# Tropical dermatology: Venomous arthropods and human skin

## Part I. Insecta

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Although many tropical insects carry infectious diseases, cutaneous injury can occur by other mechanisms, for example erucism (envenomation by caterpillars) or lepidopterism (dermatitis from moths). Pararama is a unique form of erucism seen in workers in contact with rubber trees in the Amazon, and it is caused by *Premolis* larvae, resulting in progressive periarticular fibrosis, ankylosis, and the loss of articulation. Ants and aquatic insects of the Belostomatidae family can cause painful bites and stings. Anaphylactic shock and death can result from the venom of bees and wasps. Beetles can cause vesicular dermatitis via cantharidin or paederin. Myiasis results from fly larvae (maggots) feeding on live or necrotic tissue of humans or other hosts, while New World screwworm fly larvae feed only on living tissue and burrow (ie, screw) more deeply when attempts are made to remove them. Tungiasis is characterized by very pruritic and painful papules and ulcers resulting from a *Tunga* flea penetrating the host's skin. Dermatologists should be able to diagnose and treat the cutaneous manifestations of these tropical insects and educate their patients on prevention. (J Am Acad Dermatol 2012;67:339.e1-14.)

***Key words:*** bites; envenomation; infestations; insects; stings; tropical dermatology.

Terrestrial arthropods are divided into several classes, the most important for dermatology is the class Insecta, comprising around 60% of the arthropod species in the world.[1,2] Whereas many insects are recognized as vectors of tropical diseases associated with significant morbidity and mortality (eg, mosquitoes, sand flies, tsetse flies, etc), other insects cause cutaneous injury via venom, vesicants, and allergens. This review covers tropical insects causing injury not involving an infectious agent.

**CAPSULE SUMMARY**

- Erucism is envenomation by caterpillars.
- Pararama is a unique form of erucism that is characterized by severe joint involvement.
- Lepidopterism is dermatitis caused by moths.
- Injuries from ants or aquatic insects can result from stings and/or bites.
- The venom of bees and wasps may produce anaphylactic shock and death.
- Cantharidin or paederin from beetles can cause vesicular dermatitis.
- The most common manifestation of bedbug bites is severe pruritus.
- Myiasis may occur from fly larvae feeding on necrotic or living tissue, but New World screwworm larvae burrow deeply into living tissue, causing more severe injury.
- Tungiasis is characterized by pruritic papules and ulcers.

## CLASS INSECTA

Among the insects, there are some orders which are closely related to envenomation and various human diseases, such as the orders Lepidoptera (butterflies and moths), Hymenoptera (ants, bees and wasps), Coleoptera (beetles), Diptera (flies and mosquitoes), Hemiptera (bugs), Dictyoptera (cockroaches, praying mantis, and termites), Phthiraptera (lice), and Siphonaptera (fleas).[3] Injuries by venomous and poisonous insects are associated mainly with moths and their larvae, ants, bees, beetles, bedbugs, and stink bugs.[4]

### Lepidoptera (moths and caterpillars)

**Key points**

- **Contact with *Lonomia* caterpillars can cause a potentially fatal hemorrhagic syndrome**
- **Pararama, caused by contact with *Premolis* larvae, can cause periarticular fibrosis and ankylosis**

Injuries caused by lepidopterans are called erucism and lepidopterism.[5-7] Although envenomation by caterpillars (erucism) is very frequent, they have only rarely been studied because of low reporting, which hinders a complete understanding of the problem. It is not known exactly how the caterpillar venom acts. Pathology is attributed to fluids from the hemolymph and the

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**Fig 1.** Lepidopterism. The moths of the *Hylesia* genus are capable of causing injuries in humans through barbed bristles released into the air. Photograph courtesy of João Luiz Costa Cardoso, MD.

**Fig 2.** Lepidopterism. Typical erythematous papules caused by *Hylesia* moths on exposed areas in 2 children that slept in an outdoor environment 1 day before the observation and saw the moths attracted by a light. Photograph courtesy of João Luiz Costa Cardoso, MD.

secretion of the spicules, with histamine being the main component identified thus far. Forms of adult moths can also cause dermatitis (lepidopterism).

Lepidopterism occurs through the bristles of the *Hylesia* genus (Saturniidae family); under certain conditions, this genus experiences population explosions in rural areas and during the rainy and warmer months in tropical areas.[8-11] Females in the reproductive period approach light sources and release "clouds" of bristles from their abdomens; these can penetrate human skin and cause an irritating dermatitis (Figs 1 and 2). There appears to be toxins in the bristles,[9,10] but the simple penetration of the spikes seems to cause inflammatory reactions. The irritation is severe, manifested by erythematous papules, swelling, and itching just a few hours after contact. Occasionally, conjunctivitis, keratitis, and iritis can be observed, which undoubtedly are associated with the popular belief that "the dust of the wings of moths can blind a person." Accompanied by intense pruritus, they heal 7 to 14 days after symptom onset. The histopathologic examination reveals a foreign body reaction with granulomas.

**Fig 3.** Erucism. Erythema and mild edema in patients that suffered injuries by Megalopigidae caterpillars. The pain is always more important than the inflammation. Photograph courtesy of Vidal Haddad, Jr, MD.

**Fig 4.** Erucism. Superficial skin necrosis observed after contact with a Saturniidae caterpillar. Photograph courtesy of Vidal Haddad, Jr, MD.

The use of oral antihistamines is indicated for the control of pruritus, and topical treatment with cold compresses, baths, and corticosteroid creams is recommended.[10,11]

Erucism (from the Greek *erucae* [larvae]) is the term used for envenomation caused by contact with larval forms of moths.[5-7] The majority of problems caused by lepidopterans start with inflammatory dermatologic manifestations of acute onset that occur by action of toxins.[5,6] The manifestations occur predominantly in the skin, depending on the intensity and extent of contact. There is initially local pain,

**Fig 5.** Erucism. Megalopigidae caterpillars. Note the great number of body setae or bristles. Photograph courtesy of Vidal Haddad, Jr, MD.

**Fig 6.** Erucism. Saturniidae caterpillars. The "pine trees" bristles are characteristic of this family. Photograph courtesy of Vidal Haddad, Jr, MD.

mild to moderate erythema, edema, and occasional local pruritus (Fig 3). There are characteristic infarcted and painful regional lymph nodes. In the first 24 hours, the lesions may progress to blistering and, more rarely, necrosis in the area of contact (Fig 4). Injuries associated with erucism have intense and prolonged pain as the primary symptom. The manifestations regress in 24 to 48 hours.[5,6] The main families of Lepidoptera that cause erucism are Megalopygidae, Arctiidae, and Saturniidae.

The Megalopygidae have body setae with venom (Fig 5). The most important genera are *Podalia* and *Megalopyge*. Larvae of these genera have 2 types of bristles: the true venomous bristles, which are smaller and pointed and contain the basal venom glands, and the longer bristles, which are colorful and harmless. The caterpillars of the family Saturniidae have "thorns" and pointed branches resembling small pine trees, with venom glands at the apices (Fig 6). They are colorful, with green shades, spots, and stripes that vary in individual genera and species. These colors often mimic the plants the caterpillars inhabit. The important genera are: *Automeris*, *Dirphia*, and *Lonomia*, the latter of which causes a potentially fatal hemorrhagic syndrome from contact with colonies of caterpillars in fruit trees.[5]

**Fig 7.** Erucism. The caterpillars of the *Lonomia* genus (Saturniidae family) are gregarious animals capable of causing severe envenomation with hematologic complications and occasionally, the death of the victim. Photograph courtesy of Vidal Haddad, Jr, MD.

Contact with *Lonomia* caterpillars (Fig 7) results in an intense fibrinolytic action similar to disseminated intravascular coagulation, which causes major and potentially fatal bleeding, with extremely low plasma levels of fibrinogen, plasminogen, and other coagulation factors. At the point of contact, the initial symptoms resemble those caused by other lepidopteran larvae, showing inflammatory phenomena. The presence of ecchymosis and suffusion indicates bleeding that is either local or systemic[11,12] (Fig 8). The differential diagnosis can be made by clinical history, agent identification, and observation of bleeding disorders. The treatment uses antilonomic serum, which is present in liquid form.[13,14]

**Fig 8.** Erucism. Skin bleeding showing the coagulation disorders caused by envenomation after contact with *Lonomia* catterpillars. Photograph courtesy of João Luiz Costa Cardoso, MD.

**Fig 9.** Pararama. Above: *Premolis semirufa*, the pararama caterpillar near to a rubber bowl in a sap tree. The bristles of this larvae causes severe inflammation and ankylosis in the fingers of the hands of workers of the sap tree (*right*). Note the severe alterations in the radiographic examination. Photograph courtesy of Ronaldo Monteiro Costa, MD.

Pararama is a disease that is caused by the larvae of the *Premolis* species (*Premolis semirufa* is the most often identified species); these larvae live in rubber trees and are seen only in the Amazon region (Fig 9). The caterpillars' venomous bristles penetrate into the hands of victims who collect bowls of tree sap, causing initial manifestations that do not differ from those caused by other venomous caterpillars. In some individuals, the swelling persists after 2 or 3 days, and there is a progressive periarticular fibrosis that leads to ankylosis and a loss of function of articulation.[15,16] The likely mechanism for the fibrosis and ankylosis is the presence of toxins that

**Fig 10.** Tocandira or bullet ant (*Dinoponera* spp). The sting of this ant is very painful and causes systemic manifestations. Photograph courtesy of Vidal Haddad, Jr, MD.

inactivate total and C2 complement and promote a chronic inflammation with granulomas (foreign body reaction) in deep tissues (synovial membrane, cartilage, and bone). The first contact does not provoke sequelae; the process occurs after repeated injury, suggesting an immunologic action for its development.[4]

The diagnosis of erucism is simple when the victims bring in the responsible animal. With the exception of certain caterpillar types (eg, *Lonomia* and *Premolis*), the envenomation has a good prognosis and the manifestations fade in 2 to 3 days without major complications or sequelae. The therapy of choice for envenomation by caterpillars is local blockade with 2% lidocaine. Because the injuries usually occur on the upper limbs, local anesthesia easily controls the symptoms.[5,6] In some refractory cases, successive applications of anesthetic are necessary. As an additional measure, the site can be washed, and compresses applied with cold water and topical steroids with oral antihistamines, which reduce inflammation but not pain.[5-7] Envenomation by *Lonomia* requires hospitalization, and there is a serum antivenom produced at the Butantan Institute in São Paulo, Brazil. Unexplained bleeding after contact with caterpillars guides the diagnosis, and the cases can be found in Central and South America. Pararama arthritis is a sequela progressing to total disability of the joints of the hand, and little can be done for the victim.

## Hymenoptera (ants and bees)

### Key points

- **Bullet ants (*Paraponera* species) have the most painful sting of any member of the Hymenoptera order**
- **Fire ants can cause injury simultaneously from bites and stings**

**Fig 11.** *Pseudomyrmex* ants or "novice's ants" (*Triplaris* spp). These ants live naturally in trees, and their stings cause intense pain and moderate local inflammation. Photograph courtesy of Vidal Haddad, Jr, MD.

**Fig 12.** Red fire ant (*Solenopsis invicta*). This vicious ant attacks anything that comes near the anthill with painful stings. Photograph courtesy of Vidal Haddad, Jr, MD.

- **A massive number of bee stings can result in multiple organ failure because the venom is rich in phospholipases**

**Ants.** Ants from the order Hymenoptera belong to the family Formicoidea. Injuries caused by stings or bites of ants are part of everyday life, especially for the inhabitants of rural areas. There are 3 subfamilies of medical importance.[17,18]

The subfamily Ponerinae includes the important genus *Paraponera*[19] and their close relatives, the *Dinoponera*. These ants may reach several centimeters in length, have dark coloration, and live either alone or in pairs in rotting wood and fallen logs, etc (Fig 10). They are found in South and Central America. They are commonly called bullet ants, *tocandiras*, Cape Verdean, or 24-hour ants; the latter term is probably associated with the intense and prolonged pain caused by the sting. Ponerinae ants inject venom through a stinger attached to an abdominal venom gland.[17-19] The pain associated with the bullet ant's sting is reported to be greater than that of any other member of the Hymenoptera order. The pain is rated 4+ on the Schmidt Sting Pain Index. Poneratoxin is a paralyzing neurotoxin isolated from the venom that affects voltage-dependent sodium ion channels and blocks synaptic transmission.[20] Otherwise, the venom is a poorly studied protein mix that is used by Amazon Indians for control of rheumatic pains and also used in rituals of some Indian tribes in the Amazon, who place their hands into a container full of ants to test themselves in the face of intense pain.

In subfamily Dorilinea, the *Eciton* genus (army ants) can cause human injuries. They travel through the jungles of the Amazon in thousands of individuals, preying and eating small live animals.[17,18] The stings of *Eciton* ants are moderately painful and there are no studies about the characteristics of the envenomation or the composition of the venom. Leaf-cutting ants or *saúvas* (*Atta*) do not contain venom, but occasionally can cut or lacerate human skin with their jaws. A curious fact is that some indigenous tribes use *saúvas* ants (which retains the reflexes of the mandibles even after the head is separated from the body) to approximate the edges of wounds, as "natural" sutures.[17,18]

*Pseudomyrmex* ants can attack humans that touch the "novice's tree" (*Triplaris* spp); these ants live naturally in these trees, and their stings cause intense pain and discrete to moderate local inflammation (Fig 11). The problem is common in some South American regions and can be prevented by the identification and avoidance of the trees.[21]

The subfamily Myrmicinae ants include the *Solenopsis* genus, the *lavapés* or fire ants.[17,18] The black fire ant (*Solenopsis richteri*) comes from the plains of Rio Grande do Sul State (Brazil), Argentina, and Uruguay, while the red fire ant (*Solenopsis invicta*; Fig 12) originated in the Brazilian Pantanal (a vast flooded area in the midwest of Brazil) but today is widespread throughout the southeast of Brazil and, when accidentally introduced in Louisiana and Alabama, colonized more than half of the United States in fewer than 30 years.[17,18] These ants are carnivorous, preying on insects, eggs, young birds, and small mammals. Moreover, they have the potential to cause envenomation and allergic reactions.

Fire ants are not only a major pest to humans in the southern United States, they are moving northward, possibly because of global warming. They are also a major economic problem both because of damage to livestock and to crops. Fire ants are notoriously difficult to eradicate, even self-assembling into waterproof rafts to survive floods.[22] On the other hand, fire ants are not known to carry disease, and they do consume large amounts of ticks, fleas, and other arthropods that carry infectious microorganisms.

**Fig 13.** Red fire ant. A red fire ant stinging a human and the sequence of the action of the venom (an initial urticariform papule and a sterile pustule 24 hours after the sting). Photograph courtesy of Vidal Haddad, Jr, MD.

Ants of the *Solenopsis* genus have venom that differs from most animal venoms in that it is comprised of oily alkaloids. Its major fraction is solenopsin A, which has a cytotoxic effect that can degranulate mast cells. An interesting fact is that 10% of the venom inoculated by the ants is a nontoxic protein that can cause allergic reactions of varying degrees.

The formation of a sterile pustule within 24 hours after the bite is associated with the sting of *S invicta*. The mechanism of the sting of these ants is characteristic: the ant attaches to the skin with its jaws and rotates on its axis, applying a dozen stings, if not removed.[23] Fire ants cause injury simultaneously from both bites and stings. The burning pain is the main initial symptom of the injury. An urticarial, erythematous, extremely pruritic papule immediately forms at the point of the sting, which in about 24 hours will lead to a sterile pustule caused by the migration of neutrophils (Fig 13). Envenomation with multiple stings causes important pustular manifestations that can be confused with other skin diseases.[17,23] These injuries occur with small children or intoxicated individuals. In addition to the painful symptoms common to all stings, the immunogenic capacity of protein fractions and nontoxic venom of the fire ants may cause allergic reactions of varying degrees, some extremely serious, including anaphylactic shock.[23,24]

**Fig 14.** Apiidae. A group of Africanized bees (*Apis* spp). Photograph courtesy of Vidal Haddad, Jr, MD.

The stings of ants can be aggravated by the development of secondary infection at the site and allergic reactions of varying severity. There are no laboratory tests used in the diagnosis of envenomation. Desensitizations against allergic manifestations caused by red fire ants (*S invicta*) are available in the United States, with controversial results.

Ant stings should be treated with the administration of antihistamines (dexchlorpheniramine, preferably), cold compresses to control pain, and topical

**Fig 15.** Apiidae. Fatal multiple attack by Africanized bees. Note the stingers on the skin and dead bees with the part of the digestive tube linked to the stinger. Photograph courtesy of Manoel Francisco Campos Neto, MD.

corticosteroids. Massive envenomation can be medicated with oral corticosteroids. Prednisone can be initiated at a dose of 30 mg for 1 to 3 days, tapering to 10 mg per day until the withdrawal of the drug. Patients with a history of allergy to stinging ants should have the same care as those allergic to bee stings, and if possible should have a kit available with adrenaline, antihistamines, and corticosteroids.[17,18]

**Bees.** Bees are social hymenoptera of the Apiidae family that live in colonies with varying degrees of functions between individuals (Fig 14). When disturbed, they attack through a stinger in the abdomen, similar to ants, which is detached from the bee with part of the digestive system, killing the insect (Fig 15). The stingers can be seen in the skin of the victim, and early extraction with clamps decreases the amount of the venom injected and improves the prognosis of the envenomation. Bees attack alone or in groups. In the latter situation, they cause potentially fatal injuries. The venom provokes local inflammatory reactions (pain, edema, erythema, papules, or plaques), toxic reactions (after multiple stings, with potential kidney failure, heart failure, or death), and allergic reactions, which can be serious, such as anaphylactic shock. Massive attacks became common after the hybridization of African and European bees, generating an aggressive hybrid that has spread across America from a fugitive colony in Brazil nearly 40 years ago. Bees and wasps can cause serious injuries by allergic phenomena. A high risk of death can result from multiple organ failure as a result of venom, rich in phospholipases, after a massive number of stings.[4,25]

The Meloponidae family (*jataís* or *irapoãs*) are stingless bees that can become stuck in the hair of the victims when they feel threatened. In extreme cases, they can only be removed by cutting the hair.[26]

**Fig 16.** *Paederus* beetles. Vesicant beetles of the *Paederus* genus (*top*) and *Epicauta* genus (*bottom*). These beetles are cosmopolitan, and typical injuries in humans can be observed around the world, especially in hot weather regions. Photograph courtesy of Vidal Haddad, Jr, MD.

The treatment of a few bee stings involves antihistamines and corticosteroid creams. Multiple stings are treated symptomatically. In attacks with multiple stings, it is essential to carefully extract the stingers with the venom glands still not emptied, which modifies the prognosis of the envenomation by reducing the amount of injected venom[4,25]; otherwise, the stingers will remain in the skin and, when pressed, will discharge their contents, increasing the envenomation. Anaphylactic shock should be treated with corticosteroid injections, promethazine, and millesimal adrenalin in emergency rooms because of the high risk of death.

## Coleoptera (beetles)

### Key points

- **Cantharidin in "blister" beetles cause vesicles and bullae by activation of neutral serine proteases, which cause degeneration of desmosomes**
- **Paederin in the Paederus beetle is an amide with vesicant action which blocks mitosis by acting on cellular DNA**

Vesicant beetles are cosmopolitan and cause injuries in every continent except the polar regions. Most of these insects belong to the *Paederus* genus[1-4] (Fig 16). In Brazil, the term *potó* is used for 2 different beetles, both causing vesicular dermatitis, also called

linear dermatitis. "Potó-pepper," "Potó-large," or "donkeys" are beetles that belong to the Meloidea family, measuring 1.5 to 3.0 inches in size, with 2 genera associated with injuries: *Lytta* and *Epicauta*. Both genera include beetles that feed on leaves of crops, such as tomatoes and potatoes, making their interaction with humans likely. One substance produced by these animals is cantharidin, a potent skin and mucous irritant.[3]

Cantharidin is a vesicant that comes from more than 1,500 species of "blister" beetles. It is absorbed into the lipid component of keratinocyte membranes, where it actives neutral serine proteases, leading to the degeneration of desmosomes and resulting in vesicles and bullae.[27] Cantharidin is also the primary ingredient of "Spanish fly," a purported aphrodisiac that is made by grinding dried "blister" beetles. The so-called aphrodisiac effects of cantharidin are related to its ability to produce irritation of the genital track, mimicking arousal.

*Potó* and "wildfire" are names given to the beetles of the *Paederus* genus, Staphylinidae family; they are easy to recognize from the elytra (shells that protect the wings) overlying the anterior portion of the dorsum of the abdomen. The cosmopolitan *Paederus* can fly, has nocturnal habits, and is attracted to artificial light sources, invading homes and causing linear dermatitis. They feed on plant debris and are quite common in crops of maize and beans. The life cycle of the beetle is long, passing through 7 intermediate larval stages before the adult form, multiplying at the rate of 1 cycle per year.[1]

The *Paederus* beetle produces paederin, a crystalline and powerful caustic amide with vesicant action, soluble in water and alcohol, which can block mitosis by acting on cellular DNA.[4] Paederin seems to have some differences compared to cantharidin, causing more intense erythema and smaller vesicles that converge and form blisters. Symptoms (burning and itching) are more intense in injuries secondary to *Paederus*. Injuries due to human contact with these types of secretions, however, are generally not serious, a fact that contributes to the relative lack of published literature about this disease.

First described in Indonesia in the summer of 1891, *potós* were already known to the Chinese for 1,200 years and already used in therapy, as shown in a manuscript from China dating from 739 AD: the insect has powerful venom, and when it touches the skin, it causes swelling. The venom causes the skin to peel and (can) completely remove tattoo marks. It can be used as a caustic against blisters, nasal polyps, or scurvy. The *Paederus* beetle is approximately 1 cm in length.[28]

**Fig 17.** *Paederus* beetles. The classic herpetiform lesions caused by vesicant beetles (in this case, *Paederus* spp) are localized to exposed parts of the body (*top*). The photograph on the *bottom* shows a typical pattern (the "kiss sign") caused by the contact with the venom in a skin flexure. Photograph courtesy of Vidal Haddad, Jr, MD.

More than 600 species of *Paederus* are known throughout the tropical and temperate regions of the globe. About 4% of the species cataloged as *Paederus* are recognized as causing linear dermatitis.[28-31]

The toxin of *Paederus fuscipes* was characterized as paederin, which differs chemically from cantharidin.[4,28] The dried extracts obtained from the insects maintained their activity for about 8 years.[25]

Injuries caused by vesicant beetles occurs in hot and rainy months.[1,2,31] The beetle is attracted to artificial light sources. The discharge of secretion occurs when the victim tries to ward off the animal and presses it against the skin, usually on the neck, face, or limbs, but any exposed areas may have lesions.[32] According to the extent and the number of the contacts, the injury can be classified as mild, moderate, or severe. In the latter case, there are systemic manifestations, such as nausea, vomiting, and fever.[4]

After the discharge of the substance, the skin shows erythema for a day or two, accompanied by pruritus and burning. After this period, vesicles

**Fig 18.** Pentatomidae. The stink bug of the Pentatomidae family recently was described as a cause of skin lesions in humans. Photograph courtesy of Vidal Haddad, Jr, MD.

appear (small when the injury is caused by *Paederus* and large when the agent is *Epicauta* or *Lytta*), which evolve to the formation of sterile pustules, ulcerations, and crusts (Fig 17). The lesions resolve in about a week, leaving residual erythematous or hyperchromic macules.[28] The lesions are elongated or linear because of the act of rubbing the insect against the skin and should be differentiated from contact dermatitis, phytophotodermatitis, varicella zoster, herpes simplex, pemphigus, and injuries caused by caterpillars.[4]

Lesions should be immediately and intensively washed with clean water and soap. Some authors advocate the use of tincture of iodine in early lesions, because this would act as a solvent. Vesicles, crusts, and pustules should be treated with potassium permanganate compresses (1 tablet in 4 L of water) twice a day and corticosteroid creams. If there is secondary infection, it is necessary to use topical or systemic antibiotics.

## Hemiptera (true bugs)

### Key points

- **Contact with stink bugs can cause burning and pruritus**
- **The painful bite of giant water bugs causes tissue injury by lysophospholipids in the bug's saliva, which cause paralysis in the neuromuscular junction of the prey**
- **Recent increases in bedbugs may be related to their resistance to insecticides and elimination of their predators**

### Suborder Heteroptera

**Pentatomidae family.** Similar to the vesicant beetles, some insects of the order Hemiptera (family Pentatomidae) can cause serious irritation to human skin (Fig 18). These insects are popularly known as *marias-fedidas* ("stink Mary") and they have been recently related to vesicular and erythematous plaques in the same regions affected by vesicant beetles, which are accompanied by burning and pruritus[33] (Fig 19). The differential diagnosis can be difficult. The treatment is similar to that used after contact with *Paederus* or cantharidin, although there is no information on the pharmacologic properties of substances secreted by the Pentatomidae.

**Fig 19.** Pentatomidae. Inflammation caused by a stink bug in a human. The lesions are similar to those caused by vesicant beetles. Photograph courtesy of Vidal Haddad, Jr, MD.

**Fig 20.** Belostomatidae. Giant water bugs of the Belostomatidae family are responsible for painful stings in humans. Photograph courtesy of Vidal Haddad, Jr, MD.

**Belastomatidae family.** Venomous aquatic insects are rare, but the arthropods of the Belostomatidae family can cause painful stings in humans.[34-36] The Belostomatidae or giant water bugs are cosmopolitan insects that live in tropical,

**Fig 21.** Belostomatidae. Erythematous papule at the point of a bite of a giant water bug. The skin signs were not proportional to the severe pain. Photograph courtesy of Vidal Haddad, Jr, MD.

subtropical, and temperate areas (Fig 20). The giant water bugs are classified in 2 main genera (*Lethocerus* and *Belostoma*).[35] They are found in freshwater habitats, such as ponds, lakes, and rivers, and are associated with an unpleasant sting that has led to the name of "toe biters" to describe these insects that may defensively attack the foot of a wader or hurt someone who picks them up.[35,36] They can often be observed feeding upon tadpoles, fish, and even animals as large as ducklings. They breathe in the water with a siphon tube projecting from the back of their abdomen and can be found hanging head down at the surface of the water, but are also highly capable swimmers.[2] These Hemiptera have popular names in Brazil, as water cockroach, water scorpion, *arauembóia*, *bota-mesa*, and finger stinger.

Giant water bugs can reach large diameters, as seen in the genus *Lethocerus*, where insects are recorded at sizes up to 10 cm. They have a short stout beak that is used to pierce their prey and present toxic saliva. The main species of the genus *Lethocerus* in Brazil are *L delpontei*, *L grandis*, and *L maximus*.[35,36]

The saliva of these insects is a mix of enzymes capable of liquefying the tissues of the prey, but there are also other toxic effects. The toxicity of the saliva of these animals was studied by Picado,[37] who reported "increased clotting of blood in men and animals, hemolysis similar to that associated with venom of snakes in rabbits but not in humans." Recently, there was demonstration of the presence of lysophospholipids in the saliva of the species *Belostoma anurum* that can cause paralysis in the neuromuscular junction of their prey.[38] These insects are capable of producing painful lesions in humans and possibly of carrying infections[39] (Fig 21).

**Cimicidae family.** Recently, an old foe has returned with strength: the bites of bedbugs. These

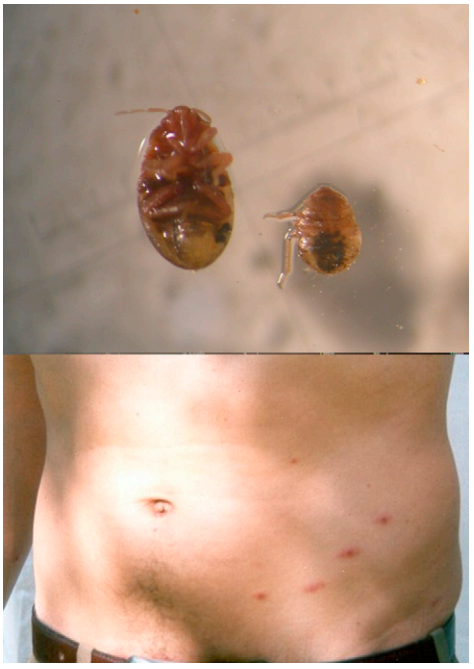

**Fig 22.** *Cimex* spp. Bedbugs are a curse resurrected in modern times. Note the blood in the abdomen of the parasite and lesions in the distribution of "breakfast, lunch, and dinner." Photographs courtesy of Vidal Haddad Jr, MD, and João Luiz Costa Cardoso, MD.

**Fig 23.** *Cimex* spp. The bites from bedbugs are not accompanied by severe manifestations in nonsensitized persons, but they can cause notable erythema, edema, and itching in those persons allergic to the bites (especially atopic individuals).

insects are parasites, and there have been reports of infestation in humans since the time of ancient Rome. They are hematophagous and have 2 blades in the proboscis: one to inject an anesthetic and the other to suck blood[1,2] (Fig 22). Like ticks, the presence of inflammatory reactions at the point of the bites can cause significant discomfort to the victim (Fig 23). Bedbugs are found in overcrowded areas of towns and cities, and their presence has traditionally had a deep relationship with low standards of sanitation, but bedbugs are now reported in

"upscale" homes and hotels. One possible reason for the increase in bedbugs may be the better control of cockroaches, which prey on them.

Bedbugs were common parasites in several countries until the deployment of dichlorodiphenyltrichloroethane and pyrethrum insecticides in the 1940s. Pesticides have greatly reduced the presence of these arthropods; for a long period, they were not a problem for domestic environments in the Americas. In recent years, a combination of factors caused bedbugs to return—the most potent insecticides have been abandoned because of the deleterious effects to the environment, the presence of bugs in some poor countries has increased, and international travel has become more common. Other factors include recent resistance to pyrethroids and dichlorodiphenyltrichloroethane, the ability of the bedbugs to survive up to a year without food, and the transportation of these bugs in luggage, resulting in numerous reports of bedbugs in European and American countries (especially in hotels); therapeutic and preventive measures should be familiar to dermatologists.

The most common species in Europe, the Americas, and Australia is *Cimex lectularius* (the common bedbug) and *Cimex hemipteras*, which is present in all warmer regions of earth.[40] Bedbugs live in groups (nymphs, eggs, and adults among blood droppings, which present a black coloration) in cracks in walls or in wood (in bed frames, for example), behind woodwork on the wall, ventilators, and in furniture of all types. They feed by sucking the blood of victims during the night, when they are attracted by $CO_2$ and heat, moving with great rapidity.[40] One interesting fact is the strong and offensive odor caused by 2 or 3 glands. The odor is capable of repelling predators of the hemiptera.

Bedbugs bite exposed areas of the victim (especially the head, neck, and arms) and cause erythematous and pruritic papules and macules (rarely blisters) that can become infected after scratching. The skin lesions show similarity with injuries caused by other arthropods, such as fleas. There is a typical distribution of the bites, seen with sequential lesions ("breakfast, lunch, and dinner"). The severity of the lesions is determined by the degree of sensitivity of the victim to the hemiptera.[40]

When necessary, treatment includes antihistamines and topical steroids. Nonsensitized individuals do not develop significant lesions or symptoms. There is the possibility of secondary bacterial infections; therefore, it is important to apply topical antibiotics. There is no proven disease transmitted by the bite of bedbugs, but numerous candidate pathogens can potentially be transmitted by *Cimex* spp.[41] Lesions in sensitized individuals may simulate infections and envenomation. The eradication and prevention of bedbugs can be tried by the removal of infested furniture, including those in transport vehicles, and exercising caution in the purchase of second-hand furniture and old building materials.

**Fig 24.** Myiasis of the scalp. *Dermatobia hominis*.

Bedbug pesticide resistance appears to be a great problem. This resistance includes deltamethrin and bait insecticides for cockroaches.[42] The most effective insecticides are pyrethroids, dichlorvos, and malathion.[42] While no infectious diseases have been proven to be transmitted by bedbugs, more than 100 illnesses have been reported with bedbug-related insecticide use, including 1 fatality.[43] Almost 90% of the cases, including the fatality, were associated with the use of pyrethroids and/or pyrethrins.

## Diptera (true flies)

### Key points

- **Botflies indirectly cause myiasis by attaching its eggs to a mosquito or muscoid fly vector which then transfers the eggs or larvae to the host**
- **The New World screwworm fly feeds on healthy tissue of livestock and humans and burrows (ie, screws) deeply into tissue**

Whereas flies are a nuisance throughout most of the world because of their bites (eg, deer flies), others carry infectious diseases (black flies carry onchocerciasis; tsetse flies carry trypanosomiasis). Most fly larvae (maggots) provide a useful function in nature by eating decaying matter, and they can even be used therapeutically. Some maggots, however, feed on living tissue. The general term for infestation of maggots feeding on the host's necrotic or living tissue is myiasis (Fig 24). This problem is commonly seen in tropical countries and in travelers returning from tropical parts of the world. Botflies, blowflies, and fleshflies are the 3 main families causing myiasis in livestock and occasionally in humans.

**Fig 25.** Screwworm larvae. *Cochliomyia hominivorax* feeding on viable human tissue of the pelvis. Photograph courtesy of Michael Mays, MD.

The female human botfly, *Dermatobia hominis*, captures one of more than 40 species of mosquitoes or muscoid flies and attaches its eggs to the vector's body. After releasing the vector, the eggs hatch while the mosquito is feeding on the host and the larvae use the bite entry site. Alternatively, the eggs simply drop off the muscoid fly when it lands on the skin. Cutaneous myiasis usually presents as slowly growing nodules that resemble furuncles or as ulcers, but myiasis may also be nasal, aural, or ophthalmic. Treatment of myiasis includes the use of forceps, excision, or occlusion/suffocation approaches (eg, tape, nail polish, glue, or petroleum jelly). An alternative method of convincing the botfly to exit the skin is to apply an irritant such as chewing tobacco, snuff, or camphor oil.

The larvae of the New World screwworm fly, *Cochliomyia hominivorax*, feed on the healthy tissue of livestock and occasionally humans. Screwworm females lay eggs in the exposed flesh (eg, wounds). When the larvae hatch, they burrow into surrounding tissue as they feed (Fig 25). If the wound is disturbed, the larvae burrow or "screw" deeper into the tissue, which is the source of the fly's name. The larvae are capable of causing severe tissue damage, including death of the host. Screwworms were officially eradicated from the United States in 1982, using the sterile insect technique, but the problem continues in Central and South America and the Caribbean. Treatment of screwworm larvae infestation includes manually removing the maggots, debriding the necrotic tissue, and prescribing antibiotic therapy for secondary infections.

## Siphonaptera (fleas)

### Key points

- **Tungiasis is associated with pruritus, pain, inflammation, and swelling, and results from penetration of the skin by the *Tunga penetrans* flea**
- **Treatment of tungiasis involves extraction, cryotherapy, or occlusion/suffocation of the flea followed by antibiotic therapy for secondary infections**

**Fig 26.** Tungiasis of the foot (*Tunga penetrans*).

Although fleas are vectors of numerous infectious diseases, their most commonly recognized noninfectious injury is their pruritic bite. Penetration of the skin by the female ectoparasitic *Tunga penetrans* flea, however, can cause severe pruritus, pain, inflammation, and swelling. Tungiasis, also known as *nigua*, *pio*, *bicho de pie*, and *pique*, is characterized by a black dot at the center of an erythematous papule surrounded by a white halo (Fig 26). Desquamation of the skin is seen after expansion of the flea during feeding. Without treatment, secondary infections, tetanus, and gangrene can develop. *T penetrans* is the world's smallest flea and is known as the chigoe flea, jigger, *nigua*, and sand flea, and is found in Central and South America, the Caribbean, Africa, and India. Treatment usually involves extraction of the flea followed by antibiotic therapy for secondary infections. Alternatively, cryotherapy or occlusion/suffocation can be used.

Many tropical insects cause morbidity and mortality in their role as vectors for infectious diseases. Other tropical insects, however, cause injury via the release of venom, vesicants, irritants, or allergens, etc. It is important for dermatologists to be familiar with these insects and the injuries they cause in order to initiate proper therapy and to advise the patient on effective prevention.

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