

Fire Ant Attacks on Residents in Health Care Facilities: A Report of Two Cases

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Background: Imported fire ants now infest more than 310 million acres in the United States and Puerto Rico. Colonies have been found in Arizona, California, New Mexico, and Virginia. Available reports suggest that each year, fire ants sting more than 50% of persons in endemic areas, resulting in a variety of medical consequences.

Objective: To describe fire ant attacks among patients in health care facilities.

Design: Case series and literature review.

Setting: Two nursing homes in Mississippi.

Patients: Two nursing home residents.

Measurements: Clinical records to describe clinical sequelae of multiple stings.

Results: With the 2 incidents reported here, the total number of reported indoor fire ant attacks on humans since 1989 is 10. Six of the persons attacked, including the 2 nursing home residents described here (who died after the stings), had preexisting neurologic impairment. Eight of the 10 attacks have been reported in the past 4 years.

Conclusions: The presence of fire ants in occupied dwellings indicates the presence of active fire ant colonies in the immediate proximity. Efforts to eradicate these insects should be undertaken immediately, especially if immobile persons are present. These persons should be considered at risk for fire ant attacks as long as the ants are present.

The progressive spread of the pugnacious venomous imported fire ant throughout the southeastern United States over the past 60 years has caused major effects on farming and wildlife, including decimation of some ground-nesting birds and other species (1, 2). This spread has been aided by the increase in fire ant densities and mating flights and by the movement of infested plants and other agricultural products to uninfested areas (2-4). The ants arrived from South America through the port of Mobile, Alabama, in the 1930s, and they now infest more than 310 million acres in the United States and Puerto Rico (Figure 1). Colonies have recently been found in Arizona, California, New Mexico, and Virginia. The ultimate range of the ants is unclear. Other factors have promoted human contact with fire ants. The urbanization of the United States, especially in the Sunbelt states, has facilitated the expansion of fire ants that thrive in disturbed habitats, including sites of new construction. In 1973, polygyne fire ant colonies (multiple egg-laying queens in a single colony) were noted (5). This adaptation has resulted in densities of 200 to 600 fire ant mounds per acre, with 100 000 to 500 000 ants per mound in some areas (2, 6, 7). Attack rates in endemic areas, including New Orleans, Louisiana, and San Antonio, Texas, now exceed 50% of the population per year (8, 9). In one study (9), 51% of previously unexposed medical students were stung within 3 weeks of arriving in San Antonio, Texas; 16% of these students developed IgE antibody specific for fire ant venom.

Since 1957, reports of medical complications of fire ant stings have appeared in the medical literature (8, 10, 11). The predominant species, *Solenopsis invicta*, usually nests in mounds formed in the ground. It is easily identified by its behavior. When the mound is disturbed, ants swarm to the surface and sting anything foreign to the environment. This is a unique behavioral characteristic of imported fire ants.

Anyone stung immediately experiences a combination of severe burning (hence the term "fire ant") and itching at the sting sites. A localized hive develops at the sting site within 20 minutes; this is followed by a necrotic lesion, termed the sterile pustule, which lasts for several days (Figure 2) (10, 11). Between 17% and 56% of persons who are stung develop venom-specific IgE and experience indurated, pruritic lumps at the site of subsequent

stings (6, 8). These lumps are called late cutaneous allergic reactions. Large reactions may rarely cause enough tissue edema to compromise blood flow to an extremity. Anaphylaxis occurs in 0.6% to 6% of persons who are stung (6, 12). More than 80 reported deaths have been attributed to anaphylactic reactions to fire ants (12). Neuropathy, seizures, cerebrovascular accidents, and the nephrotic syndrome have also been attributed to fire ant stings.

With the increase in fire ant density and the ants' propensity to attack farm animals during times of food scarcity, reports of fire ant attacks on humans who come in direct contact with mounds came as no surprise (13). We are concerned, however, by recent fire ant attacks on persons in their own homes, in motels, or in health care facilities. Two attacks on residents of widely separated nursing homes in Mississippi within 1 year led to this report.

Case Reports

Patient 1

A 67-year-old female resident of a skilled nursing home in Brookhaven, Mississippi, had dementia, chronic congestive heart failure (ejection fraction, 20%), chronic obstructive pulmonary disease, and osteoporosis. She could not ambulate without assistance and was bed-bound when not in a wheelchair.

When the patient's bed covers were pulled back during a routine 4:00 a.m. nursing check on 30 August 1998, many fire ants were noted in the bed and on the patient's left arm, chest, neck, stomach, and back. Ants were not present during the previous check 3 hours earlier. An ant trail that led from the floor to the patient's bed was identified. After the ants were washed from the patient, fire ant-induced wheal and flare reactions too numerous to count were seen at the previously noted sites. Vital signs were stable and unchanged from those recorded earlier in the day. No symptoms of anaphylaxis were observed. More than 500 of the characteristic sterile pustules were present 24 hours later (Figure 2). One week after the attack on patient 1, fire ants were found in the room of a 99-year-old patient in the same facility.

Patient 1 was initially treated with intramuscular diphenhydramine, methylprednisolone, and topical corticosteroids. Four hours later, she was transferred to a hospital for evaluation of increasing dyspnea. She received parenteral corticosteroids, diphenhydramine, and ceftriaxone sodium. Although sting sites gradually improved in appearance, the patient's chronic congestive heart failure became intractable. She died 5 days later.

The nursing home was 2 years old and had been constructed on land previously used as a cow pas-



Figure 1. Extent of fire ant infestation in the continental United States.

ture. The facility had been inspected and treated by a pest control service 4 days before the incident. The patient's family is suing the nursing home, the pest control company, and the contractor who built the facility for negligence and failure to maintain a pest-free facility.

Patient 2

This 60-year-old male resident of a nursing home in Starkville, Mississippi, had developed a right hemiparesis, dysphagia, dysarthria, and incontinence after a cerebrovascular accident in 1996. He was fed by a percutaneous enterostomy tube and had a urinary catheter. The patient was in his usual state of health at midnight on 15 February 1997 but was found covered with ants when checked at 4:00 a.m. on the same date. A trail of ants was noted coming from the baseboard of his room and up over furniture onto his hospital bed. Vital signs were stable and unchanged from those recorded earlier. No symptoms of anaphylaxis were noted. The ants were washed off, and the patient was treated with diphenhydramine and emollient ointments until the next morning. By the next morning, he had confluent areas of sterile pustules on his head, back, arms, and chest. He was admitted to the hospital and treated with parenteral corticosteroids, antihistamines, and topical corticosteroid ointments. During the next several days, he developed generalized swelling at the sites of stings and joint pain on movement. These responded to ongoing corticosteroid treatment. The patient then developed pneumonia and congestive heart failure, which had improved by hospital discharge 21 days later. However, he never regained the level of function he had had before being stung. The patient was subsequently admitted to the hospital five additional times for respiratory distress associated with aspiration pneumonia and congestive heart failure. He died of apparent sepsis 13 months after the fire ant attack.

The nursing home had been routinely inspected

by a pest control service, including on the day before the attack. No evidence of fire ant infestation had been noted during these inspections. The patient's family is suing the nursing home for negligence and failure to maintain a pest-free facility.

Methods of Literature Review

We reviewed medical records, legal depositions, newspaper reports, and other material related to the two fire ant attacks reported here. All available case reports of similar indoor attacks were obtained by using computer-assisted literature searches for all such reports in the English-language literature published from 1966 to the present (MEDLINE). These reports were also reviewed in detail. Colleagues in the entomology and allergy professional communities were also consulted for case reports not readily available through MEDLINE.

Results of Literature Review

The two attacks reviewed here were similar to two other attacks of nursing home residents, in

which poorly mobile, neurologically compromised persons could not withdraw from attacking fire ants (Table 1) (14, 15). In all four cases, no extraneous food was present on patient beds or in patient rooms to attract the ants. Stings were located on the extremities and trunk but in some cases also involved the mucous membranes. Three of the four cases, including the two described here, were associated with worsening of preexisting cardiopulmonary disease and early or late death. In contrast, Diaz and colleagues described a nursing home resident with Alzheimer disease who was stung an estimated 10 000 times, with no obvious untoward effects (16). Like the other patients reported, she was treated with intravenous fluids, antihistamines, and antibiotics, but she received no corticosteroids.

Four persons without neurologic compromise, including a diabetic patient stung in a Louisiana motel room who later died of a cerebrovascular accident, have also experienced fire ant attacks (14). An infant was attacked in a crib in Alabama in 1992 and survived after a complicated course (17). Two healthy persons and their family pets sustained re-

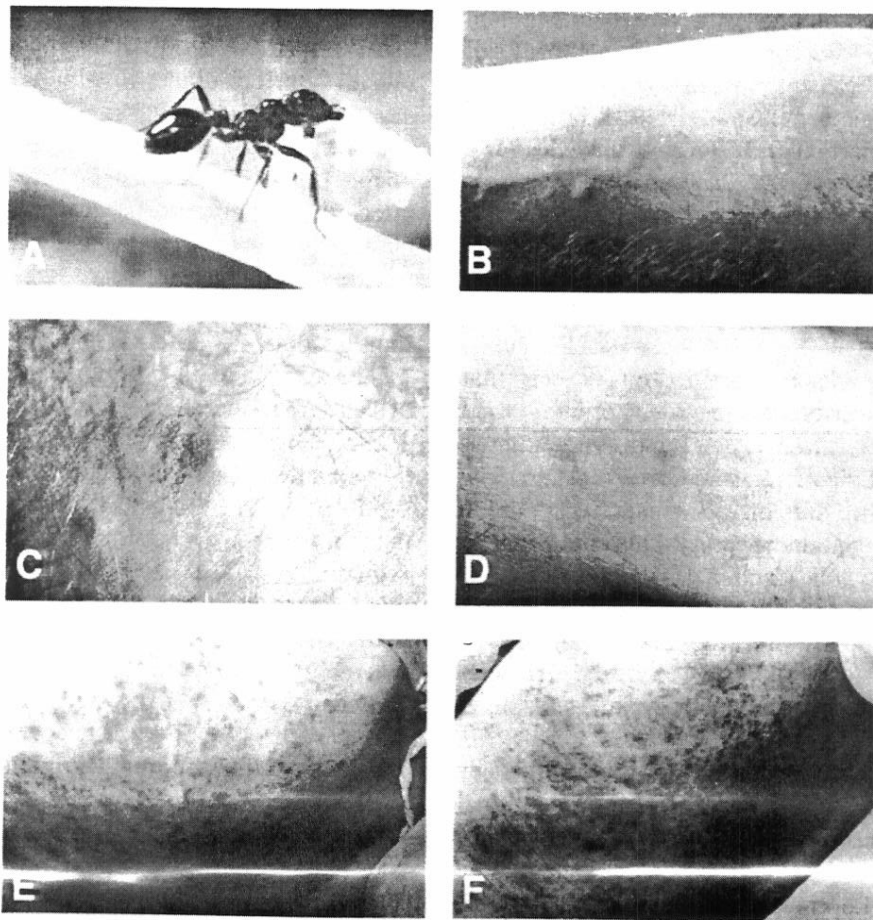


Figure 2. Fire ant and fire ant stings. A. Worker fire ant (*Solenopsis invicta*) carrying an insecticide-impregnated corn grit in its powerful mandibles. B. Wheal and flare reactions 5 minutes after multiple fire ant stings. These occur when the ant attaches to skin with its mandibles, arches its body, and injects 0.04 to 0.11 μ L of venom through a stinger located in the distal abdomen. C. Sterile pustule 24 hours after a fire ant sting. D. Cutaneous late-phase allergic reaction 24 hours after a fire ant sting. Note the excoriated sterile pustule at the center of the reaction. E and F. Abdomen (E) and left arm (F) of patient 1 showing coalescent sterile pustules after multiple fire ant stings.

Table 1. Previously Reported Cases of Indoor Fire Ant Attacks on Humans

Patient	Age	Sex	Mental Status	Location	State	Clinical Consequences	Study, Year (Reference)
1	84 y	Female	Alzheimer disease	Bed in a private home	Florida	None	Diaz et al., 1989 (16)
2	5 d	Male	Normal	Crib in a private home	Alabama	Shock, coma, sepsis, focal neurologic signs, hemolytic anemia	Hardwick et al., 1992 (17)
3	69 y	Male	Normal	Bed in a hotel	Louisiana	Late cutaneous allergic response, stroke	deShazo and Banks, 1994 (14)
4	74 y	Female	Alzheimer disease	Bed in a nursing home	Florida	None	deShazo and Banks, 1994 (14)
5	90 y	Female	Multi-infarct dementia	Bed in a nursing home	Texas	Worsened congestive heart failure, respiratory insufficiency, death 6 days later	deShazo and Williams, 1995 (15)
6	39 y	Female	Healthy	Apartment in apartment complex	Florida	None	deShazo and Williams, 1995 (15)
7	9 y	Female	Healthy	Apartment in apartment complex	Florida	None	deShazo and Williams, 1995 (15)
8	26 mo	Male	Hydrocephalus, developmental delay	Apartment	Texas	Corneal opacities	Amador and Busse, 1998 (18)
9	67 y	Female	Dementia, congestive heart failure, chronic obstructive pulmonary disease	Bed in a nursing home	Mississippi	Intractable congestive heart failure, respiratory failure	Current report
10	60 y	Male	Hemiparesis, dysarthria, dysphagia, incontinence	Bed in a nursing home	Mississippi	Pneumonia, congestive heart failure	Current report

peated stings in their apartment in Florida before an active fire ant mound with a live queen and numerous workers was discovered in the corner of one room (15). Fire ants attacked a 26-month-old boy with neurologic compromise, selectively stinging his head and, in particular, his eyes and eyelids (18). The preference for the eye has been noted in previous sting attacks on young animals (2).

Discussion

Imported fire ants are omnivorous insects that sting and kill invertebrates as their primary food source. They also scavenge dead and dying animals and some plants, ripe fruit, and seeds (19, 20). The worker caste of fire ants ingests sugars, some amino acids, and oils containing polyunsaturated fats in liquid form (21). Solid food is returned to the colony undigested in the buccal cavity of the worker ant. Solids or liquids are then fed to the brood (immature) ants by worker ants. The queen resides in her chamber within the mound and is fed food passed from workers to her court (20).

Communication among fire ants is facilitated by chemical pheromones and visual and vibrational stimuli. Most encounters with worker ants involve multiple ants. In the case of human contact, the ants can move 1.6 cm per second and accumulate on the body in large numbers before detection (2). They then sting almost simultaneously, probably on cue, inducing a sensation of intense burning at each sting site. Ants may sting multiple times if left un-

disturbed or remain in place while continuously injecting venom. The pruritic, erythematous wheal and flare reaction on each sting site resolves after several hours. Within 8 to 10 hours, a sterile pustule develops at each sting site (10, 14). Pustules left undisturbed dry up over 2 to 3 weeks. If broken open, they leave superficial ulcers that may become infected; this presents a special problem for diabetic patients stung on the feet and legs. Late cutaneous reactions usually resolve within 10 days but cause severe pain and pruritus while present. These symptoms respond to potent topical corticosteroids.

The venom of the fire ant is unique among that of venomous insects because it contains only about 1% protein. Venom proteins are responsible for host immunologic responses to venom, including the production of venom-specific IgE. The proteins that make up fire ant venom have been extensively characterized (22, 23). The nonprotein component contains aliphatic substituted alkaloids that are cytotoxic. These compounds cause the epithelial damage that results in the sterile pustule.

Because some persons have received many stings with no obvious untoward effects, the mechanism of adverse reactions reported in patients who have experienced cardiac dysfunction, pneumonia, cerebrovascular accidents, and other complications in the absence of signs or symptoms of anaphylaxis remains unclear. The reactions could represent toxic non-immunologically mediated responses to venom in sensitive persons. Fire ant venom contains the enzyme hyaluronidase, which could activate the complement, coagulation, or kinin systems in some

persons. The stress of the sting attacks or the empirical use of antihistamines, intravenous fluids, and corticosteroids to treat these reactions may also play a role in the deterioration of already debilitated patients. This observation is pertinent because topical steroids, diphenhydramine, antibiotics, or epinephrine do not alter the course of the pustular reactions (10, 24). In the absence of anaphylaxis, a conservative approach seems prudent.

Prevention of Indoor Fire Ant Attacks

Fire ant colonies cannot be destroyed unless the queen is killed (4). Thus, routine pesticide treatments with insecticide sprays may kill workers, but the queen survives to repopulate the colony. Attempts to control fire ants by biological methods, such as introduction of predators, are under evaluation (25). However, pesticides are the only control measures currently available. Slow-acting insecticides incorporated into soybean oil and impregnated on corn grits acting as bait are most effective (Table 2) (25). The oil that contains the toxicant is ingested by worker ants and carried into the mound, where it is fed to other workers, larvae, and queens. Some of these products are approved for indoor use and may be required to control fire ants in some facilities.

Although their usual habitat is outdoors, imported fire ants have the adaptive capacity to prosper indoors, probably in response to threats to their

outdoor food supply. When fire ants are noted indoors, an active infestation should be assumed. The building and perimeter should be inspected, and if ant activity is noted, bait-based insecticides should be applied as directed in the product instructions. The workers found indoors should be exterminated as soon as possible with liquid pesticides. If workers continue to be noted inside, building infestation should be assumed and an extensive extermination performed. In addition, routine pest control services should be conducted outdoors around the perimeter of the building, with bait applications conducted two to three times per year or as necessary. Reinfestation is common and should be anticipated. Because fire ants are attracted to electrical fields, equipment with wires, contact points, fuses, or switches should be inspected. Ants may accumulate in large numbers in such equipment—including computers and computer-containing devices, air conditioners, and circuit breakers—and cause short circuits or mechanical malfunction (2, 26). Until ants are no longer present, infants, neurologically compromised persons, and otherwise immobile persons should be carefully supervised.

Treatment of Patients with Fire Ant Stings

With the continued expansion of fire ant infestation in the United States, additional attacks on humans are likely. Symptoms of anaphylaxis (for ex-

Table 2. Examples of Chemicals Used To Control Fire Ants around Homes and Recreational Areas

Treatment	Chemical Name	Trade Name and Manufacturer
Outdoors Baits	Abamectin	PT Ascend Fire Ant Bait, Whitmire Micro-Gen, St. Louis, MO 63122
	Boric acid	Clinch, Novartis Crop Protection, Greensboro, NC 27419
	Fenoxycarb	Bushwhacker, The Bushwhacker Association, Inc., Galveston, TX 77552
	Hydramethylnon	Award (Logic), Novartis Crop Protection, Greensboro, NC 27419
	Methoprene	Amdro (Siege), American Cyanamid, Wayne, NJ 07470
	Pyriproxyfen	Extinguish, Wellmark International, Bensenville, IL
	Spinosad	Distance, Valent U.S.A. Corp., Walnut Creek, CA 94596
	Acephate	Conserve, Dow AgroSciences, Indianapolis, IN 46268
	Bendiocarb	Orthene, Valent U.S.A. Corp., Walnut Creek, CA 94596
	Bifenthrin	Ficam, BFC Chemicals, Inc., Wilmington, DE 19805
Drenches, granules, sprays, dusts, aerosols (these chemicals can also be used as barrier or spot treatments)	Carbaryl	Talstar, FMC Corp., Philadelphia, PA 19103
	Chlorpyrifos	Sevin, Rhône-Poulenc Ag Company, Research Triangle Park, NC 27709
	Deltamethrin	Dursban, Dow AgroSciences, Indianapolis, IN 46268
	Diazinon	DeltaGard G, AgrEvo Environmental Health, Montvale, NJ 07645
	Isofenphos	Diazinon, Novartis Crop Protection, Greensboro, NC 27419
	Propoxur	Oftanol, Bayer Corp., Kansas City, MO 64120
	Cypermethrin	Baygon, Bayer Corp., Kansas City, MO 64120
		Demon, Zeneca, Inc., Wilmington, DE 19850
Indoors Baits	Abamectin	PT Ascend Fire Ant Bait, Advance, Whitmire Micro-Gen, St. Louis, MO 63122
	Hydramethylnon	Maxforce, The Clorox Co., Pleasanton, CA 94588
	Sulfuramid	Raid Ant Bait Plus, S.C. Johnson & Son, Inc., Racine, WI 53403
Sprays, dusts, aerosols	Orthoboric acid	Dual-Choice, Whitmire Micro-Gen, St. Louis, MO 63122
	Chlorpyrifos	FluorGuard, FMC Corp., Philadelphia, PA 19103
	Cypermethrin	DRAX, Waterbury Co., Inc., Independence, LA 70443
		Dursban, Dow AgroSciences, Indianapolis, IN 46268
		Demon, Zeneca, Inc., Wilmington, DE 19850

ample, urticaria, angioedema, bronchospasm, and hypotension) should be treated with epinephrine, parenteral corticosteroids, and antihistamines, as is the standard procedure (27). In patients without anaphylaxis, we recommend a conservative approach based on observation and treatment of symptoms. This treatment is similar to that used for small numbers of stings, which, more often than not, are associated only with acute itching and burning followed by development of sterile pustules. In such cases, the ants should be removed by washing the patient with sterile saline and antiseptic soap. Itching may be relieved by the use of nonsedative antihistamines that have limited anticholinergic effects. Two of these, cetirizine and loratadine, are available in liquid form for use in children and patients with feeding tubes. Itching can also be treated with application of topical corticosteroids, such as 0.1% triamcinolone, and topical antipruritic agents, such as pramoxine HCl 1%. Care must be taken not to rupture the sterile pustules because the resulting lesions often become infected. Intravenous fluids or parenteral corticosteroids for fire ant stings are not recommended unless evidence of hypersensitivity to fire ant venom is present; these agents may lead to fluid retention and cardiovascular compromise in patients with preexisting cardiovascular insufficiency. Sites of ant stings rarely become infected, and antibiotic prophylaxis is therefore not routinely required.

Implications for Physicians

Recent fire ant attacks on humans have been reported throughout the United States in the print and broadcast media, and federal and state investigations have followed. Fire ant stings in medical facilities have almost always led to legal action against the facility and others. In such cases, physicians are often asked about the quality and appropriateness of the care they and facility personnel provided before and after stings. Physicians in areas in which fire ants are endemic should familiarize themselves with the medical consequences of stings from these ants and anticipate the predictable events that follow.

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