Venomous and Poisonous animals and plants

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Animal & plant toxins

- In most instances the numbers of people affected will be small.
- There are a few instances where larger numbers may be involved – mainly due to food-borne toxins.
Venomous & Poisonous

Generally speaking *venomous* is applied to organisms that bite or sting (offensively or defensively), *poisonous* to organisms that contain substances toxic by ingestion.

Venomous & poisonous animals

- Reptiles (snakes, some lizards)
- Arthropods (scorpions, spiders, wasps, bees, centipedes)
- Mammals (very few)
- Amphibians (e.g. dart frogs)
- Aquatic animals (fish, jellyfish, octopi)

Poisonous plants

- Contact stinging (nettles, poison ivy, giant hogweed, algae)
- Poisonous by ingestion (fungi, plants, algae)
Snakes
You can easily be in the tropics for months & never see a snake!
You can easily be in the tropics for months & never see a snake!
Venomous Snakes

- About 600 species of snake are venomous (ca. 25% of all snake species)
- Of these about 250 species are medically important
- Four main groups:
  
  - *Viperidae* (viperids). **True vipers & pit vipers** (including Rattlesnakes, Gabon viper, Copperheads & Cottonmouths)
  
  - *Colubridae* (colubrids). Mostly harmless, but includes the **Boomslang**
  
Geographical distribution

- **Elapidae:**
  - On land, worldwide in tropical & subtropical regions (except Europe)
  - Sea snakes - Indian & Pacific oceans

- **Viperidae:**
  - The Americas, Africa & Eurasia.

- Boomslangs (tree snakes – *Colubridae*)
  - Sub-Saharan Africa

- **Atractaspididae:**
  - Africa & the Middle East
Snakebite

- Common & often devastating environmental & occupational disease, especially in rural areas of tropical developing countries
- Public health importance largely ignored
- Snake venoms complex & clinically challenging
- Full burden of human suffering due to snake bite not clear
- Preventive efforts should be aimed towards education of affected communities
- Production & clinical use of antivenom must be improved
  - Need increased collaboration between clinicians, epidemiologists & laboratory toxinologists

Warrell DA. *Snakebite.* Lancet 2010;375:77-88
Snakebite – a neglected tropical disease

Global numbers
5.4 million people bitten
1.8 – 2.7 million envenomings
81,000 – 138,000 deaths

Most occur in Africa, Asia & Latin America.


- Envenoming affects women, children & farmers in poor rural communities in low- & middle-income countries
- Children & the elderly most likely to die
- Many survivors permanently disabled

Most occur in Africa, Asia & Latin America.
WHO - Snakebite Envenoming.
A strategy for Prevention & Control
May 2019

World Health Assembly Resolution 2018
Addressing the burden of snakebite envenoming. WHA 71.5 Geneva WHO
Snake venoms

<table>
<thead>
<tr>
<th>Neurotoxins</th>
<th>Act on the nervous system &amp; brain</th>
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<tbody>
<tr>
<td><strong>Proteolytics (proteases)</strong></td>
<td>Break down the tissues of the area surrounding &amp; including the bite</td>
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<tr>
<td><strong>Cytotoxins</strong></td>
<td>Localized action at the site of the bite</td>
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<tr>
<td><strong>Haemotoxins</strong></td>
<td>Cause haemolysis - act on the heart &amp; cardiovascular system</td>
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**In broad terms:**

*Elapid* venoms are mainly neurotoxic

*Viperid* venoms are mainly cytotoxic/proteolytic

*Boomslang* venoms are haemotoxic
Effects of snake venoms

- *Elapid* venoms (neurotoxic)
  - disable muscle contraction
  - cause paralysis
  - death usually due to asphyxiation (paralysis of diaphragm)
Effects of snake venoms

- *Viperid* venoms (cytotoxic/proteolytic):
  - pain
  - severe local swelling
  - necrosis
  - blood loss from cardiovascular damage complicated by coagulopathy
  - disruption of blood clotting system
  - death usually caused by collapse in blood pressure.
Effects of snake venoms

- Boomslang venoms (haemotoxic)
  - Symptoms often slow to develop
    - headache
    - nausea
    - sleepiness
    - mental disorder
  - death usually due to internal & external bleeding

Venom types & effects not invariably associated with particular families of snakes
- some elapid bites include proteolytic symptoms
- some viperid bites produce neurotoxic symptoms
Symptoms & signs of snakebite

• Initial symptoms (even if no bite or no venom injected)
  – Over-breathing leading to:
    • Pins and needles in extremities
    • Stiffness of hands and feet
    • Dizziness
  – Vasovagal shock
  – Agitation, irrationality
  – Increased blood pressure & heart rate
  – Diarrhoea
  – Sweating & trembling
Symptoms & signs of snakebite with envenomation

• Local symptoms & signs
  – Fang marks
  – Pain
    • Immediate pain of bite
    • Local pain (“burning, bursting, throbbing”)
  – Local swelling extending proximally up affected limb
  – Lymphangitis & tender, painful enlargement of lymph nodes draining bite site
  – Blistering
  – Local infection
  – Necrosis

(NB. Bites of Kraits & Sea snakes may be almost painless with little swelling)
Symptoms & signs of snakebite with envenomation

- Systemic symptoms and signs
  - General
    - Nausea
    - Vomiting
    - Malaise
    - Abdominal pain
    - Weakness
    - Drowsiness
    - Prostration
Symptoms and signs of snakebite (Viperidae)

Venoms are mainly cytotoxic/proteolytic

- **Cardiovascular**
  - Visual disturbance
  - Dizziness, fainting
  - Collapse
  - Shock
  - Hypotension
  - Cardiac arrhythmia
  - Pulmonary oedema
  - Conjunctival oedema

- **Bleeding & clotting disorders**
  - Bleeding from wounds
  - Spontaneous systemic bleeding (multiple sites)

- **Extensive tissue necrosis**
  - Severe scarring
  - Possible need to amputate
Symptoms and signs of snakebite (Elapidae)

(Venoms are mainly neurotoxic]

• Neurological
  • Drowsiness
  • Paraesthesia (abnormal sensations in the skin)
  • Abnormalities of taste and smell
  • “Heavy eyelids”, ptosis
  • External opthalmoplegia
  • Paralysis of muscles innervated by cranial nerves (esp facial)
  • Nasal voice/aphonia
  • Regurgitation through nose
  • Difficulty in swallowing secretions
  • Respiratory & generalised flaccid paralysis
Key references for treatment of snakebite

Both of these are downloadable from the WHO website.
Treatment of snakebite

• Aims of initial treatment
  – Retard systemic absorption of venom
  – Preserve life & prevent complications
  – Control distressing/dangerous early symptoms of envenoming
  – Transport patient to medical care
  – DO NO HARM!
Treatment of snakebite

• Try to identify the snake
  – Important - different types of venom
  – Different anti-venins needed for different snakes

• Do not attempt to kill it
  – Danger to you

• The head of a dead snake can still envenom!
  – Do not try to cut the head off to take with you
  – Photograph snake if possible

Do not get distracted by this process & delay treating the patient!
Treatment of snakebite – First aid

• General
  – Has the person been bitten?
  – Reassure (anxiety can raise blood pressure & increase rate of distribution of venom)
  – Immobilise (lay down, immobilise affected limb in splint/sling)
  – No food – especially alcohol
  – Remove items that could constrict affected limb (clothing, jewellery etc).
  – Pressure immobilisation for elapid bites
  – Do NOT interfere with bite wound:
    • Incision
    • Rubbing, massage
    • Vigorous cleaning, application of potassium permanganate
    • Sucking (either by mouth or pump – ineffective and dangerous to all involved!)
    • Electroshock therapy

• Tourniquets not recommended

• Risk of fatal respiratory paralysis or shock
  – Rapid transport to hospital
Treatment of snakebite - general

• Do you need to & can you transport the patient to higher levels of the health service?

• Analgesia (oral or parenteral) (not aspirin or NSAIDs - can cause bleeding)

• Treat for hypovolaemic shock

• Antivenom treatment

• Respiratory paralysis - $O_2$ by mask or ventilate

• Acute renal failure - peritoneal dialysis

• Severe bleeding - blood transfusion

• Discourage the use of ineffective & potentially harmful drugs (e.g. corticosteroids, antihistamines, heparin)
Treatment of the bitten limb

- May be painful & swollen
- Nurse in the most comfortable position
- Do not elevate excessively
  - may reduce arterial perfusion pressure & increase risk of intra-compartmental ischaemia
- Bullae may be large & tense - only aspirate if seem likely to rupture
Pressure immobilisation

• Contain venom within a bitten limb & prevent it from moving through the lymphatic system
  – pressure prevents lymphatic drainage
  – immobilization prevents pumping action of muscles

• Not suitable for cytotoxic bites (*viperidae*)

• May be effective against neurotoxic venoms (*elapidae*) - prevent rapid onset of respiratory paralysis
Pressure immobilisation

- Bind bandage around affected limb starting distally
- Include a rigid splint
- Bind firmly but do not occlude peripheral pulse
- DO NOT REMOVE BINDING until patient is at treatment centre & anti-venom treatment has begun
  (Can cause a flood of venom into the system)
Anti-venoms (anti-venins)

- May not be easily available
- Usually made by (relatively) local labs for local species
- Divided into:
  - monovalent (effective against a single species)
  - polyvalent (effective against several different species)
- Produced in suitable animals (horse, sheep)
- Some are freeze dried, some need refrigeration
- Injected IV
- *Cannot undo damage already caused by venom*
- Can cause immediate or delayed hypersensitivity reactions
Spitting cobra envenomation

- Africa & Asia
- Can spray venom forwards up to 2 metres
- Aim for the eyes
- Can deliver standard bite
- Venom contains neurotoxins & strong cytotoxins
- Treatment:
  - Eyes
    - Wash with copious amounts of water
    - 0.5% adrenaline drops
    - Fluorescein or slit lamp examination
    - Topical antimicrobials (tetracycline or chloramphenicol)
    - Topical cycloplegic drops
    - Do not instil diluted antivenom
  - Normal bite
    - Treat appropriately
Other venomous reptiles

1. Mexican beaded lizard
2. Guatemalan beaded lizard
3. Gila monster
4. Komodo dragon?
Arthropods

- Insects – bees, wasps, hornets
- Scorpions
- Spiders
- Centipedes
Scorpions

- Only 25/1000 known species are dangerous to humans
- Venom - mixture of compounds (neurotoxins, enzyme inhibitors, etc.) each with a different effect
- Major public health problem in underdeveloped tropical countries
- Estimated number of scorpion stings - 1.2 million/yr; 3250 deaths (0.27%)
- “For every person killed by a poisonous snake 10 are killed by a scorpion”
Treating scorpion stings

- Symptoms include
  - Pain at site of sting
  - Profuse sweating
  - Salivation
  - Difficulty swallowing
  - Blurred vision
  - Seizures
  - Difficulty breathing

- First aid is generally symptomatic:
  - Strong analgesia (Systemic [opiates, paracetamol etc])
  - Treat hypertension (anxiolytics & vasodilators)

- Antivenoms available for some species
Hymenoptera
(Bees, wasps, hornets, ants)

• Bee stingers remain in the wound – try to flick out asap - takes ca. 1 min for all venom to go in
  – Do not squeeze stinger – can force venom in!
  – Bee venom is acidic (formic acid)

• Wasp & hornet stingers do not stay in the wound.
  – Wasp venom is neutral (mix of toxins)
  – Sting of Asian Giant Hornet can be fatal (neurotoxin)

• Treatment
  – Elevate affected limb
  – Cold compress
  – Analgesics
  – Antihistamines
  – Some get anaphylactic reactions & should carry epinephrine (EpiPen)
Ants

• Only a few species are poisonous to humans

• Fire ants are the most toxic
  – Venom composed of alkaloids
  – Can cause painful & irritating swellings
  – Some people are allergic to the venom – anaphylaxis

• First aid for fire ant bites includes:
  – external antihistamine or topical corticosteroids
Centipedes

Bites can cause:

– Severe pain (usually in proportion to size of centipede)
– Local itching & burning
– Tissue swelling
– Swollen, painful lymph nodes in region of bitten limb
– Headache
– Palpitations
– Nausea & vomiting
– Anxiety
– Anaphylactic reactions in some individuals
Treating centipede bites

Treatment:

- Reassurance

- Pain relief
  - NSAIDs
  - Antihistamines
  - Anti-anxiety treatments
  - Severe case - elevate the affected limb & give a diuretic

- Wound care - prevent infection

- Watch for symptoms of anaphylaxis & treat
Spiders

• Venoms can be:
  
  – **Neurotoxic** (e.g. Black widow)
    
    • Can affect respiration
    
    • Latrodectism – bite of the Black widow spider.
      
      – Venom causes severe tetany
      
      – Rarely: altered heart rate, renal failure, myocarditis, paralysis, death.
  
  – **Necrotic** (Sand spiders, recluse spiders)
    
    • Can cause:
      
      – severe dermonecrotic lesions
      
      – renal failure
    
    • Some species can cause:
      
      – haemolysis
      
      – thrombocytopenia,
      
      – DIC
    
    • Occasionally fatal

• Antivenoms available for some species
• Necrosis can be difficult to treat
• Otherwise treat symptomatically
Arthropod bites & stings can become infected

- Arthropod bites & stings can become infected if bacteria are driven into the wound
- Erysipelas & cellulitis are common following such injuries
Venomous mammals

• Platypus

• (Vampire bats
  – toxic saliva with anticoagulant properties)

• (Slow Loris
  – saliva and brachial gland exudate)

• Insectivores (shrews, moles, hedgehogs)
Platypus

• Male platypus can deliver venom via its ankle spurs

• Venom not lethal to humans - causes excruciating & incapacitating pain

• Pain develops into a long-lasting hyperalgesia (heightened sensitivity to pain) that may persist for months
Venomous & poisonous marine creatures
The most toxic marine creatures of all?

- Puffer fish (fugu)
  - (poisonous)

- Blue ringed octopus
  - (venomous)

**Tetrodotoxin**
- Lethal neurotoxin
  - Ca. 100x as poisonous as cyanide
  - Paralysis of diaphragm & respiratory failure
  - No known antidote
Venomous & Poisonous Fish

• Some are venomous by contact
  (e.g. Stonefish, Stingray, Lionfish, Scorpionfish)

• Some are potentially poisonous by ingestion
Treatment for fish envenomation (Stonefish, scorpionfish, lionfish, stingray)

- Apply hot water to injured area [temperature no lower than 45°C]
- Analgesia as appropriate (check with local medical services)
- **Stone fish**
  - Antivenom is available
- **Stingray, scorpionfish, lionfish**
  - No antivenoms
  - Stingray - risk of infection
Scombrotoxin poisoning

– Produced by the action of bacteria on the skin of Scombroid fish (e.g. Mackerel, tuna, sardines)

– Thermostable toxin containing histamine – symptoms are of histamine poisoning
  • rash on face, neck & upper chest
  • flushing
  • sweating
  • nausea
  • headache
  • dizziness
  • palpitations

– Treat with anti-histamine
Ciguatera poisoning

- Poisonous protozoa → eaten by herbivorous fish → eaten by carnivorous fish (barracuda, grouper, snapper) → eaten by humans

- Thermostable highly potent sodium channel toxins
  - GI symptoms
  - Neurological symptoms
    - Headache
    - Muscle aches
    - Paresthesia
    - Numbness
    - Ataxia
  - Symptoms can last months or years & can recur (especially if fish, nuts or alcohol are ingested)

- No specific treatment
  - Supportive care
  - Amytriptyline
  - IV Mannitol?
  - Calcium channel blockers?
Jellyfish

• Venoms of most species affecting humans are painful rather than fatal

• Especially dangerous are the box jellyfishes
  – Of these the worst is the Sea Wasp, *Chironex fleckeri* (W.Pacific)
Treatment of jellyfish stings

• Apply vinegar

• Try to remove any remaining tentacles (protect hands or use inert object)

• Do NOT use:
  – Alcohol
  – Fresh water
  – Suntan lotion
  – Kerosene
  – Meat tenderiser
  – Lemon juice
  – Sand
Treating box jellyfish stings

- Apply vinegar
- Then remove any remaining tentacles (protect hands/use inert object)
- Do NOT use pressure bandages
- Cardiac arrest can occur quickly, apply CPR if required
- Give *Chironex fleckeri* antivenin
- Supportive treatment
- Can cause serious scarring
Molluscs

Blue ringed Octopus

- Pacific ocean
- Tiny (6-8 cm)
- One of the most poisonous animals known
- Venom is a mixture, primarily a tetrodotoxin (neurotoxin)
- Bites are tiny, often painless
- Onset of respiratory depression & paralysis is the first symptom!
Molluscs

Cone shell

- Tropical seas
- Attractive and “collectable”
- Some highly venomous
- Symptoms can start immediately or can be delayed in onset for days and include:
  - Intense, localized pain
  - Swelling
  - Numbness & tingling
  - Vomiting
  - Muscle paralysis
  - Vision changes
  - Respiratory paralysis
Treatment

• **Blue ringed octopus**
  – First aid
    • pressure on the wound
    • artificial respiration if respiratory muscles paralysed (often within minutes of bite)
    • continue until the victim can breathe on their own (hours)
  – Hospital treatment - ventilate until paralysis subsides
  – No antivenom available

• **Cone shell**
  – No antivenom available
  – Life support until venom is metabolised by victim
Animal bites

- Many animals can readily cause infection by biting
- Some infections (e.g. Rabies) are transmitted by bites
- Carnivorous mammals are particularly dangerous due to the wide range of oral bacteria
Cat bites are worse than those of dogs

• Cats’ teeth are sharp & can penetrate very deeply, into joints & tendon sheaths.

• Mixtures of bacteria can be injected
  – Aerobes & anaerobes may be present
  – *Pasteurella multocida* can cause cellulitis, osteomyelitis, endocarditis & meningitis

• Of 193 Mayo Clinic patients with cat bites to the hand:
  – 57 were hospitalized (for an average of 3 days)
  – 38/57 needed wound debridement
  – 8 needed more than one operation
Poisonous plants

• Many species

• Some injure by contact
  – Stinging nettle
  – Poison ivy

• Many contain substances poisonous by ingestion
  – Cassava
  – Deadly nightshade
  – Fungi

• Get information on potential hazards before you travel & after arrival
Plants able to damage by contact

- Nettles (stinging cells containing formic acid)
- Giant hogweed (phototoxic sap causes dermatitis)
- Poison ivy (causes contact dermatitis)
Poisonous plants: Cassava

- Roots & leaves contain two cyanogenic glucosides.
  - Root must be processed (soaking, cooking, fermentation, etc.) to remove toxins

- Cassava grown during drought may have unusually high levels of toxin

- Eating poorly processed cassava results in simultaneous malnutrition & high cyanide intake

- Leads to Konzo - a debilitating, irreversible paralytic disorder
  - Symptoms include paralysis (spastic paraparesis), vertigo, vomiting & collapse
  - Supportive treatment, rehabilitation & walking aids
Fungi

• Toxic forms may resemble edible species

• Deathcap (*Amanita phalloides*)
  – Toxin damages liver & kidneys
  – Can be fatal (30gm)
  – Initial GI symptoms (diarrhoea, vomiting – may become life threatening)
  – Liver & renal failure can occur
  – Death in 6 - 16 days
  – Treatment - four main categories:
    • preliminary medical care
    • supportive measures
    • specific treatments
    • liver transplant
Algal blooms

- May contain toxic organisms

- Drinking water can become contaminated & toxic
  - Nausea, headaches vomiting, diarrhoea, dehydration, liver toxicity (?fatal)
  - Skin rashes, irritation of eyes, nose, mouth, throat.

- Eating fish or shellfish from waters contaminated by blooms can be dangerous:
  - Accumulation of toxins in shellfish can lead to:
    - Amnesic shellfish poisoning
    - Diarrhetic shellfish poisoning
    - Neurotoxic shellfish poisoning
    - Paralytic shellfish poisoning
What is dangerous where you are going?

- Always seek advice
  - Before travel:
    - From embassy of country
    - From the web
  - On arrival
    - From local medical services
    - From your own embassy
    - From locals

- Find out what treatment is available locally
  - In hospitals
  - In medical centres
  - For purchase
Risks

• Warn your team about risks

• Be aware of risks to client population
  – What is common?
    • most likely to affect individuals & therefore cases you are likely to see
  – What is particularly dangerous?
    • may need
      – very urgent treatment
      – special arrangements for evacuation
      – supplies of antivenoms or other drugs etc.
  – Is there anything likely to cause large numbers of casualties?

• Consider need to provide health education material for client population
Any Questions?