



University of California  
San Francisco



ZUCKERBERG  
SAN FRANCISCO GENERAL  
Hospital and Trauma Center

# Marine Envenomations

## *Osher Mini-Med School*

Daniel Repplinger, MD  
Assistant Clinical Professor  
UCSF School of Medicine  
Department of Emergency Medicine  
Zuckerberg San Francisco General Hospital

5/10/17

# Financial Disclosures

- None



# Objectives

Learn about marine creatures that can envenomate

- Invertebrates
- Vertebrates
  
- We won't be covering marine food poisoning
  - Ciguatoxin
  - Scombroid
  - Bad sushi, etc

# Objectives

For each:

- Discuss the clinical presentations
- Learn about potential treatment modalities
- This is a BIG topic
  - But we'll try to provide a general overview

# Invertebrates

What we'll cover:

- Cnidaria
  - “Jellyfish”
- Mollusca
  - Gastropoda: e.g. cone snails
  - Cephalopoda: e.g. octopi
- Sponges and Urchins

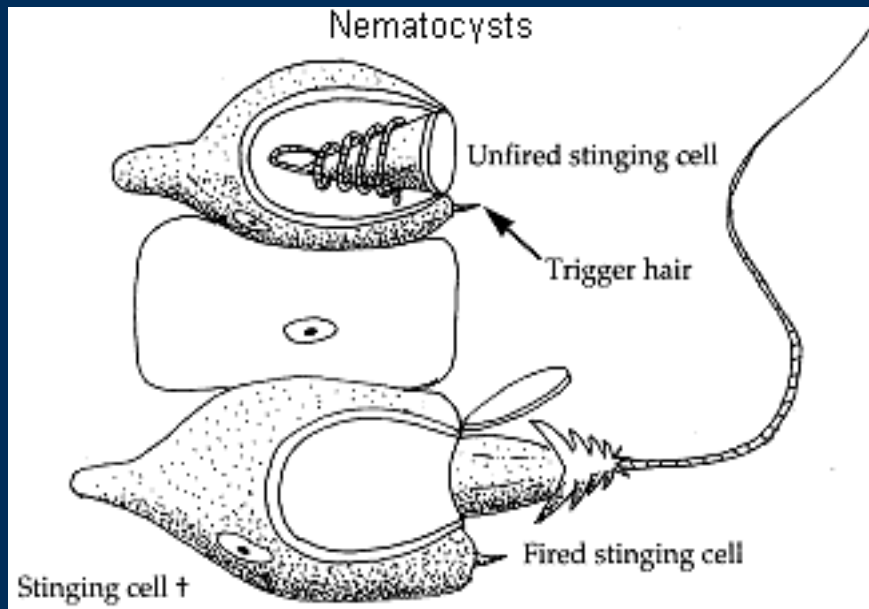


<http://www.resus.com.au/2015/02/22/box-jellyfish-stings-to-vinegar-or-not-to-vinegar/>

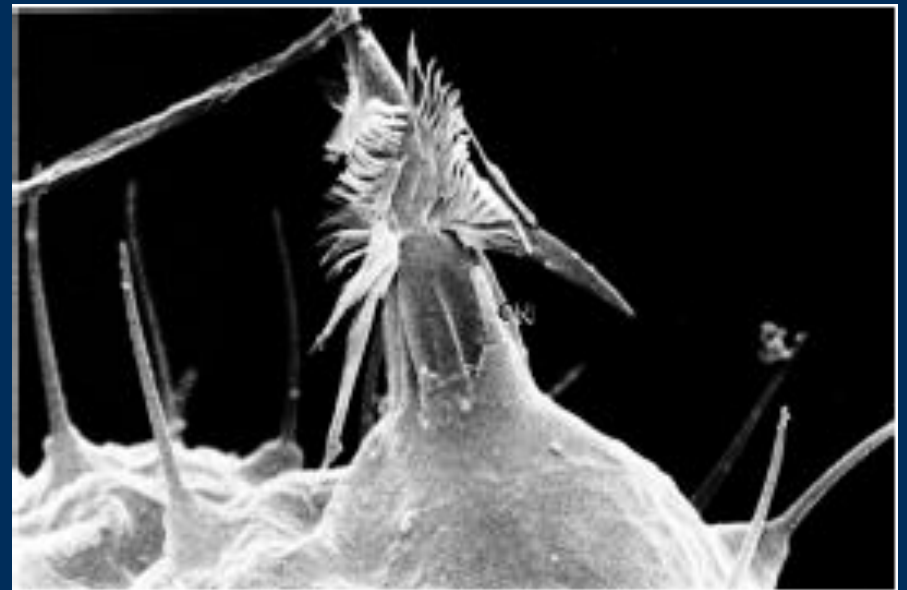
# Phylum: Cnidaria

## Jellyfish

- Over 9000 species known
  - ~100 known to cause injury to humans
- Mechanism:
  - Nematocysts along tentacles contain cnidae
  - Cnidae are organelles made of hollow barbed thread bathed in venom
  - Discharge in response to pressure/osmotic changes



<http://seorank.info/viewgallery/191215.htm>

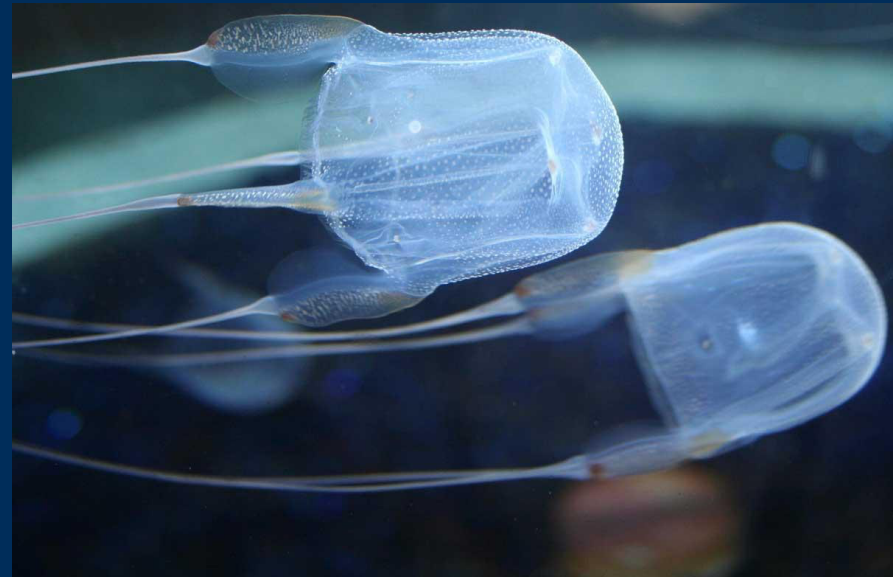


<https://en.wikipedia.org/wiki/Cnidocyte>

# Class: Cubozoa

## Not “true” jellyfish

- Characterized by a “cube-shaped” bell with four corners
  - Each corner with 1-15 tentacles
- This class produces the most morbidity/mortality of all Cnidaria

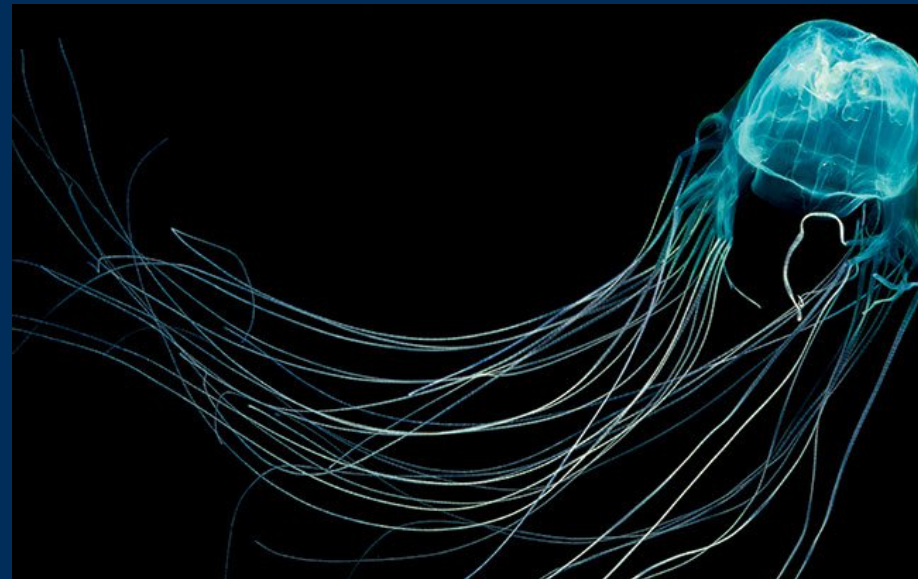


<https://www.studyblue.com/notes/note/n/chapter-33-invertebrates/deck/8032535>

# Box Jellyfish

## *Chironex fleckeri*

- Latin for, “assassin’s hand”
- Pale blue in color
  - Very difficult to detect in the water
- Bell grows to 25-30 cm in diameter
- 15 tentacles at each corner



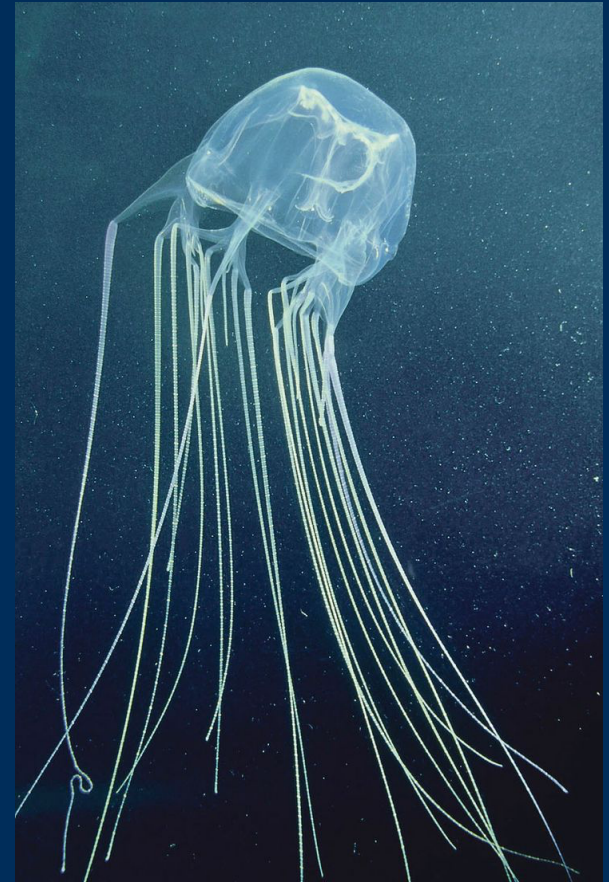
<http://www.menshealth.com/guy-wisdom/death-by-jellyfish>



# Box Jellyfish

## Venom

- Cardiovascular effects
  - Blood pressure elevation (transient)
  - Then hypotension and cardiovascular collapse
- Dermatonecrosis (skin death)
- Hemolysis (breakdown of blood cells)
- Myotoxins (muscle damage)
  
- Bad.



<https://www.pinterest.com/pin/390335492675950945/>

# Box Jellyfish

## Clinical Presentation

- Local effects
  - Severe pain
  - Whip-like linear rash (“frosted ladder”)



<http://fish.mlbcardvalue.com/box-jellyfish-stings-pictures/>



<https://local-brookings.k12.sd.us/krsience/zoology/webpage%20projects/sp11webprojects/boxjellyfish/boxjellyfish.htm>

# Box Jellyfish

## Clinical Presentation: Systemic Effects

- Nausea, vomiting, muscle spasms, headache, fever and chills
- Severe: paralysis, syncope, respiratory distress, hypotension, dysrhythmia
- Reports of patients dying in a few minutes



<http://rebrn.com/re/box-jellyfish-warning-sign-at-a-beach-in-darwin-northern-austral-73346/>

# Box Jellyfish

## Treatment

- Deactivate nematocysts with vinegar
- Scrape the remaining ones off with shaving cream and credit card
- Antivenom to *Chironex fleckeri*
  - Unclear if there is any real benefit
  - Possibly reduces pain



<http://www.fleabitesonhuman.com/treating-flea-bites-with-vinegar/>

# Irukandji Jellyfish

## *Carukia barnesi*

- Tiny but fierce – Up to 2.5cm bell
- Mechanism:
  - Catacholamine release
  - Epinephrine, norepinephrine, dopamine



<http://irukandjijellyfish.com>

# Irukandji Jellyfish

## Irukandji Syndrome

- NO skin findings!
- Severe systemic symptoms within 30 minutes
- Tachycardia, palpitations, hyperpnea, headache, pallor, restlessness, apprehension
- Whole body muscle spasms
- Hypertension
- Myocardial depression and hypotension



# Irukandji Jellyfish

## Treatment

- Same as with box jellyfish
  - Vinegar, remove nematocysts by scraping
  - Difficult to know where to apply/scrape if no skin findings and minimal localized pain
- Get to a hospital!
  - Most will need intravenous medications
  - Control pain, muscle spasms, and blood pressure



<http://irukandjjellyfish.com>



<http://www.abc.net.au/news/2016-03-02/crocodiles-jellyfish-all-in-a-days-work-for-north-qlld-lifeguards/7213458>



“I’m never getting into the ocean  
again.”

-Thinking to myself while preparing this lecture

- Chironex-type box jellyfish fatalities
- Irukandji-type box jellyfish fatalities
- Irukandji-type box jellyfish stings
- Other jellyfish fatalities

Physical Map of the World, April 2005



<http://otlibrary.com/irukandji-sea-jelly/>

# Class: Hydrozoa

Also not “true” jellyfish

- Pelagic (floating) and colonial
  - Exist in a large colony in a formed mass
- Easily recognizable blue “sail”



<http://www.arkive.org/portuguese-man-o-war/physalia-physalis/image-G97501.html>



# Portuguese Man-Of-War

*Physalia Physalis*



<http://www.marlin.ac.uk/species/detail/2093>



<https://www.pinterest.com/explore/portuguese-man-o%27-war/>

# Portuguese Man-Of-War

## Venom and Toxicity

- Similar venom to box jellyfish but less severity of systemic symptoms
- Less likely to cause death
- **Local** - severe pain and skin necrosis
- **Systemic** -headache, muscle spasms, hemolysis, renal failure, shock



<https://chickenmonkeydog.com/calling-front-desk-on-282/>



<http://www.tampabay.com/news/environment/wildlife/man-of-wars-sting-like-a-hot-knife/520573>

# Portuguese Man-Of-War

## Treatment

- Sea Water
- AVOID vinegar
  - May cause nematocyst discharge
- Human urine may be harmful
  - Do NOT pee on your friends



# Phylum: Mollusca



<http://www.australiangeographic.com.au/news/2014/03/cone-snail-pain-drug-is-non-addictive>



<http://marinebio.org/species.asp?id=403>



# Class: Gastropoda

## Cone Snails

- Mostly found in Indo-Pacific waters
- Approximately 400 species
  - 18 known to be venomous



<http://animals.nationalgeographic.com/animals/invertebrates/geographers-cone-snail/>

# Cone Snails

## Mechanism

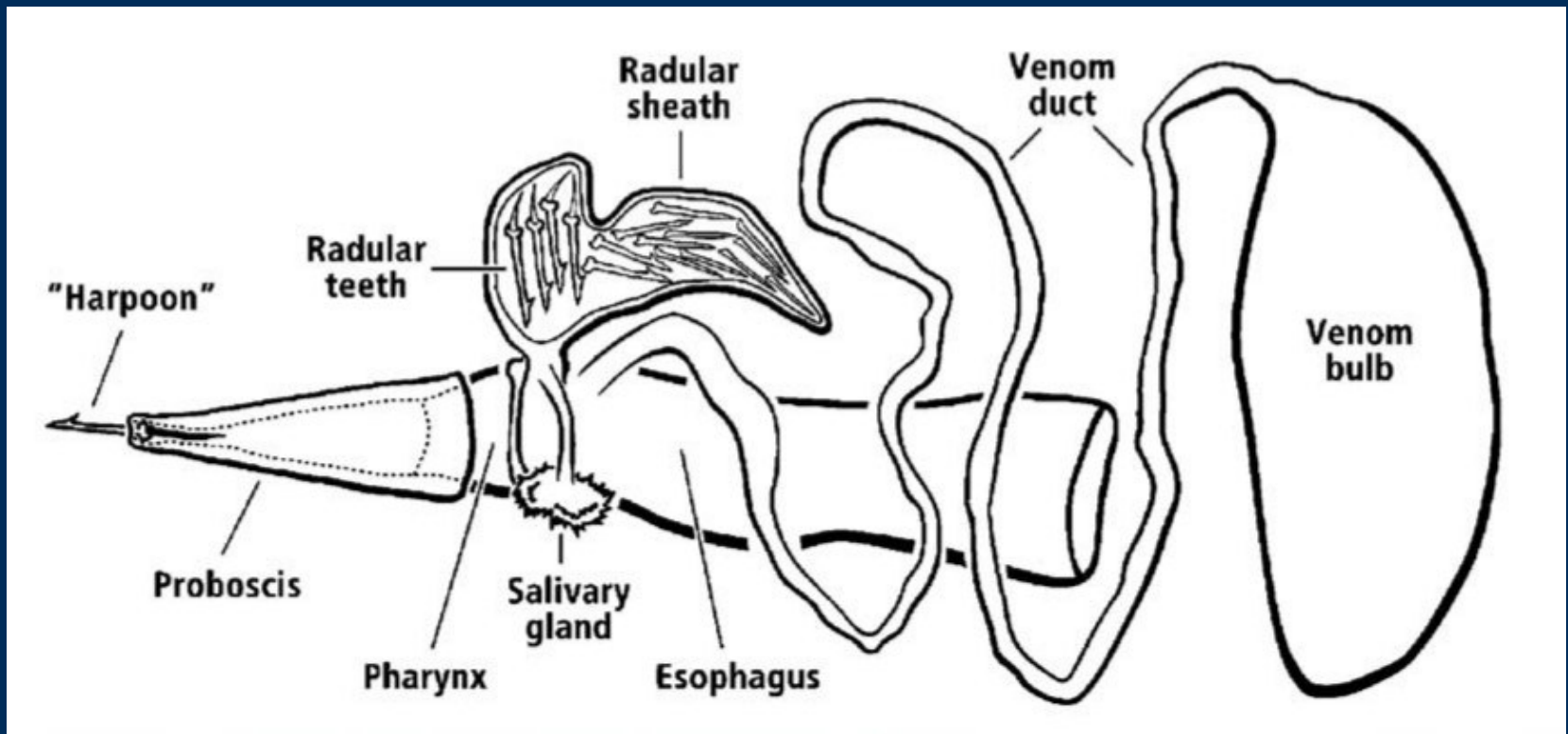
- Hollow proboscis containing a tooth bathed in venom



<http://spacecoastdaily.com/2013/06/cone-snail-venom-effective-remedy-for-pain/>

# Cone Snails

## Mechanism

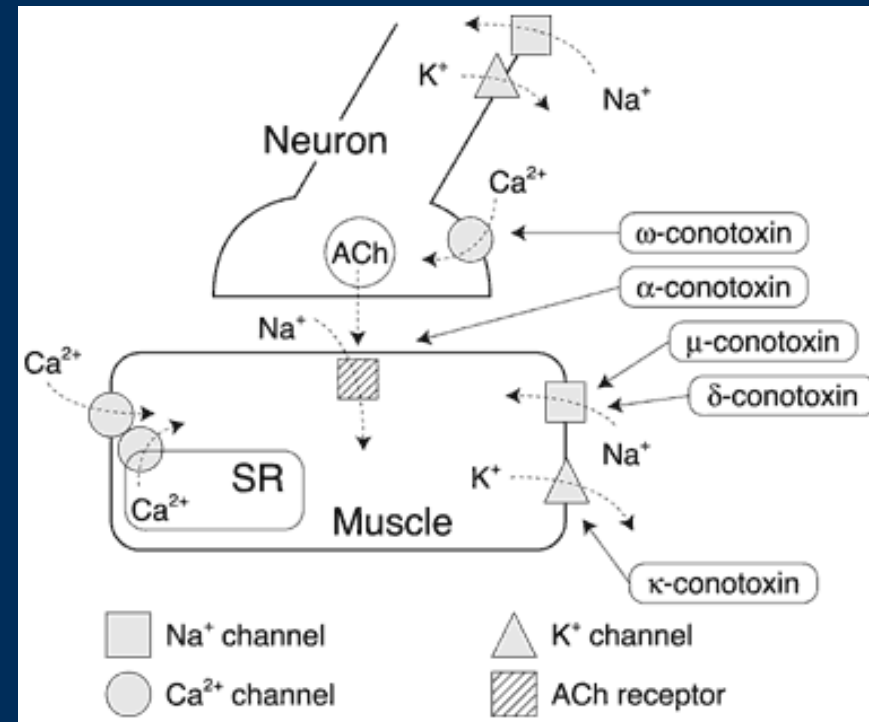


<http://bioteaching.com/the-intricate-world-of-cone-snail-venoms/>

# Cone Snails

## Venom

- Contains over 100 conotoxins
- Most function at the neuromuscular junction



[http://www.dojindo.co.jp/letterj/100/reviews\\_01\\_sub-01.html](http://www.dojindo.co.jp/letterj/100/reviews_01_sub-01.html)

# Cone Snails

## Clinical Presentation

- Local effects
  - Reports range from mild to excruciating pain
- Systemic effects
  - **Weakness, diplopia, muscle paralysis, respiratory failure, coma, cardiovascular collapse**
  - Deaths are reported

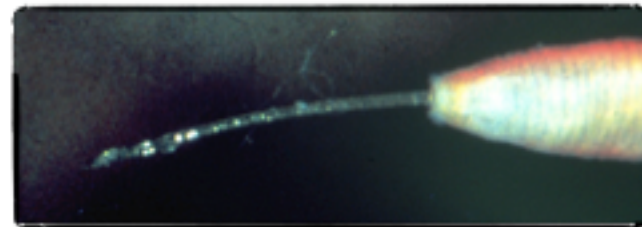
# Cone Snails

## Treatment

- Not much to do
- Supportive care, pain control
- Some reports of hot water improving symptoms



The tip of a harpoon under a microscope.



This is a microscopic view of a harpoon from the end of the proboscis.

<http://www.theconesnail.com/explore-cone-snails/venom>

# Cephalopoda: Blue-Ringed Octopus

## *Hapalochlaena maculosa*

- Found in the Indian and Pacific Oceans
- From Japan down to Australia
- Small but deadly
  - Adults only 5-8 inches



[http://www.slate.com/blogs/wild\\_things/2015/06/23/blue\\_ringed\\_octopus\\_venom\\_causes\\_numbness\\_vomiting\\_suffocation\\_death.html](http://www.slate.com/blogs/wild_things/2015/06/23/blue_ringed_octopus_venom_causes_numbness_vomiting_suffocation_death.html)

# Blue-Ringed Octopus

## Venom

- Contains TETRODOTOXIN
  - Causes paralysis
- Also include a mix of hyaluronidases, serotonin, acetylcholine, histamine, dopamine, tryptamine



<http://www.dailytelegraph.com.au/newslocal/city-east/blueringed-octopus-picked-up-on-shell-by-two-young-children-at-frenchmans-bay-la-perouse/news-story/d681aba3b52c6a5ba4233d5f96a0866f>



# Blue-Ringed Octopus

## Clinical Presentation

- 1-2 puncture wounds from bite site
- Usually minor discomfort, redness, swelling
- Rapid onset of paralysis (10 minutes)
- Recovery in 1-2 days with mechanical ventilation



<https://ferrebeekeeper.wordpress.com/2011/07/12/the-blue-ringed-octopus/>

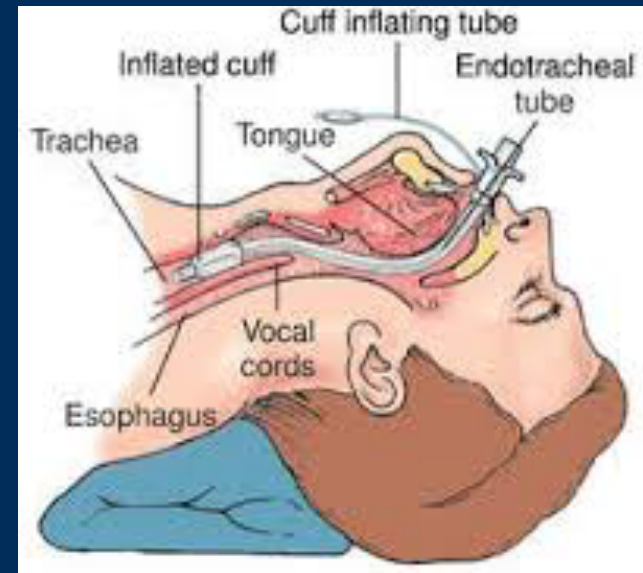
# Blue-Ringed Octopus

## Treatment

- No antidote available
- Supportive care



<https://www.smiths-medical.com/products/airway-management/endotracheal-tubes/cuffed-endotracheal-tubes/endotracheal-tube>



<http://medical-dictionary.thefreedictionary.com/endotracheal+tube>

# Phylum: Porifera and Echinodermata

## Sponges and Sea Urchins



<http://www.snorkelstj.com/volcano-fire-sponge.html>

Fire Sponge  
*Tedania ignis*



<https://jonathanbeam.wordpress.com/tag/uni-butter-pasta/>

Urchins  
*Diademia, Echinothrix,*  
*Asthenosoma))*

# Sponges

## Mechanism

- Elastic skeleton with spicules of silicon dioxide and calcium carbonate
- Clinical Manifestations
  - Pruritic dermatitis
  - Edema
  - Local joint swelling
  - Vesicles



[http://www.scielo.br/scielo.php?script=sci\\_arttext&pid=S0365-05962013000400496](http://www.scielo.br/scielo.php?script=sci_arttext&pid=S0365-05962013000400496)

# Sponges

- Dried sponges are non-toxic
  - Can be toxic with re-wetting up to several years
- Skin findings resolve in 3-7 days
- Treatment:
  - Remove spicules
    - Adhesive tape, credit card scraping
  - Antihistamines/steroids don't work



# Sea Urchins

## Mechanism and Venom

- Covered in spines and pedicellariae
- Venom contains hemolysins, proteases, serotonin, cholinergic-like substances



<http://www.theapricity.com/forum/archive/index.php/t-94584.html>



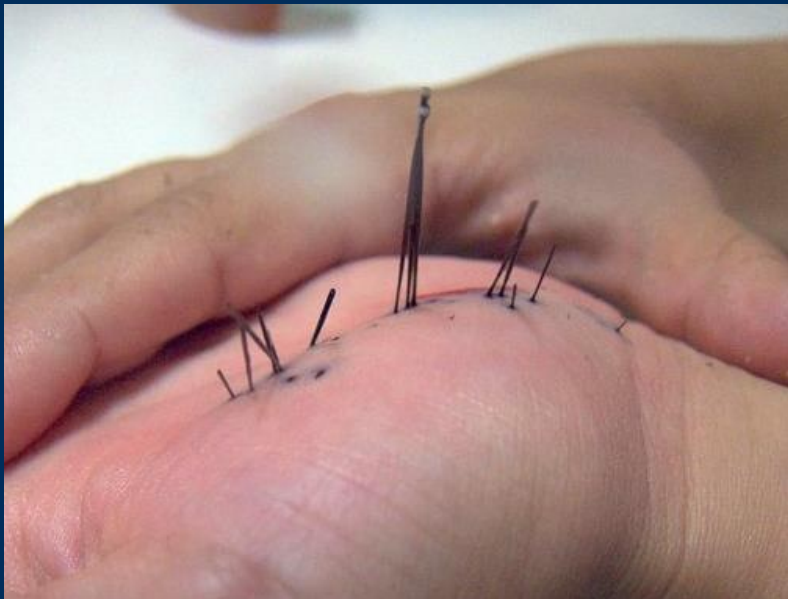
<http://www.microscopy-uk.org.uk/mag/indexmag.html?http://www.microscopy-uk.org.uk/mag/artmay02/urchin2.html>



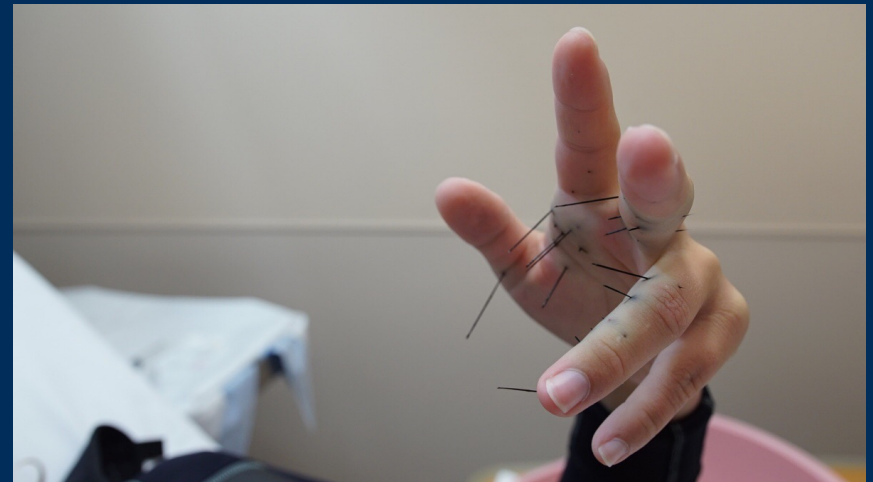
# Sea Urchins

## Clinical Presentation

- Usually a local reaction
- Pain, burning, swelling, redness



<http://www.newhealthguide.org/Sea-Urchin-Sting.html>



[https://www.reddit.com/r/ems/comments/2w5edg/sea\\_urchin\\_spines\\_how\\_would\\_you\\_treat\\_xpost\\_from/](https://www.reddit.com/r/ems/comments/2w5edg/sea_urchin_spines_how_would_you_treat_xpost_from/)

# Sea Urchins

## Treatment

- Remove spines
- Submerge affected area in hot water
- XR to evaluate for foreign bodies

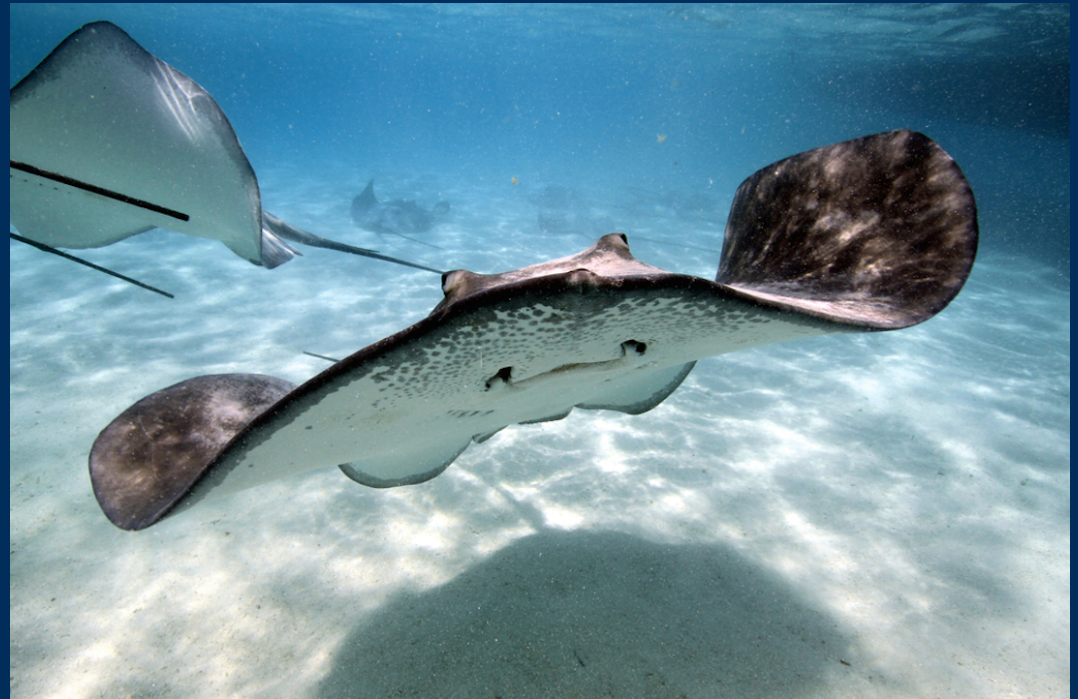


<https://www.flickr.com/photos/janakaruben/3065049259>

# Vertebrates

## Phylum: Chordata

- Stingrays
- Lionfish, stonefish
- Sea snakes

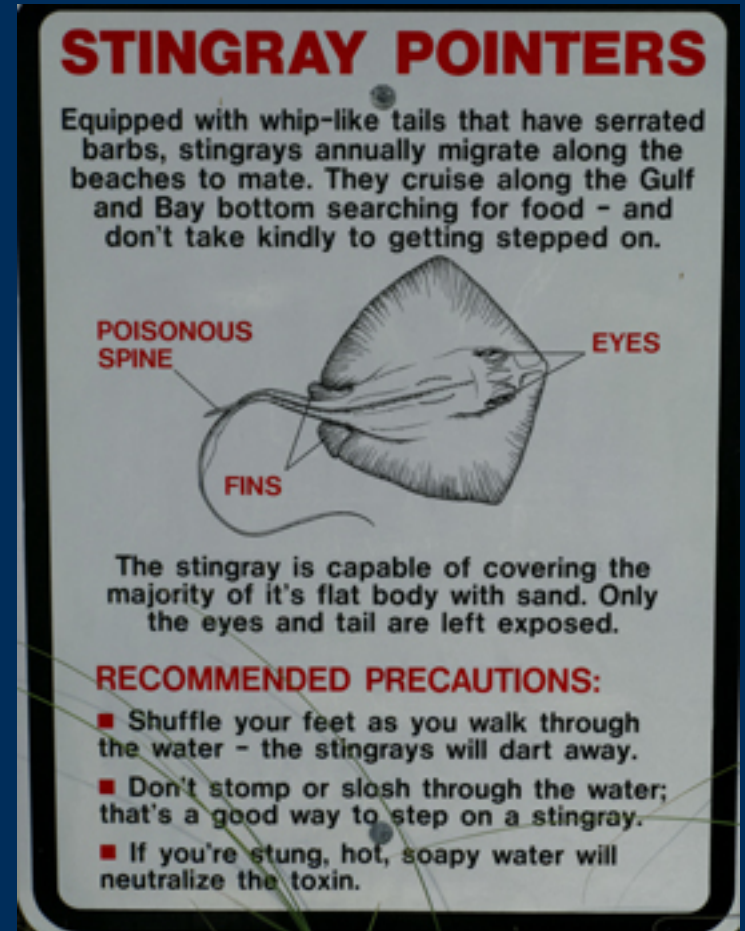


<http://www.grindtv.com/how-to/stingray-stings-can-be-painful-but-are-avoidable-and-treatable/>

# Stingrays

Class: Chondrichthyes

- Venom
  - Phosphodiesterase, 5'-nucleotidase, serotonin
- Mostly **physical trauma** and local tissue damage
- Rarely: nausea, vomiting, diarrhea, vertigo, headache, syncope, seizures, muscle cramps, hypotension



<http://www.florida-beach-lifestyle.com/stingray.html>



# Stingrays

## Mechanism

- Tapered, bilaterally retro-serrated barb
- Reflex tail whip when stepped on
- Penetrating wound from barb
- Deaths from chest/abdominal wounds



<https://www.quora.com/Is-this-a-stingray-sting>



<http://www.deependdining.com/2006/09/delicious-and-deadly-stingray-nyonya.html>

# Stingray Wounds

## Surviving a transfixing cardiac injury caused by a stingray barb

Michael W. Parra, MD,<sup>a</sup> Eugene N. Costantini, MD, FACS,<sup>b</sup> Edgar B. Rodas, MD,<sup>a</sup> Pedro J. Gonzalez, MD,<sup>a</sup> Omar J. Salamen, DDS,<sup>c</sup> Joseph D. Catino, MD,<sup>a</sup> Paul M. Taber, RN, BSN,<sup>a</sup> and Ivan Puente, MD, FACS,<sup>a</sup> Fort Lauderdale, Fla



FIGURE 1. Echocardiogram revealing the transfixing cardiac stingray barb.



FIGURE 2. Diagram depicting the intracardiac course of the stingray barb.



# Steve Irwin (1962-2006)

Struck “hundreds of times” by a large stingray in the Great Barrier Reef



<http://www.independent.co.uk/news/people/steve-irwins-father-sad-and-angry-that-cameraman-disclosed-the-grisly-final-moments-of-his-son-s-10259830.html>

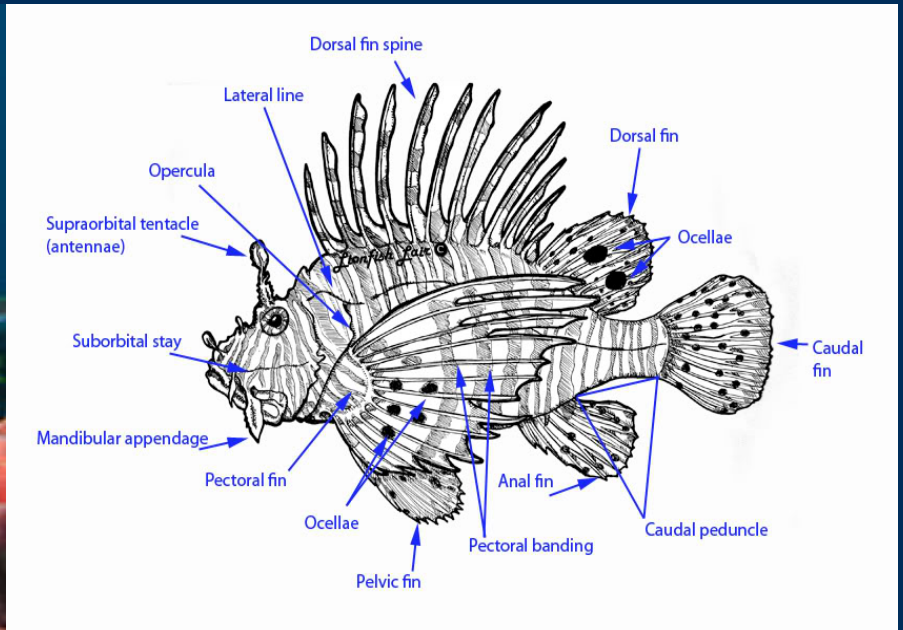
# Lionfish

*Pterois spp.*

- Most common spiny fish envenomation in North America



<https://en.wikipedia.org/wiki/Pterois>



<https://uk.pinterest.com/pin/449937819001358750/>

# Lionfish

## Mechanism and Venom

- Venom
  - Mixture of inflammatory mediators that results in severe burning pain and swelling within seconds
- Rare: abdominal pain, chest pain, hypotension, syncope



<http://fish.mlbcardvalue.com/lionfish-sting/>



<http://www.aquariusredang.com/blog/archives/02-2014>



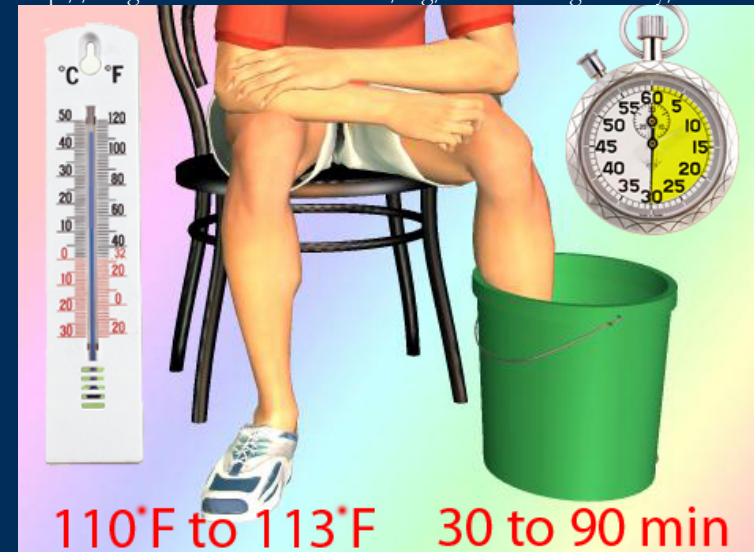
# Lionfish

## Treatment

- Analgesics
- Wound care
  - Tetanus
  - Prophylactic antibiotics
- **Hot water immersion**
  - (110-115°F)
- XR to remove spines



<http://blog.oceancaresolutions.com/tag/lionfish-sting-remedy/>



<http://www.oceansupport.org/lionfish-information>

# Stonefish

Genus: *Synanceia*



<http://www.mnn.com/earth-matters/animals/photos/10-creatures-that-deliver-the-most-painful-stings-and-bites/stonefish>



<http://fishindex.blogspot.com/2008/06/stonefish-most-venomous-fish-in-world.html>

# Stonefish

## Venom

- Stonustoxin (SNTX)
- Verrucotoxin (VTX)
- Trachynilysis (TLY)
- Stable for 24 – 48 hours **after** death of fish



<http://www.theaustralian.com.au/news/nation/sting-operation-nets-scientist-a-life-saving-payoff/news-story/c554f6218fabdf39329b15f553fb9e5f>



# Stonefish

## Clinical Presentation

- Local
  - Severe pain and swelling
- Systemic
  - Headache, seizures, paralysis, respiratory distress, cardiovascular collapse



<http://www.factzoo.com/fish/stonefish-worlds-most-venomous-fish.html>

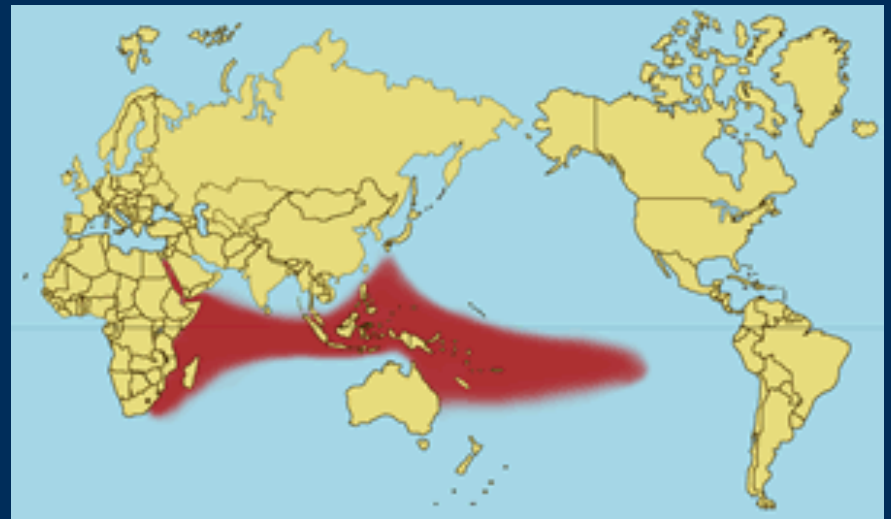


<http://theywillkillyou.com/video/stonefish-sting/>

# Stonefish

## Treatment

- **SAME as LIONFISH + Antivenom**
- Analgesics
- Wound care
  - Tetanus
  - Prophylactic antibiotics
- Hot water immersion
  - (110-115°F)
- XR to remove spines



[http://www.toxinology.com/fusebox.cfm?fuseaction=main.marine\\_vertbrates.display&mode=PrintFriendly&id=MV00116](http://www.toxinology.com/fusebox.cfm?fuseaction=main.marine_vertbrates.display&mode=PrintFriendly&id=MV00116)

# Stonefish

## Antivenom

- Equine-derived
- Fab
- Indications: systemic toxicity or uncontrolled severe pain
- Adverse effects: rash, serum sickness, anaphylaxis
- Not FDA-approved



<https://www.pinterest.com/pin/312085449150670413/>

# Sea Snakes



<http://www.bbc.com/earth/story/20141204-fishing-for-deadly-sea-snakes>



# Sea Snakes

- 52 known species
  - All venomous
- None in the Atlantic
- Mostly in SE Asia
- *Except* the yellow-bellied sea snake
  - Found along the California coast



<http://www.themonitordaily.com/yellow-bellied-sea-snakes/27610/>

# Sea Snake Relatives



<http://www.inquisitr.com/2974237/cobra-bite-kills-indonesian-pop-star-irma-bule-during-concert/>

Cobra



<http://www.factzoo.com/reptiles/krait-likes-water-deadly-bite.html>

Krait



# Sea Snakes

## ▪ Venom and Clinical Presentation

### ▪ Venom

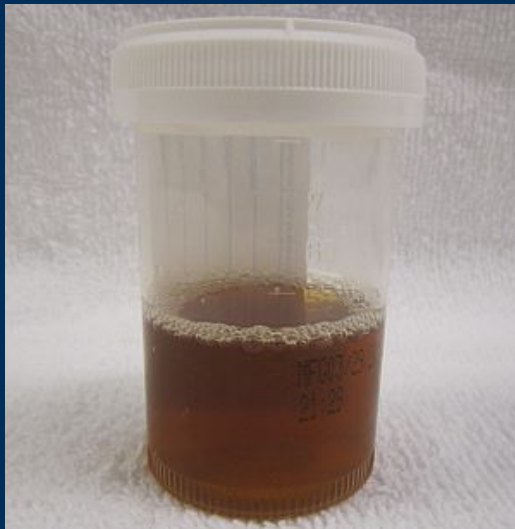
- Neurotoxic
- Myotoxic
- Hemolytic
- Nephrotoxic

- Local reaction minor
- Ascending paralysis
- Aphonia
- Nausea/vomiting
- Fasciculations
- Seizures
- Respiratory failure
- Symptom onset may be **delayed 6 – 8 hours**

# Sea Snakes

## Hallmarks

- Painful muscular rigidity
- Muscle breakdown (rhabdomyolysis)
- Myoglobinuria



<https://en.wikipedia.org/wiki/Myoglobinuria>



<https://lifeinthefastlane.com/unusual-urine-004/>

# Sea Snakes

## Treatment

- Supportive care
- Immobilize limb
- Lymphatic constriction
- Antivenom
  - Horse-derived
  - Not FDA approved
  - Not well studied



[http://www.mesa.edu.au/sea\\_snakes/default.asp](http://www.mesa.edu.au/sea_snakes/default.asp)

# Summary

## What have we learned?

### ■ Jellyfish

- Box jelly: apply vinegar, scrape off nematocysts
- Irukandji: NO skin findings, same as box jelly treatment
- Man-of-War: Sea water, NO vinegar
  - Don't urinate on it

### ■ Cone snails

- May cause severe pain and paralysis
- Hot water may help

# Summary

What have we learned?

- Blue-ringed octopus
  - Venom is tetrodotoxin – causing paralysis
  - Supportive care
- Sponges and urchins
  - Mostly local reactions
  - Remove spicules

# Summary

## What have we learned?

- Stingrays
  - Mostly mechanical trauma from tail
  - Can cause death if penetrating wounds to chest/abdomen
- Lionfish and Stonefish
  - Submerge in hot water for pain relief
  - Stonefish has an antivenom for severe cases
- Sea snakes
  - Muscle breakdown and myoglobinuria
  - Antidote available, but not FDA approved



Questions?

