

Massive Hymenoptera Envenomation in a 3-Year-Old

Patrick Leight West, MD,*† Nathanael J. McKeown, DO,*†‡ and Robert G. Hendrickson, MD*†

Background: Envenomation by a large number of hymenopterans can cause significant morbidity and mortality due to venom load. We present the first case of massive Hymenoptera envenomation by native US Hymenoptera.

Case: A 3-year-old boy and his family were hiking in Oregon and were attacked by yellow jackets. On emergency department arrival, the child was uncomfortable and vomiting. Vital signs were normal; physical examination showed more than 90 punctate lesions on the head and neck, and 30 below the neck without urticaria. Initial laboratory values were normal except for a white blood cell count of 37,500/ μ L and mild hypokalemia, including a normal creatinine kinase. Intravenously administered fluids, ondansetron, midazolam, and morphine were given for symptom control.

Generalized edema developed 12 hours later and was treated with intravenously administered dexamethasone and diphenhydramine. His creatinine kinase peaked at 2085 U/L after 32 hours. Forty-eight hours after the incident, the child began to take oral fluids with laboratory values returning to normal.

Discussion: Delayed toxic effects of mass envenomation are due to direct toxic effects from the large venom load, with several cases of death reported. All prior cases of mass Hymenoptera envenomation in the United States have involved Africanized "killer" honeybees. Guidelines recommend admitting all pediatric patients sustaining more than 50 stings for 24 hours for laboratory evaluations.

Conclusions: Delayed toxic reaction may be caused by native US species of Hymenoptera. Physicians should be aware that endemic US species can cause this reaction and should have a low threshold to admit pediatric patients with more than 50 stings for 24 hours.

Key Words: Hymenoptera, yellow jacket, massive envenomation, rhabdomyolysis

(*Pediatr Emer Care* 2011;27: 46–48)

Hymenoptera envenomations are the most common envenomation encountered in the United States. Envenomations typically result in immediate immune-mediated reactions and are subdivided into local reactions and systemic "anaphylactic" reactions. Delayed nonanaphylactic systemic reactions due to venom effects are less frequently observed, but are potentially deadly sequelae of massive envenomations for which clinicians need to be vigilant.¹ This issue is of particular importance in pediatric population as their smaller size increases the respective amount of venom in each sting per kilogram of body weight, making a nuisance for an adult a potentially life-threatening event in a child.^{2,3}

All previously reported cases of mass Hymenoptera envenomation in the United States have involved Africanized honeybees; thus, this syndrome has only been of concern for clinicians who live in the lower latitudes of the United States.³ We present the first US case of a massive Hymenoptera envenomation caused by native Hymenoptera, the "yellow jacket."

CASE

A 3-year-old (13.5 kg) previously healthy boy was hiking with his family on a trail in November in Oregon. He and his family were attacked by a large number of yellow jackets. His father fell down a ravine after being initially stung and was not able to get back to his son. His son stood in place on the trail and received continued attacks; his father then picked him up and carried him through the brush to a main trail, where they were able to elude the bees. Emergency medical services was summoned to the scene and brought the family to the emergency department.

On arrival, the child appeared uncomfortable and was quietly crying lying on his mother's lap and moving minimally when he vomited several times during the examination. He had no significant swelling, difficulty breathing, stridor, wheezing, or other symptoms. His vital signs revealed a blood pressure of 114/84 mm Hg; pulse rate, 124 beats per minute; respiratory rate, 24 breaths per minute; and oxygen saturation of 97% on room air. He had normal cardiovascular, lung, and abdominal examinations. Skin examination revealed more than 90 punctate lesions on the head and neck and 30 stings on the chest, abdomen, back, and extremities. Stingers were still present in several of the wounds and were removed. Several of the offending insects had been concealed in the family's clothing and were trapped in the emergency department, where they were identified by medical toxicologists to have the typical color pattern and body morphology of the family Vespidae. Laboratory values were obtained revealing a white blood cell count of 37,500/ μ L with neutrophils of 78%, and the remainder of the hematologic indices was normal. Metabolic panel showed normal indices except for a low potassium at 3.0 mmol/L (reference range, 3.4–5.0 mmol/L), an elevated blood urea nitrogen at 26 mg/dL (reference range, 6–20 mg/dL), creatinine at 0.56 mg/dL (reference range, 0.26–0.42 mg/dL), and glucose of 308 mg/dL. Creatinine kinase (CK) was in the reference range at 298 U/L (reference, <317 U/L). He was treated with intravenously administered (IV) normal saline initially as a bolus, then maintenance normal saline at 50 mL/h, ondansetron (0.1 mg/kg IV every 12 hours as needed for nausea), and morphine (0.1 mg/kg IV every 2 hours as needed for pain) with minimal improvement in his symptoms.

After 6.5 hours of observation, the child remained minimally active and would not take fluids by mouth, and he was admitted for further monitoring and IV fluids. On admission to the ward, his laboratory values were rechecked, revealing elevated aspartate aminotransferase at 389 U/L (reference range, 24–47 U/L) and alanine aminotransferase at 160 U/L (reference range, 13–48 U/L). Creatinine kinase had risen to 1045 U/L. White blood cells had dropped to 30,100/ μ L. His international normalized ratio was 1.16 (reference range, 0.90–1.20), and

From the *Oregon Health and Science University; †Oregon Poison Center; and ‡Portland Veterans Administration Medical Center, Portland, OR.

Reprints: Patrick Leight West, MD, 3181 SW Sam Jackson Park Rd, CB 550, Portland, OR 97239 (e-mail: westp@ohsu.edu).

No funding was received for this study.

This study was accepted as poster presentation at the September 2009

North American Congress of Clinical Toxicology (NACCT Conference), San Antonio, TX.

Copyright © 2011 by Lippincott Williams & Wilkins

ISSN: 0749-5161

partial thromboplastin time was elevated at 53.1 seconds (reference range, 26–36 seconds). Urinalysis showed no blood or other abnormalities. The remainder of his laboratory evaluation was unchanged or normal.

Overnight, he was hydrated and received continued therapy with morphine for pain and ondansetron for nausea. He began to have significant edema 18 hours after the event, particularly notable in the face, but also throughout the rest of his body in the same distribution as his stings. Lorazepam was added to the regimen for continued discomfort. He was treated with IV dexamethasone and diphenhydramine (12.5 mg orally) for the edema. On hospital day 1, he continued to refuse all oral intake and remained apathetic, complaining of pain at the sites of the stings. Twenty-four hours after the initial attack, his CK continued to climb to 1881 U/L. His transaminases began to normalize, with an aspartate aminotransferase of 191 U/L and alanine aminotransferase of 119 U/L. His international normalized ratio remained normal at 1.15, his partial thromboplastin time had returned to the reference range at 29.2 seconds, and his white blood cells had decreased to 17,500/ μ L. His CK peaked 32 hours after the attack at 2085 U/L. He continued to have normal urine output during this period.

On hospital day 2, the child was awake, alert, and playful and began to accept oral fluids. His CK returned toward normal at 825 U/L. Transaminases continued to trend toward normal. At this point, he was discharged to home with prescription for topical diphenhydramine. He experienced no further sequelae from this envenomation.

DISCUSSION

The order Hymenoptera contains stinging insects, the 2 major divisions of which are the apids (family Apidae), containing honeybees and bumble bees, and the vespids (family Vespidae), containing yellow jackets, hornets, and paper wasps.^{3,4} The venom constituents from the 2 groups is relatively similar, with histamine, dopamine, norepinephrine, bradykinin-like substances with minor variations between species.⁵ Yellow jacket venom is reported to be 3-fold less toxic than either bee or hornet venom, although it may be more stimulating to the immune system.^{3,4}

Typically, Hymenoptera envenomations are single stings that occur when an insect is disturbed while hunting for food.⁴ These envenomations typically occur during the late summer and autumn, with the occurrence of “yellow jacket delirium”—a period of increased aggression as food shortages begin as winter approaches.⁶ Venom is injected from a muscular venom sack in insects, with 90% injected in the first 20 seconds and 100% injected in 1 minute.^{2,7} Most reactions to envenomations are immediate local painful reactions that occur within minutes to hours, peak within 48 hours, and may last up to a week in duration.⁴ A small percentage of individuals sustaining Hymenoptera stings (0.3%–3%) will have immune-mediated anaphylactic (immediate systemic) reactions occurring within minutes to hours of the envenomation.⁴ Yellow jackets are responsible for most stings that cause anaphylactic reactions in the United States.⁴

Delayed nonanaphylactic systemic toxic reactions occur after envenomations by many Hymenoptera, causing significant morbidity and mortality hours to days after a massive envenomation. This pattern is not felt to be immune mediated, but rather due to direct toxic effects from the large venom load, with stings typically numbering in the teens to thousands of stings.^{2,3} Children, in particular, are thought to have significant predisposition to receiving clinically important numbers of stings, given their low body weights and their frequent lack of mobility.^{2,3} Given the relatively small number of stings required to cause this delayed

toxic reaction in children and the lack of the typically observed immediate immune-mediated reactions, this diagnosis may be easily overlooked if there is not a high degree of clinical suspicion. There are several cases of mortality from delayed systemic toxic reactions in children who were evaluated after massive envenomations and discharged only to have symptoms progress as an outpatient.^{8,9}

The large majority of the pediatric literature describing delayed systemic toxin-induced reactions is attributed to numerous Africanized honeybee envenomations,^{10–13} but there have been several cases of wasps causing significant toxicity.^{8,14,15} These case reports were reviewed extensively by Vetter et al,³ with notable similarities in the delayed toxic effects of both bees and wasps, but with severe symptoms caused with fewer wasp stings. Death and renal failure from Africanized honeybee envenomations in Arizona have been reported with as few as 100 to 130 stings in an adult, whereas deaths from international vespids have occurred with as few as 20 stings.³ Injuries associated with these delayed systemic toxic reactions typically involve renal failure (acute tubular necrosis is most frequently reported),^{12,16} hemolysis,^{8,9,12} and rhabdomyolysis,^{8–10,12} and less frequently, there are reports of altered mental status,¹⁵ cardiac toxicity,¹⁷ multi-system organ failure,^{12,18} and several cases of death.^{8,9,12} Deaths due to vespids are typically from Asian or Middle Eastern insects that are not present in the United States, in particular *Vespa orientalis* and *Vespa affinis*.³ Electrocardiographic changes,¹⁷ rhabdomyolysis,¹⁹ and renal failure¹⁹ in adults and a case of hallucinations in an Australian child¹⁵ have been ascribed to envenomation by 1 of the 25 subspecies of yellow jacket. In the United States, Africanized honeybees have caused the only massive envenomations and delayed toxic reactions that have been reported with several adult deaths reported.^{3,13} No pediatric deaths have been reported due to delayed toxic reactions from Hymenoptera envenomation.¹³ We are unaware of any reports of massive envenomations in the United States that were not caused by Africanized honeybees. Africanized honeybees have not spread to Oregon. We feel that even in areas of the country that have not experienced Africanized honeybee migration, physicians should be aware of this phenomenon and should monitor patients with massive envenomations closely.

There are published guidelines that recommend admitting all pediatric patients who sustain 50 or more stings for 24 hours, as the complications that arise from these envenomation could be more effectively treated with early therapy.¹ On presentation and 6 hours after presentation, patients should have laboratory evaluation for hemolysis, renal injury, liver injury, rhabdomyolysis, and disseminated intravascular coagulation. We feel that the level of 50 stings in this set of guidelines is adequate for treating native US species of wasp envenomations, although may be lowered to 20 for nonnative species of wasp and hornet.

Treatment for patients is typically supportive and symptomatic and includes parenteral fluids, antihistamines, corticosteroids, and opioids. Long-term therapy with corticosteroids and antihistamine medications would not be expected to be effective in treatment of renal failure as this is not immune or histamine mediated.¹³ Dialysis has been used in cases of renal failure with good results, and plasmapheresis was noted to improve renal function earlier than expected, suggesting that plasmapheresis might remove the circulating toxin or their inflammatory mediators.^{16,18,20}

CONCLUSIONS

We present a case of delayed systemic toxic reaction due to a native US species of Hymenoptera, the yellow jacket. We feel

that clinicians in all areas of the country, not just those with Africanized honeybees, should be aware of this entity and the serious sequelae it may have in pediatric patients. A high degree of clinical suspicion is required as these patients may have few significant presenting symptoms and should be admitted on mechanism. Pediatric emergency clinicians should be aware that guidelines do exist for these envenomations, which include 24 hours of inpatient monitoring for all children who receive more than 50 stings.

REFERENCES

1. Kolecki PK. Delayed toxic reaction following massive bee envenomation. *Ann Emerg Med.* 1999;33(1):114–116.
2. Sherman RA. What physicians should know about Africanized honey bees. *West J Med.* 1995;163:541–546.
3. Vetter RS, Visscher PK, Camazine S. Mass envenomations by honey bees and wasps. *West J Med.* 1999;170:223–227.
4. Reisman RE. Insect stings. *N Engl J Med.* 1994;331:523–527.
5. Geller RG, Yoshida H, Beaven MA, et al. Pharmacologically active substances in venoms of the bald faced hornet, *Vespula (Dolichovespula) maculata*, and the yellow jacket, *Vespula (vespula) maculifrons*. *Toxicon.* 1976;14:27–33.
6. Bischoff RO. Seasonal incidence of insect stings: autumn “yellow jacket delirium”. *J Fam Pract.* 1996;43(3):271–273.
7. Schumacher MJ, Tveten MS, Egen NB. Rate and quantity of delivery of venom from honeybee stings. *J Allergy Clin Immunol.* 1994;93(5):831–835.
8. Korman SH, Jabbar S, Harari MD. Multiple hornet (*Vespa orientalis*) stings with fatal outcome in a child. *J Paediatr Child Health.* 1990;26:283–285.
9. Hoh TK, Cheng CT. Fatal hemolysis from wasp and hornet stings. *Singapore Med J.* 1966;7(2):122–126.
10. Tumwine JK, Nkrumah FK. Acute renal failure and dermal necrosis due to bee stings (sic.): report of a case in a child. *Cent Afr J Med.* 1990;36(8):202–204.
11. Ariue B. Multiple Africanized bee stings in a child. *Pediatrics.* 1994;94:115–117.
12. Franca FO, Benvenuti LA, Fan HW, et al. Severe and fatal mass attacks by “killer” bees (Africanized honey bees—*Apis mellifera scutellata*) in Brazil: clinicopathological studies with measurement of serum venom concentrations. *Q J Med.* 1994;87:269–282.
13. Betten DP, Rickardson WH, Tong TC, et al. Massive honey bee envenomation-induced rhabdomyolysis in an adolescent. *Pediatrics.* 2006;117(1):231–235.
14. Watterberg N, Weizman Z, Shahak E, et al. Fatal multiple organ failure following massive hornet stings. *Clin Toxicol.* 1995;33(5):471–474.
15. Levick N, Braitberg G. Massive European wasp envenomation of a child. *Emerg Med.* 1996;8:239–245.
16. Beccari M, Castiglione A, Cavaliere G, et al. Unusual case of anuria due to African bee stings. *Int J Artif Organs.* 1992;15:281–283.
17. Rowe SF, Greer KE, Hodge RH. Electrocardiographic changes associated with multiple yellow jacket stings. *South Med J.* 1979;72(4):483–485.
18. Diaz-Sanchez CL, Liftshitz-Guinberg A, Ignacio-Ibarra G, et al. Survival after massive (>2000) Africanized honeybee stings. *Arch Intern Med.* 1998;158:925–927.
19. Bosquet J, Huchard G, Francois-Bernard M. Toxic reactions induced by Hymenoptera venom. *Ann Allergy.* 1984;52:371–374.
20. Beccari M. Dialysis or plasmapheresis for acute renal failure due to Africanized honeybee stings. *Arch Intern Med.* 1999;159:1255–1256.