Arthropod Bites and Stings

Joshua N. Nogar and Richard F. Clark

EPIDEMIOLOGY

Arthropod venoms are complex mixtures of enzymes, proteins, histamines, and other bioamines that can either damage tissue directly or elicit an allergic response. The venoms of each family are unique, and cross-reactivity is rare with the exception of wasps, hornets, and yellow jackets (vespids). Local tissue reactions from dermal exposure to arthropod antigens result in the common pruritic, urticarial, and papular lesions seen after envenomation. The most immediately life-threatening complication of arthropod exposure is anaphylaxis either to the venom itself or to the antivenom administered in the ED. Treatment of anaphylaxis merits special discussion and is covered in the next section on Hymenoptera.

HYMENOPTERA

PATHOPHYSIOLOGY

Apidae (bees), Vespidae (wasps, yellow jackets, hornets), and Formicidae (ants) are the most clinically significant groups of arthropods for two reasons. First, the incidence of Hymenoptera venom allergy has been estimated to be 0.8% to 5% in the general population and is increasing, particularly in young people. Second, because of their complex social organization, multiple stings are more likely to occur during Hymenoptera encounters than with arthropods that do not build nests or hives.

Recent research indicates that the major allergens in Hymenoptera venom are phospholipases and hyaluronidases, as well as mellitin, a peptide that causes degranulation of mast cells. Hymenoptera venom is delivered via an ovipositor stinger and gland, although some anatomic variation does exist. Male bees have no stingers and are incapable of stinging when threatened. Females have barbed stingers that become lodged in human skin and eviscerate the bee after venom delivery. The retained stinger and venom sac can be removed with tweezers. Africanized “killer” bees deserve special mention in that (1) they are far more aggressive and territorial than the more docile domesticated varieties, (2) are known to pursue perceived threats for up to 1 km, and (3) do so in much larger swarms. Africanized bees are difficult to distinguish morphologically from domesticated bees, but fortunately, this distinction is of little clinical significance because of venom...
homology between Hymenoptera Apidae. In contrast to bees, vespid (wasps, yellow jackets, and hornets) have the ability to withdraw their stinger from the victim and deliver multiple stings. Most severe allergic reactions to Hymenoptera are due to encounters with vesps, particularly wasps and yellow jackets.3,4

Ant venom is also delivered via a stinging apparatus, but ants are known to initially bite with their powerful jaws before stinging their victim and can do so en masse via a pheromone-coordinated attack. Multiple ant stings are most common with fire ants.

**PRESENTING SIGNS AND SYMPTOMS**

Hymenoptera stings cause immediate pain with subsequent erythema, edema, and pruritus. Fire ants are known for their particularly painful sting, which can eventually develop into a sterile pustule. Delayed type IV reactions can occur with all Hymenoptera venoms and result in larger, albeit localized reactions.

Massive envenomations are considered those in which the victim sustains more than 100 stings or more than 10 stings per kilogram (Fig. 140.1). Such cases merit special respect and victims should be considered for admission because of an increased risk for systemic symptoms, including nausea, vomiting, diarrhea, edema, dyspnea, hypotension, and rhabdomyolysis. Rarely, glomerulonephritis, acute renal failure, and acute respiratory distress syndrome can occur.5-7

**DIAGNOSTIC TESTING**

No laboratory testing is necessary in cases limited to cutaneous symptoms from submassive envenomations. Massive envenomations or systemic reactions require investigation to evaluate for rhabdomyolysis, renal failure, or cardiac ischemia.5,6 Appropriate testing should include a basic chemistry panel and creatine phosphokinase (CPK) level.

**ANAPHYLAXIS AND ALLERGIC REACTIONS**

It has been estimated that 40 deaths occur per year in this country as a result of anaphylaxis from Hymenoptera stings.4 Anaphylaxis is an IgE-mediated type I hypersensitivity reaction that leads to mast cell and basophil degranulation of vasoactive mediators, cytokines, prostaglandins, and platelet-activating factor. Some initial symptoms can be mild and include itchy eyes, urticaria, or cough. However, the symptoms can progress rapidly to shortness of breath, stridor, angioedema, and shock. Treatment should be initiated immediately and includes epinephrine, steroids, antihistamines, and bronchodilators (if bronchospasm is present). All available data suggest that failure or delay in the administration of epinephrine increases the chance for death from anaphylaxis. The risk for anaphylaxis with any event is dependent on the severity of the patient’s previous reaction, and it seems to be proportional to the rate of symptom onset. Once the symptoms have been controlled, patients should be observed for at

### Table 140.1 Common Clinical Manifestations of Arthropod Envenomation

<table>
<thead>
<tr>
<th>Arthropod</th>
<th>Clinical Manifestations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bees and wasps</td>
<td>Urticarial eruptions, anaphylaxis, rhabdomyolysis, ARF, ARDS (after massive envenomations)</td>
</tr>
<tr>
<td>Widow spiders</td>
<td>Pain, muscle spasm, local diaphoresis, tachycardia, hypertension</td>
</tr>
<tr>
<td>Recluse spiders</td>
<td>Dermonecrosis; hemolysis, DIC, ARDS (rarely)</td>
</tr>
<tr>
<td>Scabies</td>
<td>Migratory pruritus, secondary infections</td>
</tr>
<tr>
<td>Ants</td>
<td>Urticarial and papular dermatitis, anaphylaxis risk</td>
</tr>
<tr>
<td>Scorpions</td>
<td>Pain, tingling, cranial neuropathy, ataxia, pancreatitis, DIC, ARDS (exotic species)</td>
</tr>
<tr>
<td>Caterpillars</td>
<td>Painful dermatitis, ocular and mucosal irritation</td>
</tr>
<tr>
<td>Mites</td>
<td>Papular urticarial dermatitis</td>
</tr>
<tr>
<td>Ticks</td>
<td>Local tissue reaction, tick paralysis, infectious complications</td>
</tr>
<tr>
<td>Reduviid bug</td>
<td>Bullous lesions, infectious complications</td>
</tr>
<tr>
<td>Lice and fleas</td>
<td>Papular urticarial dermatitis</td>
</tr>
<tr>
<td>Mosquitoes</td>
<td>Urticaria, pruritus, infectious complications</td>
</tr>
<tr>
<td>Tarantulas</td>
<td>Local pain (bite), urticarial dermatitis, ocular irritation (hairs)</td>
</tr>
<tr>
<td>Centipedes</td>
<td>Local pain</td>
</tr>
<tr>
<td>Millipedes</td>
<td>Skin discoloration from oily extractions</td>
</tr>
</tbody>
</table>

ARDS, Acute respiratory distress syndrome; ARF, acute renal failure;DIC, disseminated intravascular coagulation.

**Fig. 140.1** Massive Hymenoptera envenomation. (Courtesy Richard Clark, MD.)
SPIDERS (ARANEAE)

PATHOPHYSIOLOGY

More than 40,000 species of spiders have been identified, but most of them lack venom or fangs large enough to deliver venom through human skin. In fact, fewer than 50 species are considered to be harmful to humans. The most clinically relevant spiders are widow spiders, recluse spiders, funnel-web spiders, and tarantulas.

WIDOW SPIDERS (LATRODECTUS SPECIES)

With its distinct shiny black color, bulbous abdominal segment, and ventral orange-red markings, Latrodectus species are some of the most identifiable of all spiders. Latrodectus mactans (black widow) is perhaps the best known of the genus and possesses an hourglass-shaped ventral marking (Fig. 140.2). As is the case with many arthropods, females are the larger of the two sexes, and males do not have fangs capable of piercing human skin. Latrodectus venom contains a potent neurotoxin, α-latrotoxin, a well-characterized protein that induces massive release of neurotransmitters from presynaptic neurons. The resultant effect of these neurotransmitters is activation of the autonomic and somatic nervous systems.

PRESENTING SIGNS AND SYMPTOMS

The bite itself is typically painful, and this discomfort can spread throughout the affected extremity. Local erythema and diaphoresis occur early at the site with a resultant macule developing into a target lesion. The development of painful cramping in large muscle groups and autonomic instability is known as latrodectism. This systemic syndrome has been described as being so severe as to mimic an acute abdomen, even when the site of envenomation is remote from the center mass; the exact pathophysiology of this phenomenon is not well understood. Hypertension, tachycardia, headache, nausea,
patients respond to one or multiple doses of opioid analgesics and benzodiazepines, and these medications should be titrated according to patient symptoms.

IgG antivenom for *Latrodectus* envenomation is available in the United States, but this treatment is often reserved for the rare patients whose pain and muscle spasms are refractory to large doses of analgesics and relaxants. This antivenom is a whole-antibody horse-derived IgG preparation, and anaphylactoid reactions and serum sickness are potential consequences of its administration. Therefore, it should be administered slowly and with caution. One vial of antivenom is usually sufficient to relieve symptoms. This preparation should be infused slowly (over a 15- to 30-minute period). Premedication with antihistamines can be considered. The EP must be prepared to administer epinephrine if a severe allergic reaction to horse serum occurs. Additionally, patients must be informed that serum sickness (diffuse papular rash, glomerulonephritis, arthralgias) may occur 10 to 21 days following therapy, although this reaction will rarely be seen with administration of only one vial. *Latrodectus* antivenom is in very short supply and is not readily available in many facilities. A potentially safer, Fab fragment antivenom is currently being investigated and may be available for use in the United States in the near future.

**TREATMENT**

The mainstays of therapy for widow spider envenomation are adequate analgesia and muscle relaxants. The majority of priapism, and dyspnea have also been described in association with *Latrodectus* bites.9

**SPIDERS CAUSING DERMONECROTIC ARACHNIDISM**

*Loxosceles*, or recluse, spiders cause the syndrome of dermonecrotic arachnidism. These spiders, as their
name suggests, prefer dark and isolated spaces such as attics, basements, and closets. They bite only when threatened or disturbed. In contrast to Latrodectus, Loxosceles reclusa is more difficult to identify. Many possess a violin-shaped dorsal marking (hence in some regions they are called “fiddleback” spiders), but this is not a diagnostic feature of all L. reclusa. The only unifying feature of all Latrodectus spiders is that they possess only three pairs of eyes, as opposed to the four pairs found in most spiders. Hobo spiders in the Pacific Northwest and several other species are also theorized to cause necrotic complications following bites, but these associations are more controversial. The venom of recluse spiders is a complex mixture of hyaluronidase, ribonucleases, lipases, and sphingomyelinase D, the latter being thought to be responsible for the necrosis.\textsuperscript{11,12}

**PRESENTING SIGNS AND SYMPTOMS**

The most common clinical effect of true recluse spider bites is a progressively necrotic eschar. The lesion evolves from a nonspecific erythematous wheal into an eschar with surrounding rings of blanching and erythema (“red, white, and blue” sign) over a period of days to weeks. The slow destruction of skin structure occurs as a result of the effects of venom on the dermal microcirculation, and it can extend into adjacent tissues in a gravity-dependent manner. These lesions can be cosmetically disfiguring and stressful for patients because they expand and worsen over a period of many days to weeks. It is important to stress to patients that lesions from recluse spiders sometimes progress despite medical treatment.\textsuperscript{11,12} It is also important to appreciate the rarity of these injuries in comparison with the frequency with which they are reportedly perpetrated; many cutaneous infections are mistaken for recluse bites. In one study, spider bites were confirmed in only 3.8% of all individuals with the chief complaint of a spider bite.\textsuperscript{13} Rare cases of severe hematologic toxicity with hemolytic anemia, thrombocytopenia, and coagulopathy have been described in association with Loxosceles bites, particularly in Brazil.\textsuperscript{14,15}

**TREATMENT**

Therapies aimed at limiting or preventing the necrotic sequelae of recluse spider bites are controversial. The safest management regimen that can be recommended without reservation is gentle cleansing, tetanus prophylaxis, analgesia, antipruritic medications, and immobilization if needed. Disproved treatments include early wound excision, corticosteroids, cyproheptadine, and electric shocks delivered to the bite site to denature the venom components. Hyperbaric oxygen, dapsone, and colchicine have been tried as experimental therapies, but studies proving benefit are thus far lacking. Severely disfiguring or nonhealing bites may require delayed reconstructive procedures once the destructive effect of the venom has halted.

A Loxosceles antivenom has been developed for use in Brazil, but based on animal models, it must be given within 24 hours to be effective. Because most patients are seen 2 to 3 days after being bitten, this type of antivenom is not typically a useful adjunct in the treatment of Loxosceles spider bites.\textsuperscript{15} Symptomatic and intensive supportive care is warranted in the rare case of disseminated intravascular coagulation, hemolytic anemia, renal failure, or acute respiratory distress syndrome following the bite of a recluse spider.

**TARANTULAS**

Tarantulas are distributed worldwide and recognizable by their large size and prominent hairlike projections. Large or aggressive species can bite; the effects can range from relatively painless to deep throbbing pain with a febrile reaction that requires analgesics and antipyretics. By rubbing their hind legs against their abdominal wall, tarantulas can “flick” their hairs in the direction of perceived threats, and both dermal and ocular injuries have occurred from the highly irritating “urticating” hairs of tarantulas. The presence of urticaria, hives, intense pruritus, and mild erythema characterizes dermal lesions; ocular exposure to the urticating hairs has resulted in corneal abrasions, iritis, uveitis, and chronic granulomatous reactions (ophthalmia nodosum).\textsuperscript{16}

**SCORPIONS**

Scorpions are easily recognized by the taillike abdominal segment that forms into a venom-filled bulb with a stinger (telson). In the United States, scorpions are commonly encountered hazards in the Southwest, where Centruroides exilicauda (formerly Centruroides sculpturatus), or the bark scorpion, is endemic. They commonly hide in dark spaces such as closets and shoes; the exoskeleton’s ability to fluor- esce under ultraviolet light is sometimes helpful in locating these creatures. Worldwide, species that represent significant hazards to human health include Tityus species in Trinidad and Brazil and Buthus and Parabuthus species in India, Africa, and the Middle East. Most scorpion stings occur when the creature feels threatened or alarmed.\textsuperscript{17,18}

The venom of C. exilicauda is complex and targets excit- able membranes. The result is abnormally prolonged opening of sodium channels at the neuromuscular junction and at both sympathetic and parasympathetic nerve endings. Dangerous varieties of scorpions from other countries can cause massive release of catecholamines from nerve terminals, particularly norepinephrine and acetylcholine, which can lead to diverse autonomic effects.

**PRESENTING SIGNS AND SYMPTOMS**

Local effects of erythema and tingling may be present, but these findings may be quite subtle initially. Tapping the site
of discomfort gently accentuates the reported symptoms, even in the absence of visible skin lesions. Systemic findings are often more dramatic than the local effects and peak around 5 hours after the sting; signs and symptoms commonly include hypertension, tachycardia, convulsions, cranial neuropathies, raving ophthalmoplegia (also known as oculogyric crisis), ataxia, abdominal cramps, and respiratory failure from neuromuscular dysfunction.\(^{17,18}\)

The stings of other scorpion genera may produce unique syndromes. _Tityus_ scorpions in Trinidad and South America can cause pancreatitis, and in India and Africa the _Buthus_ and _Parabissus esatus_ varieties can cause pulmonary hemorrhage, gastrointestinal bleeding, and disseminated intravascular coagulation, presumably because of the presence of phospholipase in the venom.

### DIAGNOSTIC TESTING

Testing of serum electrolytes, CPK, and cardiac isozymes, as well as chest radiography and electrocardiography, should be considered in patients at high risk for cardiac ischemia. Neurologic testing such as computed tomography of the head and lumbar puncture may be required in patients in whom other neurologic disease processes are suspected.

### TREATMENT

The majority of patients respond to supportive care and aggressive pain management with analgesics and muscle relaxants. Continuous infusion of benzodiazepines may be considered in well-monitored patients to decrease agitation and abnormal motor activity.\(^{19}\) Short-acting antihypertensives such as esmolol or nitroprusside are also appropriate in the setting of severe hypertension and tachycardia.

Respiratory failure or fatigue warrant aggressive airway management and possibly intubation; this complication is especially concerning in the pediatric and elderly populations, which are most vulnerable to mortality from scorpion stings. Rarely, pancreatitis and coagulopathy require intensive supportive care with meticulous fluid management and transfusion of blood products.

Scorpion antivenom directed against different species has been produced for research or clinical use in more than 10 countries, and recommendations for their use are variable. In the United States, a recent study demonstrated improved outcome in critically ill children after treatment with _C. exilicaudata_ antivenom.\(^{18}\)

### FOLLOW-UP, NEXT STEPS IN CARE, AND PATIENT EDUCATION

Patients with severe signs and symptoms require admission to the hospital, and intensive care may be necessary for pediatric and elderly patients. Patients who are comfortable and have normal vital signs and results of diagnostic testing can safely be discharged. Wounds from scorpion stings do not usually require specific therapy for infection.

### TICS (IXODES, DERMACENTOR, OTHERS) AND TICK PARALYSIS

The overwhelming concern regarding ticks is their role as vectors for viral, bacterial, and protozoal infectious diseases. Ticks are arachnid bloodsucking parasites that painlessly attach to their host. In addition, several members of the _Dermacentor_, _Ixodes_, and _Amblyomma_ genera of ticks can induce a rapidly progressive syndrome of ascending weakness and loss of deep tendon reflexes called tick paralysis. The condition is most common in the Rocky Mountain states and Pacific Northwestern region of the United States, but the true incidence is unknown because it is not a reportable entity. Girls seem to be affected more often because the pediatric population is more apt to harbor the tick for a longer period before being brought to medical attention and longer hair camouflage the offending tick.

Though not fully characterized, the neurotoxin is presumed to inhibit release of acetylcholine at the neuromuscular junction.

### PRESENTING SIGNS AND SYMPTOMS

The onset of lower extremity weakness is insidious, similar to Guillain-Barré syndrome, and reflexes tend to be diminished in both. Careful physical examination is the key to diagnosis because the paralytic neurotoxin is secreted by the tick as long as it remains attached to the skin. Although the tick can be found attached to the skin in any anatomic location, well-protected areas such as the clothing waistline and the occipital scalp in victims with long hair are common sites of injury. Respiratory failure is the most feared complication of a delayed diagnosis. In contrast to Guillain-Barré syndrome, the results of cerebrospinal fluid analysis are normal in patients with tick paralysis.

### DIFFERENTIAL DIAGNOSIS

The differential diagnosis for ascending paralysis is short and includes Guillain-Barré syndrome, cerebellar ataxia, spinal cord compression, hypokalemic periodic paralysis, and transverse myelitis. Work-up includes basic laboratory studies, lumbar puncture, and central nervous system imaging, all of which would be expected to show normal results in patients with tick paralysis.

### FOLLOW-UP, NEXT STEPS IN CARE, AND PATIENT EDUCATION

Removal of the offending tick rapidly leads to resolution of the symptoms and decreases the likelihood of tick-borne disease transmission. It can be achieved by grasping the tick near the skin with fine-point tweezers and pulling straight outward with steady, gentle traction. All patients with ascending paralysis should be admitted to the hospital, regardless of the cause. Once the tick has been removed and the neurologic symptoms are clearly improving, the patient can be safely discharged.\(^{20,21}\)
Caterpillars

Caterpillars are the wormlike immature forms of butterflies and moths. Of the 165,000 total species, only 12 families worldwide account for human injuries. In 2009, 1422 exposures were reported to poison centers in the United States. Most of these exposures occur in individuals younger than 18 years. The numerous hairlike projections of these organisms are called setae and, in some species, are actually hollow connections to venom glands capable of piercing the skin and result in envenomation on contact. These solid setae are highly irritating to the skin on contact and are light enough to be dispersed by the wind. In fact, dry weather and strong winds facilitated the dispersion of setae and resulted in an epidemic of dermatitis among Shanghai residents in 1972.

Several illness syndromes caused by caterpillars or butterflies (order Lepidoptera) are recognized. The most common injuries are dermal lesions, sometimes referred to as eczematous or cutaneous lepidopterism. In the United States, the most common form of lepidopterism is dermatitis caused by the puss caterpillar, also known as the woolly slug. This flat, fuzzy caterpillar is found in the southern United States from Maryland to Texas. The related flannel moth caterpillar is endemic to New England and the eastern U.S. seaboard. Other species that cause dermatitis include the Automeris io, Megalopyge opercularis, and saddleback caterpillars. All these species induce a stinging, itchy, or painful lesion on contact with the setae. Characteristic lesions are often teardrop shaped in a gridlike pattern and mimic the shape of the offending caterpillar. The woolly slug induces a dull aching pain at the site of parallel papular eruptions. Caterpillar setae can occasionally irritate the eyes or respiratory passages on direct exposure to these surfaces. Distinguishing features and treatment of these lesions are summarized in Table 140.2.

Other Arthropods—Scabies, Fleas, Lice, and Bedbugs

Mites, fleas, lice, and bedbugs are small arthropods that reside in a wide variety of environments. Various mites thrive naturally in or on grains, pets, rodent pests, feathers, furniture, house floors, and straw. Fleas and lice are ectoparasites that feed on the skin surface, whereas the scabies mite is an arachnid endoparasite that burrows under the skin. Fleas and lice are probably more important from an infectious standpoint because of the zoonotic diseases that they can transmit, such as plague and typhus, respectively. Bedbugs, in particular, have gained much publicity in recent years because of their increasing prevalence. Adults are oval shaped and resemble small (less than 5 mm) cockroaches. Bites from all four can produce self-limited pruritic papules at the feeding site, but scabies is more apt to cause a persistent dermatitis secondary to shedding and leaving fecal droppings embedded in the burrowed skin.

The worldwide prevalence of scabies has been estimated to be approximately 300 million cases annually. Most mites are transmitted via intimate interpersonal contact, but adult forms of the mite can survive remote from human tissue for 24 to 36 hours in bedding, clothing, and furniture. Dogs and cats can host other variants of the scabies mite that cannot complete their life cycle in humans but are able to survive up to more severe complications such as rhabdomyolysis and renal failure.

In contrast to centipedes, millipedes are vegetarians but can induce dermal irritation injuries because they express a toxic substance onto the exoskeleton when threatened. This oily residue can cause ocular irritation and discoloration of the skin that can last for months. Distinguishing features and treatment of these bites are summarized in Table 140.2.

BOX 140.2 Illnesses Transmitted by or Associated with Arthropods

<table>
<thead>
<tr>
<th>Insects</th>
<th>Lice: typhus, trench fever, relapsing fever</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fleas: plague, typhus,</td>
<td>Tungiasis</td>
</tr>
<tr>
<td>Bedbugs: possible</td>
<td>hepatitis B transmission</td>
</tr>
<tr>
<td>Flies and mosquitoes:</td>
<td>myiasis, malaria, yellow fever, dengue</td>
</tr>
<tr>
<td>Reduviid (kissing)</td>
<td>fever, viral encephalitis, West Nile fever</td>
</tr>
<tr>
<td>Arachnids</td>
<td>Chagas disease</td>
</tr>
<tr>
<td>Ticks: Lyme disease,</td>
<td>Rocky Mountain spotted fever, Colorado</td>
</tr>
<tr>
<td>Babesiosis, ehrlichiosis,</td>
<td>tick fever</td>
</tr>
<tr>
<td>Q fever, tularemia</td>
<td></td>
</tr>
</tbody>
</table>

Centipedes and Millipedes

Centipedes and millipedes both possess multiple body segments. The front pair of legs in the centipede is modified into a hollow fanglike appendage called a maxillepede, which expresses venom from a muscular sac. This digestive aid is also capable of piercing human skin. These nocturnal creatures range from 3 to 250 mm in length and prefer moist, warm climates. Centipedes are carnivores and can cause painful bites. Rare systemic reactions include nausea, vomiting, and diaphoresis. Solitary case reports have described
96 hours in human skin. Contact with infected pets can cause self-limited illness, papules, and urticaria in humans.

Severe pruritus and erythematous papules are the most characteristic symptoms of all these bites. Distinguishing flea, lice, and mite bites from one another is very difficult without the offending arthropod present for microscopic examination. All clothing and linen must be laundered in hot water, and potential contacts (prolonged skin-to-skin contact) must be treated simultaneously to avoid reinfection. Scabies-affected pets should also be treated with a scabicide. Features and treatment of these bites are summarized in Table 140.2.

SUGGESTED READINGS


REFERENCES

References can be found on Expert Consult @ www.expertconsult.com.
REFERENCES