Management of Snake Envenomation in Small Animals within Australia

Dr Katrin Swindells BVSc MACVSc DACVECC

Senior Lecturer Veterinary Emergency and Critical Care

Murdoch University Veterinary Hospital

Disclaimer

- The information provided in this presentation is provided to assist veterinarians in the management of snake envenomation within Australia
- Snake envenomation is always an emotive and potentially very expensive medical condition in animals
- Australia has some of the best antivenoms available within the world and our medical system covers the cost of administration to humans. However there is no government financial support available for antivenom administration to animals
- The following treatment suggestions are the personal opinion of Dr Katrin Swindells BVSc MACVSc DACVECC who works in a large tertiary referral hospital and has access to specialised equipment and staff numbers not available in the average veterinary hospital. Therefore the recommendations within this presentation should not be taken as the minimum standard of care for snake envenomations in animals
- Individual veterinarians treat snake envenomation to the best of their abilities and experience. Their local knowledge of snake envenomation is invaluable in the treatment decisions they make for their patients.
- Even in the most experienced hands and access to unlimited equipment, staff and unlimited supplies of antivenom, not all animals will survive envenomation

Snake bites recorded by veterinary practices in Australia. *Mirtschin et al. AVJ 1998*

Estimated 6000 cases per annum

Brown snake 76% of bites, Tiger snake 13% of bites

SURVIVAL				
	DOGS		CATS	
	No Antivenom	With Antivenom	No Antivenom	With Antivenom
BROWN	26%	75%	75%	92%
TIGER	24%	67%	24%	91%

Question: Were the cats which survived without antivenom bitten by Brown snakes or brown colored snakes?

Highly Venomous Snakes within Australia

- TIGER SNAKE
- BROWN SNAKE
- BLACK SNAKE
- TAIPAN
- DEATH ADDER
- COPPERHEAD
- ROUGH SCALED SNAKE

Most areas have many mildly venomous snakes some of which may require treatment with antivenom i.e. in South Australia:

Yellow-faced Whipsnake

Desert Whipsnake

Channel Country Whipsnake

Little whipsnake

White-lipped Snake

Master's Snake

Red-naped Snake

Moon Snake

Black- naped Snake

Centralian Banded Snake

Coral Snake

Desert Banded Snake

Half-girdled Snake

Hooded Snake

Mitchell's Short-tailed Snake

Mallee Black-headed Snake

Curl Snake

Common Bandy Bandy

SNAKE IDENTIFICATION

- Accuracy of the general public is approximately 19%
- Color and marking variability between species can result in inaccuracy in choice of antivenom
- Blood tests- helpful but not infallible in differentiating type of snake
- To determine the appropriate antivenom use either:
  - Snake venom detection kit
  - OR a scale identification key if you have the snakes body

Toxins Found in Australian Snake Venom

- Neurotoxins
- Myotoxins
- Procoagulants
- Anticoagulants
- Haemolysins

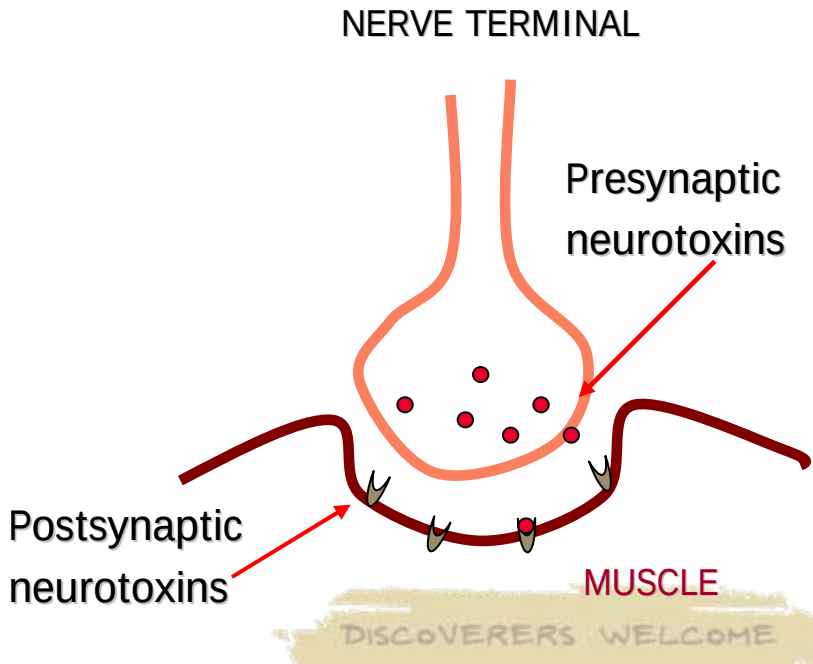
Neurotoxins

Presynaptic neurotoxins prevent release of acetylcholine from nerve terminal

Post synaptic neurotoxins bind to and block acetylcholine receptor

Result in

- Neuromuscular paralysis
- Respiratory failure
- Airway obstruction



Neurotoxins cause Paralysis

Generalised flaccid (LMN) paralysis

Weakening of gag and palpebral reflexes

Weakness and hind leg ataxia

Generalised paresis

Agonal respiratory pattern and cyanosis

Death due to hypoxia

Mydriasis sometimes takes 2-6 hours to occur and respiratory failure can occur first in peracute cases

Myotoxins

Damage skeletal muscle membrane-> damage myofibrils-> release myoglobin

Clinically see increased CK and myoglobinuria

Myotoxins are enzymes which remain active until neutralised

Delayed administration of antivenom will still be useful

Rhabdomyolysis

Generalised muscle pain

Severely increased Creatine kinase (CK)

Myoglobinuria

Megaoesophagus may occur and take up to 6 weeks to resolve if inadequate antivenom administered

Renal failure due to myoglobin induced nephropathy

Creatinine Kinase

Takes 2 hours or longer to increase

Half life 3.5 hours in dogs

If myotoxins have been neutralised CK should plateau and myoglobinuria will start to improve

Haemolysins

Damage RBC membranes

Cause haemolysis

Indication of systemic envenomation- haemolysis, haematuria

Rarely cause significant anaemia (except Black snakes)

Occasionally delayed immune mediated anaemia may occur in Red-bellied Black Snakes

Risk renal failure due to haemoglobin induced nephropathy

Procoagulant toxins

- Activate clotting system via mimicking factor Xa -> generalised thrombosis
- Potential cause of acute collapse/death immediately post snake bite
- Secondary fibrinolytic system activation results in clot lysis
- Consumption of clotting factors- when all consumed results in severe increases in clotting tests
- Clotting factor deficiency causes clinical coagulopathy

Procoagulants toxins

Factor Xa effect

Activation of clotting factors

Generalised thrombi formation

Consumption of clotting factors

Deficiency of clotting factors

COAGULOPATHY

Coagulopathy

Generally asymptomatic but diagnosed on blood tests

Clinical signs can include hyphaema, haemoptysis, haematemesis, haemorrhagic diarrhoea, haematuria.

Bleeding from bite wound and venipuncture sites. Do peripheral venipuncture and avoid cystocentesis.

CNS haemorrhage in humans (rare in dogs)

Clotting tests abnormalities due to procoagulants

Increase in ACT, PT, APTT, whole blood clotting time (consumption)

Decreased fibrinogen levels (consumption)

Increase in FDP's, D-dimers (fibrinolysis)

Return towards normal indicates procoagulant toxins have been inactivated i.e ACT improves from 360s to 240s (normal <120s)

Clotting tests may be normal at early stages with procoagulants

Anticoagulants

Have a heparin like effect

Result in mild prolongation of PT, APTT and ACT

Unlikely to be of clinical significance

Acute Renal Failure

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At present no nephrotoxins have been identified. However acute renal failure occasionally occurs

Tigers, Black Snakes : Acute renal failure due to acute tubular necrosis secondary to myoglobinuria or haemoglobinuria

Brown snake envenomation may cause renal failure. Potential causes include haemolysis, hypoxia, DIC, hypotensive ischaemia

Urine

Myoglobinuria- dark mahogany brown coloured urine

Haemoglobinuria

Haematuria

Glucosuria due to tubular cell injury

Proteinuria

Casts

Monitor urine output to ensure at least

1-2ml/kg/hr urine production

Other minor venom associated effects reported in humans

Abdominal pain

Sensory neuropathies

Lymphadenopathy

Permanent loss of smell

Preparalytic signs

Temporary signs: Obtained from history

Collapse, vomiting, salivation, trembling, tachypnoea, urination, defecation

Confirmed in dogs receiving 1-16 X LD_{50} tiger snake venom.

Indication of lethal envenomation and need for antivenom even if dog appears normal during examination

Brown Snakes

An ‘average’ bite has sufficient venom to kill a 40-80kg cat or a >250kg dog i.e. more than enough venom to kill the average animal

NEUROTOXINS: presynaptic neurotoxins and possibly postsynaptic neurotoxins

PROCOAGULANT: converts prothrombin to thrombin. DIC like coagulopathy

Nephrotoxins?

Use Brown snake antivenom

Tiger Snakes

An ‘average’ bite has sufficient venom to kill a 770kg dog or 350kg cat

NEUROTOXINS - several pre and post synaptic neurotoxins are present

MYOTOXIN

PROCOAGULANT

HAEMOLYSIN - minimal clinical significance

Renal failure secondary to myoglobinuria

Use Tiger snake antivenom

Mulga/ King Brown Snake

MYOTOXIN- rhabdomyolysis

ANTICOAGULANT

NEUROTOXINS- post synaptic and possibly presynaptic neurotoxins

HAEMOLYSIN

CYTOTOXIN – bite site swelling

Renal damage

Only Black snake antivenom is effective

Red-bellied black snakes

NEUROTOXINS

MYOTOXINS- rhabdomyolysis

HAEMOLYSINS- anaemia

ANTICOAGULANTS

BITE SITE SWELLING

Occasionally delayed immune-mediated haemolytic anaemia occurs

Use Tiger snake antivenom

Copperheads

NEUROTOXINS

ANTICOAGULANT

PLATELET INHIBITOR

MYOLYSIN

HAEMOLYSIN

Use Tiger snake antivenom

Death Adders

NEUROTOXINS- post synaptic

ANTICOAGULANT

Bardick snake has similar but less potent effects

Use Death adder antivenom

Taipan

NEUROTOXINS- presynaptic and post synaptic

MYOTOXIN

PROCOAGULANT

HAEMOLYSIN

Renal failure

Use Taipan antivenom

Unusual Snakes
The MILDLY venomous

Antivenom indicated if significant clinical signs

SVDK identifies most appropriate antivenom

Tiger snake antivenom or Polyvalent generally recommended

Tiger snake antivenom recommended for

Tropidechis, Demansia and Hoplocephalus genus and most black snakes (Pseudechis)

Black snake antivenom required for Mulga/King Brown and Yellow-bellied Black snake (Butlers)

CSL snake venom detection kit (SVDK)

Detects >10ng/mL venom

SAMPLES:- bite site is best!

However in animals it is rare to find the bite site:

Dogs- use urine

Cats <8 hours- heparinised plasma (blood)

>8 hours or uncertain of period post envenomation use urine

Treatment of the severe envenomation

The rapidly deteriorating, distressed, cyanotic and dying animal

ABC's

A= Airway- clear saliva by swabbing or suction

Intubate if required i.e. cyanosis unresponsive to oxygen, respiratory distress

light GA may be required - slow induction with 1/10-1/4 normal doses short acting agents- alfaxan, propofol, etc

- if patient is too paralysed to resist intubation then it NEEDS intubation

B= Breathing assess adequacy. If tidal volume suboptimal or high ETCO2 then ventilate

Ventilator options - machine

- hand (vet, nurse or owner)

ABC's

C= Cardiac - IV fluids/ support.

Shock rate fluids generally not required

Aim for diuresis 2-4 x maintenance

D= Drugs

- Premedication: Adrenaline 0.01mg/kgSC (not IV!)

  or Dexamethasone 0.2mg/kg IV

  Chlorpheniramine 0.5mg/kg SC

- Antivenom- if uncertain of snake ID start with appropriate bivalent (Tiger/Brown) or polyvalent antivenom

Tests

ID snake if available OR

SVDK- bite site, urine, plasma

ACT or other clotting tests

Baseline: PCV/TS, CK, urea and creatinine

Urine- place urinary catheter, start measuring output, monitor for myoglobinuria, haemoglobinuria, haematuria

Antivenom Quantities in Severe Envenomations

Ventilator cases require multiple vials of antivenom. Keep giving extra vials of antivenom until the patient starts improving:

Dogs 3-10 vials, cats at least 2 vials

Patients come off the ventilator quicker if you can give more antivenom

Murdoch University Veterinary Hospital experience: ventilation is generally required for 6-8 hours and rarely up to 24 hours. However 6-10 vials of antivenom may be used in ventilator cases

Antivenom Quantities in Severe Envenomations

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Treat all venom effects

- Paralysis 1 vial every 20minutes until deterioration stops, then expect continuous gradual improvement.
- If stops improving give more antivenom
- Coagulopathy- wait 6 hours to assess improvement the body takes time to replace consumed clotting factors. If life threatening haemorrhage give more antivenom!
- Myopathy: reassess CK/myoglobinuria every 2-4 hours. If worsening give more antivenom.
- Haemolysis if worsening anemia give more antivenom

If not improving reassess whether you have correctly identified the snake species and appropriate antivenom

Monitoring Aids

- Pulse oximetry
- Blood pressure
- Capnography
- PCV / TS and electrolytes
- Urine output hourly
- ACT 6 hourly until normal
- CK 2-6 hourly until stops increasing

Monitoring & Nursing Care

Ensure oxygenation normal SpO2>95%

End tidal CO2 < 40

Ensure blood pressure in normal range

Maintain normothermia

Turn regularly

Lacrilube in eyes

Moisten tongue/mouth

If required suction and hydrate airways of intubated patients

Criteria for Extubation

Extubation too early has high risks as animals prone to upper airway obstruction

If in doubt leave them intubated longer- use short acting drugs for sedation or light gas anaesthesia

Indications for extubation:

- At least 2 hours of unassisted breathing and ventilation remains adequate
- Animal is able to hold head up in sternal without tiring

Renal monitoring

Ensure urine output at least 1-2ml/kg/hr.

Decreased urine output?

- rule out hypovolaemia- trial 10-20ml/kg crystalloid bolus
- drugs- mannitol, frusemide, dopamine
- try to improve to >1ml/kg/hr within 6 hours

Haemoglobinuria or myoglobinuria- should start to improve if sufficient antivenom given

Treatment of less critical envenomations

Never leave animal unattended- rapid deterioration can occur

Physical and neurological exam

Blood tests PCV,TS, ACT, CK

Intravenous fluids-> diuresis

Generally only 1 vial antivenom required if still walking/ataxic (unless deteriorates)

Monitoring- ensure no deterioration

Nursing care- bladder, eyes, pressure

Discharge: Strict rest 2 weeks

Anaphylaxis secondary to antivenom

IgE Type I response.

Clinical signs include nausea, vomiting, circulatory collapse, tachycardia, bradycardia, pulmonary oedema, neurological signs, angioedema.

Treatment- stop antivenom, give adrenalin (0.01mg/kg) SC, appropriate supportive care and once stabilised restart antivenom at slower rate.

Serum Sickness

Immune response to Ag-Ab complexes deposited on endothelial surfaces

Occurs 4-14 days post antivenom

↑ vials = ↑ incidence

Clinical signs- urticaria, lymphadenopathy, polyarthropathy, proteinuria

Diagnosis-rule out other causes

Treatment- immunosuppression- prednisolone

Referral

Phone first for advice & costs

Patients may die enroute- plan ahead to minimise risks

Stabilise or start stabilisation prior to transporting

If possible a vet or nurse to travel with animal in case intubation or ventilation is required enroute

First aid advice to owners

Preparalytic signs = envenomation!

Keep patient quiet and rested during travel

Bring in snake if dead.

Do not attempt to catch/ kill active snakes

If paralysed transport patient in head down position to keep airway clear

Mouth to nose ventilation enroute to vet may keep patient alive until antivenom can be administered

In Conclusion

Animals may die from snake envenomation because:

- treatment was delayed
- the wrong antivenom was administered
- not enough antivenom was given

Veterinarians: Please let me know clinical signs and outcomes in any unusual envenomations you see especially Copperheads, Mulga's and Taipans

K.Swindells@murdoch.edu.au