Introduction
Snake bite is an occupational hazard in an agricultural country like India and is an important medical emergency and cause of hospital admission. It results in death or chronic disability for many active and young individuals, especially those involved in farming and plantation work. Worldwide, snake bites contribute as many as 1.8 million envenomations and 94,000 deaths every year. In India there are about 45,900 snakebite deaths every year (annual age-standardised rate of 4.1/100,000). The number of snake bite deaths is greatest in the states of Uttar Pradesh, Andhra Pradesh, and Bihar and snake bites are more common in rural communities especially during the monsoon season.

The objective of this article is to give an overview of field management, transport to the hospital, identification of critical conditions, initial stabilization, investigations and early management of snake bite.

Medically important snakes of India:
Out of the 250 snake species identified in India only about twenty are poisonous. The snakes that are commonly associated with snake bite fatalities belong to the Elapidae and Viperidae families. Four snakes- Cobra and krait (Elapidae), Saw scaled viper and Russel’s viper (Viperidae) constitute what is known as the “Big four”. (Fig.1). and anti snake venom (ASV) in India contains antibodies to the venom from these 4 snake species. The ‘big four’ concept however has important limitations. There are variations in venom composition within one species in different geographical regions and there are other venomous snakes that also contribute to snake bite envenomations in India. (Some of these snakes are presented in Fig. 2). ASV that is available in India therefore may not be uniformly effective all over the country and may even be ineffective against the venom of some of the snakes that are not part of the ‘big four’.

KEY POINTS
1. Reassurance of a snake bite victim, immobilization of the affected limb and early transport to hospital are crucial in management outside the hospital.
2. Early detection and management of respiratory failure (bag-mask ventilation or intubation) is life-saving.
3. Early detection of severe cellulitis and compartment syndrome is limb-saving.
4. ASV should be administered for systemic or severe local envenomation.
5. Standard dose of ASV is 10 vials stat, to be repeated if there is lack of clinical response. Lower doses can be carefully used for pure haemotoxic envenomation with dose titration.
6. Adrenaline should be loaded and ready before administering ASV. Prophylactic adrenaline is effective in preventing anaphylaxis.
7. Remember that ASV has batch to batch and syndrome and species related variability.
8. Monitor the patient for 24 hours even if there are no signs of envenomation.
Fig. 1: Medically important snakes of India - The ‘big four’

A – Common spectacled cobra (*Naja naja*), Spectacle mark on hood
B – Common krait (*Bungarus caeruleus*), Black with narrow white dorsal bands
C – Saw-scaled viper (*Echis carinatus*), small snake with brown and white patterns
D – Russel’s viper (*Daboia russelii*) diamond shaped patterns on back

Fig. 2: Other venomous species:

A - Monocellate cobra (*Naja kaouthia*)
B - King Cobra (*Ophiophagus Hannah*), Largest venomous snake, Western Ghats
C - Black krait – (*Bungarus niger* ) Black body with yellow underside
D - Banded krait – (*Bungarus fasciatus* ), Northeast India
E - Red necked keelback (*Rhabdophis subminiatus* ), Northeast India
F - Bamboo pit viper (*Timeresurus erythrurus*), Northeast India
G - Malabar pit viper (*Trimeresurus malabaricus*), Karnataka, Kerala
H - Hump nosed pit viper – (*Hypnale hypnale*)

Image sources - A- © Vivek Sharma (indiansnakes.org), B - sci-news.com, C-(indiansnakes.org)
The early management of snake bite starts in the field. Most of the familiar and traditional methods for treatment of snake-bite, (traditional/herbal, magic stones), have been found to result in more harm than good. Their use should be discouraged and they should never be allowed to delay the movement of the patient to medical care at the hospital or dispensary.

The following are recommended for management of snake bites outside the hospital.

**First Aid**

**Do’s**

1. **Reassurance** – Reassuring the person who has been bitten is very important as fear increases the sympathetic drive and increased heart rate and blood circulation hastens the circulation of venom. Most snake bites are non-venomous and telling this to the person who has been bitten is very helpful.

2. **Immobolize the bitten limb** – movement increases the spread of venom in circulation hence immobilizing the limb by using a splint or a sling is recommended. (Fig.3)

3. **Early Transport** to the nearest hospital (where anti-snake venom is available) is critical.

4. Be prepared for cardio pulmonary resuscitation (Basic Life Support).

**Tourniquet** – Application of a tourniquet is not recommended since the risk of arterial compression and subsequent gangrene with a tight tourniquet is high. If the patient presents with a tourniquet applied elsewhere, it is recommended not to remove the tourniquet until medical treatment has been started. Check for distal pulses; if absent the tourniquet will have to be removed immediately with gradual release of pressure. If distal pulses are present, avoid removing the tourniquet until ASV has been administered. This is because sudden release of pressure may result in a surge of venom into the bloodstream. Application of pressure bandage has been recommended; however the evidence for its effectiveness is not available.

**Don’ts**

1. Do not cut or incise the bite mark.
2. Do not wash the bite site with soap or any other solution.
3. Do not attempt suck out venom with your mouth.
4. Do not attempt to capture or kill the snakes.
5. Do not hold a dead snake by the head.

**Transport to the Hospital (Ambulance)**

Measures to be taken during transport include:

1. **Stabilize airway, breathing and circulation.** Be prepared for bag and mask ventilation if respiration is inadequate. Start bag and mask ventilation immediately (and intubate if possible) in case of respiratory insufficiency.

2. **Identify the neurological symptoms**
   a. Ptosis (ask the victim to look upwards, upper lid has to move upwards.)
   b. Ophthalmoplegia (impared ability to move eyes, diplopia) and weakness of neck / limbs.

3. **Watch for paradoxical respiration** (Abdomen expands rather than the chest while attempted inspiration). This is usually a late manifestation of neurotoxicity and will the patient will need endotracheal intubation and mechanical ventilation.

4. **Secure intravenous line** and rush fluids.

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**Oxygen during transport**

Patients can be connected to oxygen during transport especially if they are not maintaining saturation but constant monitoring of such patients is mandatory since oxygen will mask early signs of respiratory failure.

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**‘RIGHT’ – A mnemonic for First-aid outside the hospital**

- **R** – Reassure
- **I** – Immobilize
- **G** – Get to Hospital
- **T** - Tell the doctor about early signs and symptoms

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**Fig. 3**

Immobilization of the bitten limb using a splint
**Management in the hospital** *(Emergency department)*

The steps in management in hospital include:

1. **Assess and stabilize A, B, C (Airway, Breathing and Circulation)**

   **Airway and breathing:**
   1. The best indication of a compromised airway is noisy breathing (gurgling, whistling etc.). If the airway is patent (silent breathing) and the patient is breathing adequately place the patient in recovery position (Fig 4).
   2. If the airway is compromised, do a head tilt and chin lift maneuver to open the airway. You may also perform a jaw thrust maneuver. (Fig. 5)
   3. If not breathing – start mouth to mouth respiration or bag and mask ventilation and initiate cardiopulmonary resuscitation
   4. If the patient is not able to maintain respiration then endotracheal intubation and mechanical ventilation can be life saving. This is especially important in neurotoxic snake bite envenomation.

   **Circulation:**
   Secure a wide bore peripheral intravenous line as soon as possible. Rush in fluids if the peripheral pulses are rapid and of low volume, or if blood pressure measurement indicates hypotension.

2. **Identification of Critical conditions requiring resuscitation**

   The following are conditions that a health care provider has to be aware of, look for and manage in the emergency department.
   1. **Respiratory Failure**
   2. **Profound hypotension**
   3. **Sudden deterioration after releasing the tourniquet.** This is due to
      a. Sudden gush of poison in large amounts into circulation and
      b. Release of deoxygenated blood and harmful metabolites into circulation which leads to severe metabolic acidosis, vasodilatation and profound hypotension which can cause sudden cardiac arrest.

   Hence tourniquet must be released in the presence of a doctor’s supervision. If peripheral pulses are present, it may be released after ASV has been administered.

4. **Renal failure**: Oliguria, brown urine

4. **Cardiac arrest** precipitated by hyperkalemia (Rhabdomyolysis – sea snakes)

**Management after stabilization of A, B, C**

1. **Complete, quick History** – Where did the snake bite occur (sleeping on ground – peculiar for Krait), when was the snake bite, what part of the body was bitten, how does the person feel now (dizzy and faint, difficulty in breathing etc.)?

2. **Identify the syndrome**
   1. No envenomation - (both local and systemic) – nonpoisonous snake or dry bite
   2. Local swelling only – nonpoisonous snake
   3. Local cellulitis + bleeding manifestation (All Viperidae)
   4. Local cellulitis + Bleeding Manifestations + Neuro paralysis + Dark Urine (Russell’s viper)
   5. Local cellulitis + Neuro paralysis (Cobra)
   6. Only Neuroparalysis (Krait)
   7. Paralysis with dark color urine (Russell’s / sea snake)

**If asymptomatic** – observe for 24 hours as snake bite can cause late serum sickness.
(Snake venoms cause type III hypersensitivity reactions hence the patient may present even after 24 hours, so the patient needs to be advised on discharge regarding symptoms of envenomation)
3. Physical Examination

Signs of envenomation
a. Location Examination
   1. Fang Marks
   2. Local pain
   3. Local bleeding
   4. Bruising
   5. Lymph node enlargement
   6. Blistering
   7. Local infection / abscess formation
   8. Necrosis
b. Some signs of Neurotoxic envenomation –
   1. Ptosis,
   2. Ophthalmoplegia- Paralysis of the extra-ocular muscles results in diplopia.
   3. Broken neck sign – (Due to paralysis of the neck flexing muscles, the neck falls back when you the patient is lifted up by the shoulders (Eg. Krait envenomation)
   4. Paradoxical respiration
c. Bleeding manifestations
d. Single breath count – Normally it should be more than 20. Consider Endotracheal intubation if it is less than 16 in an adult.

Note:
1. Pregnant Women – Fetal distress, vaginal bleeding, threatened abortion. Monitor uterine contraction and fetal heart rate
2. Lactating women should be encouraged to breast feed

4. Investigations

Bed side
a. 20 minute whole blood clotting time: (5ml of blood should be withdrawn in a dried glass test tube and left undisturbed for 20 minutes. At the end of 20 minutes the tube is slightly tilted to look for clot formation. Normally, the blood is fully clotted by this time but in hemotoxic snake poisoning, the time taken for clotting is prolonged and the blood may still be liquid at 20 minutes.) This is a useful bedside test to diagnose hemotoxic envenomation.

Laboratory
b. Hemoglobin
c. Platelet count
d. Prothrombin Time, APTT
e. Urine Examination for RBC, Hemoglobin, myoglobin
f. Serum Creatinine, Urea, Electrolytes (Potassium)
g. ABG – If facilities are available
h. Complete blood counts
i. Glucose
j. Creatinine phosphokinase

5. Management (in the ER or ward)
a. Assess Airway, Breathing, Circulation, once again and stabilize if necessary. Expose and look for Fang marks
b. Administer ASV if there is systemic envenomation or severe local envenomation. (Table 1)
c. Pre medication before starting ASV
   Subcutaneous Adrenaline 0.25 mg (1: 1000), H1 blocker, Hydrocortisone. However according to existing evidence, premedication with Adrenaline only is effective.
d. Release the tourniquet carefully if present (in presence of a doctor after ASV has been given and be prepared to manage a cardiac arrest)
e. Pain management – Either paracetomol or tramadol
   • AVOID Aspirin due to risk of bleeding

All patients should be observed for envenomation for up to 24 hours.

ANTI SNAKE VENOM (ASV)

Indian polyclonal anti-snake venom (ASV)

ASV may be monovalent (neutralizes venom form one snake species) or polyvalent (effective against more than one species). Only polyvalent anti-venom is produced in India. It contains F(ab)2 antibody and its half-life is approximately 80-100 hours. (1)

The ASV preparation in India is available in two forms
   i) Liquid – 10 ml of ASV. It requires refrigeration (2-8°C)
   ii) Lyophilised – powder which is reconstituted with sterile water.

The advantage of the lyophilized form is that it does not require refrigeration. However, it is more expensive than the liquid preparation.
ISSUE IN FOCUS – Management of snake bites

Each vial of ASV neutralizes
a) 0.60 mg of dried Indian Cobra (Naja naja) venom
b) 0.45 mg of dried Common Krait (Bangarus caeruleus) venom
c) 0.60 mg of dried Russell’s Viper venom
d) 0.45 mg of dried Saw-scaled Viper (Echis carinatus) venom

INDICATIONS FOR ASV THERAPY

Anti-snake venom is the definitive treatment of snake bite envenomation and is the cornerstone of management. Systemic envenomation and severe local envenomation are indications for administering ASV to a patient (See Table 1). It is important to identify systemic envenomation early so that ASV can be administered as soon as possible before the venom becomes tissue-bound. ASV is effective only against freely circulating venom proteins and not against the tissue-bound proteins.

If there are no signs of systemic or severe local envenomation, it is advisable to monitor the patient for 24 hours and repeat a whole blood clotting time before discharge.1,2

ADMINISTRATION OF ASV

Lyophilised ASV

One ampoule of lyophilized ASV is reconstituted with 10 ml of sterile water for injection. This can then be administered in two ways

1. IV push: at a rate not more than 2 ml/min or
2. Infusion: ASV diluted in 250-500 ml of saline or 5% dextrose and infused over about 1 hour

Infusion is the most common method of administration of ASV in CMC, Vellore. Prophylactic adrenaline must be given subcutaneously along with ASV (0.25 mg of 1:1000 adrenaline).

- Keep Inj. Adrenaline 1 mg/ml 1:1000 loaded and ready

ASV is associated with high rates of anaphylaxis and therefore Inj. Adrenaline must be kept loaded and ready while administering ASV. Adrenaline is life-saving in an anaphylactic reaction.

DOSE OF ASV

The dose of ASV to be administered to a person is one of the biggest controversies in the management of snake bite envenomation. The regimens and dose of ASV according to accepted guidelines is given below 1,6,8.

ASV for neurotoxicity:

If a patient presents with features of neurotoxicity, administer 10 vials of ASV along with prophylactic adrenaline. The patient is then kept under observation for 1-2 hours. If there is worsening of neurological deficits or persistence of weakness after 1-2 hours, repeat 10 vials (100 ml) of ASV. (See Fig.6).

Table 1: INDICATIONS FOR ADMINISTERING ASV

<table>
<thead>
<tr>
<th>Systemic envenomation:</th>
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<tbody>
<tr>
<td>The clinical indicators of early systemic envenomation are</td>
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<tr>
<td>- Haemotoxicity: Clinical systemic bleeding, prolonged whole blood clotting time, thrombocytopenia</td>
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<tr>
<td>- Neurotoxicity: ptosis, ophthalmpoplegia, dysphagia, weakness of limbs</td>
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<td>- Acute kidney injury * - oliguria, elevated creatinine</td>
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<td>- Rhabdomyolysis * - elevated CPK, brown urine</td>
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<td>- Cardiotoxicity: Shock, arrhythmia, ECG changes</td>
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<td>* These are not readily reversed by ASV</td>
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Hemotoxicity responds well to ASV and neurotoxicity shows partial improvement with ASV. However, many patients may come with acute kidney injury and rhabdomyolysis (elevated CPK level, brown urine) and these are not readily reversed by ASV.

Severe Local Envenomation:

This is another indication for ASV. Suspect severe local envenomation if there is

1) Local swelling involving more than half of the bitten limb
2) Rapid extension of swelling across a joint over one to two hours following a bite to the hands or feet.

If there are signs of systemic or severe local envenomation, ASV has to be given immediately.
**Do not administer further ASV**

Fig. 6: ASV regimens in neurotoxicity and hemotoxicity

**ASV for hemotoxicity:**

In case of hemotoxicity, administer 10 vials of ASV along with prophylactic adrenaline. Check the whole blood clotting time (WBCT) 6 hours after administration of the dose. If the WBCT is more than 20 minutes or if there is clinical bleeding 1-2 hours after the dose, repeat a dose of 10 vials (100 ml) of ASV.

Administering more than 20 vials of ASV is probably not beneficial and is not recommended.

The problem with this regimen is that 20 vials of ASV costs about Rs.20,000/- which is beyond what most patients can afford in India. Moreover, the dosage of ASV is based on WHO recommendations for South East Asia. This may be more than what is required in an individual patient. To address these issue several low-dose regimens have been studied. These studies are of small sample size and have been done in primarily haemotoxic snake bites. In these studies they have found equal efficacy of low dose regimens of ASV as compared to a standard WHO regimen. Hence a low dose protocol that is being followed in many peripheral centres in India is given below. (See Fig. 1) However these should be given only in pure haemotoxic bites with careful monitoring and dose titration.

**Low Dose Protocol for Hemotoxicity**

Low dose protocol is used for hemotoxicity (typically from a viper bite) and not advisable for envenomation presenting with neurotoxicity. The recommended low dose regimen is as follows:

Give 2 vials over 30 minutes followed by 2 vials over 2 hours and then 2 vials over 4 hours. If there is evidence of clinical bleeding after 1-2 hours of starting the dose or if the whole blood clotting done after 6 hours of starting the dose is > 20 minutes, repeat 4 vials over 6 hours.

**BASIS OF DOSE OF ANTIVENOM**

The recommended dose of polyvalent ASV is based on the amount of antivenom required to neutralize the maximum amount of venom protein injected in a single bite. This ‘maximum amount’ of venom injected is based on an experimental bite and the dose of antivenom required to neutralize is calculated from this. These doses are not based on randomized control trials and are empiric doses.

Table 2 gives the approximate doses of antivenom for bites from the 4 major snake species in India.

A systematic review looked at several studies that compared high dose protocol with low dose protocols. Most of these studies were done in mission hospitals in India. The compiled data from these randomized case control studies showed that the low dose protocol was equivalent to the high dose protocol in terms of efficacy and mortality was lower in the low dose groups.

However the quality of the data is of a low grade because of two reasons – 1) The dose of ASV in the low dose protocols are different in each study which makes comparison
difficult and 2) the sample sizes are small.

The conclusion of the meta-analysis was that there is lack of sufficient evidence to establish if low dose is equivalent to high dose. However, there are several peripheral hospitals which use low dose regimens in hemotoxic bites with low mortality rates.

**ALLERGY TO ASV**

ASV is probably the most allergic drug known to humankind and about 20% will develop an allergic reaction.\(^1\) In our experience as many as 1/3rd of patients develop a hypersensitivity reaction. These allergic reactions may develop early (within a few minutes to 3 hours) or late (1-12 days). It is important therefore to be aware of this problem and observe the patient closely. Intradermal testing for a hypersensitivity reaction before giving ASV is not recommended.

**Clinical features of early anaphylactic reaction**

Allergic reactions may start as soon as 10 minutes after starting the ASV infusion. Some typical clinical features are:

- Itching
- Urticaria
- Bronchospasm
- Tachycardia
- Diarrhoea
- Severe cases – Angio-oedema, anaphylactic shock

**Treatment of anaphylactic reaction**

Adrenaline is life-saving and one must not hesitate to use it as soon as a person develops any sign of an early anaphylactic reaction.

The steps in the treatment of early anaphylactic reaction:

1. Stop the ASV infusion
2. Inj. Adrenaline (1:1000) given intra-muscular (IM)

Dose: 0.5 mg in adult, 0.01 mg/kg in children.

This can be repeated after 5 minutes if there is worsening of symptoms. (* Keep this dose loaded and ready while administering the ASV so it can be given immediately when necessary*)

3. If not responsive to IM adrenaline, or if patient develops shock, adrenaline infusion will have to be initiated.

Dose: 1 mg adrenaline to 500 ml of 5% Dextrose (2 mg/ml). Infuse intravenously at 1 ml/min. Titrate upwards to 4 ml/min (2-8 mg/min).

**Adjunctive Treatment of early anaphylactic reaction**

**Antihistamines** – Chlorpheniramine maleate given IV over few minutes. Dose: 10 mg in adults.

**Hydrocortisone** – 100 mg IV in adults. This may prevent repeat anaphylaxis.

**Late serum sickness type reactions:**

This may develop 1-12 days (mean 7 days) after administration of ASV and is characterized by fever, nausea, vomiting, arthralgia, arthritis, itching, diarrhea, myalgia, lymphadenopathy, proteinuria, neuritis and occasionally encephalopathy. Most respond to oral antihistamine like chlorpheniramine maleate. Those who do not respond to treatment after 2 days should be given a 5 day course of prednisolone (5 mg every 6 hours for adults).\(^1\)

**Can we prevent anaphylaxis? The role of prophylactic low dose adrenaline.**

A Cochrane review (Reference) to see if prophylactic adrenaline given along with ASV was effective in preventing anaphylaxis showed that the rate of severe anaphylaxis was significantly lower in the group that received adrenaline prophylaxis when compared to the group that received a placebo. However, there was no significant decrease in death rates. Other interventions like corticosteroids and antihistamines did not show the same effect and are therefore ineffective as a prophylactic measure.

**Prophylactic subcutaneous adrenaline (Dose: 0.25 mg adrenaline given subcutaneously) is therefore effective and is recommended to be given along with ASV to prevent severe ASV induced anaphylaxis. This is recommended particularly in those at high risk of allergic reaction (history of bronchial asthma, previous drug allergies etc.).**
ISSUE IN FOCUS – Management of snake bites

Management of cellulitis and when to refer for surgery

Cellulitis
The venom from a snake bite may result in tissue necrosis which can develop a secondary bacterial infection from the bacteria inoculated during the bite. The resulting cellulitis (bacterial infection involving skin and subcutaneous tissue) may be localized or may extend to involve the entire limb. In severe cases, a compartment syndrome may develop in the swollen limb necessitating surgical intervention.

Look for signs of cellulitis:
- Always examine the bite site for signs of cellulitis
- Remove any jewelry in the affected limb

Signs and symptoms:
1. Pain in the affected limb
2. Fang marks
3. Swelling
4. Blistering
5. Ecchymoses (bruising)
6. Tissue necrosis
7. Lymph node swelling and tenderness

Management of cellulitis:
Prophylactic antibiotics in every case of snake bite have not shown to be of benefit. However if there are signs of cellulitis it is recommended to initiate antibiotics. Most infections are due to staphylococcus though gram negative bacteria may also be isolated in culture.

Antibiotics – Amoxyccillin/clavulanic acid is the drug of choice

Dress the wound: Magnesium sulphate dressing if not open wound

Limb elevation and sling – to reduce oedema.

Acute Compartment syndrome (ACS)
Severe swelling and cellulitis may result in a dangerous increase in pressure in the fascial compartments of the affected limb and vascular insufficiency. Compartment syndrome is rare but one needs to be aware of it and look for signs and symptoms to save the limb. Frequent examination of the affected limb is therefore necessary to detect the development of compartment syndrome and this will require surgical management.

Symptoms
1. Pain out of proportion to apparent injury (early and common finding) Persistent deep ache or burning pain

2. Paresthesias (onset within approximately 30 minutes to two hours of ACS; suggests ischemic nerve dysfunction)

Signs
1. Pain with passive stretch of muscles in the affected compartment (This is an early sign of compartment syndrome)
2. Tense compartment with a firm "wood-like" feeling
3. Pallor from vascular insufficiency (uncommon)
4. Diminished sensation
5. Muscle weakness (onset within approximately two to four hours of ACS)
6. Paralysis (late finding)

High clinical index of suspicion is essential for diagnosis of compartment syndrome. This can save the limb.

Surgical referral: is indicated in the presence of
1. Discolouration
2. Blebs
3. Rapid increase in swelling size
4. Fall in limb temperature

A note on Neurotoxic envenomation

Neurotoxin
The snakes among the ‘big four’ that have neurotoxic venom are the Krait and Cobra. The neurotoxin, once in the circulation, can act on the presynaptic and post synaptic receptors

It is important to know that krait venom which contains β-bungarotoxin acts on presynaptic terminals and also causes destruction of the terminals causing prolonged weakness and poor response with neostigmine.

On the other hand, cobra venom contains α-cobratoxin which acts on the post synaptic terminals hence the neurological weakness is reversible, mild and responds to neostigmine.

Clinical features:
- Krait: often the patients present with severe abdominal pain and severe neurological weakness in the form of ptosis, ophthalmoplegia and more often than not, the fang marks and signs of local envenomation such as swelling are not seen.
- Cobra: the patients have signs of local envenomation fang marks with swelling and features of hematotoxicity also.
**ISSUE IN FOCUS – Management of Snake Bites**

### Management of Snake Bite in Emergency Department

**History of Snake Bite**

Observe in critical care area. Insert IV line and take bloods. Evidence of envenomation?

- **Yes**
  - Resuscitate (A, B, C)
  - Give anti-venom immediately (along with prophylactic adrenaline)
  - Be prepared for anaphylactoid reaction
  - Release tourniquet after antivenom

- **Collect Blood for Investigation**
  - Laboratory evidence of envenomation (Prolonged APTT/PT/WBCT)?
    - **Yes**
      - 1. Release Pressure Bandage Immobilisation (PBI)
      - 2. Neuro exam and repeat bloods 1 hour after removal of PBI, and 6 and 12 hours after bite
    - **No**

- **Take Bloods**
  - Admit for observation and monitoring of progress

- **No**
  - 1. Give antivenom (with prophylactic adrenaline)
  - 2. Be prepared for anaphylactoid reaction
  - 3. Release PBI after antivenom
  - Laboratory or clinical evidence for envenomation
    - **Yes**
      - Discharge
    - **No**

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**Fig. 7: Modified Algorithm from Australian Snakebite Treatment Guidelines**

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### Identifying Bitten Snake by Clinical Syndrome

**Unknown Snake Bite**

- Neurotoxicity only
  - Local swelling
    - No Local swelling
    - Bitten when lying on floor
    - Abdominal pain
  - Cobra

- Haemotoxicity

- Local swelling only
  - Non-venomous snake bite or dry bite
  - Haemotoxicity only
  - Haemotoxicity + Renal failure
  - Russell’s viper or Saw Scaled Viper
  - Russell’s viper

- Haemotoxicity + Neurotoxicity + Renal failure + Brown urine
  - Russell’s viper
Examination:
- Examine the airway and breathing – Look for noisy breathing, shallow breathing
- Neck muscle weakness – broken neck sign (head falls back when patient is lifted at the shoulders)
- Single breath count – less than 16 indicates need for intubation
- Cranial nerve dysfunction – Impaired eye movements, ptosis, difficulty swallowing
- Be prepared to intubate the patient at the first sign of respiratory failure. Do not wait for a decrease in saturation or the ABG result.

Investigations:
Arterial blood gas analysis
Oxygen saturation

Antivenom
- All patients with neurotoxic snake bite must be given 10 vials of anti snake venom stat.
- Antivenom cannot neutralise bound venom, and can be effective only if given early enough to neutralise circulating venom before it binds to target sites.
- Dose of ASV is the same for adults and children – remember that children are bitten by the same snake therefore the volume of venom injected is the same for adults and children. Pregnant women must also receive ASV at regular doses and pregnancy is not a contraindication for ASV.

Neostigmine: The use of an anti-choline esterase like neostigmine for reversing motor weakness should be restricted to patients with cobra envenomation when the snake has been identified positively.

**Step 1** – Administer atropine 0.6 mg in adult, (0.02 mg/kg up to 0.5 mg in children) before giving neostigmine. Repeat a dose of atropine after every fourth dose of neostigmine.

**Step 2** – Administer neostigmine 0.5 mg in adult, (0.025 to 0.04 mg/kg up to 0.5 mg in children) intramuscularly. Repeat a dose every 20 minutes until there is a response.

**Step 3** - Assess for motor response every 20-30 minutes (disappearance of ptosis).

Prevention of snake bite
It is important to advise patients on preventive measures against snake bites. This is particularly important for those living in villages (who are most likely to get bitten by a snake).
1. Avoid sleeping on floor
2. Use mosquito nets -This protects not only from mosquito borne diseases but from snake bites as well.
3. Use indoor toilets
4. Use torch light and wear boots while walking in the dark
5. Occupational hazard – Snake bite is an occupational hazard for farmers who work in fields and one must be careful to avoid being bitten.
6. Proper storage of food to avoid rat infestation. Rats are an important food source for snakes and proper storage of food and cleanliness of surroundings invites rats into the house which in turn invites snakes.

Conclusions
- Reassurance of the patient and management of airway and breathing are important. Consider early endotracheal intubation if breathing is inadequate.
- ASV should be administered for systemic or severe local envenomation.
- Standard dose of ASV is 10 vials stat, to be repeated if there is lack of clinical response. Lower doses can be carefully used for pure haemotoxic envenomation with dose titration.
- Adrenaline should be loaded and ready before administering ASV. Prophylactic adrenaline is effective in preventing anaphylaxis.
- A physician should remember that ASV has batch to batch and syndrome related variability.
- Daily wound examination and early surgical referral are critical in cellulitis. Amoxycillin – clavulanic acid is the drug of choice.
References


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