Pediatric Envenomations: Don’t Get Bitten By An Unclear Plan Of Care

Abstract

Children are frequently victims of terrestrial animal and insect bites and stings. While the majority of these bites or stings are non-dangerous, pediatric patients occasionally encounter a venomous animal. In such cases, children may present to the emergency department for evaluation and management. This review presents the basic epidemiology of bites and stings of spiders, bees and wasps, fire ants, scorpions, and snakes, but it primarily focuses on the underlying pathophysiology and clinical presentation of the envenomated patient. While the pathophysiology and much of the presentation and treatment are the same for both children and adults, there are occasionally subtle differences, which will be highlighted. The management and disposition of pediatric patients for each type of bite or sting will also be discussed.

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loxoscelism include various infections (bacterial, fungal, parasitic, and viral), necrotizing vasculitis, vascular occlusive disease, and a host of various systemic diseases with cutaneous manifestations (eg, pyoderma gangrenosum, pemphigus).

Widow Spiders

Epidemiology

Widow spiders, which belong to the genus *Latrodectus*, are common worldwide and can be found in Africa, Europe, Australia, Southeast Asia, and the Americas. In the United States, they are indigenous to every state except Alaska. There are > 30 different species of *Latrodectus* known to exist. The female black widow spider is black, with a 12- to 16-mm thorax and a shiny red hourglass on the ventral side. (See Figure 1.) The male black widow is smaller and is not capable of causing human envenomations.

Pathophysiology

The primary toxin contained in the *Latrodectus* species is alpha-Latrotoxin, a neurotoxin that binds to latrophilin-1 and neurexin receptors on the presynaptic neuron. Binding to these receptors results in the exocytosis of multiple neurotransmitters (including acetylcholine, glutamate, and norepinephrine) via both calcium-dependent and calcium-independent mechanisms.

Clinical Presentation

The initial bite is often painful, and a “target” lesion (which consists of an area of central pallor surrounded by erythematous rings) may be present. Among patients with these lesions, approximately 25% may develop latrodectism. This syndrome is characterized by pain, sympathomimetic effects, and other unique manifestations. The pain may be localized at the site of the bite, but it frequently causes severe muscle pain and spasms of the back, abdomen, and chest muscles. Clinicians should note that the rigidity of the abdominal musculature may mimic an

Spiders

It is estimated that nearly 40,000 unique species of spiders exist worldwide. However, despite the large number of spiders, human toxicity is rare for several reasons. First, spiders are frequently too small to be able to inject venom through human skin. Second, the small quantity of venom in most spiders, along with the lack of physiologic activity between most spider venom and humans, also contributes to toxicity being somewhat rare.

In the absence of a clear history of a spider bite, it is imperative that the clinician consider alternative etiologies, as numerous medical conditions are frequently misdiagnosed as spider bites. Some conditions that have been incorrectly diagnosed as
diagnosed in virtually every state in the United States, including many states in which the spider does not reside. The bites are most common on the trunk, thigh, or upper arm. Bites on the hands, feet, neck, or face are rare. 

Fatalities from Loxosceles laeta, which is primarily in South America, are well described. In the United States, however, fatal cases have been reported from envenomation by Loxosceles reclusa, although the exact prevalence has been debated and appears to be much less common than its South American counterpart.

Pathophysiology
There are several different components to the venom, which have various unique properties; however, the primary component, sphingomyelinase, is the principle constituent and is responsible for the dermonecrotic lesions characteristic of brown recluse envenomations.

Clinical Presentation
Following a bite from a Loxosceles spider, 1 of 4 events can occur: (1) no effects; (2) pain and erythema without systemic manifestations or sequelae; (3) dermonecrotic injury with eschar formation; or (4) systemic manifestations. The initial bite is often painless, and patients are frequently not immediately aware of the bite. Over the next several hours, erythema, pruritis, and a burning pain may develop. The bite area itself can become pale in appearance, and the surrounding tissues may become erythematous and edematous. The more severe envenomations can develop a central blue-gray wound accompanied by a bull’s eye lesion with an erythematous center, a white ring of induration, and an outer acute abdomen. Autonomic manifestations include tachycardia, hypertension, and diaphoresis. Importantly, the diaphoresis and muscle spasms can either be diffuse or confined to the region of the envenomation. Unique, but manifestations include paresthesias. The pain and local paresthesias generally develop over the first 10 to 60 minutes postenvenomation, whereas the systemic manifestations generally develop over the subsequent 2 hours. Symptoms generally peak during the first 48 hours and decline within 2 to 3 days, but they can persist for up to a week or longer.

Treatment
The primary treatment consists of aggressive supportive care. In the past, it was felt that intravenous calcium gluconate should be administered. However, due to data demonstrating its lack of efficacy, this treatment is no longer recommended. The primary treatment consists of titration of benzodiazepines for the muscle spasms and opioids for pain control. Whole immunoglobulin G antivenom has been available for many years, but it should not be considered first-line therapy due to the relatively high rate of immediate (anaphylactoid) or delayed (serum sickness) allergic reactions. It should be noted that, in a recent review of black widow envenomations in the United States, no deaths have been ascribed to the Latrodectus envenomation itself, although deaths have occurred due to administration of the antivenom. Discussion with a medical toxicologist either on staff or at a Poison Control center (1-800-222-1222) is recommended prior to administering Latrodectus antivenom.

Recluse Spiders

Epidemiology
Loxosceles reclusa is commonly referred to as the brown recluse or fiddleback spider, owing to the unique shape of a violin on its cephalothorax. These spiders are light or dark brown and are 8 to 15 mm long. (See Figure 2.) They primarily live in small, irregular webs and are frequently found in boxes, furniture, and basements or under rocks or wood. There are approximately 100 species of Loxosceles, which are typically found in the tropical and subtropical geographic distribution, although some reside in more temperate distributions. In the United States, they are primarily found in the South and Southeast, extending from Texas to Georgia and the Gulf of Mexico to Missouri and southern Illinois.

They are most active at night and generally bite when threatened. Because toxicity from these bites primarily manifests as necrotic dermal lesions, various soft tissue infections are frequently incorrectly ascribed to envenomation from this spider. Envenomation from the brown recluse has been diagnosed in virtually every state in the United States, including many states in which the spider does not reside. The bites are most common on the trunk, thigh, or upper arm. Bites on the hands, feet, neck, or face are rare. Fatalities from Loxosceles laeta, which is primarily in South America, are well described. In the United States, however, fatal cases have been reported from envenomation by Loxosceles reclusa, although the exact prevalence has been debated and appears to be much less common than its South American counterpart.

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The order *Hymenoptera* contains 3 medically important families: *Apidae* (honeybees and bumblebees), *Vespidae* (yellow jackets, wasps, and hornets), and *Formicidae* (fire ants).

**Bees And Wasps**

**Epidemiology**

*Hymenoptera* envenomations are the most common envenomation in the United States. Honeybees, bumblebees, and wasps are fairly passive animals, and they avoid humans unless disturbed. Paper wasps andumble bees generally live in hives containing 100 to 200 insects, and they are typically not involved in mass envenomations. Social wasps (which include hornets and yellow jackets) and honeybees can be involved in massive envenomations, especially if their colonies are threatened. Most cases of human toxicity from bee stings occur as a result of an immunoglobulin E-mediated anaphylactic reaction, presenting with classic diffuse urticarial hives, bronchoconstriction, and hypotension. Deaths due to anaphylaxis are more common than anaphylactoid reactions due to massive envenomation. However, it is important to recognize that, regardless of whether a patient is experiencing an anaphylactic reaction or an anaphylactoid reaction, the treatment is essentially identical. These envenomations are best treated with a combination of H1 and H2 antagonists, steroids, and epinephrine. Because pediatric patients are usually smaller than adults, there is a relatively greater amount of venom in each sting per kilogram of body weight. Consequently, massive envenomations are potentially more dangerous in the pediatric population compared to the adult population. In addition, children may be more predisposed than adults to suffer from massive envenomations due to their inherent inquisitiveness, lack of awareness of dangers associated with *Hymenoptera*, and reduced ability to effectively flee an attack.

Yellow jackets are 10 to 15 mm in length, whereas hornets are 15 to 40 mm in length. These insects reside in colonies of several hundred to a few thousand insects. Honeybees (*Apis mellifera*) generally reside in colonies consisting of approximately 40,000 worker bees and 1 queen bee. The stinger of a honeybee is barbed, causing it to remain in mammalian flesh. Because the stinger of the honeybee is attached to its abdomen, any attempt at removing the stinger results in disarticulation of the honeybee. Consequently, the honeybee is only able to sting once. In contrast, the stingers of vesps (eg, yellow jackets, wasps, and hornets) and bumblebees are not barbed, and the insect can pull itself out of the flesh after stinging without killing itself. As a result, bumblebees and vesps can sting multiple times. Because these bees are attracted to carbon dioxide,
they selectively target the head and neck region.

The Africanized honeybee (Apis mellifera scutellata) was originally introduced in Brazil in an effort to make more effective honey manufacturing. In 1957, the bees from 26 hives escaped and have progressively headed north. Unlike their non-Africanized counterpart, the Africanized insects are slightly smaller, but they frequently swarm in large populations. In addition, these bees are capable of long flights without stopping and will often attack victims following minimal provocation. While the venom components are not significantly different from their European counterparts, the quantity of stings associated with the Africanized honeybees’ habit of swarming makes them potentially fatal, as the cumulative venom dose is much greater.

Pathophysiology
The venom of virtually all Apis species (eg, honeybee and bumblebee) is similar, with small variations occurring in the quantities of the various components. The primary component of honeybee venom is melittin, which causes toxicity by inserting itself into the phospholipid bilayer of the cell membrane. Consequently, it results in destruction of red blood cells, platelets, and the vascular endothelium. In addition to melittin, the phospholipase A2 enzyme is another prominent component of honeybee venom and is considered the primary allergen. Other components cause histamine release and inflammatory reactions.

Other than anaphylactic reactions in those with prior immunity and allergy to honeybees, most envenomations result in local pain, erythema, and edema. Massive envenomations, however, can result in significant systemic manifestations, regardless of prior immunity or exposure. Based on animal models, it has been estimated that the median lethal number of stings is 18 stings per kilogram body weight. However, deaths in Arizona have been attributed to 100 to 130 stings in an adult. Systemic manifestations after massive envenomations frequently include gastrointestinal complaints (such as vomiting and diarrhea). Third-spacing of fluids and edema can occur, with resultant hypotension and shock. Hemolysis, rhabdomyolysis, hepatic injury, renal failure, cardiac toxicity, and multisystem organ failure can ensue. Importantly, many of these manifestations may not be immediately apparent and may only develop following a delay of 8 to 12 hours.

Treatment
The immediate management of patients with massive Hymenoptera envenomations involves removing the individual from the site of the bees. The next step in management involves ensuring that the patient has a patent airway. Facial edema may develop, and if progressive, endotracheal intubation may be required. Aggressive fluid resuscitation with crystalloids should be administered with a starting dose of 20 to 40 mL/kg, up to a maximum of 2 L. Additional fluid therapy should be guided by clinical response. Systemic corticosteroids (eg, 1 mg/kg of intravenous methylprednisolone) should be administered in a timely fashion. Any patient with hypotension or evidence of shock should receive epinephrine, which can be administered either as a continuous intravenous infusion or as an intramuscular injection. Antihistamines and analgesics should be administered as indicated. Any patient with systemic manifestations should be admitted to an intensive care unit. Because of the potential for delayed onset of many symptoms, any child who has > 50 stings (or 2 stings per kilogram) from a honeybee should be admitted to a monitored setting for 24 hours. For pediatric patients with < 50 stings, laboratory parameters should be obtained at presentation and at 6 hours after presentation. These laboratory tests should assess for renal injury, hepatic injury, cardiac injury, rhabdomyolysis, hemolysis, and coagulopathy. If any of these are present, the patient should be admitted to an intensive care unit, regardless of the number of stings. Patients who suffer systemic manifestations as a result of an anaphylactic reaction (but not necessarily from a massive envenomation) should be given a prescription for an epinephrine auto-injector and a referral to an allergist upon discharge.

Research has demonstrated that 90% of a bee’s venom is injected within the first 20 seconds after a sting, and virtually 100% is injected at 1 minute. Consequently, the initial management of victims of massive hymenoptera envenomations should not focus on removal of the stinger. Furthermore, in the past, it was suggested that a credit card or other object should be used to scrape out the stinger (rather than pulling it out with tweezers or forceps) to avoid further release of venom. However, because it is now recognized that the stinger is deplete of venom by the time the patient reaches the hospital, the method of removing the stinger is inconsequential. Although removal need not be a priority step in management, stingers are a foreign body and can act as a potential irritant, and they should be removed when the patient is stabilized.

Fire Ants
Epidemiology
Fire ants belong to the order Hymenoptera and the family Formicidae. While some fire ants are indigenous to the United States, most of the fire ants that cause problems to humans and crops are red fire ants (Solenopsis invicta). These were introduced to Alabama in the early 20th century and have subsequently spread throughout the Southeast. Fire ant stings may be lethal due to either anaphylaxis or
massive envenomation. As with other Hymenoptera, fatalities due to anaphylaxis often occur shortly after the envenomation, whereas death from massive envenomation may be delayed > 24 hours. The majority of fatal cases of fire ant envenomations in the United States have occurred in Florida and Texas.

Unlike other hymenoptera, which primarily attack when threatened, fire ants are aggressive. Attacks on livestock and wildlife are common, but indoor attacks on debilitated humans (eg, nursing home patients) are increasingly being reported. Fire ants are typically 3 to 4 mm in length, although the queen fire ant can be up to 1 cm in length. Mounds with multiple queens can contain up to 500,000 worker fire ants. Prior to stinging, the fire ant bites its prey, locking its mandibles into the soft tissue of the prey. The fire ant subsequently stings and withdraws the stinger, as the stinger is not barbed. While remaining attached to the victim with the strong mandible, the fire ant will rotate its body and sting again multiple times.

Pathophysiology
The venom of fire ants is a water-insoluble alkaloid. The primary components of the venom include a hyaluronidase, a phospholipase, and the enzyme N-acetyl-beta-glucosaminidase. The venom has hemolytic, cytotoxic, and neurotoxic components. It inhibits sodium-potassium adenosine triphosphatase, reduces cellular respiration, and uncouples oxidative phosphorylation. In addition, the venom can result in impaired neutrophil and platelet function, which activates the coagulation system, and results in a hypercoaguable state.

Clinical Presentation
Following envenomation, 1 of 3 patterns of toxicity can be observed. A local wheal and flair can occur within 20 minutes of the exposure. This reaction is typically 25 to 50 mm in diameter. Approximately 2 hours after the appearance of the wheal, vesicles or pustules can develop. The fluid inside the vesicles is initially clear, but it becomes cloudy within 8 hours. Although cloudy, the contents of the pustule are typically sterile. Necrosis can develop within 24 hours. Some patients can progress to develop large local reactions, which are immunoglobulin E-mediated and mast cell dependent. Occasionally, these lesions are large enough to cause some vascular compromise.

While anaphylactic reactions can occur in predisposed individuals who are stung a single time, the systemic manifestations from massive fire ant envenomation typically require a minimum of 50 to 100 stings to occur. These manifestations are a direct response to the venom, and they include rhabdomyolysis, disseminated intravascular coagulation, and seizures. Diffuse urticarial rash, bronchoconstriction, and cardiovascular collapse can occur.

**Treatment**

Treatment for cutaneous symptoms is largely supportive. Antihistamines, topical corticosteroids, and cool compresses may be beneficial. Lidocaine (administered topically or via subcutaneous injection) has occasionally been recommended to help control pain. Patients with systemic toxicity should receive aggressive supportive care in an intensive care unit. Hypotension should first be treated with intravenous fluid resuscitation (eg, 20 cc/kg normal saline for pediatric patients), along with epinephrine as either an intramuscular injection or as a continuous intravenous infusion. Systemic corticosteroids and antihistamines should be administered as well.

**Scorpions**

**Epidemiology**
Scorpions are arthropods in the class Arachnida. While there are more than 1400 species of scorpions worldwide, only 30 are capable of producing clinically significant envenomation. The only scorpion in the United States that is potentially lethal is the bark scorpion (Centruroides sculpturatus). This scorpion is found in the Southwest, especially Arizona. *C sculpturatus* scorpions are a tan-brown color and range from 1.3 to 7.6 cm in length. It is the only North American scorpion capable of walking up a vertical wall. The scorpion body consists of 4 pairs of legs, a pair of grasping claws, mouthparts, a thorax, and a tail. The tail is a 6-segmented structure extending from the abdomen and terminating in a pointed telson, which contains paired venom glands and the stinger.

While scorpion stings are quite common in the Southwest, most cases result in only minor toxicity. Despite stings to adults being more common than stings to children, children are disproportionately severely envenomated and are more likely than adults to require intensive supportive care. In the 1930s, there were 40 deaths reported due to scorpion envenomations, with most of these cases occurring in infants and children. Due to improvements in access to care as well as the medical care itself, deaths due to scorpion envenomations are currently extremely rare.

**Pathophysiology**
The venom of the bark scorpion is a complex mixture of various proteins, including neurotoxins, which act on the sodium channels during their depolarized state, resulting in an inactivation of the channel. The end result is a prolonged action potential and increased and repetitive axonal firing. Consequently, the venom results in increased release of acetylcholine and catecholamine.
Clinical Presentation
Following a sting, most patients exhibit relatively minor symptoms, primarily local pain. Because the venom lacks any dermonecrotic components, the sting site is frequently not visible. Nonetheless, a tap test (in which tapping on the envenomated area elicits a painful reaction) can assist clinicians in establishing the diagnosis in cases of diagnostic uncertainty. A grading system has been developed to classify envenomations. A grade I envenomation results in pain and/or paresthesias confined to the envenomation site. A grade II envenomation has pain and/or paresthesias both at the sting site as well as at a more remote site. Grades III and IV envenomations are characterized by the presence of either cranial nerve or skeletal muscle dysfunction (grade III), or both cranial nerve dysfunction and skeletal muscle dysfunction (grade IV). Most patients with high-grade envenomations have tachycardia, hypertension, and diaphoresis. Vomiting occurs in approximately one-third of patients with severe toxicity and it typically occurs relatively early during the clinical course and resolves spontaneously. Cranial nerve abnormalities include tongue fasciculations, opscoclonus-like roving eye movements, and bulbar muscle dysfunction resulting in impaired swallowing. Drooling is common, and aspiration is possible. Commonly encountered neuromuscular abnormalities include fasciculations, opscoclonus, ataxia, and flailing of the extremities.

Treatment
Historically, antivenom therapy consisted of whole immunoglobulin G derived from goat serum. Because of its structure, it was very immunogenic, and both immediate (anaphylactoid) and delayed (serum sickness) hypersensitivity reactions were common. Manufacturing of this antivenom was discontinued in 2001. After remaining supplies of the antivenom were exhausted, supportive care was the only option available to patients outside of clinical trials. In August 2011, a Fab2 anti-Centruroides antivenom was approved by the United States Food and Drug Administration (FDA) for the treatment of severe scorpion envenomations. The recommended initial starting dose of this antivenom is 3 vials, with additional vials given as needed. Importantly, the number of vials is independent of the patient’s weight; thus, the starting dose is the same for both children and adults.

Because of the cost of the antivenom, many clinicians may prefer aggressive supportive care rather than antivenom administration. Such supportive care includes parenteral opioid analgesics (eg, fentanyl 1-2 mcg/kg) in conjunction with benzodiazepines (eg, midazolam 0.01-0.05 mg/kg). During the time span when antivenom was not available, 20% of pediatric patients presenting with high-grade envenomations in Arizona required endotracheal intubation for respiratory failure. Thus, while most patients who are envenomed develop minimal, if any, symptoms, the clinician treating patients with high-grade envenomations must be prepared to perform aggressive supportive care, possibly including endotracheal intubation with mechanical ventilation. (Please refer to the Pediatric Emergency Medicine Practice article titled “Evidence-Based Emergency Management Of The Pediatric Airway,” available at www.ebmedicine.net/pediatricairway.)

Snakes
Epidemiology
Worldwide, venomous snakes account for more cases of severe morbidity and mortality than any other organism. It is estimated that nearly 2.5 million individuals are bitten by venomous snakes annually, with 125,000 individuals dying as a result of these envenomations. There are approximately 3000 unique species of snakes, of which 600 are venomous and 200 are medically important. Venomous snakes that are indigenous to the United States include the Elapidae (coral snakes) and the Viperidae (pit vipers). In the United States, it is estimated that 9000 individuals will be bitten annually by venomous snakes, with 5 resultant deaths. Rattlesnakes not only account for the majority of the envenomations, but they are also responsible for the greatest amount of morbidity and mortality.

While snake venoms are quite heterogeneous among different species, they all serve 3 main purposes: (1) acquisition of prey; (2) digestion of prey; and (3) defense from real or perceived threats. The venom of the crotalids (copperhead snakes, cottonmouth snakes, and rattlesnakes) is not only directly destructive to local tissues, but it also results in increased capillary permeability and inhibits platelets and fibrinogen. Some species also contain a neurotoxic component. As a general rule, the venom can be divided into low-molecular-weight proteins and peptides that are directly toxic to specific cell types and enzymes that break down specific tissues or cell membranes. The exact venom composition varies among different species of snakes and even differs within a given snake species, depending on the time of year, the age of the snake, and its geographic location.

Crotalidae
Pathophysiology
Various metalloproteinases are associated with hemorrhagic effects in Crotalidae venom. These metalloproteinases destroy the basement membrane and capillary endothelial cells, ultimately resulting in edema and ecchymosis. Platelets then occlude damaged capillaries. The venom can also affect the
coagulation cascade, resulting in coagulopathy. Due to an inability of the venom to activate factor XIII, fibrin cross-linking does not occur, and the body’s endogenous fibrinolytic system degrades the ineffective clot, resulting in hypofibrinogenemia and fibrinolysis. Thrombocytopenia can occur relatively early after the envenomation due to platelet aggregation, sequestration, and consumption.

_Crotalidae_ snakes (also called pit vipers because of the presence of a heat-sensing pit on the head of the snake) are characterized by the presence of long, highly mobile, hollow fangs, which permit the snake to strike its prey and quickly retreat. In approximately 75% of cases, venom is deposited in the subcutaneous tissue. The remaining 25% are “dry bites” in which no venom is injected. Because venom can be deposited through either fang, clinically significant envenomations can occur even if there is only a single puncture wound. Conversely, because the snakes also have small teeth, some individuals will have >2 puncture wounds noted. Local oozing is often noted from the puncture wounds. However, despite profoundly abnormal laboratory values, clinically significant hemorrhage is very uncommon.

### Clinical Presentation

Nausea, vomiting, and tachycardia may occur shortly after the bite. Hypotension may occur and is often multifactorial in origin, including preexisting dehydration and third-spacing of fluids from increased capillary permeability. While rare, hypotension can also occur in the setting of anaphylactoid reactions. In this setting, other manifestations of anaphylactoid reactions (including bronchospasm and urticarial rash) may be present.

Typically, within a few hours of venom deposition, pain and edema occur. However, especially in children with lower extremity envenomations, the onset of the edema may be delayed. Following venom deposition, the venom is absorbed and transported through the lymphatic system. Consequently, individuals will frequently develop tenderness over the proximal lymph nodes (eg, the femoral lymph nodes in the case of lower extremity bites and the axillary lymph nodes in the case of upper extremity bites). Patients envenomed by multiple pit vipers often complain of a metallic taste in their mouth. Localized neuromuscular effects (such as fasciculations and myokymia) may be present, depending on the specific species of snake. The Mojave rattlesnake can contain either of 2 distinct types of venom: A or B. Snakes that contain venom A (which contains Mojave toxin) have a curare-like mechanism of action that can result in a nondepolarizing neuromuscular blockade.

The initial evaluation of a patient with a suspected pit viper envenomation should focus on a thorough history and physical examination. Se-
All patients who receive antivenom should receive a fluid bolus of at least 20 mL/kg. Patients with copperhead bites often only require a single dose of 4 vials, but patients can be redosed in the rare setting of recurrent symptoms.

The initial dose of antivenom should be administered in a minimum concentration of 250 mL of normal saline. The infusion should start at 25 mL/hr and be steadily doubled every 5 to 10 minutes, such that the full infusion should be completed in just over 1 hour. With each rate increase, evidence of anaphylactoid reaction should be assessed. If an anaphylactoid reaction occurs, the infusion should be stopped while 1 mg/kg of diphenhydramine is administered. If continuation of the antivenom is indicated, the infusion should be restarted at a lower rate, with concurrent infusion of epinephrine, if required. While the rates of anaphylactoid reaction are much lower with CroFab® antivenom than with Wyeth® antivenom, it is still recommended that antihistamines, corticosteroids, and epinephrine be immediately available when administering antivenom.

In addition to antivenom administration, it is important to ensure adequate supportive care. Patients should have local wound care, which includes debridement of any hemorrhagic blebs that form. Tetanus vaccinations should be updated, as indicated.

Patients treated with antivenom may develop recurrence of symptoms or reactions several days after the initial treatment, in which thrombocytopenia, coagulopathy, or both occur, even if these were not initially present. Therefore, any patient who receives antivenom, or who has any manifestations of toxicity, should have laboratory parameters obtained at 2 to 4 days and at 5 to 7 days after the last dose of antivenom.5

**Elapidae**

Coral snakes are the only venomous elapids that are indigenous to North America. These snakes are brightly colored and easily identifiable by their alternating red, yellow, and black color bands. Coral snakes are often confused with the nontoxic king snake. However, several features can be used to distinguish these 2 snakes. The red band touches the yellow band in the coral snake, while the red band touches the black band in the king snake, leading to the well-known adage, “Red on yellow kills a fellow. Red on black, venom lack.” (See Figure 3.) Furthermore, king snakes have a red snout, while the coral snake has a black snout.

Among the coral snakes, the Sonoran coral snake (Micruroides euryxanthus) is not considered a medically important snake, as no case of toxicity has been described following a Sonoran coral snake bite. In contrast, the Eastern coral snake (Micrurus fulvius) and the Texas coral snake (Micrurus tener) are much more potent.

**Pathophysiology**

Unlike the fangs of the rattlesnake, coral snakes have small, fixed, rear teeth, necessitating the snake to remain attached for up to several seconds in order for venom delivery to occur. Coral snake fangs are smaller, less mobile, and more posteriorly oriented. Consequently, the snake is not able to rapidly strike; rather, it must “chew” on the victim in order to inject venom.

Coral snake bites typically do not result in significant tissue destruction. However, the neurotoxic effects can develop in a delayed fashion.37 Such neurologic effects include ptosis, bulbar muscle weakness, fasciculations, and, ultimately, respiratory arrest. The proximate cause of death in most coral snake envenomations is respiratory arrest. Symptom onset can be delayed for up to 12 hours. Therefore, with the exception of the Sonoran coral snake, all patients bitten by North American elapids should be admitted for observation. Significant hematologic effects should not be expected.

**Treatment**

There are no data demonstrating benefit from the use of pressure immobilization bandages in clinical practice with North American neurotoxic elapid envenomations, but in unique situations in which...
1. “The patient had an anaphylactoid reaction to the *Latrodectus* antivenom.”
   Reserve black widow (*Latrodectus mactans*) antivenom for individuals with end-organ dysfunction or those who are failing conservative management with opioids and benzodiazepines. Antivenom should not be a first-line therapy.

2. “The patient was bitten by a black widow, but the symptoms did not improve after calcium administration.”
   Do not administer calcium to patients with black widow bites, as data have demonstrated its lack of efficacy.

3. “This patient who resides in the Northeast was diagnosed with a brown recluse bite 2 days ago. However, on examination today, there appears to be significant cellulitis around the bite.”
   Be extremely cautious about making the diagnosis of a brown recluse bite in patients who live in areas outside the typical geographic distribution of the brown recluse spider. In such situations, the lesions are much more likely to be an abscess than a brown recluse bite. Do not mistake a necrotizing soft tissue infection for a brown recluse bite.

4. “We removed 200 bee stingers from the child, but he remains hypotensive.”
   Do not delay the initial resuscitation of a patient who presents following a massive *Hymenoptera* envenomation to remove the stingers. Research has demonstrated that 90% of a bee’s venom is injected within the first 20 seconds after a sting, and virtually 100% is injected at 1 minute. Consequently, the initial management of victims of massive hymenoptera envenomations should not focus on removal of the stinger.

5. “The patient was stung by 200 bees, but he looked good after 4 hours, so we sent him home. I don’t understand why he returned in renal failure 2 days later.”
   Observe pediatric patients with > 50 bee stings in a monitored setting for 24 hours, as many complications may have delayed onset.

6. “The patient looks like he has a classic anaphylactic reaction, but he has never been stung before.”
   Anaphylactic reactions to venom have preformed antibodies, while massive envenomations can result in anaphylactoid reactions without any prior exposure. However, the treatment is the same, and it should focus on ensuring airway patency and using epinephrine, fluid boluses, H1 and H2 antagonists, and corticosteroids.

7. “We applied a tight tourniquet to the arm of this rattlesnake bite victim to reduce absorption of venom.”
   Do not apply ice, tourniquets, suction devices or other similar objects to the skin of a rattlesnake bite, as systemic absorption may be increased. The envenomated limb should be splinted in extension and elevated.

8. “The patient was bitten by a rattlesnake, but he only had minor pain, so we gave him ibuprofen.”
   Avoid the use of nonsteroidal anti-inflammatory drugs for the treatment of pain associated with pit viper envenomation due to their antiplatelet effects.

9. “The snake had a combination of black, red, and yellow bands, and the patient didn’t have any symptoms, so we assumed it was a king snake even though we never saw the snake.”
   Do not mistake a coral snake bite for a king snake simply because of a lack of symptoms during the initial emergency department evaluation. If there is concern that a snake may have been an elapid and the patient was in an area where neurotoxic coral snakes reside, prolonged observation may be required to ensure that delayed neurotoxicity does not develop.
there is a significant delay to medical attention, pressure immobilization bandages may be considered for neurotoxic elapid envenomations. However, it should be noted that if the bandage is applied too tight, systemic absorption may be increased.

In the past, it was felt that all patients bitten by a coral snake should be admitted and receive antivenom. However, Wyeth Pharmaceuticals discontinued production of North American Coral Snake Antivenom, and supplies are limited. Thus, one approach is to observe all patients with potential coral snake bites in a monitored setting for 24 hours. Antivenom should be reserved for patients with neurologic abnormalities. In such individuals, 3 to 5 vials of antivenom should be administered in 250 mL of 0.9% sodium chloride at the first suggestion of any muscle weakness. If respiratory insufficiency develops and no antivenom is available, endotracheal intubation may be required.

For the past several years, the FDA has extended the expiration dates for the current antivenom due to limited supplies. There is currently a study in progress (clinical trial number NCT01337245) evaluating a new antivenom (which is a Fab2 fragment) for the treatment of coral snakes.

**Summary**

While bites and stings from venomous animals are somewhat rare, these cases will present to the emergency department, and it is imperative that clinicians correctly diagnose the bite or sting. This will allow for proper treatment to be administered. Clinicians should be mindful of the envenomations that require antivenom and those that can be treated with other methods. Knowledge of current information on the treatment for pediatric envenomations is key to proper care and disposition of these patients.

**Case Conclusion**

The patient’s laboratory tests were as follows: hemoglobin, 17.5 g/dL; platelets, 52x10⁹/L; prothrombin time, 58 seconds; and fibrinogen, <5 mg/dL. The patient was administered 6 vials of CroFab®. Despite the initial loading dose of antivenom, the edema progressed, although there was some improvement in the laboratory parameters when they were checked again. Because of the worsening edema, an additional 6 vials of antivenom were administered, and edema progression was halted. Subsequent laboratory values were improved. The patient was admitted overnight for serial examinations, laboratory tests, and additional antivenom therapy. After discharge, he was seen twice in follow-up and did not develop any evidence of recurrence. The patient made a full recovery.

**References**

Evidence-based medicine requires a critical appraisal of the literature based upon study methodology and number of subjects. Not all references are equally robust. The findings of a large, prospective, randomized, and blinded trial should carry more weight than a case report.

To help the reader judge the strength of each reference, pertinent information about the study will be included in bold type following the reference, where available.

13. Tambourgi DV, Gonçalves-de-Andrade RM, van den Berg CW. Loxoscelism: from basic research to the proposal of new therapies. Toxicon. 2010;56(7):1113-1119. (Review)
5. A 3-year-old boy has roving eye movements but no diffuse motor involvement following a scorpion sting. Which of the following grades most accurately describes the grade of envenomation?
   a. Grade I
   b. Grade II
   c. Grade III
   d. Grade IV

6. Which of the following prehospital therapies is recommended in the management of North American pit viper bites?
   a. Application of ice
   b. Use of a commercial suction device
   c. Splint and elevate
   d. Immersion in cold water

7. The use of antivenom may be considered for treatment of which type of envenomation?
   a. Massive Hymenoptera envenomation
   b. Massive fire ant envenomation
   c. Anaphylactic reaction to fire ants
   d. A Southern Pacific rattlesnake bite

8. Which of the following represents the ideal follow-up strategy after discharge from the hospital for a patient who received antivenom for a rattlesnake bite?
   a. Follow-up at 1-3 days and at 10 days
   b. Follow-up at 2-4 days and at 5-7 days
   c. Follow-up at 2 weeks only
   d. No follow-up is required.

9. Which of the following would be an indication for antivenom therapy after a coral snake envenomation?
   a. Dysphagia
   b. Thrombocytopenia
   c. Hyperfibrinoginemia
   d. Hypofibrinoginemia

10. Which of the following is frequently misdiagnosed as a brown recluse bite?
    a. Soft tissue infection
    b. Steven Johnson syndrome
    c. Gilbert disease
    d. Cushing ulcers
**Time- And Cost-Efficient Strategies For Treatment Of Pediatric Hematuria:**

1. Patients with isolated asymptomatic microscopic hematuria who are normotensive can be safely discharged from the emergency department with close follow-up by their primary care provider.

2. The most common cause of hematuria in children is urinary tract infection. Therefore, even without other signs or symptoms, urine microscopy and urine culture should be obtained.

3. Imaging is not necessary for isolated asymptomatic hematuria.

4. Patients with hematuria and signs of glomerular disease who are normotensive with normal urine output may follow up with pediatric nephrology as outpatients.

**Time- And Cost-Efficient Strategies For Pediatric Blunt Abdominal Trauma:**

1. Do not perform a “trauma panel” or head-to-toe computed tomography scan on every patient. Use the history and physical examination to guide workup. Ordering labs and imaging studies that are not necessary will lead to increased costs and unnecessary radiation exposure.

2. As per the Advanced Trauma and Life Support guidelines, the referring hospital should not obtain a computed tomography scan to avoid duplication of imaging unless it would somehow alter management. Imaging prior to transfer ultimately delays transfer to the trauma facility.

3. Patients who are asymptomatic, tolerating oral liquids, and ambulating without difficulty are likely safe to discharge, as long as they have adequate discharge instructions and can follow up with their primary care provider. Let clinical judgment guide decision making.
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