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Types of snakes, snake venom, snake toxicity and their treatment in animals

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ABSTRACT

Snake-bite is a natural and climatic risk and well-known veterinary crisis in numerous parts of the world, especially in rural zones of Asia. It comes about within the passing or chronic disability of large dynamic animals, mainly those involved in farming. 88% of family units rear animals, counting cattle, buffaloes, goats, sheep, pigs, and poultry (FAO,2011).Since these provincial communities are unequivocally subordinate to these animals for nourishment, work, or coordinate source of income (Smith et al.,2013). Animal mortality or impeded efficiency can intensely impact their jobs or livelihoods, particularly since group measures are for small part. In this way, it could be a major occupational risk for poor agricultural workers, farmers, and domestic animals living in rural areas of developing nations. Toxicity caused by venomous snakebite may be a common acute life-threatening, time-limiting therapeutic crisis. As of late post or unpractised specialist and insufficient offices at veterinary dispensaries, ignorance of treatment of snakebite by the specialist, assisted delayed fitting treatment of causalities and contributed to expanded horribleness and mortality. In India, the dangerous venomous snake species found (cobra, krait, Russell's viper, and saw-scaled viper) is called the big four. There are few other species of therapeutic significance, whose venom and bites have not been paid much consideration. In this way, mis-classification comes out and, therefore, incorrect treatment cannot be ruled out (Kumar et al., 2006). During therapeutic administration, non-recognizable proof of the biting species is given a low need, turning to a medication of polyvalent anti-snake venom. Concurring to WHO (World Health Organization) proposals, the administration of monovalent anti-snake venom rather than polyvalent anti-snake venom produces fewer side effects. In this way, it is fundamental to recognize the attacker snake species either by a visual review or by the symptoms of the victim. In this manner, information about the snakes is fundamental concerning their types, distinguishing proof, toxicity, and treatment.

INTRODUCTION

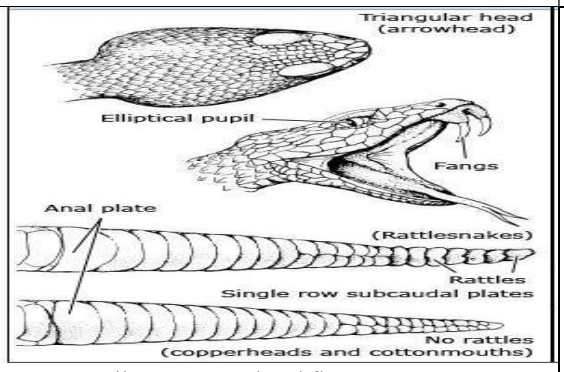
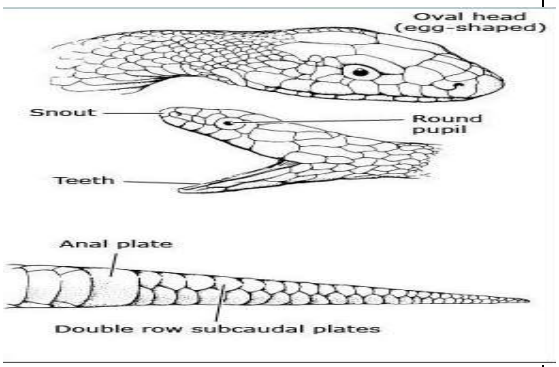
The word "snake" is from the Proto-Indo-European root *sneg-, meaning "to crawl, creeping thing." The word "serpent" is from the Proto-Indo-European root *serp-, meaning "to crawl, creep." Snakes are elongated, legless, earless (external), poikilothermic carnivorous reptiles. Snakes, not at all like people and animals, shed their skin nearly 3 times a year. This process is called Moltting. Snakes come in the class of reptilian order-squamata and suborder-serpents/ ophedia.The order of Squamates is separated into four families: Elapidae found in Southeast Asia, central and southern America and Australia. Hydrophidae conveyed in Asia. Crotalidae are found in North America as well as in South Asia. Viperidae are more plenteous in Europe, Southeast Asia and are exceptionally common in Africa. The snakes are cold-blooded animals and don't have sweat gland, so there is no efficient thermoregulatory mechanism. Depending on the species, the life span of snakes from 4 to over 25 years. Snake bite may be animal wellbeing danger among farms, forest and field grazing animals particularly in rural area of India. Males snake are prone to be bitten than females snake in proportion of 4:1. Snake activity increases during spring and summer, when snakes reproduce and eggs hatch and most domestic animals are envenomed.

Death may result from aspiration, airway obstacle or respiratory failure. Most snakebite in large animals is delivered on the feet and appendages and rarely on muzzle. Most snake-bites happen when the snake is trodden on in the dark by feet of large animals or snake may be picked up inadvertently by some animals which are attempting to maintain a strategic distance from snakes. A few bite happen when the

snake (usually a krait) comes in to the animal shed at night in search of its prey (other snakes, lizards, frogs, rodents). The head/face/neck were most frequently bitten in dogs while in cats it was the appendages. Horse, llama, and alpaca were basically chomped on the head/face/muzzle. Besides the head, sheep, goat, pig and cow were too chomped in their appendages. In poultry, several studies pointed to the breast, wings and head. Casualties of snake-bite may endure local and systemic envenoming. About 50% of bites by pit vipers and Russell's vipers, 30% of bites by cobras and 5%-10% of bites by saw-scaled vipers don't result in any symptoms of envenoming. In this brief article we have highlighted, basic information with respective big four snake bites in India (Vivek Joshi, Shahjahan Alam and Umesh Dimri.,2018). Before reading any further it is desirable to understand the distinction between Poison and venom. Poison must be inhaled, ingested, or delivered by means of touch, while venom is injected into a tissue or blood stream (Envenomated) through fangs by biting (Kini RM., 2003). Subsequently in our conclusion, the term poisonous snake is incorrect. (We also stand to be corrected). Snakes live on everywhere on Earth except Ireland, Iceland, New Zealand, and the North and South Poles.

TYPES OF SNAKES AND THEIR DISTINGUISHING PROOF

There are two types of snakes as follows

1. Venomous snakes	**2. Non-Venomous snakes**
	
• Tail- compressed and flat. • Head -triangular shaped. • Posses' two fangs or teeth in their mouth. • Bite site show clear puncher wounds of fangs with presence of edema. **Ex.** cobra, krait, Russell's viper, and saw-scaled viper	• Tail - not compressed • Head - rounded shaped • Possess several small teeth in mouth (don't have fangs). • Presence of semi-circular set of teeth marks but absence of edema at bite site. **Ex.** Rat Snakes, Kukri Snakes, wolf snake

THERE ARE 4 FAMILIES OF VENOMOUS SNAKES

More than 3500 different species of snake are present word wide. About 250 found to be venomous. In India, 216 species but approximately 52 species are venomous and the majority of bites and consequent morbidity in animals is attributable to 4 species (big four) viz. *Najanaja* (common cobra), *Daboia rusellii* (Russell's viper), *Bungarus caeruleus* (krait) and Echis carinatae (saw-scaled viper). Approximately 70% of snakes lay eggs. Those that lay eggs are called oviparous. The other 30% of snakes live in colder climates and give birth to live young called viviparous because it is too cold for eggs outside the body to develop and hatch**.**

The major 4 families of venomous snakes in the India subcontinent are follows.

Sr. no.	**Families of snake**	**Species of snake**	**Types of snake venom (Toxic protein)**	**Nature of protein**	**Target system**
1	Elapids	Cobra,common kraits,black mambas	Neurotoxin	Neurotoxic	Central NS

2	Viperids	Russell's vipers, saw scaled vipers, rattle viper	Hemotoxin	Hemotoxic	CVS
3	Hydrophide	Sea snakes	Myotoxin and Neurotoxin	Myotoxic and Neurotoxic	Neuro-muscular system
4	Crotalidae	Indian pit viper	Hemotoxin	Hemotoxic	CVS

BIG FOUR DISTINGUISHING PROOF

Sr. no	Big four Snakes	Scientific name	Photos	Distinguishing features
1.	Indian cobra	NajaNaja		Raise their Hood
2.	Common krait/ blue krait or Indian krait.	BungarusCaerulea us		Black in colour with paired bands on dorsal surface of body.
3.	Russell's viper	Doboia Russeli		Chain shaped marking on body and produce Hissing sound.'V'shaped white mark on head.
4.	Saw scaled Viper	Echis carinatus		Sandy brown in colour and having birds foot marks on head. Produce Hissing sound.

There is two main variety of or classes of venomous snakes for toxicological purposes.

Elapids	Viperids
• Family –Elapidae. • It has Fixed short fangs in 1.25 cm in length. • Head is about same width as that of neck. • Pupils of eye are circular. • Venom is neurotoxin and result in paralysis of respiratory muscles . • Elapids must close lower jaw before injecting venom into victim. • They inject all venom. • They lay eggs hence called oviparous. **Ex**. Cobra , common Krait, Banded krait, Black Mambas, copperhead snake.	• Family-Viperidae. • Fangs are long in 2.5 cm in length, movable and canalized. • Pupils of eye are elliptical slits. • Pit viper have dip dipression in between eye and nostrils on each side of head (e.g. Rattle snakes and copper head snakes). • Pitless viper have broad plates on belly (e.g. Russels viper, puff adder viper). • Viperids can bite do so without closing the lower jaw. • Viperids venom are Haemotoxic, necrotizing and anticoagulant. • They inject little venom. • They give live birth to young once hence called viviparous.

SNAKE VENOM

Snake venoms are is one of the most biochemically and pharmacologically complex toxins as secretary product of venomous (salivary) gland of snake which is synthesized and is stored in venomous gland. The glands which secrete the zootoxin (modified saliva) is a modification of the parotid salivary gland and are situated on each side of head below and behind the eye encapsulated in muscular sheath. The glands have large alveoli in which venom is stored before being conveyed by the duct to the tubular fangs, through which it is injected in animal body during biting. The main purpose of envenomation by snake (venomous) is immobilization and digestion of prey and self defence against harm. Most snakes inject 10% of the available venom in a single strike except the Russell's viper which injects 75% of stored venom in one bite due to big long sharp curved fangs. Bites in which the fangs penetrate the skin but no envenoming results are known as "dry bites" or "defence bite while the bite with envenoming is called as the "professional bite". Darker the snake, it secretes more venom as compared to a light coloured. Because of the rise in body temperature of dark skin (poor conductor of heat) snake, the venom is in more fluid state and injected rapidly with high speed and maximum quantity in a short time during envenoming. As oppose to light colour skin because of low body temperature, the venom is thick and hence fewer amounts injected at the time of envenoming.

COMPOSITION OF SNAKE VENOM

Snake venoms are clear, yellowish, water soluble substance vary in their composition from species to species but also within a single species: (i) throughout the geographical distribution of that species, (ii) at different seasons of the year (e.g WINTER, the venom are going to be in a very thick nature , whereas involves SUMMER, the venom are going to be less thickness and a free flow, just in case of MANSOON), (iii) as the snake grows older (ontogenic variation),(iv) Individual snake venom may even change with its diet (Jin and Varner ,2004 and Basheeruddin. Sk, 2015). Chemically snake venom composed of 90% water, enzymes, non-enzymes proteins (Neurotoxins, Haemotoxins, Myotoxins, Cardiotoxins and Cytotoxins), anticoagulant protein procoagulant protein, peptides, metals and amino acids. It has acidic pH. Specific gravity is 1.03-1.07 and is water soluble and on drying it becomes fine needle like crystals (Otten EJ., 1998).

TYPES OF SNAKE VENOM AND THEIR ACTION (TOXIC EFFECT)

Pharmacological active substances for toxic effect of the snake venoms are enzymes and low molecular weight peptides. Main targets of isolated enzymes from snake venoms are cell membranes, vascular wall and blood coagulation cascade. Viper venoms are usually absorbed via the lymphatics, more slowly than are elapid venoms with their lower relative molecular masses.

The snake venom are classified into 4 groups/type based on snake species.

1.Haemotoxic Venom (Haemotoxicity) effects blood and circulation using up the clotting factors so it no longer coagulates. The venom typically affects the blood, resulting in necrosis (death of tissue) and anticoagulant (preventing the blood from clotting). Haemorrhagic envenomation is characterized by bleeding from the gums; gastro-intestinal and genito-urinary tracts, recent and partly healed wounds. eg. Russell's viper and Saw-scaled vipers.

2.Neurotoxic venom (Neurotoxicity) are effects the central nervous system by inhibiting the release of acetylcholine at neuromuscular junction. Cobra venom is rich in postsynaptic neurotoxins called alpha-bungarotoxin and cobratoxin binds to nicotinic acetylcholine receptor at the motor end plate of neuromuscular junction, causing flaccid paralysis. Krait venom contains both pre-synaptic beta bungarotoxin and pre-synaptic alfa-bungarotoxins and prevent the release of acetyl choline causes spastic paralysis. Beta bungarotoxin in the krait venom bears similarity to botulinum.

There may be painful and tender enlargement of lymph glands draining the bite site. The patient may vomit, the saliva may become profuse and stringy, and eventually there may be difficulties with swallowing and breathing due to paralysis of respiratory center. The paralysis starting with drooping eyelids (ptosis) and paralysis of eye movements causing double vision due to paralysis of ciliary muscles of eyes. Neurotoxins of hydrophids bind to post synaptic acetylcholine receptors resulting in paralysis. Respiratory paralysis is the primary cause of immediate death.

3.Myotoxic venom (Myotoxicity) causes myoglobinuria by destructing the muscles lead to death from kidney and heart failure. e.g. Sea snakes. The venom results in muscle breakdown.

4.Cytotoxins (Cytotoxicity) is the most primitive form of venom, which initiate the digestion of the prey even before it is swallowed. The poison destroys cells—especially those in muscles—so they die and tissue collapses.Cytotoxic envenomation is characterized by painful and progressive swelling with blood-stained tissue fluid leaking from the bite wound, hypovolaemic shock, blistering and bruising. There is severe pain at the bite site and throughout the affected limb and tender enlargement of lymph glands draining the bite site. Resulting from cytolysis, ischaemia, blood extravasations and direct proteolytic activity, irreversible death of tissue may occur (necrosis/gangrene).

OTHER ENZYMES OF SNAKE VENOM

The venom of elapids (e.g., cobras and mambas) consists primarily of neurotoxins, cardiotoxins and haemolytic agents. Viperid venom

consists of haemorrhagic elements, thrombins and cytolysins.

Cardiotoxins- adversely affect the myocardium and cardiac conduction by increasing cellular membrane permeability to ions which blocks the action of acetylcholine esterase and increases the blood pressure. **Haemorrhagic toxins** cause considerable bleeding into tissues by damaging vascular endothelium in capillary walls. Endothelial damage promotes coagulation and bleeding is often accompanied by clotting and haemolysis. **Thrombins (procoagulants)** induce coagulation and disrupt the normal haemostatic balance and induce intravascular coagulation. **Cytolysins** lyse body tissue cells and leukocytes. **Phosphodiesterase A2** causes hemolysis by lysing cell membrane of RBCs**. Oxidases and proteases** are used for digestion. **Hyaluronidase** is proteolytic enzymes help in rapid penetration of other venom components into victim tissue by increasing tissue permeability hence it called spreading enzyme and are responsible for the local edema, blistering, and necrosis. **Ophio-oxidase** help in autolysis and putrefaction.**Coagulopathies** are the most significant and most unpredictable systemic manifestations produced by procoagulant protein like serine proteinase and mettaliproteinase (haemorrhagins) present in russels viper,saw scaled viper and rattle snake viper venom. The serine proteinase has thrombin like enzyme action (prolong clot formation) which inhibit platelet aggregation leads to bleeding and mettaloproteinases (Haemorrhagins) causes local and systemic haemorrhages (Johan P.et al.,2013).

The Indian common snakes yield and lethal dose of venom in mouse as follows.

Table: Yield and lethal dose of venom

Species	**Approximate yield of dry venom (mg)**	**i.v. Lethal dose (mg/kg)**
Common Cobra	170-325	0.4
Common Krait	8 – 20	0.09
Russell's Viper	130 – 250	0.08
Saw-scaled Viper	20 – 35	2.3
Pit Viper	40 – 60	6.2

DIAGNOSIS OF SNAKE BITE

On the basis of history –Sudden death, presence of snakes in their vicinity, symptoms and depth of fang marks identify snake as mentioned above. The symptoms of snake-bites vary according to the species of the biting snake and the amount of venom injected. If the snake has already been killed, it should be taken to the hospital for identification. This information helps the veterinarians to choose appropriate anti-venom, anticipate the likely complications and select appropriate therapeutic measures. If the animal was bitten at night and monsoon months, a krait may be suspected; and in a paddy field, a cobra or Russell's viper; and while wallowing a cobra might be the suspect. Some of the common laboratory tests done at the veterinary hospital for the diagnosis of snake bite cases include:20-minute whole blood clotting test (20WBCT) Tests like estimation of haemoglobin concentration/ haematocrit, platelet count, WBCs, muscle enzymes, creatinine and blood urea nitrogen.

The common local symptoms at the site of bitten part which can be easily visualized by farmers in cases of snake bites include: fang marks, pain, bleeding, and swelling, redness, hotness and blistering. However, bites by kraits may be painless and cause negligible local swelling. There may be raised red lines tracking up the bitten limb (Lymphangitis) and enlargement of lymph node.

The general symptoms shown by the animal may include abdominal pain, weakness, shock and oedema of conjunctiva etc. Other general signs associated with severe cases of snake bites (usually assessed by veterinarians) include: Bleeding and clotting disorders (Viperidae) including traumatic bleeding from recent wounds, prolonged bleeding from fang marks, rectal bleeding or melena, haematuria, bleeding into mucosae, skin and retina; and Neurological disorders (Elapidae, Russell's viper) including paraesthesia, ptosis, paralysis of facial muscles, regurgitation, respiratory and generalised flaccid paralysis etc (Vivek Joshi, Shahjahan Alam and Umesh Dimri.,2018). Acute renal failure characterized by ischaemia, haemoglobinuria and myoglobinuria and may cause by all three types of venomous snake viper, elapid, and sea snake envenomation and appears to be unusually common after Viper russelli bites.Venom excretion occurs primarily through the kidneys.

TREATMENT AND MANAGEMENT OF SNAKE BITE (David A Warrell., 2010)

Proper first aid is of paramount importance in the life of a snake bite victim, especially in the first hour, also known as the "golden hour". The facts state that 80 % of the snake bites are by non-venomous snakes.

First aid for treatment of snake bite is **'RIGHT'**

R-Ressure the patient about snake bite by venomous or non-venomous snake spp.

I-Immobilization of bitten limb by using splint

GH-Get to hospital immediately

T-Tell to veterinarian about snake bite and systemic symptoms.

Contraindications-First aid (to be given at the time when bite occurs)

1. If one can locate the bite site, remove the surface deposited venom by clean cloth or cotton.

2. If the snake is found or killed take it to hospital, it may help to veterinarian for diagnosis.
3. Does not use a tourniquet above the snake bite in case of Viper snake.
4. Tourniquet applied in case of elapids (e.g. cobra) bite around the upper part of the limb so tightly that the peripheral pulse gets occluded. This method can be extremely painful and very dangerous if the tourniquet is left on for too long (more than about 40 minutes), as it may cause gangrenous limbs.
5. Victim animal should not be allowed to walk.
6. Avoid any interference with the bite wound (incisions, rubbing, vigorous cleaning, massage, application of herbs or chemicals) as this may introduce infection, increase absorption of the venom and increase local bleeding.
7. Do not attempt to suck the venom out by mouth.
8. If the victim is found unconscious without respiration, provide oxygen therapy and chest compressions.
9. Do not apply KMnO4 and alcohol at site of bite causes tissue damage and vasodilatation of blood vessels leads to promote uptake of spread of venom.

Treatment

Anti-venom is the most effective therapeutic agent for snakebite treatments (snakebite antidotes). Anti-venom is immunoglobulin [usually pepsin-refined F(ab')2 fragment of whole IgG] purified from the plasma of a horse, mule or donkey (equine) or sheep (ovine) that has been immunized with the single snake venom (producing monovalent anti-venom) or against venoms of big four snake (producing a polyvalent anti-venom). It is either lyophilized or liquid forms. Anti-venom used to neutralizes a fixed amount of venom and prevent further venom absorption. The potency of anti-venom-1ml anti-venom neutralizes venom 0.6mg of cobra and russel's viper. The storage of anti-venom at 2 to 8 ^{0}C temperature keep shelf life of anti-venom up to 3 year.

The conventional dosing is based on the degree of envenomation and symptoms showed by the victim as follows. If the biting species is known, the ideal treatment is with monovalent anti-venom, otherwise polyvalent anti-venom.

Dose of polyvalent anti-venom

2 units/150 kg body weight for large animal. 10 units/20-40kg body weight for small animal intravenously. However, local administration of anti-venom at the site of the bite is not recommended (not effective).Freeze-dried (lyophilized) anti-venoms are reconstituted; usually with 10ml of sterile water for Anti-venom treatment. A proportion of animals receiving anti-venom treatment may develop reactions, which may either be in the early stages of treatment to cause urticaria, fever, colic, diarrhoea, etc, or in the late stages to cause fever, lymphadenopathy, nephritis, etc. Epinephrine (Adrenaline0.1% solution, 1 in 1,000, 1 mg/ml) is the effective treatment for early anaphylactic anti-venom reactions, by reducing bronchospasm and capillary permeability. It should always be drawn up in readiness before anti-venom is administered.

Antibiotics : Broad spectrum antibiotics (e.g injection ceftiofur sodium) are indicated to combat bacterial infections.

Antitoxins: Clostrdial bacteria have isolated from snake mouth. The single dose of anti-tetanus serum1500-3000 IU subcutaneously recommended.

Anti-inflammatory drugs: Tramadol or pethidine is valuable drug use to relive inflammatory pain. Should not use aspirin or non-steroidal anti-inflammatory drugs which can cause bleeding.

Supportive therapy:

- Fluid are indicated to combat shock and dehydration.
- Vit-C and calcium-gluconate are useful in preventing haemolysis.
- Blood transfusion and haemodialysis (if require).

PROGNOSIS

It depends on the animal age and overall health and on the location and venom content of the bite. Almost everyone animal bitten by a venomous snake can survives if treated early with appropriate amounts of anti-venom.

PREVENTION OF SNAKE BITES

Snakes have adapted to a wide range of habitats and prey species. By understanding something about the habits of snakes, the following simple precautions can be taken to reduce the chances of encounters and consequently bites in animals (Vivek Joshi, Shahjahan Alam and Umesh Dimri.,2018).

1.Animal owners should know about the venomous snake species, places they prefer to live and hide, the time of year and time of day or night and the kind of weather when they are most likely to be active (Most species are nocturnal e.g. kraits).

2. Animal owners should be vigilant about distinguishing venomous and non-venomous snakebites after rains, during flooding, at harvest time and during night.

3. The animal sheds should be regularly cleared, checked for snakes and rodents and termite mounds, heaps of rubbish, building materials etc. near the animal shed.

4. The grass must be kept short and low bushes be cleared so that snakes cannot hide close to the animal barn.

5. Livestock owners must develop a habit of using light source when an animal is made to walk outside the barn, especially after heavy rains, at night.

6. There is always a high risk of snake bites to animals which are allowing in muddy waters of estuaries and river mouths.

7. The dairy farms need to be established in areas known to be snake-free and plant the snake repellents near to animal sheds.

8. Avoid animals for grazing at typical places where snakes like to hide, such as patches of tall grass and piled leaves, and rock and woodpiles.
9. Social organizations and charities such as Rotary Club, etc. might be requested to spread snake-bite awareness among animal owners.

CONCLUSION

Scientists should make attempts to prepare venomous toxoid to immunize the animals and risky population against venomous snake toxins. Toxicologists should make an attempt to prepare the pharmacological antidote to venom actions. Anti-venom producers in India should prepare ELISA kit for detection of venom antigen in blood and prepare anti-venom from venoms obtained from snakes caught from relevant areas of the country. The attending veterinarian gets immense satisfaction when the serious poor victim of snake bite recovers.

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