Scale (RASS) score?

    A. +1
    B. 0
    C. −1
    D. −2
    E. −3

73. Which of the following malignancies is least likely to result in metastatic epidural spinal cord compression?

    A. Breast
    B. Skin
    C. Lung
    D. Prostate
    E. Lymphoma

74. A 56-year-old female diabetic patient with end stage renal disease is admitted to the ICU for status epilepticus. Worsening renal function prompts the initiation of intermittent hemodialysis. Which of the following antiepileptic medications is least likely to require redosing now that the patient is on renal replacement therapy?

    A. Levetiracetam
    B. Phenytoin
    C. Gabapentin
    D. Topiramate
    E. Ethosuximide

75. All of the following are associated with carotid-cavernous fistulae except:

    A. Corneal dendrites
    B. Pulsatile proptosis
    C. Progressive visual loss
    D. Orbital pain
    E. Orbital bruit

76. A 29-year-old male with a history of testicular cancer on chemotherapy is currently in the ICU with rapidly increasing muscle weakness and impending respiratory failure. He initially presented with symmetric weakness in his arms and legs, but is now having difficulty speaking and handling his secretions. His vital signs are as follows: temperature 37.4 °C, blood pressure 98/60 mmHg, pulse rate 108 beats/minute, respiratory rate 26 breaths/minute. On exam, he has erythematous papules overlying the interphalangeal joints in his bilateral upper extremities, and a violaceous discoloration of his upper eyelids. Which of the following is the most likely diagnosis?

    A. Lambert-Eaton syndrome
    B. Dermatomyositis
    C. Polymyalgia rheumatica
    D. Guillain-Barré syndrome (classical variant)
    E. Guillain-Barré syndrome (Miller Fisher variant)

77. A 47-year-old female with a history of metastatic breast cancer presents to the emergency department with headache and altered mental status. The patient is admitted to the hospital, and an MRI demonstrates evidence of scattered leptomeningeal enhancement. A lumbar puncture is performed. Which of the following CSF findings does not support a diagnosis of carcinomatous meningitis?

    A. Presence of malignant cells
    B. Opening pressure of 30 cm H_2O
    C. Leukocyte count of 75/mm^3
    D. Protein of 15 mg/dL
    E. Glucose of 30 mg/dL

78. Which of the following is true regarding giant cell (temporal) arteritis?

    A. It is more commonly seen in males
    B. It is more commonly seen among African Americans
    C. About half of patients also have polymyalgia rheumatica
    D. Amaurosis fugax is a classic presentation, with sudden painful vision loss
    E. All of the above

79. Which of the following is not a known risk factor for cerebral edema and herniation following an acute ischemic infarct?

    A. Male gender
    B. Younger age
    C. Significant infarct area seen on initial noncontrast head CT
    D. Absence of collateral flow
    E. Occlusion of the M1 branch of the middle cerebral artery (MCA)

80. A 74-year-old female with a history of diabetes awoke at 6:30 am with slurred speech and left arm weakness. She immediately called 9-1-1, and was taken by ambulance to a Comprehensive Stroke Center. Which of the following is most

likely to cause the paramedic to provide an inaccurate assessment of her eligibility for tPA when giving report?

A. Not checking the patient's blood sugar and missing hypoglycemia
B. Obtaining an inaccurate history due to slurred speech
C. Not recognizing ataxia as a stroke sign
D. Failing to recall the proper time intervals for tPA administration
E. Responding to a call that came in at shift change

81. A 33-year-old female, G1 P0 at 34 weeks gestation, presents to the emergency department following a generalized tonic-clonic seizure. Her mother reports that she has been complaining of headache for the last several days. Her pregnancy has been unremarkable up until this point. Her vital signs in the ED are as follows: temperature 37.1 °C, blood pressure 98/72 mmHg, pulse rate 110 beats/minute, respirations 22 breaths/minute. A non-contrast head CT demonstrates a large dense delta sign, with no other abnormalities. Which of the following is the definitive treatment for the most likely diagnosis?

A. Unfractionated heparin
B. Low molecular weight heparin
C. Continuous magnesium infusion
D. Intravenous lorazepam and fosphenytoin load
E. Stereotactic radiosurgery

82. A 40-year-old previously healthy female is admitted to the ICU after suffering an isolated traumatic subarachnoid hemorrhage from a fall. Her neurologic exam is noted to worsen on post-injury day 3 without a change in the appearance of her hemorrhage on non-contrast CT of the head. The patient then becomes hypotensive, and a bedside echocardiogram is performed. Which of the following is the most likely finding?

A. Decreased tricuspid annular planar systolic excursion
B. Paradoxical intraventricular septal wall motion during systole
C. Severe mitral regurgitation with normal left ventricular function
D. Left ventricular apical hypokinesis with preserved basal function
E. Preserved right ventricular systolic function with dilation of the right ventricular cavity

83. Which of the following is not a typical finding in patients with mitochondrial encephalopathy, lactic acidosis, and stroke-like episodes (MELAS) syndrome?

A. EEG with prominent triphasic waves
B. MRI of the head with multifocal cortical infarcts
C. CT of the head with basal ganglia calcification
D. Elevated serum creatine kinase
E. Elevated CSF lactate

84. A 44-year-old alcoholic female with a known history of gastric and esophageal varices is admitted to the ICU with massive hematemesis. Due to inclement weather, your interventional radiologist and gastroenterologist are several hours away. After intubation and appropriate resuscitation, you decide to temporize the bleeding with a Sengstaken-Blakemore tube. Known complications of this device include all of the following except:

    A. Esophageal rupture
    B. Airway compromise
    C. External cardiac compression
    D. Pressure necrosis of the lips
    E. All of the above

85. A 66-year-old male with a history of schizophrenia and psychogenic polydypsia presents to the emergency department with nausea and generalized weakness. His serum sodium is found to be 109 mEq/L, and he is admitted to the hospital with 2% hypertonic saline running at 100 cc/h. Approximately 24 h later, he develops a generalized tonic-clonic seizure, and on repeat testing, his serum sodium is 143 mEq/L. Over the next several days, he develops progressive quadraparesis. His current condition can be attributed to degeneration at which location?

    A. Gracile and cuneate fasciculus
    B. Spino-olivary fibers
    C. Anterior and posterior spinocerebellar tracts
    D. Anterior and lateral spinothalamic tracts
    E. Anterior and lateral corticospinal tracts

86. A 38-year-old male involved in a motorcycle crash sustains multiple lower extremity fractures, including fractures of the left medial malleolus, left patella, right tibial plateau and right acetabulum. He is splinted and admitted pending surgery. Twelve hours after admission, you are called to evaluate his complaint of increasing right leg pain, swelling, and tingling. On exam, you note asymmetric swelling of the right lower leg, calf and ankle; the skin is pale and shiny when compared to the left side. He screams in pain when you lightly palpate his anterior leg. His popliteal, dorsalis pedis and posterior tibial pulses are easily palpable. What is the most appropriate intervention at this time?

    A. Ice, elevation, and compression
    B. Systemic anticoagulation
    C. Fasciotomy
    D. Intravenous antibiotics
    E. Contrast-enhanced CT of the right lower extremity

87. A 64-year-old female with a history of poorly controlled hypertension presents to the emergency department with nausea, vomiting, and severe headache. Her blood pressure on exam is 260/110 mmHg, and a non-contrast head CT is

unremarkable. She has no focal neurologic deficits. Which of the following blood pressure targets would be ideal in the initial management of this patient?

A. 210/100
B. 160/100
C. 150/70
D. 140/80
E. 120/70

88. A 72-year-old male is currently in the ICU after receiving alteplase for treatment of an acute ischemic stroke 2 days ago. He has a past medical history of hypertension, diabetes mellitus and renal insufficiency. His laboratory values are as follows: sodium 142 mEq/L, potassium 3.4 mEq/L, carbon dioxide 18 mEq/L, blood urea nitrogen (BUN) 70 mg/dL, and serum creatinine of 2.5 mg/dL. He weighs 70 kg. His repeat head CT this morning is stable with no signs of hemorrhagic conversion. In addition to intermittent pneumatic compression devices, what is the most appropriate deep vein thrombosis (DVT) prophylaxis for the patient at this time?

A. No chemoprophylaxis is indicated
B. Enoxaparin 40 mg subcutaneously daily
C. Heparin 5000 IU subcutaneously twice a day
D. Rivaroxaban 2.5 mg daily
E. Apixaban 2.5 mg daily

89. A 58-year-old male with a history of lupus and end-stage renal disease is currently in the ICU following an allogeneic renal transplant, and is initiated on tacrolimus and prednisone therapy. On day 5 of his immunosuppressive treatment, the patient becomes increasingly confused and disoriented. He is also complaining of nausea, severe headache, and blurry vision. His current blood pressure is 158/90 mmHg. His latest tacrolimus level is 13 ng/mL. A non-contrast head CT is performed, demonstrating scattered area of vasogenic edema in the occipital and parietal lobes. Which of the following is correct about the most likely diagnosis?

A. Tacrolimus is not the culprit, since it is within therapeutic range
B. Tacrolimus should be discontinued, and the patient should be continued on prednisone monotherapy for the next 3–6 months
C. Tacrolimus should be discontinued, and sirolimus should be administered instead
D. Prednisone should be discontinued, and dexamethasone should be administered instead
E. This patient now has an absolute contraindication to the future use of all calcineurin inhibitors

90. A 65-year-old male with no known medical history undergoes transsphenoidal resection of a pituitary macroadenoma discovered on work-up for blurry vision. Pre-operatively, serum sodium and endocrine function were normal. Post-operatively, she develops polyuria, with urine output greater than 300 cc/h for

the first several hours. Specific gravity is <1.006, and the serum sodium rises to 155 mmol/L. He was treated with intravenous desmopressin and encouraged to drink water with resultant normonatremia. On post-operative day 7, he developed hyponatremia with serum sodium of 128 mmol/L, urine sodium 110 mmol/L and urine osmolality 800 mOsm/kg. He was then treated with 1 L free water restriction, and again, experienced normalization of his serum sodium. On post-operative day 10, he again developed polyuria. Regarding this patient's condition, all of the following are true except:

A. Permanent diabetes insipidus is uncommon after pituitary surgery
B. Permanent diabetes insipidus results from degeneration of supraoptic nuclei magnocellular neurons
C. A triphasic water balance disorder is common after pituitary surgery
D. A triphasic water balance disorder can present as drastic shifts between hyponatremia and hypernatremia
E. All of the above are true

91. Which of the following is the final step in the clotting cascade that results in a stable, cross-linked clot?

A. Conversion of prothrombin to thrombin
B. Conversion of fibrinogen to fibrin
C. Conversion of factor VII to factor VIIa
D. Conversion of factor XII to factor XIIa
E. Conversion of factor XIII to factor XIIIa

92. While performing a bedside echocardiogram on a patient in the ICU, you observe the following (see Image 4). To what does the large white arrow refer?

A. Inferior vena cava (long axis)
B. Pleural effusion
C. Pericardial effusion
D. Aorta (long axis)
E. Left ventricle

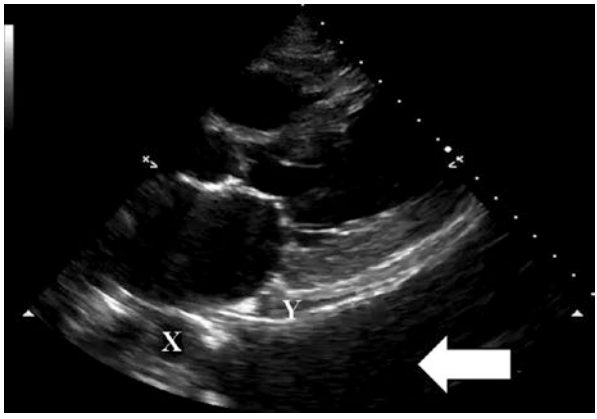

Image 4 Bedside echocardiogram

93. Which of the following PCO_2 targets is ideal for treatment of an intracranial pressure (ICP) crisis while preventing severe cerebral vasoconstriction and ischemia?

    A. 24–28 mmHg
    B. 28–32 mmHg
    C. 32–36 mmHg
    D. 34–38 mmHg
    E. 40–45 mmHg

94. Which of the following is the pathologic hallmark of acute respiratory distress syndrome (ARDS)?

    A. Usual interstitial pneumonia
    B. Hemosiderin-laden macrophages
    C. Masson bodies
    D. Diffuse alveolar damage
    E. Foamy alveolar macrophages

95. Which of the following adverse reactions should be expected from a continuous Phenobarbital infusion?

    A. Pneumonia and prolonged ventilator-dependence
    B. Gut ischemia and severe metabolic acidosis
    C. Pulmonary edema, anasarca and intra-abdominal compartment syndrome
    D. Severe cognitive impairment and peripheral neuropathy
    E. All of the above

96. A 41-year-old female is currently in the ICU following a subarachnoid hemorrhage secondary to a ruptured middle cerebral artery (MCA) aneurysm. A non-contrast head CT was obtained on admission (see Image 5). Which of the following is present on the scan below?

    A. Spot sign
    B. Arrow sign
    C. Westermark sign
    D. Dural tail sign
    E. Hyperdense MCA sign

Image 5 Noncontrast CT of the head

97. All of the following are true regarding the initiation and dosing of renal replacement therapy except:

    A. Urea clearance by hemodialysis is expressed as Kt/V and may be modified by increasing the surface area of the dialyzer, blood flow rate, dialysate flow rate, treatment duration, or frequency
    B. Urea clearance by continuous renal replacement therapy (CRRT) is expressed as mL/kg/h of effluent
    C. Earlier initiation of renal replacement therapy (RRT) (i.e. oliguria <6 h with creatinine clearance <20 mL/min) compared with conventional criteria has been shown to improve mortality
    D. A less intensive dose of intermittent hemodialysis (IHD) (weekly Kt/V of 3.9, 3× per week) has been shown to be adequate compared to a more intensive dose (i.e. IHD 6× per week)
    E. A less intensive dose of CRRT (25 mL/kg/h) has not been shown to improve survival compared to a more intensive dose of CRRT (40 mL/kg/h)

98. Which of the following is the drug of choice for empiric treatment of viral encephalitis?

    A. Acyclovir
    B. Ganciclovir
    C. Valganciclovir
    D. Cidofovir
    E. Oseltamivir

99. A 47-year-old female with a history of hyperlipidemia and hypothyroidism has recently undergone endovascular pipeline stenting of a left ophthalmic artery aneurysm. She is currently on dual antiplatelet therapy with aspirin and clopidogrel, and a serum P2Y12 assay is pending. A value above which cutoff indicates sufficient platelet inhibition and a decrease risk of thrombotic and ischemic complications?

    A. >5% P2Y12 inhibition
    B. >10% P2Y12 inhibition
    C. >15% P2Y12 inhibition
    D. >30% P2Y12 inhibition
    E. >60% P2Y12 inhibition

100. Which of the following is appropriate coverage for the treatment of severe pneumonia in a patient with a history of COPD and multiple recent hospitalizations over the past 3 months who now requires ICU admission?

    A. Ceftriaxone and azithromycin
    B. Vancomycin, cefepime, and levofloxacin
    C. Levofloxacin only
    D. Vancomycin and piperacillin-tazobactam
    E. Amoxicillin-clavulanate and azithromycin

Exam 5 Answers

Truth in medicine in an unattainable goal, and the art as described in books is far beneath the knowledge of an experienced and thoughtful physician.

Muhammad ibn Zakariya al-Razi
(854–925)

1. **The correct answer is C.** Patients treated with a continuous magnesium infusion need to be monitored closely for magnesium toxicity. Signs of magnesium toxicity include absent deep tendon reflexes, decreased urine output, respiratory depression, and coma. Treatment involves discontinuing the infusion, and for more severe toxicity, administration of calcium gluconate. Furosemide may increase renal magnesium elimination, but will not be immediately beneficial in acute magnesium toxicity.
2. **The correct answer is B.** Supplementary motor area (SMA) syndrome (not to be confused with superior mesenteric artery syndrome) is characterized by contralateral hemiparesis and mutism, usually after resection or surgical manipulation of the SMA. Symptoms may persist for several weeks before gradually resolving. Aside from physical therapy and rehabilitation, there is no specific treatment. Answers A, C, D and E refer to normal pressure hydrocephalus, one-and-a-half syndrome, central cord syndrome, and Wernicke's encephalopathy, respectively [1].
3. **The correct answer is E.** Current guidelines from the American Academy of Neurology (AAN) recommend several prerequisites before performing a neurologic examination for the determination of brain death. The guidelines are as follows: establish a proximal and irreversible cause of coma, rule out the presence of neuromuscular blocking agents, rule out the presence of severe electrolyte, acid base or endocrine disturbances, achieve a core temperature >36.0 °C, and achieve a systolic blood pressure >100 mmHg. Once these criteria are met, the practitioner can proceed to the neurologic assessment [2].
4. **The correct answer is E.** This patient's 4T score places her in the low risk category (0–3), meaning her risk of having heparin induced thrombocytopenia (HIT) is sufficiently low that no further testing is required at this time. Sending the heparin PF4 immunoassay is more likely to result in a false-positive result in this setting, subjecting the patient to unnecessary further testing and necessitating the discontinuation of all heparin products while awaiting the results.
5. **The correct answer is A.** Acute chest syndrome is defined as a new infiltrate seen on chest x-ray plus any combination of the following: fever, cough, sputum production, hypoxia, or respiratory distress. Patients with significant respiratory or cardiovascular compromise should be considered for prompt exchange transfusion, which helps prevent sickle cell related end-organ dysfunction.

6. **The correct answer is E.** All of the above are true regarding MRI imaging of the pituitary. As it lacks a blood-brain barrier, it enhances rapidly and intensely after gadolinium administration.
7. **The correct answer is A.** Although the terms may be used somewhat interchangeably, vasospasm more accurately refers to a radiographic finding, rather than a clinical syndrome. DCI is the appropriate term to describe clinical deterioration which may be a result of cerebral vasospasm [3]. The onset of DCI is usually somewhere between post-bleed days 4 and 10, and the resulting deficits may be quite significant.
8. **The correct answer is E.** The SEDCOM trial was a randomized, double-blind trial of continuous infusion dexmedetomidine versus midazolam for sedation in the intensive care unit. There was an increased incidence of bradycardia in the dexmedetomidine group, a decreased incidence of delirium, and no difference in episodes of hypotension. Mean time to extubation was also shorter in the dexmedetomidine group, though there was no significant difference in ICU length of stay [4].
9. **The correct answer is B.** This patient is suffering an acute ischemic infarct, likely secondary to atrial fibrillation in the absence of systemic anticoagulation. The CT scan shows a classic hyperdense right middle cerebral artery (MCA) sign; therefore, you would most likely expect this patient to have left sided weakness and dysarthria on exam. The other answer choices refer to pathology of the anterior cerebral artery (ACA), pons, cerebellum, and spinal cord, respectively.
10. **The correct answer is B.** In patients with hypoxemia caused by venous admixture and intrapulmonary shunt, application of external PEEP may allow recruitment of previously non-aerated lung units for ventilation. This in turn leads to an increase in functional residual capacity by opening of closed alveolar units, which shifts the tidal volume to more compliant portion of the pressure-volume curve for the lung and reduces the work of breathing. In patients with obstructive pulmonary disease who are developing intrinsic PEEP on the ventilator, addition of extrinsic PEEP decreases the pressure that must be generated by inspiratory muscles to offset intrinsic PEEP (necessary to initiate inspiratory flow or trigger the ventilator). The effect of PEEP on $PaCO_2$ is variable. On one hand, addition of PEEP may increase the end-expiratory lung volume and alveolar recruitment, thereby improving alveolar ventilation and reducing $PaCO_2$. On the other hand, PEEP may cause overdistension of nondependent lung regions, an increase in dead space ventilation, and a higher V/Q ratio leading, to rise in PaCO2. Addition of PEEP increases end-expiratory intrathoracic pressures, and hence reduces venous return.
11. **The correct answer is D.** In the setting of atrial fibrillation and hemodynamic instability, digoxin and amiodarone are probably least likely of all the antiarryhthmic agents to cause significant hypotension. Amiodarone is usually administered as a 150 mg bolus, following by a 24 h continuous infusion.
12. **The correct answer is A.** The anterior choroidal artery usually branches off from the C7 segment of the internal carotid artery; the superior hypophyseal

artery and ophthalmic arteries, from C6; the meningohypophyseal artery, from C4; and the Vidian artery, from C2.

13. **The correct answer is B.** All these patients have pituitary adenomas. Surgical resection is the recommended initial treatment for symptomatic corticotrophic and somatotrophic adenomas. Medical management with dopamine agonists are the preferred initial treatment for lactotrophic macroadenomas, even in the presence of visual disturbances. Patients with lactotrophic macroadenomas that fail medical therapy or wish to avoid dopamine agonist treatment during pregnancy should be referred for surgery.
14. **The correct answer is A.** Unlike artificial heart valves, IVC filters are not prone to developing vegetations and septic emboli All of the other answer choices are known long-term complications of IVC filter placement, including filter migration, filter fracture, IVC perforation, and (ironically) an increased risk of lower extremity DVT.
15. **The correct answer is A.** Complete spinal cord injury results in loss of sympathetic tone, also known as sympathetic decentralization, which leads to altered regulation of the autonomic function. With acute, severe, complete spinal cord injury at the cervical or high-thoracic levels, the clinical scenario of pronounced hypotension and persistent bradycardia (i.e. profound neurogenic shock) is often observed [5].
16. **The correct answer is E.** Surgical management of refractory status epilepticus in the absence of a definable brain lesion is a last-ditch effort, and usually with more of a palliative purpose. In this case, there are numerous other medical therapies that can be attempted before resorting to surgical options, including midazolam, pentobarbital, ketamine, and therapeutic hypothermia.
17. **The correct answer is C.** Although this patient's overall prognosis is poor, the presence of the IDH1 mutation actually confers a slightly better outcome as compared to the wild-type IDH gene [6]. The remainder of the answer choices are correct.
18. **The correct answer is A.** Left-sided catheter placement may be a risk factor for superior vena cava perforation. This is due largely to the acute angle that is necessary for left-sided catheters to make once crossing the mediastinum. A key finding is the acute onset of a pleural effusion or mediastinal widening as seen on a plain radiograph of the chest. One can confirm the diagnosis by injecting radiocontrast dye through the central line and observing dye in the mediastinum or pleural effusion.
19. **The correct answer is B.** The West Haven criteria are used to grade the severity of hepatic encephalopathy. Grade 1 hepatic encephalopathy is mild, and may be difficult to detect clinically. It is characterized by day/night reversal, mild inattention, euphoria, and anxiety. Grade 2 is characterized by lethargy and mild disorientation. Grade 3 involves somnolence, confusion and severe disorientation. The final stage of hepatic encephalopathy, Grade 4, is marked by coma.
20. **The correct answer is A.** Fludrocortisone is a synthetic mineralocorticoid that is sometimes used in cerebral salt wasting and orthostatic hypotension.

Use of fludrocortisones results in sodium retention, at the expense of increased potassium excretion. Therefore, patients on fludrocortisone must be monitored for the development of significant hypokalemia.

21. **The correct answer is A.** The injury above is consistent with a Brown-Sequard lesion (cord hemisection). Specifically, the lesion refers to an injury of the left half of the spinal cord, with impaired ipsilateral motor function and contralateral nociception.
22. **The correct answer is B.** Elevated levels of neuron-specific enolase (NSE) on day 1 in hypothermic patients does not necessarily indicate a poor prognosis. On the other hand, elevated levels of NSE in *normothermic* patients on day 1 does indicate a poor prognosis, as does myoclonic status epilepticus on day 1 (or 3).
23. **The correct answer is E.** This patient has experienced a post-tPA intracranial hemorrhage, which carries a significantly increased risk of in-hospital mortality. While there are a number of theoretical treatment options, there are no evidence-based guidelines demonstrating the superiority of one approach over another. Hospital protocols may dictate care in this case, and may include aminocaproic acid, cryoprecipitate, fresh frozen plasma, prothrombin complex concentrate, and recombinant factor VII. Immediate surgical clot retrieval is usually not an option, due to concerns over ongoing coagulopathy [7].
24. **The correct answer is A.** Clinically significant antibiotic-associated QTc prolongation (or exacerbation of concurrent QTc prolongation) is rare overall, but is associated with several common agents. The risk appears to be greatest among macrolides and flouroquinolones (most notably, erythromycin, clarithromycin, levofloxacin, and moxifloxacin), though this risk may still be minimal unless these agents are paired with other medications associated with QTc prolongation [8]. Azithromycin and ciprofloxacin appear to be safe options within their respective classes [9].
25. **The correct answer is A.** The finding of gram positive cocci in clusters strongly suggests the possibility of *Staphylococcus aureus*. This patient should be covered empirically for MRSA until culture results are available with either vancomycin or linezolid. Neither nafcillin nor cefazolin cover MRSA. Daptomycin is inactivated by surfactant, and is therefore not used for treatment of pneumonia. Significantly lower clinical cure rates and increased mortality have been seen among patients with VAP randomized to tigecycline [10].
26. **The correct answer is A.** A substance with a reflection coefficient of 1 is completely excluded by the blood-brain barrier, while a substance with a reflection coefficient of 0 is completely penetrant. The basis for hypertonic saline's osmotic effect is the reflection coefficient of sodium chloride, which is 1. The coefficients of the other substances in descending order are: mannitol (0.9), glycerol (0.59), and urea (0.48) [11].
27. **The correct answer is A.** Although all of the answer choices listed may be risk factors for the development of abdominal aortic aneurysms, tobacco use

appears to be the greatest risk factor, and consequently, smoking cessation may help to significantly reduce this risk [12].

28. **The correct answer is B.** Approximately half of myasthenic patients present with ocular symptoms only; 15% will remain limited to ocular involvement, while the rest will generalize. The two demographics most likely to develop myasthenia are women in their second and third decade of life, and men in their 50s to 70s. This patient is not at high risk of decompensation given her otherwise normal exam and lack of evidence of an infectious exacerbation, so she is stable for discharge home. The first-line management for myasthenia is usually pyridostigmine for symptom relief, not glucocorticoid administration [13].
29. **The correct answer is E.** All of the answer choices correctly describe the spinal cord ligaments with the bony portions of the spinal column to which they connects, except for the alar ligament. The alar ligament connects the lateral margins of the upper margin of the dens of C2 to the lateral margins of the foramen magnum. The ligamentum flava are what run between the laminae of adjacent vertebrae.
30. **The correct answer is C.** The characterization of hemorrhagic infarcts is as follows: H1, small hyperdense petechiae; H2, larger confluent hyperdensities without mass effect; PH1, hyperdensity <30% of the infarct zone with mass effect; and PH2, >30% of the infarct zone with mass effect (or any hemorrhage that extends beyond the infarct zone) [14].
31. **The correct answer is C.** This patient is newly diagnosed with HIV. The decision to initiate antiretroviral (ARV) treatment includes reviewing resistance patterns, as well as determining the patient's ability to adhere to ARV regimen, as initiating ARV regimen in a non-compliant patient may lead to the emergence of resistant strains. ARV treatment is not emergent, and should be initiated in stable patients; therefore, treatment can be deferred to the outpatient setting post-discharge. Viral load is used to determine treatment success while on ARV therapy, and so is not needed during this hospitalization. ARV treatment can be initiated for patients with $CD4^+$ <500 cells/mm^3 [15].
32. **The correct answer is C.** The patient's clinical presentation suggests colonic perforation after colonoscopy with signs of peritonitis. An upright chest x-ray can quickly establish the diagnosis by demonstrating free air under the diaphragm.
33. **The correct answer is A.** Guillain-Barre often follows an antecedent respiratory or gastrointestinal illness by several days to weeks. Distal muscle groups are primarily affected, with gradual progression to more proximal groups. As it is a peripheral nerve disorder, areflexia or at least hyporeflexia are common. Approximately 50% of patients develop weakness of the facial or oropharyngeal muscles.
34. **The correct answer is C.** Current guidelines classify status epilepticus as one seizure lasting longer than 5 min, or multiple seizures over 5 min without returning to baseline in between episodes. This is different from the previous definition using a 30-min cutoff, based on the observation that both

pharmacoresistance and neuronal excitotoxicity may develop before the 30 min threshold is reached. Epilepsia partialis continua is the focal motor equivalent of status epilepticus, with a threshold of at least 1 h (but may persist for several weeks) [16].

35. **The correct answer is E.** In general, mannitol may be administered if the serum osmolarity is 320 mOsm/kg or less. For levels greater than 320, the osmolar gap should be calculated. This is measured as follows: serum osmolarity − [(Na × 2) + (BUN/3) + (Glucose/18)]. A gap >20 indicates the presence of circulating mannitol, and a new dose should be held until the circulating mannitol is cleared. In this case, the gap is 338 − (318 + 7 + 10), or 3; the next dose of mannitol may be administered [17].
36. **The correct answer is D.** In healthcare, the determination of whether something is value-added is always from the viewpoint of the patient. Value-added are essential to delivering a particular service, are done correctly the first time, and are desired and paid for by the patient.
37. **The correct answer is D.** The x-ray shows what appears to be a large left pleural effusion; in the setting of penetrating thoracic trauma, this is assumed to be hemothorax. This should be drained with a large-bore (≥36 French) chest tube. Smaller tubes or drainage catheters would be prone to occlusion by clot.
38. **The correct answer is A.** Although structurally similar to GABA, gabapentin does not act on GABA A or GABA B receptors. It does modulate GABA synthesis and bind to voltage-gated calcium channels, and this is one of the mechanisms through which it modulates pain signaling [18].
39. **The correct answer is C.** The therapeutic reference range for phenytoin is 10–20 mg/L. This patient's level is 7 mg/L, but must be corrected for her hypoalbuminemia. For patients with normal kidney function, the correction formula is: measured level/(0.2 × serum albumin) + 0.1. In this case, 7/(0.2 × 2) + 0.1 = 14, which is in the therapeutic range. Therefore, this patient had a second seizure despite adequate phenytoin therapy. Of the choices listed, the most appropriate next step is to begin a second agent.
40. **The correct answer is B.** Of the answer choices, contracting hepatitis B is by far the most likely possibility. Hepatitis B incidence in blood donors is approximately 1:300,000 transfused blood components, compared to 1:1,490,000 for Hepatitic C and 1:1,467,000 for HIV. The risk of fatal hemolytic reactions is approximately 1:1,250,000 [19].
41. **The correct answer is E.** Neurologic deterioration following tumor resection may be due to a number of causes, including postoperative hemorrhage, cerebral edema, and seizures (both convulsive and nonconvulsive). Although cerebral vasospasm is more traditionally thought of as a complication following subarachnoid hemorrhage, it may also complicate the postoperative period following tumor resection, particularly skull base lesions [20].
42. **The correct answer is B.** In this patient with recent cardiac arrest, known renal insufficiency, and an EKG with sine wave morphology suggesting hyperkalemia, administration of calcium gluconate in order to promote

cardiac stabilization is the next most important step. The role of sodium bicarbonate in severe hyperkalemia is controversial, and although it is not unreasonable to administer it in this setting, it is certainly not as crucial as giving this patient calcium [21]. Initiation of therapeutic hypothermia, non-contrast head CT, and cardiology consultation are reasonable considerations, but not before addressing the patient's underlying hemodynamic instability.

43. **The correct answer is E.** Patients with chronic indwelling foley catheters may be prone to recurrent urinary tract infections. Although these patients may suffer from infections caused by unusual pathogens, the most common in this setting is still *E. coli*.
44. **The correct answer is A.** This patient presents as a Hunt-Hess 2, modified Fisher 4 subarachnoid hemorrhage, with an aneurysmal source being high on the differential diagnosis; she will almost certainly require conventional angiography to look for a culprit vessel. She is also at high risk for vasospasm and delayed cerebral ischemia (DCI) based on the pattern of subarachnoid blood. There are several imaging studies used to predict the onset of vasospasm and to evaluate severity. These include transcranial doppler, CT perfusion imaging, and continuous EEG. Diffusion tensor imaging (DTI) is an MRI technique that uses the restricted diffusion of water to map out neural tracts. DTI has several uses, including prognostication in traumatic brain injury and operative planning for cerebral neoplasms, but it is not currently utilized in the management of acute subarachnoid hemorrhage.
45. **The correct answer is A.** Patients with ALS usually present with limb weakness initially, which then progresses to involve the trunk and bulbar weakness [22]. Bladder and diaphragmatic dysfunction are late manifestations of the disease.
46. **The correct answer is B.** Leukoaraiosis refers to ischemic damage to the subcortical white matter, usually as a result of chronic hypertension, and is most evident on MRI T2/FLAIR sequences. The presence of leukoaraiosis has been shown to be a risk factor for the development of intracranial hemorrhage following tPA administration [23].
47. **The correct answer is E.** Normal pressure hydrocephalus is a clinical syndrome of gait abnormalities, cognitive dysfunction, and urinary incontinence. It may be idiopathic, or the result of prior CNS insult. There are numerous clinical entities which may result in secondary hydrocephalus. These include trauma, hemorrhage, neoplasm, and CNS infection.
48. **The correct answer is A.** Multiple system atrophy, previously known as Shy-Drager syndrome or olivopontocerebellar atrophy, is a disease categorized by neuronal degeneration of the cerebellum, striatum, and autonomic nervous system. It classically presents as a variable combination of parkinsonism, ataxia, and dysautonomia. It is due, at least in part, to the accumulation of insoluble fibrils of alpha-synuclein proteins [24].
49. **The correct answer is C.** Acetaminophen toxicity accounts for nearly 50% of cases of acute liver failure in the United States. While some cases may be

intentional, many are unintentional, as many over-the-counter and prescription pain medications contain acetaminophen. Chronic alcohol use may be a contributing factor.

50. **The correct answer is D.** Neuroleptic malignant syndrome and serotonin syndrome both present with fever, diaphoresis, confusion, and tachypnea. Rigidity and elevation in serum creatine phosphokinase easily sway towards the former, while diarrhea, shivering, hyperreflexia, and myoclonus are suggestive of the latter.
51. **The correct answer is B.** Chlorpropamide is a sulfonylurea that may also be used in cases of central diabetes insipidus. However, it results in predictable and often severe hypoglycemia that has caused it to fall out of favor in the treatment of central DI, particularly compared to desmopressin.
52. **The correct answer is E.** Rhabdomyolysis is a condition in which large amounts of muscle breakdown products are in circulation. There are numerous causes, include physical injury and exercise, seizure activity, inflammatory myopathies, viral infections, reperfusion injuries, arterial thrombosis, and the use of certain medications.
53. **The correct answer is C.** The patient in the vignette has hypoxic respiratory failure from pneumonia, and has moderate ARDS (the PaO_2/FiO_2 ratio is 116) as per the Berlin definition. Lung protective strategies during mechanical ventilation are calculated from ideal body weight (IBW) that is derived from patient's height and gender as per the following: 50.0 + 2.3 cc per inch over 5 ft for males, 45.5 + 2.3 cc per inch over 5 ft for females. The IBW for this patient is 61 kg; hence, decreasing the tidal volume is the appropriate initial step in this case. Increasing PEEP may improve oxygenation, and help in lung recruitment; however, tidal volume should be lowered first before increasing PEEP.
54. **The correct answer is E.** A lower GI bleed, by definition is any bleeding that originates distal to the ligament of Treitz. This ligament suspends the distal duodenum, and marks the small bowel transition from the duodenum to the jejunum.
55. **The correct answer is A.** Upwards hernation may result from a space occupying lesion in the posterior fossa which displaces a portion of the cerebellum through the tentorial notch. Uncal herniation is also a form of transtentorial herniation, except in the opposite direction (downwards).
56. **The correct answer is E.** The tip of a pulmonary artery (PA) catheter, or Swan Ganz catheter, should rest in West zone 3. The balloon holds approximately 1.5 cc of air; overinflation may cause pulmonary artery rupture, one of the most feared complications of PA catheter placement. A normal wedge pressure is between 2 and 10 mmHg. Finally, thermodilution operates according to the Stewart-Hamilton equation, i.e. the rate of blood flow is inversely proportional to the change in temperature over time. The Hering-Breuer reflex describes the inhibition of respiration as a result of over distention of the lung.
57. **The correct answer is C.** CIP is a potential complication of various conditions requiring prolonged ICU care, and often initially manifests as difficulty

weaning from mechanical ventilation. The development of CIP has been linked to multiple factors, including the simultaneous use of neuromuscular blocking agents and corticosteroids, as well as uncontrolled hyperglycemia. It usually presents as symmetric muscle weakness with diaphragmatic involvement and cranial nerve sparing [25].

58. **The correct answer is C.** This patient is in diabetic ketoacidosis (DKA). Although she has no established history of diabetes, her A1c indicates probable longstanding untreated hyperglycemia. Per recommendations from the American Diabetes Association, the use of insulin to treat DKA can involve either a bolus of 0.1 units/kg followed by continuous infusion of 0.1 units/kg/h, or no bolus followed by a continuous infusion of 0.14 units/kg/h. There is no evidence that one approach is superior to the other. Routine sliding scale insulin would not be appropriate at this time [26].
59. **The correct answer is C.** In the Spetzler-Martin grading system for arteriovenous malformations, the following are considered eloquent areas: the sensorimotor, language, and visual cortices; hypothalamus and thalamus; internal capsule; brain stem; cerebellar peduncles; and deep cerebellar nuclei. Surgical resection of AVM's adjacent to these areas carries a greater risk of disabling neurological deficits than excision of AVM's in less critical regions. Areas such as the anterior frontal or temporal lobes or the cerebellar cortex are considered non-eloquent. For the purpose of grading, Wada testing or mapping techniques to localize eloquent cortex precisely are not required [27].
60. **The correct answer is D.** Nearly two thirds of the cases of volvulus and subsequent large bowel obstruction occur at the sigmoid colon, with the cecum being the second most common location. Volvulus of the descending colon, transverse colon, or splenic flexure have been documented, but are rare [28].
61. **The correct answer is C.** A class I view is defined by visualization of the uvula and tonsillar pillars, while a class II view is defined by partial visualization of the uvula and pillars. A class III view is defined by visualization of the hard and soft palate only, and a class IV view is defined by visualization of the hard palate only. There is no Mallampati class V.
62. **The correct answer is E.** Acute respiratory failure can affect up to 30% of patients following upper abdominal surgery. Noninvasive positive pressure ventilation has been shown to reduce rates of tracheal intubation in this patient population, thus avoiding the potential complications and mortality associated with intubation and mechanical ventilation. There is no conclusive evidence that noninvasive ventilation causes a potentially problematic amount of gastric insufflation or leads to anastomatic breakdown. Therefore, given its proven benefits and lack of evidence to show complications following upper abdominal surgery, noninvasive positive pressure ventilation is the best first modality to try on this patient [29].
63. **The correct answer is A.** Inhalational injury is the most common cause of death in burn patients. The combination of facial burns and being found in an enclosed space denotes a significant probability of inhalational burns. Further, being found unconscious in a closed space also increases the likelihood of

lower respiratory tract injury. Respiratory tract edema, secretions, and debris formation are important consequences of inhalational injury, and airway obstruction from these factors are a cause of significant morbidity and mortality. As such maintaining respiratory tract patency and bronchial clearance are key priorities in the management of these patients. While therapeutic bronchoscopy is an effective technique in aiding in secretion and debris clearance, it should be employed when chest physiotherapy, positioning and tracheal suctioning fail [30].

64. **The correct answer is E.** The most likely diagnosis in this case is acute disseminated encephalomyelitis (ADEM), a monophasic autoimmune demyelinating process that typically occurs 1–3 weeks after a viral illness, followed by complete recovery in a majority of cases. Acute fulminant multiple sclerosis, or Marburg variant multiple sclerosis (MS), is a severe, aggressive form of MS that often results in death within 1 year of diagnosis. Tumefactive MS presents with large, atypical lesions which may demonstrate edema and mass effect, and may be indistinguishable from neoplastic lesions. Progressive multifocal leukoencephalopathy is also a severe demyelinating disease, but is almost always seen in patients with some degree of immunosuppression. Multiphasic disseminated encephalomyelitis is closely related to ADEM, but as the name suggests, MDEM is more episodic in nature (versus the monophasic ADEM).
65. **The correct answer is C.** Fluid in Morrison's pouch in a hypotensive trauma patient is hemoperitoneum until proven otherwise. Therefore, the patient should be taken urgently for laparotomy and surgical stabilization.
66. **The correct answer is E.** The only absolute contraindications to prone positioning during mechanical ventilation are spinal instability and unmonitored increased intracranial pressure. Relative contraindications include the presence of an anterior chest tube, pregnancy, and recent pacemaker placement [31].
67. **The correct answer is A.** Management of isolated brain stem hemorrhages is somewhat controversial, with surgical options often impractical due to the relative inaccessibility of the clot and limited effectiveness of decompression without clot evacuation. Expectant medical management is often the only viable treatment option.
68. **The correct answer is A.** According to the widely accepted Mayo Clinic guidelines, patients with neuromyelitis optica must meet two absolute criteria and at least two of three possible supportive criteria. Absolute criteria include episodes of both optic neuritis and transverse myelitis. Supportive criteria include the presence of serum anti-aquaporin IgG, an abnormal T2-weighted spinal MRI, and a brain MRI not consistent with multiple sclerosis [32].
69. **The correct answer is B.** Though SIADH and cerebral salt wasting may be seen in brain injury, the most likely cause of polyuria in this patient is diabetes insipidus. Ischemia of the supraoptic nuclei and posterior pituitary lead to loss of intrinsic vasopressin, and results in central diabetes insipidus.
70. **The correct answer is C.** Although not a direct measurement of intracranial pressure, increased optic nerve sheath diameter is a strong indicator of

intracranial hypertension. Carotid duplex, transcranial Doppler, and transesophageal echocardiography cannot reliably detect secondary signs of elevated ICP [33].

71. **The correct answer is C.** Passive oxygenation is, as the name implies, the provision of oxygen to a patient during the endotracheal intubation attempt itself. This is obviously not possible if the patient is on BiPAP or a nonrebreather, and is accomplished via nasal cannula. While 15 L/min is too uncomfortable for awake patients to tolerate, it is quite effective at preventing deoxygenation during intubation attempts on sedated and/or paralyzed patients. The cannula can easily be applied and removed, and it is even possible to maintain an adequate seal with a bag-valve mask with the cannula still in place.
72. **The correct answer is E.** The RASS score is used as an objective measure of a patient's level of either agitation or sedation, and ranges from +4 to −5. The scores are as follows: +4, combative and frankly violent; +3, aggressive behavior and pulling on tubes/lines; +2, agitated with frequent nonpurposeful movements; +1, restless and anxious; 0, alert and calm; −1, drowsy, but with sustained (>10 s) eye contact to voice; −2, drowsy, with only brief (<10 s) eye contact to voice; −3, drowsy, with no eye contact to voice; −4, no response at all to voice, but moves with physical stimulation; −5, unarousable.
73. **The correct answer is B.** Breast, lung, and prostate cancer make up 15–20% of all metastatic epidural spinal cord compression cases. Non-Hodgkins lymphoma, renal cell cancer, and multiple myeloma account for another 5–10%. The remainder of cases are attributable to colorectal cancers, sarcomas, and unknown primary tumors [34].
74. **The correct answer is B.** Antiepileptic medications that are hydrosoluble, of low molecular weight, low volume of distribution, and low protein-binding are extensively eliminated by the kidneys. They are easily removed by hemodialysis and require post-hemodialysis supplementation, and include gabapentin, topiramate, ethosuximide, vigabatrin and levetiracetam. Lipophilic and highly-protein-bound antiepileptic medications such as phenytoin, carbamazepine, and valproate are less affected by renal disease and hemodialysis.
75. **The correct answer is A.** Carotid-cavernous fistulae may present with pulsatile proptosis, an orbital bruit, visual loss, and eye pain. Corneal dendrites, on the other hand, are seen in the setting of herpes simplex epithelial keratitis.
76. **The correct answer is B.** Muscle weakness, Gottron's papules, and a heliotrope rash are pathognomonic for dermatomyositis, an immune-mediated inflammatory condition of the skin and musculature. In the setting of an active malignancy, dermatomyositis is a type of paraneoplastic syndrome, although it may also manifest as a postinfectious autoimmune phenomenon. Treatment may include steroids, intravenous immunoglobulin, plasmapharesis, and other immunosuppressive medications.
77. **The correct answer is D.** Carcinomatous meningitis involves widespread malignant seeding of the leptomeninges, and evidence of leptomeningeal

enhancement may be present on brain MRI. CSF findings may include an elevated opening pressure, increased leukocyte count, increased protein, and decreased glucose. The presence of malignant cells is diagnostic, but the yield is relatively low in a single sample, and repeat sampling may be required to confirm the diagnosis.

78. **The correct answer is C.** Giant cell arteritis is more commonly seen in females of Scandinavian descent, and is uncommon in African Americans. 40–50% of patients with giant cell arteritis have polymyalgia rheumatica, and about 15% of patients with polymyalgia rheumatic have giant cell arteritis. Amaurosis fugax is a classic presentation of giant cell arteritis, but is associated with painless vision loss [35].
79. **The correct answer is A.** Known risk factors for significant cerebral cytotoxic edema following an acute ischemic infarct include young age, significant infarct seen on initial imaging, absence of collateral flow, and proximal MCA occlusions. Male gender by itself is not a known risk factor.
80. **The correct answer is D.** In studies of EMS evaluations of stroke symptoms, the most common mistakes were missing symptoms of dizziness or ataxia as stroke signs. Additionally, paramedics often mistake symptom onset as the time the patient awoke (rather than the time last seen normal) [36].
81. **The correct answer is B.** Cerebral venous thrombus (CVT) is an uncommon complication of pregnancy, particularly in the third trimester and peripartum period. Although non-contrast head CT may be unremarkable, indications of CVT may include hyperdensity of the cortical veins or the presence of a dense triangle in the posterior sagittal sinus ("dense delta sign"). Definitive treatment include anticoagulation with either unfractionated or low molecular weight heparin, although the latter is preferred in pregnancy due to concerns regarding teratogenicity and an increased risk of fetal bleeding with the former. Although anticonvulsant therapy may be reasonable in this case, it is not the definitive therapy. A magnesium infusion would be the definitive therapy for ecclampsia, which is less likely in this hypotensive patient with a clear hyperdensity on CT. There is no role for stereotactic radiosurgery in CVT [37].
82. **The correct answer is D.** Left ventricular ballooning with preserved basal function is the most common echocardiographic pattern of stress-induced left ventricular dysfunction from neurologic injury (also known as Takotsubo cardiomyopathy). Preserved right ventricular apical function with basal dilation is often referred to as McConnell's sign, and is a marker of acute right ventricular failure in the setting of an acute increase in right-sided afterload. The other choices represent valve-related pathology that would be less likely in a patient with no past medical history.
83. **The correct answer is A.** Mitochondrial encephalopathy, lactic acidosis, and stroke-like episodes (MELAS) is a mitochondrial cytopathy, a group of disorders that also includes Leber's hereditary optic neuropathy (LHON) and Leigh syndrome. Typical findings may include basal ganglia calcification on head CT, MRI with multifocal cortical infarcts, and elevated creatine kinase and lactate

(in both serum and CSF). Triphasic waves are a non-specific finding in a number of encephalopathies, but are not associated with MELAS syndrome.

84. **The correct answer is E.** Sengstaken-Blakemore tubes can be placed in an emergency to temporize a variceal bleed until definitive therapy can be performed. The tube is designed to be placed with a massive balloon inflated in the stomach with modest traction applied to wedge it against the esophagogastric junction. If bleeding is still not controlled, the esophageal balloon can be inflated. The tube can be placed both orally and nasally; however, given the onerous size of the balloons that are inflated, intubation and sedation for airway protection and comfort is generally required. Additionally, far less air is inflated into the esophageal balloon (versus the gastric balloon) because of a significant rate of esophageal necrosis and rupture that can occur. There are also case reports that demonstrate external cardiac compression causing poor ventricular filling and ST segment changes. Due to the traction applied to tubesthe tube, soft tissue pressure necrosis of the lips or nose is possible [38].
85. **The correct answer is E.** Central pontine myelinolysis (CPM) is a demyelinating disorder affecting the pyramidal (corticobulbar and corticospinal) tracts. It is often the result of a rapid correction of hyponatremia, generally faster than 0.5 mEq/L/h. Common symptoms including diplopia, dysphagia, and limb weakness. Locked-in syndrome is the most dramatic and severe presentation [39].
86. **The correct answer is C.** This patient manifests signs and symptoms consistent with compartment syndrome of the right lower extremity. Timely diagnosis requires a high degree of clinical suspicion based on the injury and clinical presentation. Management is urgent fasciotomy in order to relieve pressure and restore adequate limb perfusion and venous return. Delays in performing fasciotomy can result in muscle necrosis, infection, and limb loss.
87. **The correct answer is B.** Initial blood pressure management in hypertensive emergency involves lowering the mean arterial pressure (MAP) by about 25%. A simple way to calculate the MAP is ([diastolic × 2] + systolic)/3; therefore, this patient's initial MAP is (220 + 260)/3, or 160, and the target MAP should be about 120 [40].
88. **The correct answer is C.** The patient has a stable head CT without evidence of bleeding, therefore DVT chemoprophylaxis can be initiated. Unfractionated heparin is preferred for this patient over low molecular weight heparin given his renal impairment. The evidence for using new oral anticoagulants for DVT prophylaxis is limited to orthopedic surgery patients only.
89. **The correct answer is C.** Evidence suggests that following the development of posterior reversible encephalopathy syndrome (PRES), different calcineurin inhibitors can be used in this setting without recurrent symptoms. Sirolimus is an m-TOR inhibitor, and is a safe alternative to tacrolimus. Steroids are not the causative agent in this case, nor are they sufficient monotherapy [41].
90. **The correct answer is C.** At least 90% of the supraoptic and paraventricular nuclei magnocellular neurons must bilaterally degenerate to lead to permanent

DI; thus, this complication is rare. The "classic" triphasic response is reported in ~1% of patients after transsphenoidal surgery [42].

91. **The correct answer is E.** The final step in the clotting cascade is the formation of a cross-linked fibrin clot. This is accomplished via the conversion of factor XIII to factor XIIIa. All of the other answers precede this final step in the clotting cascade.
92. **The correct answer is B.** In the parasternal long axis view, it is important to have the depth setting sufficient to show the short axis view of the descending aorta (labeled "X"), as it is used as a landmark to distinguish more superficial fluid as being pericardial and deeper fluid as pleural. "Y" is labeling the pericardium. Since the arrow is pointing to an anechoic finding below the descending aorta, it is pleural fluid.
93. **The correct answer is B.** In cases of ICP crisis, hyperventilation can be initiated to a target PCO_2 of 28–32 mmHg. Anything lower than 28 mmHg places the patient at undue risk of vasoconstriction-mediated ischemia, while levels above 32 mmHg may not produce an adequate ICP-lowering effect.
94. **The correct answer is D.** Pathologically, ARDS is characterized by diffuse alveolar damage, including the accumulation of extravascular lung water, protein, and inflammatory cells in interstitial and alveolar spaces which creates characteristic hyaline membranes. The other findings listed are seen in conditions that also present with diffuse alveolar infiltrates, and can mimic ARDS clinically. Usual interstitial pneumonia is characterized by areas of normal lung alternating with interstitial inflammation, fibroblastic foci, and honeycomb changes characteristic of idiopathic pulmonary fibrosis. Masson bodies are granulation tissue plugs within the lumen of small airways that extend into alveolar ducts and alveoli, and are typically found in cryptogenic organizing pneumonia. Hemosiderin laden macrophages are seen in alveolar hemorrhage. Foamy alveolar macrophages are seen in lavage specimens in *Pneumocystis* pneumonia.
95. **The correct answer is E.** Observed adverse effects from a continuous pentobarbital infusion for status epilepticus include peripheral neuropathy, cerebral atrophy, volume overload, metabolic acidosis, gastrointestinal ischemia, hemodynamic instability, respiratory depression, peripheral neuropathy, and an increased rate of infectious complications.
96. **The correct answer is B.** Image 5 demonstrates an MCA arrow sign, which is the result of blood pooling in ipsilateral Sylvian fissure of a ruptured MCA aneurysm. The spot sign refers to a focus of enhancement within an intracerebral hemorrhage indicating contrast extravasation and continued active bleeding. Westermark sign is a dilated pulmonary artery adjacent to a collapsed vessel in the setting of pulmonary embolism seen on plain x-rays of the chest. A dural tail sign represents thickening of the dura adjacent to a mass, most commonly a meningioma. A hyperdense MCA is seen in the setting of an acute infarct, and represents clot within the vessel [43].
97. **The correct answer is C.** Urea clearance is used to measure the intensity of RRT in AKI. Urea clearance by hemodialysis is expressed as Kt/V, and urea

clearance by CRRT is expressed as mL/kg/h of effluent. Two studies have provided guidance on the dose of renal replacement in AKI. The Veterans Affairs acute tubular necrosis study evaluated the intensity of RRT; in this trial, IHD was prescribed at a Kt/V of 1.4 and performed six times weekly in the intensive arm and three times weekly in the less intensive arm. CRRT was performed at an effluent flow rate of 35 mL/kg/h in the intensive arm and 20 mL/kg/h in the less intensive arm. Mortality and recovery of kidney function were similar in both groups [44]. Another study, the RENAL study, randomized patients with AKI treated with CRRT to doses of 40 versus 25 mL/kg/h, and this trial showed no difference in survival between the two groups [45].

98. **The correct answer is A.** Acyclovir is recommended for empiric treatment of viral encephalitis. Ganciclovir and Valganciclovir are treatment options for cytomegalovirus infections. Cidofovir has poor central nervous system penetration, and so would not be used for this purpose. Oseltamivir is used for the treatment influenza [46].
99. **The correct answer is D.** P2Y12 assays can be used to identify patients who are clopidogrel-resistant, and may require either dose modifications or switching to an alternative agent to prevent stent thrombosis and other ischemic complications. A cutoff of >30% has been used to define ideal P2Y12 inhibition and a decreased risk of thrombotic events for patients who have received endovascular stents [47].
100. **The correct answer is B.** Based on a history of COPD and multiple recent hospitalizations, coupled with severe pneumonia requiring ICU admission, coverage is needed for MRSA, *Legionella*, and *Pseudomonas*, among others. According to Infectious Disease Society of America guidelines, a ß-lactam and fluoroquinalone are required in this scenario, in addition to either vancomycin or linezolid [48].

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