CASE REPORT

CUTANEOUS ALLERGIC VASCULITIS DUE TO *SOLENOPSIS GEMINATA* (HYMENOPTERA: FORMICIDAE) ENVENOMATION IN INDONESIA

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Abstract. Severe cutaneous allergic vasculitis in a 60 year-old Caucasian male following the bite of the tropical fire ant, *Solenopsis geminata* (F.) is reported. Over the course of 8 weeks, the pathology progressed from an extensive red papular urticaria to vasculitis with peri-vascular inflammation and ulceration of the skin on the feet, ankles and lower limbs. Many of the affected areas of the skin eventually became covered with black eschar associated with further tissue breakdown and ulcer formation. After debridement, compression dressings, antimicrobial ointment and corticosteroids, complete healing eventually took place with only residual scarring. An awareness of the severe dermatologic reactions caused by a bite of *S. geminata*, albeit rare, is clinically important. Recognizing the characteristic skin lesions caused by the bite of *S. geminata,* treated with prompt administration of appropriate chemotherapy will speed recuperation of the patient and reduce possible secondary complications.

INTRODUCTION

For many people, an ant sting is an uncomfortable but transitory event. The small, moderately painful site often heals in a matter of days and is soon forgotten. On rare occasions, some people experience severe life-threatening reactions. For those unfortunate few, hypersensitivity to these stings can set off a rapid pathophysiological process resulting in anaphylaxis and death (Helmly, 1970; Stafford, 1996; Prahlow and Barnard, 1998; Solley *et al*, 2002). For others, envenomation can lead to delayed hypersensitivity type reactions, sometimes resulting in necrosis and ulceration with secondary infection or even presentations of neurological sequelae (Hoffman, 1995). To avoid or counteract such adverse episodes, prompt diagnosis, specific treatment and medical observation are essential.

As primary toxins, histamine melittin hyaluronidase and other venom components common to most stinging Hymenoptera (ants, bees, wasps and hornets) are not typically dangerous unless a person is hypersensitive to the venom or multiple stings are received at one time (Hoffman, 1997). Additionally, fire ants have a necrotizing component in their venom that generally results in a more persistent lesion at the sting site (Baer *et al*, 1979). Most immunological and toxicological studies have focused on the red imported fire ant, *Solenopsis invicta* Buren, the most notorious and aggressive of the fire ant species. However, the structure and composition of many myrmicine venom allergens have a strong similarity among the different species in the genus and immunologically appear to be highly cross-reactive (Hoffman, 1997). Patients that

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are initially sensitized to *S. invicta* can have life-threatening reactions to subsequent stings of native fire ant species (Stafford, 1996; Prahlow and Barnard, 1998). Although proven fire ant allergen-specific immunotherapy can greatly reduce the risk of subsequent severe systemic reactions, such allergy management therapy is highly specialized and not available to most human populations exposed to fire ant venom. Therefore, it becomes important for clinicians and other health care providers to have the awareness and means to deal with ant stings. To illustrate, we report an unusual adverse reaction following multiple stings from *Solenopsis geminata* (Fabricius 1804) in a remote coastal location of western Sumbawa Island (9º 01′ N, 116º 45′ E), Nusa Tenggara Barat Province, Republic of Indonesia.

CASE REPORT

A 60-year-old Caucasian male, a native of the United Kingdom, reported being stung by many small ants on the dorsum of both feet, ankles and shins of both lower legs on 19 August 2002 in the late afternoon. The incident occurred on the margin of a sandy beach high above the surf line. He had removed his boots and socks to walk on the sand that day. Shortly after putting his socks and boots back on he felt multiple sharp and painful irritations on his lower legs. On investigation he found his socks and boots were infested with numerous small ants that were actively biting and stinging him. He returned home and did nothing medically to attend to the areas that had been recently attacked.

Two days later, he was seen at the local clinic complaining of extensive papular urticaria, without pustules, on both lower legs and feet. He was immediately provided with Phenergan® antihistamine cream, (Promethazine HCl 2%) and Betnovate-C™ cream (Betamethasone valerate 0.1% w/w and Clioquinol 3% w/w), an anti-inflammatory topical corticosteroid to be applied twice daily for one week. Two weeks later (4 September) he presented with frank edema of both ankles and some initial breakdown of the skin of both ankles and feet along the contact points with his boots and sandals. There were no signs of secondary infection and he was given Clarityne® 10 mg (loratadine) antihistamine orally daily and clean dressings were applied to the areas of skin breakdown.

Six days later (10 September, 23 days post-attack) he was reviewed again. He complained of mild aching and pain and intense itching of both lower limbs. He had extensive ulceration and breakdown of the skin involving the dorsum of both feet and ankles circumferentially (Figs 1 and 2). Some of the areas of breakdown had become confluent and many of the ulcerated areas had developed black necrotic centers (eschar). Extensive pitting edema was seen on both lower legs. Many of the smaller lesions had a marked red hemorrhagic center and in some cases were associated with tissue breakdown and ulcer formation. At this point he was immediately hospitalized and the limbs were elevated and wet compressive dressings applied to both lower limbs following initial debridement of the eschar. The dressings were comprised of a combination of anti-inflammatory sulphasalazine ointment (silver sulfadiazine), Tulle Gras gauze dressing, and Melamine (Melolin) low adherent pads with a compressive bandage. He was also continued on Clarityne 10 mg daily for 2 weeks.

During the more aggressive therapy, the patient made steady progress and all the wounds healed rapidly with repeated clean dressings and continual elevation of the legs. However, on re-examination (30 September) he presented with recent punctate hemorrhagic lesions located mainly on the feet and a few small areas of tissue breakdown and necrosis (Fig 3). He was given a course of prednisone 40 mg orally daily for 5 days and

Fig 1–Day 23 post-envenomation response Extensive involvement of the skin in the area of stings involving the dorsum of the feet, ankles and lower limbs circumferentially. Some purpuric areas have become confluent with tissue breakdown, necrosis and ulceration. Note ulcerated areas covered with black eschar and numerous punctate petechial hemorrhagic spots. There was significant pitting edema of both lower limbs.

Fig 3–Day 43 post-envenomation response. Mild to moderate pitting edema present with delayed punctuate and confluent lesions developing on dorsum of feet, many presenting as smaller lesions associated with an intense red hemorrhagic center and tissue breakdown. The hypersensitivity reaction was successfully suppressed after a course of oral corticosteroids.

Fig 2–Day 23 post-envenomation response: Close-up of pathology on right lower leg.

Clarityne was continued for an additional 3 weeks. Eventually all the lesions healed completely leaving only some residual scarring. He was advised to carry epinephrine in the event of an anaphylactic reaction to further ant attack.

A blood profile and chemistry findings were within the normal range throughout the entire treatment episode. A CBC and erythrocyte sedimentation rate were conducted on 3 occasions and a urinalysis was done on one occasion. Unfortunately, a determination of total IgE immunoglobin level was not possible during the observation period.

A diagnosis of a subacute hypersensitivity allergic vasculitis due to fire ant (*Solenopsis*) bite was made based on patient history and clinical appearance of lesions as well as initial entomological identification of the ant genera found at the place of the attack. The attack sites developed delayed peri-vascular inflammation resulting in vascular occlusion in the skin and localized tissue necrosis and ulceration. Treatment using topical and oral corticosteroids, limb elevation and sterile dressings was prolonged but successful. Although species determination remains provisional, based on the morphology of the offending ant population and the known geographic distribution of members in the genus, *Solenopsis geminata* is the most likely culprit. Although

certainly not the first occurrence of its kind in Indonesia, we believe this report represents the first account of adverse allergic events following multiple stings from a *Solenopsis* species in this country. It also represents an unusual type of delayed (subacute) hypersensitivity reaction to fire ant venom with the development of cutaneous allergic vasculitis.

DISCUSSION

The true ants (Formicidae) are highly social organisms and are perhaps the most numerous and successful of all insect groups. Virtually all female ants (excepting members in a few subfamilies), can inflict a painful sting and may also bite in defense. In the subfamily Myrmicinae, which includes the fire ants in the genus *Solenopsis*, members can bite and sting the same site simultaneously. As social insects, formicid ants are often found in large aggregations that can pose a significant health hazard, capable of inflicting multiple stings from many individuals during a single encounter with a disturbed colony (Harris, 2005). Moreover, the potent antigenic properties of the venom can result, albeit rarely, in severe allergic responses, including anaphylactic shock and death (Hoffman, 1995). These allergens can produce a wide spectrum of hypersensitivity and rapid atopic immune responses that can range from localized skin reactions (intense pain, swelling, pustules) to life-threatening anaphylaxis. Most notably, the pathophysiological response to overproduction of specific IgE antibodies that follows venom inoculation can require immediate emergency treatment, often needing i.v. epinephrine and close supportive therapy. In this case, there was marked delayed (type 4) hypersensitivity to the venom that resulted in severe local effects, eliciting a local T-cell response and resultant perivascular inflammation, edema and tissue breakdown. The term "cutaneous allergic vasculitis" is one of several descriptions that have been used for similar reactions, including "hypersensitivity vasculitis", "leukocytoclastic vasculitis" and "cutaneous vasculitis". The most commonly cited etiological agents causing this type of vasculitis are various drugs and infections (Shi *et al*, 1998), but no reports were found in the literature linking *Solenopsis* stings with allergic vasculitis or cutaneous allergic vasculitis.

Acute allergic reactions to the sting of the tropical fire ant, *S. geminata*, have been reported worldwide (Helmly, 1970; Hoffman, 1997; Rhoades, 2001). Worker ants have powerful stings. Reports of serious reactions beyond transient localized skin inflammation are rare, especially in the Asian-Pacific region, yet severe systemic and fatal anaphylactic reactions to fire ant stings have been reported (Stafford, 1996; Wongsathuaythong *et al*, 1977; Prahlow and Barnard, 1998; Solley *et al*, 2002). Because the venom of *Solenopsis* species is similar enough in protein structure to cross-react, the possibly of *S. geminata* causing serious life-threatening harm has been recognized (Helmly, 1970). Although the venom is chemically different from that of *S. invicta* and considered less potent (Baer *et al*, 1979), severe allergic reactions to *S. geminata* stings have occurred in subjects already known to have been exposed (sensitized) to *S. invicta* venom (Hoffman, 1997; Rhoades, 2001). Our patient had no known underlying medical conditions (*eg*, diabetes, immunosuppression) that could have promoted or exacerbated the adverse reaction to *Solenopsis* venom and no reported history of prior encounters with the sting of *Solenopsis* species. There was no evidence of secondary infection following excoriation or contamination at the wound sites. The progressive pathologic response seen in this patient appears to have been exclusively the result of a profound allergic reaction.

The foraging ants (all minor workers) captured from the contact site were provisionally identified as *S. geminata* (Trager, 1991; Japa-

nese Ant Database Group, 1995). Unfortunately, specimens of the major groups were not collected and would have been required to make a definitive identification. However, we are confident the ants implicated in this case were in the *S. geminata* group of closely related species, including *S. geminata, S. invicta, S. richteri*, *S. saevissima*, *S. xyloni*, and *S. invicta* x *S. richteri* hybrid (Trager, 1991). From the material examined, a distinguishing character, the central medial tooth found between the lateral teeth on the clypeus of minor workers of *S. invicta* was lacking. Moreover, the yellowish colorization and the flange above the front leg coxae seen in our specimens were inconsistent with most descriptions of *S. invicta*. Even though considerable polymorphism and coloration variation exists in this genus, all the direct and circumstantial evidence we have indicates the offending party was *S. geminata*, a well-established and widely distributed resident in Asia. Moreover, unlike stings from *S. invicta* and other members in the Saevissima complex of fire ants, *S. geminata* stings rarely result in pustule formation. Our patient's initial reaction to the stings was restricted to small red areas, followed several days later by a more extensive papular urticaria (no pustules), and more consistent with pathology seen with *S. geminata* stings.

The injuriousness of *S. geminata* is well known and has become a serious problem in some introduced areas of the Pacific and South Asia, especially Okinawa, Japan and Guam (Hoffman, 1997). It is a common species throughout much of its range in Asia, and holds a dual role as either a serious agricultural pest in select field crops (Way *et al,* 1998, 2002), or as an important natural predator and biological control agent by feeding on eggs, prepupae and pupa of pest snails, noctuid moths, weevils and hemipterans that attack cotton, potato, soybean, maize, sugarcane, rice and other cereals (Risch and Carroll, 1982; Way and Khoo, 1992). Foragers can also prey on smaller vertebrates (birds, turtles).

Solenopsis geminata has been variously described as a "tramp" species, having been carried extensively to other regions, predominately by ship, from its original range in South and Central America (coastal NE Brazil, Guiana, western Amazonia, coastal Peru, and Mexico) (Buren, 1985; Trager, 1991). Its initial period of introduction to Asia is unknown but it is suspected to have begun spreading outside its native range at least several centuries ago in response to increased commercial trade (Harris, 2005). This opportunist species now has a near worldwide distribution following accidental and repeated introduction in many tropical and temperate climates. In Asia this ant extends from Japan, through China and the Southeast Asian region to the Philippines and Australia. This particular species is more prevalent in isolated areas and capable of nesting in dry to moist soil, more often preferring open, relatively barren areas, grasslands and sandy environments. Having a greater predilection for disturbed ecosystems, this species is also common on or near coastal zones in addition to inland moist lowlands. Foraging ants collected at the site of attack were concentrated along a leading edge of sandy beach near the tidal zone. Numerous small nests were located in open sunny areas forming small mounds of sandy soil around clumps of low vegetation.

Currently, the more troublesome development is the potential increased introduction and establishment of the red imported fire ant, *S. invicta*, into Asia and the Western Pacific (Harris, 2005). The recent discovery of *S. invicta* on the eastern coast of Australia has caused alarm and a greater awareness of the possibilities of this destructive species invading other areas of the Asia-Pacific region (Kemp *et al,* 2000; McCubbin and Weiner, 2002; Solley *et al,* 2002). It is important for countries in the region to coordinate and de-

velop routine monitoring programs for detection of invasive species that may have a harmful outcome on local agriculture and public health (Stanaway *et al,* 2001; Holway *et al,* 2002). Unfortunately, the risk that such intruders will become established in new environments increases as commerce and travel accelerates worldwide.

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