



Venomous bites and stings (seafood poisoning)

David A. Warrell
Nuffield Department of Clinical Medicine,
University of Oxford, UK
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Venomous snakes:

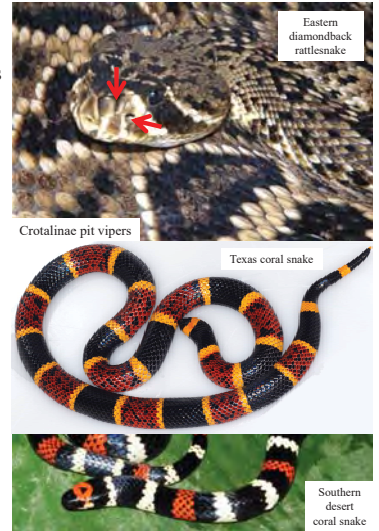
2 major medically-important families

- Viperidae: vipers, adders, pit vipers, moccasins, rattlesnakes

relatively short, thick, short-tailed, often with **distinctive dorsal pattern**, slow-moving but strike-like-lightning

- Elapidae: cobras, kraits, mambas, coral snakes, Oceanian venomous snakes, sea-snakes

relatively long, thin, long-tailed, often uniformly coloured, some spread a hood, fast moving



Snake venoms

Highly complex!

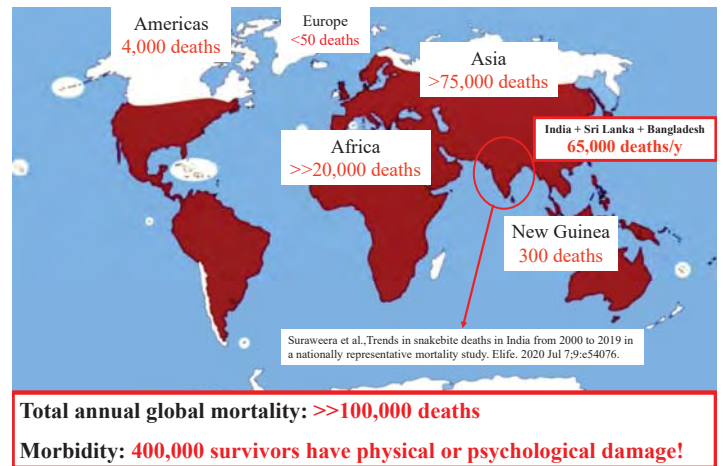
Each venom contains more than 100 protein/polypeptide toxins in 4 main families:

- Phospholipases A₂
- Metalloproteases
- Serine proteases
- Three-finger toxins (neuro-, cyto-toxins)



Other toxins: cysteine-rich secretory proteins, L-amino acid oxidases (**riboflavin cofactor yellow**), Kunitz peptides, C-type lectins, disintegrins, natriuretic peptides.....

Snakebite: global burden of human suffering

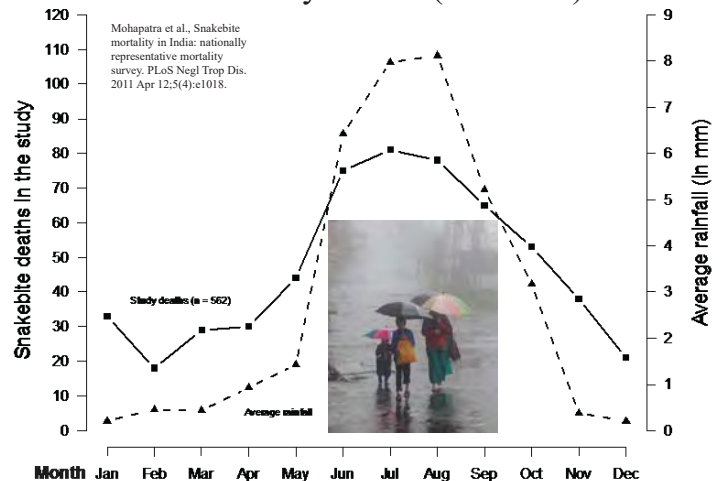


Snakebite: epidemiology

- Obviously depends on snake-human interaction (usually inadvertent), and snakes' "irritability" - readiness to strike (varies between species)
- Meteorology: heat, rains, flooding
- Cycles of diurnal and seasonal activity:
Snake - nocturnal hunting, mating season
Human – occupational (agriculture, pastoralism), building projects, travel
- Sleeping on the ground - nocturnal krait bites in South Asia
- Intentional snake-handling:
Snake restaurants, snake leather
Performance - snake charmers, macho males, rattlesnake round-up, religious
Science - herpetologists, toxinologists

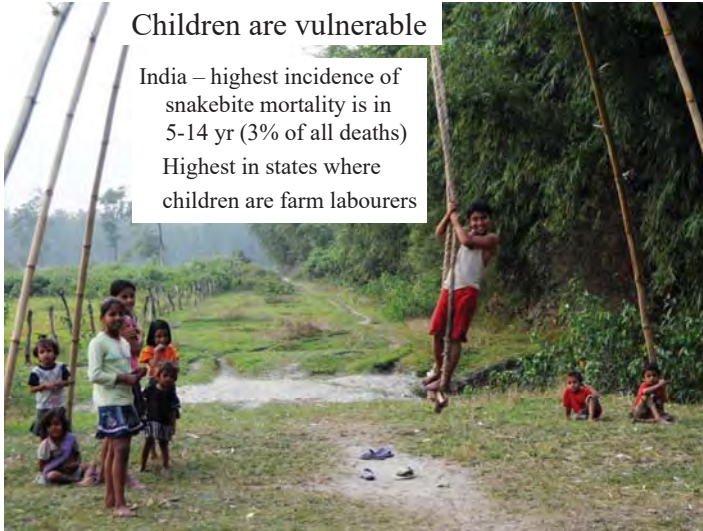


Snake bite is a rainy season (monsoon) disease



Children are vulnerable

India – highest incidence of snakebite mortality is in 5-14 yr (3% of all deaths)
Highest in states where children are farm labourers



Snakebite: prevention

- Learn about local snakes and their favourite habitats
- Practise safer **working, walking and sleeping by:** Protecting feet, legs and hands
Using a light and prodding stick at night
- Sleeping off the ground, or under well-tucked-in bed net to protect against night-prowling kraits (S Asia)



Snakebites: clinical effects

Effects of:

- Anxiety (hyperventilation, conversion disorder)
- Pre-hospital (traditional) treatment
- Background medical conditions, and medications
- Secondary bacterial wound infections (septicaemia, necrotising fasciitis); they may dominate clinical picture!
- Venom (if injected) causing **local and/or systemic envenoming** (US “envenomation”)



“Dry bites”

- Bites by venomous snakes causing puncture marks on the skin indicating penetration by teeth or fangs
- But resulting in no evidence of local or systemic envenoming over the next 24h (no venom injected)
- Incidence varies with snake species: saw-scaled vipers (*Echis*) inflict <10% dry bites
Australian brown snakes (*Pseudonaja*) inflict >80% dry bites
- Mechanism unknown (?mechanical disadvantage ?snake-controlled – “venom metering”)

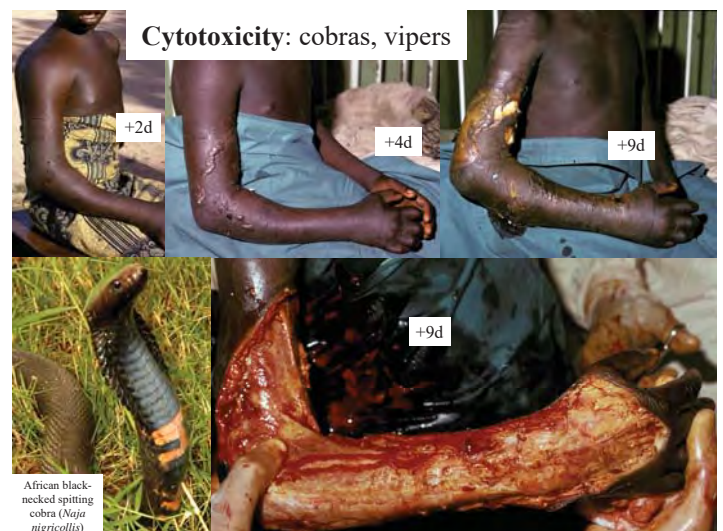
Principal clinical effects of envenoming

Local (at site of bite)

- **Cyto-toxicity:** local swelling, bruising, blistering, necrosis (risk of bacterial infection)

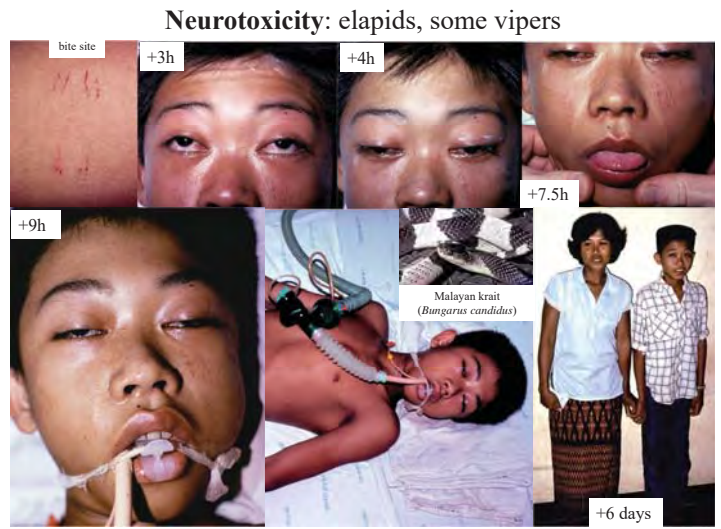
Systemic

- **Haemato-toxicity:** coagulopathy, bleeding, extravasation
- **Neuro-toxicity:** descending flaccid paralysis
- **Cardiovascular-toxicity:** arrhythmias, myocardial damage, capillary leak, hypovolaemia, shock
- **Myo-toxicity:** generalised rhabdomyolysis, hyperkalaemia
- **Nepbro-toxicity:** acute kidney injury (AKI)



Cytotoxicity: cobras, vipers

African black-necked spitting cobra (*Naja nigricollis*)



Cardiovascular-toxicity: shock often caused by hypovolaemia resulting from extravasation



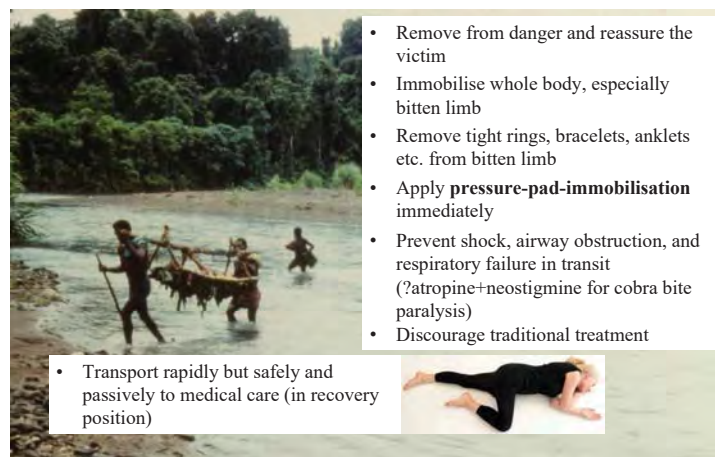
Generalised myotoxicity (rhabdomyolysis): sea-snakes and some other elapids, some vipers



Nephrotoxicity: Russell's vipers and some other vipers, elapids and colubrids



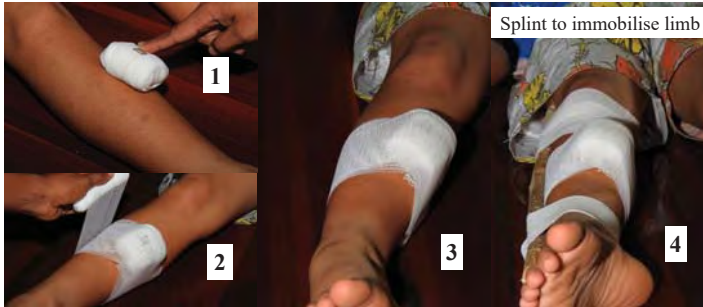
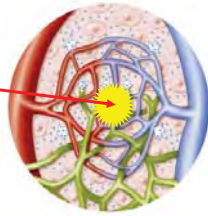
Snakebite: recommended first-aid treatment



Pressure-Pad-Immobilisation

Aim: to compress veins and lymphatics in immediate vicinity of bite, draining depot of injected venom

- Apply fist-sized (approx 3 x 3 x 2 inch) pad of any available compressible material (cloth, handkerchiefs, bandage, foam rubber) directly over the bite site
- Bind-on tightly with non-stretchy band or bandage



Acute medical treatment of snakebite patients

- Resuscitate!
- Admit all proven or suspected snakebite cases for a minimum of 24 h observation to cover late evolution of symptoms of envenoming
- Assess for signs of local and systemic envenoming (including bed-side test for coagulopathy) ?ANTIVENOM
- Try to make a species diagnosis
- Give analgesia (paracetamol/acetaminophen)
- Give tetanus toxoid booster to all cases (all bites are penetrating injuries and the injection provides reassurance)
- Beware of secondary bacterial wound infections (potentially-fatal tetanus, necrotising fasciitis, septicæmia)

Antivenom (antivenin, anti-snake venom ASV, snakebite antiserum)



- Refined IgG from hyperimmune horse/sheep plasma
- Only specific antidote to snake venoms
- Scarce, expensive, limited shelf-life, commonly causes adverse events
- Highly specific: neutralises only venom(s) used in its manufacture and those of closely-related species (para-specific activity)
- Polyvalent antivenoms - cover medically-most-important species in the region (e.g. USA CroFab and Anavip cover medically-important pit vipers)
- Monovalent antivenoms - cover one species (e.g. African boomslang)
- Venom of one species may vary throughout its geographical range – immunise with pooled venom from entire range to cover this variation

Antivenom: indications

- Shock
- Spontaneous systemic bleeding +/-
- Coagulopathy (+ve 20 minute Whole Blood Clotting Time)
- Neurotoxicity
- Black urine (rhabdomyolysis /intravascular haemolysis)
- Rapidly-progressive local swelling (especially bites on digits with known necrotic venom)



Antivenom: administration

- Check species covered and expiry date
- Same initial dose for adults and children
- No “hypersensitivity tests”! (time-wasting, useless!)
- Prophylactic adrenaline/epinephrine (adult 0.25 mg of 0.1% subcutaneously) reduces incidence of severe reactions
(de Silva et al. PLoS Med. 2011 May;8(5):e1000435.)
- Inject/infuse intravenously over 10-60 min
- Beware antivenom reactions!



Early anaphylactic antivenom reactions

R_x intramuscular 0.1% adrenaline epinephrine (0.5 mg/ml adult dose)

Early pyrogenic reactions

R_x physical cooling, antipyretics

urticaria (hives, nettle rash)

5-15th d: urticaria, arthropathy, fever, lymphadenopathy
R_x anti-histamines or corticosteroids



Life saving ancillary treatments

- Support failing systems: cardiovascular, respiratory, renal



- Except in special circumstances, **NO ROLE** for corticosteroids, anti-histamines, **anticoagulants, anti-fibrinolytics, Fresh Frozen Plasma and other blood products, plasmapheresis, prophylactic antibiotics**
- **BUT** give tetanus toxoid booster

Care of the bitten limb

- Antibiotics for 1° or 2° infection
- Early débridement, skin grafting, amputation for tissue necrosis
- **Discourage fasciotomy!**
Consider only if 1-antivenom has been given, 2-directly-measured P^{IC} exceeds threshold over 30-60 minutes, and 3-haemostasis has been restored
- Encourage early rehabilitation to restore normal function

Scorpion stings: global hot spots

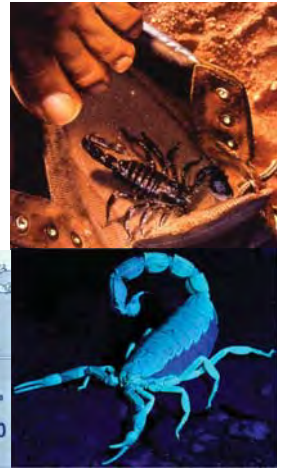
Global:
Stings >1.2 million Deaths >3,250

- **Brazil (2022)** scorpion stings: 178,261 (92 deaths)
[compare snakebites: 28,701 (92 deaths)]
- **Mexico** (250,000 stings, <50 deaths/y)
- **Iran** (?42,500 stings, ?20 deaths/y)
- North, South Africa
- India
- Southern US (Arizona)
- Trinidad



Scorpion stings: prevention

- Wear gloves or watch very carefully where you're putting your fingers/toes
- Wear solid boots, long trousers, and socks in sand or undergrowth
- Tip-out shoes and backpacks before putting them on
- Check camp site with **ultra-violet light**

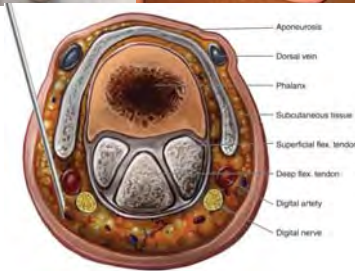
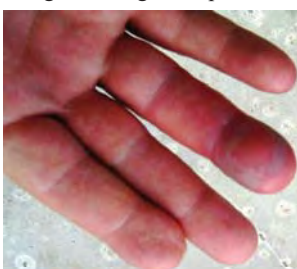
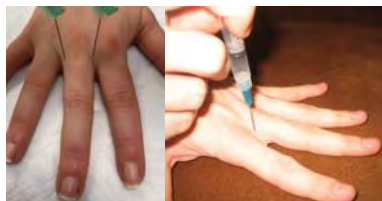


Scorpion stings: local envenoming

Usually just excruciating local pain:

Treatment

- Infiltrate with local anaesthetic (e.g. 2% lignocaine) - very effective!
- OR give strong oral opioid



Scorpion stings: systemic envenoming "Autonomic storm"

Massive release of catecholamines and acetyl choline causing sympathetic and para-sympathetic overactivity:

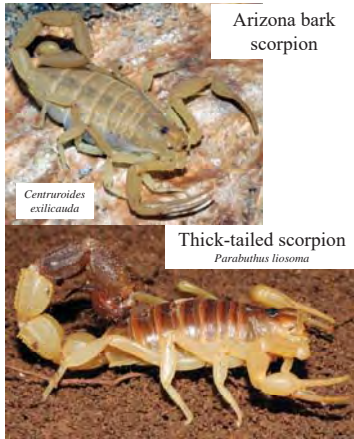
- Sweating, salivation, priapism etc.
- Cardiovascular – myocarditis, pulmonary oedema
- Gastrointestinal effects - pancreatitis



Neurotoxic scorpion sting envenoming

(in addition to autonomic excitation)

- *Centruroides* (Americas): hyperexcitability, **involuntary movements** - muscle spasms, abnormal eye movements (nystagmus, opsoclonus), tongue fibrillation, respiratory distress, convulsions, coma
- *Parabuthus* (Africa, Middle-East): hyperexcitability, **hyperaesthesia, flaccid paralysis** - ophthalmoplegia, ptosis, dysphagia, dysarthria, respiratory paralysis



Scorpion stings: treatment of systemic envenoming

- Antivenom
- Ancillary vasoactive drugs: hypertension/pulmonary oedema: vasodilators (prazosin etc.), Hypotension: dobutamine
- Cardiac intensive care

Spider bites

Necrotic:

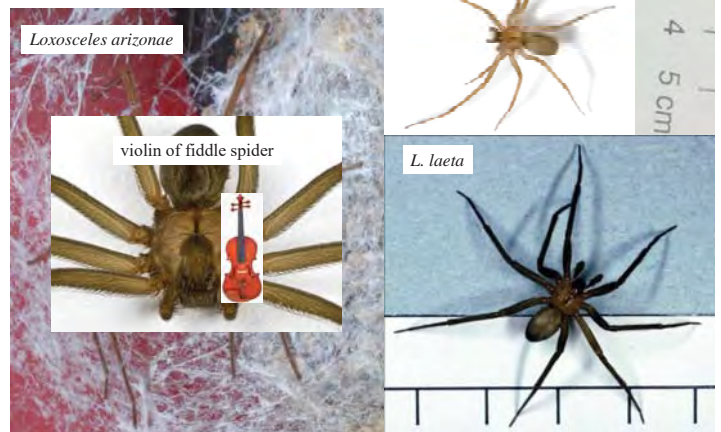
- Brown recluse spiders (*Loxosceles*)

Neurotoxic:

- Black/brown widow spiders (*Latrodectus*)
- Latin American wandering spiders (*Phoneutria*)
- Australian funnel-web spiders (*Atrax*, *Hadronyche*)



Brown recluse spiders



Cutaneous (dermonecrotic) araneism (loxoscelism)

- Initially painless
- 2-24h: progressive local discomfort, stinging/ burning pain, local erythema, itching, indurated swelling
- 12-72h: painful, tender ischaemic lesion 'red-white-and-blue' sign with serous or haemorrhagic vesicles/blisters, may spread gravitationally
- 24-48h: systemic symptoms (90%) headache, malaise, fever, myalgia, scarlatiniform/morbiliform rash (>60%)

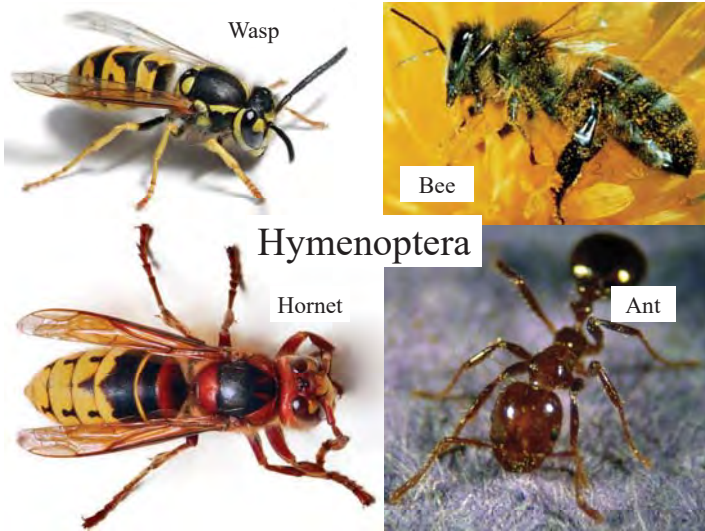
Treatment: early antivenom ?effective
No proven-effective ancillary treatment



Neurotoxic araneism

Sweating and muscle spasms
Treatment: antivenom





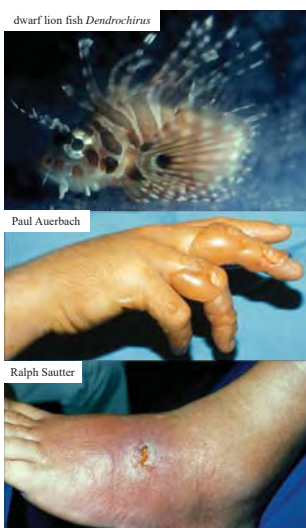
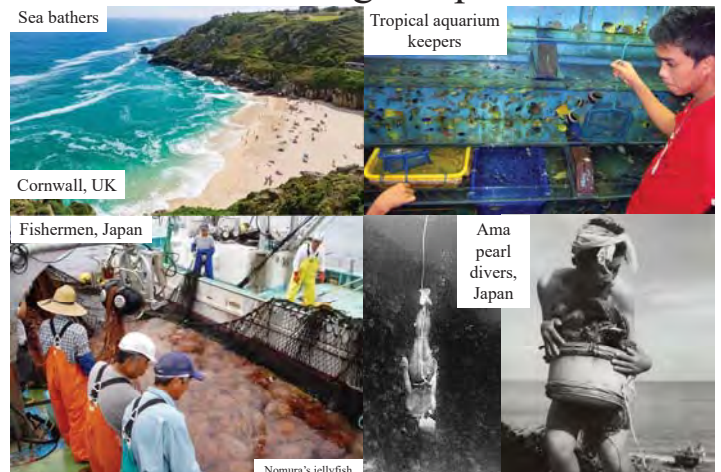
Hymenoptera stings (wasp/yellow jacket, hornet, bee, fire ant, or jack jumper ant):

- A single sting can cause fatal **anaphylaxis** in someone who has been hypersensitised by a previous sting (allergy)
- Multiple stings can cause fatal direct envenoming without prior hypersensitisation

Hymenoptera sting anaphylaxis

- Occurs in someone previously hypersensitised by (sometimes long-forgotten) wasp/yellow jacket, hornet, bee, or ant sting
- Treat with immediate im adrenaline /epinephrine 0.1% (1:1,000)
- Detect serum venom-specific IgE by radio-allergo-sorbent test (RAST)
- Confirm anaphylaxis by plasma mast cell tryptase level
- Consider desensitisation (proven effective)
- Prescribe/train to use self-injectable adrenaline/epinephrine
- Wear identifying badge

Marine stings: exposure

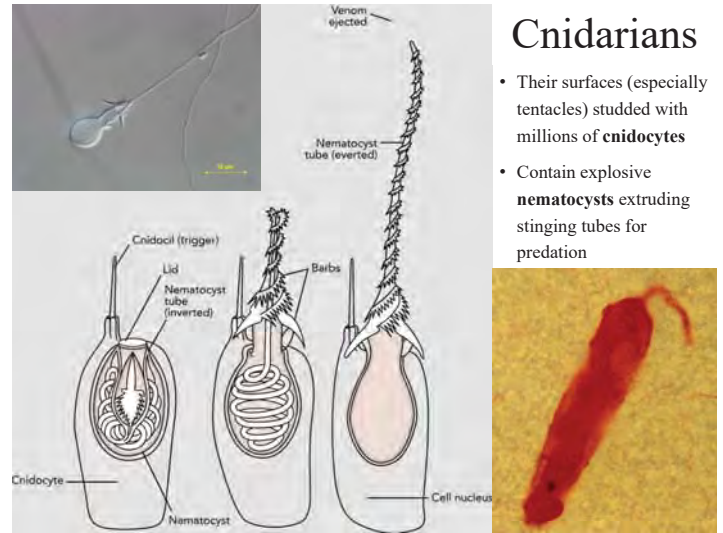
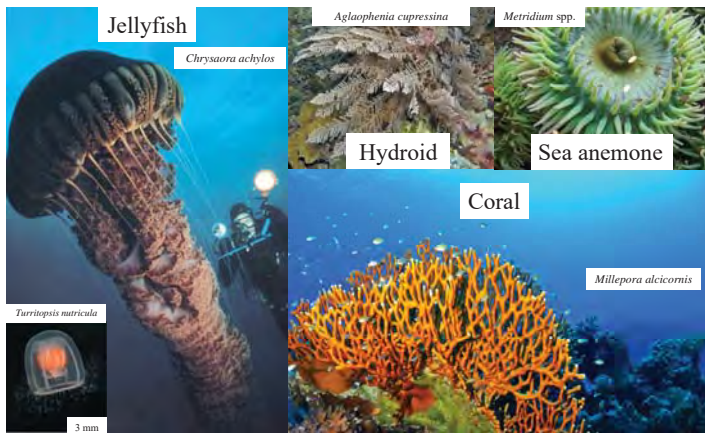


Scorpion fish stings
 Excruciating pain!
 First Aid: immerse in hot
 (not scalding!) water

Fresh water stingray (*Potamotrygon*) injury



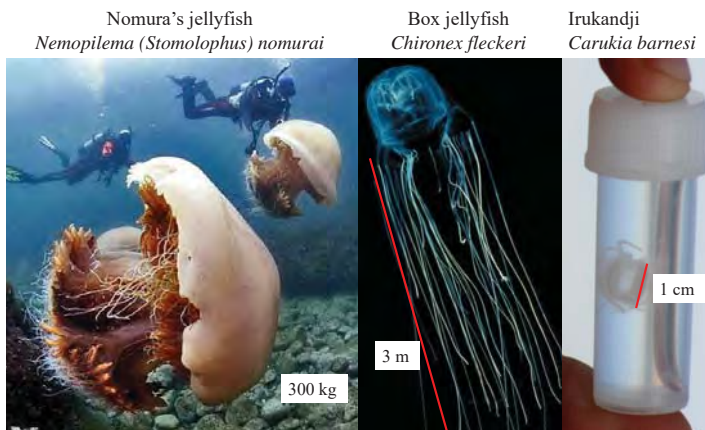
Cnidarians (Coelenterates)



Cnidarians

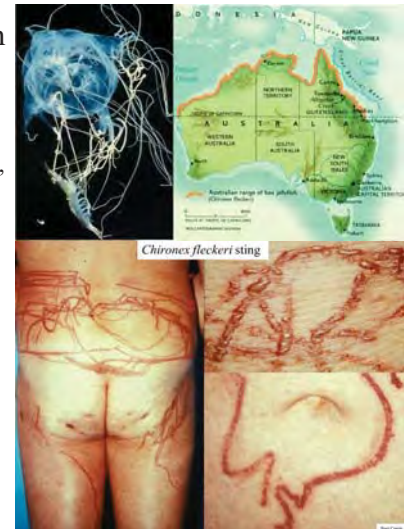
- Their surfaces (especially tentacles) studded with millions of **cnidocytes**
- Contain explosive **nematocysts** extruding stinging tubes for predation

Deadly Jellyfish (Coelenterates/Cnidarians)



Australian box jellyfish (*Chironex fleckeri*) "sea wasp"

- Intense local pain, blistering, necrosis
- Cough, nausea, vomiting, abdominal colic, diarrhoea, rigors
- Severe musculoskeletal pains
- Syncope, profuse sweating, cyanosis, generalised convulsions, pulmonary oedema, rapid cardiac arrest



Marine stings: treatment



- Remove victim from the water to prevent drowning
- Fish, sea urchin, jellyfish stings: immerse stung part in hot, not scalding, water! (<45°C) water (test on your own elbow first)
- Box jellyfish stings: wash/shave off tentacles with sea water
- **Once popular vinegar/acetic acid, alcoholic sun tan lotion, and pressure-immobilisation, may stimulate further nematocyst discharge!**
- Topical lignocaine HCl spray may relieve pain of jellyfish stings and inhibit further nematocyst discharge
- *Chironex fleckeri* "sea wasp" antivenom (CSL Seqirus Australia)
- Scorpion fish antivenom (CSL Seqirus Australia)

Jellyfish stings: Prevention

- Obey warning notices
- Look out for washed-up jellyfish before entering the sea
- Don't swim alone in tropical seas
- Wear protective clothing (wet suit, nylon tights)
- Stings, especially by Portuguese men o' war, may hypersensitise so that re-exposure will cause anaphylaxis



Venomous bites and stings: further information

WHO Publications

- snake/antivenom database <https://www.who.int/teams/control-of-neglected-tropical-diseases/snakebite-envenoming/snakebite-information-and-data-platform>
- antivenom guidelines <https://www.who.int/publications/m/item/snake-antivenom-immunoglobulins-annex-5-trs-no-1004>
- Africa snakebite guidelines <https://www.who.int/publications/i/item/9789290231684>
- South-East Asia region snakebite guidelines <http://apps.who.int/iris/handle/10665/249547>

Others

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- Vetter RS. Clinical consequences of toxic envenomation by spiders. *Toxicon*. 2018 Sep 15;152:65-70.
- Hornbeak KB, Auerbach PS. Marine Envenomation. *Emerg Med Clin North Am*. 2017 May;35(2):321-337.



- Fish poisoning:
Ciguatera
Scombroid
Tetrodotoxic
- Shellfish poisoning

Ciguatera fish poisoning

- Cause: ciguatoxins (polyethers) from 80µm dinoflagellates via tropical reef fish (e.g. grouper, red snapper, red bass, barracuda etc.)
- 50,000 - 200,000 cases/y reported
- Incubation: 1-24 (2-8) h
- Acute gastro-enteritis – then
- Paraesthesiae (extremities); reversed hot-cold sensation (“paradoxical dysaesthesia or cold allodynia”); pruritus; circumoral numbness; weakness; ataxia; myalgia (may persist for months)
- Cardiovascular: bradycardia, hypotension, hypovolaemia
- Rash
- Rarely fatal



Scombroid fish poisoning

- Cause: histamine, saurine released from dark-fleshed decaying tuna, mackerel, sardines etc. by histidine decarboxylase from enteric *Proteus*, *Morganella*
- Incubation: 1 m-2 h post-ingestion
- Histaminic (anaphylactic) symptoms
- Peri-oral tingling, burning, urticarial rash, flushing of face, neck, arms, trunk
- Diarrhoea, vomiting, abdominal pain
- Sweating, throbbing headache, palpitations, syncope, bronchospasm, angioedema
- Case fatality <1%
- Differential diagnosis: seafood allergy (?past history ?others affected)



Tetrodotoxic/Puffer fish (Japanese “Fugu”) poisoning

- Cause: tetrodotoxins (amino-perhydro quinazolines) derived from *Pseudomonas* bacteria - bind to Na⁺ channels
- Occur in many other related Tetraodontiform fish and marine invertebrates (horseshoe crabs, xanthid crabs, newts, octopuses, etc.)
- Incubation: 10 (10-45) m - 3 h
- Rapid generalised paralysis
- 7% case fatality



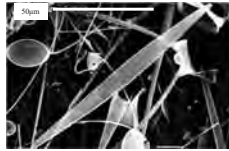
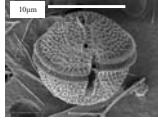
Shellfish poisoning

“Red tide” (harmful algal blooms) and animal die-offs on the beach **WARN OF INCREASED RISK!**



Shellfish Poisoning

- **Diarrhoeal:** ½ - 12 h after eating bivalves or green crabs - acute gastroenteritis only – **toxin: dinoflagellate okadaic acid**
- **Neurotoxic:** 1-3 hours after eating bivalves - paraesthesiae, cold allodynia, myalgia, vertigo, ataxia, but no paralysis - **toxin: *Karenia brevis* dinoflagellate brevetoxins – “red tide”**
- **Paralytic:** <30 min after eating bivalve mollusc (mussels, clams, oysters, cockles, scallops) and xanthid, coconut, horseshoe crabs - descending paralysis progressing to fatal respiratory paralysis < 12 h – **toxin: *Alexandrium*, *Pyrodinium*, *Gymnodinium* dinoflagellate tetrahydropurine saxitoxins and gonyautoxins – “red tide”**
- **Amnesic:** <24h after eating mussels - severe headache, short-term or permanent amnesia, agitation, seizures, coma, death – **toxin: *Pseudonitzschia* spp. diatom domoic acid**



Marine poisoning: prevention

- Don't rely on cooking – **seafood toxins are heat/acid stable!**
- Avoid very large (>10kg) tropical reef fish and high risk species
- Prevent scombroid poisoning by eating only fresh fish
- Never eat any kind of puffer (scaleless) fish
- Avoid shellfish when there are red tides, die-offs of fish, sea birds and other marine animals
- Don't swallow any seafood that makes your lips tingle! Spit it out!



190 kg

Giant Pacific grouper (*Epinephelus lanceolatus*)



30 kg

Spanish mackerel (*Scomberomorus commerson*) Cairns, Australia

Marine poisoning: treatment

General:

- If ingestion was within 1-2h - eliminate gut contents (safely!)
- Repeated doses of activated charcoal
- Hypotension: correct hypovolaemia, atropine for bradycardia

Ciguatera poisoning:

- Early IV mannitol, restore acid-base, electrolyte, fluid homeostasis
- Amitriptyline, gabapentin, pregabalin for persisting symptoms

Scombroid poisoning:

- Epinephrine/adrenaline, histamine H1 and H2 receptor blockers
- Paralytic poisonings (tetrodotoxin, shellfish):
- Respiratory paralysis: mechanical ventilation (beware of diagnosing “brain death”!)