

# Envenomations

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## Disclosures

- I have no relevant financial relationships with the manufacturers(s) of any commercial products(s) and/or provider of commercial services discussed in this CME activity
- I do intend to mention an unapproved/investigative use of coral snake antivenom which is not FDA approved for routine use yet.

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## **Objectives**

**After participating in this conference, you should have improved your knowledge of, and enhanced your competence to:**

- Provide general information about land stings and marine envenomations.
- Choose the best treatment strategy for your patients with marine envenomation.

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## **Envenomation Turf & Surf**

- Land (Turf)
  - Snakes
  - Arthropods
  - Komodo dragons and their relatives
- Marine (Surf)
  - Jellyfish
  - Fish

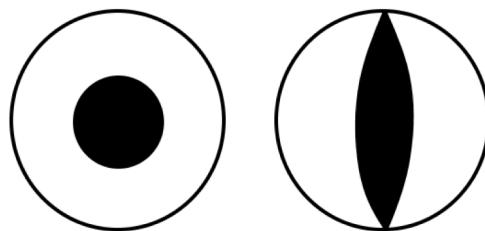
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## **Snakes**

- All scary to me, but toxic or non-toxic?
  - Pupil
  - Triangular head
  - Red, black, yellow
- Copperhead
- Pit vipers
- Coral snake

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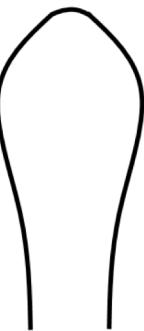
## **Pupil**



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## Triangular head

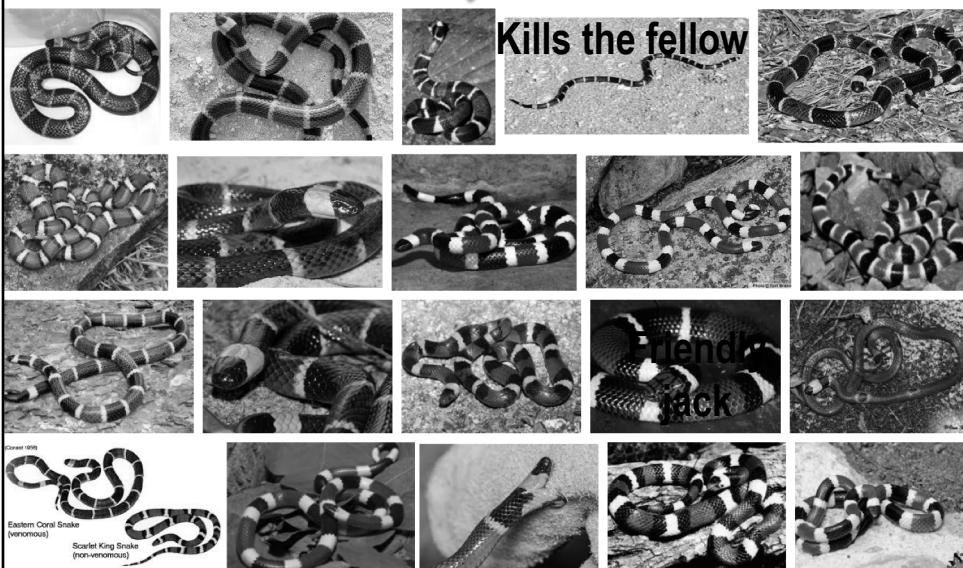
Triangular  
(toxic)  
“747”



Non-  
triangular  
(non-toxic)  
“777”

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## Red on black, venom it lacks



Red on yellow, kills the fellow

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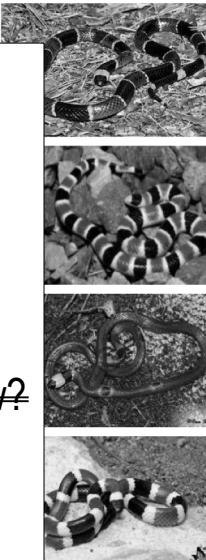
## Red, yellow, black



- Red on black, venom it lacks
- Red on yellow, kills the fellow
- Red on black, friendly Jack
- Red on yellow, friendly fellow
- Red on black, kills the Jack
- ~~Black on yellow kills the fellow?~~
- Yellow on red, you're dead
- ~~Black on red, you're dead~~

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Eastern Coral Snake  
(venomous)  
Scarlet King Snake  
(non-venomous)



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## Basic Snake rules

- Are unreliable
- Must know the snakes in your area
- Pit viper / Rattlesnake
- Copperhead
- Coral snake

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## **Pit viper / Rattlesnake**

- Snake is often surprised and bites in defense
- If you're lucky, it could be a "dry bite" (no venom).
- 25% are dry bites.
- If bite site is swollen, there likely is envenomation.
- Can have systemic envenomation without swelling.
- Treat with anti-venom under the guidance of an expert.

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## **Copperhead**

- Fairly common.
- Less venomous.
- Often not treated.
  - "It's just a bee sting !!"
- Not sure what kind of snake.
- Sometimes treated with anti-venom.

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## **Coral snake**

- Red on yellow, kills the fellow.
- Highly toxic.
- Coral snake anti-venom (still in trials).
- Expert guidance goes without saying.

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## **Venom removal strategies**

Bush SP. **Snakebite suction devices don't remove venom: they just suck.**  
Ann Emerg Med. 2004;43(2):187-188.  
PMID: 14747806

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## **Arthropods**

- Centipedes – painful, slightly venomous
- Scorpions – painful, slightly venomous. Some large ones, more venomous.
- Spiders – Black widow, brown recluse, sometimes serious. Black widow antivenom available, dantrolene; seek toxicology assistance
- Bees, wasps – Painful, slightly venomous, risk of allergic reaction.

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## **Marine envenomations**

- Jellyfish
- Snails
- Fish – venom, toxins

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## **Jellyfish stings**

- Protein toxin – marine toxin, optimized for cold water
- Toxin is typically cardiotoxic or neurotoxic to render prey immobile so they can't escape.
- Toxins are proteins, thus, they can be denatured to a state in which they are less bioactive.
- pH, proteolysis, heat all disable protein toxins

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## **Jellyfish stings**

- Treatments originate from altering pH, proteolysis, heat
- Vinegar - pH
- Papain (meat tenderizer) – proteolysis
- Heat – “cooking” the protein
- Cold – no effect on toxin (rather it preserves it)
  - It does reduce pain temporarily
  - But the pain will return when the ice is removed

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## **Jellyfish stings**

- Vinegar
  - Very acidic
  - But it does not penetrate the skin
  - Has no effect on toxin that is already in the skin
- Urine
  - Could be acidic or basic depending on net acid/base consumption. Tends to be acidic.
  - Not likely to have any effect on toxin that is already in the skin.

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## **Jellyfish stings**

- Papain
  - Proteolytic enzyme found in papaya – some surfers recommend fresh papaya.
  - Active substance in Adolph's meat tenderizer
  - Other meat tenderizers (e.g., Schilling) has no papain in it; rather it is MSG
- Papain cannot reach the toxin that is already in the skin. Not likely to have any significant effect.

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## **Jellyfish stings**

- Heat
  - Denatures (“cooks”) the protein rendering less bioactive.
  - Immediate pain relief in studies and clinical experience.
  - Unlike other topical treatments, heat penetrates the skin.
- Optimal hot temperature 40°C (104°F) to 45°C.
  - Feels like a hot bath
  - Febrile seizure type temperature – urine from such patients might work (no studies on this).

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## **Jellyfish Case 1**

- 12 year old comes to ED with jellyfish sting on arm, chest, and face. Shivering, moderate distress.
- Arm placed under faucet with very warm water (as a test); patient indicates that this feels much better.
- Patient placed in shower to take hot shower.
- Stays in shower for 30 minutes
- Comes out feeling much better.
- No analgesics given

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## **Jellyfish Case 2**

- 12 year old comes to ED with jellyfish sting on arm.
- Arm stings area bathed in a slurry of meat tenderizer and alcohol (to make it cool)
- Patient indicates that this feels much better.
- Pain eventually resolves.

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## **Jellyfish Case 3**

- 12 year old with a jellyfish sting over his mid to lower abdomen.
- Ice makes it feel better.
- He has been applying ice for many hours during the day, for 6 days.
- Over these 6 days, the skin has become dark.
- Frostbite type injury.
- Switched to hot water; improved.

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## **Jellyfish treatment studies**

- Variation due to sting severity (minor to very bad)
- Variation in pain perception (between subjects)
- **Variation in treatment efficacy (between treatments)**
- Three sources of statistical variance
  - A study utilizing actual stings would require a large sample size to reach a conclusion. Just a casual estimate would be 250 subjects if comparing two treatments, 500 subjects if comparing three treatments.

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## **Unpaired Jellyfish treatment study**

- Thomas, et al. Hawaii Med J 2001;60(4):100-107. 133 swimmers with real-life jellyfish stings. Heat pack vs cold pack.
- Heat pack showed trend toward pain reduction.
- Cold pack had no efficacy.

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## **Jellyfish treatment studies**

- Variation due to sting severity (minor to very bad)
- Variation in pain perception (between subjects)
- **Variation in treatment efficacy (between treatments)**
- Is it possible to reduce the sources of statistical variance to just one?
  - The study sample size required would be much smaller.

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## **Paired Jellyfish treatment study**

- ~~Sting severity variance~~: Study only one sting severity.
- ~~Pain perception variance~~: Subjects serve as their own control. One sting on each arm.
- **Variation in treatment efficacy**: Apply one treatment on left arm and the other treatment on right arm. Which one is better? – Paired T-test

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## **Paired Jellyfish treatment study**

- Carybdea alata (Hawaiian box jellyfish)
- Acquire jellyfish at 5am (Ala Wai Yacht harbor)
- One jellyfish per bucket.
- Transport buckets to ER.
- Any volunteers?
- Randomize arm side. Randomize treatments.
  - Heat versus papain
  - Heat versus vinegar

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## **Paired Jellyfish treatment study**

- Cut off two of the 4 tentacles.
- Simultaneously apply tentacle to each volar proximal forearm (right and left), size of a quarter.
- Subject should feel pain.
  - If no pain, then immediately harvest another tentacle and re-apply and reset timer for that side only
- Apply treatments (heat, papain, or vinegar)
- Serial pain scores.
- Apply hydrocortisone

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## **Paired Jellyfish treatment study**

- 25 subjects (note small sample size, but sufficient)
- At start time: Pain 3.6cm vs 3.7cm (heat vs other)
- 2 minutes following treatment: 2.1 (heat) vs 3.2
- 20 minutes post treatment: 0.2 (heat) vs 1.8
- Visual appearance better for 16 out of 25 patients.
- All pain gets better, but **heat** is the best treatment
- Nomura, et al. Am J Emerg Med 2002;20:624-626.

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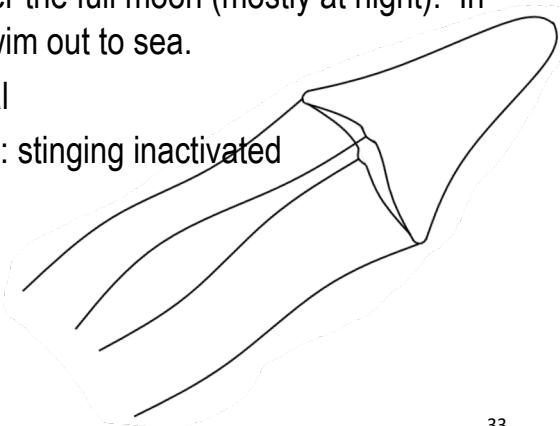
## **Evidence-Based Treatments**

- Ward NT. Ann Emerg Med 2012;60:399-414.
- 9 studies – only 1 was paired trial (KMCWC); all others were unpaired
- Efficacious treatments are: heat, lidocaine
- Physalia might benefit from vinegar

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## **Jellyfish types – Box Jellyfish**

- Carybdea alata: Hawaiian box jellyfish
  - 4 tentacles (“box” corners), but looks more like a cone
  - Arrive 9-10 days after the full moon (mostly at night). In the morning, they swim out to sea.
  - Painful, but not lethal
  - Jellyfish on the sand: stinging inactivated
  - Clear, difficult to see
  - About a foot long



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## **Jellyfish types - Physalia**

- Physalia physalis: Portuguese Man-o-war (aka blue bottles).
  - Not a single organism but a symbiotic organism
  - Not moon dependent, fairly wind dependent.
  - Jellyfish on the sand are still potent (unlike box jellyfish)
  - The term “Portuguese Man-o-War” can mean many things. In other parts of the world, this term refers to a jellyfish that is much larger.

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## **Jellyfish stings**

- Both Portuguese Man-o-war and Hawaiian box jellyfish stings are painful and are due to protein toxins optimized for cold water.
  - It is very likely that heat works for both of these jellyfish stings.
  - Most patients can't tell what stung them.
  - Most patients were swimming and felt a lot of pain.
  - Patients do not come in with the jellyfish still on them
  - Hot showers work on everyone I have tried it on.

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## **Unfired nematocysts**

- Lots of attention and commentary on this.
- No good studies. Fairly impossible to study.
- Of little practical value because no one has a jellyfish on them when they come in for medical treatment except maybe at the beach.
  - What should lifeguards recommend for patients with the jellyfish still on them?

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## **Unfired nematocysts**

- Scrape it with a credit card/razor? – doubt if this is helpful.
- Use salt water, not fresh water. – evidence against this. Use any kind of hot water that won't burn.
- Vinegar will denature unfired nematocysts on skin. This might be correct, but only for the unfired nematocysts or for tentacles still on the skin. But because it is painful, most patients have removed the tentacles.

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## **What you should do**

- Hot water if you have it. Test it first on a small part of the sting. Don't burn the patient. If it works, use a hot shower if available. If not use hot packs or something similar. Lean against a hot car but don't get burned. Don't use the engine block or muffler tail pipe.
- If the patient still has tentacles on him/her:
  - Denature with vinegar if you have this.
  - Otherwise, remove the tentacles carefully.

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## **What you shouldn't do**

- Cold pack. While this reduces pain, it's temporary and might prolong the sting.
- Papain and vinegar don't do much if the toxin is already in the skin.
- Don't use MSG.
- Don't use urine.

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## **Australian Box Jellyfish**

- Chironex fleckeri
- Deadly paralytic toxin
- CPR / Life support required

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## **Irukandji jellyfish**

- Tiny jellyfish resembling box jellyfish
- 5mm body, 1 meter long tentacles
- Deadly toxin
- Severe pain and muscle cramps
- Waters north of Australia

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## **Sea urchin**

- Wana
- Spikes have local toxicity. Unlikely to have significant systemic effects.
- Presents with multiple foreign bodies embedded in the sole that can't be removed easily.
- Soak in hot water or vinegar.
- Spikes will work their way out.

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## **Cone snails**

- Very pretty shell
- They possess a retractable spear that injects toxin into their prey.
- Painful, potentially toxic
- Uncommon for clinically significant effects to develop

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## **Fish toxins**

- Lion fish, scorpion fish. Venom/toxins in spines. Similar toxins in other “ugly fish”. Be careful with ugly fish or ones with spines.
- Scombroid poisoning
  - Explanation is that histidine from spoiled fish breaks down into histamine. Big histamine reaction. Treat with antihistamine. Outpatient management. Common fish here is mahi mahi.
- Ciguatera poisoning – more serious

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## **Ciguatera case**

- A family of 6 arrives in the ER with vomiting, abdominal cramps, feeling dizzy.
- They were at a wedding reception dinner (Chinese banquet) on the same table. They had eaten 5 courses when they began to feel ill. Cold cuts, chicken, pork, steamed fish, noodles.
- Food poisoning suspected.
- Ciguatera suspected.
- IV's started in all of them.

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## **Ciguatera case**

- A 7<sup>th</sup> victim with similar symptoms arrive. This is a 9-year old who is a cousin of the first family. He was sitting on a different table and no one else on his table is ill.
- However, he moved to the first family's table temporarily and he ate the steamed fish at that table before returning to the table he was supposed to be sitting at.
- Ciguatera poisoning suspected.

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## **Ciguatera poisoning**

- Dinoflagellate (micro marine plankton) produce the toxin. They live on algae, reefs, and shallow tropical marine environments (i.e., reefs).
- Fish eat the dinoflagellates directly or they eat smaller fish that have eaten dinoflagellates. If they eat enough of these; trouble.
- Local fish: Parrot fish (uhu), jacks (papio/ulua), baraccuda, Moray eel, snapper, wrasse, mackerel, smaller tunas (amberjack).

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## **Ciguatera poisoning**

- Onset of GI sx in 6-12 hrs. Resolves in 1-4 days.
- Neurologic symptoms, paresthesia, metallic taste, sensation of loose teeth, itching, muscle pain, arthralgia, headache, dizziness. Coma, hallucinations occur, but are rare.
- Hot/cold “reversal”: Touching cold thing results in burning.
- Cardiac, neuropsychiatric symptoms.
- IV mannitol
- Rarely fatal

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## **Review article citations**

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- Kohn AJ. Human injuries and fatalities due to venomous marine snails of the family Conidae. *Int J Clin Pharm Ther* 2016;54(7):524-538.
- Friedman MA, et al. An Updated Review of Ciguatera Fish Poisoning: Clinical, Epidemiological, Environmental, and Public Health Management. *Marine Drugs* 2017;15(3):E72.

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End

Questions?

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End

Questions?

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