Multiple Fire Ant Stings: Report of 3 Cases and Review of the Literature

Matthew J. Reschly, MD, Gainesville, Florida
Francisco A. Ramos-Caro, MD, Gainesville, Florida
Barbara M. Mathes, MD, Gainesville, Florida

GOAL

To learn how to recognize the characteristics of and reactions of humans to fire ant stings.

OBJECTIVES

1. To discuss the entomology of the red and black varieties of imported fire ants.
2. To describe the systemic reactions caused by fire ant stings.
3. To outline the identifying characteristics of fire ant stings.

CME Test on page 190

This article has been reviewed by Michael Fisher, MD, Professor of Dermatology, Albert Einstein College of Medicine, in August 2000.

Imported fire ant sting reactions are becoming an increasing problem in the United States. It is important for clinicians to be familiar with their possible cutaneous and noncutaneous presentations. We present 3 cases with multiple fire ant stings, followed by a review of the literature.

The imported fire ant has become an important health hazard in the Southern and Southeastern United States and Puerto Rico, with a significant number of residents living in its indigenous areas being stung each year.[1,2] Reactions to imported fire ant stings range from limited to large local allergic reactions, to systemic hypersensitivity, including anaphylaxis and death.[3,4] We present 3 cases of multiple imported fire ant stings (more than 50 bites in 2 patients and more than 200 in the third). Clinicians should become aware of the possible reactions to this threatening insect.

Dr. Reschly is an intern and Dr. Mathes is Assistant Professor of Medicine (Dermatology) at the Division of Dermatology and Cutaneous Surgery, University of Florida College of Medicine, Gainesville, Florida. Dr. Ramos-Caro is Associate Professor of Medicine (Dermatology) at the Division of Dermatology and Cutaneous Surgery, University of Florida College of Medicine, and is Chief of the Section of Dermatology and Cutaneous Surgery at the Gainesville Veterans Medical Center (GVAMC), Gainesville, Florida. REPRINT REQUESTS to the Division of Dermatology and Cutaneous Surgery, PO Box 100277, Gainesville, FL 32610-0277 (Dr. Ramos-Caro).

Figure not available online

FIGURE 1. Patient 3. Disfiguring swelling on the face.

Case Reports

Patient 1—A 42-year-old white man with epilepsy was found unconscious with numerous fire ants covering his face. He was hospitalized for treatment of status epilepticus and multiple fire ant bites (more than 200 red papules and pustules on the face, neck, and shoul-

ders). During his 9-day hospitalization, he developed an unexplained leukocytosis and thrombocytopenia that healed on its own without specific therapy. He recovered uneventfully with healing of his skin and normalization of blood counts.

Patient 2—An 81-year-old white woman was ejected from her car and lost consciousness during a motor vehicle accident. Numerous fire ants were found on her trunk and upper extremities. She was hospitalized for treatment of multiple fractures. She had more than 50 red papules with crusted pustules on her chest, abdomen, and extremities. Her cutaneous lesions healed uneventfully during her hospitalization.

Patient 3—While camping, a 17-year-old white man was bitten on his scalp by more than 50 fire ants. Within 24 to 48 hours, he developed progressive grotesque swelling of his upper face (Figure 1) and scalp, but had no difficulty breathing or swallowing. He was treated conservatively as an outpatient and made a complete recovery within a week.

Comments

The red imported fire ant, *Solenopsis invicta*, infests much of the Southeastern and Southern Central United States and represents a significant hazard to agriculture, animals, and humans (Figure 2).[1,5] *S invicta* (native to Brazil, Paraguay, and Argentina), along with the black imported fire ant, *Solenopsis richteri* (native to Argentina and Uruguay), appear to have entered this country by ship through the port city of Mobile, Alabama, in the early 1900s.[4] Although *S richteri* has remained in a small area in Northern Alabama and Northern Mississippi, *S invicta* has spread each year, covering much of the Southern and Southeastern United States.[6] Fire ants are omnivorous and aggressive, with the queen living an average of 6 to 7 years, the males dying after mating, and the workers living 2 to 6 months.[1] Thousands of worker ants live, usually outdoors, in 1 of 2 types of colonies, according to their degree of aggressivity.[1] The more aggressive ants live in widely separated, mound-shaped, single-queen colonies, and the least aggressive ants live in closely located, sometimes flattened, multiple-queen colonies.[1] Multiple-queen colonies may improve the chances of colony survival.[4] Warm temperatures—an average minimum yearly temperature higher than −12.2°C or 10°F—seem to be needed for their survival, with cold temperatures being a limiting factor for their spread.[4] Hybrids of *S invicta* and *S richteri*, which are more tolerant to cold, have been found.[4] Many eradication techniques, such as broadcast baits, individual mound treatment, and barrier and spot treatments, have been used with limited success.[1] In infested areas, imported fire ants may account for a significant proportion of the ant population.[3] It is estimated that the fire ants could ultimately infest about one quarter of the land area of the continental United States.[4]

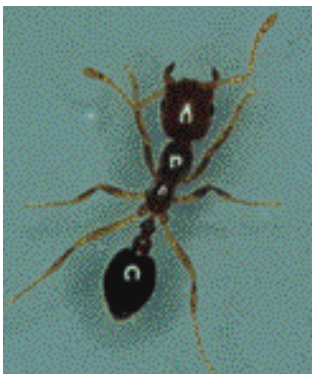

FIGURE 2. Fire ant.

The imported fire ant has become a particular nuisance and health hazard to residents of its expanding territory. The ants have been known to attack farm animals and damage crops and farm equipment with their mounds.[2,4] A significant percentage of the population in infested urban areas is stung each year.[1,2] Stings are usually multiple because ants tend to attack en masse and sting repeatedly.[3] When disturbed, the imported fire ant produces painful lesions with its unique method of stinging. The fire ant attaches itself to the victim with its jaws and then arches its body to insert a lancet-like stinger from the distal abdomen into the skin.[4,7] The ant holds this position for about 20 to 25 seconds and then may rotate its head and reinsert in 2 or 3 additional sites.[7] Each sting may deliver 0.04 to 0.11 µL of venom, which induces immediate pain at the site of injection.[4] Local itching may be intense and could last for hours.[4]

The imported fire ant venom is composed primarily of toxic alkaloids, as opposed to a primarily aqueous solution of proteins found in most other insect venoms.[4,8] Unlike other Hymenoptera venoms that contain a large percentage of protein, the imported fire ant venom is 95% alkaloid, 99% of which is composed of 2,6-disubstituted piperidines.[3,4] These alkaloids have antibacterial, insecticidal, hemolytic, cytotoxic, and neurotoxic properties and appear to induce necrosis and pustule formation on the skin.[4,8] The protein component makes up to 0.1% of the venom by weight and contains a hyaluronidase, a phospholipase, and probably *N*-acetyl-B-glucosaminidase.[3,4] The protein component of *S invicta* also contains at least 4 different allergens that may induce an IgE allergic response, including anaphylaxis.[4] Because, unlike other Hymenoptera, the venom is present in substantial amounts in imported fire ant whole-body extracts, it has been used effectively as immunotherapy in sensitized individuals.[4]

Reactions to imported fire ant stings range from limited to large local allergic reactions, to systemic hypersensitivity types, including anaphylaxis and death.[3,4] Almost all victims have an immediate wheal-and-flare reaction at the site of the sting,

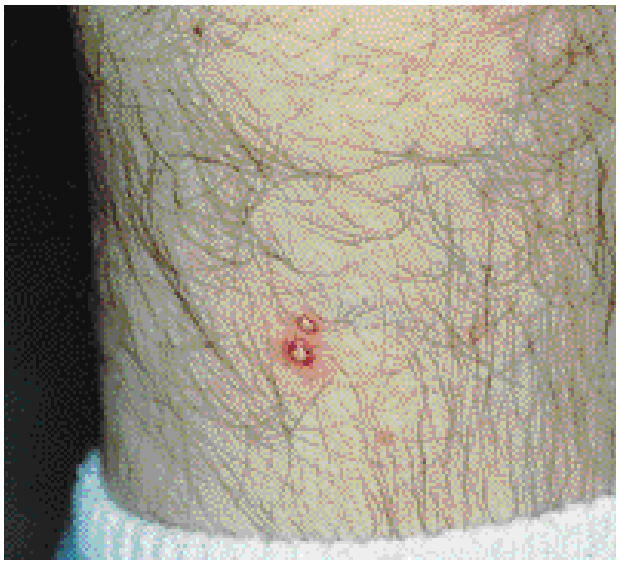

FIGURE 3. Pustule with the narrow rim of erythema.

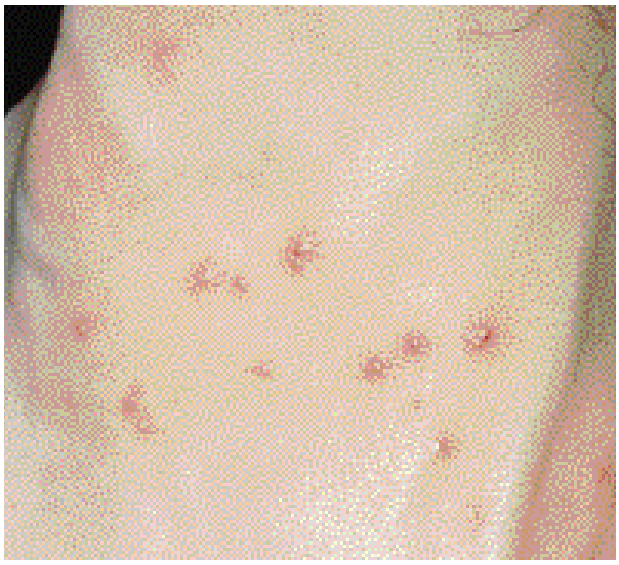

FIGURE 4. Grouping of lesions.

which normally disappears within 1 hour.[4] By 4 hours, the site develops into a thin, clear, superficial vesicle, and by 24 hours, it forms a sterile pustule surrounded by a narrow rim of erythema (Figures 3 and 4).[7] The sterile pustule usually persists from 3 to 10 days and then ruptures with crust formation and healing.[7] Scratching of the ruptured pustule may induce secondary infection and pyoderma. It has been noted that 17% to 56% of patients may react with a large local allergic reaction, consisting of erythema, edema, and induration of at least a 5-cm diameter.[4] These lesions typically are very pruritic and last from 24 to 72 hours.[4]

Histologic examination of a typical lesion 24 hours following a sting reveals a superficial pustule with a thin horny roof, containing few layers of epidermal cells. The base consists of dense necrotic connective tissue with an interspersed diffuse infiltrate of polymorphonuclear leukocytes and lymphocytes, which are also around blood vessels.[7] The contents of the pustule include many necrotic polymorphonuclear leukocytes and lymphocytes.[7] At 72 hours, an intact pustule has a very thin roof with many eosinophilic leukocytes and plasma cells. The inflammatory changes are much more severe than those usually associated with other insect bites or stings and often lead to some degree of scarring.[7]

It has been estimated that 16% of those stung experience some type of systemic reaction, with around 0.6% to 2% experiencing life-threatening anaphylaxis.[4,5] More than 80 deaths due to anaphylaxis to the fire ant sting have been reported.[9] Neurologic complications, such as mononeuropathy and seizures, have rarely been reported as a result of imported fire ants.[5,10] Most neurologic sequelae to the Hymenoptera stings (including those from bees, wasps, yellow jackets, and ants) consist of alterations of consciousness and less commonly hypoxic nonfocal seizures associated with anaphylactic shock.[10] Other neurologic disorders that have been reported include optic neuritis, mononeuropathy, and demyelinating lesion of the brain.[10]

Venom from imported fire ants does not seem to be a common cause of non–IgE-mediated systemic toxicity.[3,5] There are reports of multiple imported fire ant stings (one with up to 10,000 bites) without systemic effects.[6,8] One case report suggested that non–IgE-mediated toxicity resulted after a 5-day-old infant suffered a nearly fatal severe systemic reaction, including coma, shock, coagulopathy, and hemolytic anemia, after approximately 5000 imported fire ant stings in the absence of anaphylaxis.[3] In vitro research has found that, in addition to hemolytic, cytotoxic, and neurotoxic properties, venom from imported fire ants activates platelet and neutrophil function, inhibits mitochondrial respiration and oxidative phosphorylation, causes lytic release of histamine from mast cells, and inhibits Na^+–K^+ATPase.[11-14] It is conceivable that high enough systemic doses of venom could cause significant systemic effects. Research is limited, due to the rarity of cases involving multiple fire ant stings with possible non–IgE-systemic toxicity.

Acknowledgment—We would like to thank Michael Ford, MD, who provided us with some of the photographs.

REFERENCES

1. deShazo RD, Williams DF. Multiple fire ant stings indoors. *South Med J*. 1995;88:712-715.

2. deShazo RD, Griffing C, Kwan TH, Banks WA, Dvorak HF. Dermal hypersensitivity reactions to imported fire ants. *J Allergy Clin Immunol.* 1984;74:841-847.
3. Hardwick WE, Royall JA, Petitt BA, Tilden SJ. Near fatal fire ant envenomation of a newborn. *Pediatrics.* 1992;90: 622-624.
4. deShazo RD, Butcher BT, Banks WA. Reactions to the stings of the imported fire ant. *N Engl J Med.* 1990;323:462-466.
5. Candiotti KA, Lamas AM. Adverse neurologic reactions to the sting of the imported fire ant. *Int Arch Allergy Immunol.* 1993;102:417-420.
6. Diaz JD, Lockey RF, Stablein JJ, Mines HK. Multiple stings by imported fire ants (*Solenopsis invicta*), without systemic effects. *South Med J.* 1989;82:775-777.
7. Caro MR, Derbes VJ, Jung R. Skin responses to the sting of the imported fire ant (*Solenopsis invicta*). *Arch Dermatol.* 1957;75:475-488.
8. deShazo RD, Banks WA. Medical consequences of multiple fire ant stings occurring indoors. *J Allergy Clin Immunol.* 1994;93:847-850.
9. Rhoades RB, Stafford CT, James FK Jr. Survey of fatal anaphylactic reactions to imported fire ant stings: report of the Fire Ant Subcommittee of American Academy of Allergy and Immunology. *J Allergy Clin Immunol.* 1989;84:159-162.
10. Fox RW, Lockey RF, Bukantz SC. Neurologic sequelae following the imported fire ant sting. *J Allergy Clin Immunol.* 1982;70:120-124.
11. Javors MA, Zhou W, Maas JW Jr, Han S, Keenan RW. Effects of fire ant venom alkaloids on platelet and neutrophil function. *Life Sci.* 1993;53:1105-1112.
12. Cheng EY, Cutkomp LK, Koch RB. Effect of an imported fire ant venom component on respiration and oxidative phosphorylation of mitochondria. *Biochem Pharmacol.* 1977;26:1179-1180.
13. Lind NK. Mechanism of action of fire ant (*Solenopsis*) venoms, I: lytic release of histamine from mast cells. *Toxicon.* 1982;20:831-840.
14. Koch RB, Desaiah D, Foster D, Ahmed K. Effect of piperidines and fire ant venom on ATPase activities from brain homogenate fractions and characterization of Na^{+}-K^{+}ATPase inhibition. *Biochem Pharmacol.* 1977; 26:983-985.