Effects of Global Warming on Toxicological Problems: Marine Envenomations and Poisonings

Today's topic

• Marine poisoning
  – Harmful algal bloom
  – Paralytic shellfish poisoning
  – Ciguatera fish poisoning
  – Scombroid poisoning
• Marine envenomation
  – Box jellyfish
  – Irukandji jellyfish

Harmful algal blooms (HABs)

• HABs: Natural phenomena caused by the proliferation of algae, resulting in damage to the environment and/or risk to the health of humans and aquatic life
• Marine algal toxins are responsible for more than 60,000 intoxication incidents per year worldwide, with an overall mortality rate of 1.5%
• Increase in HABs
  – Increase in numbers of HABs outbreaks
  – Expansion of geographic range of HABs
  – Occurrence of novel HAB-related syndromes

Global increase in reported incidence of algal toxins

Factors potentially contribute to increase in HABs

• Transport of exotic species
• Eutrophication of coastal waters
• Anomalous weather events
• Global climate change

Paralytic shellfish poisoning (PSP)

• Ingestion of bivalve shellfish (mussels, oysters, and clams) containing toxin
• The main paralytic shellfish toxin: saxitoxin
  – Heat stable
  – Blocks tetrodotoxin-sensitive Na+ channels
  – Disrupts nerve conduction
  – Motor and sensory nerve abnormalities
• Toxins are produced by toxic marine microalgae dinoflagellates
• These dinoflagellates are commonly associated with “red tides” (sea discoloration)
Red tide

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PSP distribution

- Prior to the 1970s, PSP was known to be endemic only to North America, Europe, and Japan
- Currently, PSP outbreaks are also documented in South America, Australia, Southeast Asia, and India
  - Thailand, 1983
    - Pranburi
    - Ingestion of mussel from the red tide area
    - 53 cases, 1 death

PSP clinical manifestation

- Median onset time: 1 h (range: 30 min to 3 h)
- Headache, nausea, and vomiting in the initial part of the poisoning
- Paresthesia of the tongue and lips spreading to the face, neck, fingers, and toes
- Feeling of dizziness or "floating", owing to distortion of sensation and proprioception
- Arm and leg weakness and ataxia
- Patients are conscious and alert throughout the poisoning
- Duration: 2–3 days in mild to moderate poisoning
  - In more severe cases weakness may persist for a week

Ciguatera Fish Poisoning

- Ciguatoxin produced by the marine dinoflagellate *Gambierdiscus toxicus*
  - heat stable, odorless
  - Activate voltage-sensitive Na+ channels, causing sodium channels opening at resting membrane potentials
- Toxin accumulates in the tissues of larger predacious coral reef fish: red snapper, sea bass, grouper, barracuda

PSP: Diagnosis and Management

- Diagnosis
  - History of exposure and clinical manifestation
  - Paralytic shellfish toxins: mouse bioassay, immunoassay, high performance liquid chromatography
- The treatment of paralytic shellfish poisoning is supportive
- Closely observation for progressing paralysis and respiratory failure
Ciguatera Fish Poisoning

- Endemic in tropical regions: Indian Ocean, South Pacific, and Caribbean
- Outbreaks of ciguatera are greatest between the months of April and August
- Incidence in endemic areas: 500-600 cases per 10,000
- Barracuda ciguatoxicity
  - No longer showed a prominent seasonality
  - Fraction of randomly caught barracuda that were ciguatoxic significantly increased during this period

Ciguatera Fish Poisoning

- Onset: 2 to 6 hours
- Gastrointestinal symptoms: nausea, vomiting, profuse watery diarrhea and abdominal pain
- Neurologic symptoms: dysesthesias and paresthesias around the throat and the perioral area
- Central nervous system changes: ataxia, vertigo, visual hallucinations, delirium and coma
- Duration: 1 to 2 weeks with gradual improvement

Ciguatera Fish Poisoning: Diagnosis and Management

- History of fish consumption in combination of gastrointestinal and neurologic symptoms, particularly dysesthesias
- Confirmation by ciguatoxin assay from fish sample
- Treatment is primarily supportive
  - No specific antidote

Jellyfish envenomation

- In fall of 2007, billions of jellyfish attacked a salmon farm in Northern Ireland destroying more than 100,000 fish
- In Japan, the number of jellyfish has risen so dramatically they are devastating the livelihoods of fishermen
- Mass jellyfish sightings are now common along the Mediterranean coast and off southern Africa, the west coasts of England, Wales and Scotland, the beaches of Waikiki, and the Gulf of Mexico

Irukandji jellyfish and Box jellyfish
Jellyfish envenomation

- Venom in nematocysts
- The immediate effect is pain and inflammation.
- Few of jellyfish envenomations cause systemic effects
- The most common reaction to jellyfish envenomation is a local painful sting accompanied by urticaria
  - Pain, edema, angioedema, anaphylaxis, superficial thrombophlebitis, and compartment syndrome
- In serious envenomations, this may progress to full skin necrosis
- Rare cases of anaphylactic reactions to a jellyfish sting
- Death is rare
  - Ann NY Acad Sci 1960; 90:75.

Box jellyfish (Chironex fleckeri)

- Found in Indian and Pacific Oceans
- The jellyfish is box-shaped, up to 20 cm along each side and with as many as 15 tentacles up to 3 m long.
- Because of their translucency, they are often invisible in the water

Box jellyfish (Chironex fleckeri)

- The victim experiences immediate excruciating pain
- Erythema and edema
- Over several days, skin lesions become ulcerated or necrotic, leading to permanent scarring
- Systemic reactions
  - Altered mental status
  - Respiratory depression
  - Death can occur within the first hour from cardiorespiratory complications

Irukandji Syndrome

- Sting by Irukandji jellyfish (Carukia barnesi)
- Most stings have been reported as occurring in Australia, especially in Queensland
  - Also reported from Papua New Guinea, Hawaii, Japan, Florida, USA, and China
  - Nursing and Health Sciences (2006), 8, 66–70

- Diagnosis:
  - Immediate linear wheals and blisters (tentacle tracks)
  - Muscle spasm
  - Respiratory paralysis
  - Hypotension
  - Cardiac arrest
Irukandji Jellyfish (Carukia barnesi)

Irukandji Syndrome

• Initially the sting mark is hardly visible
• Then, the area of skin may become red and swelling lasting up to 30 min
• Onset of systemic signs and symptoms 10–40 min
• Pain: chest pain/paresthesia
  – Severe muscle cramps are always present
• Catecholamine response (epinephrine-like effects): diaphoresis, piloerection, restlessness, tachycardia, hypertension, tachypnea, pallor or cyanotic peripheral skin
• Cardiac effects: nonspecific ekg changes, elevated cardiac enzymes, pulmonary edema

  • J Travel Med 2006; 13: 240–243

Symptoms may last 2–3 days
Death is a rare event
  – Intracerebral hemorrhage
  – Myocardial infarction
  – MJA 2002; 177: 362-363)

Management of Irukandji Syndrome

• Management is based on treating the patient’s signs and symptoms
• Observation for 12 hours
• Pain management: morphine, pethidine
• Hypertension: phentolamine, nitroprusside, nitroglycerine

Recommended first aid

• Remove the victim from the water
• Resuscitation and life support
• Pour household vinegar on the tentacles and affected area to stop any unirred nematocysts from firing
  – No neutralizing effects on the venom
  – 1–2 L over 30–60 s is considered adequate
• Prevent rubbing
• Do not wash the area with water
• After nematocyst inhibition, remaining tentacles may be removed

Management of box jellyfish envenomation

- Supportive care
- Wound care: treated as burn wounds
- C. fleckeri antivenom


Both box jellyfish and Irukandji jellyfish envenomations have been reported to occur in Thailand!!

  - J Travel Med 2001; 8: 150 – 151
  - J Travel Med 2006; 13; 240 - 243

Thank you
for your attention

Treat the earth well.
It was not given to you by your parents.
It was loaned to you by your children.
Kenyan Proverb