

# 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

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 he is 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 =  $80 \times (\text{mean arterial pressure}/\text{cardiac output})$
  - D. Pulmonary vascular resistance =  $80 \times (\text{mean pulmonary artery pressure}/\text{cardiac output})$
  - 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<sub>2</sub> 60 mmHg, PaO<sub>2</sub> is 61 mmHg, HCO<sub>3</sub> 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<sub>2</sub>O, and FiO<sub>2</sub> of 50%. Peak airway pressure is 50 cm H<sub>2</sub>O and plateau pressure is 15 cm H<sub>2</sub>O. 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<sub>2</sub> 49 mmHg, PaO<sub>2</sub> 71 mmHg, HCO<sub>3</sub> 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 holo-hemispheric 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  $88 \times 10^3/\mu\text{L}$ ). 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  $\beta_2$  agonist use
  - B. Add a standing long-acting inhaled  $\beta_2$  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<sub>2</sub> is 55 mmHg. Labs are notable for the following: white blood cell count 14.4 × 10<sup>9</sup>/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<sub>2</sub>O and 50% FiO<sub>2</sub>, 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<sub>2</sub> 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 fluconazole
  - 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 presence 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<sub>2</sub>O.
  - 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<sub>2</sub> 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  $31.5 \times 10^9/L$  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  $31.5 \times 10^9/L$
  - 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/ $\mu L$  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 intrahepatic 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 delirium 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. Serotonin 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<sub>2</sub> 50%. The peak pressures are 45 cm H<sub>2</sub>O. Six hours later, the patient becomes agitated, and the airway pressures rise to 65 cm H<sub>2</sub>O. 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 bronchoscopy
  - 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?
- Grade 1: GCS 13–15, no motor deficit
  - Grade 2: GCS 12–13, no motor deficit
  - Grade 3: GCS 12–13, with motor deficit
  - Grade 4: GCS 7–12, with or without motor deficit
  - 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?
- 6 L
  - 9 L
  - 12 L
  - 15 L
  - 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 arms 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  $\text{FiO}_2$  of 0.4, pressure support of 5 cm  $\text{H}_2\text{O}$  and PEEP of 5 cm  $\text{H}_2\text{O}$ . 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,  $\text{pO}_2$  480 mmHg,  $\text{pCO}_2$  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 fomepizole, 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<sub>2</sub>O. 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 open his eyes, moans, and reaches for your hand with his right upper extremity. An 18-gauge 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 neuro-critical 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  $18.8 \times 10^9/L$  on admission to  $22.3 \times 10^9/L$  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/ $\mu L$
  - B. 100 cells/ $\mu L$
  - C. 200 cells/ $\mu L$
  - D. 500 cells/ $\mu L$
  - E. 1000 cells/ $\mu L$
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<sup>2</sup>, 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  $50 \times 10^3/\mu\text{L}$
  - 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  $(\text{serum A1c} \times 29) - 47$ , assuming the A1c is accurate (i.e. no condition that significantly increases or decreases red cell lifespan). In this case, the answer is  $(10 \times 29) - 47$ , 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 patients 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. *Neisseria 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 intramedullary 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 =  $80 \times (\text{mean arterial pressure} - \text{right atrial pressure}) / \text{cardiac output}$ . Pulmonary vascular resistance =  $80 \times (\text{mean arterial pressure} - \text{pulmonary artery occlusion pressure}) / \text{cardiac output}$ .
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 place 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 asthmaticus 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 upregulation 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  $\beta$ -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 osmolality. 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 *Propionibacterium 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  $\mu$ -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 eucapnic (35–45 mmHg) baseline blood gas should be obtained, although higher levels of PaCO<sub>2</sub> 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<sub>2</sub> ≥60 mmHg or ≥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 parasymphseal 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/ $\mu$ L. A CD4 count greater than 500 cells/ $\mu$ L 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<sup>2</sup> 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. Galactorrhea 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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