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Florida Related Injuries and Illnesses...

SPECIAL CME ISSUE
3 FREE HOURS

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MARINE ENVENOMATIONS

Common Florida Injuries

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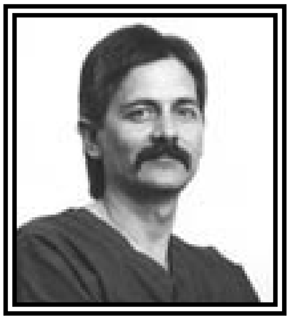

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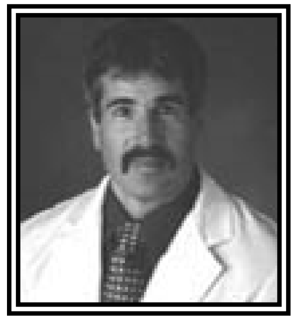


EDUCATIONAL OBJECTIVES:

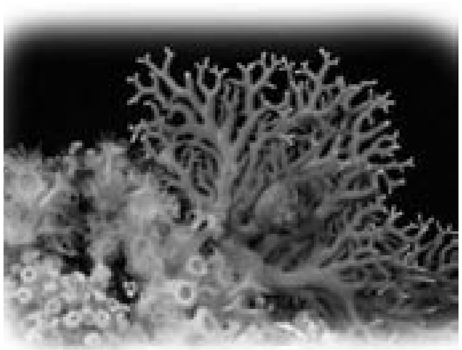
At the completion of this section, the reader will be able to:

1. Describe the differing and novel m echanisms of marine envenomations.
2. Describe the most common signs and symptoms of marine invertebrate envenomations.
3. Describe the most common signs and symptoms of marine vertebrate envenomations.
4. Explain the basic treatment recommendations for marine envenomations

The sea can be a dangerous place.

There are thousands of species of stinging animal life in the ocean, and thousands of people are envenomed each year along the coast of Florida. Although deaths from these envenomations are uncommon, an appreciation of the venoms and their injection mechanisms, as well as knowledge of appropriate treatment regiments for specific stings, is important for all providers in the emergency medicine community.

In this article, we will identify the common stinging offenders found in Florida's waters, discuss the differing and novel mechanisms of envenomation, describe the effects of the various toxins involved, review the usual symptomatology of envenomed victims, and offer recommendations for treatment.



The scope of this discussion will be limited to the common stingers within the Cnidaria phylum of envenoming invertebrates, e.g., Portuguese man-of-war and various jellyfish, and to the very common stingray and catfish envenomations that are representative of numerous venom-capable vertebrate species.

[We will not, therefore, review the less commonly encountered injuries from other invertebrate phyla, i.e., Mollusca (cone shells, octopuses), Annelida (fireworms), Porifera (sponges), or Echinodermata (starfish, sea urchins, sea cucumbers). Discussion of other vertebrate stingers, e.g., scorpionfish, lionfish, stonefish, and sea snakes, will be reserved for a future time, since their victims are also less commonly seen in Florida's emergency departments.]

INVERTEBRATES

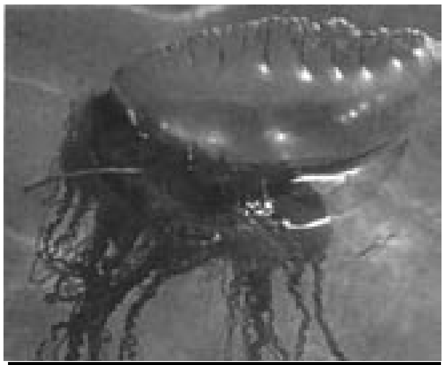
There are approximately 9000 species within the invertebrate phylum Cnidaria, but only about 100 of these are dangerous to humans.[1] Also known as Coelenterata, the phylum is divided into four major classes, the first three of which will be discussed:

- Hydrozoa, such as Portuguese man-of-war and fire coral
- Cubozoa, such as the potentially deadly "box jellyfish"
- Scyphozoa,true jellyfish
- Anthozoa, such as sea anemones

These animals are predators, feeding on crustaceans, mollusks, and fish, stinging both to capture prey and as a defense mechanism. Tiny capsules (cnidae), each with a single, compressed, and folded injection tubule, lie ready to fire with incredible relative speed and force when stimulated. In the jellyfish and Portuguese man-of-war, these cnidae organelles are called nematocysts.

Hydrozoa

The Atlantic Portuguese man-of-war (Physalia physalis) is topped by a free swimming, surface inhabiting float (the main body), with a series of tentacles that may reach 100 feet in length and carry millions of stinging nematocysts. While confirmed deaths from Physalia envenomations are rare, some have been reported[2], and the pain of significant envenomations has brought many to tears. Detached, moistened tentacles



The Atlantic Portuguese man-of-war*

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that wash up near a beach are capable of administering their venom for months.

The prominent blue or purple gas-filled float (which contains up to eight percent carbon monoxide[3]) carries an erectile sailing crest. Onshore winds commonly blow large numbers of the animals up onto beaches. However, since there are both left- and right-handed colonies, allowing sailing at 40-degree angles to the left or right of the wind direction, not all in a colony will be blown up onto the beach.

Cubozoa

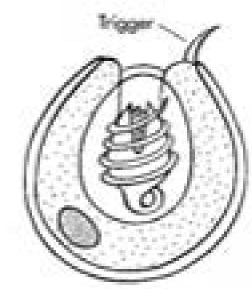
This class includes the marine world's most toxic species, Chironex fleckeri (Australian "box jellyfish"), Carukia barnesi (small but deadly Irukandji, also found in Australian waters), and the apple-sized "sea wasp" (Chiropsalmus quadrigatus). Until recently, the sea wasp was said to not be present along American shores. However, an unexplained summer, 2002 sea wasp invasion along Florida's east coast sent hundreds of beachgoers to hospital emergency departments. No deaths were reported from this invasion, and the creatures disappeared from coastal waters after tormenting swimmers and surfers for approximately 10 weeks (personal experience, ARS).

Scyphozoa

The true jellyfish (Chrysaora and Cyanea species) are responsible for the most Cnidaria envenomations. While the morbidity caused by stings from these creatures is generally less than that resulting from Cubozoa or Hydrozoa envenomations, there are tens of thousands of jellyfish stings along Florida's coastline each year. In addition, another common envenomation syndrome seen in emergency departments is "sea bather's eruption," a burning pruritic dermatitis caused by the 0.5 mm larval form of Linuche unguiculata, the thimble jellyfish. These creatures are commonly misnomered "sea lice."

Mechanism of envenomation:

Cnidaria species are blessed with sophisticated injection tools. Millions of nematocysts in small individual cells (nematocytes) are generally found on the

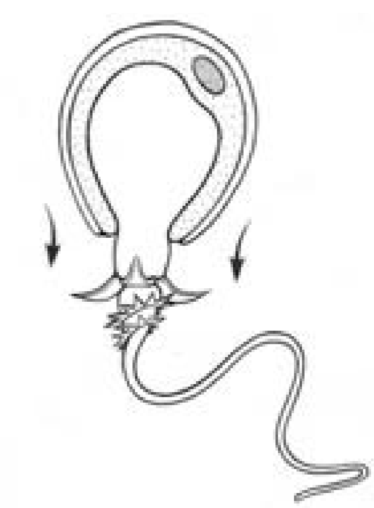


Nematocyst prior to discharge*

outer surfaces of the tentacles or near the mouths of the animals. Each nematocyst is approximately 50 microns in size, and each is capable of discharging just once, after which it is replaced by a new cell). The huge number of stinging cells more than compensates for any disadvantage presented by the small size of each nematocyst.

A complex series of stimuli and feedback mechanisms that control the firing of the nematocysts is becoming better understood. Nematocyst discharge to envenom prey or fend off a threat is promoted by physical contact as well as by certain chemical or protein cues. Avoiding "inappropriate" discharges, such as when a tentacle touches sand, another tentacle, or the jellyfish body itself, allows preservation of the nematocysts and is controlled by various feedback or inhibitory mechanisms, including sensory nerve cells.

The nematocysts fire with an initial acceleration of 40,000 times gravity, propelled by tension within the collagenous capsule walls and by a resting osmotic pressure of 150 barr. The acceleration and rapidity of the firing motion of these organelles make it one of the fastest natural biological events.



Nematocyst after discharge occurs *

Nematocysts fire and discharge by eversion, turning inside out as the venom-laden tubule leaves the capsule. Spines on the tubule anchor it to the victim, and venom is delivered into the injured party.

The venom:

The venom is viscous, delivered into the upper dermis, and can then enter the general circulation. The active portion of the venom is comprised of a complex mixture of polypeptides and protein molecules, and as such can be destroyed by heat, ethanol, or drying. The damage inflicted by the venom includes effects created by catecholamines, histamines, phospholipases, fibrolysins, kinins, and several cardiotoxic, dermatonecrotic, and hemolytic components.

In serious stings by adult jellyfish, detectable human blood levels of the venom can be found within minutes.

Signs and symptoms:

Although one should always be wary of the possibility for anaphylaxis and cardiopulmonary collapse, particularly in elder victims with previous sensitization to venom antigens, these complications are rare from Cnidaria envenomations in North American waters. However, dozens of victims have died near Australia over the years from box jellyfish or Irukandji stings.

The most common reactions to stings in Florida waters are localized skin symptoms. A "tentacle print" is frequently visible, with lines or cross-hatchings of darkened red, brown, or purple, representing the precise areas of skin contacted by the tentacles.

Instantaneous burning, redness, and urticaria are common early symptoms, and may be the only symptoms. Progression to papules, vesicles (with or without hemorrhagic signs), and even skin necrosis may follow over hours to days in victims with more severe reactions. Subcutaneous fat atrophy can occur, and hyperpigmentation that persists for months or longer is common with more severe injuries.

An estimated one-half of the summer, 2002 sea wasp victims along Florida's east coast developed vesicular rashes, and many sustained hyperpigmentation changes that have persisted to this day.

Treatment recommendations:
Treatment begins with attention to the ABCs, with appropriate treatment measures undertaken immediately when more severe reactions are apparent. Be vigilant for signs and symptoms of anaphylaxis, and manage the victim accordingly.

With stings that occur in Floridian waters, first aid for the jellyfish victim should begin with removal of the person from the water to prevent further stings, and removal of any visible tentacles adherent to the skin (by metal instrument or double-gloved hand). Then, either five percent acetic acid (vinegar, the preferred decontaminant) or isopropyl alcohol should be applied to the affected areas for at least 30 minutes. Any attached nematocysts are thereby deactivated, and ongoing envenomation is minimized. Other detoxicants reported as possibly effective include household ammonia, papain (such as unseasoned meat tenderizer, and sodium bicarbonate (baking soda), but none are preferable to vinegar. Gentle application of fresh water should never be used on a jellyfish sting, since it may stimulate any remaining nematocysts to discharge. Some lifeguards report pain relief if a forceful jet of water is used to physically dislodge adherent tentacles.

After pain relief has been sustained from the topical decontaminant, any remaining tentacle fragments should be removed. This is particularly true in Portuguese man-of-war injuries, as several feet of tentacles may be adherent to the skin, and additional envenomation may occur if they are not removed.

Two common methods of tentacle fragment removal are application of a layer of shaving foam followed by gentle shaving of the area, and application of talcum ("baby") powder to the vinegar-moistened skin, forming a layer of wet powder, which is then removed by gentle scraping with a wooden tongue depressor.

Application of topical steroids or administration of oral antihistamines often diminishes the pruritis and inflammatory changes that develop hours or days after a sting. More significant reactions, such as urticaria and angioedema, may benefit from systemic steroid administration .

Sheep-derived antivenom, widely available in Australia for stings of Chironex fleckeri, can be obtained in America from entities such as Sea World. However, the victims that die of Australian box jellyfish or Irukandji envenomations often do so within minutes, before initiation of any treatment can be begun[4].

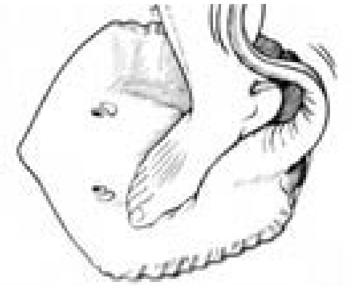
"Safe Sea Jellyfish Safe Sun Block" (Nidaria Technology Ltd.) is a recent commercial product. It shows promise as a truly effective "sting inhibitor" when applied to human skin prior to jellyfish tentacle contact. Studies using sea wasp (and other species') tentacles on volunteers' forearms revealed a decrease in the number and severity of stings on skin protected with the lotion (unpublished data). The product, which reportedly interferes with the recognition and feedback pathways that affect the discharge of the nematocysts, is available commercially [5].

VERTEBRATES
The two marine vertebrates that commonly envenom people in Florida are stingrays and catfish.

Stingray
Stingrays are bottom dwelling, flat-bodied creatures with tail-like caudal appendages, upon which reside venom carrying cartilaginous spines. Of the seven species inhabiting the Atlantic Ocean, the southern stingray, Dasyatis americana, is the most common along the Florida coasts, and usually exists in shallow intertidal waters. Commonly encountered in bays and estuaries, it

often lies buried in the sand, with only its eyes and spiracles exposed. The smaller males generally grow to a disc width of less than 2.5 feet, whereas females may attain a disc width of nearly six feet.

With one to four venomous stinging spines on the dorsum of a whip-like tail, the stingray envenoms its victim by accurately whipping the tail upward toward a perceived threat, thrusting a spine(s) into the victim. In addition to



The stingray tail whips upward, puncturing the victim*

the injection of venom, a jagged laceration or deep puncture wound often results, because the force of the spine delivery is substantial.

Mechanism of envenomation:
The barbed spine, with its enveloping integumentary sheath and venom glands, lies flat against the creature's tail and is bathed in mucus and venom[6]. The retroussé (backwards-pointing) barbs, located at the base of the long, whip-like tail, may reach several centimeters in length, and may be delivered with force sufficient to penetrate a rubber boot.

A stingray spine tip embedded in the heel*

Stingrays are not aggressive, but react swiftly if frightened or threatened. During a strike, the tip of the spine pierces the integumentary sheath, while it lacerates the victim's skin, thereby delivering the venom.

The venom:
Stingray venom induces significant pain, while it has a powerful tissue necrosing action,. Certain protein components of the venom are believed to be thermolabile.

Signs and symptoms:
Instant – often severe – pain occurs following a puncture wound. In addition, systemic symptoms, such as nausea, vomiting, diarrhea, muscle cramps and fasciculations, hypotension, and syncope, may occur. Since the lacerations and punctures may be deep wounds, virtually any internal organ can be injured, and infections are a common threat.

Treatment recommendations:
After managing the ABCs, pain control, wound care, and infection prevention are the mainstays of treatment.

Immediate immersion of the affected area in hot water (preferably 110-115°F) to tolerance may provide pain relief. Local infiltration or a nerve block with lidocaine or bupivacaine may be useful, and parenteral anlagesics may be needed.

Meticulous assessment of damaged tissue and excellent would care are necessary to avoid subsequent complications and infections. Administration of prophylactic antibiotics that expand coverage to include Vibrio species should be considered for deep wounds and in persons suffering from any form of immunosuppression.

Catfish
Catfish, named for their harmless sensory "whiskers," are common in all waters in Florida. Puncture wounds and envenomations are common among fishermen, and sometimes also occur in beachwalkers, when they accidentally step upon a dead catfish.

Mechanism of envenomation:
Catfish sleep with their three protective spines locked in the upright position. When threatened, they also lock the dorsal and bilateral pectoral fins in place. When the retroussé spine's integumentary sheath is ruptured and the serrated barb is inserted into the skin, compressed venom glands rupture to release their venom.

The venom:
The concoction of proteins possesses hemolytic, dermatonecrotic, and vasospastic properties. Like stingray venom, some of the proteins appear to be heat-labile.

Signs and symptoms:
The immediate, intense, burning pain is similar to that caused by stingray venom. In addition, systemic effects, such as local muscle spasm and fasciculations, may occur. The punctures and tears may injure various soft tissues and organs. Retained spines are not uncommon.

Treatment recommendations:
Symptom relief (hot water immersion and local and/or systemic analgesia), wound care, and infection prevention for catfish injuries and envenomations are similar to those for stingray injuries. Determination of a foreign body and the necessity for its removal are guided by x-rays, and when necessary, adjunctive tests such as MRI.

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