CASE REPORT

Stonefish Poisoning

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Scuba diving is becoming an increasingly popular recreation. Divers are traveling further afield, often to remote dive locations. These locations are often home to poisonous marine creatures such as stonefish. A case of acute stonefish poisoning in a scuba diver is described, including his treatment, the difficulties encountered with his management and evacuation, and his subsequent return to full health. The proper management of stonefish poisoning is reviewed, and the implications for divers traveling to remote locations are given.

Key words: poisoning, stonefish, scuba diving, antivenom

Introduction

Vanuatu consists of 82 islands located west of Fiji, north of New Caledonia and south of the Solomon Islands. It has a population of roughly 182 000. It is rapidly becoming a favorite destination with recreational scuba divers, partly because the world's largest accessible shipwreck, the SS *President Coolidge*, is located there. The wreck is off the island of Espirito Santo, the largest but one of the more remote islands of the Vanuatu chain. The waters of Vanuatu are inhabited by stonefish (Figure 1). The family of scorpion fishes (*Scorpaenidae*) is found worldwide in tropical and temperate regions and is divided into 3 main groups: zebra fish (*Pterois*); scorpionfish (*Scorpaena*); and stonefish (*Synanceja*).¹ The stonefish (*Synanceja horrida*) is 30 cm long and is common in the South Pacific. It is exceptionally well camouflaged. It lies nearly motionless in shallow waters, buried in the sand, mud, or coral, and is practically indistinguishable from its surroundings. It has 13 dorsal spines capable of piercing a shoe with a soft sole 0.5 cm thick. Each spine contains 5 to 10 mg of venom.² This venom is uniquely distinct from other venoms produced by poisonous animals,³ and it produces intense vasoconstriction, increased vascular permeability, and myotoxicity—blocking conduction in skeletal, involuntary, and cardiac muscles.^{1,2,4,5} This results in muscular paralysis, respiratory depression, peripheral vasoconstriction, shock, and, in severe cases, cardiac arrest.^{1–6} The clinical features of stonefish envenomation^{1,2,4–7} include one

or more puncture wounds, which are anesthetic, and local pain that increases in intensity for a few minutes and then lessens after a few hours. The site is inflamed and sometimes cyanotic. The surrounding area is hypersensitive, pale, and swollen. Regional lymph nodes are tender and painful. Distress may be disproportionate to the clinical findings. There is frequently malaise, nausea and vomiting, sweating, delirium, and pyrexia. Cardiogenic shock, respiratory distress, and possibly death can occur in severe cases.

There is great variation in the duration of symptoms, which may last from days to weeks, and full recovery may take many months.^{1,2} There is an effective antivenom available for stonefish stings from the Commonwealth Serum Laboratories in Melbourne, Australia.

While it is generally accepted that stonefish are the most toxic of the *Scorpaenidae* family, there is debate surrounding their purported lethality. Williamson et al¹ noted the absence of any well-documented Australian fatalities or life-threatening symptoms and cited only 3 specific references describing death attributable to stonefish venom poisoning. One of these cases was postulated to represent direct intravascular deposition of venom or possibly anaphylaxis, as the victim's foot showed no local reaction. Other reports^{8,9} describe deaths occurring days or months following envenomation, which suggests that venom poisoning has secondary complications (eg, wound infection). It is possible that the actual number of stonefish-related deaths is less than widely believed. Nonetheless, severe and incapacitating local and systemic effects have often been described.

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Figure 1. Stonefish. Photograph by Ms Liesa Coates.

Case report

A 49-year-old man, “JM,” and his wife traveled from Brazil to dive on the wreck of the *Coolidge*. Because of the weight restrictions on the small Twin Otter island-hopper aircraft, they opted to leave their own diving equipment at home and rent it locally instead. The local dive operator had no wet suit boots available for rent, and so the couple used barefoot-style fins. These fins are almost impossible to walk in; as a result, divers must walk barefoot into and from the water. Having completed his second dive on the *Coolidge*, JM surfaced and started the 40-m walk, in knee-deep water, across a sandy bottom to the shore. Twenty meters from the shore, he stepped on “a sharp spike” and instantly screamed out in excruciating pain. He looked in the water and recognized what he believed to be a stonefish.

The victim was carried from the water by fellow divers and transported in the dive minibus to the local hospital. This 130-bed hospital serves the 32 000 people of the island Santo and the surrounding northern islands and is run by 2 local Ni-Vanuatu doctors and 2 visiting Chinese doctors. On his arrival 40 minutes after the initial sting, the duty emergency nurse noted 3 puncture wounds on the sole of the patient’s left foot (see Figure 2) and a large hematoma. The patient described intoler-

erable pain and paresthesias ascending up the leg. Initial vital signs showed a pulse rate of 108 beats/min, a blood pressure reading of 100/64 mm Hg, and a tympanic membrane temperature of 37.2°C. On examination, he was in considerable pain; his left foot and lower leg were red and extremely swollen. The dorsalis pedis and posterior tibial pulses were not palpable in the affected leg. Capillary refill in the toes was 5 seconds. Movement in the limb and foot was markedly reduced. He had decreased sensation to finger touch over all aspects of the foot. He also described difficulty in swallowing, although an examination of his cranial nerves revealed no abnormalities, and he showed no sign of brain stem dysfunction. He remained fully conscious throughout.

The duty nurse, who had never seen a case of stonefish poisoning, injected 5 mL of lidocaine with 1:1000 epinephrine into the wound. The nurse was unaware of the adverse effect that a vasoconstrictor such as epinephrine could have in a wound already containing a venom that can reduce local blood circulation. The local hospital physician, who had also never seen a case of stonefish poisoning, started the patient on 50 mL of intravenous normal saline every 6 hours and 1 g of intravenous penicillin every 6 hours and transferred him to the surgical ward with the reassurance that he would be able to leave the hospital the following morning.

Figure 2. Stonefish injury to scuba diver's foot. Photograph by author.

The author was, at that time, doing a rotation in the hospital as part of his undergraduate elective study period and, after seeing the patient, consulted standard texts,^{2,4} which emphasized the need to place the affected part in hot water (115°F/45°C) for 30 to 90 minutes, and this was duly undertaken by the nursing staff.

After the patient's second night in the hospital, he was unable to move his leg below the knee. He had a tympanic membrane temperature of 38.5°C. He developed a large fluid-filled collection on the lateral aspect of his thigh and multiple blisters containing clear fluid on the affected foot. A distinct red line was visible on the medial aspect of the patient's thigh. A femoral nerve block was performed by a nurse practitioner to relieve the patient's pain. He developed macroscopic hematuria. The only blood analysis available was a complete blood count, which showed a white blood cell count of $20.0 \times 10^9 \cdot L^{-1}$ and hemoglobin levels and platelet counts within the reference range.

No antivenom was available in Vanuatu. The need to keep the serum between 0°C and 5°C and protected from

light made delivery to the tropical region problematic. The nearest country with available antiserum was Australia. Considering the seriousness of the condition and the risk of gangrenous necrosis of the wound, the local team decided to evacuate the patient to Australia for further treatment, including possible antivenom administration.

Arrangements were made with local and international commercial airlines to evacuate the patient. An emergency immigration visa was arranged with the Australian High Commission. The patient was transported in the island's only ambulance to the airport accompanied by 2 nurses and was placed on a scheduled Twin Otter flight to Port Vila, Vanuatu's capital, where the only other hospital in Vanuatu is located. He was admitted to the Vanuatu hospital, where he was maintained on the same intravenous regimen as before. Twenty-four hours later, he was transferred on the first scheduled Air Vanuatu 737 flight to Brisbane, Australia. Four hours after departing Port Vila, he arrived at the hospital in Brisbane.

Later communications with the patient indicated that

the Australian doctors believed it to be too late for antivenom administration, and he was treated with an unknown intravenous antibiotic. Five days after his arrival, the patient was discharged with improved swelling but continued inability to bear weight on the foot. He traveled back to Brazil and, 26 days after being stung, remained under medical care for a 4-cm-wide ulcer on the sole of his foot. The wound was dressed 3 times weekly. He was able to walk without crutches a month after being stung and subsequently made a full recovery.

Discussion

Proper management of stonefish poisoning^{1,2,4,7,8} involves immediate evaluation and stabilization of the patient. The wounds should be explored and copiously irrigated using sterile techniques. This cleanses the wound area and may remove venom as well as components of the spine, slime, and sand. Any foreign material left in the wound is likely to delay or arrest the healing process. Stonefish venom is heat labile; therefore, hot soaks (115°F/45°C) should be performed for 30 to 90 minutes^{1,7} or until the pain is relieved and does not recur. The wound may be infiltrated with local anesthetic without epinephrine if pain relief is required. Systemic analgesics or narcotics are rarely needed. General wound care should be administered, including antibiotics if indicated. The affected area should be elevated. Antivenom administration should be considered in cases of severe stonefish poisoning. This should be given as soon as possible after the initial sting, preferably within 48 hours. Antivenom is produced by Australia's Commonwealth Serum Laboratories and is recommended for intramuscular use only. However, for serious intoxication, this route may not be ideal because of erratic absorption. In such cases, the antiserum should be further diluted and given via slow intravenous administration: 1 ampoule (2000 U) for every 1 to 2 punctures, up to 3 ampoules for more than 4 punctures. It should be diluted in 50 to 100 mL of isotonic sodium chloride solution and infused over at least 20 minutes. Because the antivenom is of equine origin, there are risks of acute allergic reaction and serum sickness in the recipient. Skin testing and/or pretreatment should precede administration. Australian sources tend to avoid skin testing and to proceed with pretreatment with subcutaneous epinephrine and an intramuscular antihistamine, adding an intramuscular corticosteroid for patients with known hypersensitivity.¹⁰

Conclusions

This case highlights a number of important issues when persons are scuba diving in waters known to be inhab-

ited by stonefish. First, the use of strong dive boots or firm sandals would offer some protection from the sharp stonefish spines and should be encouraged. Dive guides operating in remote areas should be aware of this and be more aware of the need to recommend adequate protective equipment. They should also be aware of basic first aid measures for the treatment of poisonous stings and have measures in place to evacuate divers, should the need arise. Second, the lack of availability of stonefish antivenom in this remote region was a problem. Third, divers and other travelers should also be aware of the difficulty of arranging emergency medical evacuation from remote locations, such as the South Pacific islands, and should be well informed, should the need arise. They should know how to contact the necessary airlines and governmental agencies to arrange their own transport or have an adequate insurance policy that will arrange emergency medical evacuation. Certain diving organizations offer advice on local dive sites and local hazards and provide advice and assistance in the event of a dive accident. Ultimately, however, scuba divers must take responsibility for their own health and protection.

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