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Late Presentation of a Retained Stingray Spine in the Plantar Medial Hindfoot

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Case Report

A 29 year-old healthy female presented to clinic in October of 2018 with new onset of left ankle redness and swelling at the posteromedial aspect of the ankle along the tarsal tunnel. She denied recent trauma, but recalled that she was stung by a stingray in the left plantar medial hindfoot in August of 2017 while at the beach in New Jersey. The patient did not seek medical attention initially because pain from the sting resolved within 24 hours.

Approximately three months following the initial injury, the patient presented to an outside emergency department with worsening left medial ankle pain. Radiographs of the left foot and ankle were negative for bony pathology and no foreign body was visualized. She continued to have pain, and MRI was obtained in March 2018 at the recommendation of the patient's primary care physician. The radiology read was significant for an accessory navicular, posterior tibial tendon tenosynovitis, flexor hallucis longus (FHL) and flexor digitorum longus (FDL) synovitis, and a moderate ankle effusion. There was no mention of retained foreign body. She was treated in a CAM boot and completed a short course of physical therapy with no improvement. Her symptoms remained stable until October 2018, when she developed a tender erythematous lump over the posteromedial aspect of her left ankle along tarsal tunnel, causing her to seek orthopaedic treatment.

At the initial visit at Foot & Ankle clinic, the patient denied new trauma, fevers, or other constitutional symptoms. Physical examination of the left foot and ankle revealed a 2.5 cm fluctuant mass along the tarsal tunnel with overlying cellulitis. She had mild tenderness at the posterior tibial tendon proximal to the mass, and pain with range of motion at the ankle. The patient was able to bear weight with an antalgic gait on the left side. The remainder of the physical exam was unremarkable. She was instructed to obtain an updated MRI. Oral antibiotics were prescribed to treat the cellulitis.

Two days later, the patient returned to clinic for follow up. Thick, purulent fluid was draining from the inflamed area along left tarsal tunnel (Figure 1). She remained afebrile and the remainder of her exam was unchanged. White blood cell (WBC) count, Erythrocyte Sedimentation Rate (ESR), and High Sensitivity C-Reactive Protein (hsCRP) were all within normal limits [WBC 6.5 (nml 4.0-11.0 THO/ul); ESR 3 (nml 0-30 mm/h); hsCRP 0.5 (nml<7.4 mg/L)]. MRI was reviewed, which showed 2-3 thin linear foreign bodies at the quadratus plantae and tarsal tunnel, with subcutaneous edema of the medial ankle (Figure 2a and 2b). Of note, closer review of the previously obtained MRI from March 2018 also demonstrated the presence of foreign bodies. Surgical exploration and extraction of foreign bodies under anesthesia were recommended.

Intra-operatively, an incision was made along the tarsal tunnel centering at the draining wound. Purulent fluid was encountered just deep to the skin. The laciniate ligament was then identified and found to be extremely thickened. This was excised and sent to Pathology. Culture of the cloudy fluid was obtained and was sent to Microbiology. The neurovascular bundle was carefully retracted posteriorly using a blunt retractor. There was a small piece of the retained stingray barb superficial to the FHL tendon sheath and anterior to the neurovascular

Figure 1. Swelling of posteromedial aspect left ankle with a sinus draining purulent fluid with surrounding cellulitis.

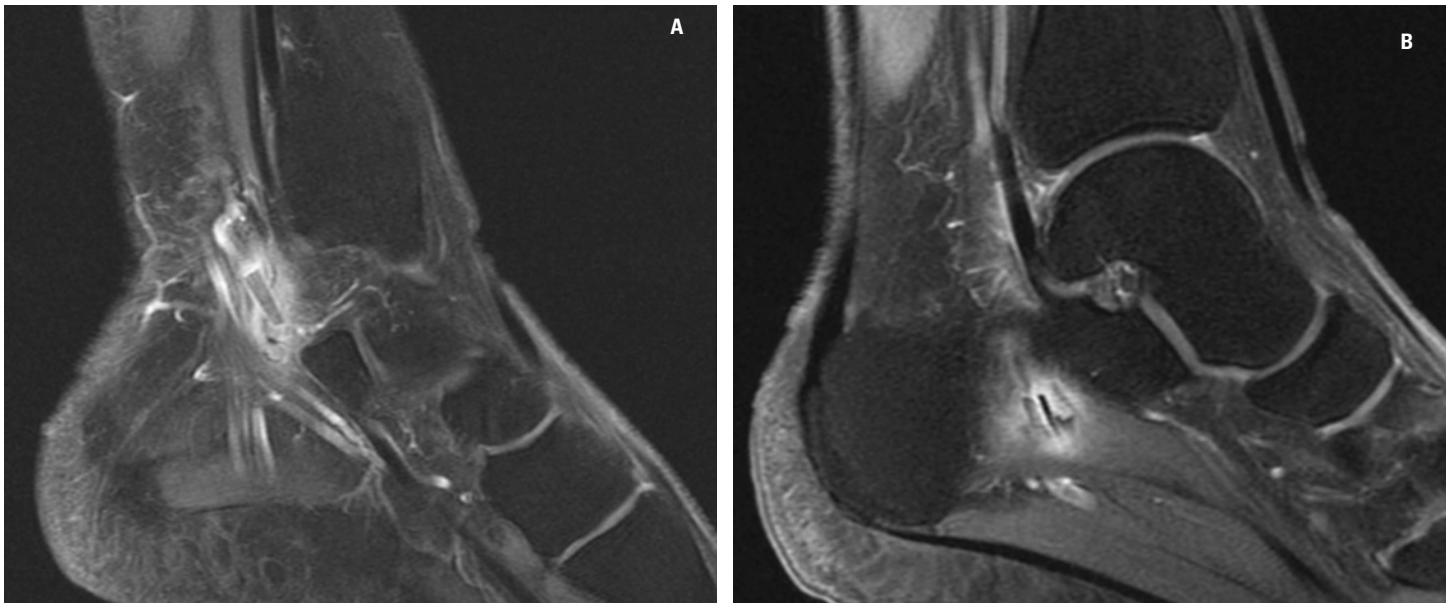

Figure 2. Sagittal T2 MRI, showing **(A)** 2-3 thin, linear low signal intensity foci within the quadratus plantae muscle, compatible with foreign bodies; **(B)** A large linear low signal intensity focus within the tarsal tunnel, compatible with a foreign body.

bundle. This was removed using forceps. The FHL tendon sheath was then incised. There was evidence of tenosynovitis surrounding the FHL tendon. The FHL tendon itself was intact with no evidence of tear. Tenosynovectomy was performed along the FHL tendon. The FHL tendon was then carefully retracted in anterior direction.There was a large stingray barb just posterior to the FHL tendon which was removed using forceps (Figure 3a). Further exploration in deeper planes revealed multiple pieces of stingray barb in quadratus plantae, which were removed using a pair of forceps and a small curved mosquito clamp (Figure 3b). The wound was then irrigated with 3 L of gentamicin-containing solution using urology tubing. Two grams of Ancef was given intravenously by the Anesthesia team after the soft tissue culture was obtained prior to removal of foreign bodies. The friable skin edges were excised using a #15 scalpel blade. Skin closure was then made with 3-0 nylon sutures and the patient was placed into a CAM boot post-operatively.

Microbiology analysis of the intra-operative specimen was unrevealing. Gram stain showed occasional PMNs, but no

Figure 3. (A) Intra-operative image showing a large piece of retained stingray barb in tarsal tunnel; **(B)** Multiple pieces of broken stingray barb extracted from the patient.

organisms. Operative cultures finalized as no growth at 5 days. Pathology showed fibrous tissue with granulation tissue, acute and chronic inflammation, and granuloma formation. Acid-Fast Bacilli (AFB) and fungal stain were negative.

At 6 week follow-up, the patient's incision was well-healed. Other than mild numbness at the plantar-medial hallux, the patient's exam was unremarkable. At 12 week follow-up, she has resumed full activities except for running.

Discussion

Stingrays are responsible for stinging more humans than any other fish in the sea, affecting at least 2,000 individuals annually in the United States alone.[1] These flattened, cartilaginous fish with muscular wings share their ancestral roots with sharks, and can range in size from several inches up to 12 feet long.[1,2] The stingray's whip-like tail is uniquely structured, possessing 1 to 6 stiletto-sharp spines, also known as barbs, along its length.[3] Each spine is lined with retro-serrated edges and encased by a thin integumentary sheath, which serves to house the venom located along the underside of the spine.[1]

Despite this powerful tail, stingrays are usually thought of as docile, non-aggressive scavengers who only attack when their habitat is unintentionally invaded during recreational and occupational activities. Most victims are young males in their 20s who sustain an injury to an extremity.[4,5] The dorsal and plantar aspects of the foot, as well as the ankle and lower leg are the most commonly implicated body parts among unsuspecting beachgoers or divers who step on a stingray buried in the sand.[2,5] Fisherman are also susceptible to hand injuries, sustained while disentangling stingrays from hooks or nets.[2]

When disturbed, the stingray's tail reflexively whips forward in an effort to embed a spine into the victim.[3] On contact, a 2-part injury occurs.[4] First, there is direct trauma to the affected body part in the form of a laceration or puncture wound. The second part of the injury is caused by envenomation. As the stingray spine plunges into a victim's skin, the integumentary sheath containing the stingray's venom is ripped open, and venom is released into the wound.[2] The venom, composed of heat-labile 5'-nucleotidase, phosphodiesterase, and serotonin can cause both local and systemic symptoms. Classically, envenomation causes localized pain and swelling that peaks within an hour of injury.[1] Systemic signs of envenomation can include weakness, nausea/vomiting, diarrhea, tachycardia, arrhythmias, hypotension, syncope, seizures, muscle cramps or fasciculations, paralysis, and in rare cases, death.[1] Often, pieces of the spine itself or sand and debris from the surrounding environment remain lodged in the wound, increasing the risk of prolonged envenomation, infection, wound breakdown, and granulomatous foreign body reactions.[2]

Management of stingray injuries should begin at the scene. Initial treatment focuses on identifying the extent of anatomic damage, reducing the effects of the venom, controlling pain, and preventing infection.[6] Following assessment of cardiopulmonary stability, the wound should be irrigated to remove non-embedded spine fragments and debris. Initial irrigation may be performed with seawater, though it is preferred to soak the wound in hot water up to 45° C [113° F] for 30–90 minutes as the hot water is thought to promote breakdown of the heat-labile venom.[1,2] If the spine is retained and located superficially within the wound, it may be removed at the scene to minimize exposure to venom. Under the rare circumstance that the spine deeply penetrates the abdomen, chest, or neck, it should be left in place and secured until the patient can be evaluated in an operating room.[1]

Following transfer to a medical facility, patient's should receive tetanus prophylaxis and pain control should be initiated.[2] Oral or parenteral analgesics, non-epinephrine containing local anesthetics, and regional nerve blocks may be necessary to achieve adequate analagesia, though hot water immersion alone has also been found to be effective.[1,7]In addition to these standard methods to alleviate pain, a single case report from Australia found that pain control can also be achieved by applying half of an onion bulb to the stingray wound.[8]

Once pain is controlled, the wound should again be irrigated and explored to evaluate for retained spine fragments or debris. Radiographs of the affected body part can then be obtained to rule out the presence of gas in the tissues, suggestive of bacterial infection, and for further evaluation of retained fragments.[1,9]Although multiple studies have found hyperdense, radio-opaque pieces of retained spine on plain film x-ray, fragments are not always visibly apparent as the spine itself is composed of a cartilagenous material known as vasodentin.[2,9,10] Ultrasound can be utilized in cases with high index of suspicion for a retained foreign body despite negative radiographs, as it has been shown to be effective in identifying radiolucent objects in wounds.[11] MRI also has utility in cases of established infection.[12]

In addition, prophylactic antibiotic therapy should be initiated, directed at common marine bacteria including *Staphylococcal, Streptococcal,* and *Vibrio* species.[4] While evidence on the efficacy of prophylactic antibiotics is limited, Clark et al. found a higher rate of return visits to the emergency department with symptoms suggesting wound infection among patients who did not receive antibiotics prior to discharge from their initial visit following a sting.[7] These authors advocate for a 5-day course of quinolone therapy following stingray injury, though other authors recommend trimethoprim/sulfamethoxazole.[2]

The majority of reports on stingray injuries to the foot and ankle reflect acute injuries, and delayed presentations such as this case are rare. Of these delayed presentations, authors have described multiple reports involving wound complications related to infection and one case of acquired adult flatfoot deformity, all of which occurred within 1-2 months following the initial sting.[12–15] None were associated with a retained spine.

To our knowledge, this is the first case to describe complications in the foot and ankle from a retained stingray spine in the tarsal tunnel sustained from a sting more than one year prior to presentation. Interestingly, Saunders et al.

reported a unique case of a 44 year-old male who presented with a coronary artery occlusion due to a retained spine, which had been implanted when he was stabbed in the chest with a stingray spine 17 years prior to presentation.[16] Both cases demonstrated the potential for stingray spines to migrate over time.

This case is unique because of the extended delay in diagnosis and treatment of a retained sting ray spine in the foot and ankle. It also emphasizes both the importance of obtaining a detailed history and the need to always personally review the patient's diagnostic images in the context of the injury or trauma history.

References

1. Auerbach PS. *Envenomation by Aquatic Vertebrates.* Seventh Ed. Elsevier Inc.; 2016.

2. Diaz JH. The evaluation, management, and prevention of stingray injuries in travelers. *J Travel Med.* 2008;15(2):102-109.

3. Berling I, Isbister G. Marine envenomations. *Aust Fam Physician.* 2015;44(1):28-32.

4. Clark AT, Clark RF, Cantrell FL. A retrospective review of the presentation and treatment of stingray stings reported to a poison control system. *Am J Ther.* 2017;24(2):e177-e180.

5. Myatt T, Nguyen BJ, Clark RF, *et al.* A Prospective Study of Stingray Injury and Envenomation Outcomes. *J Emerg Med.* 2018;55(2):213-217.

6. O'Malley GF, O'Malley RN, Pham O, *et al.* Retained Stingray Barb and the Importance of Imaging. *Wilderness Environ Med.* 2015;26(3):375-379.

7. Clark RF, Girard RH, Rao D, *et al.* Stingray Envenomation: A Retrospective Review of Clinical Presentation and Treatment in 119 Cases. *J Emerg Med.* 2007;33(1):33-37.

8. Whiting SD, Guinea ML. Treating stingray wounds with onions. *Med J Aust.* 1998;168(11):584.

9. Srinivasan S, Jie B, Lohan R. Marine stingray injuries to the extremities : Series of three cases with emphasis on imaging. 2013;59(4):309-312.

10. Moyles BG, Wilson RC. Stingray spine foreign body in the foot. *J Foot Surg.* 28(1):30-32.

11. Hill R, Greissinger P, Heller M. Ultrasound for the Detection in Human Tissue of Foreign Bodies. https://ac-els-cdn-com.proxygw.wrlc.org/S0196064497703470/1-s2.0-S0196064497703470-main.pdf?_tid=ec710b59-a76c-4534-ad1e-fc12826e3803&acdnat=1549410867_685db721270bf79777d8e939f436720d. Accessed February 5, 2019.

12. Jarvis HC, Matheny LM, Clanton TO. Stingray Injury to the Webspace of the Foot. *Orthopedics.* 2012;35(5):e762-e765.

13. Hambright D, Guss D, Smith JT. Unique Case of Posterior Tibial Tendon Dysfunction After Stingray Strike. *Foot Ankle Spec.* 2016;9(3):275-278.

14. Gabrie. Case synopsis. *Dermatol Online J.* 2014;20(2):3-7.

15. Fino P, Onesti MG, Felli A, *et al.* Case Series and Case Reports Clinical Examination and Treatment of a Leg Ulcer Caused by a Stingray Puncture. *Int J Low Extrem Wounds.* 2015;14(2):183-186.

16. Saunders CR, Saro E, Patel P, *et al.* Stingray barb injury: A cause of late coronary occlusion and stent failure. *Ann Thorac Surg.* 2013;96(5):1875-1877.