

Bites: Snakes and spiders

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Red-back spider bite

The CARPA STM as it stood in the third edition was adequate. In symptoms, however, abdominal pain can be added, especially in children.

The antivenom can in fact be given up to several weeks following the bite. Ideally it should be given in a hospital, but it is an incredibly safe antivenom and could be given in any reasonable clinic that has basic resuscitation facilities. It should be considered for the larger clinics, especially those that have an on-site doctor. The visiting doctor (DMO) also could take antivenom to a clinic in a situation where the patient was reluctant to go to hospital or where there was doubt about the diagnosis, as symptoms start to resolve within 30–60 minutes after administration of the antivenom. The ASH-ED protocol is that any residual symptoms after 1–2 hours mandate repeated antivenom until symptoms resolve. Recent experience has shown that in severe envenomation symptoms can recur within days and do resolve with further treatment.

The toxin of the red-back spider moves very slowly and there is rarely a need to react emergently. Patients need to be reassured that it will not kill them (no-one has died since the introduction of the antivenom) and the treatment can be delayed until the next day unless there are significant systemic signs (e.g. hypertension, severe pain, severe vomiting). Not all patients will need to be evacuated in the middle of the night, many can wait until first light or the day plane.

Snakebite

There are the same three most important venomous snakes in the Top End and in Central Australia, so it is appropriate to have the same protocol throughout the NT.

Blood should be taken for whole blood clotting time as this can guide the doctor (who can take antivenom out to the patient) and hospital emergency department, as it will save time waiting for blood tests, prior to treatment. If the blood has not clotted after 20 minutes the doctor must be informed. It may be helpful to look at the venipuncture site or cannula site for oozing.

If there is blood in the urine on dipstick this probably indicates rhabdomyolysis/myoglobinuria (unless the person has had it documented before, e.g. has renal disease) and IV fluids should be started at a rate of 10 ml per kilo as a bolus and then at a rate of 5 ml per kilo per hour. Urine output needs to be monitored in these patients by insertion of an IDC and output maintained at 0.5 ml per kg per hour. The doctor should be informed of the haematuria as antivenom may need to be taken to the clinic.

[Editor: The following extracts are from the review paper on snakebite by Currie (listed in references below).]

The time course of envenoming

Figure 1 overleaf shows the progression of envenoming, with features depending on the snake species.

- The early collapse and recovery, if present, are the first features (5–30 minutes).

- Lymph node pain (tenderness on palpation may precede the symptom of pain), early non-specific systemic features and haemostatic abnormalities (manifest by oozing bite site or venepuncture sites, spitting blood, macroscopic or dipstick haematuria or prolonged glass tube clotting time) usually begin from 30–120 minutes after the bite.
- Neuromuscular paralysis onset is often delayed for several hours, and occasionally even 24 hours, possibly due to tissue sequestration of venom in the extreme case. First aid with bandaging and immobilisation may also delay onset. The classical pattern of taipan envenoming without medical intervention is onset four hours after the bite, followed by steady progression for around 24 hours to a maximum deficit. Ptosis is followed by ophthalmoplegia, then bulbar palsy and finally intercostal, then diaphragmatic, paralysis. Limb weakness is usually less severe and may be not evident. Death adder course may be faster (related to post-synaptic neurotoxins), but may also be delayed and less severe without progression in mild cases.
- The potential delay in neurotoxicity onset, although unusual, justifies all cases of possibly venomous snakebite in tropical Australia, Papua New Guinea and Irian Jaya being observed medically, ideally in hospital, for 24 hours after the bite.

Figure 1: Australasian elapid envenoming

Important bedside tests

A urine dipstick: Positive for ‘blood’ can mean haematuria from consumptive coagulopathy, haemoglobinuria from intravascular haemolysis or myoglobinuria from rhabdomyolysis, or a combination of these.

A glass tube whole blood clotting test: This simple test can be very useful to demonstrate procoagulant activity. A clot should normally be forming in the glass tube by 10 minutes. An assay validated in the field is the 20WBCT, which simply determines whether or not a clot is formed in the glass tube by 20 minutes.¹ With brown snake envenoming it is not unusual for the blood to remain completely unclotted.

Therapeutic issues

There is a large amount of documented clinical experience in management of Australasian elapid envenoming, however a number of important uncertainties and controversies remain, justifying an evidence-based approach to toxinology as well as toxicology.²

First aid

Despite impressive case reports there remains a lack of data on overall efficacy of pressure-immobilisation and, despite it being central to all Australian snakebite protocols, it has still only been correctly applied in 18%–53% of snakebites.^{3,4} The critical importance of strict immobilisation has been reinforced by lymphoscintigraphy studies.⁵ Overseas, prospective patient serum venom level studies have shown a pressure pad method of first aid to retard venom absorption.⁶ Preliminary venom level studies in the Northern Territory support concerns that crepe bandages become loose.⁷ Seven patients bitten by western brown snakes (*Pseudonaja nuchalis*) had severe coagulopathy on presentation to hospital despite documented full pressure-immobilisation.⁸ With the rapid onset of envenoming in brown snakebites (hypotensive collapse is usually within 30 minutes) direct vascular absorption of some venom components may be occurring, suggesting timing of first aid is critical.

Use of venom detection kits (VDKs)

The current VDK was released in 1991⁹ and takes 25 minutes for a result. It should not be used to determine whether antivenom should be given, but if antivenom is clinically indicated it may enable monovalent antivenom to be used instead of polyvalent. Erroneous results occasionally occur, especially if blood is tested rather than bite swab or urine.¹⁰ However, VDKs are very

useful if the positive result is a snake genus (e.g. 'brown') consistent with the patient's clinical syndrome and with the snake species known to be present in the region.

Use of monovalent antivenoms

Monovalent antivenoms should only be used in tropical Australia if: a) the (dead or alive) snake brought to hospital with the patient is positively identified by a trained reliable expert and was definitely the snake that bit the patient or b) the VDK result is consistent with the clinical findings and the snakes in the region, as above. If there is uncertainty, polyvalent antivenom should be used. Relying on local 'experts' to identify snakes is dangerous and incorrect identification can have tragic consequences.¹¹

Use of antivenom premedication

The use of subcutaneous adrenaline before antivenom as premedication against anaphylaxis is controversial. A recent study from Sri Lanka showed a significant decrease in acute adverse reactions to antivenom with use of subcutaneous adrenaline.¹² However, antivenom reactions occurred in 43% of controls in the study, a rate much higher than that now seen with the more purified current Commonwealth Serum Laboratories (CSL) antivenoms. There appear to have been no deaths from snake antivenom reactions in Australia for over 40 years.^{9,13,14} The concern with routine use of adrenaline is that it may occasionally exacerbate bleeding in snakebite patients with severe coagulopathy. The last five snakebite deaths from intracranial haemorrhage in Australia were all given adrenaline before antivenom, although three had intravenous adrenaline (which is not recommended).^{11,15} It was considered that the time course in the two given subcutaneous adrenaline made a causal association unlikely.¹¹ However it remains possible that even subcutaneous adrenaline may occasionally be harmful, especially in the context of the severe haemostatic abnormalities with brown snake envenoming, with intracranial haemorrhage usually a fatal outcome if it occurs. With the very low rate of severe reactions to antivenom seen in Australia and Papua New Guinea, and the ability of emergency medicine physicians to adequately manage reactions that may occur, a policy of withholding premedication but always having adrenaline drawn up and ready is now recommended by many authorities and is policy in the Northern Territory. The primary role of adrenaline in any severe reaction that does occur is well documented.¹⁶

Antivenom doses

The number of ampoules of antivenom used has been empirically determined over many years for the various snake species. Although one ampoule of each of the CSL antivenoms was designed to neutralise venom from an 'average' bite, based on milking venom from snakes¹³, it is clear that larger doses are often required. This is especially evident for bites from brown snakes, where venom yields are very variable and may be substantially larger than previously thought¹⁷. Animal studies have suggested many ampoules of antivenom may be required for neutralisation of venom components.^{18,19} However, for bites from death adders and mulga snakes clinical response has usually been adequate after one or two ampoules of antivenom.^{7,20,21}

While antivenom reverses the post-synaptic neurotoxicity from death adder venom, established pre-synaptic damage from taipan venom is not reversed with antivenom.^{22,23,24,25} Adequate antivenom may prevent deterioration in taipan envenoming by preventing further venom binding, but recovery requires time for neurotransmitter pathway restoration, not necessarily more antivenom. It appears that for taipan envenoming the timing of antivenom is especially important. After four hours from the bite, giving more than one ampoule of antivenom usually has no additional benefit.^{22,25} However, in a case series from Townsville larger doses of antivenom given within several hours of taipan bites appeared effective in hastening neurological recovery.²⁶ This is consistent with reversal of early post-synaptic neurotoxicity while neutralising pre-synaptic neurotoxins before binding. These findings have important financial implications for treatment in Papua New Guinea, where the cost of antivenom is prohibitive and most patients present beyond four hours from the bite.

There have now been a number of well-conducted studies overseas comparing either different antivenoms or different doses of antivenom, using serial patient blood venom levels and clinical criteria to assess comparative efficacy.^{27,28,29,30} Similar collaborative studies within Australia, using serial venom levels before and after defined antivenom doses, would enable a more objective understanding of antivenom dose requirements for the various Australasian elapids.

Treatment in the absence of antivenom

Anticholinesterase therapy, such as neostigmine, can be beneficial by competitively displacing post-synaptically acting neurotoxins. It has been beneficial in reversing death adder neurotoxicity in Papua New Guinea and should be considered, especially in remote locations in Irian Jaya and Papua New Guinea where antivenom is not affordable or available.³¹ Prolonged use of pressure-immobilisation with graded release has been considered useful for death adder envenoming in Papua New Guinea and requires further study (J. Oakley, personal communication).

The distribution of potentially lethal terrestrial snakes in tropical Australia, in decreasing order of bites seen in each region

Tropical Western Australia	Northern Territory	Tropical Queensland
<i>Pseudonaja nuchalis</i> Western brown snake (Gwardar)	<i>Pseudonaja nuchalis</i> Western brown snake (Gwardar)	<i>Pseudonaja textilis</i> Common (Eastern) brown snake
<i>Pseudechis australis</i> Mulga	<i>Pseudechis australis</i> Mulga	<i>Oxyuranus scutellatus</i> Taipan
<i>Acanthophis</i> spp. Death adder	<i>Acanthophis</i> spp. Death adder	<i>Pseudonaja nuchalis</i> Western brown snake (Gwardar)
<i>Oxyuranus scutellatus</i> * Taipan	<i>Oxyuranus scutellatus</i> * Taipan	<i>Pseudechis australis</i> Mulga
		<i>Acanthophis</i> spp. Death adder
		<i>Tropidechis carinatus</i> Rough-scaled snake
		<i>Rhinoplocephalus</i> <i>nigrescens</i> Eastern small-eyed snake

*Taipans have been found in the Top End of the Northern Territory and across to the Kimberley in north Western Australia, but are very uncommonly encountered in these regions, with no recorded human bites.

Clinical syndromes of the major Australasian snakes

	Early Collapse	Local swelling	Tender regional lymph nodes	Non-specific 'systemic features' ¹	Myotoxicity	Coagulopathy	Neurotoxicity
Brown snakes	++	+/-	+/-	+/-	-	+++ ²	Yes
Mulga snake	-	++	++	++	++	+ ³	Yes
Death adder	-	+/-	+/-	+/-	-	-	++ ⁴
Taipans	+	+/-	+	+	+	+ ²	++ ⁵
Rough-scaled snake	+	+/-	+	+	+	+ ²	+
Eastern small-eyed snake	-	+/-	+	+	+	+/-	?
Papuan black snake	-	+/-	+	+	-	+	+
New Guinea small-eyed snake	-	+/-	+	+	+	+ ³	+ ⁴
Whip snakes ⁶	-	+	+/-	+/-	-	-	-
Tiger Snakes ⁷	+	+	+	+	++	+ ²	++ ⁵

- 1 Abdominal pain, nausea, vomiting, headache
- 2 Predominantly procoagulant with fibrinogen depletion
- 3 Anticoagulant, no fibrinogen depletion, usually mild
- 4 Predominantly post-synaptic
- 5 Predominantly pre-synaptic
- 6 Not potentially lethal but common
- 7 Not in the tropics but included for comparison

References for extracts from: Currie BJ. Snakebite in tropical Australia, Papua New Guinea and Irian Jaya. *Emergency Medicine* 2000; 12:285-94.

1 Warrell DA, Davidson NM, Greenwood BM, et al. Poisoning by Bites of the Saw-Scaled or Carpet Viper (*Echis carinatus*) in Nigeria. *Quarterly J Med* 1977; 181:33-62.

- 2 Whyte IM, Buckley NA. Progress in clinical toxicology: from case reports to toxicoepidemiology. *Med J Aust* 1995; 163;340–341.
- 3 Jamieson R, Pearn J. An epidemiological and clinical study of snake-bites in childhood. *Med J Aust* 1989; 150;698–702.
- 4 Jelinek GA, Hamilton T, Hirsch RL. Admissions for suspected snakebite to the Perth adult teaching hospitals, 1979 to 1988. *Med J Aust* 1991; 155;761–4.
- 5 Howarth DM, Southee AE, Whyte IM. Lymphatic flow rates and first aid in simulated peripheral snake or spider envenomation. *Med J Aust* 1994; 161;695–700.
- 6 Tun-Pe, Aye-Aye-Myint, Khin-Ei-Han, Thi-Ha, Tin-Nu-Swe. Local compression pads as a first aid measure for victims of bites by Russell's viper (*Daboia russelii siamensis*) in Myanmar. *Trans R Soc Trop Med Hyg* 1995; 89;293–5.
- 7 Currie B, Richards A, Lawrie P, Jacups S, Theakson D, Warrell D. The Top End Prospective Snakebite Study and unresolved issues for Australia and Papua New Guinea, Annual Scientific Meeting Australasian Tropical Health Conference. Tropical Millennium Bugs 23rd–26th June, 2000. Noosa, Queensland, 2000.
- 8 Currie B. A prospective study of snakebite in tropical Australia (abstract). *Aust NZ J Med* 1999; 29;602.
- 9 Sutherland SK. Antivenom use in Australia. Premedication, adverse reactions and the use of venom detection kits. *Med J Aust* 1992; 157;734–9.
- 10 Mead HJ, Jelinek GA. Suspected snakebite in children: a study of 156 patients over 10 years [see comments]. *Med J Aust* 1996; 164;467–70.
- 11 Sprivulis P, Jelinek G. Fatal intracranial haematomas in two patients with Brown snake envenomation. *Med J Aust* 1995; 162;215–16.
- 12 Premawardhena AP, de Silva CE, Fonseka MM, Gunatilake SB, de Silva HJ. Low dose subcutaneous adrenaline to prevent acute adverse reactions to antivenom serum in people bitten by snakes: randomised, placebo controlled trial. *BMJ* 1999; 318;1041–3.
- 13 Trinca GF. The treatment of snakebite. *Med J Aust* 1963; 1;275–280.
- 14 Sutherland SK, Lovering KE. Antivenoms: Use and adverse reactions over a 12 month period in Australia and Papua New Guinea. *Med J Aust* 1979; 2;671–4.
- 15 Tibballs J. Premedication for snake antivenom. *Med J Aust* 1994; 160;4–7.
- 16 Brown AFT. Therapeutic controversies in the management of acute anaphylaxis. *J Accid Emerg Med* 1998; 15;89–95.
- 17 Masci PP, Mirtschin PJ, Nias TN, Turnbull RK, Kuchel TR, Whitaker AN. Brown snakes (*Pseudonaja* Genus): venom yields, prothrombin activator neutralization and implications affecting antivenom usage. *Anaesth Intens Care* 1998; 26;276–81.
- 18 Tibballs J, Sutherland S. The efficacy of antivenom in prevention of cardiovascular depression and coagulopathy induced by brown snake (*Pseudonaja*) species venom. *Anaesth Intens Care* 1991; 19;530–4.
- 19 Sprivulis P, Jelinek GA, Marshall L. Efficacy and potency of antivenoms in neutralizing the procoagulant effects of Australian snake venoms in dog and human plasma. *Anaesth Intens Care* 1996; 24;379–81.
- 20 Lalloo DG, Trevett AJ, Black J, et al. Neurotoxicity, anticoagulant activity and evidence of rhabdomyolysis in patients bitten by death adders (*Acanthophis* sp.) in southern Papua New Guinea. *Quarterly J Med* 1996; 89;25–35.
- 21 Campbell CH. The death adder (*Acanthophis antarcticus*): the effect of the bite and its treatment. *Med J Aust* 1966; 2;922–5.
- 22 Campbell CH. The taipan (*Oxyuranus scutellatus*) and the effect of its bite. *Med J Aust* 1967; 1;735–9.
- 23 Currie BJ, Theakston RDG, Warrell DA. Envenoming from the Papuan taipan (*Oxyuranus scutellatus canni*). In: Gopalakrishnakone P, Tan CK, eds. Recent advances in toxinology research. Singapore: Venom and toxin research group, 1992; 308–14.
- 24 Lalloo DG, Trevett AJ, Korinhona A, et al. Snakebites by the Papuan taipan (*Oxyuranus scutellatus canni*); paralysis, haemostatic and electrocardiographic abnormalities and effects of venom. *Am J Trop Med Hyg* 1995.