

Diagnosis and Management of Injuries From Dangerous Marine Life CME

Thomas P. Brown, DO
Medscape General Medicine 7(3):, 2005. © 2005 Medscape

Abstract

Injuries from marine life encompass a wide spectrum, from mild stings to severe bites. Fortunately most of the injuries are mild, although some may be significant, resulting in death. Most of these injuries can be treated by family physicians with a knowledge of the cause of the pathology. Over the years, there have been many treatment options. Some have actually caused an increase in severity. An important rule in treating these injuries is to inactivate the venom, treat the local reaction or injury, and treat the systemic sequelae. Jellyfish stings are the most common type of marine injury. The tentacles possess nematocysts, which are stinging units that are inactivated by the application of vinegar. Sea urchin and stingray injuries require the removal of the imbedded spines after the wound is soaked in hot water. Coral, sea bathers eruption, and swimmer's itch require thorough scrubbing and irrigation. Sea snakes, cone shells, and venomous fish possess a neurotoxin that requires close monitoring in the event of cardiopulmonary collapse. All of these injuries require tetanus status monitoring and consideration of coverage for infectious sequelae.

Dangerous Marine Life

With the ease of travel, the world is becoming a smaller place. Reefs that were once considered remote are now easily accessible. As humans enter this aquatic environment, the possibility of coming into contact with dangerous marine life significantly increases.

Most venomous marine life resides in the warm waters of the tropics and subtropics, especially around reefs. Because of their beauty and marine inhabitants, these same reefs are frequently used for diving and snorkeling.

Fortunately, most of the injuries that occur will result in nothing more than an uncomfortable sting or pruritic lesion, although on occasion, the injury will be significant and may even prove to be fatal.

This article discusses various types of venomous marine life and the treatments for the injuries that they inflict. There have been almost as many remedies for each of these injuries as there are species of venomous marine life. Many came about because the substances used to treat the injuries were the only options available.

An important rule to remember when treating these injuries involves 3 steps:

- Arrest the envenomation by inactivation of the venom;
- Treat the local reaction or injury; and
- Treat the systemic reactions.

The following are important points to remember during the treatment phase:

- Be prepared for cardiopulmonary collapse even in what appears to be a minor envenomation.

- Be prepared for anaphylactic reactions.
- When culturing wounds, it is important to inform the laboratory that the injury was in a marine environment. Factors, such as salt concentration of the media, incubation temperatures, and time, need to be adjusted.
- Cover for infectious pathogens, including *Vibrio vulnificus*, *Aeromonas hydrophila*, *Edwardsiella tarda*, *Erysipelothrix rhusiopathiae*, *Mycobacterium marinum*, *Streptococcus iniae*, and *Vibrio damsela*.^[1]
- Check tetanus status and treat accordingly.

Jellyfish Stings

Although many of the species of dangerous marine life inhabit the warm waters of the tropics and subtropics, jellyfish can be found in numerous locations throughout the world. In fact, jellyfish stings are the most common marine injury.^[2]

The degree of injury by a jellyfish depends on the specific species, amount of surface contact, duration of contact, anatomic location, age, number of nematocysts (stinging capsules) involved, body weight, thickness of skin, and allergic reaction of the victim.^[2-4] Anaphylactic reactions are becoming more common as the number of people with previous exposure and sensitization to the venom has increased over the years.^[5]

The tentacles of jellyfish are abundant with cnidocytes.^[6,7] Enclosed within these cells are stinging capsules called nematocysts.^[7] Nematocysts present in 2 forms, one that adheres to the prey by a sticky mucus or a coiled spring configuration, and another that acts like a needle that penetrates its prey and then discharges venom.^[3] The needlelike filament may be as long as .5 mm.^[3] The velocity of the filament exiting the capsule may reach 2 m/second.^[7] Tactile stimulation causes the nematocyst to fire, incapacitating its prey.^[7] Even when the tentacle is avulsed, the nematocysts have the ability to discharge especially if doused with freshwater, a method once commonly used for treatment.^[6]

Experienced physicians may be able to identify the type of jellyfish that caused the injury by the type of nematocyst, the aggregation of the nematocyst on the tentacle, by the morphology of the tentacle itself, or by the characteristic pattern on the skin of the victim.^[3] An example is the Portuguese man-of-war, which produces a single long strap with small blisters along it.^[3] However, the deadly box jellyfish or sea wasp inflicts a pattern of multiple, interlaced long red lines that may remain adherent to the victim due to a sticky substance.^[3]

Symptoms:

- Stinging sensation immediately on contact;
- Intensity increasing over 10 minutes;
- Erythema;
- Pruritus;
- Papules, vesicles, pustules; and
- Necrotic ulcers.^[3-5]

Generalized:

- Increased oral secretions;
- Gastrointestinal disturbance;
- Muscle spasm;
- Respiratory distress; and
- Cardiovascular failure.^[3-5]

Treatment:

- Immobilize the limb;
- Inactivate the nematocysts by applying vinegar or 3% to 10% acetic acid for 10 minutes;
- Do not apply alcohol, freshwater, ammonia, or bleach because this will stimulate the nematocysts to discharge venom;
- Lift away; do not brush any remaining tentacles;
- Apply shaving cream and carefully shave the area to remove any remaining nematocysts;
- Topical steroid creams and anesthetic creams may help relieve the pain and swelling;
- Oral antihistamines and narcotics for pain control are occasionally warranted;
- Antibiotics should be considered for vesicular lesions to prevent secondary infection; and
- Muscle spasms can be treated with 10 mL of calcium gluconate of a 10% solution intravenously (IV).^[2,4-6]

Alternatives:

- Until the vinegar or acetic acid is available, a seawater rinse may be useful in an attempt to wash away any remaining nematocysts. Ensure that the seawater is free of jellyfish or even fragments of tentacles because they remain toxic for months.
- Nematocysts that remain adherent to the skin should not be rubbed with sand, scrubbed with a cloth, or vigorously washed.
- If necessary, dust the area with fine sand, baking soda, powder, or flour and then scrape away the remaining nematocysts with the back edge of a knife.
- If ice is the only option available, avoid condensation because the freshwater will initiate nematocyst firing.^[4-6,8]

Box Jellyfish (Sea Wasp)

The box jellyfish or sea wasp is commonly associated with the northern coast of Australia, although it and other species of sea wasp can be found in the Atlantic Ocean, the Gulf of Mexico, and the Caribbean Sea.^[4] It is considered to be the most venomous marine animal known.^[3,8,9] It is responsible for 1 Australian death per year, which may occur in minutes.^[8,9] Because it is pale blue in color and near transparent, it is difficult to see in the water.

The characteristic box-shaped body has 4 pedalia, 1 on each corner. Each pedalia possesses as many as 15 tentacles, each measuring 3 m in length.^[3,9] Death has occurred after contact with as little as 7 m of tentacle.^[3]

The sting is followed by immediate pain and swelling, which increases in intensity, often coming in waves. The characteristic skin lesions are interlaced whiplash lines, which are beaded in appearance. They measure .5 cm wide and are red, purple, or brown in color. If the victim survives, the lesions will ulcerate after 7 days. The lesions may take months to heal.^[3]

The venom can rapidly lead to respiratory failure, cardiovascular collapse, and subsequent death.^[8] If death is to occur, it will take place in the first 10 minutes.^[3] It is not uncommon to have an oscillating cardiovascular response when there are episodes of hypotension and bradycardia followed by hypertension and tachycardia.^[3,8] This apparent improvement in the cardiovascular status leads to a belief that the victim is improving. This change occurs just prior to death.^[3]

Treatment consists of close monitoring and treatment for cardiopulmonary collapse along with the aforementioned treatment for jellyfish stings. There is also an antivenom that has been developed by the Australian Commonwealth Serum Laboratories (CSL). In Australia many lifeguards are equipped with this antivenom.^[8]

Sea Urchins

There are 6000 species of sea urchins. Of these, 80 species are thought to be venomous to humans.^[3] There are 2 mechanisms of injury from the sea urchin. The first includes the mechanical effects of embedded broken spines and injected venom along with an inflammatory reaction.^[3,4] The second mechanism is due to pedicellariae. These organs are found on the surface of the urchin and spines and act as jaws to clamp onto prey.^[4,8] Even when separated from the spine, they continue to function. After the injury occurs, there is immediate onset of pain that is out of proportion to the trauma.^[4] The duration of the pain is several hours.

Symptoms:

- Pain;
- Edema and swelling;
- Partial paralysis of a limb;
- Facial swelling;
- Muscle spasm;
- Dyspnea;
- Weakness;
- Cardiac arrhythmias; and
- Collapse.^[3,4]

The symptoms of pedicellariae are usually more severe than the spines, including aphonia, respiratory distress, and possibly death.^[3]

Treatment:

- Soak the wound in hot water (43.3°C to 45.0°C).
- Protruding spines should be removed carefully without bending because they are easily broken. The use of a local anesthetic may be required.
- Purple or black dye from the surface of a spine may tattoo the skin and lead to a false assumption that a spine is imbedded in the skin. The dye will be absorbed in 48-72 hours. If the mark remains visible after 72 hours, then a spine fragment is likely imbedded.
- Analgesics.
- If the species possesses pedicellariae (pincer system), apply shaving cream and carefully shave the area.
- Secondary infection may occur requiring antibiotics and the possible need for debridement or drainage.
- Surgical treatment will be required if the spine is imbedded in a joint space, nerve, or tendon.^[2-4,8]

Stingrays

In the United States, stingrays are responsible for 1500 injuries each year.^[2] They are commonly found lying in the sand of coastal waters. Most of the injuries that occur result when the victim unknowingly steps on the ray. In defense, the muscular tail swings upward and forward driving as many as 4 sharp, barbed stingers into the victim.^[3,8] The injury results in a deep puncture and envenomation after the integument over the spine is ruptured.^[3-5] Fatalities are possible if the pericardium, peritoneum, or pleural cavity is perforated.^[3]

The venom is a heat-labile and water-soluble protein with an IV LD50 of 28.0 mg/kg. Pain is the initial symptom that increases over 1-2 hours and then decreases over the following 6-48 hours. Bleeding may be present, and in some cases profuse, but may actually lessen the degree of pain. The wound commonly becomes ulcerated and necrotic, and secondary infection of the damaged tissue along with osteomyelitis has been reported.^[3]

Symptoms:

- Pain;
- Anorexia;
- Nausea and vomiting;
- Diarrhea;
- Increased micturition and salivation;
- Muscle cramping and tremor;
- Tonic paralysis;

- Convulsions;
- Cardiac abnormalities to include asystole;
- Hypotension;
- Respiratory depression;
- Ulceration and necrosis; and
- Infection.^[3,4]

Treatment:

- Place the patient in the supine position and elevate the limb;
- Extract the spine or integument;
- Irrigate with saline and scrub the surface with soapy water;
- Immerse in hot water at 48.8°C for 30-90 minutes;
- If bleeding has not occurred, a small incision may be advisable prior to immersion in hot water;
- Infiltrate with lidocaine to help with pain control and to aid in thorough cleansing;
- Analgesia;
- Ten percent calcium gluconate 5-10 mL IV may relieve muscle spasms;
- X-rays if you suspect a foreign body;
- Close loosely with suture and a drain;
- Antibiotic coverage; and
- Because systemic symptoms can be dramatic, monitor for respiratory and cardiovascular collapse.^[3,4]

Coral

While admiring coral, divers and snorklers are often washed against it by the undersea current. The surface of coral is covered by living material, which is easily removed from the hard architecture beneath. This outer surface can then enter cuts and scrapes caused by the abrasive undersurface. At the time of injury, there may be little discomfort and the wound may go unnoticed. A few hours later, an inflammatory reaction may occur, which increases over the following 24-48 hours.^[3] The damage caused by coral may take weeks or months to heal.^[4]

Symptoms:

- Swelling;
- Discoloration;
- Pruritus;
- Tenderness;
- Ulceration; and
- Abscess.^[3,4]

Treatment:

- Scrub the wound with soap and water;
- Flush with large amounts of water;
- Then flush the wound with half-strength hydrogen peroxide and water;
- Rinse again with water;
- Apply antibiotic ointment, such as neomycin/bacitracin/polymyxin (*Neosporin*) or mupirocin;
- Cover with a nonadherent sterile dressing;
- Dress twice daily; and
- Monitor for signs of infection.^[3,8]

Swimmer's Itch

Swimmer's itch is caused by skin contact with free swimming organisms called cercariae, which are the larval form of parasitic schistosomes.^[2,8] Symptoms occur when cercariae-infested water dries on exposed skin.^[8] The cercariae penetrate the skin, resulting in an erythematous bumpy, highly pruritic rash that occurs within minutes. Blister formation may develop over the following 24-48 hours.^[8] Occasionally, the lesions may become infected secondary to scratching.

Treatment:

- Immediately after leaving the water, briskly rub the skin with a towel in an attempt to prevent the cercariae from penetrating the skin;
- If cercariae have penetrated the skin and a reaction has occurred, the skin should be lightly rinsed with isopropyl alcohol and then coated with calamine, cortisone, or diphenhydramine hydrochloride (*Benadryl*) creams;
- Oatmeal or baking soda baths may also be helpful;
- Significant reactions may require oral prednisone; and
- Monitor for secondary infection from scratching.^[8]

Sea Bathers Eruption

Sea bathers eruption is caused by the larval forms of thimble jellyfish.^[2,8] The condition is common along the coasts of Florida and Cuba and the Caribbean. These organisms are very small -- about the size of flakes of black pepper. They become trapped in bathing suits or attach to hair and rarely affect noncovered skin.^[2] Stinging occurs in the same manner as mature jellyfish (nematocysts) in areas that are covered.^[2,8]

Symptoms:

- Rash;
- Pruritus (which may become severe);
- Headache;
- Fever;
- Chills;
- Weakness;
- Vomiting; and
- Burning of eyes and urethra.^[2,8]

Treatment:

- Remove the bathing suit or wet suit;
- Rinse in freshwater shower;
- Apply vinegar to neutralize the nematocysts if no shower is available;
- Apply hydrocortisone cream 1% twice daily to rash;
- Systemic reactions should be treated with oral prednisone; and
- Machine wash the bathing suit or thoroughly rinse in alcohol or vinegar followed by soap and water.^[2,8]

Sea Snakes

There are 50 species of sea snakes, which are the most abundant of all reptiles.^[3] They average 3-4 ft in length but may reach as much as 9 ft. Sea snakes are commonly found in the temperate or tropical zones, especially in the Indo-Pacific region.^[3]

They are inquisitive and attracted to moving objects. They may become aggressive if handled or walked on. Land snakes on occasion may find their way into water and could be confused with a sea snake. A distinctive trait of a sea snake is a flat, paddle-shaped tail that land snakes do not possess.^[3]

Sea snake venom is 2-10 times more toxic than that of the cobra, although they tend to deliver much less venom. In most species the delivery system is poorly developed and the mouth is small. However, certain species are capable of delivering enough venom to kill 3 adults. Bites may possess as many as 20 fang marks. Four puncture sites, in which teeth may remain in the wound, are more common.^[3]

The venom is a heat-stable, nonenzymatic protein that blocks the effects of acetylcholine. Of interest, only 25% of victims will develop symptoms after a bite, which may occur 10 minutes to several hours after the injury.^[3]

Symptoms -- Mild:

- Euphoria;
- Anxiety;
- Restlessness;
- Thirst;
- Swelling of tongue;
- Nausea and vomiting;
- Weakness;
- Stiffness; and
- Muscle ache.^[3]

Symptoms -- Severe:

- Paralysis (ascending or spreading from bite);
- Trismus;
- Ptosis;
- Facial and ocular palsies;
- Speech and swallowing pathology;
- Respiratory distress;
- Cardiac failure;
- Convulsions; and
- Coma.^[3]

Treatment:

- Place a wide-pressure dressing over the bite, applying the same pressure as used for treating a sprain. The dressing should then extend proximally to distally.
- Immobilize the limb.
- Exertion is to be avoided.
- Local excisions and suction should be avoided.

- Monitor for any cardiac, pulmonary, renal, fluid, and electrolyte abnormalities.
- If possible, the snake should be killed and obtained for identification.
- Upon arrival to the treatment facility, the pressure dressing should be removed prior to administering antivenom.
- Sea snake venom should be used cautiously and administered in strict accordance to guidelines by the CSL of Australia.
- Preparation for anaphylactic shock should be immediately available.
- If land snake antivenom is to be used, then the tiger snake type is preferred.
- Victims should be hospitalized for 24 hours.^[3,4]

Cone Shells

These mollusks are sought after for their beautiful shells. They are a common collector's item and are found worldwide. Of the 400 species, 8 are lethal for humans.^[4] Many of the other species can deliver a painful sting.^[2] Stings commonly occur during handling of the shells.

They are carnivorous predators and use a highly developed venom delivery system for hunting and defense.^[4] They possess an extendable proboscis from the narrow end of the shell that can reach most of the surface of the shell. The proboscis has 1-10 teeth, which penetrate and inject the venom. Mortality may be as high as 25%.^[3]

The venom is composed of 2 substances, one that interferes with neuromuscular activity, resulting in sustained muscular contraction, and the other abolishes the excitability of the muscle fiber.^[3] If a sting occurs while diving, even by a nonlethal species, death can occur by drowning.

Symptoms:

- Pain at the site is noted immediately;
- Swelling;
- Erythema;
- Peripheral cyanosis;
- Nausea;
- Sensory numbness and parathesias may ascend to involve the entire body as rapidly as 10 minutes;
- Motor incoordination and paralysis;
- Loss of deep tendon reflexes;

- Aphonia;
- Dysphagia;
- Diplopia;
- Blurred vision;
- Coma;
- Respiratory failure; and
- Cardiac failure.^[3,4]

Treatment:

- Apply a pressure bandage over the wound;
- Immobilize the limb;
- Monitor and treat for cardiopulmonary failure;
- The use of neostigmine may prove beneficial to block the neurotoxin; and
- Recovery is slow and may take weeks.^[3,4]

Fish

There are over 200 species of venomous fish.^[3] They commonly inhabit shallow waters, especially around reefs. Common offenders include lionfish (zebra fish), scorpion fish, stonefish, catfish, and stingrays. Popular additions to marine aquariums include scorpion fish and lionfish (zebra fish).

Venomous fish possess spines and a venom delivery system that are used for both protection and for incapacitating prey.^[2,3] The venom is composed of proteins and polysaccharides of various sizes. The venom is unstable and is rapidly destroyed by heat.^[8] After penetration by the venomous spine, there is immediate and intense pain that radiates along the course of the lymphatics. The puncture site is often anesthetic, but surrounding tissue becomes swollen, discolored, and even gangrenous.^[2,3] The pain may last for 16-24 hours.^[2]

Of the venomous fish, stonefish are perhaps the most dangerous because their venom has been compared to that of the cobra.^[5] They are found in the Indo-Pacific regions.

Stonefish may grow to 30 cm in length and possess 13 dorsal spines that are extremely strong and covered by loose skin. When pressure is applied over the spines, 2 venom glands discharge through ducts. The venom causes intense vasoconstriction and thus remains localized. The venom is heat-labile and is destroyed at 50°C in 2 minutes or by alkalis or acids (pH greater than 9 or less than 4). The venom is a myotoxin that acts on skeletal, involuntary, and cardiac muscle by blocking conduction, which may result in cardiorespiratory collapse and paralysis. The venom can be neutralized by antivenom from the Australian CSL.^[3]

Symptoms:

- Nausea and vomiting;

- Diarrhea;
- Hypotension;
- Delirium;
- Diaphoresis;
- Fever;
- Leukocytosis;
- Respiratory distress;
- Cardiovascular collapse;
- Convulsions; and
- Death.^[3]

Treatment:

- Elevate the limb;
- Immerse in hot water (45°C) for 30-90 minutes;
- Thoroughly wash and irrigate the wound;
- Local anesthesia or regional block may be warranted prior to exploring the wound for broken spines;
- Systemic analgesics;
- Topical antibiotics;
- Tetanus prophylaxis; and
- Healing may take weeks to months.^[3]

Treatment for Stonefish:

- Use the above protocol. Topical application of a weak solution of potassium permanganate.
- Local injection of hyoscine *N*-butylbromide may provide relief if infiltrated in the first 15 minutes.
- Two milliliters of stonefish antivenom are given intramuscularly (1 mL neutralizes 10 mg of venom, which is the amount released from each spine). The antivenom can be administered IV in severe cases.

- Culture both aerobes and anaerobes for any signs of infection.
- Convalescence from a stonefish sting may take months.^[3,4,5,8]

Acknowledgements

Special thanks to Capt. Robert Hoyt, MD, US Navy, and Peggy Harris, biologist.

References

1. Lehane L, Rawlin G. Topically acquired bacterial zoonoses from fish: a review. *Med J Aust.* 2000;173:256-259.
2. Scharf M, Daly J. *Fitzpatrick's Dermatology in General Medicine*. 5th ed. New York: McGraw-Hill; 1999.
3. Edmonds C, Lowry C, Pennefather J. *Diving and Subaquatic Medicine*. 3rd ed. Oxford, United Kingdom: Butterworth & Heinemann; 1992.
4. Hunter GW, Strickland GT. *Hunter's Tropical Medicine and Emerging Infectious Diseases*. 8th ed. Philadelphia, Pa: WB Saunders; 2000.
5. Semadeni B. Marine envenomations. *Utox Update*. Salt Lake City, Utah: Utah Poison Control Center for Health Care Professionals. 2001;3:1-4. Available at: http://uuhsc.utah.edu/poison/healthpros/utox/Vol3_No2.pdf. Accessed August 16, 2005.
6. Landow K. Best treatment of jellyfish stings? *Postgrad Med.* 2000;107:1-2.
7. Hickman HP, Roberts LS, Larson A. *Animal Diversity*. 2nd ed. Dubuque, Iowa: McGraw-Hill; 2000.
8. Auerbach PS. Marine life trauma. *Divers Alert Network*. Available at: <http://www.diversalertnetwork.org/medical/articles/article.asp?articleid=10>. Accessed August 10, 2005.
9. International Consortium of Jellyfish Stings. *Jellyfish sting newsletter*. College Park, Md: University of Maryland; 2003:29.

Authors and Disclosures

As an organization accredited by the ACCME, Medscape requires everyone who is in a position to control the content of an education activity to disclose all relevant financial relationships with any commercial interest. The ACCME defines "relevant financial relationships" as "financial relationships in any amount, occurring within the past 12 months, that create a conflict of interest."

Medscape encourages Authors to identify investigational products or off-label uses of products regulated by the U.S. Food and Drug Administration, at first mention and where appropriate in the content.

Author

Thomas P. Brown, DO

Contract Physician, Naval Hospital, Pensacola, Florida
docbrown14@mchsi.com

Disclosure: Thomas P. Brown, DO, has disclosed no relevant financial relationships.

CME Author

Charles P Vega, MD



Associate Professor, Residency Director, Department of Family
Medicine, University of California, Irvine

Disclosure: Charles Vega, MD, FAAFP, has disclosed that he has
received grants for educational activities from Pfizer.