

# Venomous animals

David A Warrell

## Abstract

Every year, snake-bites kill more than 100,000 people, while survivors suffer physical and mental sequelae; insects cause over 5000 anaphylactic deaths, scorpion-stings kill more than 1000 and spiders and jellyfish kill hundreds. Aquatic venomous animals include sea-snakes, fish, jellyfish, corals, cone shells, blue-ringed octopuses and sea urchins. Specific antidotes – hyperimmune serum antivenoms – are manufactured for serious envenoming. Adrenaline (epinephrine) is essential treatment for anaphylaxis. Cardiorespiratory and kidney failure require supportive treatment. Surgical intervention is rarely needed. Prevention is all important; community education can reduce risk by encouraging the use of protective clothing, lights after dark, bed nets and urgent medical treatment rather than traditional remedies.

**Keywords** antivenom; antivenom reactions; autonomic storm; haemostatic disturbances; hot water treatment; hymenoptera sting anaphylaxis; neurotoxicity; prevention; respiratory paralysis; rhabdomyolysis; soft tissue necrosis

## Snake bites

### Epidemiology and importance

Medically important snakes belong to four families: elapids (African and Asian cobras, Asian kraits, African mambas, American coral snakes, Australian and New Guinean venomous snakes, sea-snakes), vipers (Old World vipers and adders, and pit vipers, including American rattlesnakes and Asian pit vipers), atractaspids (African and Middle-Eastern burrowing asps) and colubrids (African boomslang and twig snakes and Asian keelbacks). Each year, 46,000 people are killed in India<sup>1</sup> and 6000 in Bangladesh;<sup>2</sup> global totals exceed 100,000. West Africa, South and South-East Asia, New Guinea and the Amazon region are hyperendemic.

### Clinical features

The main effects of envenoming are:<sup>3–9</sup>

- local pain, bleeding from fang punctures, spreading swelling, bruising, blistering (Figure 1), lymphangitis, regional lymph node enlargement and local necrosis
- anti-haemostatic disturbances:<sup>10</sup> consumption coagulopathy, thrombocytopenia, spontaneous systemic bleeding from the gums (Figure 2), nose, skin, gut, genitourinary tract, intracranial haemorrhage and thrombosis, and thrombotic microangiopathy
- shock (hypotension) and myocardial damage
- a generalized increase in capillary permeability (Russell's vipers): albuminuria, haemoconcentration, serous

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## What's new?

### Snake bites:

- Prioritization of pressure pad immobilization first aid
- Expanded clinical spectrum (e.g. cerebral thrombosis, microangiopathic haemolysis, capillary leak syndrome)
- Prevention – community education and accelerated transport to medical care have proved effective in Nepal
- Reducing risk of antivenom reactions
- Aquatic bites and stings: updated first aid

effusions, pulmonary oedema, retinal macular oedema, glaucoma, bilateral parotid enlargement, chemosis (Figure 3) and facial swelling<sup>6</sup>

- symmetrical descending paralysis: progressing from bilateral ptosis and external ophthalmoplegia (Figure 4) to bulbar, respiratory muscle and total flaccid paralysis
- generalized rhabdomyolysis with myoglobinuria
- intravascular and microangiopathic haemolysis
- acute kidney injury.

### First aid

#### Must do –

- reassure – even the most venomous species can bite without injecting harmful amounts of venom ('dry bites')
- immobilize the whole patient, especially their bitten limb (see pressure-immobilization methods, below)
- remove tight rings, bracelets, anklets, bands, clothing, etc. from the bitten limb
- transport to medical care as quickly, safely and passively as possible, avoiding early death from shock, aspiration of vomit or respiratory obstruction/paralysis.

#### Must not do –

- use traditional methods, such as incision, suction, tourniquet, electric shock, cryotherapy, instillation of chemicals and herbs, and snake stones, all of which are useless and potentially harmful
- give aspirin or non-steroidal anti-inflammatory agents, which exaggerate haemostatic problems
- attempt to pursue or kill the snake.

**Pressure-immobilization methods** (Figure 5)<sup>3,11,12</sup> delay the systemic absorption of lethal venom toxins by compressing the lymphatics and veins draining the bite site, using pressures below arterial (50–70 mmHg) to avoid unacceptable dangers of arterial tourniquets.

**Pressure pad** – a rubber and/or folded material pad approximately 5 cm<sup>2</sup> and 2–3 cm thick is bound firmly, directly over the bite site, using a non-elastic bandage and immobilizing the bitten limb with a splint.<sup>11</sup>

**Pressure bandage** – elasticated (not crepe) bandages, approximately 10–15 centimetres wide and 4.5 metres long are bound firmly around the entire bitten limb (but not so tightly as to occlude the peripheral pulses) incorporating a splint, starting around the fingers or toes and extending proximally, up to the axilla or groin.<sup>3,12</sup>



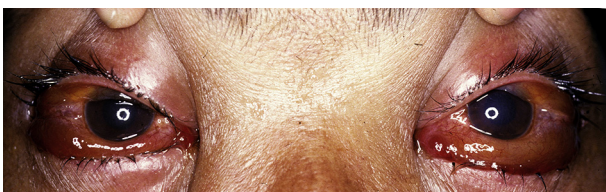
**Figure 1** Swelling, blistering and local bleeding after a bite above the ankle (fang punctures circled) by a Malayan pit viper (*Calloselasma rhodostoma*) in Southern Thailand. Copyright of Professor David A Warrell.



**Figure 4** Bilateral ptosis, external ophthalmoplegia and facial paralysis in a boy bitten by a death adder in Papua New Guinea (*Acanthophis* species). Copyright of Professor David A Warrell.



**Figure 2** Bleeding from the gums following a bite by a jararaca (*Bothrops jararaca*) in São Paulo, Brazil. Copyright of Professor David A Warrell.



**Figure 3** Bilateral chemosis (conjunctival oedema) in a victim of Russell's viper (*Daboia siamensis*) bite in Myanmar – evidence of a generalized increase in capillary permeability. Copyright of Professor David A Warrell.

**Principles of hospital treatment**

- Rapid assessment and resuscitation
- Reassurance and analgesia (paracetamol, codeine phosphate, other opioids)
- Species diagnosis
- Simple test of blood coagulability (e.g. 20-minute whole blood clotting test)<sup>13</sup>
- Is antivenom indicated? – calculate initial and repeated dosage, assess the response, anticipate and treat any reactions

- Support failing organs/systems
- Treatment of the bitten limb
- Rehabilitation – restoration of function
- Advice to the victim on how to reduce the risk of future bites.

**Indications for antivenom:** any of the following:

- spontaneous systemic bleeding (see above)
- incoagulable blood indicating consumption coagulopathy: blood fails to clot when placed in a new, clean, dry, glass tube and left undisturbed for 20 minutes;<sup>13</sup> other laboratory tests can also be used (e.g. international normalized ratio (INR) but not 'point-of-care' bedside INR or D-dimer devices, which are unreliable in snake-bite envenoming)
- shock: low or falling blood pressure or cardiac arrhythmia
- paralysis
- black urine positive for blood, haemoglobin or myoglobin (indicating rhabdomyolysis or haemolysis)
- local swelling: rapidly advancing, involving more than half the bitten limb or fingers and toes after bites by species whose venoms are known to cause necrosis.

Mild local swelling alone is not an indication for antivenom.

**Adrenaline prophylaxis:** adrenaline (epinephrine) (adult dose 0.25 millilitres of 0.1% solution) given subcutaneously before the start of antivenom infusion reduces the risk of serious early (anaphylactic) antivenom reactions.<sup>14</sup> During the hours after antivenom treatment, adrenaline should be readily available to treat anaphylaxis.<sup>6,7</sup>

**Antivenom:**<sup>15</sup> most antivenoms are raised against the venoms of medically important venomous species of a defined region to provide polyspecific/polyvalent cover that neutralizes the venoms of these and a few closely related species. Monospecific/monovalent antivenoms are raised against one venom and can be used only if the snake is identified, a distinctive syndrome of envenoming develops or only one species inhabits the region

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