



Life-threatening stings, bites, infestations, and parasitic diseases

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Abstract Bites, stings and infestations can be fatal. Anaphylaxis to vespids and bees can be prevented with immunotherapy. Patients should be referred to an allergist. The acute care and prevention of arthropod injury is discussed below.

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Introduction

Life-threatening reactions to bites and stings may be mediated by toxin or may be related to an allergic response to arthropod proteins. Arthropods may kill by means of neurotoxins or by transmitting infectious organisms. Both endoparasitic and ectoparasitic infestations may have life-threatening consequences. This article will provide an overview of life-threatening bites, stings, and infestations.

Life-threatening bites and stings

Anaphylaxis

Anaphylaxis commonly occurs with stings from hymenopterids, which include bees, wasps, hornets, and fire ants.¹ Hymenopterids (Fig. 1) possess membranous wings and complex venoms that can contain proteinaceous allergens, as well as formic acid and kinins. Individuals allergic to bees or wasps should refrain from wearing perfume or bright colors. They should carry epinephrine.

In a large series, 24% of cases of anaphylaxis in an allergy practice were related to insect stings. Many of these patients have an atopic background. In some, insect-induced anaphylaxis was the first manifestation of mastocytosis.² Patients with anaphylaxis are more likely to die if they have preexisting cardiac disease. Cardiac arrhythmia related to bee stings may also occur in the absence of anaphylaxis.³ Numerous stings such as those associated with killer bee attacks may cause myoglobinuria or hemoglobinuria and acute tubular necrosis.⁴

Patients cannot always anticipate exposure, and unexpected stings are frequent. Patients allergic to bee stings should never be without their epinephrine.⁵ Kits should be protected from heat and light, and syringes should be inspected periodically for brown discoloration. During an episode of anaphylaxis, airway maintenance, oxygen, and treatment of shock may be necessary. Residual bee stingers should be removed as quickly as possible.⁶ Patients should be referred to an allergist for desensitization.

Scorpions

The most deadly scorpion in the United States is *Centruroides exilicauda* (*C sculpturatus*; Fig. 2). This small tan scorpion with elongated tail segments and a blunt thorn

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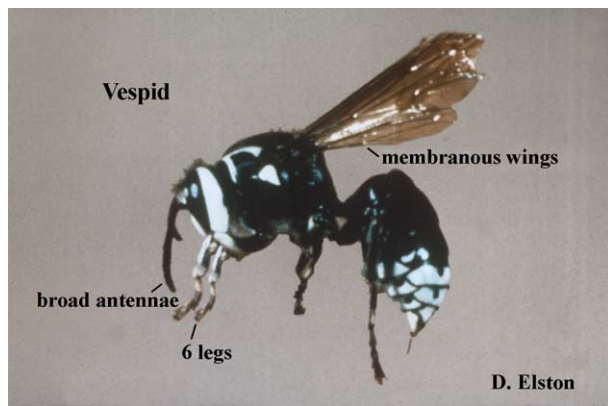


Fig. 1 Hymenopterids, such as vespid, have membranous wings. They are responsible for most arthropod-induced anaphylaxis.

proximal to the stinger is restricted to the southwest, mostly in areas of Arizona. Fortunately, most stings are not fatal and are actually associated with minor symptoms. Young children are more prone to severe toxicity.⁷

Asian red scorpions, including *Mesobuthus tamulus*, possess much more potent venom capable of producing an *autonomic storm*. The initial cholinergic stimulation is followed by severe and sustained adrenergic hyperactivity. The high mortality associated with these scorpions is commonly related to pulmonary edema. Stings may also result in severe pancreatitis.⁸ Atropine treatment during the initial cholinergic portion of tropical scorpion intoxication has been shown to result in greater mortality.⁹ This suggests that most organ damage results from the sympathetic stage of the syndrome. The postsynaptic α -receptor blocker prazosin has been used successfully in acute pulmonary edema.¹⁰ The combination of prazosin and nifedipine is more effective in preventing myocardial muscle damage than nifedipine alone.¹¹ Hydralazine and sodium nitropruside have also been used. Red scorpion envenomation appears to be a risk factor for cardiomyopathy.¹² In Arizona, where scorpion stings are less toxic, a small study showed atropine to be of benefit with no adverse effects.¹³

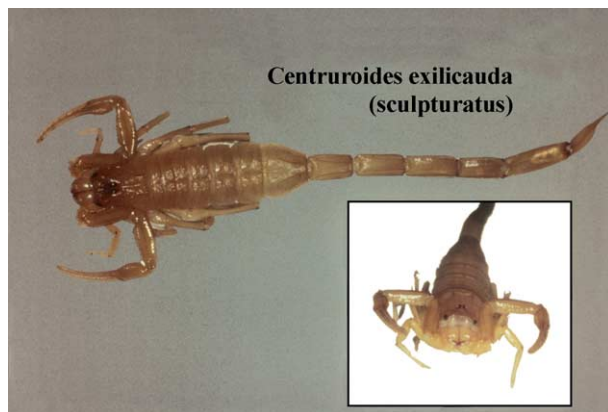


Fig. 2 *Centruroides exilicauda* is the most lethal scorpion in the United States.

Parabuthus transvaalicus, *P. granulatus*, and *P. villosus* are all associated with severe envenomation in South Africa. The venoms inhibit potassium channels as well as alter sodium channel gating, a common phenomenon with scorpion venoms.¹⁴ About 10% of *P. transvaalicus* stings result in significant direct cardiac damage in the absence of excess catecholamines.¹⁵ In Israel, *Leiurus quinquestriatus hebraeus*, a yellow scorpion, is a cause of severe scorpion envenomation. Sting causing severe cardiovascular injury is more common in children. As with other scorpions, pulmonary edema, cardiac failure, and arrhythmia may occur.¹⁶

Scorpions are often found under tabletops, and stings occur when the table is lifted. They also find their way into shoes, woodpiles, and bed linens. Scorpions can also find their way into clothing, and a sting to the penis has been reported.¹⁷ Stings generally occur when the scorpion is squeezed, trapped, or feels threatened.

In severe scorpion stings, the immediate burning sensation at the site of the sting is followed within hours by restlessness and motor dysfunction. Dysphagia, dysarthria, sialorrhea, and loss of the gag reflex are common. Hypertension and pyrexia may occur. Respiratory muscle function can be impaired, which exacerbates the respiratory embarrassment associated with pulmonary edema. Interleukin 8 appears to play a role in the pathogenesis of cardiac damage after North African scorpion envenomation. Cardiac troponin I appears to be the most sensitive marker for myocardial damage.¹⁸ In Brazilian scorpion envenomation, a variety of interleukins and tumor necrosis factor α have been implicated.¹⁹

In tropical countries, scorpion envenomation is common. In many countries, scorpion-induced myocardial damage, arrhythmia, and pulmonary edema are major causes of mortality. Houses on the canals in Thailand are supported by pilings, and a slick tape is placed at the top of the pilings, and any pipes that enter the house, to prevent scorpions from crawling up into the building. Antivenin therapy is contro-



Fig. 3 Brown recluse spiders have small bodies and long delicate legs. A characteristic violin case pattern is noted on the cephalothorax.

versal, but sometimes helpful, especially if given within 1 hour after the envenomation.^{20,21} Animal studies have demonstrated that antivenin can be effective for red scorpion envenomation, if given in time.²² In adults, the course of envenomation is often less severe, and the benefits of antivenin therapy is less certain.²³ Although serum sickness is a common sequel of *Centruroides* antivenin use, anaphylactic reactions to antivenin are uncommon.²⁴ In a study in North Africa, steroid therapy was of no benefit in the treatment of scorpion envenomation.²⁵

Spiders

Loxosceles reclusa and related brown spiders have small bodies but a wide leg span (Fig. 3). Although they have 8 legs, such as other spiders, brown recluse spiders have only 3 sets of eyes, instead of the usual 4. They may also be identified by the dark brown violin case pattern on the cephalothorax. *Loxosceles* spiders may cause severe dermonecrotic reactions. Severe systemic reactions include shock, hemolysis, and disseminated intravascular coagulation.

Loxosceles spiders are found worldwide, but are particularly numerous in the south central United States. Several species in the United States, including *L. reclusa*, *L. laeta*, *L. rufescens*, *L. deserta*, and *L. arizonica*, are capable of causing extensive skin necrosis. *L. rufescens* is a cause of dermonecrotic arachnidism in Israel as well as the United States.²⁶ Fortunately, most bite reactions are mild.

There are many other spiders capable of producing severe dermonecrotic and systemic reactions, and many are not well characterized.^{27,28} An enzyme immunoassay and a passive hemagglutination inhibition test for *Loxosceles* venom can be used on skin biopsy specimens. The tests may still be positive 3 to 4 days after envenomation.^{29,30} Like scorpions, brown spiders are often found in wood-piles, attics, and under radiators. They are nonaggressive and bite when threatened, with most bites involving the extremities.³¹

The major toxin in brown recluse venom is sphingomyelinase D.³² Hyaluronidase promotes spreading of eschars in a gravity-dependent fashion. The extent of the eschar relates directly to diffusion of the venom.³³ Maximal lesion severity predicts the time to healing.³⁴ Necrotizing fasciitis may occur after spider bites, and *Clostridium perfringens* has been isolated from the venom and fangs of *L. intermedia*.^{35,36} Although neutrophils are not directly activated by the venom, they play an important role in vascular damage.^{37,38} Large-vessel vasculitis resembling polyarteritis nodosa has been noted in an animal model.³⁹

Most bites can be treated with rest, ice, and elevation. Intradermal injection of an antivenin can attenuate necrosis in an animal model up to 4 hours after envenomation.⁴⁰ Fused recombinant protein immunization has been shown to protect rabbits and mice from *Loxosceles* dermonecrotic reactions.⁴¹ This provides a model for further work on immunotherapy. Hyperbaric oxygen therapy may be of some



Fig. 4 Black widow spiders have a large shiny black abdomen with a characteristic hourglass pattern.

benefit, although study results are varied.⁴² One study suggested that the combination of dapsone and antivenin was superior to either agent alone.⁴³ Unfortunately, dapsone often appears to be of little benefit and is complicated by the potential for hemolysis, especially in individuals with glucose-6-phosphate dehydrogenase deficiency. Topical nitroglycerin has also proved ineffective.⁴⁴

Funnel web spiders are large hairy spiders that favor dark moist areas, especially basements. Unlike brown spiders, they tend to be aggressive. *Tegenaria agrestis*, the hobo spider, has become a significant problem in northwestern United States. It is a cause of severe necrotic arachnidism. Dangerous species are also found in Canada, Europe, and Australia. The bites are not very painful, but the ensuing necrosis can lead to amputation. Systemic symptoms may occur, which include headache, nausea, and weakness. Hemolysis and thrombocytopenia are reported. Antivenin therapy has been shown to neutralize in vitro effects of the venom in a variety of Australian funnel web spiders.⁴⁵

Widow spiders (Theridiidae) are found throughout the world and can result in severe muscle spasm and rhabdomyolysis. *Latrodectus mactans* (Fig. 4) is the most common black widow spider in North America. It is a large shiny black spider with a large round abdomen and an hourglass design on the abdomen. *L. tredecimguttatus* is found in Europe, and *L. curacaviensis* is found in South America.^{46,47} Black (*L. indistinctus*) and brown (*L. geometricus*) widow spiders are found in southern Africa and Madagascar.^{48,49} In general, the symptoms of brown widow bites tend to be milder. In Australia and New Zealand, the red-black spider (*L. mactans hasselti*) is a problem.⁵⁰ Widow venom acts by depolarizing neurons, increasing intracellular calcium, and stimulating uncontrolled exocytosis of neurotransmitters and disrupt lipid membranes.^{51,52}

Antivenin is available and can still be effective as long as 90 hours after black widow envenomation.^{53,54} Benzodiazepines and intravenous calcium gluconate can also be helpful.

Ticks

Dermacentor ticks are the North American ticks most closely associated with tick paralysis. In Australia, a species of *Ixodes* tick is an important cause of tick paralysis. Tick paralysis is associated with a 10% mortality rate, with the tick commonly found at autopsy or by the mortician. The presentation is often dramatic, with rapidly progressive ascending paralysis. The disorder is associated with a toxin produced by the female tick. Removal of the tick leads to rapid improvement. Because *Dermacentor* ticks tend to attach to the head and neck region, they are often hidden by hair, and a careful search may be required.

Dermacentor variabilis (the American dog tick) is the most important vector of Rocky Mountain spotted fever. *D. andersoni* is the major vector only in the Rocky Mountain States. Rocky Mountain spotted fever remains the most deadly of the tick-borne diseases. Delays in therapy can prove fatal. Tetracyclines and chloramphenicol are both active against the organism, but doxycycline is preferred, even in children. In endemic areas, the diagnosis should be considered in anyone with fever and headache, regardless of the presence of a characteristic eruption.

Antimicrobial prophylaxis after tick bites remains controversial. In guinea pigs, even a single dose of tetracycline is effective if given just before expected onset of symptoms. Single doses taken more than 48 hours before expected disease onset may only delay the onset of symptoms, but not prevent disease.⁵⁵ The incubation period ranges from 4 to 10 days; thus, timing of a single dose is difficult. There is no evidence that a 10-day course of antibiotic is less effective if started before clinical symptoms appear, but the cost-effectiveness of such regimen is questionable. A 10-day course of tetracycline may be considered in a patient with heavily engorged ticks in a highly endemic area. In cases like this, some physicians will prescribe the patient 10 days of a tetracycline, which should be taken if fever, accompanied by headache or a eruption, develops.

When the physician is faced with an attached tick, it is helpful if one can recognize the genus of tick. *Dermacentor* ticks are large, with brown legs and short mouthparts. The mouthparts are attached by a rectangular basis capituli. They have an ornate scutum (hard dorsal plate), widely spaced eyes, and festoons. In female, the scutum is small, allowing for engorgement (Fig. 5). *Rhipicephalus* ticks, which can carry Rocky Mountain spotted fever, babesiosis, and Congo-Crimean hemorrhagic fever, are brown with brown legs and a distinctive teardrop shape.^{56,57} They have widely spaced eyes and festoons, but the scutum is plain brown without markings. *Amblyomma* ticks, the major vector of human monocytic ehrlichiosis, is smaller, rounder, and have very long mouthparts.⁵⁸ *D. variabilis* has also been implicated as a vector of human monocytic ehrlichiosis and tularemia.^{59,60}



Fig. 5 *Dermacentor* ticks are responsible for most fatal cases of tick paralysis in North America. They are large ticks with small anterior mouth parts and posterior festoons. The small scutum in the female allows for engorgement.

Ixodes ticks carry babesiosis, Lyme disease, and human granulocytic ehrlichiosis. Babesiosis is a malaria-like illness. Human granulocytic ehrlichiosis is an acute febrile illness often accompanied by leukopenia, thrombocytopenia, and elevated hepatic transaminases.⁶¹ A single *Ixodes* tick may transmit more than 1 disease. In one study in New Jersey, 55% of adult *Ixodes scapularis* ticks carried at least 1 disease, whereas 10% carried more than 1 disease.⁶² Coinfection with more than 1 disease is also common among Midwestern ticks.⁶³ In Europe, *Ixodes* ticks are vectors for viral encephalitis.⁶⁴ *Ixodes* ticks have a distinctive teardrop shape, an ornate brown scutum, and lack festoons.

Mosquitoes

Life-threatening diseases are carried by mosquito vectors. Anopheline mosquitoes that carry malaria usually bite at night, whereas mosquitoes that carry dengue tend to bite during the day. West Nile virus has spread rapidly since its introduction into the United States. There were 1856 cases reported in 22 states during the first 8 months of 2003. Acute symptoms of West Nile virus are mild in most patients. A small minority experience fatal disease. Acute neurological symptoms include tumor, myoclonus, and parkinsonism. An irreversible poliomyelitis-like syndrome may occur.⁶⁵ Intravenous immunoglobulin containing West Nile virus-specific antibodies can protect mice from the disease, but pooled human immune globulin from the United States, where the prevalence of disease remains low, provided no protection.⁶⁶ Mosquito-borne encephalitis viruses are prevalent throughout the world. In the United States, St. Louis encephalitis and equine encephalitis remain important pathogens.

Prevention of bites and disease included the use of pyrethroid-impregnated mosquito netting, repellents, and oral malaria prophylaxis. The use of effective repellents and protective clothing is essential to prevent transmission.^{67,68}

N, N-diethyl-3-methylbenzamide, previously called *N, N*-diethyl-*m*-toluamide, remains the most effective mosquito repellent.⁶⁹ Although toxic reactions are rare, they do occur.⁷⁰ The American Academy of Pediatrics recommends concentrations of 30% or lower for children. High concentrations are more likely to produce toxic reactions and dramatic bullous eruptions.⁷¹ Anaphylaxis to *N, N*-diethyl-*m*-toluamide has been reported.⁷² The repellent effect of high concentrations may peak quickly then fade. Long-acting formulations reduce the need for high concentrations and repeated application.

Citronella candles and incense show limited efficacy.⁷³ Neemos has been used as an adjunctive mosquito repellent in areas with malaria.⁷⁴ Area sprays of insecticide and mosquito control traps that produce carbon dioxide, such as the Mosquito Magnet, can be helpful in reducing the risk of transmission.

Fleas

Fleas transmit bubonic plague, endemic typhus, brucellosis, melioidosis, and erysipeloid. Effective agents are now available to control fleas on family pets. Lufenuron, a growth and reproduction regulator, is effective in oral and injectable formulations for cats and dogs. Topical agents such as fipronil are also effective. A knowledgeable veterinarian is the best source of information about newer products. Boric acid and insecticides containing growth regulators may be needed when a house is infested.

Life-threatening infestation

Head and pubic lice are not proven vectors of life-threatening diseases, but body lice remain important disease vectors. Body lice thrive in conditions of poverty, natural disaster, and war. In these settings, they act as vectors of diseases that can kill thousands. Among the homeless in our cities, *Bartonella* organisms transmitted by body lice can cause endocarditis.⁷⁵⁻⁷⁷ A study of homeless subjects in Paris demonstrated positive serology for *Bartonella quintana* in more than half of the subjects. Positive serology correlated with episodes of pediculosis.⁷⁸ In Tokyo, *B. quintana* was detected in 16.7% of homeless subjects.⁷⁹ It is important to note that the arthropod vector influences the disease manifestations caused by *B. quintana*⁸⁰; cat-scratch disease or bacillary angiomatosis occurs if the organism is transmitted by a flea, whereas endocarditis occurs if the organism is transmitted by a louse.

Body lice remain important vectors for relapsing fever, trench fever, and epidemic typhus.⁸¹ In refugee settings, surveillance of lice for the presence of organisms has predicted outbreaks of disease. Louse-born relapsing fever emerged as an important problem in refugee camps in Somalia and in Ethiopian prisoner of war camps. Infection with *Rickettsia prowazekii*, the agent of typhus, has been noted in body lice from Burundi, Zimbabwe, Russia, Peru,

and France.⁸² The finding of the organism in lice correlated with disease outbreaks in Russia⁸³ and Burundi.⁸⁴ The largest epidemic of typhus since World War II occurred recently in Burundi. During this epidemic, body lice were noted to be coinfecting with *R. prowazekii* and *B. quintana*. They proved capable of spreading both diseases simultaneously.

Life-threatening parasitic disease

Strongyloides stercoralis remains the most important life-threatening parasitic worm to present with skin manifestations. It is heavily endemic in Southeast Asia, Central Africa, Brazil, and the southern United States.⁸⁵ Larva currens, a characteristic skin lesion, presents as a rapidly moving urticarial track. Lesions are typically noted on the buttocks or lower trunk and may migrate up to 10 cm in a matter of hours. Thumbprint purpura, another characteristic skin manifestation, presents on the lower trunk and buttocks. In one study, skin biopsy of thumb print purpura demonstrated the parasite in 10 of 12 specimens.⁸⁶ Nonspecific skin manifestations include urticaria, morbilliform eruptions, and generalized pruritus. *Strongyloides* infection also presents as prurigo nodularis or lichen simplex chronicus.⁸⁷ The diagnosis depends upon recognition of characteristic skin signs, peripheral eosinophilia, enzyme-linked immunosorbent assay testing of serum, or the recovery of larvae from stool. Intermittent larval shedding hampers diagnosis in stool specimens.⁸⁸

Dissemination of strongyloidiasis is commonly associated with immunosuppression and has been seen after a single large dose of systemic corticosteroid.⁸⁹ In human T-cell leukemia/lymphoma virus infection, *Strongyloides* dissemination has presented with death from gastrointestinal bleeding and multiorgan failure.⁹⁰ In systemic lupus erythematosus, *Strongyloides* dissemination has presented with death from massive pulmonary hemorrhage.⁹¹

Ivermectin and albendazole are commonly used in the treatment of strongyloidiasis. Thiabendazole may be associated with a higher incidence of side effects.⁹²

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