Series Editor: Lewis S. Nelson, MD

Fish "Sticks"

Nicholas Connors, MD, and Lewis S. Nelson, MD

A toxic exposure in a home aquarium results in sudden, excruciating pain for a 48-year-old man.

Case

A 48-year-old man with a history of diabetes is cleaning his salt-water aquarium when he feels a sudden sharp pain in his right hand. He takes an over-the-counter nonsteroidal anti-inflammatory drug, which does not relieve his pain. He presents to the ED complaining of severe pain radiating from his right hand to his shoulder. On arrival, he states that the pain is constant and is among the worst he has ever experienced. Vital signs are: blood pressure, 172/93 mm Hg; heart rate, 94 beats/min; respiratory rate, 17 breaths/min; temperature, 98.1°F. Oxygen saturation is 96% on room air.

Dr Connors is a fellow of medical toxicology in the department of emergency medicine at the New York University School of Medicine and the New York City Poison Control Center. **Dr Nelson**, editor of "Case Studies in Toxicology," is a professor in the department of emergency medicine and director of the medical toxicology fellowship program at the New York University School of Medicine and the New York City Poison Control Center. He is also a member of the EMERGENCY MEDICINE editorial board.

FIGURE 1 Lionfish: All bright colors and striping

On physical examination, the patient appears uncomfortable and is cradling his right hand. His cardiac, pulmonary, and abdominal examinations are normal. However, his right upper extremity is edematous and erythematous throughout the hand and fingers, with swelling extending to the wrist. There is a single puncture wound on the dorsum of the right hand but no visible matter or discharge from the wound.

What happened to this man?

While some people keep many types of exotic and dangerous creatures as pets, a limited number of toxic exposures are present in a home fish tank. For example, while *Zoanthid* coral in home saltwater aquaria is known to cause serious palytoxin-induced illness through dermal or inhalational exposure,[1] envenomation by a member of the Scorpaenidae (scorpionfish) family of spiny fish is more common. Fish of the genus *Pterois* are brightly colored and striped; they are commonly known as lionfish (Figure 1), but are also referred to as zebrafish, turkey fish, and red fire fish. Most spiny fish envenomations in the United States are caused by *Pterois volitans* and *Pterois lunulata,* the species commonly kept as exotic pets. One US poison center reports seeing an average of one or two cases of spiny fish-related envenomations a month.[2] Although their native range includes the Indian and Pacific Oceans, due to their release into the wild, these fish have become an invasive species along the American East Coast and the Caribbean.

FIGURE 2 Stonefish: Camouflage adds to the danger

There are other types of spiny fish that are not kept as home-aquarium pets but still pose an envenomation threat, specifically to bathers and fishermen. Stonefish are one such example. Unlike the beautiful lionfish, stonefish are rather hideous in appearance. Their coloring and appendages are more adapted for camouflage among rocks on the ocean floor, thus offering less of a warning to potential victims (Figure 2). Among members of the genus *Synanceja*, the Australian estuarine stonefish (*S. trachynis*), Indian stonefish (*S. horrida*), and reef stonefish (*S. verrucosa*) pose the greatest envenomation threat to humans. Another threat is the California sculpin (*S. guttata*), which is native to the West

Continued on page 20

Continued from page 10

Coast of the United States. In addition, the *Trachinidae* family of spiny fish, commonly known as weeverfish, is also known to envenomate humans; these fish are foot-long and are found primarily in the European Atlantic Ocean (Figure 3).

How is venom delivered? How does it work?

Poisoning by one of these toxic species can be differentiated from tetrodotoxin (from puffer fish), scombroid (from tuna-type fish), and ciguatoxin (from reef fish), in that clinical effects occur as a result of envenomation rather than ingestion. Fish in the *Scorpaenidae* and *Trachinidae* families have spines along their dorsum, pelvis, and anus, with small venom ducts at the base. Lionfish have long, delicate spines with small venom glands, whereas stonefish have short, thick spines with very well-developed venom glands. Stonefish and weevers rest on the bottom of the sea, partially buried in the sand, awaiting prey. Their spines and venom may also serve as a defensive measure against larger fish predators. Since some species prefer very shallow water, bathers are at risk of foot envenomation.

FIGURE 3 Weeverfish

As with most types of venom, those from poisonous fish consist of a milieu of peptides with varying actions. The most concerning is stonefish envenomation, which has been compared to that of a cobra and can be lethal. This type of venom contains hyaluronidase, which breaks down connective tissue and allows wider dispersion of venom. Stonustoxin, trachynilysin, and verrucotoxin, each specific to a different species, act directly on cardiac, skeletal, and involuntary muscle to cause dysfunction or paralysis. Stonefish venom has also been reported to have hemolytic properties.[3] Venom from lionfish (*P. volitans*) and from stonefish (*S. trachynis*) cause increases in neuronal intracellular calcium, either by opening existing ion channels or creating new pores formed by the toxin. This results in the severe neuropathic pain and muscle dysfunction characteristic of envenomations.[4]

How do patients present after marine envenomations?

In an analysis of 51 cases of *Scorpaenidae* envenomation, 88% were caused by lionfish and were aquaria-related.[5] Six of the 51 patients were envenomated by the California sculpin while scuba diving or fishing.[5] In all 51 victims, severe pain in the envenomated region was the typical presenting symptom. Without treatment, pain generally abated approximately 30 to 90 minutes post-envenomation and resolved completely by 24 hours. A small percentage of patients experienced sensory deficit in the affected extremity for several days post-incident. In this analysis, all envenomations occurred on the upper extremity, with the vast majority to the hand. Almost 60% of patients had local swelling and approximately 20% had radiation of the pain up the arm to the shoulder. Systemic symptoms of nausea, diaphoresis, dyspnea, chest or abdominal pain, weakness, hypotension, and syncope were noted in about 10% of the cases.[5]

Stonefish venom can cause similar—albeit more—severe reactions, which include hallucinations and delirium, both of which can last for days. Edema, ischemia, and then cyanosis of the tissue around the wound occur prior to necrosis of the site. Severe systemic symptoms

such as dysrhythmia, hypotension, seizures, respiratory depression, and acute respiratory distress syndrome can develop, and rarely, death may occur.[3,6]

How are patients with marine envenomations treated?

As the toxins found in the various forms of spiny fish are heat labile, the mainstay of treatment involves exposure of the wound to warm, nonscalding water (urine also has been used) to denature the toxin and reduce associated pain.[6] This practice is supported by animal models, in which heating stonefish venom to 122°F for 5 minutes was shown to prevent hypotension and wound necrosis.[7] In the largest study to date of human envenomation from spiny fish, 80% of patients describe relief from this intervention[5]; however, it is possible that the toxin simply distributed or was metabolized. Although local anesthetics (eg, subcutaneous lidocaine) can be used, patients generally require no more than a nonprescription analgesic upon discharge from the ED.

In Australia, an equine-derived stonefish antivenom (IgG against the venom of *S. trachynis*) has been used in over 200 cases, with a successful reduction of pain and improvement in systemic symptoms.[8] There is anecdotal evidence that stonefish antivenom is also effective in treating exposures to other fish venoms of the Scorpaenidae family, but no trials exist to support this. The antivenom is administered intramuscularly and is based on how many puncture wounds are present. For example, if one or two punctures exist, treatment requires one ampule of antivenom; three or four punctures require two ampules; and more than four punctures require three ampules.[8]

Regarding wound care, normal principles apply. A careful examination should be performed, with consideration of a radiograph to assess for any retained foreign body, especially pieces of a broken fish spine. The envenomation site should be examined for the total number of puncture wounds, as an increased number suggests greater potential venom burden. Of note, in one cohort, 10% of wounds sustained from the spine of lionfish or scorpionfish became infected, with one patient requiring admission for intravenous antibiotics.[5] Typical organisms found in infected wounds include skin flora as well as serious pathogens such as *Vibrio vulnificus*.[9]

Case Concluded

The patient in this case was envenomated on his right hand when he inadvertently brushed against a pet lionfish while cleaning its tank. In the ED, the affected hand was immersed in warm, nonscalding water for about 60 minutes, and subcutaneous lidocaine was administered for additional pain control at the wound site. His tetanus immunization was updated, and no fish spine was noted subcutaneously on a plain film. Because this patient had a medical history significant for diabetes, he was discharged with oral antibiotics to cover typical skin flora and *Vibrio* species. He was instructed to return in 2 days for a wound check.

References

1. Hoffmann K, Hermanns-Clausen M, Buhl C, et al. A case of palytoxin poisoning due to contact with zoanthid corals through a skin injury. *Toxicon*. 2008;51(8):1535-1537.
2. Aldred B, Erickson T, Lipscomb J. Lionfish envenomations in an urban wilderness. *Wilderness Environ Med*. 1996;7(4):291-296.
3. Auerbach PS. Envenomation by aquatic vertebrates. In: Auerbach PS, ed. *Wilderness Medicine*. 6th ed. Philadelphia, PA: Elsevier Mosby; 2007:1628-1645.
4. Church JE, Moldrich RX, Beart PM, Hodgson WC. Modulation of Intracellular Ca2+ Levels by Scorpaenidae venoms. *Toxicon*. 2003;41(6):679-689.
5. Kizer KW, McKinney HE, Auerbach PS. Scorpaenidae envenomation. a five-year poison center experience. *JAMA*. 1985;253(6):807-810.
6. Atkinson PR, Boyle A, Hartin D, McAuley D. Is hot water immersion an effective treatment for marine envenomation? *Emerg Med J*. 2006;23(7):503-508.
7. Brush DE. Marine envenomations. In: Nelson LS, Lewin NA, Howland MA, Hoffman RS, Goldfrank LR, Flomenbaum NE. *Goldfrank's Toxicologic Emergencies*. 9th ed. New York, NY: McGraw Hill; 2010:1587-1600.
8. Currie BJ. Marine antivenoms. *J Toxicol Clin Toxicol*. 2003;41(3):301-308.
9. Haddad V Jr, Lupi O, Lonza JP, Tyring SK. Tropical dermatology: marine and aquatic dermatology. *J Am Acad Dermatol*. 2009;61(5):733-750.