Environmental Dermatology: HAZARDS TO YOUR SKIN ON LAND, SEA, AND AIR

Sea
Aquatic hazards to the skin
Navigating the perils of the open seas, hot tubs and your aquarium

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RELEVANT RELATIONSHIPS WITH INDUSTRY
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I do not have any relevant relationships with industry.
Objectives

* Following the presentation, the participant will be able to:
  • Identify the marine and freshwater organisms discussed.
  • Recognize the cutaneous manifestations associated with exposures to marine and freshwater organisms.
  • Select the most appropriate therapy and/or preventative measures for the various marine and freshwater exposures presented.
Aquatic hazards

- Human contact with marine environment occurs through travel to beaches throughout the world and participation in activities such as swimming, diving, beachcombing
- Domestic and commercial aquariums, kitchens where seafood and fish are prepared provide additional sources of contact
- Exposures occur in both freshwater and marine environments
Mechanisms of cutaneous manifestations:
* Trauma- punctures, bites, cuts, suction, abrasions, lacerations
* Envenomation
* Allergic reactions
* Infections
* Cutaneous exposure to dead organism or its parts
* Penetration/invasion of exposed skin
Aquatic hazards

- Sources of aquatic exposures:
  - Bacteria, fungi
  - Plants
  - Sponges
  - Cnidarians
  - Seaworms
  - Echinoderms (starfish, sea cucumbers, sea urchins)
  - Mollusks (bivalve shells and octopi)
  - Crustaceans
  - Fish
Which of the following causes the most infections in the marine environment?

A. *Staph aureus*
B. *Vibro vulnificus*
C. *Mycobacterium marinum*
D. *Erysipelothrix rhusiopathiae*
E. *Aeromonas hydrophilia*
Aquatic bacteria
- *Staphylococcus aureus, Streptococcus pyogenes* are the major causes of infections occurring in the marine environment
- Other bacteria causing aquatic infections include: *Mycobacterium marinum, Vibrio vulnificus, Aeromonas hydrophilia, Mycoplasma* (cause of “seal finger,” resulting from seal bite to hand), *Erysipelothrix rhusiopathiae*

Aquatic fungi
- *Sporothrix schenckii*
- Lacaziosis (formerly lobomycosis)- humans and bottlenose dolphins
Most *Vibrio* infections are related to ingestion of raw or undercooked oysters/shellfish or penetrating injuries in brackish water

- Ingestions result in vomiting, diarrhea, abdominal pain
- Exposures of immunocompromised or patients with diabetes or liver failure can result in sepsis with mortality rate of more than 50%
- Hemorrhagic bullae, petechiae or purpura can occur in septic patients
Aquatic infections- *Vibrio* infections

- Primary cutaneous *Vibrio* infection can result in cellulitis, ulceration or necrosis
- Infected wounds not promptly/effectively treated can lead to amputation
- Diagnosis through history, wound or blood cultures
- Treatment: doxycycline, third-generation cephalosporin
- Prevention- public education/warnings about consumption of raw seafood; CME for physicians to enhance early recognition
Aquatic infections - erysipeloid

- Erysipeloid (*E. rhusiopathiae*) - gram-positive organism
  - Self-limited localized infection
  - Occurs most commonly on the hand 24-72 hours after inoculation resulting from injury
  - Exposures occur in both fresh- and saltwater
  - Often seen in those who handle seafood or fish
  - Presents as pruritic, painful well-demarcated erythematous plaque; usually no constitutional signs/symptoms
  - Hematologic dissemination can occur with sepsis, septic arthritis and endocarditis
  - Localized infection treated with antibiotics (penicillins, erythromycin, first-generation cephalosporins)
Mycobacterium marinum infection (fish tank granuloma)

- Occurs in both fresh- and saltwater tanks
- Can result in setting of minor skin trauma (e.g., reaching in to clean tank)
- Presentations include skin tumor, ulcer or sporotrichoid pattern of lesions; can cause septic arthritis and osteomyelitis
- Skin biopsy with culture confirms diagnosis
- Treatment with antibiotics (rifampin, ethambutol, minocycline, TMP-SMX), hot compresses or surgical removal of localized lesions
Aquatic hazards- aquatic plants

- Red tide- caused by dinoflagellates (Gymnodinum and Alexandrium species)
- These contain neurotoxins which are released into the water or air
- Toxins are deadly to fish in small concentration
- Human exposure can result in contact dermatitis, sneezing, coughing, conjunctivitis- eruption can occur within minutes
- Other species can cause similar signs/symptoms in freshwater lakes, rivers, estuaries
- Prevention: avoid areas where these organisms are known to be endemic
Cyanobacteria (blue-green algae)
- Found in marine and freshwater environments
- More than 1/3 of species produce toxins
- Manifestations include GI symptoms, respiratory irritation and contact or irritant dermatitis most prominent in distribution of bathing suit- rash can occur within minutes of exposure
- Treat with prompt removal of bathing suit; showering and rinsing with rubbing alcohol; topical steroids may reduce inflammatory response
Toxins produced by bacterial algae and dinoflagellates can also cause human disease in settings of ciguatera and pufferfish ingestion.

Ciguatera- common disease in tropical waters; caused by ciguatoxin (produced by dinoflagellates) contained in alimentary tracts of ingested fish; symptoms primarily neurologic but can cause rash and intense pruritus.
Aquatic hazards- pufferfish ingestion

- Pufferfish meat ingestion
  - most common in cultures where pufferfish frequently consumed (e.g., Japan)
  - envenomation due to ingestion of tetrodotoxin (TTX), which is produced by several bacteria
  - TTX is a potent neurotoxin with rapid onset of symptoms 5-45 minutes after consumption) including paresthesias of lips and tongue progressing to face and limbs, increase salivation, nausea/vomiting/diarrhea, loss of motor coordination, muscle weakness, motor paralysis
  - No specific treatment- early gastric emptying important; may require mechanical ventilation; high mortality rate
Cnidarians - members of the phylum Cnidaria

Four classes:
- Hydrozoa (fire corals, Physalia species)
- Anthozoa (true corals and sea anemones)
- Cubozoa (box jellyfish)
- Scyphozoa (true jellyfish)

All possess nematocysts ("stinging capsules") - organelles which contain a harpoon-like microtubule responsible for venom injection.

Nematocysts can be harmlessly deposited on the skin and activated later by specific stimuli.
Which of the following has caused the greatest number of deaths?

A. Portuguese Man-of-war
B. Sea urchin
C. Pacific box jellyfish
D. Stingray
E. Lionfish
Fire corals ("false" corals- stinging corals) found in tropical and subtropical waters

Localized burning is followed within minutes by urticarial papules and wheals; pruritus, vesicular and bullous eruptions, lichenified plaques and chronic granulomatous reactions also occur

Both type I and delayed-type hypersensitivity reactions can occur

Venom has dermonecrotic, hemolytic and vasopermeable properties and is heat labile

Removal of residual organisms with cold seawater rinsing is important

Acetic acid may decrease nematocyst discharge.
Aquatic hazards- Portuguese man-of-war

- Portuguese man-of-war (*Physalia physalis*, AKA “bluebottle”)
  - Found in warm ocean waters worldwide
  - Tentacles dangle 20-30 feet into the water
  - Nematocysts discharge causing extremely painful stings; can penetrate wet suits
  - Result in linear injuries with persistent pigmentation
  - Symptoms can include muscle pain, burning, anxiety, nausea, weakness, bradycardia
Portuguese man-of-war

- Portuguese man-of-war
  - Treatment of stings:
    - Cardiac/respiratory support as necessary
    - Rinsing affected area with sea water or vinegar, not fresh water which causes nematocysts to rupture
    - Use tweezers to remove tentacles still stuck to skin- don’t rub or pull tentacles
  - Avoid contact with beached organisms as nematocysts can still discharge if touched
Aquatic hazards- true corals

- Hard/soft true corals (class Anthozoa) are common sources of skin injuries in scuba divers
- Hard corals have not only nematocysts, but also have a sharp calcium carbonate skeleton
- Result in eczema-like, vesicular, bullous, hemorrhagic, necrotic, ulcerative and/or urticarial eruptions, granulomas
- Some individuals can develop delayed or recurrent dermatitis
- Treatment: oral and topical antibiotics, tetanus prophylaxis; granulomas may require intralesional steroid or surgical removal
* Sea anemone
  * Cause contact dermatitis
  * History of exposure- often presents as persistent rash with onset during beach vacation
  * “Ghost anemone” (*Haloclava producta*)- burrowing sea anemone found off east coast of US and in Gulf of Mexico; causes outbreaks of dermatitis off coast of Long Island
Aquatic hazards- Pacific box jellyfish

* Pacific box jellyfish (Chironex fleckeri) AKA sea wasp- one of nature’s most dangerous creatures
  * Found in Australia’s Great Barrier Reef
    * Small, nontransparent jellyfish with cube-shaped body and underlying tentacles
    * Neurotoxins, cardiotoxins and hemolytic elements contained in venom
      * One jellyfish has enough toxin to kill 20 people; death can occur in 60 secs
      * C. fleckeri envenomation has caused hundreds of deaths
  * Related dangerous species of box jellyfish exist on the tropical Atlantic coasts of South America, Mexico and the US (Texas)

* Clinical:
  * Envenomation causes excruciating pain and linear brown-purple plaques
  * Main symptoms are cardiac and pulmonary manifestations
Treatment:
- Immobilize affected areas to prevent spread of venom
- Apply cold seawater compresses/cold packs
- Use the compresses or wash with vinegar to inactivate nematocysts
  - New formulations containing copper gluconate, magnesium sulfate, and urea may be more effective in inhibiting both tentacle firing and subsequent venom-induced hemolysis
- No evidence to support use of antihistamines, urine, cola, alcohol
- Transfer immediately to hospital if systemic symptoms
- Antivenom is available in Australia but must be administered promptly
Aquatic hazards- jellyfish

* Jellyfish
  * distributed worldwide
  * anatomy includes bell or body, pedalia (arms), tentacles
  * Important species: Chrysaura quinquecirra (sea nettle), Aurelia spp (moon jellyfish) Cynea spp (hair jelly) and Linuche unguiculata (thimble jelly)
Aquatic hazards- jellyfish

- Localized burning, pruritus on contact, sometimes severe, followed by linear urticarial and vesicular eruption at areas of contact
  - Scotch tape applied to site of sting may allow for retrieval of nematocysts and species identification
- Persistent delayed reactions, ocular injury and systemic manifestations (abdominal pain, headache, nausea) have been reported
- Treatment:
  - Cold seawater to aid in tentacle removal
  - Cold seawater compresses for analgesia
  - Application of acetic acid for deactivation of nematocysts
  - Pt should be monitored for rare possibility of anaphylaxis.
Aquatic hazards - sea urchin

- **Sea urchins**
  - Cause physical injuries with lasting manifestations
  - Long spines can penetrate skin and break off resulting in granuloma formation
  - Pigment from the spine diffuses into the wound making it difficult to find and remove spines from skin
  - Occasionally bits of spine will migrate into the interior of the body - can result in synovitis and arthritis if deposited near joints
  - If patient presents with history of stepping on sea urchin, obtain X-ray to determine if there are retained spine fragments which may require surgical removal
Cone shells (gastropods)- multi-colored shells sought by collectors
- Members of Conidae family; shallow water inhabitants
- Main victims are careless collectors
- 15-20% mortality rate for more deadly members of this family found in Australia and California
- One cone shell has enough poison to kill 12 people
- Sting only occurs if shell is inverted
- Contains venomous teeth (radula) that become charged with venom and inflict wound through the opening in their proboscis
Cone shells (Conidae family)

- Produce puncture-wound injuries - sharp stinging or burning sensation
- Wound site rapidly becomes edematous, erythematous - wound ischemia, muscle paralysis and heart failure can occur in six hours
- Local pressure and immobilization may limit spread of toxin
Systemic symptoms: numbness, paresthesias, swelling begin at the wound site and may spread to involve the entire body; in severe cases, paralysis of voluntary muscles can be followed by complete generalized muscular paralysis, including aphonia and dysphagia. Coma and cardiac failure can ensue.

Treatment- cleanse area with soap solution; heat treatments may be useful, neostigmine may be helpful; maintain circulating volume with IV solution and vasopressors; local epinephrine injection of unproven value

Prevention: wear gloves when collecting shells; never hold cone shells in the hand any longer than necessary
Stingrays (class Chondrichthyes)

- Skeleton made of cartilage
- True stingrays have one or more serrated barb on the tail
- Injuries due to trauma and toxin in the serrated barbs in the dorsal tail; barbs regenerate when broken or as animal grows; epithelium is rich in secretory cells of toxins
- Live in bottom of waterways, where injuries occur when fisherman or bathers inadvertently step on them
- When stepped on stingrays rapidly whip their tail against the offending leg; tail spine breaks the skin allowing injection of venom with cardiotoxic and neurotoxic properties; respiratory distress can also occur
- Erythema, edema and intense pain occur at site; rare cases of death due to injection of venom into vital organs (heart, lungs) by direct penetration of barb
Steve Irwin ("Crocodile Hunter") was killed by a stingray while snorkeling on September 4, 2006, off the coast of Port Douglas in Queensland, Australia.

He was pierced in the chest by a stingray barb, which hit his heart. He died of cardiac arrest shortly after being stung.
Seabather’s eruption

- Caused by a variety of stinging larvae, including the thimble jellyfish (*Linuche unguiculata*- esp off Florida coast and Caribbean), sea anemone (*Edwardsiella lineata*, off coast of Long Island)
- Characterized by pruritic papules beneath the bathing suit and in intertriginous areas
- Lesions occur within hours of seabathing; however new lesions can occur for days after the initial exposure
Seabather’s eruption

* Treatment
  * Symptomatic- topical steroids usually effective
  * Eruption usually resolves within a week
Aquatic hazards- prevention

- Prevention of aquatic injuries
  - Avoid touching marine animals, including beached organisms
  - Wear a wet suit while surfing, diving, snorkeling
  - Wear gloves when collecting shells
  - Avoid areas with known high-risk of exposure, such as shallow coral reefs
  - Walk with a shuffle in shallow waters where stingrays may be encountered
Osteichthyes (bony fishes) includes Scorpaenidae family (includes lionfish, scorpionfish)

- Brightly-colored aquarium bottom-dwellers who have toxin-containing venom glands at the base of their spinal fins
- Spines are covered by a thin sheath that tears upon contact with the skin, allowing venom to enter a wound
- Throbbing, burning pain of the affected extremity can ensue. Skin may demonstrate erythema, vesiculation, cyanosis and necrosis and edema.
- Paresthesias, and rarely, systemic effects (nausea, vomiting, tachycardia, muscle weakness, chest pain) can occur
Aquarium hazards- bony fishes

- Lionfish toxin is heat labile, so immediate immersion of wound in hot water (45°C) for 15-60 minutes can reduce pain
- Examine wound for retained spine fragments
- Apply topical antibiotics
- Owners sometimes release these fish into the ocean, so they are now proliferating in areas where they are non-indigenous (e.g., Gulf of Mexico)
Catfish cause puncture wounds

- Intense pain, erythema, edema and rarely necrosis
- Venom has potent vasoconstrictive effects
- Complications include retained fragments of spines and infections
Aquarium hazards

- Recommendations for aquarium owners:
  - Avoid direct contact with aquarium occupants known to be hazardous
  - Wear thick gloves when cleaning tank
* Ottuso P. International Journal of Dermatology 2013;52:136-52 (Part I); 268-78 (Part II)
* Trizna Z. Medscape article: “Cutaneous exposures following exposures to marine life”
* Dangers of the deep, Dermatology World, June 2015.
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