

# **STANDARD TREATMENT GUIDELINES**

## **Management of Snake Bite**

**Quick Reference Guide  
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सत्यमेव जयते

**Ministry of Health & Family Welfare  
Government of India**

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## 1. Introduction

Snakebite is an acute life threatening time limiting medical emergency. It is a preventable public health hazard often faced by rural population in tropical and subtropical countries with heavy rainfall and humid climate. There are more than 2000 species of snakes in the world and about 300 species are found in India out of which 52 are venomous. The venomous snakes found in India belong to three families Elapidae, Viperidae and hydrophinae (Sea Snakes). The most common Indian elapids are *Naja naja* (Indian Cobra) and *Bungarus caeruleus* (Indian Krait), *Daboia russalii* (Russells' Viper) and *Echis carinatus* (Saw scaled viper) (Alirol et al 2010). Clinical effects of envenoming by same species of snake are almost similar except a few regional variations. Kraits are active during night hours, often biting a person sleeping on floor bed. Maximum Viper and Cobra bites occur during the day or early darkness, while watering the plantation or walking bare foot in grown grass or soybean crops. Although total number of bites may be more than 5-6 lakhs but only 30% are venomous bites. On the basis of Million Death Study), non-fatal bites may be as high as 1.4 million per year. Though snakebite is a life threatening centuries old condition, it was included in the list of neglected tropical diseases (Warrell and WHO 2009; Bawaskar HS 2014). With its triad of high mortality, high disability, and substantial psychological morbidity, snake bite warrants high priority research (lancet 2015).

Currently, treatment quality is highly varied, ranging from good quality in some areas, to very poor quality treatment in others. The high fatality due to Krait bite is attributed to the non-availability of antsnake venom (ASV), delayed and inappropriate administration of ASV, lack of standard protocol for management and inexperienced doctors and non-availability of ventilator or bag and valve (Bawaskar et al 2008). In India, there has always been a crisis of antivenom supply (Bawaskar HS and Bawaskar PH 2001). On one hand there is shortage of ASV but on the other hand scarce ASV is being wasted due to excessive dosage of ASV in the absence of a Standard Treatment Guideline. Victims are not only misdiagnosed as - abdominal colic, and vomiting due to indigestion, appendicitis, stroke, head injury, ischemic heart disease, food poisoning, trismus, hysteria and Guillain-Barre' syndrome but also subjected to unnecessary investigations including MRI scans of the brain and lumbar

puncture thus causing undue delay in ASV therapy. Delayed administration of ASV or waiting until victim develops systemic manifestations i.e., a 6 h wait results in systemic envenoming and high fatality (Bawaskar et al 2008). Morbidity and mortality depends on the age and size of victim (children receive larger envenomation relative to body size), co-morbid conditions (elderly patients succumb more easily to snake venom) as well as nature of first aid given. Factors not contributing to outcome are size of the snake and time of bite (day/night)

## **2. Incidence of Snake Bite in India**

There is a huge gap between the number of snakebite deaths reported from direct survey and official data. Only 7.23% snakebite deaths were officially reported (Majumdar, 2014 and Mohapatra 2011). Earlier hospital based reports estimated about 1,300 to 50,000 annual deaths from snakebites per year in India. Mohapatra et al, 2011, reported direct estimates from a national mortality survey of 1.1 million homes in 2001–03. The study found 562 deaths (0.47% of total deaths) were assigned to snakebites, mostly in rural areas, and more commonly among males than females and peaking at ages 15–29. This proportion represents about 45,900 annual snakebite deaths nationally or an annual age-standardized rate of 4.1/100,000, with higher rates in rural areas (5.4) and with the highest rate in the state of Andhra Pradesh (6.2). Annual snakebite deaths were greatest in the states of Uttar Pradesh (8,700), Andhra Pradesh (5,200), and Bihar (4,500). Other Indian states with high incidence of snakebites cases are Tamil Nadu, West Bengal, Maharashtra and Kerala. Because a large proportion of global totals of snakebites arise from India, global snakebite totals might also be underestimated (Mohapatra et al 2011).

In a retrospective study conducted in one district of West Bengal only 22.19% of the snakebite victims attended the hospitals (Majumder et al, 2014). This is because even today most of the victims initially approach traditional healers for treatment and many are not even registered in the hospital. Singh et al reported among the snakebite victims, about 60.76% received first aid at the site of incident, and 20.25% of them sought hospital care after consulting the traditional healers (ozhas, or mantrik and tandrik). Time lapsed for seeking hospital treatment was less than 4 h in 55.69% of the cases and more than 12 h

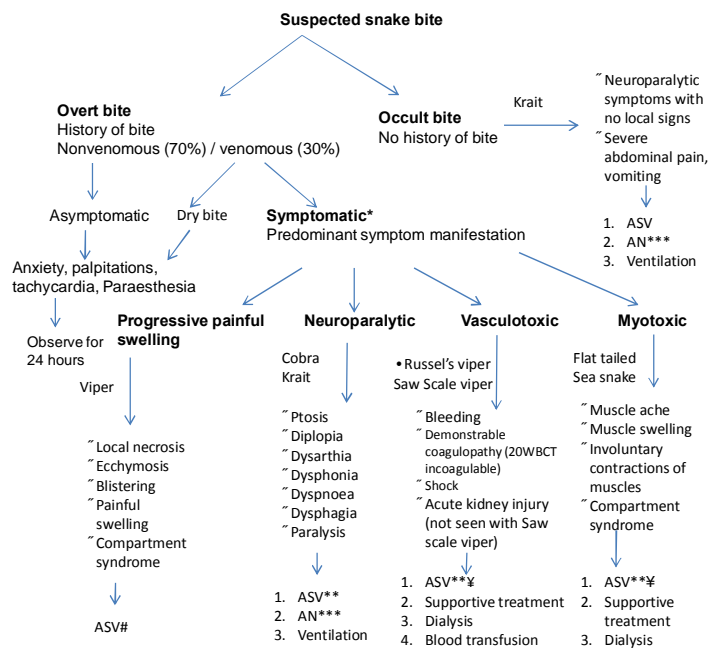
in 7.59% of the cases. Most (41.79%) patients were frightened, but no local or systemic symptoms had appeared when they reported the emergency (Singh A et al 2015).

### **3. WHEN TO SUSPECT/RECOGNIZE SNAKEBITE**

#### **CLINICAL PRESENTATION:**

Clinical presentation of snakebite victim depends upon species of snake, amount of venom injected, season of the bite, whether snake is fed or unfed, site of bite, area covered or uncovered, dry or incomplete bite, multiple bites, venom injection in vessel, weight of the victim and time elapsed between the bite and administration of ASV. Venom concentration and constitution depends on environmental conditions as well as snake's maturity and darkness of colour of snake (Bawaskar HS et al 2014).

Patient can present in any of the four clinical syndromes or with overlapping syndrome i.e. progressive weakness (neuromuscular/neurotoxic), bleeding (vasculotoxic/haemotoxic), myotoxic and painful progressive Swelling (Figure 1).



- \* Even though present as predominant manifestation but there may be overlap of syndrome as well.
- # ASV indicated in rapidly developing swelling only. Purely localized swelling with or without bite marks is not an indication of ASV.
- \*\* For reaction to antsnake venom (ASV) Dose of Adrenaline 0.5 mg IM (in children 0.01 mg/kg)
- ¥ Specific ASV for sea snake and Pit viper bite is not available in India. However, available ASV may have some advantage by cross reaction.
- \*\*\* 'AN' injection Atropine 0.6 mg followed by neostigmine (1.5mg) IV stat (In children Inj. Atropine 0.05 mg/kg followed by Inj. Neostigmine 0.04 mg/kg IV). Repeat neostigmine 0.5 mg (in children 0.01mg/kg) with atropine every 30 minutes for 5 doses. Thereafter taper dose at 1 hour, 2 hour, 6 hours and 12 hour. Positive response is measured as 50% or more recovery of the ptosis in one hour. If no response after 3<sup>rd</sup> dose stop AN injection. **No AN injection in confirmed krait bite**
- The snake specie shown above are indicative only. Russell's viper envenoming in Tamil Nadu and some other areas commonly causes paralysis – the venom of this species varies considerably across its range in India.

**Figure 1.** Four presenting clinical syndromes of snakebite i.e. progressive weakness (neuroparalytic/neurotoxic), bleeding (vasculotoxic/haemotoxic), myotoxic and painful progressive Swelling and its management.

## 4. Recommendations

### 4.1 FIRST AID MEASURES

**4.1.1 - By bystander or victim-** Immediately transfer after providing first aid to a health facility where optimal medical care with antsnake venom (ASV) is available, close observation and definite treatment can be provided.

### 4.1.2 At The Community or Village Level

- Check history of snakebite and look for obvious evidence of a bite (fang

puncture marks, bleeding, swelling of the bitten part etc.). However, in krait bite no local marks may be seen. It can be noted by magnifying lens as a pin head bleeding spot with surrounding rash.

- Reassure the patient as around 70% of all snakebites are from non-venomous species.
- Immobilize the limb in the same way as a fractured limb (Apply splint extending to the entire length of the limb, immobilizing all of the joints of the limb) in the recovery position (prone, on the left side) with his/her airway protected to minimize the risk of aspiration of vomitus. Use any rigid object as a splint e.g. spade, piece of wood or tree branch, rolled up newspapers etc.), **but do NOT block the blood supply or apply pressure.**



- Nil by mouth till victim reaches a medical health facility.
- Shift the victim to the nearest health facility (PHC or hospital) immediately.
- Arrange transport of the patient to medical care as quickly, safely and passively as possible by vehicle ambulance (toll free no. 102/108/etc.), boat, bicycle, motorbike, stretcher etc. Motorbike may be a feasible alternative for rural India where no other transport is available **but third person must sit behind the patient.**



- Victim must not run or drive himself to reach a Health facility.
- Remove shoes, rings, watches, jewellery and tight clothing from the bitten



area as they can act as a tourniquet when swelling occurs.

- Leave the blisters undisturbed.
- Inform the doctor of any symptoms such as progress of swelling, ptosis or new symptoms that manifest on the way to hospital.
- If patient is being referred if possible medical officer can accompany with patient to know the progress, manifestation of the new symptoms (such as progress of swelling, ptosis or new symptoms) and management and treatment of shock and cardiopulmonary resuscitation (CPR) on the way.

#### 4.1.3 Important don'ts

- Do not attempt to kill or catch the snake as this may be dangerous.
- Traditional remedies have NO PROVEN benefit in treating snakebite. Some of them may produce confusing signs and symptoms.
- Discard traditional first aid methods (black stones, scarification) and alternative medical/herbal therapy as they have no role and do more harm than good by delaying treatment.
- Do not wash the wound or interfere with the bite wound (incisions, suction, rubbing, tattooing, vigorous cleaning, massage, application of herbs or chemicals, cryotherapy, cautery) as this may introduce infection, increase absorption of the venom and increase local bleeding.
- Do NOT apply or inject antivenom (ASV) locally.
- Do not tie tourniquets as it may cause gangrenous limbs.
- If victim is expected to reach the hospital in more than 30 minutes but less than 3 hours crepe bandage may be ***applied by qualified medical personnel only*** till the patient is shifted to the hospital. The bandage is wrapped over the bitten area as well as the entire limb with the limb placed in a splint. It should be capable of admitting a finger beneath it (See Figure 2.) **If trained personnel is not present , Do NOT try)**

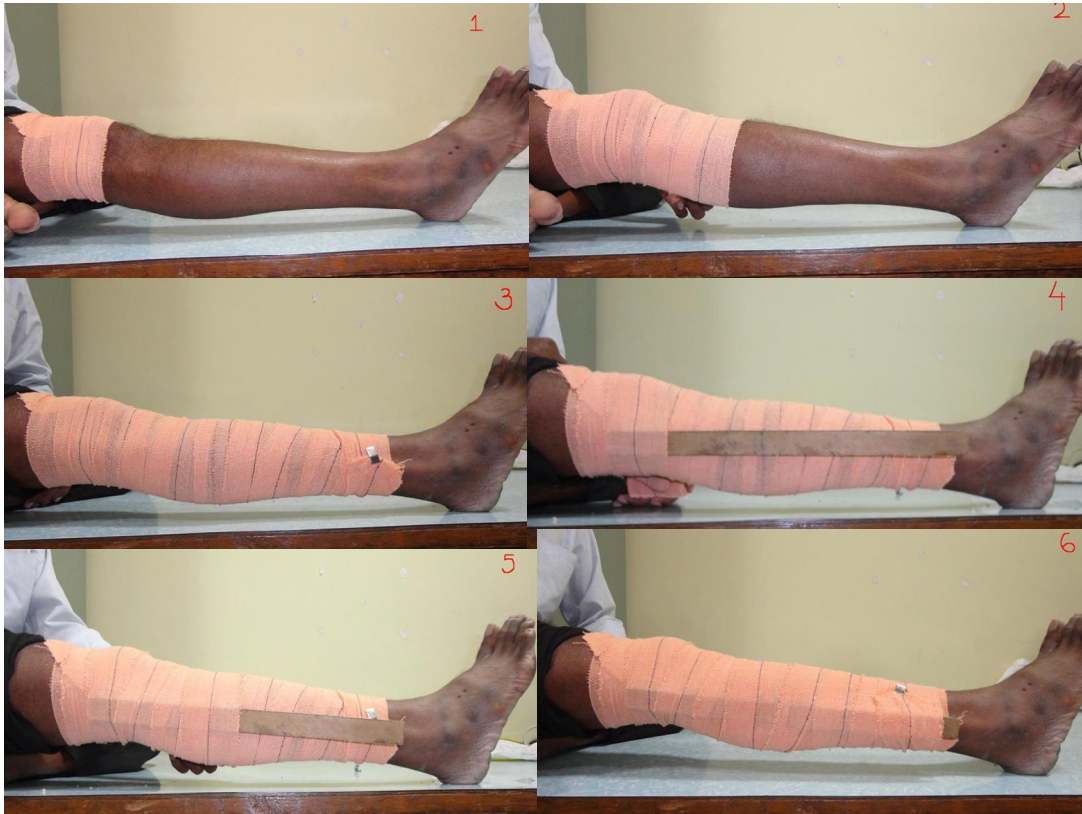


Figure 2: Pressure immobilization (Sutherland method) modified (Sutherland 1979)

#### 4.1.4 At A Health Care Facility

- . Secure IV line in PHC itself and use normal saline to keep IV access open.
- . Start fluids, if patient is in shock.
- . **Admit all victims of snakebite confirmed or suspected and keep under observation for 24 hours.**
- . Provide first-aid measures and supportive measures immediately.
- . Observe for signs of envenomation.
- . Administer ASV therapy as soon as there is evidence of envenomation.

#### 4.2 Sign & Symptoms

The clinical presentation of a snakebite victim varies with the age and size of the patient, the species of snake, the number and location of the bites, and the quantity and toxicity of the venom.

See figure 1 for presenting clinical syndromes of venomous snakebite. ***There may be considerable overlap of clinical features.***

Victims of snakebite may suffer any or all of the following (WHO 2015 adopted):

1. No physical effects other than the fang/tooth puncture due to bites by non-venomous snakes, animals other than snakes (lizards, fish, rodent, spiders), dry bite by venomous snake.

**Examination of the bite site**

Examine the bite site and look for fang marks, or any signs of local envenomation. **Fang mark or their patterns have no role to determine whether the biting species was venomous or non venomous or amount of venom injected, severity of systemic poisoning and nature of poisoning – Elapidae or viperidae venom etc.** Some species like Krait may leave no bite marks.

2. Local envenoming confined to the bitten part of the body. These effects may be transient, resolving in hours or a few days; may persist for few weeks or debilitating, some time permanently due to local necrotic effects of venom and complicating infections.
3. Systemic envenoming involving organs and tissues distant from the bitten part of the body. These effects may be transient, persistent, life threatening and debilitating, sometimes permanently.
4. Effects of anxiety prompted by frightening experience of being bitten (real or imagined) and by exaggerated beliefs about the potency and speed of action of snake venoms. The symptoms may mislead the treated personnel.
5. Effects of first-aid and other pre-hospital treatments that may cause misleading clinical features.

**4.2.1 Asymptomatic (i.e., non Venom related symptoms)**

Patients many a times present with nonspecific symptoms related to anxiety. Common symptoms in these patients are:

- . Palpitations, sweating, tremulousness, tachycardia, tachypnoea, elevated blood pressure, cold extremities and paraesthesia (pins and needles pricking sensation of the extremities). These patients may have dilated pupils suggestive of sympathetic over activity. Other may develop vasovagal shock (faintness and collapse with profound slowing of heart) after the bite or suspected bite.

- . Differentiate from symptoms and signs of envenomation listed below.
- . Redness, increased temperature, persistent bleeding and tenderness locally. However, local swelling can be present in these patients due to tight ligature.

#### 4.2.2 Dry Bite

Bites by nonvenomous snakes are common and bites by venomous species are not always accompanied by the injection of venom (dry bites).

- . The percentage of dry bites ranges from 10–80% for various venomous snakes.
- . Even in case of dry bite, symptoms due to anxiety and sympathetic over-activity (as above) may be present. As symptoms associated with panic or stress sometimes mimic early envenoming symptoms, clinicians may have difficulties in determining whether envenoming occurred or not.
- . Some people who are bitten by snakes (or suspect or imagine that they have been bitten) or have doubts regarding bite may develop quite striking symptoms and signs, even when no venom has been injected due to understandable fear of the consequences of a real venomous bite.

#### 4.2.3 Neuroparalytic (Progressive weakness; Elapid envenomation)

- . Neuroparalytic snakebite patients present with typical symptoms within 30 min– 6 hours in case of Cobra bite. 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; however, ptosis in Krait bite have been recorded as late as 36 hours after hospitalization.
- . These symptoms can be remembered as 5 Ds and 2 Ps.
  - 5 Ds – dyspnea, dysphonia, dysarthria, diplopia, dysphagia
  - 2 Ps – ptosis, paralysis
- . In chronological order of appearance of symptoms – furrowing of forehead, **P**tosis (drooping of eyelids) occurs first (Figure 3), followed by **D**iplopia (double vision), then **D**ysarthria (speech difficulty), then **D**ysphonia (pitch of

voice becomes less) followed by **Dyspnoea** (breathlessness) and **Dysphagia** (Inability to swallow) occurs. All these symptoms are related to 3<sup>rd</sup>, 4<sup>th</sup>, 6<sup>th</sup> and lower cranial nerve paralysis. Finally, paralysis of intercostal and skeletal muscles occurs in descending manner.

- . Other signs of impending respiratory failure are diminished or absent deep tendon reflexes and head lag.
- . Additional features like stridor, ataxia may also be seen.
- . Associated hypertension and tachycardia may be present due to hypoxia.



Figure 3. Ptosis with neuroparalytic snakebite

- . To identify impending respiratory failure bedside lung function test in adults viz.
  - Single breath count – number of digits counted in one exhalation - normal >30
  - Breath holding time – breath held in inspiration – normal > 45 sec
  - Ability to complete one sentence in one breath.
- . Cry in a child whether loud or husky can help in identifying impending respiratory failure.
- . ***Bilateral dilated, poorly or a non-reacting pupil is not the sign of brain dead in elapid envenoming (Figure 3).***
- . **Refer patients presenting with neuroparalytic symptoms immediately to a higher facility for intensive monitoring after giving Atropine Neostigmine (AN) injection (schedule of AN injection described below).**

#### 4.2.4 Vasculotoxic (haemotoxic or Bleeding)

**General signs and symptoms of Viperine envenomation (Vasculotoxic bites are due to Viper species. They can have local manifestations as well as systemic manifestations.**

**Local manifestations** – These are more prominent in Russel’s viper bite followed by Saw scaled viper and least in Pit viper bite. Local manifestations are in form of:

- Local swelling, bleeding, blistering, and necrosis.
- Pain at bite site and severe swelling leading to compartment syndrome. Pain on passive movement. Absence of peripheral pulses and hypoesthesia over the fields of nerve passing through the compartment helps to diagnose compartment syndrome.
- Tender enlargement of local draining lymph node.

**Systemic manifestations** –

- Visible systemic bleeding from the action of haemorrhagins (Figure 4) e.g. gingival bleeding, epistaxis, ecchymotic patches, vomiting, hematemesis, hemoptysis, bleeding per rectum, subconjunctival hemorrhages, continuous bleeding from the bite site, bleeding from pre-existing conditions e.g. haemorrhoids, bleeding from freshly healed wounds.
- Bleeding or ecchymosis at the injection site is a common finding in Viper bites.
- The skin and mucous membranes may show evidence of petechiae, purpura ecchymoses, blebs and gangrene.
- Swelling and local pain.
- Acute abdominal tenderness may suggest gastro-intestinal or retro peritoneal bleeding.
- Lateralizing neurological symptoms such as asymmetrical pupils may be indicative of intra-cranial bleeding.
- Consumption coagulopathy detectable by 20WBCT, develops as early as within 30 minutes from time of bite but may be delayed.

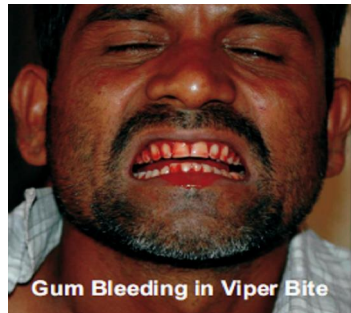


Figure 4. Local and systemic Vasculotoxic (haemotoxic or Bleeding) manifestations of Viperine envenomation.

#### 4.2.5 Locked in syndrome (LIS)

Locked in syndrome (LIS) is defined as quadriplegia and anarthria with preserved consciousness. Patients retain vertical eye movement, facilitating non-verbal communication. In complete locked in syndrome (LIS) patient cannot communicate in any form. Central LIS is seen commonly due to lesions in the ventral pons (Smith and Delargy 2005; Prakash 2008; Poovazhagi 2013). Peripheral causes of LIS are severe acute polyneuropathies, neuromuscular junction blockade due to myasthenia gravis toxins and snakebite (Prakash 2008). Knowing the peripheral causes are very important as one may make a wrong diagnosis of brain death and is treatable and complete recovery can be possible with timely intervention. Confirmatory tests like EEG, cerebral blood flow, nerve conduction velocities are recommended to avoid misdiagnosis of coma or brain death.

Peripheral LIS usually occurs in Elapidae bites, especially Krait bite and hence increasing ones suspicion rate is important as they can be referred to a centre with ventilator support.

#### 4.2.6 Life threatening complications

- Acute Kidney Injury (AKI) e.g. declining or no urine output, deteriorating renal signs such as rising serum creatinine, urea or potassium. Some species e.g. Russell's viper (*Daboia* sp) frequently cause acute Kidney Injury. Patient presents with bilateral renal angle tenderness, albuminuria,

hematuria, hemoglobinuria, myoglobinuria followed by oliguria and anuria with AKI.

- Hypotension due to hypovolaemia or direct vasodilatation or direct cardiotoxicity aggravates acute kidney injury.
- Parotid swelling, conjunctiva oedema, sub-conjunctival haemorrhage, renal failure, acute respiratory distress syndrome [leaking syndrome] and refractory shock.
- Long term sequelae e.g. pituitary insufficiency with Russell's viper (*Daboia* sp), Sheehan's syndrome or amenorrhea in females.

### Systemic Capillary Leak Syndrome (SCLS)

Idiopathic systemic capillary leak syndrome (ISCLS) is a rare disorder characterized by episodes of severe hypotension, hypoalbuminemia, hemoconcentration without albuminuria due to profound derangement of the vascular endothelium resulting in leakage of plasma and proteins into the interstitial compartment. Capillary leak syndrome is a sinister complication of *Daboia russelii* bite as it is beset with an excess of morbidity and mortality. Manifestations like parotid swelling, conjunctival chemosis, myalgia, thirst and systemic hypotension observed in patients of *Daboia russelii* bite indicate capillary leak syndrome. It is seen in more commonly in males as compared to females.

Hemoconcentration, increased HCT, leukocytosis, pleural effusion are early laboratory and radiological markers of capillary leak syndrome and should alert the clinician to seek urgent interventions in *Daboia russelii* bite.



**Figure** : A) 17 year old patient with viper bite at admission. B) & C) Same patient with Periorbital swelling, Conjunctival chemosis and icterus 24 hours later. D) Another patient with viper bite developing parotid swelling 24 hours later.



#### 4.2.6 Painful Progressive Swelling (PPS)

Progressive painful swelling is indicative of local venom toxicity. It is prominent in Russel's viper bite, Saw scaled viper bite and Cobra bite. This is associated with

- Local necrosis which often has a rancid smell. Limb is swollen and the skin is taut and shiny. Blistering with reddish black fluid at and around the bite site. Skip lesions around main lesion are also seen. (Figure 5).
- Ecchymoses due to venom action destroying blood vessel wall.
- Significant painful swelling potentially involving the whole limb and extending onto the trunk.
- Compartment syndrome will present invariably.
- Regional tender enlarged lymphadenopathy.



**Envenomed foot**



Figure 5. Snakebite marks and local swelling and necrosis

#### 4.2.7 Myotoxic

This presentation is common in Sea snakebite. Patient presents with:

- Muscle aches, muscle swelling, involuntary contractions of muscles.
- Passage of dark brown urine.
- Compartment syndrome, cardiac arrhythmias due to hyperkalaemia, acute kidney injury due to myoglobinuria, and subtle neuroparalytic signs.

#### 4.2.8 Occult snakebite

- Krait bite victims often present in the early morning with paralysis with no local signs with no bite marks.

- Snakebite victim gets up in the morning with severe epigastric/umbilical pain with vomiting persisting for 3 – 4 hours and followed by typical neuroparalytic symptoms within next 4- 6 hours. There is no history of snakebite.
- Unexplained respiratory distress in children in the presence of ptosis or sudden onset of acute flaccid paralysis in a child (locked-in syndrome) is highly suspicious symptoms in endemic areas particularly of Krait bite envenomation. Sometimes patients may present with throat, chest or joint pain.

Early morning symptoms of acute pain abdomen with or without neuroparalysis can be mistaken for a acute appendicitis, acute abdomen, stroke, GB syndrome, myasthenia gravis and hysteria (Bawaskar 2002). Krait bite envenoming is diagnosed by developing descending neuroparalysis while GB syndrome is by ascending paralysis.

Strong clinical suspicion and careful examination can avoid not only costly and unnecessary investigations such as CT scan, MRI, nerve conduction studies, CSF studies and many others but also help in avoiding undue delay in initiation of a specific treatment with ASV. Atropine neostigmine (AN) test helps to rule out myasthenia gravis.

**Snakebite is a medical emergency, history, symptoms and signs must be obtained rapidly.**

**ON PRESENTATION, PATIENTS CAN BE CRITICAL OR NON CRITICAL (See FIGURE 1).**

### **4.3. ASSESSMENT**

#### **4.3.1 Critical Arrival: *Patient assessment on arrival***

1. Assess circulation, airway and breathing and deal with any life threatening symptoms on presentation.  
**Vasculotoxic patients** presenting with bleeding from multiple orifices with hypotension, reduced urine output, obtunded mentation (drowsy,

confused), cold extremities need urgent attention and ICU care for volume replacement, pressor support, dialysis and infusion of blood and blood products (See following sections).

**Neuroparalytic patients** presenting with respiratory paralysis, tachypnoea or bradypnoea or paradoxical respiration (only moving abdomen), obtunded mentation, and peripheral skeletal muscle paralysis need urgent ventilator management with endotracheal intubation, ventilation bag or ventilator assistance.

Other patients can be evaluated to decide severity of their illness (see non-critical arrival below).

2. Establish large bore intravenous access and start normal saline slow infusion.
3. Before removal of the tourniquet/ligatures, test for the presence of a pulse distal to the tourniquet. If the pulse is absent ensure a doctor is present before removal or ligatures.
4. **In case of clinically confirmed venomous bite, remove tourniquet only after starting of loading dose of ASV and keep Atropine Neostigmine injection ready.** In case of multiple ligatures, all the ligatures can be released in Emergency Room EXCEPT the most proximal one; which should only be released after admission and all preparations.
5. Carry out a simple medical assessment including history and physical examination and record (see Annexure 2) and repeat all above, every 1-2 hourly – bite site local swelling, painful tender and enlarged local lymph glands, persistent bleeding from the bite wound, blood pressure, pulse rate, bleeding (gums, nose, vomit, stool or urine), level of consciousness, drooping eyelids (ptosis) and other signs of paralysis. ***The Glasgow Coma scale cannot be used to assess the level of consciousness of patients paralyzed by neurotoxic venom.***
  - . Check for and monitor the following: Pulse rate, respiratory rate, blood pressure and 20 minutes Whole Blood clotting test (20 WBCT) every hour for first 3 hours and every 6 hours for remaining 24 hours.
  - . Check distal pulses and monitor, if there is presence of gross swelling. The presence of a pulse does not rule out compartment syndrome. ***Pain on passive movement, pallor, pulseless limb, hypoaesthesia over the sensory nerve passing through the compartment are suggestive of compartment***

**syndrome** (see compartment syndrome below for details).

#### **4.3.2 Patient assessment:**

##### ***Non critical arrival and Critical patients after stabilization: patient assessment***

- . Determine the time elapsed since the snakebite and as to what the victim was doing at the time of the bite, history of sleeping on floor bed in previous night.
- . Determine if any traditional medicines have been used.
- . Obtain a brief medical history (e.g., date of last tetanus immunization, use of any medication, presence of any systemic disease, and history of allergy)

**Examination of pregnant women** - Monitor uterine contractions and foetal heart rate. Lactating women who have been bitten by snakes should be encouraged to continue breast feeding.

#### **4.3.3 Differential identification of type of snakebite based on the symptoms and signs**

Though to a large extent the manifestation of snakebite depends upon the species of snake, unfortunately, in many cases the biting snake is not seen, and if it is, its description by the victim is often misleading (Harris et al 2010). Therefore identification of the type of snake should not hold the treatment. At times the bite mark might not be visible (e.g., in the case of Krait). The clinical manifestations of the patient may not correlate with the species of snake brought as evidence. Examine carefully the snake, if brought, and identified (Figure 6), if possible. *Discourage bringing the killed snake into the emergency department.* Identification of the species even if killed should be carried out carefully, since crotalids can envenomate even when dead.

If snake is not available for identification in such a situation showing specimens of snakes preserved in formalin in glass jars or pictures of snakes would help the patient or the witness to recognize the offending snake which facilitates the judgment of the clinician. One smart phone photograph of the snake, dead or alive, if can be taken safely, for confirmation by an expert would help in identifying the snake.

Inspection of local bite site and bitten limb can also help to identify snake's species. Local swelling, bleeding, blistering, necrosis suggests Cobra bite. Minimum local changes indicate Krait bite. Local bleeding suggests Nilgiri Russel's viper. Pain in abdomen and hyper peristalsis indicates Krait bite.



**Figure 6.** Snake identification by the patient

**Clues for severe snake envenomation are:**

- Rapid early extension of local swelling from the site of the bite. In Cobra bite on finger, necrosis may start in few minutes.
- Early tender enlargement of local lymph nodes, indicating spread of venom in the lymphatic system
- Visible signs of neurological impairment such as ptosis, muscular weakness, respiratory distress or respiratory arrest.
- Early spontaneous systemic bleeding especially bleeding from the gums, bite site, haematuria, haemoptysis, epistaxis or ecchymoses.
- Unconsciousness either with or without respiratory arrest.
- Passage of dark brown urine
- Snake identified as a very venomous one i.e., Cobra, Russel's viper.

**4.4 LAB INVESTIGATIONS**

**4.4.1 Bedside 20 minute whole blood clotting test (20 WBCT)**

Place 2 ml of freshly sampled venous blood in a small glass test tube and leave undisturbed for 20 minutes at ambient temperature. Gently tilt the test tube to see if the blood is still liquid; the patient has hypofibrinogenaemia (“incoagulable” blood or “**not clotted**”) as a result

of venom-induced consumption coagulopathy (Figure 7). **Caution:** Use clean new dry glass test tube only to avoid false positive tests.

***If blood clot is formed and signs and symptoms of neurotoxic envenomation present, classify as neurotoxic envenomation.*** In case where the 20WBCT result is inconsistent with the patients' clinical condition, repeat the test in duplicate, including a "control" (blood from a healthy person). If the blood is solid i.e. has clotted the patient has passed the coagulation test and no **ASV is required at this stage**. 20 WBCT may remain negative (clotting) in patients with evolving venom – induced DIC, therefore, the patient is re-tested every hour for the first three hours and then 6 hourly for 24 hours until either test result is not clotted or clinical evidence of envenomation to ascertain if dose of ASV is indicated. Antivenom treatment should not be delayed if there is other evidence of spontaneous systemic bleeding distant from the bite site. In case test is non-clotting, repeat 6 hour after administration of loading dose of ASV. In case of neurotoxic envenomation repeat clotting test after 6 hours. (Expert Consensus)

*Counsel patient and relatives in the beginning that, 20WBCT may be repeated several times before giving any medication.*

## 20WBCT

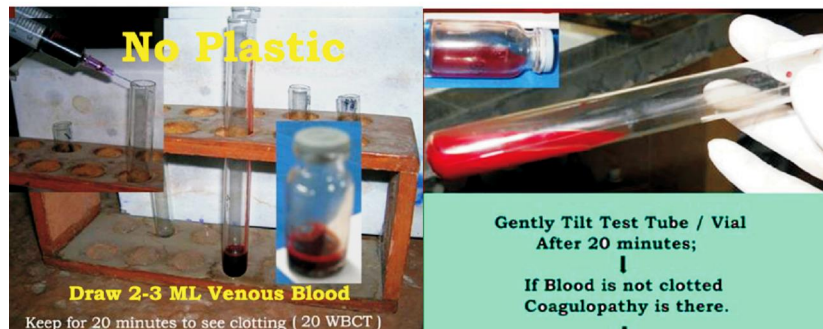


Figure 7. 20 minute whole blood clotting test (20 WBCT).

The first blood drawn from the patient should be typed and cross-matched, as the effects of both venom and ASV can interfere with later cross-matching.

## **Other investigations that may assist in the management of snake bite at various levels of healthcare**

### **4.4.2 – Other Lab tests at Primary health centre**

- . Peak flow meter in patients (adolescents and adults) presenting with neuromuscular syndrome.
- . If Peak flow meter is not available in PHC then assess respiratory function using bedside tests - single breath count, breath holding time and ability to complete one sentence in one breath as described earlier.
- . Urine examination for albumin and blood by dipstick.

### **4.4.3 Others lab test at District Hospital**

In addition to the above

- |                             |                          |
|-----------------------------|--------------------------|
| . Prothrombin time          | . Serum Amylase          |
| . Platelet count,           | . Blood sugar            |
| . Clot retraction time      | . ECG                    |
| . Liver function test (LFT) | . Abdominal ultrasound   |
| . Renal Function test (RFT) | . 2D Echo (if available) |

### **4.4.4 Others Lab test at Tertiary Health Care Centre**

In addition to the above

- . *In neuromuscular envenomation*
  - Arterial blood gases. Caution: Arterial puncture is contraindicated in patients with haemostatic abnormalities.
  - Pulmonary function tests
- . *In Vasculotoxic venomation*
  - For coagulopathy- BT, CT, PT, APTT, Platelet, Serum Fibrinogen, FDP D-Dimer assay, LDH, peripheral blood smear
  - Hemolysis -Urine for myoglobin, Urine haemoglobin
  - For renal failure- Urine microscopy for RBC, casts, RFT, urinary proteins, creatinine ratio
  - Hepatic injury – LFTs including SGOT, SGPT, Alkaline phosphatase, serum proteins
  - Cardiotoxicity- CPK-MB, 2D Echo, BNP
  - Myotoxic – CPK, SGOT, Urine myoglobin, compartment pressure

- Infection- Serum procalcitonin, culture (blood, urine, wound) and sensitivity
- . Arterial blood gases and urine examination should be repeated at frequent intervals during the acute phase to assess progressive systemic toxicity).

#### 4.4.5- Rationale and interpretation of the tests

1. Hemogram: The hemogram may show transient elevation of hemoglobin level due to hemoconcentration (because of the increased capillary leak) or may show anemia (due to hemolysis, especially in viper bites). Presence of neutrophilic leucocytosis signifies systemic absorption of venom. Thrombocytopenia may be a feature of viper envenomation.
2. *Platelet count*: This may be decreased in victims of envenoming by vipers.
3. *White blood cell count*: An early neutrophil leucocytosis is evidence of systemic envenoming from any species.
4. *Blood film*: Fragmented red cells (“helmet cell”, schistocytes) are seen when there is microangiopathic haemolysis.
5. *Plasma/serum*: May be pinkish or brownish if there is gross haemoglobinaemia or myoglobinaemia.
6. Serum creatinine: This is necessary to rule out acute kidney injury after viper and sea snakebite.
7. Serum creatinine phosphokinase (CPK): Elevated levels of these markers suggests muscle damage (caution for renal damage) and raised amylase suggests pancreatic injury. In patients who develop capillary leak syndrome meticulous monitoring of CPK and blood pressure control is necessary to avoid the inception of renal failure.
8. Prothrombin time (PT) and activated partial thromboplastin time (aPTT): Prolongation may be present in viper bite (to be repeated 6 hourly, if abnormal).
9. Fibrinogen and fibrin degradation products (FDPs): Low fibrinogen with elevated FDP is present when venom interferes with the clotting mechanism.
10. Urine examination for Proteinuria/ RBC/ Haemoglobinuria/ Myoglobinuria: The colour of the urine (pink, red, brown, black) should be noted and the



urine should be tested by dipsticks for blood or haemoglobin or myoglobin. Standard dipsticks do not distinguish blood, haemoglobin and myoglobin. Haemoglobin and myoglobin can be separated by immunoassays but there is no easy or reliable test. Microscopy will confirm whether there are erythrocytes in the urine.

11. Electrocardiogram (ECG): Common electrocardiographic changes seen are sinus tachycardia, sinus arrhythmia, sinus bradycardia, tall T-wave in V2, pattern suggestive of acute anterior wall infarction with reciprocal changes, myocardial ischemia, non-specific ST-T changes and atrioventricular block (Nayak et al 1990).
12. Electroencephalogram (EEG): EEG changes have been noted in up to 96% of patients bitten by snakes. However, rarely needed for patient management. These changes start within hours of the bite but are not associated with any features of encephalopathy. 62% showed grade I changes, 31% cases manifested grade II changes (moderate to severe abnormality), and the remaining 4% showed severe abnormality (grade III). These abnormal EEG patterns were seen mainly in the temporal lobes (Ramachandran S et al 1995).
13. Pulse oximetry for oxygen in patients with respiratory failure or shock.
14. Electrolyte determinations: These tests are necessary for patients with respiratory paralysis and systemic symptoms.
15. Arterial blood gases and pH may show evidence of respiratory failure (neurotoxic envenoming) and acidaemia (respiratory or metabolic acidosis).
16. X-Ray/ CT/ Ultrasound (The use of X-Ray and ultrasound are of unproven benefit, apart from identification of bleeding in Viperine bites).

## 5. ANTI SNAKE VENOM (ASV) THERAPY

1. **If ASV is indicated i.e. signs and symptoms of envenomation with or without evidence of laboratory tests, administer FULL dose** without any delay. **Do NOT** wait for any test report. In a patient with a history of Bite; known or unknown, if there is spontaneous abnormal bleeding beyond 20 minutes from time of bite, start ASV, do NOT wait for 20 WBCT report.
2. Carry out a more detailed clinical and laboratory assessment including biochemical and haematological measurements, ECG or radiography, as indicated to get a baseline data.

3. **There are no absolute contraindications to ASV.** However, do not routinely administer ASV to any patient claiming to have bitten by a snake as ASV exposes such patients to the risks of ASV reactions unnecessarily; besides wastage of valuable and scarce stocks of ASV. **However, at the same time do not delay or withhold ASV on the grounds of anaphylactic reaction to a deserving case. Do NOT give incomplete dose.**
4. Purely local swelling, even if accompanied by a bite mark from an apparently venomous snake, is not a ground for administering ASV. Swelling, a number of hours old is also not a ground for giving ASV. **However, rapid development of swelling indicates bite with envenoming requiring ASV.**

### 5.1 Antisnake venom (ASV)

- . Antisnake venom treatment is the only specific treatment, it should be given as soon as it is indicated. It may reverse systemic envenomation abnormality even when this has persisted for several days or, in the case of haemostatic abnormalities, persisting for two or more weeks. The dosage required varies with the degree of envenomation.
- . In the presence of coagulopathy, Polyvalent ASV freeze-dried (heat stable; to be stored at cool temperature; shelf life 3-5 years) or neat liquid ASV (heat labile; ready to use; requires reliable cold chain (2-8°C and NOT frozen) with a refrigeration shelf life of 2 years but costlier) whichever is available may be used before expiry date. If integrity of the cold chain is not guaranteed use of lyophilized ASV is preferred. However, in patients with severe envenoming recently expired antivenoms may be used if there is no alternative (WHO 2015).

### 5.2 Antisnake venom (ASV) DOSE

Reconstitute ASV supplied in dry powder form by diluting in 10 ml of distilled water/normal saline. Mixing is done by swirling and not by vigorous shaking. Caution: Do not use, if reconstituted solution is opaque to any **extent**.

**Dose of ASV for neuroparalytic snakebite** – ASV 10 vials stat as infusion over 30 minutes followed by 2<sup>nd</sup> dose of 10 vials after 1 hour if no improvement within 1<sup>st</sup> hour.

**Dose of ASV for vasculotoxic snakebite** - Two regimens low dose infusion therapy and high dose intermittent bolus therapy can be used. Low dose infusion therapy is as effective as high dose intermittent bolus therapy and also saves scarce ASV doses (Expert Consensus).

**Low Dose infusion therapy** – 10 vials for Russell’s viper or 6 vials for Saw scaled viper as stat as infusion over 30 minutes followed by 2 vials every 6 hours as infusion in 100 ml of normal saline till clotting time normalizes or for 3 days whichever is earlier.

**OR**

**High dose intermittent bolus therapy** - 10 vials of polyvalent ASV stat over 30 minutes as infusion, followed by 6 vials 6 hourly as bolus therapy till clotting time normalizes and/or local swelling subsides.

**No ASV for Sea snakebite, confirmed Green Pit snakebite even if with signs of envenomation as available ASV do not contain antibodies against them.**

The range of venom injected is 5 mg-147 mg. The total required dose range is between 10 and 30 vials as each vial neutralizes 6 mg of Russell’s Viper venom. Depending on the patient condition, additional vials can be considered.

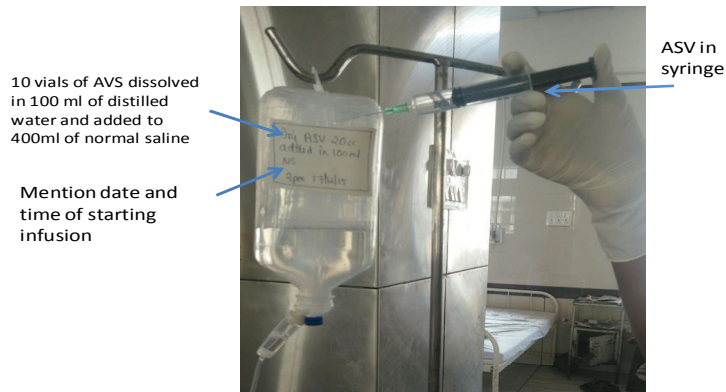
Patients with capillary leak syndrome required higher dose of ASV compared to those without it. Early recognition and effective treatment like infusion of fresh frozen plasma and reduction of hemoconcentration may play a key role to reduce its gruesome mortality (Menon and Joseph 2014; Atkinson, et al 1977).

### **5.3 Monitoring of Patients and Precautions during ASV Administration**

- **Give ASV only by the IV route, and slowly, with the physician at the bed side during the initial period to intervene immediately at the first sign of any reaction.** Observe all patients carefully every 5 min for first 30 min, then at 15 min for 2 hours for manifestation of a reaction. At the earliest sign of an adverse reaction suspend temporarily.
- The rate of infusion can be increased gradually in the absence of a reaction until the full starting dose has been administered (over a period of ~1 hour).
- Give prophylactic epinephrine 0.25 mg of 0.1% solution by subcutaneous injection (Children 0.005 mg/kg body weight of 0.1% solution) except in

known hypertensive or patients with cardiovascular disease and draw Epinephrine (adrenaline) in readiness in two syringes before ASV is administered.

- **NEVER** give ASV by IM route and do **NOT** inject the ASV locally at the bite site.
- **Take all aseptic precautions before starting ASV to prevent any pyrogenic reactions to ASV.**
- Maintain a strict intake output chart and note colour of urine to detect acute kidney injury early.



Administer 10 vials of ASV in first hour.  
Maintain slow drip for 24 hours

Figure 8. ASV infusion and dosage schedule Each vial of AVS be dissolved in 10 ml of distilled water and added to an infusion medium such as normal saline (i.e. 10 vials of AVS dissolved in 100 ml of distilled water and added to 400ml of normal saline). The volume of infusion is reduced according to the body size and the state of hydration of the patient. In oliguric patients restrict fluids and use infusion pump to give full dose of ASV over 30 minutes.

#### 5.4 ASV dose in pregnancy

Pregnant women are treated in exactly the same way as other victims. The same dosage of ASV is given. Refer the victim to a gynecologist for assessment of any impact on the foetus.

#### 5.5 ASV dose in children

Children also are given exactly the same dose of ASV as adults as snakes inject the same amount of venom into children and adult.

Infusion: liquid or reconstituted ASV is diluted in 5-10 ml/kg body weight of normal saline. However, reduce amount of fluid in running bottle to 200 ml to avoid fluid over load.

#### **5.6 ASV dosage in victims requiring life saving surgery**

Rarely patient may develop intracranial bleeding for which a life saving surgery is required. In such cases, before surgery, coagulation must be restored to avoid catastrophic bleeding and higher initial dose of ASV (up to 30 vials) can be administered.

#### **5.7 Repeat dose of ASV**

##### **Repeat dose: in Vasculotoxic or haemotoxic envenomation**

Repeat clotting test every 6 hours until coagulation is restored. Administer ASV every 6 h until coagulation is restored. In patients who continue to bleed briskly repeat ASV within 1-2 hours (WHO 2015). Envenomation by the Hump-nosed Pit viper does not respond to normal Indian polyvalent ASV and coagulopathy may continue for up to 3 weeks. If 30 vials of ASV have been administered reconsider whether continued administration of ASV is serving any purpose, particularly in the absence of proven systemic bleeding.

If large doses have been administered and the coagulation abnormality persists, give fresh frozen plasma (FFP) or cryoprecipitate (fibrinogen, factor VIII), or give fresh whole blood, if both FFP and cryoprecipitate are not available.

##### **Repeat dose: neuroparalytic or neurotoxic envenomation**

Initial dose of ASV 10 vials stat as infusion to be followed by 2<sup>nd</sup> dose of 10 vials if no improvement within 1<sup>st</sup> hour. Repeat 2<sup>nd</sup> dose may be required even after 2-3 hours if relapse of signs of neurotoxicity are noted (may be due to delayed absorption). Maximum dose is 20 vials of ASV for neurotoxically envenomed patients.

#### **5.9 Victims who arrive late**

Sometimes victims arrive late after the bite, often after several days, usually with acute kidney injury. Determine current venom activity such as bleeding in case of viperine envenomation. Perform 20WBCT and determine if any coagulopathy is present then administer ASV. If no coagulopathy is evident, treat kidney injury, if any.

### 5.10. ASV reaction

- . **NO ASV TEST DOSE MUST BE ADMINISTERED.**
- . **SKIN/CONJUNCTIVAL HYPERSENSITIVITY TESTING DOES NOT RELIABLY PREDICT EARLY OR LATE ANTISNAKE VENOM REACTIONS AND IS NOT RECOMMENDED.**
- . Rarely patients may develop severe life-threatening anaphylaxis characterized by hypotension, bronchospasm, and angioedema. However, 20%-60% patients treated with ASV develop either early or late mild reactions (Deshpande et al.2013; Deshmukh et al 2014).
- . **Early anaphylactic reactions** occurs within 10–180 min of start of therapy and is characterized by itching, urticaria, dry cough, nausea and vomiting, abdominal colic, diarrhoea, tachycardia, and fever. A minority of these patients may develop severe life-threatening anaphylaxis, hypotension, bronchospasm and angio-oedema (WHO 2015)
- . **Pyrogenic reactions** usually develop 1–2 h after treatment. Symptoms include chills and rigors, fever, and hypotension. These reactions are caused by contamination of the ASV with pyrogens during the manufacturing process.
- . ***Any new sign or symptom after starting the ASV in drip should be suspected as a reaction to ASV.***
- . **Late (serum sickness–type) reactions** develop 1–12 (mean 7) days after treatment. Clinical features include fever, nausea, vomiting, diarrhoea, itching, recurrent urticaria, arthralgia, myalgia, lymphadenopathy, immune complex nephritis and, rarely, encephalopathy.

### 5.11 Premedication with Adrenaline (epinephrine)

Routine use of prophylactic adrenaline is recommended before ASV, except **in** known hypertensive, and if patient presents with blood pressure more than 140/90 in adult victims **or** if **evidence of suspicion of underlying cardiovascular disease**. The adult dose of adrenaline (epinephrine) is 0.25 mg of 0.1% solution by subcutaneous injection (Children 0.005 mg/kg body weight of 0.1% solution).

Use of histamine, anti-H1 and anti-H2 blockers, corticosteroids and the rate of intravenous infusion of antivenom between 10 and 120 minutes),

do not affect the incidence or severity of early antivenom reactions. (de silva 2011)

### **5.12 Treatment of Early ASV reaction**

1. Stop ASV temporarily.
  2. Oxygen
  3. Start fresh IV normal saline infusion with a new IV set
  4. Administer Epinephrine (adrenaline) (1 in 1,000 solution, 0.5 mg (i.e. 0.5 ml) in adults **intramuscular over deltoid or over thigh**; In children 0.01 mg/kg body weight) for early anaphylactic and pyrogenic ASV reactions.
  5. Administer Chlorpheniramine maleate (adult dose 10 mg, in children 0.2 mg/kg) intravenously.
- . Hydrocortisone can be given but it is unlikely to act for several hours.
  - . Once the patient has recovered, re-start ASV slowly for 10-15 minutes keeping the patient under close observation. Then resume normal drip rate.

#### **For high risk patients**

In patients with history of hypersensitivity or exposure to animal serum such as equine ASV, tetanus-immune globulin or rabies-immune globulin in past, severe atopic conditions:

- Give ASV only if they have signs of systemic envenoming.
- Give Inj. Hydrocortisone 200 mg and Chlorpheniramine maleate 22.75 mg prior to the administration of ASV.

#### **Treatment of Late (serum sickness–type) reactions**

- . Inj. Chlorpheniramine 2 mg in adults (In children 0.25 mg/kg/day) 6 hourly for 5 days.
- . In patients who fail to respond within 24–48 h give a 5-day course of Prednisolone (5 mg 6 hourly in adults and 0.7 mg/kg/day in divided doses in children).

#### **Desensitization procedure only in case of severe anaphylaxis reaction to ASV**

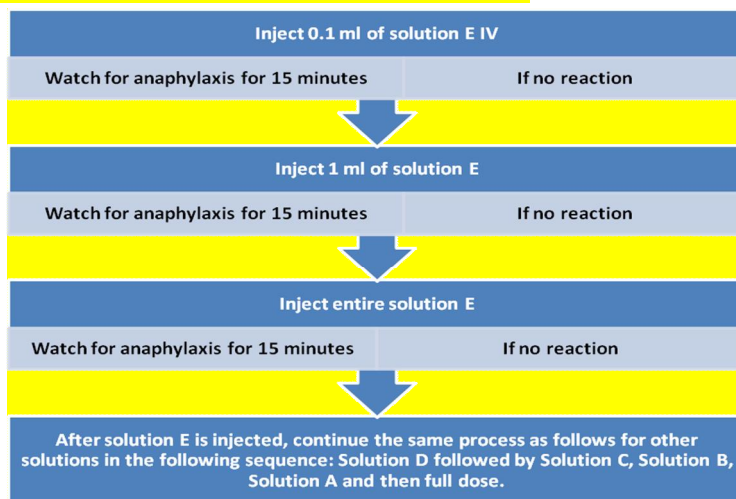
with shock and generalised anasarca after injection of very few ml of ASV usually less than 5 ml of diluted ASV.

- . Change the batch of ASV
- . Pre-medication: Administer Inj. Hydrocortisone 100 mg I.V. and Inj. Adrenaline 0.5 ml subcutaneously/ intramuscularly (± Promethazine)

#### **Table 1. Steps of dilution of ASV**

Steps of dilution	Instructions	Total Volume	Solution	Dilution
1.	Dilute 1 ml of ASV in a vial with 10 ml of normal saline	10ml	A	
2.	1ml of solution A + 9 ml of saline	10 ml	B	1: 10
3.	1ml of solution B+ 9 ml of saline	10 ml	C	1: 100
4.	1ml of solution C + 9 ml of saline	10 ml	D	1: 1000
5.	1ml of solution D + 9 ml of saline	10 ml	E	1: 10,000

After dilution and preparation of Solution E,



## 6. MANAGEMENT NEUROTOXIC (NEUROPARALYTIC) ENVENOMATION

Antisnake venom treatment alone cannot be relied upon to save the life of a patient with bulbar and respiratory paralysis. Administer following in addition:

1. Oxygen
2. Assisted ventilation. If the patient has evidence of bulbar or respiratory paralysis, insert endotracheal tube with the help of the anesthesiologist, if available or by a trained medical personnel or use laryngeal mask airway (LMA). If there is evidence of respiratory failure, assist ventilation manually by anaesthetic bag or mechanical ventilator. The duration of mechanical



ventilation in snakebite victims is usually short since neuromuscular paralysis reverses quickly with prompt administration of ASV. Manual ventilation (self ventilating anaesthetic bag) is also effective if mechanical ventilator is not available. Prolonged assisted ventilation with room air or oxygen is followed by complete recovery in case of Guillain-Barre syndrome and delayed neuropathy following snakebite.

3. Administer 'Atropine Neostigmine (AN)' schedule described as below. Give one dose of "AN" injection before transferring to the higher centre. Rapid deterioration of Cobra bite neurotoxic syndrome may kill the patient on the way during transfer. ***Some patients go into a deep coma state but recover completely. Hence, diagnosis of brain death should not be considered. Do not give AN in case of confirmed krait bite.***
4. **Initial dose of ASV is administered over 1 hour.** If ASV not available refer to a higher facility where ASV is available or if no improvement after initial dose.

#### **6.1 Atropine neostigmine (AN) dosage schedule**

- . Atropine 0.6 mg followed by neostigmine (1.5mg) to be given IV stat and repeat dose of neostigmine 0.5 mg with atropine every 30 minutes for 5 doses (In children, Inj. Atropine 0.05 mg/kg followed by Inj. Neostigmine 0.04 mg/kg **Intravenous** and repeat dose 0.01 mg/kg every 30 minutes for 5 doses). A fixed dose combination of Neostigmine and glycopyrolate IV can also be used.
- . Thereafter to be given as tapering dose at 1 hour, 2 hour, 6 hours and 12 hour. Majority of patients improve within first 5 doses. Observe the patient closely observed for 1 hour to determine if the neostigmine is effective. After 30 minutes, any improvement should be visible by an improvement in ptosis. Positive response to "AN" trial is measured as 50% or more recovery of the ptosis in one hour.
- . Stop Atropine neostigmine (AN) dosage schedule if:
  - Patient has complete recovery from neuromuscular paralysis. Rarely patient can have recurrence, carefully watch patients for recurrence.
  - Patient shows side effects in the form of fasciculations or bradycardia.
  - If there is no improvement after 3 doses.
- . Improvement by atropine neostigmine indicates Cobra bite. A few Nilgiri Russel's viper bites victims also improve with this regimen.

- . If there is no improvement after 3 doses of atropine neostigmine, this indicates probable Krait bite. Krait affects pre-synaptic fibres where calcium ion acts as neurotransmitter. Give Inj. Calcium gluconate 10ml IV (in children 1-2 ml/kg (1:1 dilution) slowly over 5-10 min every 6 hourly and continue till neuromuscular paralysis recovers which may last for 5-7 days.

## **7. MANAGEMENT OF VASCULOTOXIC SNAKEBITE**

1. Strict bed rest to avoid even minor trauma.
2. Screen for hematuria, hemoglobinuria, myoglobinuria by Dipstick method. Dipstick test is positive in all three presentations listed above. Centrifuged urine showing pink color indicates hemoglobinuria, clear supernatant (RBCs settle down as deposit) indicates myoglobinuria.
3. Closely monitor urine output and maintain 1 ml/kg/h urine output.
4. If the patient is bleeding severely irrespective of full dose of ASV or is already seriously anaemic give transfusion of blood or fresh frozen plasma or transfer where facility is available.
5. Prompt recognition of organ dysfunction and immediate intervention may reverse organ impairment and improve the outcome.

### **7.1 Volume Replacement in snake bite:**

If the patient has intravascular volume depletion, indicated by supine or postural hypotension, or empty neck veins, proceed as follows:

1. Establish intravenous access.
2. Give fluid challenge: In adult patient 200 ml in saline in 5 minutes first, check BP response, if positive additional fluid given over 30 min or until the jugular venous pressure/central venous pressure has risen to 8-10 cm above the sternal angle (with the patient propped up at 45°).
3. Observe the patient closely while this is being done. The fluid challenge must be stopped immediately if pulmonary oedema develops.

### **7.2 Forced Alkaline Diuresis (FAD)**

If urine output does not improve or dipstick positive for blood give a trial of FAD **within first 24 hours of the bite** to avoid pigment nephropathy leading to acute tubular necrosis (ATN). **Delayed FAD has no role.** Sequence of FAD in adults is as follows:

- i. Inj. Frusemide 40 mg IV stat
  - ii. Inj. Normal saline 500 ml + 20 ml of NaHCO<sub>3</sub> over 20 minutes
  - iii. Inj. Ringer's lactate 500 ml + 20 ml of NaHCO<sub>3</sub> over 20 minutes
  - iv. Inj. 5% dextrose 500 ml + 10 ml of Potassium Chloride over 90 minutes
  - v. Inj. Mannitol 150 ml over 20 min
- . Whole cycle completes in 2 h 30 min and urine output of 3 ml/min is expected.
  - . **If patient responds to first cycle continue for 3 cycles.** FAD converts oliguria into polyuria and avoid ATN and acute kidney injury needing dialysis in more than 75% patients.
  - . **If there is no response to furosemide discontinue FAD** and refer patient immediately to a higher center for dialysis.

### 7.3 Detection and management of hyperkalemia

Hyperkalaemia (>7 mmol/l or hyperkalaemic ECG changes- tall peaked T waves, prolonged P-R interval, absent P wave, wide QRS complexes)

1. Give 10 ml of 10% calcium gluconate intravenously over 2 minutes (with ECG monitoring if possible) repeated up to 3 times.
2. Give 50 ml of 50% dextrose with 10 units of soluble insulin intravenously
3. Sodium bicarbonate 40 ml of 8.4% by slow intravenous infusion and Salbutamol aerosol by inhaler may also be used.

### 7.4 Management of severe acidosis

If the patient is hypotensive and profoundly acidotic (deep sighing "Kussmaul" respirations, very low plasma bicarbonate levels or very low pH <7.10, administer sodium bicarbonate

1. Calculate bicarbonate deficit
2. Administer 2-3 ampoules (40 ml of 8.4% sodium bicarbonate equivalent to 1 mmol/ml) in 55 dextrose water or half of the calculated deficit can be replaced in 3-4 hours. **Caution:** Intravenous bicarbonate may precipitate profound hypocalcaemia and seizures, especially in patients with rhabdomyolysis.

3. Severe acidosis in snakebite is usually associated with acute renal failure. Volume expansion by sodium bicarbonate can cause fluid overload. If no clinical improvement dialysis is indicated.

### **7.5 Indications for dialysis**

- Absolute value of Blood urea >130 mg/dl (27 mmol/L) (BUN 100 mg/dl), Sr. Creatinine > 4 mg/dl (500 µmol/L) OR evidence of hypercatabolism in the form of daily rise in blood urea 30 mg/dl (BUN > 15), Sr. Creatinine > 1 mg/dl, Sr. Potassium > 1 mEq/L and fall in bicarbonate >2 mmol/L
- Fluid overload leading to pulmonary oedema
- Hyperkalaemia (>7 mmol/l or hyperkalaemic ECG changes- tall peaked T waves, prolonged P-R interval, absent P wave, wide QRS complexes)
- Unresponsive to conservative management.
- Uremic complications – encephalopathy, pericarditis.

- . Haemodialysis is preferable in cases of hypotension or hyperkalaemia. Peritoneal dialysis can be performed at a secondary health care center. Continuous renal replacement therapies and intermittent hemodialysis are equivalent in patients with severe sepsis and acute renal failure because they achieve similar short-term survival rates.
- . Continuous therapies are recommended to facilitate management of fluid balance in hemodynamically unstable patients. An efficient dose for continuous renal replacement therapy would be 20 to 25 mL/kg/h of effluent generation.

### **7.6 In case of Shock, myocardial damage**

1. Correct hypovolaemia with colloid/crystalloids, controlled by observation of the central venous pressure.
2. Infusion of isotonic crystalloids or albumin, with boluses of up to 20 ml/kg for crystalloids (or albumin equivalent) over 5 to 10 min (in children over 30 min) titrated to reversing hypotension, increasing urine output, and attaining normal capillary refill, peripheral pulses and level of consciousness without inducing lung crepitations or hepatomegaly.

3. If hepatomegaly or rales develop, initiate inotropic support with dopamine or dobutamine. If patient doesn't respond to fluid resuscitation, inotropic support must be given.
4. In sepsis, noradrenaline is the inotropic agent of choice. Treat patients with hypotension associated with bradycardia with atropine.
5. **For coagulopathy** – in case of prolonged CT, PT, aPTT administer fresh frozen plasma (FFP) infusion. Associated low platelets indicates consumptive coagulopathy and disseminated intravascular coagulopathy (DIC). To confirm fibrinogen level FDP should be estimated. Low fibrinogen and high FDP will require fibrinogen/FFP supplementation. Bleeding leads to anaemia, PCV of 30% must be maintained, therefore, measure serial PCV every 4 – 6 h depending upon bleeding severity of patients. If PCV is lower than 30 needs blood transfusion/PCV transfusion.
6. Avoid intramuscular injections.
7. FFP administration after ASV administration results in more rapid restoration of clotting function in most patients, but no decrease in discharge time. Early FFP administration (< 6-8 h) post-bite is less likely to be effective. Administer 10-15 ml/kg of FFP within over 30–60 min within 4 hours of ASV administration. The aim should be a return of coagulation function, as defined by an INR of < 2.0, at 6 h after ASV administration was commenced. Non –response to FFP can occur with use of FFP that has low activity of FV and FVIII, because of either poor storage or premature thawing (> 24 hours) prior to administration.  
**Heparin** is ineffective against venom-induced thrombosis and may cause bleeding on its own account. It should never be used in cases of snakebite. **Antifibrinolytic agents** are not effective and should not be used in victims of snakebite.

## 8. MANAGEMENT OF SEVERE LOCAL ENVENOMING

1. Local necrosis, intracompartmental syndromes and even thrombosis of major vessels is more likely in patients who cannot be treated with ASV.
2. Surgical intervention may be needed but the risks of surgery in a patient with consumption coagulopathy, thrombocytopenia and enhanced

fibrinolysis must be balanced against the life-threatening complications of local envenoming.

3. Give prophylactic broad-spectrum antimicrobial treatment for cellulitis after completion of first 10 vials of ASV) is as following.

Inj. Amoxicillin+ clavulanic acid 1.2 g IV thrice daily for first 7 days then switch to oral therapy Tab. Amoxicillin+clavulanic acid 625 mg three times a day for further 3-7 days; In children, the dose is 100 mg/Kg/day in three divided doses intravenously; for oral therapy, the dose is 50 mg/kg/day in three divided doses. Reduce dose of Amoxicillin+clavulanic acid and Ceftriaxone in case of acute kidney injury due to Viper bites.

Alternatively Inj Ceftriaxone 1 g IV twice daily (in children the dose is 100 mg/kg/day in two divided doses) for 7 days.

- Inj. Metronidazole 400 mg IV infusion thrice daily for 7 days; in children- 30 mg/kg/day in 3-4 divided doses.

## 9. Recovery phase

Observation of the response to adequate dose of antsnake venom

- Response to infusion of ASV is marked by normalization of blood pressure. Within 15–30 min bleeding stops, though coagulation disturbances may take up to 6 h to normalize.
- Neurotoxic envenoming of the postsynaptic type (Cobra bites) begins to improve within the first 30 min, but patients may require 24–48 h for full recovery. Envenoming with presynaptic toxins (Kraits and sea snakes) do not respond in this way usually takes a considerable time to improve. Recovery of respiratory muscles is reflected by improvement of neck flexors where flexing the neck against gravity indicates timing to wean off ventilation. Prophylactic antibiotics are unnecessary.
- Nausea, headache and generalized aches and pains may disappear very quickly.
- In shock patients, blood pressure may increase within the first 30-60 minutes and arrhythmias such as sinus bradycardia may resolve.
- Active haemolysis and rhabdomyolysis may cease within a few hours and the urine returns to its normal colour. However, red colour urine may

persist for several days in spite of adequate ASV treatment, does not require further ASV.

- Patient in deep coma recover fully provided there is no hypoxic brain damage. Autonomic dysfunctions are transient and don't need treatment. Sometimes treatment might be harmful e.g. treating with antihypertensive drugs to lower the increased blood pressure due to sympathetic hyperactivity.

## 10. Other measures

1. Clean the bitten site with povidone-iodine solution, but do not apply any dressings.
2. Leave blisters alone. Allow them to break spontaneously and heal. If there is local necrosis, excise and apply saline dressings. Surgical decompression may be necessary in some cases.
3. Administer booster dose of Tetanus toxoid injection, if not vaccinated earlier or vaccination history is not reliable after correction of coagulopathy.
4. For mild pain, in adults Paracetamol 500-1000 mg (in children 10-15 mg/kg) every 4-6 hourly orally. Do not use aspirin or other non steroidal anti-inflammatory drugs (NSAIDs). In case of severe pain in adults, Tab. Tramadol 50 mg or Inj. Tramadol 50 mg IV and in children Ibuprofen cautiously 5-10 mg/kg/dose every 8 hourly. Avoid drugs such as sedatives, pethidine, morphine and neuromuscular blocking agents ***in neurotoxic envenomation. A deeply sedated patient may create confusion regarding level of neuro-paralysis.***
5. Maintain hydration and nutrition.
6. If there is local pain and spreading oedema, elevate the affected limb and allow it to rest on a sand bag.

### 10.1 Surgical procedures in snakebite

#### 10.1.1 Debridement of necrotic tissue

Wait for 5-7 days before commencing debridement of necrotic tissue in order to specify the line of demarcation between viable and non-viable tissue. Refer patients requiring skin grafting and amputation of a

necrotic digit/limb to a Surgeon after completion of ASV treatment.

### 10.1.2 Compartmental syndrome

**Clinical features of a compartmental syndrome (5 'P') –**

- Pain (severe)
- Pallor
- Paraesthesia
- Pulselessness
- Paralysis or weakness of compartment muscle.

### 10.1.3 Criteria for fasciotomy in snakebite limb

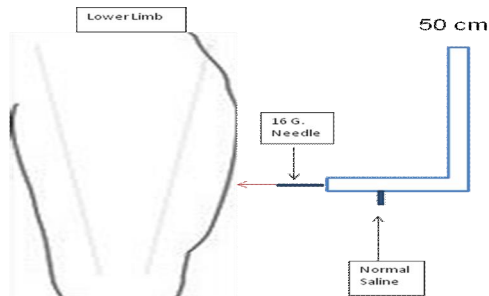
- Clinical evidence of an intracompartmental syndrome
- Intra-compartmental pressure >40 mmHg of normal saline (in adults). Compartment pressure can be measured bed side using 3 way cannula – 16 G needle attached to one end, BP apparatus attached to 2<sup>nd</sup> end and saline infusion on 3<sup>rd</sup> side (Figure 9).
- This can be confirmed by vascular Doppler and rising CPK in thousands. Timely fasciotomy decreases the need for repeated dialysis.
- Haemostatic abnormalities have been corrected (with ASV or without clotting factors), otherwise the patient may bleed to death.

**Early treatment with antsnake venom (ASV) remains the best way of preventing irreversible muscle damage.** Antsnake venom may also be helpful in reducing severe limb oedema (Rojnuckarin et al., 2006). Corticosteroids should not be used as they are not effective in ameliorating local effects of envenoming and carry the risk of side-effects (Reid et al., 1963; Nuchprayoon et al., 2008). The limb can be raised in the initial stages to see if swelling is reduced. However, this is controversial as there is no trial evidence to support its effectiveness.

- Persistent moderate swelling of the limb after viper bite can be successfully managed by systemic broad spectrum antibiotics and repeated Magnesium Sulphate compresses (in the layers of wet bandage, changed 2-3 times a day) for 5-7 days.

Compartment pressure measurement procedure is shown in Figure 10.





Insert a 16 no. needle in the suspected compartment at a depth of 1 cm and connect to a simple tubing irrigated with normal saline. Measure rise in the saline column in the tubing. A rise more than 40 cm of saline corresponds to 30mm Hg of lymphatic/ capillary pressure and is suggestive of compartment pressure. This necessitates fasciotomy procedure.

Figure 10. Compartment pressure measurement procedure.

- Refer the patient to a surgical specialist but it is worth the treating clinician ensuring that objective criteria are used to assess the actual intracompartmental pressure in the limb (A2).

## 11. Discharge

If no symptoms and signs develop after 24 hours the patient can be discharged. Keep the patient under observation for 48 hours if ASV was infused.

### 11.1 Follow-up

- A snakebite victim discharged from the hospital should continue to be followed up.
- At the time of discharge patient should be advised to return to the emergency, if there is worsening of symptoms or signs such as evidence of bleeding, worsening of pain and swelling at the site of bite, difficulty in breathing, altered sensorium, reduced or increased urine output etc.
- The patients should also be explained about the signs and symptoms of serum sickness (fever, joint pain, joint swelling) which may manifest after 5-10 days.

### 11.2 Rehabilitation

- In patients with severe local envenoming, maintain limb in a functional position. For example, in the leg, equinus deformity of the ankle should be prevented by application of a back slab.
- Start simple exercises while the patient is still in hospital for restoration of normal function in the bitten part. Conventional physiotherapy after discharge from hospital may accelerate functional recovery of the bitten limb. Give a time table of rehabilitation activities.

- Functional effects of local envenoming range from persistent stiffness and induration to severe deformity, tissue loss, especially dermonecrosis, requiring skin grafting and gangrene requiring debridement and amputation.

## 12. REFERRAL CRITERIA

Vasculotoxic envenomation	Neurotoxic Envenomation
<p>If no ASV is available, transfer to a hospital (where ASV availability is confirmed over the phone).</p> <p>If 20 WBCT is “not clotted” after loading dose of 10 vials of ASV as in case of Viper bite.</p> <p>If patient is continuing to bleed even after full dose of ASV transfer to a tertiary care medical college or higher level of health facility.</p> <p>Progressive septicaemia</p> <p>Signs of kidney injury or abnormal kidney function test transfer to a tertiary care medical college or higher level of health facility.</p>	<p><b>Progressive neuromyopathy</b> - transfer with life support in ambulance for mechanical ventilation (<i>Battery operated Transport Ventilator</i>) operated by qualified staff <i>or ambulance bag as a last resort</i> to a hospital where facility of a ventilator is available.</p> <p>The key criteria to determine need for mechanical ventilation is the ‘neck lift’ to elicit broken neck sign.</p> <p>Check frequently on patient’s ability to perform a neck lift.</p> <p>If they are able to carry out the neck lift action continue treatment until recovery in the PHC.</p> <p>If patient cannot perform neck lift action, immediately refer the patient to a hospital with a mechanical ventilator.</p> <p>Very young children may not be able to follow commands for neck lift.</p> <p>Other tests which indicate descending paralysis are declining single breath</p>

	count, pooling of saliva.  Oxygen saturation <90% using pulse oximetry indicates requirement for ventilator support.
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Figure 11. “Broken neck” sign observed in a 14-year-old girl bitten by a Russell’s viper in India. Envenoming by cobras, kraits and—in some areas—by Russell’s viper frequently leads to progressive descending paralysis. In this case, neuroparalysis persisted for five days despite antivenom treatment, but without progression toward respiratory failure.

H. S. Bawaskar. doi:10.1371/journal.pntd.0000603.g002

#### **Instructions while referring**

- . Inform the need for referral to the patient and/caregiver (family member or the accompanying attendant).
- . Give prior intimation to the receiving centre using available communication facilities.
- . Arrange for an ambulance. Call Emergency helpline 102/108 etc. Transport in an ambulance equipped with transport ventilator. If ventilator is not available tight-fitting face mask connected to an anaesthetic (Ambu) bag should be available. However, do not waste time to get an ideal ambulance. Motorbike is a practical alternative in rural areas for rapid transport but third person must sit behind the patient to support on bike.

- . If ASV is not available at First contact centre transfer to the nearest health facility where ASV is available after confirmation by telephone.
- . Transfer to a higher health facility (Secondary Care Hospital or Tertiary Care Hospital) where facilities for mechanical ventilator and dialysis are available, **if required after completion of ASV infusion only.**
- . During transfer, continue life-supporting measures and provide airway support with the help of an accompanying staff, if required.
- . Do not insert nasogastric tube routinely. It is indicated only if victim has obtunded mentation and or gag reflex is poor. If this is not possible give head up position to victim during transport to avoid aspiration of gastric contents.
- . Send the referral note with details of treatment given clearly mentioning the clinical status at the time of referral.

[See Annexure II for management of snakebite at various levels of healthcare](#)

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## Annexure 1. SNAKE BITE EXAMINATION PERFORMA

Name ..... Age ..... Sex M/F  
Address .....

Date .....time of bite .....Activity at time of bite .....

Sleeping on floor bed ... *Yes/No* .... Cot ..... *Yes/No* ..... Mosquito net *Yes/No*

Snake Seen *Yes/No* Killed *Yes/No* Specimen photo in mobile *Yes/No*

Identification of snake in photos specimen as .....

Confirmed specimen of snake .....

### Local site

Fangs marks .....Active bleeding from fangs *Yes/No* Blood clot *Yes/No*

Time of development of edema .....

Extension of edema .....

Regional lymphangitis .....

Pain in abdomen .....Vomiting .....

Blood pressure ..... Pulse rate .....

Active bleeding Gum/ from abrasions /any other site

**20WBCT on arrival** Clotted /Not clotted Time.....

Repeat 20WBCT Clotted /Not clotted Time.....

Repeat 20WBCT Clotted /Not clotted Time.....

**ASV administered** ..... **Dose given** .....vials **Time**.....

Repeat 20WBCT **after ASV** Clotted /Not clotted Time.....



**Progress after ASV**

20WBCT at 1h .....2h.....3h.....6h.....12h.....18h.....24h...

Progress INR .....APTT .....

Blood urea .....Serum creatinine .....

Urine ..... Haematuria /hemoglobinurea

Haemogram .....Platelet count.....

Blood transfusion, if any .....

Fresh Frozen Plasma (FFP), if any .....

Dialysis, if any .....

**Compartment syndrome Present/Not present**

**Neuroparalytic symptoms**

Bilateral Ptosis ..... Ophthalmoplegia .....

Bulbar palsy .....

Respiratory rate ...../min sPO<sub>2</sub> .....% One minute count .....

**Muscle power** on arrival

Upper limb .....lower limb ..... Progress .....

Pelvic girdle .....

Reflexes Planter on arrival .....Progress .....

Voice on arrival .....

Distance between Inter teeth margin .....On arrival ..... Progress .....

Protrude of tongue in relation to teeth margin .....On arrival .....progress

Pupil size ..... reacting to light..... On arrival.....

Progress after ASV total dose .....After Repeat dose .....

Intubation time .....Ambu bag ventilation/ Mechanical ventilator

**Follow up**

**Recovery time in days**..... **Total ASV dose given**.....

**Blood transfusion** given/not given **FFP** given/not given **Dialysis days**.....

Ventilations total days ..... Disability.....

Hypoxic brain injury ..... Amputation of limb ..... Plastic surgery

## Annexure 2. SNAKE BITE MANGEMENT DIFFERENT LEVELS OF HEALTHCARE

### AT A PRIMARY HEALTH CARE CENTER (PHC)

#### Patient Arrival & Assessment

1. Assess circulation, airway and breathing and deal with any life threatening symptoms on presentation.
2. Establish large bore intravenous access and start normal saline slow infusion.
3. Before removal of the tourniquet/ligatures, test for the presence of a pulse distal to the tourniquet. If the pulse is absent ensure a doctor is present before removal or ligatures.
4. **In case of clinically confirmed venomous bite, tourniquet should be removed only after starting of loading dose of ASV and keep Atropine Neostigmine injection ready.** In case of multiple ligatures, all the ligatures can be released in Emergency Room EXCEPT the most proximal one; which should only be released after admission and all preparations.
5. Carry out a simple medical assessment including history and simple physical examination – local swelling, painful tender and enlarged local lymph glands, persistent bleeding from the bite wound, blood pressure, pulse rate, bleeding (gums, nose, vomit, stool or urine), level of consciousness, drooping eyelids (ptosis) and other signs of paralysis. The Glasgow Coma scale cannot be used to assess the level of consciousness of patients paralyzed by neurotoxic venoms.
6. The snake, if brought, should be carefully examined and identified, if possible. (One smart phone photograph of the snake, dead or alive, if available, should be taken for confirmation by an expert).
7. Clotting test '20WBCT' in clean, new, dry, glass test tubes should be carried out to diagnose vasculotoxic envenomation. Report should be given as Clotted or Not Clotted. Never write Positive/negative. If clotted continue every 1 hour for the 1<sup>st</sup> 3 hours from the time of hospitalization and then 6 hourly for 24 hours. If a neurotoxic snakebite is confirmed, clotting test can be repeated after 6 hours. If not clotted administer antsnake venom (ASV).
8. Give analgesia by mouth if required: Paracetamol (acetaminophen) (adult dose 500 mg to 1 g maximum 4 g in 24 hours; children 10-15 mg/kg/dose

(maximum 100mg/kg/day). Do NOT give aspirin or non-steroidal anti-inflammatory drugs which can cause bleeding and renal dysfunction.

9. Assess the need and feasibility of transporting the patient to a higher level of the health service (see A above).
10. If the necessary skills, equipment, antivenom and other drugs are available, give intravenous fluid to correct hypovolaemic shock. These skills include ability to diagnose local and systemic envenoming, set up intravenous infusion or intravenous injection, identify the early signs of anaphylaxis.
11. If the patient fulfils criteria for antivenom treatment, give ASV. If no ASV is available, transfer to a health facility where ASV is available.
12. Give premedication with Adrenaline 0.25 mg (0.1% solution) and in Children 0.005 mg/kg body weight of 0.1% solution subcutaneously except in hypertensive and patients with cardiovascular disease. Adrenaline is made ready in two syringes of 0.5mg (1:1000) for IM administration if symptoms of any adverse reaction appear. If symptoms do appear, ASV is temporarily suspended while the reaction is dealt with and then recommenced (for details see treatment of early ASV reactions).

If the patient has evidence of respiratory paralysis, give oxygen by mask or laryngeal mask airway (LMA), and intubate the patient and make arrangements for transfer to a higher facility accompanied by a Medical Officer carrying an Ambu bag, additional endotracheal tubes, oxygen, facemasks and basic drugs for resuscitation (Suri et al 2006; Maurya et al. 2008)

13. During the journey the endotracheal tube may slip into right bronchus leading to left lung collapse and right side pneumothorax may also occur. To prevent the tube being bitten, a mouth gag should be inserted. The tube may get obstructed due to secretions or kinking leading to cyanosis and resistance to Ambu-ventilation. Then the tube should be pulled out immediately and Ambu-ventilation could be continued with a face mask.
14. Administer Atropine and Neostigmine before transferring to a hospital as recommended above.
15. It is assumed that assisted ventilation other than by a tight-fitting face mask connected to an anaesthetic (Ambu) bag will not be possible at this

level.

16. Injection Tetanus Toxoid to be given after ruling out or correction of coagulopathy.
17. Patient should be placed under observation for 24 hours (even if the victim gives a history of a nonvenomous snakebite. The bite victim becomes so frightened and confused immediately after a bite, many a time gives false identification history). If no symptoms develop after 24 hours the patient can be discharged.
6. Discourage the use of ineffective and potentially harmful drugs such as corticosteroids, antihistamines, and heparin.



#### **SNAKE BITE MANGEMENT AT THE DISTRICT HOSPITAL**

Proceed as in PHC above in addition to the followings:

1. If ASV indicated and had not been given already start without any delay, do not wait for any test report.
2. Carry out a more detailed clinical and laboratory assessment including biochemical and haematological measurements, ECG or radiography, as indicated to get a baseline data.
3. If the patient is bleeding severely irrespective of full dose of ASV or is already seriously anaemic give transfusion of blood or fresh frozen plasma or transfer where facility is available.
4. Reassess analgesia (see B above) and, if required, consider giving Tramadol 50 mg orally. In case of severe pain administer Inj. Tramadol 50 mg IV. ***Avoid pethidine or morphine in neurotoxic envenomation. A deeply sedated patient may create confusion regarding level of neuro-paralysis.***

5. Give tetanus toxoid booster (if not given already), to all snakebite victims provided coagulation is restored.
6. In case of cellulitis consider antibiotics, and consider surgical debridement of dead tissue.
7. If the patient has evidence of acute kidney injury (AKI), treat with dialysis. If this is not available, transfer to a specialized hospital. For details see Annexure.
8. If the patient has evidence of bulbar or respiratory paralysis, insert endotracheal tube with the help of the anesthesiologist if available or by a trained medical personnel or laryngeal mask airway (LMA). If there is evidence of respiratory failure, assist ventilation manually by anaesthetic bag or mechanical ventilator.
- 9. Initial dose of ASV is administered over 1 hour. The first blood drawn from the patient should be typed and cross-matched, as the effects of both venom and ASV can interfere with later cross-matching.**
10. Atropine neostigmine “AN” challenge test is administered using 0.6mg of atropine IV first followed by 1.5 mg of neostigmine IV (Schedule described above). Rarely, if patient require more than 2<sup>nd</sup> dose of AN test. Stop after 3<sup>rd</sup> dose if there is no response. In Krait bite practice of continuing Neostigmine drip till ptosis persists beyond 24 h is not beneficial. Pre-synaptic blockage by Krait venom does not respond to AN injection.
11. If after 2 hours from the end of the first dose of ASV, the patient’s symptoms have worsened i.e. paralysis has descended further, a second full dose of ASV is given over 1 hour.

#### **SNAKE BITE MANGEMENT AT THE TERTIARY CARE OR MEDICAL COLLEGE**

Proceed as in PHC and District hospital above in addition to the following:

1. In the ICU, the standard protocol should be followed during assisted ventilation and the patient should be monitored for all parameters including level of consciousness.

Avoid drugs such as sedatives, morphine and neuromuscular blocking agents. Some patients go into a deep coma state but recover completely. Hence, diagnosis of brain death should not be considered.

Recovery of respiratory muscles is reflected by improvement of neck flexors

- where flexing the neck against gravity indicates timing to wean off ventilation. Prophylactic antibiotics are unnecessary.
2. Multiple organ failure. Management is supportive, and prevention of organ damage in those at risk are therefore crucial. Aggressive early resuscitation, adequate antivenom therapy, excision of devitalized tissue and treatment of infection are important. Prompt recognition of organ dysfunction and immediate intervention may reverse organ impairment and improve the outcome.
  3. If the patient has evidence of acute kidney injury peritoneal or haemodialysis or haemofiltration. Indications for dialysis as described above.
  4. More advanced surgical management of local necrosis (e.g. split skin grafting).
  5. More advanced investigations including bacterial cultures and imaging (CT scans) as indicated.
  6. CNS complication and intracranial bleeding to be managed according to the standard practice. Neurosurgical opinion may be requested according to intracranial pathology. However, haemostatic abnormalities must be corrected.
  7. **Coma, autonomic dysfunctions.** Patient in deep coma recovers fully provided there is no hypoxic brain damage. Autonomic dysfunctions are transient and don't need treatment. Sometimes treatment might be harmful e.g. treating with antihypertensive drugs to lower the increased blood pressure due to sympathetic hyperactivity.
  8. **Uncommon complications** such as hepatic dysfunction, pancreatitis, endocrine insufficiency and deep venous thrombosis should be managed according to the standard practice.
  9. Implement rehabilitation by physiotherapists.