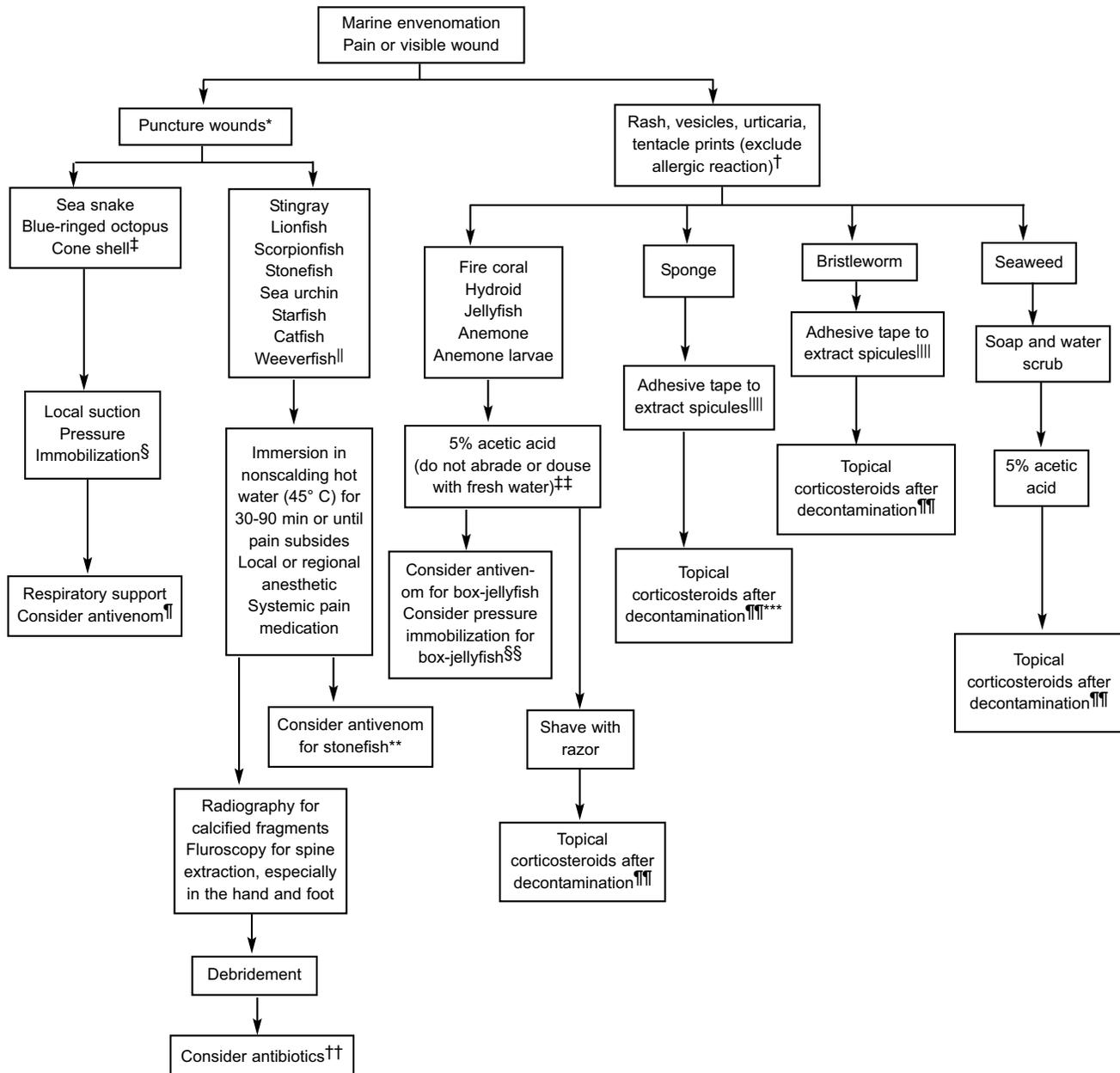


Figure 1. Algorithmic Approach to Marine Envenomation



* A gaping laceration, particularly of the lower extremity, with cyanotic edges suggests a stingray wound. Multiple punctures in an erratic pattern with or without purple discoloration or retained fragments are typical of a sea urchin sting. One to eight (usually two) fang marks are usually present after a sea snake bite. A single puncture wound with an erythematous halo and rapid swelling suggests scorpionfish envenomation. Blisters often accompany a lionfish sting. Painless punctures with paralysis suggest the bite of a blue-ringed octopus; the site of a cone shell sting is punctate, painful, and ischemic in appearance.

† Wheal and flare reactions are nonspecific. Rapid (within 24 hours) onset of skin necrosis suggests an anemone sting. "Tentacle prints" with cross-hatching or a frosted appearance after application of aluminum-based salts suggest a box-jellyfish (*Chronex fleckeri*) envenomation. Ocular or intraoral lesions may be caused by fragmented hydroids or coelenterate tentacles. An allergic reaction must be treated promptly.

‡ Sea snake venom causes weakness, respiratory paralysis, myoglobinuria, myalgias, blurred vision, vomiting, and dysphagia. The blue-ringed octopus injects tetrodotoxin, which causes rapid neuromuscular paralysis.

§ As soon as possible, venom should be sequestered locally with a proximal venous-lymphatic occlusive band of constriction, or (preferably) by the pressure-immobilization technique, in which a cloth pad is compressed directly over the wound by an elastic wrap that should encompass the entire extremity at a pressure of 9.33 kPa (70 mmHg) or less. Incision and suction are not recommended.

¶ Early ventilatory support has the greatest influence on outcome. The minimal initial dose of sea snake antivenom is one to three vials; up to 10 vials may be required.

(Continued on next page.)

Figure 1. Algorithmic Approach to Marine Envenomation (continued)

|| The wounds range from large lacerations (stingrays) to minute punctures (stonefish). Persistent pain after immersion in hot water suggests a scorpionfish or stonefish sting or a retained fragment of spine. The puncture site can be identified by forcefully injecting 1% to 2% lidocaine or another local anesthetic agent without epinephrine near the wound and observing the egress of fluid. Do not attempt to crush the spines of sea urchins if they are present in the wound. Spine dye from already-extracted sea urchin spines will disappear (be absorbed) in 24 to 36 hours.

** The initial dose of stonefish antivenom is one vial per two puncture wounds.

†† The antibiotics chosen should cover *Staphylococcus*, *Streptococcus*, and microbes of marine origin, such as *Vibrio*.

‡‡ Acetic acid (5%; i.e., vinegar) is a good all-purpose decontaminant and is mandated for the sting from a box-jellyfish. Alternatives, depending on the geographic region and indigenous jellyfish species, include isopropyl alcohol, bicarbonate (baking soda), ammonia, papain, and preparations containing these agents.

§§ The initial dose of box-jellyfish antivenom is one ampule intravenously or three ampules intramuscularly.

¶¶ If inflammation is severe, steroids should be given systematically (beginning with at least 60 to 100 mg of prednisone or its equivalent), and the dose should be tapered over a period of 10 to 14 days.

||| An alternative is to apply and remove commercial facial peel materials.

*** An alternative is to apply and remove commercial facial peel materials followed by topical soaks of 30 mL of 5% acetic acid (vinegar) diluted in 1 L of water for 15 to 30 minutes several times a day until the lesions begin to resolve. Anticipate surface desquamation in 3 to 6 weeks.

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The venom apparatus is a bilaterally retroserrated spine and the enveloping integumentary sheath. There may be up to 4 spines on the tail of a single ray. The spines are attached to the dorsum of the tail. Along the edges of the spines are hollow grooves that contain soft venom glands.

A stingray wound is both a mechanical wound and an envenomation. The cartilaginous spine and strength of the strike combine to cause significant tissue damage. Most injuries involve the lower extremity. There are also reported injuries to the upper extremity, abdomen, and thorax. In very rare cases, the heart may be injured directly. In addition, a detached stingray spine may be used as a combat weapon.

Envenomation is accompanied by immediate intense local pain with variable edema and bleeding. The pain radiates centrally, peaks at 30–60 minutes, and may last for 48 hours. Systemic symptoms include nausea, vomiting, diarrhea, diaphoresis, vertigo, tachycardia, headache, syncope, seizures, muscle cramps, fasciculations, generalized edema, paralysis, hypotension, arrhythmias, and death.

Treatment. Treatment is aimed at combating the effects of the venom, relieving pain, and preventing subsequent infection.

First, as in all marine injuries, remove the victim from the water. Muscle contractions and fasciculations may be caused by the venom and/or pain, causing problems for a swimmer.

Immediately soak the injury in non-scalding hot water (45°C, 113°F) for 30–90 minutes. If hot water is not available, irrigate the wound with nonheated water or saline. If sterile water or saline is not available, use tap water. The goal is to remove as much of the venom and organic material as quickly as possible. In addition, the heat may attenuate some of the thermolabile components of the venom or interrupt nerve impulse transmission. It has no proven effect on the ultimate degree of tissue necrosis.

There is no indication for additives for the soaking solution.

During the hot water soak, explore the wound and remove any

visible portions of the sting or its integumentary sheath. *Note:* The exception is a penetrating injury of the chest or other body location where the presence of the spine may be occluding a blood vessel with the propensity to bleed torrentially. These should be removed in the operating room under sterile conditions with adequate preparation for uncontrolled bleeding or other catastrophic events.

There is no role for cryotherapy, steroids, or antihistamines.

Initiate pain control as soon as possible during the first soaking period. Parenteral narcotics may be required. Local infiltration with 1% or 2% lidocaine or bupivacaine 0.25–0.50% without epinephrine may be needed. A regional nerve block can be used.

Upon completion of the soaking procedure, explore the wound in a sterile fashion.

Excise hemorrhagic fat and obviously devitalized tissue.

Pack the wound for a delayed primary closure or close loosely around adequate drainage. An alternative includes excising the wound and packing it with an alginate dressing.²⁵

Provide tetanus prophylaxis.

Prescribe prophylactic antibiotics to prevent secondary infection. To cover *Vibrio* species implicated in cases of stingray infection,²⁶ administer oral doxycycline 100 mg twice daily, tetracycline 500 mg four times daily, or trimethoprim-sulfamethoxazole double-strength twice daily. Ciprofloxacin 500 mg or 750 mg daily is an alternative. Topical becaplermin gel was used with some success in one patient who suffered prolonged healing.²⁷

Obtain an MRI if a retained foreign body is expected and none is seen on plain radiographs. Stingrays have cartilaginous endoskeletons, so spine fragments may not be visible without advanced imaging.

Obtain surgical consultation for repair of vascular injuries, lacerated nerves and tendons, and for all stab wounds of the abdomen, thorax, or neck.^{28,29}