

2740 the victim. Residual dye from the surface of a spine remaining after the spine's removal may mimic a retained spine but is otherwise of no consequence. Soft tissue radiography or MRI can confirm the presence of retained spines, which may warrant referral for attempted surgical removal if the spines are near vital structures (e.g., joints, neurovascular bundles). Retained spines may cause the formation of granulomas that are amenable to excision or to intralesional injection with triamcinolone hexacetonide (5 mg/mL). Chronic granulomatous arthritis of the proximal interphalangeal joints has been treated with synovectomy and removal of granulation tissue. Erbium-YAG laser ablation has been deployed to destroy multiple sea urchin spines embedded in the foot and identified visually at the surface level without causing thermal necrosis of the adjacent tissues. Eosinophilic pneumonia and local and diffuse neuropathies have been observed separately after penetration by multiple spines of the black sea urchin (presumed *Diadema* species). The pathophysiologies of these phenomena have not been determined.

Starfish The crown-of-thorns *Acanthaster planci* produces venom in glandular tissue underneath the epidermis, which is released via its spiny surfaces (Fig. 474-5). Skin puncture causes pain, bleeding, and local edema, usually with remission over 30–180 min. Multiple punctures may result in reactions such as local muscle paralysis; retained fragments may cause granulomatous lesions and synovitis. There has also been a case report of elevated liver enzymes after *A. planci* envenomation. Envenomed persons benefit from acute immersion therapy in hot water, local anesthesia, wound cleansing, and possible exploration to remove foreign material.

Sea Cucumbers Sea cucumbers produce holothurin (a cantharin-like liquid toxin) in their body walls. This toxin is concentrated in the tentacular organs that are projected when the animal is threatened. Underwater, holothurin induces minimal contact dermatitis in the skin but can cause significant corneal and conjunctival irritation. A severe reaction can lead to blindness. Skin should be detoxified with 5% acetic acid (vinegar), papain, or isopropyl alcohol. The eye should be anesthetized with one or two drops of 0.5% proparacaine and irrigated with 100–250 mL of normal saline, with subsequent slit-lamp examination to identify corneal defects.

Cone Snails Cone snails use a detachable dartlike tooth to inject conotoxins into prey, inducing tetanus followed by paralysis. In an unknowing handler, stings result in small, burning punctate wounds followed by local ischemia, cyanosis, and numbness. Dysphagia, syncope, dysarthria, ptosis, blurred vision, and pruritus have also been documented. Some envenomations induce paralysis leading to respiratory failure, coma, and death. There is no antivenom. Pressure-immobilization (see “Octopuses,” below), hot-water soaks, and local anesthetics have been used empirically with success. The wound should be inspected for a foreign body. Edrophonium has been recommended as therapy for paralysis if a Tensilon test is positive.

Octopuses Serious envenomations and deaths have followed bites of Australian blue-ringed octopuses (*Octopus maculosus* and *Octopus*

lunulata). Although these animals rarely exceed 20 cm in length, their salivary venom contains a potent neurotoxin (maculotoxin) that inhibits peripheral nerve transmission by blocking sodium conductance. Oral numbness and facial numbness develop within several minutes of a serious envenomation and rapidly progress to total flaccid paralysis, including failure of respiratory muscles. Immediately after envenomation, a circumferential pressure-immobilization dressing 15 cm wide should be applied over a gauze pad (~7 × 7 × 2 cm) that has been placed directly over the sting. The dressing should be applied at venous-lymphatic pressure, with the preservation of distal arterial pulses. The limb should then be splinted. Once the victim has been transported to the nearest medical facility, the bandage can be released. Because there is no antidote and passive immunotherapy (rabbit IgG antibody) has been proven effective only against tetrodotoxin in mice, treatment is supportive. Patients with respiratory failure may need to be mechanically ventilated. If respirations are assisted, the victim may remain awake although completely paralyzed. Even with serious envenomations, significant recovery often takes place within 4–10 h, although complete recovery may require 2–4 days. Sequelae are uncommon unless related to hypoxia.

VERTEBRATES

As for all penetrating injuries, first-aid care should be undertaken. In addition, consideration must be given to local wound infection by marine *Vibrio* species and freshwater *Aeromonas hydrophila* as well as other “aquatic bacteria,” particularly if spines and needles remain embedded.

Stingrays A stingray injury is both an envenomation and a traumatic wound. Thoracic and cardiac penetration, major vessel laceration, and compartment syndrome have all been observed. The venom, which contains serotonin, 5'-nucleotidase, and phosphodiesterase, causes immediate, intense pain that may last up to 48 h. The wound is very painful (with the pain peaking at 30–60 min and lasting up to 48 h), often becomes ischemic in appearance, and heals poorly, with adjacent soft tissue swelling and prolonged disability. Systemic effects include weakness, diaphoresis, nausea, vomiting, diarrhea, dysrhythmias, syncope, hypotension, muscle cramps, fasciculations, paralysis, and (in rare cases) death. Because of differences in the toxins present on the tissues covering the stingers, freshwater stingrays may cause more severe injuries than marine stingrays.

Scorpionfish The designation *scorpionfish* encompasses members of the family Scorpaenidae and includes not only scorpionfish but also lionfish and stonefish. A complex venom with neuromuscular toxicity is delivered through 12 or 13 dorsal, 2 pelvic, and 3 anal spines. In general, the sting of a stonefish is regarded as the most serious (severe to life-threatening); that of the scorpionfish is of intermediate seriousness; and that of the lionfish is the least serious. Like that of a stingray, the sting of a scorpionfish is immediately and intensely painful. Pain from a stonefish envenomation may last for days. Systemic manifestations of scorpionfish stings are similar to those of stingray envenomations but may be more pronounced, particularly in the case of a stonefish sting, which may cause severe local tissue necrosis in addition to vital organ failure. The rare deaths that follow stonefish envenomation usually occur within 6–8 h. There is a commercially available stonefish antivenom.

Other Fish Three species of marine catfish—*Plotosus lineatus* (oriental catfish), *Bagre marinus* (sail catfish), and *Galeichthys felis* (common sea catfish)—as well as several species of freshwater catfish are capable of stinging humans. Venom is delivered through a single dorsal spine and two pectoral spines. Clinically, a catfish sting is comparable to that of a stingray, although marine catfish envenomations are generally more severe than those of their freshwater counterparts. Surgeonfish (doctorfish, tang), weeverfish, ratfish, and horned venomous sharks have also envenomed humans.

Platypus The platypus is a venomous mammal. The male has a keratinous spur on each hind limb; the spur is connected to a venom gland within the upper thigh. Skin puncture causes soft tissue edema and



FIGURE 474-5 Spines on the crown-of-thorns sea star (*Acanthaster planci*). (Courtesy of Paul Auerbach, with permission.)