WILDERNESS & ENVIRONMENTAL MEDICINE 2021; 32(2): 235–9

CASE REPORT

# Marine Penetrating Injury to the Shoulder of Uncertain Origin

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Penetrating injuries from marine animals are rare events; however, published case reports have detailed critical injuries including death occurring as a result of such incidents. We present a case of a marine penetrating injury to the right posterolateral shoulder of a 10-y-old boy. The patient underwent open surgical debridement and a course of oral antibiotics before returning to normal function. Clinicians should have an appreciation of various clinical patterns of marine penetrating wounds, the need for prompt imaging to exclude foreign bodies, and appropriate antibiotics to cover gram-negative bacteria and *Vibrio* species, which are commonly found in marine-related injuries.

*Keywords:* emergency medicine, trauma, Australia, orthopedic, aquatic, musculoskeletal

## Clinical Record

A 10-y-old boy presented to the emergency department in the northwest of Western Australia after being struck in the right posterolateral shoulder while paddling in whitewash while surfing. The boy sustained a 2 cm crescentic wound, which was actively bleeding on arrival to hospital. On presentation to the emergency department, he reported mild pain in his shoulder at the wound site but was otherwise hemodynamically stable and exhibited no systemic signs of envenomation, such as nausea/vomiting, respiratory distress, abdominal pain, or altered conscious state. Additionally, there was no localized edema, erythema, bony deformity, or foreign body at the wound site (Figure 1). Although examination of shoulder strength and mobility was difficult owing to mild pain, the patient had no signs of neurovascular compromise. The clinical impression of the treating team was that the pain on examination was in keeping with a penetrating injury rather than due to envenomation. Given the rurality of the location, the treating team was unable to access imaging to exclude the presence of a foreign body. The patient underwent examination under local anesthesia, which revealed no foreign body, and the wound was vigorously irrigated. Given the clinical impression that there was no remaining foreign body, the wound was sutured to promote wound healing by primary intention. Oral azithromycin was commenced to cover *Staphylococcus* and *Vibrio* species.

Although the exact mechanism of injury was unclear, hospital staff explored the possibility of a shark attack or stingray barb; however, neither fit the clinical picture. Hospital staff raised the possibility of a needlefish injury given the prevalence of large schools of needlefish in the region and the clinical pattern of a single penetrating wound with an absence of systemic signs of envenomation.

Twenty-four hours after initial injury, the patient was systemically stable; however, he reported worsening pain in his upper arm, with pain radiating down his biceps. Biceps pain in the context of a penetrating injury to the posterior shoulder was of concern because there was a suspicion of intra-articular penetration and risk of septic arthritis. Given the patient's worsening pain and the possibility of a septic joint or foreign body, the patient was transferred to Perth, Western Australia, via a commercial flight the following day to a higher center of care for advanced imaging and surgical intervention.

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Submitted for publication September 2020.

Accepted for publication January 2021.

**Figure 1.** Open penetrating wound at the posterolateral shoulder on initial presentation.

Magnetic resonance imaging (MRI) performed on arrival to Perth revealed that the patient had sustained a deep injury to the posterior scapula involving the posterior fibers of the deltoid, the full thickness of the infraspinatus muscle belly, and the deep aspect of the supraspinatus muscle belly. There was edema at the spinoglenoid notch, narrowly avoiding the shoulder joint itself and the suprascapular nerve (Figure 2). No foreign body, hematoma, or fluid collection was noted.

Ongoing anterior shoulder and biceps pain in conjunction with suspected intra-articular penetration 48 h after initial injury prompted surgical examination (Figure 3). Surgical examination revealed that the injury did extend to the intra-articular space. The suprascapular nerve was visualized and was found to be intact but contused. Swabs were taken for microscopy, culture, and sensitivity, which subsequently revealed no growth of pathological microorganisms.

After infectious disease consultation, the patient commenced oral ciprofloxacin and amoxicillin-clavulanic acid because marine wounds are prone to infection with gram-negative bacteria and *Vibrio* species.

Follow-up at 2 wk after the original injury revealed the wound had healed and the patient had regained full shoulder mobility and strength.

## Discussion

This case represents a rare penetrating injury that presented several challenges for clinicians, particularly given the rurality of the location.

The initial challenge was that the exact mechanism of injury was unclear. The patient was initially concerned that the injury may have been caused by either a shark bite or stingray barb. However, the pattern of injury of a single penetrating wound to the posterior shoulder did not match what would generally be expected in either of these events. In cases in which the exact diagnosis is unclear, a broad range of differential causes should be explored by the treating team.

Stingrays are most often trodden on; as such, injury to the lower limb is most commonly involved, with penetrating injuries to major body cavities being rare but life-threatening. Those impaled by a stingray barb may have a retained barb or, if the barb has been removed, may have a macerated appearance to the wound owing to the retroserrated barb. The pain is severe immediately and worsens over the next few hours as a result of envenomation.[1] A shark attack would typically present with multiple crescent-shaped penetrating wounds, extensive soft tissue injuries, and damage to aquatic gear such as surfboards.[2] The clinical pattern of a single penetrating injury to the posterior shoulder did not match what would generally be expected in either of these events.

The possibility of the injury being caused by a needlefish was raised by hospital staff, given the clinical picture of a single penetrating wound, no systemic signs of envenomation, and local knowledge of large schools of needlefish in this region. Furthermore, hospital staff described a prior experience with a patient who had sustained pneumothorax as a result of a penetrating injury from a needlefish. Previous case reports have detailed presentations of retained foreign bodies, neurovascular

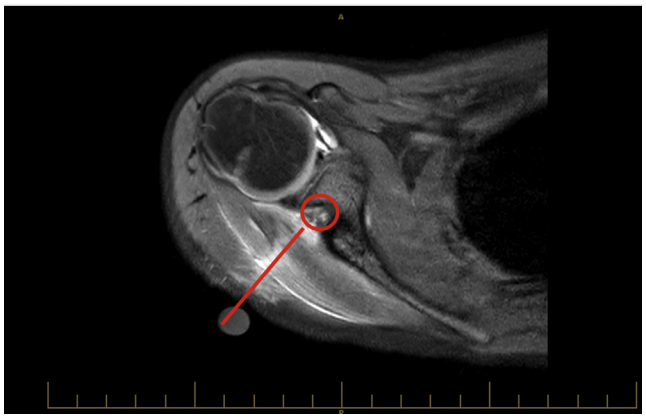

**Figure 2.** Magnetic resonance imaging axial view showing penetration tract from skin into the spinoglenoid notch. Red line indicating path of penetrating wound; red circle indicating the location of suprascapular nerve.

compromise, persistent pain, and localized infection resulting from needlefish injuries.[3,4]

Needlefish species commonly found in temperate waters of northern Western Australia include the Garfish (*Belone belone*) and Longtom (*Tylosurus gavialoides*).[4] These species are silvery in color with elongated cylindrical bodies up to 70 cm in length and long narrow jaws that extend into a sharp beak with jagged teeth (Figure 4). These surface-swimming, predatory fish can achieve speeds of up to 60 $km \cdot h^{-1}$ when hunting small baitfish or avoiding predators.[4] These species are commonly observed leaping out of the water, making them a risk to swimmers, surfers, and fishermen. The majority of reported penetrating injuries due to needlefish are to the head, neck, and torso.[4,5]

Appropriate and prompt imaging after a penetrating injury may be challenging in remote locations. The wound margins can underrepresent the depth of the injury, with physical examination alone being an unreliable means of determining the severity of penetrating injuries. Clinicians should select an imaging modality that is appropriate to the suspected type, size, and depth of foreign body, anatomic location, and injury to adjacent tissues.[6] X-rays are an excellent screening tool and

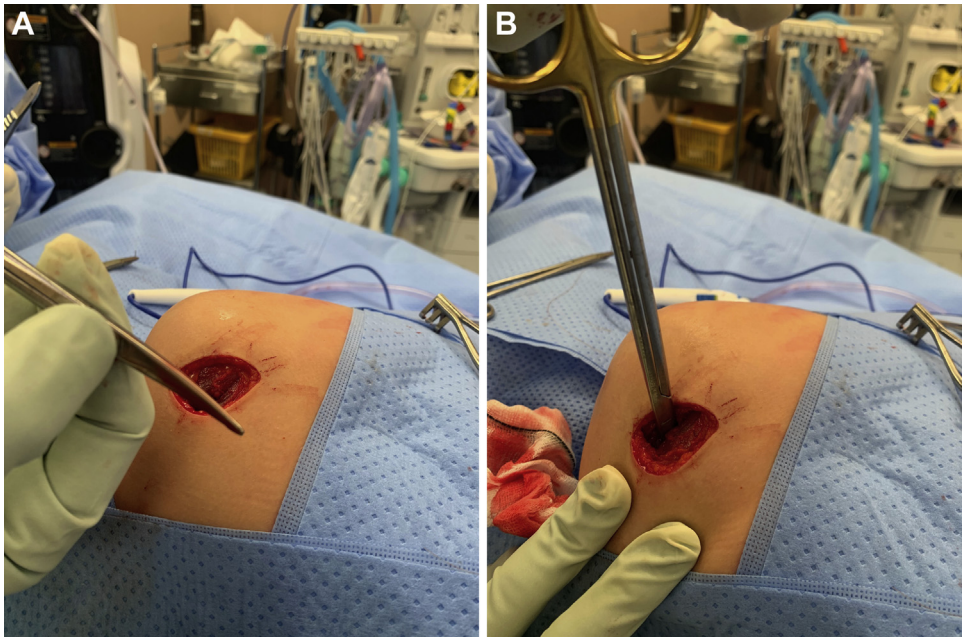


**Figure 3.** Open penetrating wound at the posterolateral shoulder when examined under anesthesia.

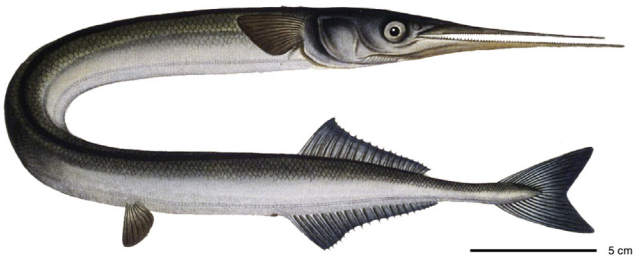


**Figure 4.** Longtom fish (*Tylosurus gavialoides*).

should be routinely employed to rule out residual radiopaque foreign bodies. Computed tomography scanning is superior to x-ray if there is a high suspicion for retained foreign body because it allows for precise localization of foreign bodies, which is a prerequisite to surgical removal.[6] Ultrasonography is more useful for locating superficial foreign bodies and has the advantage of not involving radiation exposure. However, ultrasound is unsuitable for foreign bodies located within deeper tissues or inside the air-filled cavities. In this case, as in many others, MRI was the superior imaging option and was chosen given the assumed depth of injury, ability to visualize retained soft tissues such as cartilage, and need to localize the exact position of the foreign body before surgical removal.[6] MRI is also seen as a superior modality particularly in children because there is no exposure to radiation.

Finally, there are both broad principles and species-specific protocols for the management of marine penetrating injuries, which may be challenging owing to the often-remote nature of these incidents. As with all penetrating injuries, there is a need to achieve hemostasis and commence early resuscitation if required. Appropriate imaging should be performed to exclude the presence of a foreign body. In the case of a stingray barb, medical treatment includes achieving hemostasis followed by submersion of the affected region in hot, but not scalding, water (42–45°C) until pain resolves because stingray venom is heat labile.[7] All wounds should be examined under anesthesia in either the emergency department or the operating room.[1] This decision is based on the size of the wound, depth of the wound, presence of debris, and any potential joint involvement.[1] Wounds should be thoroughly cleansed, and delayed closure should be allowed. Surgical exploration may be necessary to remove residual foreign bodies and to conduct debridement.[8] Given the clinical impression that there was no remaining foreign body, the wound was sutured to promote wound healing by primary intention. In wounds with the possibility of retained foreign material, the decision to leave the wound open (healing by secondary intention) or suture the wound should be made based on the clinician's risk assessment.[8] Clinicians should consider the likelihood of a retained foreign body, need for hemostasis, and potential for infection when deciding whether to suture the wound. Marine penetrating injuries are prone to secondary infection, and antibiotics are routinely indicated to provide coverage for gram-negative species, such as *Aeromonas, Escherichia coli,* and *Vibrio*.[9] Empirical antibiotic therapy should include a combination of a beta-lactam antibiotic (flucloxacillin) and tetracycline (doxycycline), or clindamycin and ciprofloxacin in the penicillin-sensitive patient.[10] Tetanus immunization status should be reviewed and immunization given if appropriate.

Clinicians should explore a broad range of differential causes when presented with marine penetrating wounds. Radiologic examination is important in all cases of penetrating injury to identify retained foreign bodies, with the choice of imaging modality based on anatomic location and adjacent tissues, as well as suspected type, size, and depth of the foreign body itself. The definitive management of marine penetrating wounds may be challenging in remote locations and may require transfer to a higher center of care capable of advanced imaging and surgical intervention. The mainstay of treatment involves exploration under sterile conditions, irrigation, debridement, suturing (where clinically appropriate), and antibiotics as guided by the organisms of concern, the depth of injury, and the potential anatomic structures involved.

Author Contributions: Conception of paper (JB, AK); drafting (JB, JJ, AK); critical revision (JB, AK); final approval of article (JB, JJ, AK).
Financial/Material Support: None.
Disclosures: None.

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