Chapter 94

Snake Bite: Indian Guidelines and Protocol

Surjit Singh, Gagandip Singh

BACKGROUND

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.[1] 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.[2] At 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[3] to provide doctors and lay people with the best possible, evidence-based approach to deal with this problem in country. This chapter describes its salient features.

SNAKES OF INDIA

There are about 236 species of snakes in India, most of which are nonpoisonous. Their bites, apart from causing panic reaction and local injury, do not harm the patient. However, there are 13 known species that are poisonous and of these four, namely common cobra (*Naja naja*), Russell's viper (*Dabiola russelii*), saw-scaled viper (*Echis carinatus*) and common krait (*Bungarus caeruleus*) are highly venomous and believed to be responsible for most of the poisonous bites in India.[4] However, this assumption of great four, has led to nonidentification of other poisonous species which are going unnoticed and leading to deaths. The recent discovery of the humpnosed pit viper, capable of causing life threatening symptoms has demonstrated this. This nonrecognition has led the ASV manufacturers to produce antivenom only against these four species only.[5] Thus there is a need to abandon the old concept of "The Big Four" in order to determine all the medically significant species in India.

FIRST AID

Much of the first aid currently carried out is ineffective and dangerous. The case management at the field level should include reassurance, immobilizing the bitten limb and transporting the victim to nearest treatment facility at the earliest where definite treatment can be provided.

What can be Done in the Field?

Reassure the victim that death is not imminent and medical care is available. Control anxiety as excitement will increase heart rate and lead to spread of venom. Make the victim lie flat with bitten limb below the heart level. Remove shoes, rings, watches, jewelry and tight clothing from the bitten area as they can act as a tourniquet when swelling occurs. Immobilize the victim's bitten limb using a splint and lightly put a bandage. Be prepared to treat the shock and provide cardiopulmonary resuscitation (CPR). Get the victim to the nearest secondary or tertiary care hospital where antivenom can be provided.

Do not apply a tourniquet.[6] Do not wash the bite site with soap or any other solution to remove the venom. Do not make cuts or incisions on or near the bitten area.[7] Do not use electrical shock.[8] Do not freeze or apply extreme cold to the area of bite. Do not apply any kind of potentially harmful herbal or folk remedy. Do not attempt to suck out venom with your mouth.[9] Do not give the victim drink, alcohol or other drugs. Do not attempt to capture, handle or kill the snake and patients should not be taken to quacks. There has been some initial research which suggests that a "Pressure Pad" at the site of bite may be of benefit.[10] This, however, needs to be evaluated in field in India to assess its efficacy.

SNAKE BITE TREATMENT PROTOCOL

This can be divided into:

The initial management includes dealing with airway, breathing and treatment of shock. Administer tetanus toxoid if skin is breached and antibiotics if there is cellulitis or local necrosis.

Diagnosis Phase

Wherever possible, try to identify the snake responsible. Snake coloration, its pupil shape and bitemarks[11] are unreliable means of determining species, generally scalation helps. Ask the victim relatives to carefully bring the snake to hospital if it has been killed and then use the snake identification material in protocol to identify it. Determine if any traditional medicines have been used as they can sometimes lead to confusing symptoms. Determine the exact time of bite which helps in determining progression of signs and symptoms.

Hemostatic abnormalities are the prima facie evidence of a viper bite. Cobras and kraits do not cause hemostatic disturbances. Saw-scaled vipers do not cause renal failure where as Russell's viper and hump-nosed pit viper do.[12] Russell's viper can also manifest with neurotoxic symptoms in a wide area of India which can cause

confusion. Further work is necessary to determine the areas in which this species exists. The neurotoxic symptoms in Russell's viper are believed to be due to presence of a presynaptic toxin like that in common Krait.

All the patients should be kept under observation for a minimum of 24 hours. Many species, particularly the Krait and the hump-nosed pit viper are known for delayed appearance of symptoms which can develop after 6–12 hours.

Investigations

Twenty-minute whole blood clotting test (20WBCT) is considered as reliable test of coagulation which can be carried out by bedside[12] and is considered to be superior to 'capillary tube' method for establishing clotting capability in snake bite. A few milliliters of fresh venous blood should be placed in a fresh, clean and dry glass vessel preferably test tube and left undisturbed at ambient temperature for 20 minutes. After that tube should be gently tilted to detect whether blood is still liquid and if so then blood is incoagulable. The test should be carried out every 30 minutes from admission for 3 hours and then hourly after that.

Other Useful Tests (If Facilities Available)

- Hb/platelet count/peripheral smear prothrombin time (PT)/activated partial thromboplastin time (APTT)/fibrin degradation products (FDP)/D-Dimer
- Urine examination for proteinuria/RBC/hemoglobinuria/Myoglobinuria
- Biochemistry for serum creatinine/Urea/Potassium
- ECG/X-ray/CT/Ultrasound (The use of X-ray and ultrasound are of unproven benefit, apart from identification of clot in viperine bite)
- Oxygen saturation/arterial blood gas (ABG)
- Enzyme-linked immunosorbent assay (ELISA) to confirm snake species.

Treatment Phase

Pain can be relieved with oral paracetamol or tramadol. Aspirin or nonsteroidal anti-inflammatory drugs (NSAIDs) should not be administered.

Handling tourniquets though not recommended, current practices being followed would see many snakebite victims reaching the emergency with tight tourniquets. Care must be taken while removing these as sudden removal can lead to a massive surge of venom, leading to paralysis, hypotension, etc. Before removal of the tourniquet, check for the presence of pulse distal to it. If it is absent, ensure doctors presence before removal who should be able to handle complications such as sudden respiratory distress or hypotension. If the tourniquet has occluded the distal pulse, then blood pressure cuff should be applied and pressure should be slowly reduced.

Anti-snake venom (ASV) is the mainstay of treatment. In India, polyvalent ASV, i.e. effective against all the four common species; Russell's viper, common cobra, common Krait and saw-scaled viper and no monovalent ASVs are available. There are known species such as the humpnosed pit viper (*Hypnale hypnale*) where polyvalent ASV is ineffective. In addition, region specific species such as Sochurek's saw-scaled viper (*Echis carinatus sochureki*) in Rajasthan, where the effectiveness of polyvalent ASV is questionable. ASV is produced both in liquid and lyophilized forms. There is no evidence to suggest which form is more effective. Liquid ASV requires a reliable cold chain and has 2-year shelf life. Lyophilized ASV, in powder form, has 5-year shelf life and requires only to be kept cool.

Anti-snake Venom Administration

Anti-snake venom should be administered only when there are definite signs of envenomation, i.e. coagulopathy or neurotoxicity. Only unbound, free flowing venom in bloodstream or tissue fluid, can be neutralized by it. It carries the risk of anaphylactic reaction and doctors should be prepared to handle such reactions.

Prophylaxis for Anti-snake Venom Reactions

There are no systematic trials of sufficient power to show that prophylactic regimes are effective in preventing ASV reactions. Two regimens are normally recommended, i.e. hydrocortisone (100 mg) + antihistamine or 0.25–0.3 mg adrenaline subcutaneously.[13]

Anti-snake Venom Test Dose

Test doses have not been shown to have predictive value in predicting anaphylactic reaction or late serum sickness and not recommended.

Anti-snake Venom Dose

There have been some studies to evolve low-dose strategies.[14] These studies have serious flaws and have no validity in India. Similarly are high-dose regimes. The recommended dosages are as following:

Initial Dose

- Mild envenomation (systemic symptoms manifest > 3 hours after bite) neurotoxic/hemotoxic 8–10 Vials
- Severe envenomation (systemic symptoms manifest < 3 hours after bite) neurotoxic or hemotoxic 8 Vials

Each vial is 10 ml of reconstituted ASV. Children should receive the same ASV dosage as adults.

Further Doses

It will depend on the response to the initial dose. ASV should be administered either as intravenous infusion (5–10 mL/kg body weight) or as slow intravenous (IV) injection i.e. 2 mL/min). ASV should be administered over 1 hour at constant speed and patient should be closely monitored for 2 hours.

In victims requiring life saving surgery a higher initial dose of ASV is justified (up to 25 vials) solely on the presumption that coagulation will be restored in 6 hours.

Local administration of ASV near or at the bite site should not be done. It is ineffective, painful and can raise the intracompartmental pressure.

Victims Who Arrive Late

A frequent problem witnessed in our country is victims who arrive in hospital several days after the bite usually with acute renal failure. The key determining factor to decide on ASV treatment is presence of current venom activity as venom can only be neutralized only if it is unattached. Perform a 20WBCT to determine if any coagulopathy is present. If it is present, administer ASV, otherwise treat renal failure.

In the case of neurotoxic envenoming where the victim is having symptoms such as ptosis, respiratory failure, etc. it is probably wise to administer 1 dose of 8–10 vials of ASV to ensure that no unbound venom is present. However, at this stage it is likely that most of the venom is bound and respiratory support will be required.

Anti-snake Venom Reactions

Anaphylaxis with ASV may be life-threatening. The patient after ASV administration should be monitored closely and if anaphylaxis is evident, ASV should be discontinued. Antihistaminics can be administered to control the reaction and if severe, adrenaline should be administered. Once the patient has recovered, the ASV can be restarted slowly after 10–15 minutes, keeping close observation. Late serum sickness can be treated with oral prednisolone and/or antihistaminics.

Neostigmine is an anticholinesterase, which is particularly effective in postsynaptic neurotoxins such as those of cobra and is not useful against presynaptic neurotoxin i.e. common Krait and the Russell's viper.[15] Neostigmine test should be performed by administering 0.5–2 mg IV and if neurological improvement occurs, it should be continued 1/2 hourly over next 8 hours.

Repeat Doses of Anti-snake Venom

After initial ASV dose, no additional ASV should be given until the next clotting test at 6 hours. This is due to the inability of the liver to replace clotting factors in less than 6 hours. If WBCT more than 20 minutes repeat dose of 5–10 vials of ASV, i.e. 1/2-1 full dose, should continue 6 hourly till coagulation is restored or species is identified against which polyvalent ASV is ineffective.

The ASV regime for neurotoxic envenomation is not clear. After 1–2 hours of initial dose, patient should be reassessed and if symptoms have worsened or have not improved, a second dose of ASV should be given. This dose should be the same as the initial dose, i.e. 10 vials and then discontinued. Once the patient develops respiratory failure, has received 20 vials, ASV therapy should be discontinued assuming that all the circulating venom is neutralized and should have assisted ventilation if required. Only for snakes which inject massive amounts of venom, such as the King cobra or Australian elapids, massive doses of 50+ vials are required.

In viper bites, heparin and botropase have been used but role is not clear and not recommended.[16]

FOLLOW-UP

After discharge from hospital, victim should be followed. If discharged within 24 hours, patient should be advised to return if there is any worsening of symptoms such as bleeding, pain or swelling at the site of bite, difficulty in breathing, altered sensorium, etc. The patients should also be explained about serum sickness which may manifest after 5–10 days.

REFERENCES

1. Kasturiratne A, Wickramsinghe AR, DeSilva N, et al. The global burden of snakebite: A literature analysis and modelling based on regional estimates of envenoming and deaths. PLOS Med. 2008;5:e218.
2. Simpson ID. A study of current knowledge base in treating snake bite among doctors in high risk countries of India and Pakistan: does snake bite treatment training reflect local requirements? Trans R Soc Trop Med Hyg. 2008;102:1108-14.
3. National snakebite management protocol, India. (2008). [online] Avaialable at www://mohfw.nic.in (Directorate General of Health and Family Welfare, Ministry of Health and Family Welfare, India).
4. Warrell DA. WHO/SEARO Guidelines for the Clinical Management of Snakebite in the Southeast Asian Region. SE Asian J Trop Med Pub Health. 1999;30:1-85.
5. Simpson ID, Norris RL. Snakes of medical importance: is the concept of big four still relevant and useful? Wilderness Environ Med. 2007;18:2-9.
6. Amaral CF, Campolina D, Dias MB, et al. Tourniquet ineffective-ness to reduce the severity of envenoming after Crotalus durissus snake bite in Belo Horizonte, Minas Gerais, Brazil. Toxicon. 1998;36:805-8.
7. Bush SP, Hegewald KG, Green SM, et al. Effects of a negative-pressure venom extraction device (Extractor) on local tissue injury after artificial rattlesnake envenomation in a porcine model. Wilderness Environ Med. 2000;11:180-8.
8. Davis D, Branch K, Egen NB, et al. The effect of an electrical current on snake venom toxicity. J Wilderness Med. 1992;3: 48-53.
9. Anker RL, Staffon WG, Loiselle DS, et al. Retarding the uptake of "mock venom" in humans. Comparison of three first-aid treatments. Med J Australia. 1982;1:212-4.
10. Tun-Pe, Aye-Aye-Myint, Khin-Ei-Han, et al. 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.
11. Norris RL. Bite marks and the diagnosis of venomous snakebite. J Wilderness Med. 1995;6:159-61.
12. Simpson ID. Snakebite Management in India, the first few hours: A guide for primary care physicians. J Indian Med Assoc. 2007;105:324-35.
13. McLean-Tooke AP, Bethune CA, Fay AC, et al. Adrenaline in the treatment of anaphylaxis: what is the evidence? BMJ. 2003; 327:1332-5.
14. Srimannanarayana J, Dutta TK, Sahai A, et al. Rational use of anti-snake venom (ASV): Trial of various regimens in hemotoxic snake envenomation. J Assoc Phys India. 2004;52:788-93.
15. Anil A, Singh S, Bhalla A, et al. Role of neostigmine and polyvalent antivenin in Indian common krait (Bungarus caeruleus) bite. J Infection Public Health. 2010;3:83-7.
16. Paul V, Prahlad KA, Earali J, et al. Trial of heparin in viper bites. J Assoc Phys India. 2003;51:163-6.