



## Treatment of Snake Bite in India: A Review

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### Review Article

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### Abstract

India is estimated to have the highest snakebite mortality in the world. World Health Organization (WHO) estimates place the number of bites to be 83,000 per annum with 11,000 deaths. Most of the fatalities are due to the victim not reaching the hospital in time where definite treatment can be administered. In addition community is also not well informed about the occupational risks and simple measures which can prevent the bite. It continues to adopt harmful first aid practices such as tourniquets, cutting and suction, etc. Studies reveal that primary care doctors do not treat snakebite patients mainly due to lack of confidence. The secondary and tertiary care level, multiple protocols are being followed for polyvalent anti-snake venom (ASV) administration, predominantly based on western textbooks. In response, Government of India, Health and Family Welfare Department has prepared a National Snakebite Management Protocol to provide doctors and lay people with the best possible, evidence-based approach to deal with this problem in country. This article describes its salient features.

**Keywords:** Antivenom, Cobra Naja naja, Common Krait, Polyvalent anti-snake venom (ASV), Snakebite, Echis carinatus, Russell's Viper Daboria russelli

### Introduction

India's first national survey of the causes of death, the Million Death Study, undertaken in 2001-03 by the Registrar General of India and the Centre for

Global Health Research gives an estimate of 46,000 annual deaths by snakebite in the country whereas the Government of India's Central Bureau of Health Intelligence reports only 1,350 deaths each year for the period 2004 to 2009. This massive statistical disparity has important and urgent implications. There are four species groups of snakes (nearly 300 different species in India) primarily responsible for what is likely to be the highest death rate from snakebite in any country in the world, the 'Big Four': cobra (four species), krait (eight species), saw-scaled viper (two subspecies) and Russell's viper. All are widely distributed throughout most of the country although areas like the far Northeast, the Himalayan region and the Andaman's and Nicobar Islands have distinctive snake fauna.<sup>1-5</sup>

The venom for producing antivenom comes mainly from the Irula Snake-catchers Industrial Cooperative Society at the Madras Crocodile Bank on Chennai's East Coast Road. And herein lies one of the problems. Clinicians in other parts of the country are reporting that the antivenom they are using is relatively ineffective in counteracting the effects of a venomous bite. This could be explained by geographic variation in the composition of the venom of a single species<sup>6</sup>. Since snakebite is a rural problem, primarily affecting India's farmers, rural labors and their families it would make sense for antivenom and associated treatment to be available at Primary Health Centers and other rural medical facilities. However, this is often not the case and training in snake identification and snakebite treatment is woefully inadequate.



### The Snakebite Problem

Snakebite affects the lives of around 4.5 million people worldwide every year seriously injuring 2.7 million men, women and children, and claiming some 125,000 lives. Globally the greatest burden is experienced in the tropical world; where many nations remain under developed or suffer from poor governance, political and/or social, conflict, resource scarcity, high disease burdens, or food insecurity. The available evidence shows that it is in the world's poorest economies that the burden of snakebite mortality is the greatest, and survival is no guarantee of a full recovery, with many thousands of victims being left permanently disabled and emotionally destroyed by their injuries<sup>7</sup>.

The World Health Organization added snakebite to the list of Neglected Tropical Diseases in 2009, but made no provision to seek global funding to do anything about the problem. Like all endeavors, global health is highly politicized, and it wasn't long before snakebite was downgraded by WHO under a sub-definition: "Other 'neglected' conditions". This belies the extent of the problem – snakebite is a global catastrophe affecting millions of the world's poorest, and least empowered people. WHO analysis of global snakebite envenoming incidence and mortality provided figures that can be used to place snakebite in comparison to other tropical illnesses.

**Table 1** Snakebite in comparison to other tropical illnesses

Disease	Incidence	Deaths
Snakebite envenoming	2,682,000	100,000
Chaga's disease	217,000	14,000
Cholera	178,000	4,000
Dengue Haemorrhagic fever	73,000	19,000
Leishmaniasis	1,691,000	51,000
Japanese encephalitis	44,000	14,000
Schistosomiasis	5,733,000	15,000
Yellow fever	2,100	100

### Do's and dont's when a snake bites

Snakes commonly bite men/women engaged in the farming or construction activities. The extensive grass/foilage cover is perfect for snakes to hide and they attack victims when they are disturbed by accidental stepping on them or holding/pricking them (especially vipers). Common krait bites laborers and farmers especially during night time. The construction site workers or farmers, sleeping on the floor are particularly at increased risk<sup>8</sup>.

The symptoms can be minimal or absent and the diagnosis is often missed initially especially in common krait bite. Common krait does not usually cause any local symptoms at bite site, where as viper bite is characterized by severe local swelling and bleeding. The only initial manifestation in common krait envenomation may be pain in abdomen. This is followed by neuroparalysis over few hours. Pain abdomen can be misdiagnosed as gastritis or other abdominal condition resulting in delay in institution of anti snake venom. The other manifestations are drooping of eye lids, disturbances in vision, difficulty in speaking or swallowing. If left untreated, these patients can develop progressive weakness of chest muscles resulting in difficulty in breathing and death due to respiratory paralysis<sup>9</sup>.

Simple precautions like sleeping on the cot (snakes cannot climb up) would take care. Since cots may not be available to workers / farmers sleeping on the floor, a simple intervention in the form of "mosquito nets" has been found to be very useful. This not only keeps the insects away but also prevents snakes to come in contact with person sleeping inside. This cheap and simple intervention should be made available to construction workers / laborers working in the field.

If the snake has bitten a person, he /she should be brought immediately to a health care facility and unnecessary delay by taking the victim to faith healers/ traditional snake charmers should be avoided. One should keep the bitten limb/part of body immobile



and tourniquet should not be tied. The wound should be washed with soap and water and no cream/gel/antiseptic should be applied. Avoid cutting, burning, sucking the wound as it may cause more harm. If anti snake venom is not available at a health care facility, patient should be referred to a bigger hospital after cleaning the wound and giving tetanus toxoid injection. If the respiratory paralysis has already set in, endotracheal intubation and bag mask ventilation should be initiated as soon as possible. Any delay in initiating ventilation can result in permanent hypoxic damage to the brain. A bedside whole blood clotting time or commercially available tests for coagulation factors can be used for guiding treatment for vasculotoxic bites<sup>10</sup>.

Anti snake venom is difficult to obtain, is costly and should be used with caution as it can cause anaphylaxis. "National snake bite protocol" is available on the internet and should guide anti snake venom administration. Initial dose of anti snake venom should never be less than / exceed 100 ml (10 vials) dissolved in 250 ml of normal saline, given intravenously over one hour. The dose can be repeated at 6 hour interval if the manifestations do not revert. There is no role of sensitivity testing but initial 10-20 ml of the dose should be administered slowly to prevent allergic reactions<sup>11</sup>.

The total dose of anti snake venom should never exceed 200 ml (20 vials) for common krait (neuroparalytic snake bite) envenomation and 300 ml (30 vials) for Russell's viper (vasculotoxic) envenomation. Early interventions like mechanical ventilation for neuroparalytic snake bite and dialysis for vasculotoxic snake bites will go a long way in preventing mortality.

#### **Do's in snake bite victims**

- Reassure the victim
- Immobilize limb
- Wash with soap and water
- Get to a hospital
- Give tetanus toxoid injection
- Hydrate the patient
- Keep a close watch on respiration and bleeding
- Intubate and ventilate if needed
- Anti snake venom if needed
- Use correct dose and formulation

#### **Don'ts in snake bite**

- Do not handle a snake/dead snake
- Do not move the limb/ do not run
- Do not tie a tourniquet
- Do not cut/burn/suck the wound
- Do not waste time
- Do not keep the patient starved
- Do not use antiserum in all patients
- Do not delay transportation to a better hospital
- Do not delay antiserum
- Do not delay ventilation and dialysis, if needed

#### **Symptoms**

Symptoms depend on the type of snake, but may include bleeding from wound, blurred vision, burning of the skin, convulsions, diarrhea, dizziness, excessive sweating, fainting, fang marks in the skin, fever, increased thirst, loss of muscle coordination, nausea and vomiting, numbness and tingling, rapid pulse, tissue death, severe pain, skin discoloration, swelling at the site of the bite, weakness.<sup>12</sup>

#### **Treatment**

It is not an easy task determining whether or not a bite by any species of snake is life-threatening. A bite by a North American copperhead on the ankle is usually a moderate injury to a healthy adult, but a bite to a child's abdomen or face by the same snake may be fatal. The outcome of all snakebites depends on a multitude of factors: the size, physical condition, and temperature of the snake, the age and physical condition of the person, the area and tissue bitten (e.g., foot, torso, vein or muscle), the amount of venom injected, the time it takes for the person to find treatment, and finally the quality of that treatment<sup>13</sup>.

#### **Snake identification**

Identification of the snake is important in planning treatment in certain areas of the world, but is not always possible. Ideally the dead snake would be brought in with the person, but in areas where snake bite is more common, local knowledge may be sufficient



to recognize the snake. However, in regions where polyvalent antivenoms are available, such as North America, identification of snake is not a high priority item. Attempting to catch or kill the offending snake also puts one at risk for re-venomation or creating a second person bitten, and generally is not recommended. The three types of venomous snakes that cause the majority of major clinical problems are vipers, kraits, and cobras. Knowledge of what species are present locally can be crucial, as is knowledge of typical signs and symptoms of envenomation by each type of snake. A scoring system can be used to try to determine the biting snake based on clinical features, but these scoring systems are extremely specific to particular geographical areas<sup>14</sup>.

### **First aid**

Snakebite first aid recommendations vary, in part because different snakes have different types of venom. Some have little local effect, but life-threatening systemic effects, in which case containing the venom in the region of the bite by pressure immobilization is desirable. Other venoms instigate localized tissue damage around the bitten area, and immobilization may increase the severity of the damage in this area, but also reduce the total area affected; whether this trade-off is desirable remains a point of controversy. Because snakes vary from one country to another, first aid methods also vary.

### **First aid guidelines agree on the following:**

1. Protect the person and others from further bites. While identifying the species is desirable in certain regions, risking further bites or delaying proper medical treatment by attempting to capture or kill the snake is not recommended.
2. Keep the person calm. Acute stress reaction increases blood flow and endangers the person.
3. Call for help to arrange for transport to the nearest hospital emergency room, where antivenom for snakes common to the area will often be available.
4. Make sure to keep the bitten limb in a functional position and below the person's heart level so as to minimize blood returning to the heart and other organs of the body.

5. Do not give the person anything to eat or drink. This is especially important with consumable alcohol, a known vasodilator which will speed up the absorption of venom. Do not administer stimulants or pain medications, unless specifically directed to do so by a physician.

6. Remove any items or clothing which may constrict the bitten limb if it swells (rings, bracelets, watches, footwear, etc.)

7. Keep the person as still as possible.

8. Do not incise the bitten site.

Many organizations, including the American Medical Association and American Red Cross, recommend washing the bite with soap and water. Australian recommendations for snake bite treatment recommend against cleaning the wound. Traces of venom left on the skin/bandages from the strike can be used in combination with a snake bite identification kit to identify the species of snake. This speeds determination of which antivenom to administer in the emergency room<sup>20</sup>.

### **India developed a national snake bite protocol in 2007 which includes advice to:**

1. Reassure the person. Seventy percent of all snakebites are from non-venomous species. Half of bites from venomous species poison the person.
2. Immobilize in the same way as a fractured limb. Use bandages or cloth to hold the splints, with care taken not to apply pressure or block the blood supply (such as with ligatures).
3. Get to a hospital immediately. Traditional remedies have no proven benefit in treating snakebite.
4. Tell the doctor of any systemic symptoms, such as droopiness of a body part, that manifest on the way to hospital.

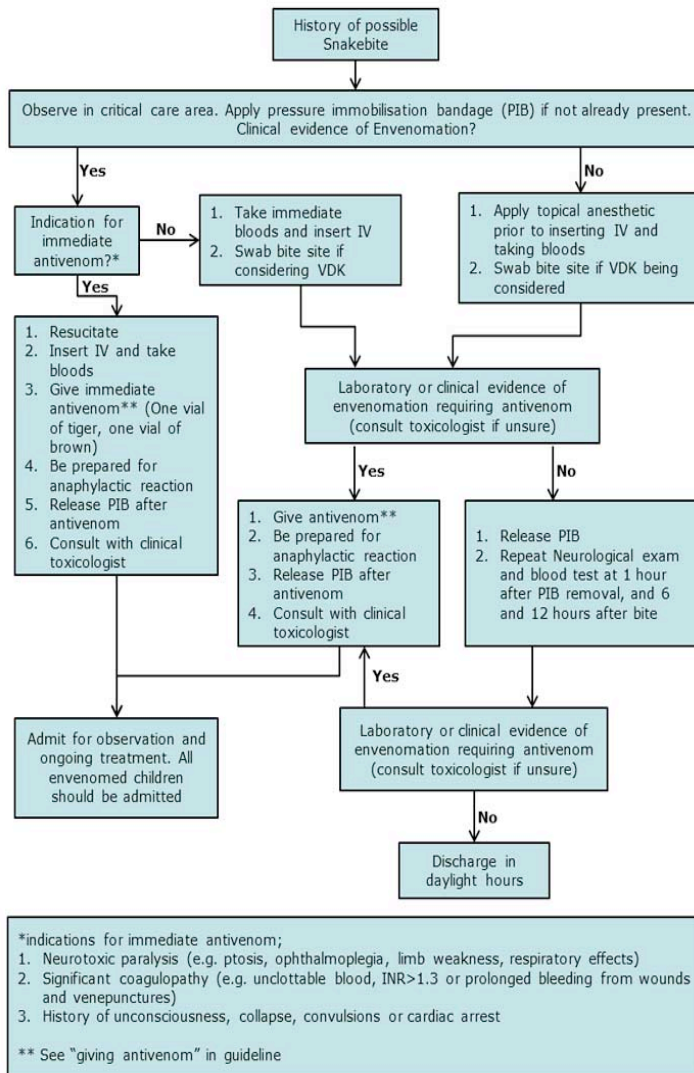


Fig. 1 Algorithm chart for the treatment of snake bite

### Prevention

1. Avoid areas where snakes may be hiding, such as under rocks and logs.
2. Even though most snakes are not venomous, avoid picking up or playing with any snake unless you have been properly trained.
3. If you hike often, consider buying a snake bite kit (available from hiking supply stores). Do not use older snake bite kits, such as those containing razor blades and suction bulbs.
4. Don't provoke a snake. That is when many serious snake bites occur.
5. Tap ahead of you with a walking stick before entering an area where you can't see your feet. Snakes will try to avoid you if given enough warning.

6. When hiking in an area known to have snakes, wear long pants and boots if possible.

### Antivenom

Antivenom (or antivenin or antivenene) is a biological product used in the treatment of venomous bites or stings. Antivenom is created by milking venom from the desired snake, spider or insect. The venom is then diluted and injected into a horse, sheep, rabbit, or goat. The subject animal will undergo an immune response to the venom, producing antibodies against the venom's active molecule which can then be harvested from the animal's blood and used to treat envenomation. Internationally, antivenoms must conform to the standards of pharmacopoeia and the World Health Organization.<sup>15</sup>

The name "antivenin" comes from the French word *venin*, meaning venom, which in turn was derived from Latin *venenum*, meaning poison.

Historically, the term antivenin was predominant around the world, its first published use being in 1895. In 1981, the World Health Organization decided that the preferred terminology in the English language would be *venom* and *antivenom* rather than *venin* and *antivenin* and *antivenene*<sup>16, 17</sup>.

### Investigations:

For timing and interpretation of blood tests see management flow chart below.

- Initial blood tests: coagulation screen (INR, APTT, fibrinogen), FBE and film, CK, EUC, LDH, LFT.
- Serial blood tests: INR, APTT, fibrinogen, CK, FBE, EUC.
- Role of snake venom detection kit (VDK)
- The choice of antivenom is based on the clinical syndrome and local geographical patterns of snake distribution.
- Attempted identification of snakes by witnesses should never be relied upon as snakes of different species may have the same colouring or banding.





• Snake venom detection kits can be useful but in inexperienced hands they can have significant rates of snake misidentification, false positives and false negatives. The results should not over-ride clinical and geographical data. Discuss use and results with a clinical toxicologist.

**Table 2: List of Antivenom available for the treatment of snake bite**

<b>Antivenom</b>	<b>Species</b>	<b>Country</b>
Polyvalent snake antivenom	South American Rattlesnake <i>Crotalus durissus</i> and fer-de-lance <i>Bothrops asper</i> .	Mexico (Instituto Bioclon)
Polyvalent snake antivenom	South American Rattlesnake <i>Crotalus durissus</i> and fer-de-lance <i>Bothrops asper</i>	South America
Polyvalent snake antivenom	Saw-scaled Viper <i>Viper Echis carinatus</i> . Russell's Viper <i>Daboia russelli</i> , Spectacled Cobra <i>Naja naja</i> , Common Krait <i>Bungarus caeruleus</i>	India
Death adder antivenom	Death adder	Australia
Taipan antivenom	Taipan	Australia
Black snake antivenom	<i>Pseudechis</i> spp.	Australia
Tiger snake antivenom	Australian copperheads, Tiger snakes <i>Pseudechis</i> spp., Rough scaled snake.	Australia
Brown snake antivenom	Brown snakes	Australia
Polyvalent snake antivenom	Many Australian snakes	Australia
Sea snake antivenom	Sea snakes	Australia
Vipera tab	<i>Vipera</i> spp.	UK
Polyvalent crotalid antivenin (CroFab— <i>Crotalidae</i> Polyvalent Immune Fab (Ovine))	North American pit vipers (all rattlesnakes, copperheads, and cottonmouths)	North America
Soro antitropicocrotalico	Pit vipers and rattlesnakes	Brazil
Antielapidico	Coral snakes	Brazil
SAIMR polyvalent antivenom	Mambas, Cobras, Rinkhalses, Puff adders (Unsuitable small adders: <i>B. worthingtoni</i> , <i>B.</i>	South Africa [8]

	<i>atropos</i> , <i>B. caudalis</i> , <i>B. cornuta</i> , <i>B. heraldica</i> , <i>B. inornata</i> , <i>B. peringueyi</i> , <i>B. schneideri</i> , <i>B. xeropaga</i> )	
SAIMR echis antivenom	Saw-scaled vipers	South Africa
SAIMR Boomslang antivenom	Boomslang	South Africa
Panamerican serum	Coral snakes	Costa Rica
Anticoral	Coral snakes	Costa Rica
Anti-mipartitus antivenom	Coral snakes	Costa Rica
Anticoral monovalent	Coral snakes	Costa Rica
Antimicrurus	Coral snakes	Argentina
Coralmyn	Coral snakes	Mexico
Anti-micruricoscorales	Coral snakes	Colombia

• If used, a VDK should be used on a bite site swab, and a single operator should be dedicated to perform the VDK interpretation and should do so free from other clinical responsibility and interruption. This takes 20-30 minutes, and as such should be omitted in the unwell or arrested patient. A brief lapse in concentration when watching for colour change in the VDK can result in a false reading<sup>18</sup>.

• If there is no apparent bite, a VDK may be done on urine, but never blood.

• Most venomous snakebites in Victoria are from brown or tiger snakes, and both may present with an initial coagulopathy on blood testing. As a result, it may be appropriate to administer one vial each of brown and tiger snake antivenom where envenomation is evident and a person experienced in the use and interpretation of a venom detection kit is not immediately available<sup>19-22</sup>.

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#### AUTHORS' CONTRIBUTIONS

Authors contributed equally to all aspects of the study.

#### PEER REVIEW

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#### CONFLICTS OF INTEREST

The authors declare that they have no competing interests.