



Environmental Emergencies

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Question 1

Which of the following statements regarding pediatric drowning is TRUE?

- A. Sudden immersion of young children in cold water (<20 °C) leads to apnea, reflex tachycardia, and vasodilation.
- B. Clinically significant hyponatremia is caused by ingestion of large volumes of freshwater.
- C. Survivors of swimming pool drowning should receive prophylactic antibiotics because pneumonia is the most common sequelae of aspiration.
- D. Primary CNS injury is worse among children with hypothermia.
- E. Drowning occurs due to reflex laryngospasm when water contacts the lower respiratory tract.

Correct Answer: E. Drowning occurs due to reflex laryngospasm when water contacts the lower respiratory tract.

There is a predictable physiologic response in drowning. First, there is panic to stay afloat

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and alteration in breathing pattern with breath holding, subsequent reflex breathing and causes laryngospasm and/or aspiration. It was previously thought that significant electrolyte disturbances, such as hyponatremia, resulted from ingestion of large volumes of freshwater (rather than aspiration). However, more recent studies have shown this phenomenon to be untrue. Patients with submersion injury develop hypoxia and organ damage due to reduced lung compliance, ventilation–perfusion mismatch with intrapulmonary shunting. Sudden immersion of young children in cold water (<20 °C) leads to apnea, bradycardia (not tachycardia), and vasoconstriction of nonessential vascular beds with shunting of blood to the coronary and cerebral circulation. Chemical pneumonitis is a more common sequela than infectious pneumonia, especially if the submersion occurs in a chlorinated pool or in a bucket containing a cleaning product.

CNS injury remains the major determinant of survival and long-term morbidity in cases of drowning. Around 2 minutes after immersion, a child will lose consciousness. Irreversible brain damage usually occurs after 4–6 minutes. Most children who survive are discovered within 2 minutes of submersion. Most children who die are found 10 minutes or later after submersion.

Primary CNS injury is initially associated with tissue hypoxia and ischemia. If the period of

hypoxia and ischemia is brief or if the person rapidly develops core hypothermia, then primary injury may be limited, and the patient may recover with minimal neurologic sequelae, even after more prolonged submersion.

Take-Home Message

Patients with submersion injury develop hypoxia and organ damage due to reduced lung compliance and ventilation–perfusion mismatch with intrapulmonary shunting

ABP Content Specification

- Understand the pathophysiology of drowning/submersion injuries.

Question 2

Five children were brought to the Emergency Department with a history of having been struck by lightning while playing soccer during a rainy day. Which patient’s management is CORRECT?

- Patient A – fixed and dilated pupils: presume brain death and stop resuscitation attempts
- Patient B – cold and pulseless extremities: focus on treating hypothermia
- Patient C – new QT prolongation on ECG: immediate cardiology consultation and urgent transfer to cardiac catheterization laboratory for electrophysiological studies
- Patient D – fern-like skin marks: test for urine myoglobin and serum creatinine kinase
- Patient E – prolonged paresis on presentation: obtain MRI to evaluate for spinal cord injury

Correct Answer: E. Prolonged paresis on presentation: obtain MRI to evaluate for spinal cord

Paresis that persists should mandate further radiological assessment for spinal cord injury. Though paresis may be associated with high-voltage electrical injury without any CNS injury, this scenario is typically transient. If paresis persists, then spinal cord imaging is warranted.

Fixed and dilated pupils are more typically a result of transient autonomic disturbances, not

necessarily serious head injuries or death. Hence, in this setting, resuscitation should be continued regardless of the pupillary findings.

Cold and pulseless extremities may occur with vasomotor instability, common after lightning strike. Nonetheless, hypothermia should be checked for and managed accordingly.

QT prolongation is the most common electrocardiogram (ECG) abnormality, and it tends to resolve spontaneously over several months without treatment. Other ECG abnormalities should receive standard treatments.

The fernlike Lichtenberg/keraunographic marks are pathognomonic of lightning strike, probably related to the flashover phenomenon, from the transmission of electricity along the superficial vasculature. The erythema begins to fade in 4–6 hours with no residual skin changes, and the fernlike marks usually disappear after several days. Because the electrical current is presumed to have passed on the surface of the skin, assessing urine myoglobin and serum creatinine kinase is unnecessary.

Take-Home Message

A *lightning strike* is both a serious medical and *traumatic* event. Strongly consider spinal immobilization in the management of *lightning strike victims*.

ABP Content Specification

- Recognize the signs and symptoms of potentially life-threatening electrical injuries.

Question 3

A 15-year-old boy was brought to the Emergency Department after an episode of electrical shock. He was fixing his computer at home when he accidentally touched a live wire from the main supply. There was no loss of consciousness nor seizures observed, and his vital signs are heart rate 98 beats/minute, respiratory rate 12 breaths/minute, blood pressure 116/68 mmHg, and oxygen saturation 99%. Physical examination reveals no burn marks and no neurological deficit. The statement which BEST describes appropriate management is:

- A. If his ECG is normal, then he can be safely discharged home to his parents.
- B. Initiate IV fluids according to the Lund and Browder chart.
- C. If it had been a high-voltage exposure, then he is almost certain to develop rhabdomyolysis.
- D. Admit to the observation unit for regular hemodynamic monitoring overnight.
- E. Refer for out-patient neurological follow-up.

Correct Answer: A. If his ECG is normal, then he can be safely discharged home to his parents.

Admission for cardiac monitoring is not needed for asymptomatic patients with normal ECG on presentation after a low-voltage electrical injury; household electricity is in fact low voltage. Patients can be safely discharged, and admission for monitoring is unnecessary in this scenario.

The Lund and Browder chart is used for calculation of burns surface area, hence not applicable here. High-voltage exposures may result in rhabdomyolysis, but this case is not universal. Multivariate modeling revealed that high-voltage exposure, prehospital cardiac arrest, full-thickness burns, and compartment syndrome were associated with myoglobinuria. Defining “positive” as ≥ 2 of these findings has a sensitivity of 96% and negative predictive value of 99%.

There is no indication for referral to neurological follow-up.

Take-Home Message

Electrical injuries are typically divided into high-voltage and low-voltage injuries, using 500–1000 V as the cutoff. High morbidity and mortality have been described in 600 V direct current injury associated with railroad “third rail” contact.

Typical household electricity provides 110 V for general use and 240 V for high-powered appliances, while industrial electrical and high-tension power lines can have more than 100,000 V.

ABP Content Specification

- Plan the management of pediatric patients with electrical injuries.

Question 4

A 16-year-old schoolboy is brought to your Emergency Department during a summer football game. He was noted by the athletic staff to be shaking before he passed out on the field. He has moist skin and his vital signs are temperature 41.2 °C (106.1 °F), heart rate 135 beats/minute, respiratory rate 16 breaths/minute, blood pressure 108/62 mm Hg, and oxygen saturation 100%. His teachers and friends are not aware of any significant medical or medication history, and there are no obvious signs of trauma. His ECG reveals sinus tachycardia, but otherwise no abnormalities are detected. After placing the patient on a monitor and giving oxygen, the next immediate management is:

- A. IV loading dose of phenytoin
- B. Brain CT scan
- C. Cold IV fluids, external fans, and cover with cold water-soaked sheets
- D. Neurology consult
- E. Toxicology screen including amphetamines and cocaine

Correct Answer: C. Cold IV fluids, external fans, and cold sponging

Hyperthermia with CNS manifestations are the hallmarks of heatstroke, which must be immediately recognized and promptly treated. The exertional-type of heat stroke is characterized by hyperthermia, diaphoresis (or cessation of diaphoresis) and altered sensorium, which may manifest suddenly during extreme physical exertion in a hot environment.

Heat stroke is particularly problematic in high school athletes and is the third leading cause of death after traumatic and cardiac arrest. The American College of Sports Medicine recommends that cooling be initiated at the scene, before transporting the patient to an Emergency Department for further evaluation and treatment. Given the persistent hyperthermia, management should focus on cooling while resuscitation is

on-going. The other investigation and treatment measures do not take priority and can be considered at a later stage. If treatment is rapidly initiated and aggressive enough to rapidly reduce the core body temperature, complications (including multisystem organ failure) may be averted, and the patient may have a much better prognosis. The aim is to reduce the temperature by at least 0.2 °C/min to approximately 39 °C. Active external cooling generally is halted at 39 °C to prevent overshooting and after-drop to prevent iatrogenic hypothermia. Removal of restrictive clothing and spraying water on the body, covering the patient with cold water-soaked sheets and exposure to external fans can reduce the patient's temperature significantly.

There is no role for a loading dose of phenytoin at this point. If seizing, the medication of choice would be a benzodiazepine, but a loading or prophylactic dose is not indicated at this time. Because of the global nature of the CNS insult, phenytoin would not be the optimal medication

for these seizures. There is no need for neurology consult, and screening for stimulants will not alter the patient's management.

Take-Home Message

Hyperthermia is a medical emergency and rapid cooling result in improved prognosis.

ABP Content Specification

- Plan the management of severe hyperthermia.

Question 5

A teenage girl presents to your Emergency Department with painful toes. She had just returned from a college camping trip (month of January) where the temperature was 3 °C–5 °C and the ground was wet. She is otherwise fit and healthy, and her vital signs are within normal range. Foot examination reveals the finding below:



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The statement which BEST describes your management is:

- A. Rewarm with a dry bar heater.
- B. Local heat and lubricants to keep the skin supple.
- C. Nifedipine should be avoided.
- D. Gentle rewarming via air-drying, bed rest, extremity elevation, and early physical therapy.
- E. Reassurance, discharge on analgesics.

Correct Answer: B. Local heat and lubricants to keep skin supple.

Chilblains, or pernio, is characterized by a chronic, recurrent vasculitis. Physical examination manifestations include red-to-violaceous raised lesions in unprotected extremities (see picture above). It is caused by exposure to nonfreezing temperatures and damp conditions. Blisters, erosions, and ulcers may also develop. Treatment involves local heat, gentle massage, and lubricants to keep the skin supple. Lesions usually resolve in 1–3 weeks.

Calcium channel blockers, such as nifedipine, may be used to reduce pain and speed healing. This is most useful in young- to middle-aged women with Raynaud's phenomenon.

Response (D) is recommended therapy for immersion/trench foot, which is not for her condition. This condition is a disease of the sympathetic nerves and blood vessels in the feet. It occurs in individuals whose feet have been wet, but not freezing, for prolonged periods of time. Patients typically report numbness, tingling pain with itching, and cramps.

Response (E) would be appropriate treatment for cold panniculitis, which is an inflammation of the subcutaneous adipose tissue after exposure to cold temperatures, most commonly seen in children and obese women. It typically develops 48 hours after cold exposure to a poorly protected area.

Take-Home Message

Chilblain or pernio presents as red to violaceous lesions seen usually in extremities caused by exposure to cold temperatures and damp conditions and treated with local heat, gentle massage, and lubricants.

ABP Content Specification

- Plan the management of local and systemic injuries due to hypothermia.

Question 6

After a potential leakage at a local nuclear power station, a family presents to you with worries about the detrimental effects to them and their children. Which component of a complete blood count (CBC) initially becomes abnormal, indicating early damage from radiologic exposure?

- A. Platelets
- B. Hemoglobin
- C. Lymphocytes
- D. Neutrophils
- E. Eosinophils

Correct Answer: C. Lymphocytes

Acute radiation syndrome occurs when the body absorbs high radiation doses, injuring rapidly proliferating cells first (e.g., hematopoietic, reproductive, and gastrointestinal systems). The earliest adverse effects may be detected at 8 hours postexposure, when lymphocytes and the stem cells (lymphopenia) may have been destroyed. Hence, lymphocyte count (at 48 hours after an acute exposure) of $>1000/\text{mm}^3$ suggests an exposure of <2 Gy and carries a good prognosis.

Ultimately, pancytopenia may occur, but later. The importance of recognition of hematopoietic effects from radiation exposure is to permit vigilance for infection. These patients are similar to neutropenic patients undergoing chemotherapy and are susceptible to opportunistic infection.

Other radiation effects include mucositis, which results in toxicity to the GI tract, and in high-dose exposures, CNS toxicity, and rapid death.

Take-Home Message

Acute radiation syndrome initially presents with lymphopenia that progresses to pancytopenia. Additionally, it can cause mucositis and CNS toxicity.

ABP Content Specification

- Understand the pathophysiology and differentiate between stages of acute radiation sickness/syndrome.

Question 7

A group of school students aged 6 years and 7 years old present at your Emergency Department after an inhalational exposure to some white powder believed to be highly suspicious for anthrax. Guidelines for management include:

- A. Amoxicillin should be given as postexposure prophylaxis (PEP) for 60 days if used alone in unvaccinated victims.
- B. If asymptomatic, stable, and with normal baseline blood chemistry and hematology, then they can be treated as an outpatient with oral doxycycline.
- C. Raxibacumab should be used for cutaneous disease.
- D. Strict barrier nursing with negative pressure in a dedicated isolation room should be applied to victims confirmed to have inhalational anthrax.
- E. Assessment of chest imaging to detect apical infiltrates, consolidation, and occasionally cystic lesions.

Correct Answer: A. Amoxicillin should be given as PEP for 60 days if used alone in unvaccinated victims.

The Centers for Disease Control and Prevention (CDC) recommend postexposure

antimicrobial prophylaxis for 60 days if used alone for PEP of unvaccinated exposed persons. The suggested antimicrobials are ciprofloxacin, doxycycline, or amoxicillin for children and pregnant or breastfeeding women exposed to strains susceptible to penicillin.

Oral doxycycline is used for cutaneous exposure to anthrax. While the majority of anthrax is cutaneous (95%), the remaining cases are inhalational (5%) and gastrointestinal (<1%). Inhalational cases are usually fatal, with symptoms noted days after exposure. Hence, bioterrorism must be suspected in all cases of inhalational anthrax and the relevant authorities informed.

Raxibacumab is available from the CDC for treatment of inhalational anthrax or as prophylaxis when other therapies are not available or appropriate.

Patients can be admitted to a normal hospital room with barrier nursing procedures (i.e., gown, gloves, and mask) and secretion precautions (i.e., special handling of potentially infectious dressings, drainage, and excretions).

In inhalational anthrax, the chest X-ray (CXR) typically shows widening of the mediastinum and pleural effusions, whereas the parenchyma may appear normal. Chest CT may detect hemorrhagic mediastinal and hilar lymph nodes and edema, peribronchial thickening, and pleural effusions.

Take-Home Message

Amoxicillin for 60 days is the treatment of choice for children exposed to anthrax.

ABP Content Specification

- Plan the management of biologic exposures (i.e., chemoprophylaxis) and the treatment of acute illness due to biologic agents in children.

Question 8

Which of the following statements concerning botulism is CORRECT?

- A. Typical symptoms include ascending paralysis, paralytic ileus, and blurred vision.

- B. Stool samples for toxin analysis should not be refrigerated.
- C. A heptavalent antitoxin is available and can neutralize all seven known botulinum nerve toxin serotypes.
- D. Foodborne botulism should be treated with penicillin G.
- E. In severe constipation, administer magnesium to minimize absorption of gastrointestinal toxin.

Correct Answer: C. A heptavalent antitoxin is available and can neutralize all seven known botulinum nerve toxin serotypes.

On March 22, 2013, the FDA approved the first botulism antitoxin that can neutralize all seven known botulinum nerve toxin serotypes (types A, B, C, D, E, F, and G). The heptavalent antitoxin is derived from horse plasma and is the only drug available for treating botulism in patients over 1 year of age, including adults. It is also the only available drug for treating infant botulism that is not caused by nerve toxin type A or B. A different medication used for infants is available from the California Department of Health.

Botulism can manifest with various neurological signs and symptoms. For this reason, most cases of botulism in children are initially misdiagnosed. Early symptoms are often nonspecific and relate to feeding. These may include the mother's complaints that the child is feeding less, has a weaker suck, or even of mastalgia resulting from breasts not being relieved of their milk as usual. Other potential symptoms include cranial nerve paralysis, which may present with blurred vision, diplopia, ptosis, extraocular muscle weakness or paresis, fixed/dilated pupils, dysarthria, dysphagia, and/or suppressed gag reflex. Symmetrical descending paralysis or weakness and autonomic nerve dysfunction may occur. Respiratory muscle weakness may be subtle or progressive, advancing rapidly to respiratory failure. Deep tendon reflexes are also diminished. Autonomic nervous system dysfunction may include paralytic ileus, constipation, urinary retention, orthostatic hypotension, reduced salivation, and reduced lacrimation.

Clostridium botulinum may be grown on selective media from samples of stool or foods. Note that the specimens for toxin analysis should be refrigerated, but culture samples should not be refrigerated.

Antibiotic therapy is useful in wound botulism, but has no role in foodborne botulism. Magnesium salts, citrate, and sulfate should not be administered because magnesium can potentiate the toxin-induced neuromuscular blockade.

Take-Home Message

The heptavalent botulism antitoxin is the only drug available for treating all seven botulinum nerve toxin serotypes.

ABP Content Specification

- Plan the management of biologic agents in children.

Question 9

A 12-year-old girl is brought to the Emergency Department by her uncle, who works as a farmer. She had been playing around his barn the whole morning but returned to the house complaining of abdominal cramps, vomiting and diarrhea after she sipped liquid from a bottle of pesticide. Her vital signs are temperature 36.4°C heart rate 62/minute, respiratory rate 32/minute, blood pressure 108/64 mmHg, and oxygen saturation 92%. She is sweaty, has small pupils, and wheeziness on auscultation of her chest. The rest of her examination is unremarkable. After initiating 100% oxygen and IV access, your NEXT BEST action is:

- A. Send her to the decontamination room before proceeding with other measures.
- B. Prepare for endotracheal intubation.
- C. Use succinylcholine for paralysis of her vocal cords in RSI.
- D. Order oral activated charcoal.
- E. Administer atropine.

Correct Answer: E. Administer atropine

This patient has muscarinic symptoms of organophosphate toxicity, and treatment would be to administer atropine which antagonizes the central and muscarinic effects by blocking these receptors. It is recommended that the anticholinergic is repeated until atropinization occurs, which is clinically detected by pupillary dilation.

Muscarinic symptoms are “wet” symptoms such as salivation, lacrimation, urinary incontinence diarrhea, and emesis. The mnemonic DUMBELS not only covers the same symptoms as SLUDGE but also has miosis and most importantly bradycardia, bronchorrhea, and bronchospasm. These three symptoms beginning with the letter “b” are the only muscarinic symptoms that are truly life threatening; thus, DUMBBBELS is a better mnemonic. Nicotinic symptoms are primarily symptoms of muscular involvement or “weak” symptoms. They include weakness, fasciculation, and paralysis. Patients with nicotinic symptoms should be treated with pralidoxime. Atropine does not play a role in treatment of nicotinic toxicity.

This patient has probably been exposed to organophosphate insecticide at her uncle’s farm. Symptoms vary depending on age. Any patient may have the typical SLUDGE and DUMBELS signs and symptoms, though young children may present with isolated seizure and coma.

Decontamination is very important, but it is not clear that she has any external contamination, as the exposure is reported to be by ingestion. If a patient does have external contamination, they should not be brought into the clean or “green” zone of the ED until decontamination is completed.

The girl does not require urgent intubation, and even if she does, succinylcholine worsens the toxicity.

Take-Home Message

The specific antidote for organophosphate poisoning is pralidoxime, but atropine is essential to reverse the muscarinic effects of the toxin.

ABP Content Specification

- Plan management of non-accidental chemical exposures in children.

Question 10

Your pediatric Emergency Department has appointed you to brief the staff on chemical weapon agents (CWAs) in the wake of terrorist incidents in the area. Which of the following statements is CORRECT?

- Double-layer latex gloves should be worn while handling victims of blistering agent such as mustard.
- A 0.5% hypochlorite solution should be avoided when decontaminating victims of sarin exposure.
- In the event of exposure to nerve agent tabun at a tower block apartment, tenants should move to floors lower than the floor with the tabun contamination.
- Of the nerve agents, VX is comparatively very toxic, and dermal contact at small doses can be lethal.
- Victims of phosgene exposure who are asymptomatic have a normal ECG and CXR, and baseline blood investigations can be safely discharged after a 4-hour observation period.

Correct Answer: D. Of nerve agents, VX is relatively more toxic by dermal exposure.

List of CWAs includes:

- Nerve agents (e.g., sarin, soman, cyclosarin, tabun, VX)
- Vesicating or blistering agents (e.g., mustards, lewisite)
- Respiratory agents (e.g., chlorine, phosgene, diphosgene)
- Cyanides
- Antimuscarinic agents (e.g., anticholinergic compounds)
- Opioid agents (opioid derivatives)
- Riot control agents (e.g., pepper gas, cyanide, CS)
- Vomiting agents (e.g., adamsite)

The least volatile agent, VX, has the consistency of motor oil. The consistency and high

lipophilicity make VX 100–150 times more toxic than sarin when victims sustain dermal exposure. A 10-mg dose applied to the skin is lethal to 50% of unprotected individuals.

CWA can either be in liquid aerosols or vapors and absorbed via three routes: skin (liquid and high vapor concentrations), eyes (liquid or vapor), and respiratory tract (vapor inhalation). Their volatility (i.e., tendency of liquids to vaporize, which directly increases with temperature) and persistence (i.e., tendency of liquids to remain in a liquid state) determine their characteristics. In general, volatile liquids pose the dual risk of dermal and inhalation exposure, while persistent liquids are more likely to be absorbed across the skin. Vapors are largely influenced by ambient wind conditions; even a slight breeze can blow nerve agent vapor away from its intended target, and the exposure is prolonged when deployed within an enclosed space.

Large inhalational exposures to nerve agents or mustards are likely to be lethal immediately. Small dermal exposures to nerve agents and mustards are particularly insidious and generally require expectant observation for variable periods because of possible delayed effects.

Adequate PPE is a must for all rescuers and staff treating the victims, the levels of which vary with the agents. Double layers of latex gloves are useless against liquid nerve and blistering agents, and surgical masks and air-purifying respirators are inadequate against nerve agent vapors. A solution of 0.5% hypochlorite used as a rinsing agent will chemically neutralize most CWAs (e.g., nerve agents, mustards). This solution can be conveniently prepared by mixing 1 part 5% hypochlorite (household bleach) with 9 parts water.

All nerve agents rapidly penetrate the skin. Their vapors are heavier than air and tend to sink into low places (e.g., trenches, basements).

The highly toxic substance phosgene exists as a gas at room temperature. In view of its poor water solubility, one of the hallmarks of phosgene toxicity is an unpredictable asymptomatic latent phase before the development of non-cardiogenic pulmonary edema. Respiratory manifestations, which can develop relatively early

with exposures to a concentration greater than 4.8 ppm, may not develop until 4–24 hours post-exposure with lower concentrations. Therefore, a 24-hour period of observation is recommended.

Take-Home Message

CWAs can either be in liquid aerosols or vapors and absorbed via the skin (liquid and high vapor concentrations), eyes (liquid or vapor), and respiratory tract (vapor inhalation). Large inhalational exposures to nerve agents or mustards are likely to be lethal immediately, and PPE is necessary to protect rescuers and staff.

ABP Content Specification

- Plan triage decontamination and healthcare worker protection in chemical exposures.

Question 11

After a college diving trip, an otherwise fit young man presents to the medical center with paresthesia in his legs and dyspnea, which he attributes to the “fright of his life” on seeing some sharks during the dive and swimming up fast for safety. He denies any alteration in mental status, ear symptoms, or chest pains. Clinical examination reveals no evident abnormalities while ECG and bedside thoracic ultrasound are normal. Your NEXT action would be to organize:

- Cranial CT
- Transthoracic echocardiogram for patent foramen ovale (PFO)
- Chest CT and CXR to rule out pneumothorax
- Referral for urgent hyperbaric oxygen therapy
- MRI of the spine

Correct Answer: D. Referral for urgent hyperbaric oxygen therapy.

The history is highly suggestive of decompression sickness myelopathy. This scenario is spinal cord dysfunction that manifests with deep sea diving. Gas bubbles in the venous plexus of the spinal cord is the postulated mechanism of injury. Symptoms typically develop during or

immediately after ascent, but they can be delayed for hours or even days. Hyperbaric therapy typically reverses symptoms, though injury can persist for weeks to months and may be permanent.

Decompression that occurs during ascent from diving, if occurring too rapidly, may result in liberation of gas bubbles in the blood which can be distributed in any location in the body. Most commonly, decompression sickness presents as skeletal pain or arthralgia, commonly referred to as “the bends.”

Barotrauma resulting from gas expansion may have different presentations. Sinus, ear, and dental barotrauma result from gas expansion in the sinuses, middle ear, or dental cavity. More dangerous forms of barotrauma include pneumomediastinum, pneumothorax, and arterial gas embolism. A chest image would be appropriate in this patient, but only using US or X-ray; there is no indication for a chest CT at this time.

Likewise, there is no indication for a cranial CT or spinal MRI at this time. A PFO can contribute to decompression sickness, but detection of a PFO is non-emergent and should be carried out at a later time.

Ultrasound is highly sensitive (>95%) in picking up a pneumothorax; hence, a CXR is not indicated at this stage.

Take-Home Message

Hyperbaric oxygen therapy is effective in the management of decompression sickness myelopathy that can occur after deep sea diving.

ABP Content Specification

- Understand the pathophysiology of barotrauma and differentiate according to severity and type of exposure.
- Recognize the signs and symptoms of each type of barotrauma in children.
- Plan the management of barotrauma.

Question 12

You are accompanying a group of teenagers who are on their first skiing trip to a mountain resort. At the second station, 3000 m above sea level, an otherwise healthy 16-year-old boy complains of

headaches and mild shortness of breath. No other abnormalities are found on examination. Presuming all treatments below are possible, which is likely to bring the fastest symptomatic relief?

- Rest and acclimatize
- Administer acetazolamide
- Descent to lower altitude
- Give supplemental oxygen by nasal cannula
- Administer IM dexamethasone

Correct Answer: D. Give supplemental oxygen by nasal cannula

Acute mountain sickness (AMS) is defined as “in the setting of a recent gain in altitude, the presence of headache and at least one of the following symptoms: gastrointestinal (anorexia, nausea or vomiting), fatigue or weakness, dizziness or lightheadedness, or difficulty sleeping.” Symptoms may start at elevations above 1500–2000 m, and at greater than 2500 m, they become more noticeable. Though the precise pathophysiology is not fully clear, hypoxia is believed to be the primary insult on ascent to high altitudes.

When severe, serious complications may ensue, which include high-altitude pulmonary edema (HAPE) and high-altitude cerebral edema (HACE), they will require rapid descent, and, if available, hyperbaric oxygen therapy (e.g. the portable Gamow bag). Management of AMS includes no further ascent until symptoms resolve, descent to a lower altitude if medical therapy shows no improvement, and if HACE/HAPE appears, then immediate descent is required. Descent to below the altitude where symptoms started is the goal, which may not be practically possible in certain circumstances.

Treatment for mild AMS symptoms may include rest and waiting at that same altitude for acclimatization. Often this process takes 24–48 hours, and it is common that climbers or their group will want to ascend without waiting for this period of time. Resuming ascent too early may result in more severe symptoms and result in HACE or HAPE.

Though acetazolamide has been a traditional therapy taken prophylactically, its adverse side-

effect profile often limits use. Relatively recently, ibuprofen has also been demonstrated to be effective to prevent headache associated with ascent.

Descent to lower altitude is always an appropriate treatment for any degree of AMS, but is only absolutely necessary in the most severe cases, particularly for HACE/HAPE. In this case, descent will take a significant amount of time, and if the patient were to choose this option, then he should still receive oxygen therapy because it will bring symptomatic relief sooner.

Dexamethasone is the drug of choice for treating HACE. It swiftly reverses symptoms (2–4 hours) and hence should be given early, but it does not improve acclimatization. It should be used in conjunction with descent.

Oxygen is extremely effective treating AMS and is always an appropriate treatment regardless of the severity. Users typically respond very quickly to treatment, though after discontinuation the symptoms will return in 12–24 hours. Oxygen is now used prophylactically to prevent AMS in travelers who rapidly ascend to high altitude and commonly used in travelers who reach altitude by aircraft.

Take-Home Message

AMS and HAPE are seen in personnel exposed to high altitude that are not adequately acclimatized. Therapy consists of immediate descent and in some cases acetazolamide and hyperbaric oxygen.

ABP Content Specification

- Plan the management of each type of high-altitude illness.

Question 13

Concerning animal exposures, which of the following is TRUE?

- Dog bite wounds should never be primarily closed in view of infection risks.
- Rabies does not occur with cat bites.

- Children are most commonly bitten by stray dogs in unprovoked attacks.
- Rabies from a bat may occur even without a known bite.
- Rabies postexposure vaccine is best given intradermal.

Correct Answer: D. Rabies from a bat may occur even without a known bite.

Based on epidemiology of rabies cases, Post-exposure prophylaxis (PEP) is recommended for persons exposed to bats in settings where a bite or scratch may have occurred, even if it is unclear that the event did occur. The common setting for this scenario is a patient or family who discovers a bat in their home, and they were asleep during the bat's presence. In such cases, PEP is recommended due to the possibility that a bite or scratch unknowingly occurred. Similarly, for children who are preverbal or unable to communicate, if it is discovered that they have had exposure to a bat, then PEP is indicated.

A study of dog bites showed improved cosmetic scores and no increased risk of infection with primary closure of wounds in multiple anatomic locations with provision of prophylactic antibiotics. Facial wounds have a low risk of infection even when closed primarily due to their increased blood supply. A randomized clinical trial showed no increased risk of infection (without the use of prophylactic antibiotics) and improved wound healing times with primary closure of facial wounds from dog bites. Given the cosmetic implications of facial wounds, primary closure is therefore advisable.

Anti-rabies treatment may be indicated for bites by dogs and cats whose rabies status cannot be obtained or in foxes, bats, raccoons, or skunks in the United States.

Bite wounds from cats and dogs can occur without provocation, but provoked bites, such as those that occur when an animal is disturbed while eating, are more common. Older animals often are less tolerant of disturbances, especially by children. Most dog bites involve a dog that belongs to

the family or friend of the victim, and approximately half occur on the pet owner's property.

Rabies is spread via the animal's saliva. Though a bite would be the most expected mode of transmission, it is not a necessity as the saliva may be spread by other means. In the United States, the CDC recommends rabies PEP with intramuscular (IM) cell-cultured vaccines. Prophylaxis includes injection of the rabies IG into the wound itself, and if there is any left, the remainder is injected into the same limb or area. The vaccine is given on the contralateral side – as far from the wound as possible. For example, if bitten in the left hand, then the rabies IG would be administered to the left hand and arm, and the vaccine would be administered to the right thigh or buttock. The reason for this action is that the rabies IG can potentially neutralize the rabies vaccine.

Take-Home Message

PEP for rabies is indicated after bat exposures even when uncertain if there was a bite or a scratch.

ABP Content Specification

- Know the risk factors and indications for prophylaxis, and plan the management of potential rabies exposure.

Question 14

A 16-year-old boy presents with a puncture wound over the fourth metacarpophalangeal joint of his right hand after a fist fight an hour earlier. The statement which BEST describes your management is:

- Cephalexin should be prescribed for the skin flora.
- Ampicillin/sulbactam should be prescribed for anticipated *Pasteurella multocida* infection.
- Amoxicillin/clavulanic acid is effective for suspected *Eikenella corrodens* contamination.
- Thorough irrigation and debridement is all that is required if the wound looks clean.
- All such wounds will require surgical exploration.

Correct Answer: C. Amoxicillin/clavulanic acid is effective for possible *Eikenella corrodens* contamination.

This boy most probably sustained the injury by punching his clenched fist into the mouth of his opponent, sustaining a bite wound. This case is sometimes referred to as a “fight bite.” Human bite wounds are at high risk for infection. *Eikenella corrodens* is the most common bacterial species implicated in human bite infections, although *Staphylococcus aureus* is the most commonly isolated organism; treatment includes amoxicillin/clavulanic acid or ampicillin/sulbactam.

Pasteurella multocida is treated with amoxicillin/clavulanic acid or ampicillin/sulbactam. This organism is commonly associated with cat bites rather than human bites.

An adequate inspection will determine the need for further exploration.

Take-Home Message

Human bite wounds are at high risk for secondary infection and should be treated with amoxicillin/clavulanic acid.

ABP Content Specification

- Understand the pathophysiology and plan the management of human bites.

Question 15

During a walk along an outdoor school trek, a boy heard a rattling sound and suddenly felt pain in his leg. His teacher managed to take a picture of the snake with her smart phone that is clearly a viper with a rattle (rattlesnake).

The BEST statement which explains his condition or your management is:

- Non-envenomation (dry bite) occurs in majority of cases (>80%).
- Use of a negative-pressure venom extracting device greatly reduces chances of envenomation.

- C. In the presence of compartment syndrome, fasciotomy is never necessary if antivenom is available.
- D. Administration of diphenhydramine is indicated in the treatment of envenomation.
- E. CroFab antivenom should be given for even mild signs of envenomation.

Correct Answer: E. CroFab antivenom should be given for even mild signs of envenomation.

CroFab has been available for nearly 2 decades and has improved treatment of rattlesnake bites tremendously. As a Fab antivenom, it has minimal side effects and is extremely safe. The previously used antivenom was a polyvalent antivenom derived from horses exposed to venom from rattlesnakes and similar venomous snake relatives. As a horse-derived antidote, various allergic reactions, ranging from anaphylaxis to serum sickness, were common. Polyvalent antivenom treatment for rattlesnake bites is no longer recommended because CroFab is available.

Dry bites by rattlesnakes occur in 10% and 50% of bites, so envenomation should be anticipated in most cases. To date, there is no strong evidence to support the benefits of venom extracting devices with regards to envenomation. When compartment syndrome is present, antivenom becomes the first-line treatment as it may even resolve the compartment syndrome. CroFab is safe and indicated even if the envenomation is minimal or mild.

If any signs of rattlesnake envenomation exist, CroFab should be given as a preventative measure. There is no consensus on the routine use of CroFab for asymptomatic bites from less toxic snakes such as cottonmouth and copperhead snakes.

Antihistamines (e.g., diphenhydramine) are used to treat the allergic reactions of antivenom use.

Take-Home Message

Antivenom CroFab is effective against envenomation by rattlesnakes and has fewer side effects compared with previous horse serum-derived antitoxin.

ABP Content Specification

- Plan the management of snake envenomation by type and severity.

Question 16

An otherwise healthy 5-year-old boy was immediately brought by the mother after he was stung by an insect. She described it as a fly with yellow and black stripes. The boy looks irritable, weeping in pain, and his vital signs are temperature 36 °C (axilla), heart rate 168/minute, respiratory rate 28/minute, blood pressure 60/46 mm Hg, RR 28/minute, and oxygen saturation 95%. There are wheezes heard on auscultation of his chest, and you notice puffiness to his face and neck. On examining his right hand, there is a small wound with a tiny black foreign body and surrounding inflammation. After initiating 100% oxygen via non-rebreather mask, your NEXT action would be:

- A. Administer topical lidocaine gel to the right hand and acetaminophen suppository.
- B. Request the nurse to get a suture set and other instruments that could be used to attempt to remove the foreign body.
- C. Immediately administer IM epinephrine.
- D. Give nebulized salbutamol with the oxygen.
- E. Order for diphenhydramine IV.

Correct Answer: C. Administer IM epinephrine.

The patient appears to be having a type I hypersensitivity reaction to a wasp sting. He already has hypotension, wheezing, and dermal findings; thus, multiple organ systems are involved. His severe reaction could be fatal, even with appropriate treatment. Immediate treatment with IM epinephrine is indicated.

Immediately discontinuing the exposure that is causing this reaction, which could be the presence of a stinger and venom sac, is important, but, given the impending cardiovascular collapse, is not the first thing to do.

Nebulized albuterol could be used to treat wheezing, but it may be unnecessary because all the symptoms of anaphylaxis may resolve after

treatment with epinephrine. Nebulized albuterol administration is lower priority than epinephrine administration in this case.

An H1 and H2 blocker as well as a corticosteroid should all be administered, but the time for these medications to take effect is much longer than that for epinephrine, and these do not have the immediate usefulness and lifesaving effect of epinephrine.

Take-Home Message

Bee or wasp stings cause type I hypersensitivity reaction including anaphylaxis and should be treated with IM epinephrine.

ABP Content Specification

- Plan the management of bites/stings by type, including scorpions, spiders, ticks, and insects.

Question 17

Which of the following statements regarding arthropod bites and stings is CORRECT?

- Most symptomatic exposures to tarantulas result from allergic response to its hairs rather than venomous bites.
- The black widow is recognized by its violin-like pattern on the thorax.
- Black widow spider venom is cytotoxic and hemolytic.
- Systemic envenomation by the brown recluse is more frequent in adults than in children.
- Application of warm compress deactivates the brown recluse venom.

Correct Answer: A. Most symptomatic exposures to tarantulas result from allergic response to its hairs rather than venomous bites.

Both tarantulas and centipedes have “urticating hairs” that may cause severe allergic reactions. Though not true hairs, as hair only grows in mammals, tarantulas grow hairlike bristles that are highly irritating. Exposure may occur passively, but the tarantula may also use these hairs defensively. When threatened, tarantulas may

flick or kick these hairs off the body toward a threatening animal. Most commonly, the tarantula pulls a hair off the abdominal area and flicks it using two legs.

These urticating hairs usually cause dermal or ocular symptoms with occasional respiratory symptoms. The urticating hairs are irritants even after the tarantula is dead, and handling a live or dead tarantula may result in symptoms.

The black widow typically has a red hourglass on its black body, while the violin-like pattern on the thorax belongs to the brown recluse spider. The venom is neurotoxic.

Brown recluse spider bites can cause significant cutaneous injury with tissue loss and necrosis. Less frequently, more severe reactions develop, including systemic hemolysis, coagulopathy, renal failure, and, rarely, death.

Brown recluse venom, like many of the other brown spider venoms, is cytotoxic and hemolytic. Systemic involvement, although uncommon, occurs more frequently in children than in adults. Because the activity of sphingomyelinase D (one of the enzymes in its venom) is temperature dependent, application of local cool compresses is helpful and should be continued until progression of the necrotic process appears to have stopped.

Take-Home Message

Urticating hairs are responsible for most of the allergic reactions caused by tarantulas and centipedes.

ABP Content Specification

- Plan the management of bites/stings by type, including scorpions, spiders, ticks, and insects.

Question 18

A 16-year-old boy presents with severe pain in his left foot while out snorkeling. He thinks that he stepped on a fish and has something in his foot. His vital signs are normal. Which of the following statements would BEST describe your initial therapy?

- A. Give supplemental oxygen and observe the patient for signs of respiratory failure.
- B. Recommended initial therapy is immersion in cold water to soothe the pain.
- C. Envenomation stops after the spine is broken off the fish.
- D. Ultrasound can detect if the fish spine is still in his foot.
- E. Prophylactic antibiotics are recommended.

Correct Answer: D. Ultrasound can detect if the fish spine is still in his foot.

This patient has probably been envenomated by a fish. Although the spines rarely break off into the skin, debridement of loose spines should be undertaken promptly, because retained spines continue to envenomate. Embedded structures should be pulled straight out with forceps to avoid breaking them.

The Scorpaenidae family represents a large array of fish characterized by the ability to envenomate with various types of specialized spines. Potency of the venom is highest in the stonefish, which can be fatal, followed by the scorpionfish and then the lionfish.

The most commonly recommended therapy is immersion in non-scalding hot water (upper limit of 114 °F or 45 °C) after removal of visible spines and sheath, in order to inactivate the heat-labile components of the venom that might otherwise cause a severe systemic reaction.

With the exception of persons with deep puncture wounds and those who are immunocompromised, prophylactic antibiotics generally are not indicated. Once infection is established, however, prompt therapy must be instituted with emphasis on coverage for potential marine pathogens. Especially in cases where x-ray of the foot shows no abnormality, ultrasound of his foot can very helpful in locating the foreign body.

Take-Home Message

The treatment for exposure to fish from the Scorpaenidae family is similar to that for jellyfish envenomation, that is, to immerse the affected area in non-scalding hot water (about 114 °F) to

inactivate the heat labile components of the venom, and removal of any visible (or sonogram detected) spines.

ABP Content Specification

- Plan the management of acute marine bites, punctures, and envenomation.

Question 19

Three teenagers present to the Emergency Department after having just returned from a camping trip in the desert during a cold winter night. They say they skinned and cooked a wild rabbit, over a portable stove for dinner the night before. They also used the stove to heat the tent. They awoke with headaches, nausea, and malaise they describe as “flu.” There is no fever, vomiting, or diarrhea, and they give no significant past medical history. The action that would most likely be helpful in this situation is to:

- A. Initiate non-rebreather oxygen therapy and obtain carboxyhemoglobin levels.
- B. Do brucellosis titres.
- C. Order a CXR to evaluate for anthrax.
- D. Expose and examine the skin for rashes and bite marks.
- E. Prescribe oseltamivir to each of them and advise to quarantine themselves at home.

Correct Answer: A. Initiate high FiO₂ oxygen therapy and obtain carboxyhemoglobin levels.

The most probable diagnosis here would be carbon monoxide poisoning. The clinical presentation of CO poisoning is highly variable, which leads to misdiagnosis in many cases. Clinical scenarios range from that of an unconscious patient pulled from a house fire or from a running car in a closed garage, to the patient with “flu-like” symptoms, or the elderly person presenting with syncope and ischemic ECG changes. Given the lack of any fixed set of signs or symptoms for carbon monoxide poisoning, a strong clinical suspicion remains the best initial method of detection.

Brucellosis may be a systemic or localized infection and has many different possible presentations. When systemic, it occurs after a 1- to 4-week incubation period, after which fever, malaise, arthralgia, myalgia, back pain, headache, and loss of appetite are common. Abdominal pain and cough may be present, and hepatomegaly/splenomegaly also may be part of the clinical picture. It is diagnosed by blood culture, serology, or PCR. Localized brucellosis may involve osteoarthritic, genitourinary, pulmonary, neurologic, cardiac, or ophthalmologic symptoms.

Inhalational anthrax has in recent times become a focus of interest due to malicious mailing of anthrax as an act of terrorism in the United States, but inhalational and cutaneous anthrax occur naturally. Particularly in the setting of persons who handle animals, anthrax may occur. Fortunately, it is rare and usually manifests as cutaneous anthrax, which is not typically life-threatening. Inhalational anthrax may cause mediastinal widening, but it is not a consideration in this case.

Oseltamivir may be used to prophylaxis or treat viral infections such as influenza.

Take-Home Message

CO poisoning can present with vague symptoms, and one must have a high index of suspicion. The most important initial therapy for carbon monoxide poisoning is administration of supplemental oxygen.

ABP Content Specification

- Know the common etiologies of fatal or disabling inhalation injuries and carbon monoxide and cyanide poisoning.

Question 20

Which of the following statements is typically TRUE concerning cyanide toxicity?

- Treatment is with sodium nitroprusside.
- The poison or the patient may smell like garlic.
- Oxygen saturation is low.

D. Cherry red skin may be seen.

E. Oral cyanosis is severe.

Correct Answer: D. Cherry red skin may be seen.

Cyanide toxicity, which occurs most commonly after exposure to closed-space fires that release cyanides, results in inhibition of mitochondrial oxidative phosphorylation. The mitochondria cannot use oxygen and, therefore, arterial and venous blood are highly oxygenated; therefore, the skin (in fair skinned persons) is cherry red due to abnormal saturation of venous hemoglobin. Diagnosis is suspected based on syncope, shock, or cardiac arrest after a closed-space fire and is corroborated by elevated serum lactate levels. Elevated lactate results from anaerobic cellular respiration.

Sodium nitroprusside is one of the iatrogenic causes of cyanide toxicity. Cyanide is a component of nitroprusside, and patients on nitroprusside infusions may develop metabolic acidemia and tachycardia. They may decompensate if the infusion is not discontinued and antidote administered.

The typical odor is of bitter almonds, though this is noted in only about 40% of patients exposed to cyanide. Garlic smell is associated with sulfur mustard, heavy metals such as arsenic or arsine gas, and organophosphorus agents.

High, falsely reassuring pulse oximetry occurs as oxygen cannot be effectively used in oxidative phosphorylation, though the blood is saturated with oxygen.

Cyanosis occurs with prolonged respiratory failure and shock, but it is not a typical feature of cyanide poisoning.

Take-Home Message

Cyanide toxicity should be considered in patients after exposure to fire in closed spaces.

ABP Content Specification

- Recognize the signs and symptoms of life-threatening inhalation injuries and carbon monoxide and cyanide poisoning.

Question 21

An 18-year-old male presents complaining of fever and muscle aches. He was diagnosed to have mild acute gastroenteritis four days earlier and given chlorpromazine parenterally and discharged with a prescription for oral use. There is no significant other past medical or drug history. On examination, his vital signs are temperature 101.1 °F (38.4 °C), heart rate 112 beats/minute, respiratory rate 16 breaths/minute, and blood pressure 145/91 mm Hg. He has rigid limbs, and on reassessment a while later, his blood pressure is 168/99 mm Hg with a WBC count of 19,000. The statement which BEST describes your management is:

- A. Chlorpromazine should be avoided in the future.
- B. His presentation is much more expected to be in the cold winter months.
- C. Serum myoglobin levels are characteristically low.
- D. No specific medication would be indicated at this time, just discontinuation of antiemetics.
- E. Metoclopramide is not associated with this condition.

Correct Answer: A. Chlorpromazine should be avoided in the future.

This patient appears to have neuroleptic malignant syndrome (NMS), which is an idiosyncratic reaction to a neuroleptic medication. NMS involves elevation of body temperature, muscular rigidity, altered mental status, and autonomic dysfunction. Although potent neuroleptics (e.g., haloperidol, fluphenazine) are most commonly associated with NMS, all antipsychotic agents, typical or atypical, may precipitate the syndrome. For example, these agents have been associated with NMS: promethazine (Phenergan®), metaclopropamide (Reglan), prochlorperazine (Compazine®), clozapine (Clozaril®), and risperidone (Risperdal®). After developing NMS, the medication that precipitated it should be avoided in the future. Treatment of NMS includes discontinuing the offending medication, ensuring adequate hydration by giving IV flu-

ids and use of bromocriptine and possibly dantrolene. NMS would be more severe in summer, rather than winter months. Rhabdomyolysis does not frequently occur, but if it does, serum myoglobin levels are elevated. Rhabdomyolysis management includes maintaining vigorous hydration and alkalization of the urine with intravenous NaHCO₃ to prevent renal failure.

Take-Home Message

NMS is an idiosyncratic reaction, often to a neuroleptic medication which presents with muscle rigidity, altered mental status, and elevated body temperature. Treatment of NMS includes discontinuing the offending medication, ensuring adequate hydration by giving IV fluids, and use of bromocriptine and possibly dantrolene.

ABP Content Specification

- Differentiate the most common causes of fatal hyperthermia by age group.

Question 22

You have been given the task of educating a group of new residents in your ED. Which of the following management statements below is correct?

- A. A jagged teeth-mark wound with very small puncture of the skin over the dorsal fifth MCP joint of the hand should undergo x-ray; if negative, then administration of tetanus booster is the primary treatment.
- B. The black widow spider venom causes necrotizing ulceration at the bite area, often requiring skin debridement.
- C. A 17-year-old boy with scorpion sting to the hand 5 hours before admission should be observed for another 7–19 hours (so 12–24 hours after envenomation) before discharge.
- D. A teenage girl who developed fever, headache, and fatigue plus an expanding circular rash 3 weeks after a camping trip into the forest will require 10–21 days of doxycycline.

E. The primary consideration in managing a teenage boy with abrasion marks on ankles after feeling scratching across both legs while cave exploration should be evaluation for snakebite.

Correct Answer: D. A teenage girl who developed fever, headache, and fatigue plus an expanding circular rash after camping trip into the forest will require 10-21 days of doxycycline.

The rash described is ECM (erythema chronicum migrans), which is typical of Lyme disease. Oral antibiotics are used unless there is a specific complication such as meningoen­cephalitis. Doxycycline is recommended for children older than 8 and adults, but amoxicillin may also be used and is often better tolerated. A 14- to 21-day course of antibiotics is usually recommended, but some studies suggest that courses lasting 10 to 14 days are equally effective.

Response A describes a “fight bite” which has a high likelihood for infection. Besides x-ray, the wound should be thoroughly cleaned and the patient treated with prophylactic antibiotics, typically amoxicillin/clavulanic acid.

Response B is incorrect: Black widow envenomation includes muscle cramping, abdominal pain, weakness, and in severe cases, nausea, vomiting, faintness, dizziness, chest pain, and respiratory difficulties. Brown recluse bites, however, cause necrotizing ulceration. It is unclear if black widow antivenom administration is of value in black widow envenomation, and there is no brown recluse antivenom in the United States.

Response C is incorrect because scorpion envenomation does not result in delayed onset of effects; after 5 hours, the patient is not expected to have any exacerbation of symptoms or increase in severity of disease. There are several species of related scorpions in the United States that most commonly cause symptomatic envenomation by stings, but these symptoms are usually limited to local pain in the extremity that is stung. More severe poisoning will also include remote pain and paraesthesia, and the most severe envenomations result in cranial nerve dysfunction such as nystagmus, tongue fasciculation, or slurred speech.

Skeletal neuromuscular dysfunction that occurs may include restlessness, fasciculation, involuntary movement of extremities, or opisthotonos.

For Answer E, the primary concern would be treatment for rabies prophylaxis with the presumption that the patient may have been exposed to bats.

For Answer E, numerous cases of rabies presumably contracted from bats occurred with no knowledge of a bite by the victim. Therefore, any exposure with disruption of skin integrity or of patients who have been sleeping in the presence of bats should be treated as a presumed bat bite. Healthcare providers are reminded to take notice of new Advisory Committee on Immunization Practices (ACIP) recommendations for rabies PEP that reduces the number of vaccine doses in the series from 5 to 4 doses. The new recommendations for PEP reduce the number of human rabies vaccine doses to 4 given on days 0, 3, 7, and 14 by eliminating the previously recommended fifth dose on day 28. Human rabies immune globulin (HRIG) continues to be recommended (20 IU/Kg) on day 0 for persons not considered previously immunized for rabies.

Take-Home Message

Lyme disease should be a strong consideration among patients with history of a tick bite in an endemic area and report developing a rash suggestive of ECM, and treatment with antibiotics such as doxycycline and amoxicillin are indicated.

ABP Content Specification

- Recognize the signs and symptoms of complications of bites and stings.

Question 23

You are the team doctor of a mountain climbing expedition. On reaching Camp Zulu 5, a team member complains of dyspnea on exertion. He had been having headaches since the day before after the team left Camp Zulu 4. On examination, he is alert and oriented but short of breath on exertion, and his vital signs are heart rate 130/minute, respiratory rate 20/minute, and oxygen

saturation 70%. He requires assistance to walk because of fatigue, but heel-to-toe walking is normal. There are bibasilar crackles on lung examination, but no peripheral edema detected. Which of the following statements is MOST accurate?

- A. Camp Zulu 5 must be at least 6000 ft. above sea level.
- B. The patient likely has High Altitude Cerebral Edema (HACE) as his primary medical issue.
- C. Use portable hyperbaric chamber to avoid descent.
- D. Nifedipine may be used as medical treatment.
- E. If he had been regularly taking acetazolamide from base camp, then he should be able to rest in the current location and begin ascent when symptoms resolve.

Correct Answer: D. Nifedipine may be used as medical treatment.

High-altitude illness refers to clinical conditions associated with ascent to high elevations that can cause reduction in partial pressure of oxygen (depending on the degree of elevation) with resultant in hypoxia.

These primarily include HACE and High Altitude Pulmonary Edema (HAPE). Acute Mountain Sickness (AMS) is a mild, commonly encountered illness that may include headache, malaise, anorexia, nausea/vomiting, and difficulty sleeping. Symptoms are usually delayed 6–12 hours after arriving at high altitude, but onset may be as soon as one hour or as late as 24 hours after arrival. Symptoms are typically most severe the first night and then progressively resolve if there is no further ascent while symptomatic. AMS symptoms may be treated or prevented using ibuprofen, acetazolamide, and possibly antiemetics such as ondansetron.

HACE is more severe and rapidly fatal if not treated. Symptoms include encephalopathy, including ataxic gait and progressive decline of mental function and consciousness.

HAPE is an uncommon problem that occurs days after arriving at high altitude, usually 2500 m (8200 feet) or greater. It usually begins with cough and progresses to dyspnea on exertion. Expectoration of frothy pink sputum is expected with pulmonary edema. On examination, crackles and hypoxia are evident. Pulse oximetry is very useful to distinguish HAPE from other altitude-related conditions.

The scenario described above is a very straightforward case of pure HAPE. Besides the overall signs/symptoms and examination, hypoxia detected by pulse oximetry strongly corroborates the diagnosis. HAPE treatment considerations include the following: oxygen, nifedipine, sildenafil, albuterol, and dexamethasone. Hyperbaric treatment also helps to treat the condition, but descent is mandatory in both HAPE and HACE.

Take-Home Message

High-altitude pulmonary edema requires administration of oxygen, immediate descent, and in some cases hyperbaric oxygen and other medications.

ABP Content Specification

- Plan the management of each type of high-altitude illness.

Question 24

While retrieving a football from the bushes, a teenager was bitten by a snake on his right hand. He describes the snake as having red bands bounded by yellow bands. He has no pain or swelling but looks very anxious. Which of the following would best describe your management?

- A. Irrigate bite wound, apply a venous pressure tourniquet, use sterile suction catheter to remove venom, and administer anti-tetanus toxoid and antibiotics.
- B. Prepare Crotalidae polyvalent immune fab ovine (CroFab) antivenin to administer if any signs or symptoms of envenomation appear.

- C. Observe in short stay unit for 6 hours, and if asymptomatic, discharge.
- D. Locate and prepare for use of coral snake antivenom.
- E. Do elective intubation and prophylactic ventilation in anticipation of respiratory paralysis.

Correct Answer: D. Locate and prepare for use of coral snake antivenom.

Coral snake venom is neurotoxic and may result in paralysis and apnea. Onset of symptoms may be late, as late as 24 hours. The coral snake antivenom stock in the United States is extremely low, making decisions regarding antivenom use difficult. Generally, if a patient has symptoms after coral snake envenomation, then antivenom administration is recommended. Some clinicians advocate the use of antivenom for any credible coral snake bite, though that is not universal. In this situation, determining the location of and preparation for the possible need of antivenom is recommended. Usually, contacting your local poison control center is the most appropriate first step.

Coral snakes have a characteristic band pattern for which there are several mnemonics: Red touches black venom lack, red touches yellow, kills a fellow. Basically, red/yellow band contact is specific to coral snakes. In the United States, coral snakes are primarily dominant in the South, including Florida, Arizona, Texas, and California, but they exist throughout the Americas as well as in Asia and Southern Africa.

Option A is incorrect as venous tourniquets and suction are not advised. Although devices such as a Sawyer extractor are sometimes used in the field, but found to be ineffective and should be avoided.

CroFab is a Fab antibody for crotalids, which include rattlesnakes, cottonmouths, and copperheads. It is typically administered based on symptomatology.

Answer E is completely inappropriate. A detailed neurologic examination done every

1–2 hours is recommended to detect the onset of neurotoxicity and paralysis, but elective intubation is not a consideration in the scenario described.

Take-Home Message

Coral snake venom is neurotoxic and can cause paralysis and apnea, and antivenom should be strongly considered for those with progressive neurological symptoms.

ABP Content Specification

- Plan the management of snake envenomation.

Question 25

EMS brings in a school boy who was trapped in a burning factory during a school trip. The patient is unconscious. Initial laboratory investigations reveal an arterial blood gas of pH 7.01, PCO₂ 28, PO₂ 250, carboxyhemoglobin level is 10%, and lactate is 12 mmol/L. The statement which BEST describes appropriate management is:

- A. Hyperbaric oxygen therapy will improve his clinical status.
- B. Increased arteriovenous oxygen saturation difference (>10%) almost confirms the diagnosis.
- C. He requires immediate and large doses of sodium nitroprusside.
- D. Presence of neurological signs requires immediate MRI assessment.
- E. Give hydroxycobalamin and/or sodium thiosulphate immediately.

Correct Answer: E. Give hydroxycobalamin and/or sodium thiosulfate immediately.

This patient has cyanide poisoning resulting from being in a closed-space fire. He requires immediate treatment with cyanide antidote, which may be hydroxycobalamin (Cyanokit) or the older Lilly Cyanide Antidote kit. Cyanide is released from numerous cyanogenic compounds such as plastics and clothing that are typically consumed in closed space fires. There are numerous labora-

tory indicators that can be considered highly suggestive or even pathognomonic of cyanide poisoning. Because cyanide blocks oxidative phosphorylation, oxygen will not be consumed normally, and a lactic acidemia will develop. A serum lactate level greater than 10 mmol/L, irrespective of the percentage of body surface area burn or carboxyhemoglobin level, should be considered diagnostic of cyanide poisoning. Increased pO₂ resulting from inability of the mitochondria to use oxygen appropriately is highly suggestive of cyanide poisoning, and comparison of an arterial and venous blood gas drawn at the same time may be used for this purpose. A low methemoglobin level is also suggestive of cyanide poisoning, due to cyanide binding with methemoglobin to form cyanomethemoglobin.

Treatment of cyanide poisoning may be carried out using hydroxycobalamin, which directly binds cyanide. There are few significant side effects, but the orange/red hue of this medication will derange pulse oximetry readings, so this scenario must be taken into consideration. A Lilly antidote kit includes sodium nitrite, sodium nitroprusside, and sodium thiosulfate. The nitrates are administered to develop methemoglobinemia. Their use in fire victims is controversial because methemoglobin does not carry oxygen; in cases of carbon monoxide poisoning, there is great concern that use of nitrates will further reduce oxygen carrying capacity of the blood. It is common for poison control centers or toxicologists to recommend empirical use of sodium thiosulfate alone without the nitrate portions of the kit in patients who have been in a closed space fire. Sodium thiosulfate has no effect on oxygen carrying capacity of the blood and has few side effects; therefore, it is considered very safe. Thiosulfate binds cyanide to form thiocyanate, and it is excreted.

Response B is incorrect. A difference of <10%, not >10%, would be indicative of lack of oxygen extraction between arterial and venous blood.

Response C is incorrect because large doses of nitroprusside would simply induce methemoglobin, which would decrease the oxygen carrying capacity of blood and likely cause severe hypotension.

Response D is incorrect. MRI may be used in inpatients with carbon monoxide poisoning to determine injury to specific areas of the brain, but there is no role for this method in the emergency department.

Take-Home Message

Serum lactate levels in cyanide poisoning can be very high (>10 mmol/L). The antidote for cyanide toxicity is sodium thiosulfate and hydroxycobalamin, both directly bind to cyanide.

ABP Content Specification

- Plan the management of inhalation injuries and carbon monoxide and cyanide poisonings, and know the indications for hyperbaric oxygen therapy.

Question 26

Which of the following concerning electrical injuries is CORRECT?

- Alternating current has a higher predisposition to ventricular fibrillation than direct current.
- Compartment syndrome occurs in high-voltage shocks of long duration, typically >5 seconds.
- Even for low-voltage injury, admission for cardiac monitoring is necessary regardless of initial ECG.
- CK-MB level is more specific for cardiac injury than skeletal muscle injury from electrical injury.
- In managing rhabdomyolysis, maintenance fluids should be administered.

Correct Answer: A. Alternating current has a higher predisposition to ventricular fibrillation than direct current

Standard household electricity is AC. Electricity in batteries and lightning is DC. Low-frequency (50 to 60 Hz) AC can be more dangerous than similar levels of DC because the alternating current fluctuations can result in

ventricular fibrillation. The identification of electric shock as due to AC or DC is also important to reconstruct the mechanism of injury. AC current can produce tetany, and if this is involved in a hand grasping an electrified object, then the victim cannot let go of the electrical source. Both AC and DC current can hurl the victim away from the current source, which results in severe blunt force injury.

Patients with high-voltage shocks are at significant risk for development of compartment syndrome, even if the contact (or arcing) lasted <1 second. Compartment syndrome has also been noted in patients with injuries from 120-V AC or higher, who sustain contact for longer than a few seconds. Patients typically exhibit ongoing muscle pain with movement.

Cardiac arrhythmias can be treated according to accepted ALS guidelines. ED cardiac monitoring should be instituted for patients with high-voltage injuries and all symptomatic patients. Cardiac complications are more common in patients with high-voltage injuries and in those with loss of consciousness and include ventricular and atrial dysrhythmias, bradydysrhythmias, and QT-interval prolongation. Admission for cardiac monitoring is not needed for asymptomatic patients with normal ECG on presentation after a low-voltage electrical injury.

Elevation of creatine kinase MB isoenzyme in the face of electrical injury correlates more strongly with skeletal muscle injury than with cardiac injury and is therefore not helpful in determining the extent of cardiac damage. Patients should be monitored for the onset of compartment syndrome, rhabdomyolysis, and renal failure.

If myoglobinuria is suspected, then aggressive IV fluid resuscitation to maintain a urinary output of between 1 and 2 mL/kg/h and correction and prevention of electrolyte abnormalities with sodium bicarbonate and mannitol therapy should be initiated. Lack of large randomized controlled studies concerning the benefits of bicarbonate therapy makes it difficult to make strong recommendations for or against its use in the treatment of rhabdomy-

olysis. Initial IV rate in the adult is up to 1.5 L/h (more if there is hypotension or obvious blood loss). Maintain a high urine output until serum creatine kinase level is less 1000u/L or urine myoglobin measurements return to normal.

Take-Home Message

AC current has higher predisposition to cause tetany and ventricular fibrillation.

ABP Content Specification

- Plan the management of pediatric patients with electrical injuries.

Question 27

Concerning management of burn patients, which of the following is correct?

- Circumferential neck burns without signs of inhalational injury is an absolute indication for definitive airway (endotracheal intubation).
- The half-life of carbon monoxide in smoke inhalation is reduced to approximately 1 hour with 100% oxygen therapy at 1 atmospheric pressure.
- A burn causing painful erythema but no blisters requires analgesics and IV fluid therapy.
- In small children <30 kg, fluid therapy should be carefully controlled with non-glucose solutions to achieve urine output of 0.5 mL/kg/hr.
- Major thermal burns (>10% BSA) which are painful will benefit from the analgesic effect of cold sterile water application.

Correct Answer: B. Half-life of carbon monoxide in smoke inhalation is reduced to approximately 1 hour with 100% oxygen therapy at 1 atmospheric pressure.

Circumferential neck burns can compromise the airway rapidly from edema and thus MAY require early ETT, regardless of inhalational inju-

ries; however, a circumferential burn is not an absolute indication for endotracheal intubation. Carbon monoxide has approximately 240× more affinity for Hb than oxygen. On room air, the approximate carboxyhemoglobin half-life is 4 hours, which decreases to 1 hour on 100% oxygen. This half-life further decreases to approximately 30 minutes in hyperbaric oxygen (3 atm).

First-degree burns (sunburn) do not have loss of the skin barrier; and hence, do not need IV fluids. Small children (<30 kg) will require maintenance fluid therapy containing glucose in addition to the fluids calculated based on the percentage of burn to sufficiently produce UO of at least 1.0 ml/kg/hr. Cold water should be avoided in extensive burns (>10%) to avoid hypothermia.

Take-Home Message

The half-life of carboxyhemoglobin is affected by the concentration of inhaled oxygen, hyperbaric oxygen causes the steepest decline, followed by 100% oxygen, both of which are standard therapeutic interventions based on carboxyhemoglobin levels.

ABP Content Specification

- Plan the management of inhalation injuries and carbon monoxide and cyanide poisonings, and know the indications for hyperbaric oxygen therapy.

Question 28

During a summer marathon event, an otherwise healthy young teenager who has been drinking Red Bull containing caffeine and taurine presents having fainted toward the end of the race. He complains of a bad headache, is confused, and has dry skin. His vitals are as follows: HR 138/min, BP 92/46 mmHg, RR 28/min, T 40.8 °C, and SpO₂ 96%. No other abnormal clinical findings are noted. Your management would BEST follow treatment protocols for which of the following:

- A. Heat exhaustion
- B. Heat stroke
- C. Rhabdomyolysis

- D. Stimulant toxicity
- E. Severe dehydration

Correct Answer: B. Heat stroke

What is described in this scenario is heat stroke. Heat stroke is defined as a core temperature $\geq 40^{\circ}\text{C}$ (104°F) accompanied by central nervous system dysfunction in patients with environmental heat exposure. Absence of sweating is common, though not part of the diagnostic criteria. Heat stroke may be further differentiated as classic versus non-exertional and exertional heat stroke. The scenario described here is exertional heat stroke.

Other heat-related illnesses include the following:

- Heat exhaustion is a milder problem associated with heat exposure and body temperature less than 40°C (104°F). Additional symptoms may include tachycardia, sweating (typically absent in heat stroke), headache, nausea/vomiting, dizziness/syncope, and confusion. There is some overlap between heat exhaustion and heat stroke. If there is any doubt as to which condition is present, then it should always be presumed that it is heat stroke and managed accordingly, due to the high morbidity and mortality.
- Heat syncope is dizziness, orthostatic hypotension, and syncope that occur in patients with heat-related peripheral vasodilation and venous pooling. Syncope often occurs in patients who remain standing after significant exertion or who rapidly change position during exertion. These patients have a normal core body temperature and a rapid return to normal mental status once they are supine.
- Heat cramp is painful muscular cramping that may occur during or after exertion in hot environments. Cramping commonly involves the large muscle groups of the legs, abdomen, or arms. Patients may have a normal or elevated core body temperature that does not exceed 40°C (104°F).

Rhabdomyolysis could occur with any intense sports such as marathon running, but it would be

suspected based on symptoms of myalgias, serum and urinary findings. If there were a clinical scenario involving muscle pain, then one would also consider the possibility of rhabdomyolysis.

Stimulant toxicity could cause confusion, tachycardia, and elevated temperature, but would likely cause a widened pulse pressure. It is a likely contributor to the development of heat stroke, but in itself is unlikely to cause such an elevated temperature. Furthermore, the treatment would be primarily supportive care.

The clinical scenario above is not expected to result from severe dehydration, though dehydration may be an associated problem.

Take-Home Message

Sweating is often absent in heat stroke but present in heat exhaustion.

ABP Content Specification

- Differentiate the most common causes of life-threatening hyperthermia in children.

Question 29

Which one of the following types of radiation is LEAST likely to cause radiation sickness?

- Alpha
- Beta
- Neutron
- X-ray
- Gamma

Correct Answer: A. Alpha

Alpha radiation possesses a significant biological hazard only when internalized. Alpha particles are very weak. Alpha radiation is easily shielded and cannot penetrate paper or the keratin layer of the skin.

Beta particles can cause significant skin burns and, such as alpha particles, are hazardous if internally deposited, but beta particles are easily blocked by clothing. Neutron radiation, gamma radiation, and x-rays all pose significant whole-body irradiation hazards.

Take-Home Message

Alpha particles are least likely to cause radiation sickness unless internalized.

ABP Content Specification

- Plan Emergency Department preparation, healthcare worker protection, and patient decontamination in radiation exposure.

Question 30

You are the emergency physician of a medical mobile team, responding to an incident of a bomb explosion at the city mall. Which of the following statements is true?

- Safety of trapped victims is the topmost priority during the evacuation process.
- Permission for entrance into the hot zone is the prerogative of the medical staff.
- Incident Command Centers are established for each agency independently.
- Usual cell phone use is encouraged to facilitate communications.
- There may be a mixture of both trauma and medical emergencies.

Correct Answer: E. There may be a mixture of both trauma and medical emergencies

In any disaster response, the safety and welfare of the rescuers is always the topmost priority, followed by that of the survivors and the surrounding people. A bomb explosion usually demands special bomb disposal squads from the military, hence, their authority to advise other agencies on issues of security and safety. Incident command centers (as part of the IC System) are standards of disaster response management and should be within agencies and between them. As in any radio-communication practice, call signs and codes are utilized to facilitate communications. A bomb explosion is anticipated to cause cases of blast lung, burns, ruptured globe, or tympanic membrane and also possibly angina or myocardial infarct, exacerbation of asthma, COPD, smoke inhalation, etc.

Take-Home Message

In mass disaster scenarios, it is important to anticipate both trauma and medical emergencies.

ABP Content Specification

- Plan Emergency Department preparation for mass casualty incidents.

Question 31

A 17-year-old boy presents to your Emergency Department after being found obtunded. In his workup, a brain CT is done; bilateral globus pallidus low-density lesions are reported. What MOST likely diagnostic possibilities would you consider?

- Methanol, hydrogen sulfide, or CO poisoning
- CO₂ poisoning
- Chlorine gas poisoning
- Ethanol or ethylene glycol poisoning
- Methane or butane gas toxicity

Correct Answer: A. Methanol, hydrogen sulfide, or CO poisoning

CT of the brain in patients with severe CO exposure may show signs of cerebral infarction secondary to hypoxia, ischemia, and hypotension. However, a well-reported finding is bilateral globus pallidus low-density lesions. The development of this lesion has been correlated with low local blood flow to the globus pallidus, metabolic acidosis, and hypotension during CO poisoning in animal models. Globus pallidus lesions may be delayed several days after initial presentation and may resolve with time. Concomitant white matter lesions also may be seen. Although globus pallidus lesions are not pathognomonic for CO poisoning and may be seen in other intoxications, such as methanol or hydrogen sulfide poisoning, their presence should alert the clinician to the possibility of CO exposure. MRI in patients with CO exposure may show diffuse, symmetric white matter lesions, predominantly in the periventricular areas, although the centrum semiovale,

deep subcortical white matter, thalamus, basal ganglia, and hippocampus also may be affected.

Take-Home Message

Globus pallidus low-density lesions seen on CT head often suggest CO poisoning.

ABP Content Specification

- Understand the pathophysiology of inhalation injuries and carbon monoxide and cyanide poisoning in infants and young children.

Question 32

You have been recruited to be on your hospital's emergency response team for radiation disasters in the city. Apart from individual exposure time and presence of intervening shielding, what other factor is most important in determining the radiation dose received?

- Season of the year
- Activity of the individual during exposure
- Presence of comorbidities
- Distance from the source
- The age of the patient

Correct Answer: D. Distance from the source

The individual's exposure time, any intervening shielding, and distance from the source are most important in determining the dose of radiation received. The other factors may influence the effect of the exposure to a small degree; these factors may include what sort of clothing is worn and duration of exposure due to what they are doing at the time and what tissues are most sensitive.

Take-Home Message

An individual's radiation exposure time along with actual distance from the radiation are the most important determinants of radiation dose received.

ABP Content Specification

- Plan Emergency Department preparation, healthcare worker protection, and patient decontamination in radiation exposure.

Question 33

A teenager presents to the Emergency Department with a swollen painful left lower leg, aggravated on walking. His vital signs are temperature 36 °C (Oral), heart rate 99 beats/minute, respiratory rate 20 breaths/minute, blood pressure 104/51 mm Hg, and oxygen saturation 100% on room air. The lower leg is tender to palpation, and passive movements inflict further pain. Intra-compartmental pressure registers 45 mmHg on the Stryker™ device. After starting a normal saline bolus, which of the following statements BEST describes your management?

- A. If the compartment syndrome is due to snake-bite, then fasciotomy might not prevent myonecrosis.
- B. His measured intra-compartmental pressure is NOT a strong indication for fasciotomy.
- C. Mannitol should be initiated early as an evidenced-based treatment for compartment syndrome.
- D. Administer strong analgesics and elevate his leg for pain relief.
- E. Supplemental oxygen therapy will be redundant given his pulse oximetry reading.

Correct Answer: A. If the compartment syndrome is due to snakebite, then fasciotomy might not prevent myonecrosis.

It appears that myonecrosis associated with compartment syndrome after envenomation is multifactorial and that fasciotomy may not prevent myonecrosis. Myonecrosis is thought to be due to a direct toxic effect of the venom and the inflammatory response. Therefore, these patients should be aggressively treated with antivenom if available because this method has been shown to decrease limb hypoperfusion.

Compartment pressures of 30 mmHg are typically considered to be the appropriate threshold for performing fasciotomy, and in this case the pressure is high enough to warrant fasciotomy. There is some evidence that mannitol may be useful in treating compartment syndrome, but this remedy is not definitive, and mannitol is not

a standard component in treatment of compartment syndrome. Elevation of the legs will not decrease intra-compartmental pressure, but will work to decrease perfusion pressure. Supplemental oxygen is indicated in treatment of compartment syndrome, as is IV fluid therapy.

Take-Home Message

The mechanism for compartment syndrome after snake bite is multifactorial, and fasciotomy alone may not prevent myonecrosis.

ABP Content Specification

- Plan the management of snake envenomation.

Question 34

A 13-year-old boy is winter camping with his family when he is caught in a blizzard and gets lost. He is rescued the next day, found wandering in subzero temperatures. He is brought to the Emergency Department where he complains of foot numbness. The toes on both feet are dry and appear pale and waxy with mild swelling. He has sensation over the dorsum of both feet but not at the toes.

What is true regarding this condition?

- A. Does not require actual tissue freezing to occur.
- B. Most common presenting symptom is pain.
- C. Tetanus booster is not required.
- D. Requires rapid rewarming by immersion in warm water.
- E. Presence of hemorrhagic blebs would be reassuring.

Correct Answer: D. requires rapid rewarming by immersion in warm water.

Frost bite occurs when tissues are exposed to subfreezing temperatures and ice crystals form, resulting in cellular damage and microvascular thrombosis. A common symptom is numbness and a “dead weight” feeling of hands or feet. Clear vesicles can form early and are similar to second-degree burns involving the dermis.

Hemorrhagic blebs develop late and indicate subdermal vascular injury, akin to third-degree burns and associated with poorer outcome. The treatment is rapid rewarming with warm water immersion, which will result in hyperemia, edema, and pain. After rewarming, frostbite is treated like a burn with elevation and sterile dressings. Clear vesicles can be debrided to prevent thromboxane-mediated tissue injury. Hemorrhagic blisters should be left intact to reduce risk of infection. Tetanus booster should be given if not up to date.

Take-Home Message

Treatment of frostbite is to rapidly rewarm the affected extremity with warm water immersion.

ABP Content Specification

- Plan the management of local hypothermia.

Question 35

A group of children got into a construction site, and one of them presents to the ED after getting hot tar spilled on his right arm. The safety manager on the scene immersed his arm in a pail of cold water. The tar is currently solidified and cool. Which of the following do you want to use to remove the tar?

- Naphthalene (aromatic hydrocarbon)
- Normal saline
- Viscous lidocaine
- Bacitracin ointment
- None, to prevent further injury

Correct Answer: D. Bacitracin ointment

Hot tar burns should be managed by first using cold water until the tar is hardened and cool. The tar should then be removed to prevent bacterial growth at the site of injured skin. Organic solvents can theoretically be useful for this purpose, but can be systemically absorbed and cause their own ill effects. Bacitracin ointment does not cause systemic or local toxicity but allows for tar removal due to its petrolatum ointment component, while also providing antibacterial effects.

Normal saline will not assist in removing tar and neither will viscous lidocaine.

Take-Home Message

Hot tar burns should be managed by first using cold water until the tar is hardened and cool and then application of bacitracin that facilitates removal.

ABP Content Specification

- Plan the acute management of burns.

Question 36

A 17-year-old boy complains of pain and swelling in his right hand and forearm, perioral numbness, and vomiting after being bitten by a rattlesnake. His vital signs are temperature 36.2 °C (oral), heart rate 112 beats/minute, respiratory rate 20 breaths/minute, blood pressure BP 90/61 mm Hg, RR 20, and oxygen saturation 98% on room air. His arm looks swollen with numbness up to the elbow and finger movements aggravated by pain, but pulses are intact and equal. At this stage, you would manage him with the following:

- Maintenance fluids
- Administration of 10 vials of antivenom
- Measurement of electrolytes
- Urgent fasciotomy of the hand and forearm
- Supplemental oxygen

Correct Answer: B. Administration of 10 vials of antivenin

The mainstay of treatment after rattlesnake bites is neutralization of the venom with antivenin. Large amounts of antivenin may be required. Crotalid antivenom currently used in the United States is CroFab, which is a Fab product that does not cause any anaphylactic reaction and is very safe. Coagulation factors and platelets should be checked in all snakebite victims to help determine the severity of envenomation, but electrolytes are not expected to be altered. Supportive care, including fluid resuscitation, is important

for all patients with pit viper envenomation. If compartment syndrome is suspected, then pressures should be measured. In this case, there is some concern about a condition that may be developing into compartment syndrome, but no measurement of compartment pressures has taken place; at this point, there is no diagnosis of compartment syndrome.

Ideally, fasciotomy should be performed when compartment pressures remain above 30 mm Hg *AND* after “failed” medical treatment. Though some toxicologists and emergency physicians prefer treatment with antivenom as first-line therapy for compartment syndrome associated with rattlesnake envenomation, medical treatment alone without fasciotomy is not standard of care. In this case, it is irrelevant because the patient does not have compartment syndrome.

Take-Home Message

Crotalid antivenom (CroFab) is an effective and safe antidote for bites from rattlesnakes.

ABP Content Specification

- Plan the management of snake envenomation.

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