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Skin problems from marine echinoderms

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ABSTRACT: Marine echinoderms include more than 6000 species of sea stars, sea urchins, sand dollars, heart urchins, and sea cucumbers. Several sea urchins, a sea star, and sea cucumbers have been found responsible for human injury. Thermolabile toxins are reputed to be responsible. Immersion in hot water provides pain relief and promotes resolution of symptoms.

KEYWORDS: echinoderms, sea cucumber, sea stars, sea urchins.

The invertebrate phylum Echinodermata is the largest group of marine deuterostomes. Echinoderms develop by indeterminate and radial cell cleavage, and produce body cavities by enterocoelic pouching. The body cavities are then modified into a series of fluid-filled chambers that allow nutrient transfer. Four classes represent the major divisions: Stelleroidea (sea stars), Echinoidea (sea urchins, sand dollars, heart urchins), Holothuroidea (sea cucumbers), and Crinoidea (sea lilies, feather stars). The class Stelleroidea is further subdivided into subclass Asteroidea (sea stars) and subclass Ophiuroidea (brittle stars) (1). The only members of the echinoderm phylum capable of causing significant human injury are members of the Asteroidea, Echinoidea, and Holothuroidea.

Sea stars

Sea stars (or starfish) are free-living animals with arms extending radially from the central body and an exoskeleton covered with calcium carbonate spines (Fig. 1). Glandular tissue located in the integument produces a slime that can enter puncture wounds after inadvertent contact with the spines. Although most sea star contacts are harmless, puncture wounds caused by the crown-of-thorns star (*Acanthaster planci*) may produce significant injury. These spines may reach several centimeters in length and are capable of puncturing neoprene diving suits (2).

Crown-of-thorns sea star puncture wounds produce immediate intense burning pain. Burning and throbbing may last up to a month, suggesting the presence of a toxin. It has been suggested that the crown-of-thorns may be the only truly venomous sea star in the world (3). Spines may break off and become embedded in skin, producing erythema and edema. Systemic symptoms include nausea, vomiting, and paresthesia, all of which may last several days (4,5). If spines are not completely removed, foreign body granulomata may develop. Handling of other sea stars may produce a mild irritant contact dermatitis, probably due to exposure to the integumentary slime (4,6).

Therapy

Treatment of sea star spine injury is immersion in hot water (110°F–120°F). This gives prompt pain relief. In addition, any residual spines must be removed by irrigation and, if needed, exploration. The irritant contact dermatitis should be treated with thorough cleansing of the area. Symptomatic relief has been noted after application of topical corticosteroids or calamine lotion with 0.5% menthol. Systemic features are self-limited and

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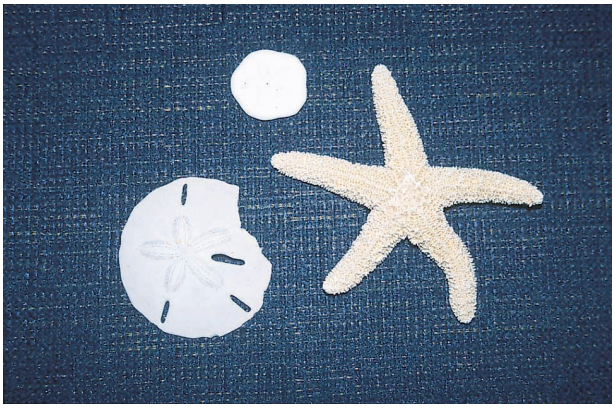

Fig. 1. Common echinoderms. Clockwise from top: sea biscuit, sea star, sand dollar.

may be managed with symptomatic treatment alone (2,4,7). Tetanus prophylaxis should be considered.

Sea urchins

About 6000 species of sea urchins have been identified. Approximately 80 of these species are toxic to humans. Sea urchins are slow-moving, nonaggressive bottom dwellers found in deep water, on the continental shelf, and on tropical and temperate reefs. They have ovoid or globular bodies with hard calcium carbonate exoskeletons enclosing the central body cavity. A thin epithelial integument covers the calcareous shell. Spines and three-pronged pinching mobile pedicellariae are attached to the integument. Some species do not have pedicellariae. Pedicellariae, when present, may be attached to venom glands. Spines may be hollow or solid, and may have toxins associated with the spines themselves or with the thin epithelial sheath. Spines may be short and thick, as in the pencil urchins, or quite long, thin, and sharp (up to 30 cm long) as in *Diadema* species (Fig. 2). These long-spined tropical *Diadema* urchins are particularly worrisome because the spines can readily penetrate sandals, shoes, and swim fins, often breaking off in the skin of victims (2,4,5,8). Toxic properties identified thus far include serotonin, steroid glycosides, cholinergic substances, histamines, and bradykinin-like substances (9).

The primary injury from sea urchins is due to spine puncture. Common sites of injury are the feet and ankles from stepping on the urchins, and the hands due to handling or as a defensive mechanism when being washed into a reef by wave action. Spine puncture produces immediate intense burning pain and bleeding, followed by development of erythema, edema, local myalgias, and an aching sensation. Joint penetration leads to profuse bleeding and painful synovitis. Purple to black dye contained in the spines may stain skin and may be confused with retained fragments. Spines often break off and leave fragments in the wound (4,7–10). These fragments present a nidus for infection and potential foreign body reactions. Pain and edema may last for a week.

Some of the more toxic urchins, such as the genus *Tripneustes* from the Pacific Ocean, produce severe pain locally as well as systemic features of dizziness, dyspnea, and cranial nerve palsies. While the local pain may ease within an hour or so, the nerve palsies may last for up to 6 hours (9). Systemic symptoms are especially common if more than 15–20 spines penetrate the skin. These may include paresthesia, hypotension, muscle paralysis, and respiratory distress (2).

Urchins with pedicellariae tend to be quite toxic, often with neurotoxic properties. Some, like *Toxopneustes pileolus*, are known to have venom glands attached to the pedicellariae. In some instances the pedicellariae may remain attached to the victim and may continue to secrete toxin even after the urchin is removed. Symptoms associated with pedicellaria stings include intense radiating pain, faintness, numbness, muscle paralysis, respiratory distress, aphonia, and even death (2,7,11).

Long-term effects include granuloma formation, chronic arthropathy, persistent neuropathy, local bone destruction, and a vesicular delayed-type hypersensitivity reaction (4,10–12). Granulomatous reactions (Fig. 3) are thought to be largely foreign body reactions to the various inorganic salts contained in the spines (calcium carbonate, magnesium carbonate, calcium sulfate,

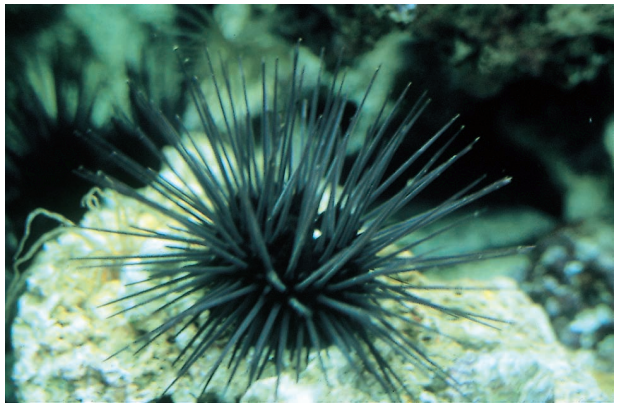

Fig. 2. Long-spined *Diadema* sea urchin.

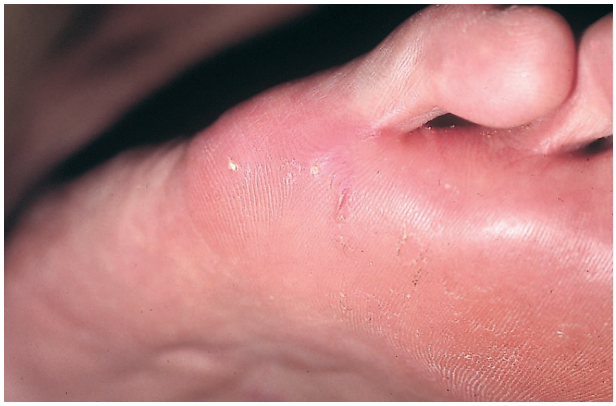

Fig. 3. Sea urchin granuloma lateral to the fifth metatarsal.

phosphates, and silicon dioxide). They present as pink to cyanotic 2–5 mm papules that later develop a brownish tint. Scale is variable, as are associated symptoms (4,11,12).

The histopathology of persistent sea urchin spine injuries has been reported by de la Torre and Toribio (13). They examined 50 biopsy specimens from 35 patients (31 men) injured by the Atlantic and Mediterranean urchin, *Paracentrotus lividus*. The mean duration of lesions in the series was 7.5 months. Granulomas comprised 70% of the patterns, with foreign body granulomas in 26%, sarcoidal granuloma in 20%, necrobiotic granuloma in 12%, suppurative granuloma in 8%, and tuberculoid-type granuloma in 4%. The remaining 30% showed acute and chronic inflammation with and without suppuration. Epidermal changes such as perforation and umbilication were seen in half the cases. The dermal infiltrate was deep in 66%, and fibrosis was noted in 60%. A companion study by the same group used polymerase chain reaction (PCR) to amplify DNA from 41 specimens to probe for mycobacterial sequences. Eight specimens from seven patients were positive for mycobacterial DNA sequences, three of which were specific for *Mycobacterium marinum*. This suggests a need to look for infection in the chronic granulomatous lesions after urchin injury (14).

Therapy

Treatment of sea urchin spine (or pedicellaria) injury begins with immersion in hot water (110°F–115°F) mixed 1:1 with vinegar. The hot water inactivates the toxin and provides prompt pain relief. Pedicellariae and spines should be removed by irrigation and gentle traction. Because the spines are so fragile, crumbling is to be expected. Roentgenograms with soft tissue windows may be needed to identify and locate retained spines. Surgical exploration may be necessary, particularly if joint spaces are violated. Tetanus prophylaxis should be considered. Wound infection is common and, if present, should be treated with antibiotics such as ciprofloxacin. Immersion of the wound in urine or alcohol is based solely on folklore and has no merit (5,8,15). Persistent embedded spines may be destroyed with one or two applications of erbium:YAG laser ablation (16).

Sea cucumber

Sea cucumbers are free-living, bottom dwelling echinoderms shaped like sausages (Fig. 4). They produce a toxin called holothurin, which is concentrated in the tentacular organs of Cuvier. These organs can be extruded defensively, releasing holothurin into the surrounding water. Holothurin is also found in the slime layer of the integument and in their "squirt" (Fig. 5). Skin contact produces a burning and itching irritant dermatitis. Sea cucumbers also eat jellyfish and then secrete undigested nematocysts through the integument. This results in a typical coelenterate sting. Contact with the eyes due to direct instillation or swimming nearby can produce a painful chemical conjunctivitis. If corneal injury occurs, blindness may result. Ingestion can prove fatal, since holothurin is a potent cardiac glycoside (4,6,7,10).

Therapy

Treatment of sea cucumber skin injuries should begin with thorough cleansing of the exposed area

Fig. 4. A sea cucumber.

Fig. 5. The "squirt" of the sea cucumber contains holothurin.

with hot water and soap, vinegar, or isopropyl alcohol. These agents remove the slime and deactivate holothurin. Cleansing alone may relieve symptoms. Treatment of ocular injury should begin with topical anesthesia followed by copious irrigation. Fluorescein staining may be performed to assess corneal injury. Ophthalmologic consultation should be considered. Nematocyst injury should be treated as other coelenterate stings (4,6,7).

Conclusion

Echinoderm injury may involve thermolabile toxins that can be treated effectively with hot water immersion or irrigation.

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