Aquatic Antagonists: Dermatologic Injuries From Sea Urchins (Echinoidea)

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**PRACTICE POINTS**
- Sea urchin spines easily become embedded in human skin upon contact and cause localized pain, edema, and black or purple pinpoint markings.
- Immediate treatment includes soaking in hot water (113°F [45°C]) for 30 to 90 minutes to inactivate proinflammatory compounds, followed by extraction of the spines.
- Successful methods of spine removal include the use of forceps and a hypodermic needle, as well as excision, liquid nitrogen, and punch biopsy.
- Prompt removal of the spines can reduce the incidence of delayed granulomatous reactions, synovitis, and sea urchin arthritis.

Sea urchin injuries are common following accidental contact with sharp sea urchin spines. Immediate manifestations of injury include local erythema, pain, and myalgia. Failure to remove the spines from the skin may result in delayed systemic reactions, secondary infection, granulomas, and—if joint spaces are involved—inflammatory or infectious synovitis and arthritis. The majority of severe complications can be avoided if the spines are fully removed from the skin soon after injury, which can be difficult. This article aims to bring awareness to the myriad complications from sea urchin injuries as well as the mechanisms for successful spine removal.

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Sea urchins—members of the phylum Echinodermata and the class Echinoidea—are spiny marine invertebrates. Their consumption of fleshy algae makes them essential players in maintaining reef ecosystems. Echinoids, a class that includes heart urchins and sand dollars, are ubiquitous in benthic marine environments, both free floating and rock boring, and inhabit a wide range of latitudes spanning from polar oceans to warm seas. Despite their immobility and nonaggression, sea urchin puncture wounds are common among divers, snorkelers, swimmers, surfers, and fishers who accidentally come into contact with their sharp spines. Although the epidemiology of sea urchin exposure and injury is difficult to assess, the American Association of Poison Control Centers’ most recent annual report in 2022 documents approximately 1426 annual aquatic bites and/or envenomations.

**Sea Urchin Morphology and Toxicity**
Echinoderms (a term of Greek origin meaning spiny skin) share a radially symmetric calcium carbonate skeleton (termed stereom) that is supported by collagenous ligaments. Sea urchins possess spines composed of calcite crystals, which radiate from their body and play a role in locomotion and defense against predators—namely sea otters, starfish/sea stars, wolf eels, and triggerfish, among others (Figure). These brittle spines can easily penetrate human skin and subsequently break off the sea urchin body. Most species of sea urchins possess solid spines, but a small percentage (80 of approximately 700 extant species) have hollow spines containing various toxic substances. Penetration and systemic absorption of the toxins within these spines can generate severe systemic responses.

The venomous flower urchin (Toxopneustes pileolus), found in the Indian and Pacific oceans, is one of the more common species known to produce a systemic reaction involving neuromuscular blockage. The most common species harvested off the Pacific coast of the United States—Strongylocentrotus purpuratus (purple sea urchin) and Strongylocentrotus franciscanus (red sea urchins)—are not inherently venomous.

Both the sea urchin body and spines are covered in a unique epithelium thought to be responsible for the majority of their proinflammatory and pronociceptive properties. Epithelial compounds identified include serotonin, histamines, steroids, glycosides, hemolysins, proteases, and bradykininlike and cholinergic substances. Additionally, certain sea urchin species possess 3-pronged pincerlike organs at the base of spines called pedicellariae.
Presentation and Diagnosis of Sea Urchin Injuries

Sea urchin injuries have a wide range of manifestations depending on the number of spines involved, the presence of venom, the depth and location of spine penetration, the duration of spine retention in the skin, and the time before treatment initiation. The most common site of sea urchin injury unsurprisingly is the lower extremities and feet, often in the context of divers and swimmers walking across the sea floor. The hands are another frequently injured site, along with the legs, arms, back, scalp, and even oral mucosa.\(^\text{11}\)

Although clinical history and presentation frequently reveal the mechanism of aquatic injury, patients often are unsure of the agent to which they were exposed and may be unaware of retained foreign bodies. Dermoscopy can distinguish the distinct lines radiating from the core of sea urchin spines from other foreign bodies lodged within the skin.\(^\text{6}\) It also can be used to locate spines for removal or for their analysis following punch biopsy.\(^\text{6,12}\) The radiopaque nature of sea urchin spines makes radiography and magnetic resonance imaging useful tools in assessment of periarticular soft-tissue damage and spine removal.\(^\text{8,11,13}\) Ultrasoundography can reveal spines that no longer appear after injury following a period of minimal symptoms and begins as a gradual increase in joint swelling and decrease in range of motion.\(^\text{8}\) Infectious tenosynovitis manifests quite similarly. Although supplicative etiologies generally progress with a more acute onset, certain infectious organisms (eg, *Mycobacterium*) take on an indolent course and should not be overlooked as a cause of delayed symptoms.\(^\text{8}\) The Kavelan cardinal signs are a sensitive tool used in the diagnosis of infectious flexor sheath tenosynovitis.\(^\text{8,24}\) If suspicion for joint infection is high, emergency referral should be made for debridement and culture-guided antibiotic therapy. Left untreated, infectious tenosynovitis can result in tendon necrosis or rupture, digit necrosis, and systemic infection.\(^\text{24}\) Patients with joint involvement should be referred to specialty care (eg, hand surgeon), as they often require synovectomy and surgical removal of foreign material.\(^\text{8}\)

From 1 month to 1 year after injury, prolonged granulomatous synovitis of the hand may eventually lead to joint destruction known as “sea urchin arthritis.” These patients

Initial treatment includes soaking the wound in hot water (113 °F [45 °C]) for 30 to 90 minutes and subsequently removing spines and pedicellariae to prevent development of delayed reactions.\(^\text{5,15,16}\) The compounds in the sea urchin epithelium are heat labile and will be inactivated upon soaking in hot water.\(^\text{16}\) Extraction of spines can be difficult, as they are brittle and easily break in the skin. Successful removal has been reported using forceps and a hypodermic needle as well as excision; both approaches may require local anesthesia.\(^\text{8,17}\) Another technique involves freezing the localized area with liquid nitrogen to allow easier removal upon skin blistering.\(^\text{18}\) Punch biopsy also has been utilized as an effective means of ensuring all spiny fragments are removed.\(^\text{9,19,20}\) These spines often cause black or purple tattoo-like staining at the puncture site, which can persist for a few days after spine extraction.\(^\text{9}\) Ablation using the erbium-doped:YAG laser may be helpful for removal of associated pigment.\(^\text{21,22}\)

Delayed Dermatologic Effects

Delayed reactions to sea urchin injuries often are attributable to prolonged retention of spines in the skin. Granulomatous reactions typically manifest 2 weeks after injury as firm nonsuppurative nodules with central umbilication and a hyperkeratotic surface.\(^\text{7}\) These nodules may or may not be painful. Histopathology most often reveals foreign body and sarcoidal-type granulomatous reactions. However, tuberculoid, necrobiotic, and suppurative granulomas also may develop.\(^\text{15}\) Other microscopic features include inflammatory reactions, supplicative dermatitis, focal necrosis, and microabscesses.\(^\text{21}\) Wounds with progression to granulomatous disease often require surgical debridement.

Other more serious sequelae can result from involvement of joint capsules, especially in the hands and feet. Sea urchin injury involving joint spaces should be treated aggressively, as progression to inflammatory or infectious synovitis and tenosynovitis can cause irreversible loss of joint function. Inflammatory synovitis occurs 1 to 2 months on average after injury following a period of minimal symptoms and begins as a gradual increase in joint swelling and decrease in range of motion.\(^\text{8}\) Infectious tenosynovitis manifests quite similarly. Although supplicative etiologies generally progress with a more acute onset, certain infectious organisms (eg, *Mycobacterium*) take on an indolent course and should not be overlooked as a cause of delayed symptoms.\(^\text{8}\) The Kavelan cardinal signs are a sensitive tool used in the diagnosis of infectious flexor sheath tenosynovitis.\(^\text{8,24}\) If suspicion for joint infection is high, emergency referral should be made for debridement and culture-guided antibiotic therapy. Left untreated, infectious tenosynovitis can result in tendon necrosis or rupture, digit necrosis, and systemic infection.\(^\text{24}\) Patients with joint involvement should be referred to specialty care (eg, hand surgeon), as they often require synovectomy and surgical removal of foreign material.\(^\text{8}\)

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present with decreased range of motion and numerous nodules on the hand with a hyperkeratotic surface. Radiography reveals joint space narrowing, osteolysis, subchondral sclerosis, and periosteal reaction. Synovectomy and debridement are necessary to prevent irreversible joint damage or the need for arthrodesis and bone grafting.14-24

Other Treatment Considerations

Other important considerations in the care of sea urchin spine injuries include assessment of tetanus immunization status and administration of necessary prophylaxis as soon as possible, even in delayed presentations (Table).16,25 Cultures should be taken only if infection is suspected. Prophylactic antibiotics are not recommended unless the patient is immunocompromised or otherwise has impaired wound healing. If a patient presents with systemic symptoms, they should be referred to an emergency care facility for further management.

Final Thoughts

Sea urchin injuries can lead to serious complications if not diagnosed quickly and treated properly. Retention of sea urchin spines in the deep tissues and joint spaces may lead to granulomas, inflammatory and infectious tenosynovitis (including mycobacterial infection), and sea urchin arthritis requiring surgical debridement and possible irreversible joint damage, up to a year after initial injury. Patients should be educated on the possibility of developing these delayed reactions and instructed to seek immediate care. Joint deformities, range-of-motion deficits, and involvement of neurovascular structures should be considered emergent and referred for proper management. Shoes and diving gear offer some protection but are easily penetrable by sharp sea urchin spines. Preventive focus should be aimed at educating patients and providers on the importance of prompt spine removal upon injury. Although dermatologic and systemic manifestations vary widely, a thorough history, physical examination, and appropriate use of imaging modalities can facilitate accurate diagnosis and guide treatment.

**Tetanus Prophylaxis in Sea Urchin Injury**16,25

<table>
<thead>
<tr>
<th>Immunization status</th>
<th>Prophylaxis</th>
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</thead>
<tbody>
<tr>
<td>Unimmunized*</td>
<td>TDap + TIG</td>
</tr>
<tr>
<td>Immune†</td>
<td>Tdap</td>
</tr>
<tr>
<td>≥5 y since last dose</td>
<td>Tdap</td>
</tr>
<tr>
<td>&lt;5 y since last dose</td>
<td>No prophylaxis needed</td>
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Abbreviations: TDap, tetanus-diphtheria-acellular pertussis; TIG, tetanus immune globulin.

*<3 lifetime doses of tetanus vaccine or unknown.
*Human TIG should be injected in part around the site of traumatic injury.
>3 lifetime doses.

REFERENCES