

PEDIATRIC Emergency Medicine Practice

Evidence-Based Education • Practical Application

CLINICAL CHALLENGES

- What are the typical presentations of common pediatric envenomations?
- For which types of envenomations is antivenom available, and what are the indications for its use?
- Which patients need observation, and how long should the observation period be?

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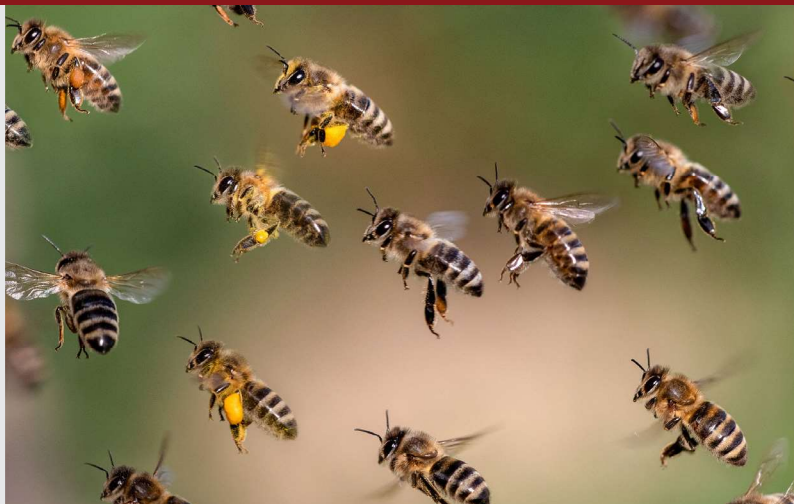
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Terrestrial Envenomations in Pediatric Patients: Identification and Management in the Emergency Department

■ Abstract

The majority of bites and stings from terrestrial animals are not dangerous. However, due to their smaller size, children may be more susceptible to the effects of venom, and they may experience more-severe envenomation effects than adults. This issue reviews the basic epidemiology and underlying pathophysiology of the bites and stings of spiders, bees and wasps, fire ants, scorpions, snakes, and lizards. Clinical presentations are reviewed, and evidence-based recommendations are provided for management of the envenomated patient. While the pathophysiology and much of the presentation and treatment are similar for both children and adults, there can be subtle differences, which will be highlighted in this review.



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Case Presentations

CASE 1

An 8-year-old boy presents after a rattlesnake bite on his right ankle...

- The boy was hiking with his parents when he was bitten by a rattlesnake. He says the pain began almost instantly.
- On examination in the ED, he has edema extending from the mid-foot to proximal to the knee. The calf compartments are soft. Ecchymosis is noted as well as oozing from the 2 puncture wounds.
- You order laboratory studies and wonder if antivenom administration is warranted.

CASE 2

A 9-year-old girl presents after she felt a “pinch” on her arm while raking leaves...

- While en route to the hospital, the girl developed worsening pain at the site and localized sweating over the affected extremity.
- In the examination room, the girl is crying, appears to be in great discomfort, and has abdominal cramping. Your examination is notable for a tiny puncture mark surrounded by 2 to 3 cm of erythema over the right arm but minimal edema.
- Based on these findings, you are concerned that this is a black widow bite. You recall that there is an antivenom, but you are not sure whether it would be the best choice for this patient.

CASE 3

A 17-month-old boy presents after awakening crying in his crib shortly after midnight...

- The boy resides in Arizona and was in his usual state of health when he went to sleep. The parents note that the boy is drooling, flailing all of his extremities, and has “funny” eye movements.
- On examination, no bite or sting marks are appreciated.
- Based on the findings and the geographical location, you are concerned for scorpion envenomation and wonder how to confirm the diagnosis.

■ Introduction

In 2018, the American Association of Poison Control Centers received more than 13,000 calls for bites and stings involving patients aged <20 years.¹ Due to underreporting, it is widely believed that these numbers significantly underestimate the true prevalence. Additionally, because of the relative rarity of these events and the potential for misidentification of the animal, the exact prevalence is not known. While many of these incidents involve relatively minor symptoms, severe toxicity and hospitalization are not uncommon, and, rarely, some envenomations can be fatal.

Neither the underlying mechanisms of action of the toxin nor the treatment recommendations differ substantially between pediatric and adult patients. However, due to their smaller size, children may be more susceptible to the effects of the venom, and they may experience more-severe envenomations than adults, especially in the case of scorpion or honeybee envenomation.

In an effort to minimize severe effects, antivenom is often used after envenomation. In the United States, antivenom is available for black widow spiders, bark scorpions, pit vipers (copperheads, cottonmouths, rattlesnakes), and coral snakes. Historically, most antivenoms were made from whole immunoglobulin. Wyeth North American coral snake antivenom was effective at

stopping progression of swelling and reversing systemic and other hematologic effects of the venom, but was associated with significant hypersensitivity reactions, some of which were immediate (eg, anaphylactoid reactions) and some of which were delayed (eg, serum sickness).² Consequently, a safer option was sought, which led to production of antivenom that contains Fab or F(ab')₂ fragments. Immunoglobulin G (IgG) is a large protein that is divided into an Fc (fragment, crystallizable) portion and a Fab (fragment, antigen binding) portion.² Enzymatic cleavage of IgG with papain can generate 2 Fab fragments, whereas cleavage with pepsin yields a V-shaped F(ab')₂ fragment.³ Such enzymatic cleavage allows isolation of the Fab portion, which retains the antigen-specific binding component, while eliminating the most immunogenic parts of the immunoglobulin. Because Fab and F(ab')₂ are small molecules, they have a distribution that mirrors the extracellular fluid and have a relatively rapid elimination. Most antivenoms in the United States today are either Fab or F(ab')₂.

This issue of *Pediatric Emergency Medicine Practice* focuses on the mechanism of action of the various toxins of common envenomating terrestrial creatures and provides recommendations for the clinical evaluation and management of pediatric patients who have been envenomated by spiders, various

stinging insects, scorpions, snakes, and lizards. Indications for antivenom use and dosing recommendations are provided.

For a detailed review of marine toxins, see the April 2020 issue of *Pediatric Emergency Medicine Practice* titled "Identification and Management of Marine Envenomations in Pediatric Patients," available at: www.ebmedicine.net/marine-envenomations.⁴

■ Critical Appraisal of the Literature

The literature search was comprised primarily of a PubMed search. Specific search terms used were *envenomation, spider, Hymenoptera, bee, wasp, vespid, scorpion, rattlesnake, snake, and Heloderma*. Abstracts from several national toxicology meetings, including the Scientific Meetings of the American College of Medical Toxicology and the annual meeting of the North American Congress of Clinical Toxicology, were reviewed for the most current literature. Most of the literature focused on retrospective reviews and consensus guidelines. A few randomized clinical trials were identified, which primarily focused on antivenoms. Many of the randomized trials are evidence-based, but many of the clinical practice recommendations are based on consensus.

■ Differential Diagnosis

The differential diagnosis of envenomations can be quite broad, as patients often do not know what type of creature bit or stung them. Furthermore, differentiating venomous bites and stings from nonvenomous bites and stings can be difficult. The geographic location where the envenomation occurred may offer some clues as to what the envenomating creature was. **Table 1** pro-

Table 1. Components of the History in the Assessment of Terrestrial Bites and Stings

- Species of biting or stinging creature (eg, bee, wasp, hornet, ant, scorpion, snake) or description of creature, if species unknown
- Location where bite or sting occurred, or activity being undertaken at the time of the bite or sting
- Time elapsed since bite or sting or onset of symptoms
- Progression of symptoms since bite or sting occurred
- Site of bite or sting on the body
- Usual appearance of the affected area
- First aid measures already taken or treatments received
- History of previous bites or stings (how many, location, etc), reaction to those stings (symptoms, length of reaction, treatment), and any additional symptoms
- Allergy history including any medications used and any history of serious allergy, such as anaphylaxis, Stevens-Johnson syndrome, serum sickness
- Medication history (particularly corticosteroids, other immunosuppressing drugs, anticoagulants)
- Other medical conditions, or chronic or recent/acute episodes of illness
- Recent surgical procedures or indwelling devices around area of the bite or sting

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vides questions to ask while taking the history.

In the absence of a clear history of a spider bite, alternative etiologies should be considered, as numerous medical conditions can be misdiagnosed as spider bites. Most commonly, abscesses (particularly those from methicillin-resistant *Staphylococcus aureus*) are thought to be spider bites by patients. Conditions that can be misdiagnosed as loxoscelism (systemic symptoms from envenomation by a *Loxosceles reclusa* [brown recluse] spider) include infections (bacterial, fungal, parasitic, and viral), necrotizing vasculitis, lymphomatoid papulosis, pyoderma gangrenosum, and pemphigus.⁵ Black widow bites on the abdomen have been misdiagnosed as an abdominal pathology, such as appendicitis, because of the intense pain surrounding the bite. Scorpion stings might be perceived as an intoxication rather than an envenomation, due to the symptoms of altered mental status and roving eye movements. Determining anaphylactic reactions versus direct venom reaction from massive envenomation (anaphylactoid reactions) can be a challenge in patients who have been stung by hymenoptera (bees, wasps, ants, etc). While anaphylactic reactions are IgE-mediated, anaphylactoid reactions are not. Fortunately, treatment for both are similar, and determination of the specific etiology can be delayed until the patient is stabilized.

■ Prehospital Care

Prehospital care should focus on ensuring adequate airway, breathing, and circulation. Analgesics can be administered for pain; fentanyl is preferred, due to minimal histaminergic effects.⁶ The immediate management of patients with massive Hymenoptera envenomation is to remove the individual from the swarm. For non-snake envenomations, the extremity should be placed in a position of comfort. Pressure immobilization and tourniquets are contraindicated for North American snake bites.⁷ For pit viper envenomation, the extremity should be splinted and elevated; the splint should be applied loosely and posteriorly, to maintain the extremity in full extension. Patients should be transported in a position of comfort, ideally to an emergency department (ED) with capabilities to care for the patient. For snake bites specifically, this should be to a facility that carries adequate doses of the recommended antivenom. In cases of a foreign body, there is no urgent need for removal, and removal should not delay care or transportation to an ED.

■ Spiders

Despite spider bites being relatively common, human toxicity is rare. Many spiders are too small to be able to inject venom through human skin. Additionally, most spiders produce only a small amount