Irukandji Syndrome

Isabel M. Algaze Gonzalez, MD
Assistant Professor of Emergency Medicine
Wilderness Medicine Fellowship Co-Director
University of California, Irvine
Physician at Catalina Island Medical Center
Avalon, Catalina

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PI Angel Yanagihara
Objectives

• Brief bio-chemical review

• Pathophysiology

• Clinical presentation

• Most recent treatment strategies

No disclosures
Why is this important to you? - Goals

- You can not diagnose what, to your knowledge, does not exist

- Increasingly prevalent around the world coastal areas

- Need to prevent:
  - Misdiagnosis
  - Underreporting
  - Improper treatment strategies
Why is this important to you? - Goals

- Has a great burden of morbidity and mortality
- Associated financial costs are high

Credit: Dianna Emmanuelli
Jellyfish Background Information
Distribution

- Chironex-type box jelly fatalities
- Irukandji-type box jelly fatalities
- Other jellyfish fatalities
- Irukandji-type box jelly stings
Alatina alata Nematocyst
Sting Mechanism

1. Missiles Strike
Box jelly tentacles are covered with tiny booby traps called nematocysts. Just one touch and they’ll launch microscopic missiles filled with venom.
What do we know

- Severity increases with:
  - Dose
    - Jellyfish size
    - Extent of contact
    - Delicacy of the victim's skin
  - Fish have nucleated cells
    - Capability to repair makes them 1,000 times more resistant than humans
  - Nematocysts Injects Spines
    - Mineralized Chitin- Triggers Mannose protein mediated prolonged immune response
  - Porin
    - Approximately 1% if the venom
    - Causes holes in cells
    - Platelets are affected first
      - Releases catecholamines
    - Anthrax porin (anthrolysin O) as a model
      - Copper (better than zinc) Gluconate inhibits Calcium mediated porin assembly
  - Death
    - Marker of death is potassium
    - After well intentioned epinephrine
Cubozoan Venom-Induced Cardiovascular Collapse Is Caused by Hyperkalemia and Prevented by Zinc Gluconate in Mice

Angel A. Yanagihara, Ralph V. Shohet

Abstract
Chironex fleckeri (Australian box jellyfish) stings can cause acute cardiovascular collapse and death. We developed methods to recover venom with high specific activity, and evaluated the effects of both total venom and constituent porins at doses equivalent to lethal envenomation. Marked potassium release occurred within 5 min and hemolysis within 20 min in human red blood cells (RBC) exposed to venom or purified venom porin. Electron microscopy revealed abundant 12 nm transmembrane pores in RBC exposed to purified venom porins. C57BL/6 mice injected with venom showed rapid decline in ejection fraction with progression to electromechanical dissociation and electrocardiographic findings consistent with acute hyperkalemia. Recognizing that porin assembly can be inhibited by zinc, we found that zinc gluconate inhibited potassium efflux from RBC exposed to total venom or purified porin, and prolonged survival time in mice following venom injection. These findings suggest that hyperkalemia is the critical event following Chironex fleckeri envenomation and that rapid administration of zinc could be life saving in human sting victims.

Citation: Yanagihara AA, Shohet RV (2012) Cubozoan Venom-Induced Cardiovascular Collapse Is Caused by Hyperkalemia and Prevented by Zinc Gluconate in Mice. PLoS ONE 7(2): e31368. doi:10.1371/journal.pone.0031368

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Pathophysiology of cubozoan envenomation
Clinical presentation

• 1 to 2 hours after the sting
• May not have cutaneous marks
• Cutaneous:
  • May progress over a course of days to local necrosis, skin ulceration, and secondary infection
  • Can resolve 2w-2mo
  • Residual hyperpigmentation to lichenification
• Ocular:
  • Conjunctivitis, chemosis, corneal ulcers, corneal epithelial edema, keratitis, iridocyclitis, elevated intraocular pressure, synechiae, iris depigmentation, chronic unilateral glaucoma, and lacrimation
• Systemic:
  • “Feeling of doom”, Trembling, Acute renal failure, lymphadenopathy, chills, fever, and nightmares
Clinical presentation

• Neurologic:
  • Malaise, headache, aphonia, diminished touch and temperature sensation, vertigo, ataxia, spastic or flaccid paralysis, mononeuritis multiplex, Guillain-Barré syndrome, parasympathetic dysautonomia, plexopathy, radial–ulnar–median nerve palsies, brainstem infarction, delirium, loss of consciousness, convulsions, coma, and death

• Cardiovascular:
  • Hemolysis, hypotension, small artery spasm, bradyarrhythmias, tachyarrhythmias, elevated serum troponin I level in the absence of myocardial injury, vascular spasm, deep venous thrombosis, thrombophlebitis, acute myocardial infarction, congestive heart failure, and ventricular fibrillation

• Respiratory:
  • Rhinitis, bronchospasm, laryngeal edema, dyspnea, cyanosis, pulmonary edema, and respiratory failure

• Musculoskeletal or rheumatologic:
  • Abdominal rigidity, diffuse myalgia and muscle cramps, muscle spasm, fat atrophy, arthralgias, reactive arthritis, and thoracolumbar pain

• Gastrointestinal:
  • Nausea, vomiting, diarrhea, paralytic ileus, dysphagia, hypersalivation, and thirst
Treatment
Clinical trial and piglet model

• Collaboration
  • DOD
  • Puerto Rico Sea Grant
  • Hawaii Sea Grant
  • NIH grant
Treatment

• ACLS/BLS protocols acutely
  • Anticipate drowning
  • Hypothermia
  • Decompression sickness or arterial air embolism

• If only local symptoms:
  • Treat symptomatically:
    • Vinegar and then hot water
    • Sting no More products
  • Observe until the victim is asymptomatic for 6 hours*

• Antivenom vs inhibitor
  • Technical limitations
Treatment

• What \textbf{NOT} to do:
  • Rinse with fresh water
  • Rinse with cold water
  • Apply ice
  • Scrape with a credit card
  • Shave with shaving cream
  • Rub sand

• Rinse with urine
• Rinse with alcoholic drinks or rubbing alcohol
• Touch with bare hands
• Administer Epinephrine
Literature

Article
Experimental Assays to Assess the Efficacy of Vinegar and Other Topical First-Aid Approaches on Cubozoan ("Alatina alata") Tentacle Firing and Venom Toxicity

Angel A. Yanagihara 1,2,*, Christie Wilcox 1,†, Rebecca King 2, Kikiana Hurwitz 2,3 and Ann M. Castelfranco 2

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1 Department of Tropical Medicine, Medical Microbiology and Pharmacology, John A. Burns School of Medicine, University of Hawaii at Manoa, Honolulu, HI 96822, USA
wilcoxci@hawaii.edu

Article
Cubozoan Sting-Site Seawater Rinse, Scraping, and Ice Can Increase Venom Load: Upending Current First Aid Recommendations

Angel Anne Yanagihara 1,2,*,† and Christie L. Wilcox 1,†

1 Department of Tropical Medicine, Medical Microbiology and Pharmacology, John A. Burns School of Medicine, University of Hawaii at Mānoa, Honolulu, HI 96822, USA
2 Békésy Laboratory of Neurobiology, Pacific Biosciences Research Center, University of Hawaii at Mānoa, Honolulu, HI 96822, USA

* Correspondence: Tel.: +1-808-956-8328
† These authors contributed equally to this work.

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Literature

Without blood skin agar

With skin blood agar
Prevention

• Beach monitoring

• Flag system and beach signs

• Bay Watch and EMS most have updated protocols

• Monitoring of victims*

• Poison center reporting

Credit: Dianna Emmanuelli
Management

• If symptomatic:
  • Monitor - some end up admitted to ICU
  • Opioids – spasm pains, careful of pulmonary edema
  • Nausea medication
  • Phentolamine - Alpha blockers have been recommended for the control of hypertension, as a result of catecholamine release.
  • Mag - for arrhythmias?
You have an expert in your backyard

Please forward cases and pictures to:

**Angel A. Yanagihara, Ph.D.**
Associate Research Professor
Bekesy Laboratory of Neurobiology, PBRC
and Dept of Trop Med, JABSOM
University of Hawaii at Manoa
1993 East West Road
Honolulu, Hawaii 96822 USA
Email ayanagih@hawaii.edu
Tel 808 956-8328
FAX 808 956-8713

http://manoa-hawaii.academia.edu/AngelYanagihara
https://www.researchgate.net/profile/Angel_Yanagihara

**Isabel M. Algaze Gonzalez, MD**
Assistant Professor of Emergency Medicine
Wilderness Medicine Fellowship Co-Director
University of California, Irvine
333 City Boulevard West, 640, Orange, CA, 92868
Physician at Catalina Island Medical Center
Avalon, Catalina
100 Falls Canyon Rd, Avalon, CA 90704
Email ialgazeg@uci.edu
Tel 714 456-3713
FAX 714-456-3714

http://www.ucirvinehealth.org/find-a-doctor/a/isabel-m-algaze-gonzalez
For the future

• More research is needed on
  • Species
  • Distribution
  • Syndrome
    • Variations in signs and symptoms between species
  • Validated Treatment
  • Prevention strategies
Any jelly questions?
References


References


