Envenomation

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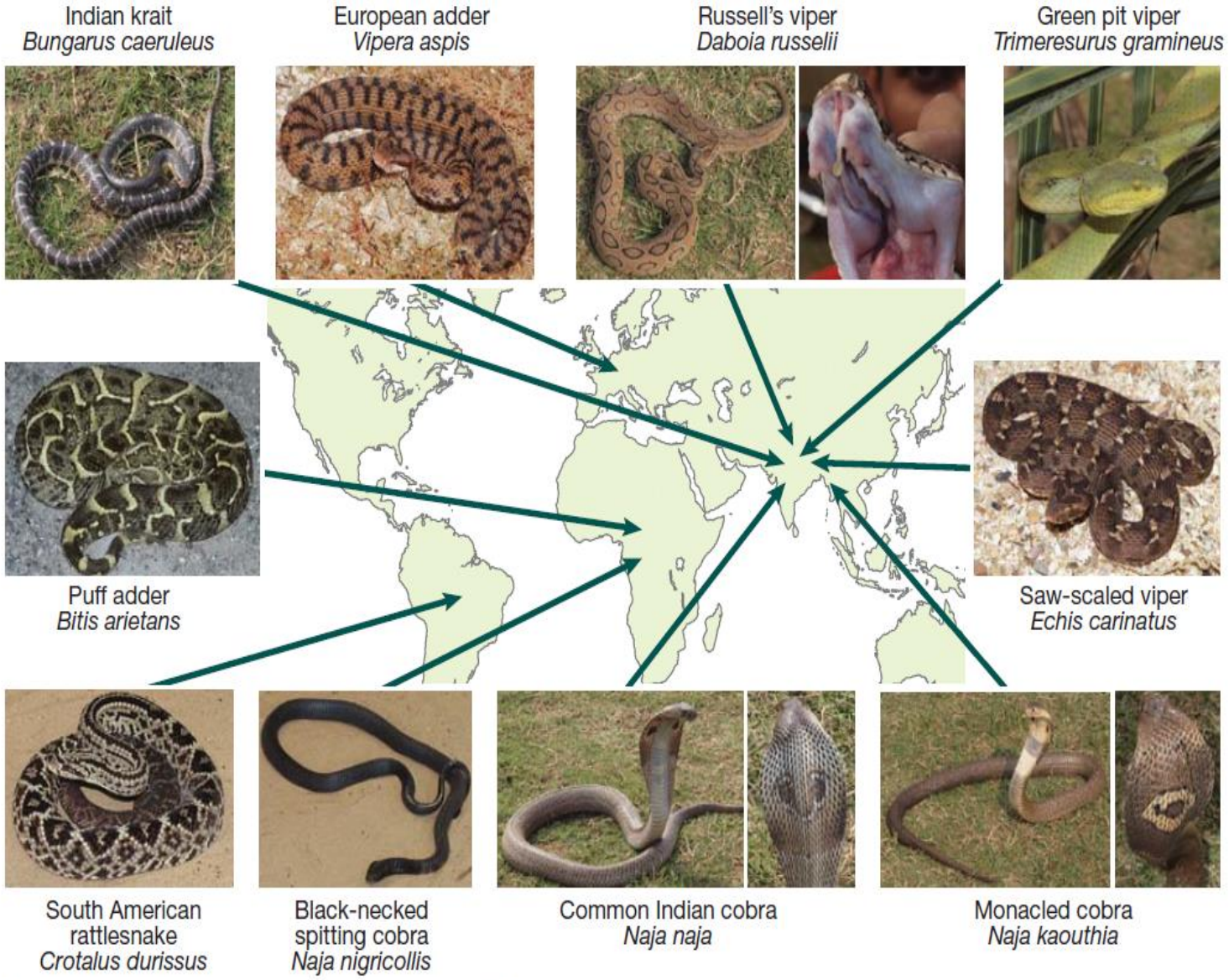
- Envenomation occurs when a venomous animal injects sufficient venom by a bite or a sting into a prey item or perceived predator to cause deleterious local and/or systemic effects. This is defined as a venom-induced disease (VID).

- Accidental encounters between venomous animals and humans are frequent, particularly in the rural tropics, where millions of cases of venomous bites and stings occur annually.



The geographical location of a snakebite determines the likely animal(s) involved and the nature and risks of the envenomation. *Copyright © Julian White.*

- Venom is a complex mixture of diverse components (notably toxins), often with several separate toxins that can cause adverse effects in humans, and each is potentially capable of multiple effects.

- Only some bites/ stings by venomous animals result in significant envenoming, the remainder being 'dry bites'.

- The concept of dry bites is important in understanding approaches to first aid and medical management.

8.1 Key venom effects*

Venom component	Clinical effects
Neurotoxin	
Paralytic	Flaccid paralysis
Excitatory	Neuroexcitation: autonomic storm, cardiotoxicity, pulmonary oedema
Myotoxins	Systemic or local myolysis
Cardiotoxins	Direct or indirect cardiotoxicity; cardiac collapse, shock
Haemostasis system toxins	Variation from rapid coagulopathy and bleeding to thrombosis, deep venous thrombosis and pulmonary emboli
Haemorrhagic toxins	Local vessel damage, fluid extravasation, blistering, ecchymosis, shock
Nephrotoxins	Renal damage
Necrotoxins	Local tissue injury/necrosis, shock
Allergic toxins	Induction of acute allergic response (direct and indirect)

*All venom components have lethal potential.

Clinical Effects:

Trivial to severe effects

Nonspecific

Important in diagnosis &treatment

8.3 Local and systemic effects of envenomation

Local effects

- Pain
- Sweating
- Erythema
- Major direct tissue trauma (e.g. stingray injuries)
- Blistering
- Necrosis
- Swelling
- Bleeding and bruising

Non-specific systemic effects

- Headache
- Nausea
- Vomiting and diarrhoea
- Abdominal pain
- Tachycardia or bradycardia
- Hypertension or hypotension
- Pulmonary oedema
- Dizziness
- Collapse
- Convulsions
- Shock
- Cardiac arrest

Specific systemic effects

- Neurotoxic flaccid paralysis (descending or ascending)
- Excitatory neurotoxicity (catecholamine storm-like and similar)
- Rhabdomyolysis (systemic or local)
- Coagulopathy (procoagulant/fibrinolytic or anticoagulant or thrombotic or antiplatelet)
- Cardiotoxicity (decreased/abnormal cardiac function or arrhythmia or arrest)
- Acute kidney injury (polyuria or oliguria or anuria or isolated elevated creatinine/urea)

General approach to the envenomed patient:

First aid: 👩‍⚕️👩‍⚕️

- ❑ It is recommended that for most forms of envenoming, the patient should be kept still, the bitten limb immobilised with a splint and vital systems supported, where required.
- ❑ A patent upper airway should be specifically ensured and respiratory support provided, if required.
- ❑ For some animals, notably snakes in certain regions, the use of a local pressure pad bandage over the bite site (Myanmar) or a pressure immobilisation bandage (Australia, New Guinea) is recommended.
- ❑ Ineffective or dangerous first aid, such as suction devices, 'cut and suck', local chemicals, snake stones (stones of some sort placed over the snakebite) and tourniquets, should not be used.
- ❑ Tourniquets, in particular, have the potential to cause catastrophic distal limb injuries in snakebite when applied too narrowly or too tightly, or left on too long.

Transporting patients:

- ❑ Transport should be brought to the patient.
- ❑ Obtain medical assessment and intervention at the earliest opportunity, so any delay in transporting the patient to a medical facility should be avoided.
- ❑ Severely envenomed patients may develop life-threatening problems, such as shock or respiratory failure, during transport, so ideally the transport method used should allow for management of these problems en route.

Assessment and management in hospital:

- On arrival at a health station or hospital, there are two immediate priorities:

I. Identifying and treating any life-threatening problems (e.g. circulatory shock, respiratory failure).
II. Determining whether envenoming is present and if that requires urgent treatment.

Assessment and management of life-threatening problems:

- Patients who are seriously envenomed must be identified early so that appropriate management is not delayed.
- Critically ill patients must be resuscitated and this takes precedence over administration of any antivenom.
- Clinicians should look for signs of:

1. shock/hypotension.
2. airway and/or respiratory compromise (likely to be secondary to flaccid paralysis).
3. major bleeding, including internal bleeding (especially intracranial).
4. impending limb compromise from inappropriate first aid (e.g. a tourniquet) – though beware sudden envenoming on removal of a tourniquet.

- In a patient with severe neurotoxic flaccid paralysis, who is still able to maintain sufficient respiratory function for survival, clinical assessment may suggest irretrievable brain injury (fixed dilated pupils, absent reflexes, no withdrawal response to painful stimuli, no movement of limbs, fixed forward gaze with gross ptosis) when, in fact, the patient is conscious.

Assessment for evidence of envenoming:

- Comprehensive assessment of a patient bitten/stung by a venomous animal requires a good history, a careful targeted examination and, where appropriate, ‘laboratory’ testing.
- Animals that are unlikely to cause serious envenomation in humans should be identified so that inappropriate admission and intervention are avoided.
- Patients may be unaware they have been bitten/stung and thus provide a misleading history.
- Multiple bites or stings are more likely to cause major envenoming.

HISTORY:

The following key questions should be asked:

- ❑ When was the patient exposed to the venomous bite/sting?
- ❑ Was the organism causing it seen and what did it look like (size, colour)?
- ❑ What were the circumstances (on land, in water etc.)?
- ❑ Was there more than one bite/sting?
- ❑ What first aid was used, when and for how long?
- ❑ What symptoms has the patient had (local and systemic)?
- ❑ Are there symptoms suggesting systemic envenoming (paralysis, rhabdomyolysis, coagulopathy etc.)?
- ❑ Is there any significant past medical history and medication use?
- ❑ Is there a past exposure to antivenom/venom and allergies?

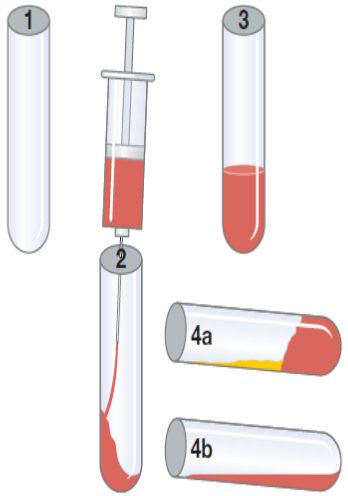
- Even with dangerously venomous animals, some bites/stings will be dry bites and will not require antivenom.
- The time to onset of first symptoms and signs of envenomation is variable, depending on both animal and patient factors.
- It may range from a matter of minutes post-bite/sting to 24 hours later in some cases.
- The initial assessment, if normal, must be repeated multiple times during the first 24 hours.
- Some types of envenomation will not cause symptoms or signs at all, or they may appear very late, long after the optimum time for treatment has passed.
- Evidence of envenomation may become apparent only through laboratory testing.

Laboratory investigations:

- ❑ Specific tests for venom are currently commercially available only for Australian snakebites but are likely to be developed for snakebites in other regions.
- ❑ For snakebite, a screen for envenoming includes full blood count, coagulation screen, urea and electrolytes, creatinine, CK and electrocardiogram (ECG).
- ❑ Lung function tests, peripheral oximetry or arterial blood gases may be indicated in cases with potential or established respiratory failure.
- ❑ In areas without access to routine laboratory tests, the 20-minute whole-blood clotting test (20WBCT) is useful.

Bedside tests in the envenomed patient

Examination of urine. Haematuria may indicate a coagulopathy. Dark urine is suggestive of myoglobinuria, which is a sign of extensive rhabdomyolysis. *Copyright © Julian White.*



1 Obtain a clean **glass** container (test tube or bottle) that is either new, or has only been washed with water (not detergent/soap)

2 Place 2–3 mL venous blood in the **glass** container

3 Allow to stand undisturbed for 20 mins

4 Gently invert/tip the glass container checking for presence of a blood clot

4a Clot present = negative test (no coagulopathy present)

4b Clot absent = positive test (coagulopathy present)

Twenty-minute whole-blood clotting test (20WBCT). The presence of coagulopathy is a key indicator of major envenoming for some species. While full laboratory coagulation studies may be the ideal, the 20WBCT has emerged as a simple standardised bedside test of coagulopathy, applicable even in areas with limited health facilities. *Copyright © Julian White.*

Treatment:

- Once a diagnosis of likely envenoming has been made, the next and urgent decision is whether to give antivenom.
- Antivenom may not be the only crucial treatment.
- For a snakebite by a potentially lethal species such as Russell's viper, the patient might have local effects with oedema, blistering, necrosis, and resultant fluid shifts causing shock, and at the same time have systemic effects such as intractable vomiting, coagulopathy, paralysis and secondary renal failure.
- Specific treatment with antivenom will be required to reverse the coagulopathy and may prevent worsening of the paralysis and reduce the vomiting, but will not greatly affect the local tissue damage or the renal failure or shock. The latter will require intravenous fluid therapy, possibly respiratory support, renal dialysis and local wound care, perhaps including antibiotics.
- Each venomous animal will cause a particular pattern of envenomation, requiring a tailored response.

Antivenom:

- It is made by hyperimmunising an animal, usually horses, to produce antibodies against venom. Once refined, these bind to venom toxins and render them inactive or allow their rapid clearance.
- Antivenom is available only for certain venomous animals and cannot reverse all types of envenoming.
- With a few exceptions, it should be given intravenously, with adrenaline (epinephrine) ready in case of anaphylaxis. It should be used only when clearly indicated, and indications will vary between venomous animals.

8.7 Indications for antivenom

General indications

- Shock/cardiac collapse
- Respiratory compromise
- Rapidly increasing swelling of the bitten limb
- Active bleeding
- Intractable non-specific symptoms, including recurrent vomiting

Specific indications

- Developing paralytic features (ptosis etc.)
- Developing rhabdomyolysis
- Developing coagulopathy
- Developing renal failure
- Developing neuroexcitatory envenoming

Non-antivenom treatments:

- Anticholinesterases are used as an adjunctive treatment for post-synaptic paralysis.
- Prazosin (an α-adrenoceptor antagonist) is used in the management of hypertension or pulmonary oedema in scorpion sting cardiotoxicity, particularly for Indian red scorpion stings, though antivenom is now the preferred treatment.

- Antibiotics are not routinely required for most bites/stings, though the animal cause significant wound infection or abscess.
- Tetanus is a risk in some types of bite or sting, such as snakebite, but intramuscular toxoid should not be given until any coagulopathy is reversed.
- Mechanical ventilation is vital for established respiratory paralysis that will not reverse with antivenom and may be required for prolonged periods (up to several months in some cases).
- Fasciotomy should be reserved as a treatment of last resort and be used only in cases where compartment syndrome is confirmed by intracompartment pressure measurement and after first trying limb elevation and antivenom, and ensuring that any coagulopathy has resolved.

Follow-up:

- ❑ Cases with significant envenomation and those receiving antivenom should be followed up to ensure any complications have resolved and to identify any delayed envenoming.

Thanks a lot...