A STUDY OF SNAKE BITE ENVENOMATION

By

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ABSTRACT

Objectives:

The objectives of the study is to know the Socio demographic profile of snakebite victims, to know the first aid methods practiced and type of snake species prevalent in this region and the morbidity and mortality due to snake bite.

Methods:

The material for the study will be all the cases with history of Snake bite that are admitted and treated in BLDE University's Shri. B. M. Patil Medical College, Hospital and Research Centre, Vijayapur from January 2014 to December 2014with detailed history includingtime of bite, type of snake, and first aid measures taken along with complete clinical examination, and details of treatment given and prognosis.

Results:

Among the 68 cases in the present study ,Maximum 69% victims belonged to 20-49 yrs age group, maximum victims were males 69%.More than half(51%) of the victims are farmers by occupation from rural area(91%) and belonged to lower class of socioeconomic status(57%).Most of the bites 68% occurred in fields. A rise in number of cases were seen in monsoon season(June to September) of 38% with maximum number of cases in august month(22%).Most common site of bite was foot 56%. Krait was the most commonly identified snake and most victims were taken to quacks first (32%), Mean duration of hospital stay is 4.6 days with mortality rate of 9%.

Conclusion:

Public health education about preventive measures, easy availability of ASV at affordable prices, prompt hospitalization and specific treatment and prior first aid measures may be responsible for preventing systemic envenomation and reducing the mortality.

Keywords: snakebite, ASV, first aid, neurotoxic, krait

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INTRODUCTION

Snakebite is a major public health problem throughout the world especially in tropical and sub-tropical countries. Snake venom is probably the oldest known poison to mankind. The estimated total of 45,900 national snakebite deaths in 2005 constitutes about 5% of all injury deaths and nearly 0.5% of all deaths in India.[1]

Snakebites cause considerable morbidity and mortality worldwide. The highest burden exists in South Asia, Southeast Asia, and sub-Saharan Africa. Globally, at least 421,000 envenomations and 20,000 deaths occur each year due to snakebite. These figures may be as high as 1,841,000 envenomations and 94,000 deaths. Based on the fact that envenomation occurs in about one in every four snakebites, between 1.2 million and 5.5 million snakebites could occur annually.[2]

However Ghulam Nabi Azad, the union health and family welfare minister of the government of India, told the Lok Sabha, India's lower house of parliament, in April 2012 that only 1440 people had died from snakebite in India in 2011.[3]

Most regions lacked either population based studies or surveillance systems that might measure snakebite incidence at the population level. In some cases, many countries in a region lacked data. For example, data were available for only one country in eastern sub-Saharan Africa, where snakebite is known to be an important public health problem. Population-based studies of incidence and mortality are urgently needed to describe the epidemiology of snakebite in these areas. In some countries that encompass large geographical areas and have large populations such as India, China, Indonesia, and Russia, country estimates had to be calculated on the basis of single or few regional incidence or mortality figures. This also means that relatively small changes in the incidence rates could lead to considerable differences

in the estimation of the total burden in terms of the number of envenomations and deaths. The proportion of the population that is rural, and therefore exposed to the risk of snakebites, can also considerably affect estimates for these countries.[4]

Alexander the Great invaded India in 326 BC, and was greatly impressed by the skill of Indian physicians; especially in the treatment of snakebites.[5]

Since then, India has remained famous for its venomous snakes and the effects of their bites. With its surrounding seas, India is inhabited by more than 60 species of venomous snakes – some of which are abundant and can cause severe envenomation. The snakes most commonly associated with human mortality in India are cobra (Naja Naja), krait (Bungarus Caeruleus), Russell's viper (Daboia Russelii) and saw scaled viper (Echis Carinatus).[6]

WHO recognized that snakebite does not have the epidemic potential of infectious and vector-borne parasitic diseases, but it should be emphasized that the yearly mortality caused by snakebite is much greater than that attributed to several presently recognized neglected tropical diseases, including dengue haemorrhagic fever, cholera, leishmaniasis, schistosomiasis, Japanese encephalitis, and Chagas' disease.[7]

The high incidence of snakebite is due to the climate which favors a large population of snakes. Indian population resides mostly in rural areas and their main occupation is agriculture. The exact statistics of snakebite are not available in India. Hospital records also do not reflect correct estimation as many victims get treated by traditional healers. The magnitude of problem can be even larger.

OBJECTIVES

This study was conducted with the following objectives-

1) To know the Socio-demographic profile of snakebite cases admitted and treated in BLDE University's Shri. B. M. Patil Medical College, Hospital and Research Centre, Vijayapur.
2) To know morbidity and mortality due to snakebite and the effectiveness of Hospital management.

REVIEW OF LITRATURE

Snakebite is a common life-threatening condition in many tropical countries; farmers, hunters and rice pickers are at particular risk and prompt medical treatment is vital.[8]

Snakebites cause considerable morbidity and mortality worldwide. The highest burden exists in South Asia, Southeast Asia, and sub-Saharan Africa.[2]

There are about 216 species of snakes identifiable in India, of which 52 are poisonous. The major families of poisonous snakes in India are Elapidae (includes common cobra, king cobra and common krait) Viperidae (includes Russel's viper, Echis carinatus and pit viper) and Hydropidae (sea snakes).[9]

Definition of snake[10]

It is defined as an ectothermic vertebrate with elongated body covered with scales and have no limbs or limb girdles, external auditory openings and movable eyelids.

Evolution of snakes[10, 11]

Researchers believe that snakes are the most recently evolved group of reptiles. It is believed that they evolved from lizard or lizard like animals which adopted a subterranean life style. The first snake appeared during the early cretaceous period i.e.130 million years ago in the 'Mesoic era' also known as 'The Age of The Reptiles', in the geographical area which is now known as the North Africa (the first Humanoids evolved less than six million years ago). During evolution, the snakes lost limbs in order to burrow more effectively and also developed a transparent covering

called ‘Brille’ to protect their eyes. The venom glands are believed to have evolved from posterior part of supra-labial salivary glands.

History[12]

Though snakes are known to human beings since time immemorial, the actual scientific study about Indian snakes was done by Dr. Patrick Russell (1727-1805). Thus he is known as ‘Father of Indian Ophiology’. He was the pioneer in Indian ophiology and also first to distinguish venomous snakes from the non-venomous snakes and to describe Russell’s viper which is named after him. Joseph B Frayer (1824-1907), was the first person to distinguish between the effects of the venom of elapid and viper species. George Albert Boulenger (1858-1937) was the first person to prepare exhaustive keys for the identification of Indian snakes and gave descriptions of 246 species of Indian snakes. Colonel Frank’s contribution about Indian snakes has been a major one. Today, descriptions of most of the snakes are based on Malcolm Smith’s book “Fauna of British India”.

Studies conducted in India

Kulkarni ML &Anees S[13] conducted eight years prospective study on pediatric victims up to 18 yrs age in a teaching hospital from 1985 to 1992 in Karnataka. Males were predominant over females with male to female ratio of 2:1. Most of the victims 40.4% belonged to 11-15 yrs. Maximum (33%) bites occurred between October to December followed by 31.4% between April to June. Majority 90% of victims were from rural area and 79.9% bites were on the lower limbs. 58.6% victims had hemotoxic envenomation and 12.5% cases had neurotoxic envenomation. Mortality recorded was 5.2%.

Lal P et al[14] carried out a seven years retrospective descriptive study to know the Socio-demographic profile of snakebite cases admitted to JIPMER Hospital, Pondicherry from 1990 to1996. A proportional increase in incidence of snakebite was observed from 2.9/1000 admissions in 1990 to 5.2/1000 admissions in 1996.Adults of 15-60 yrs age group accounted 81.8% of cases and male to female ratio was 2.1:1. Majority(68%) were rural males and 93.8% of cases were agricultural workers/ laborers. 40% of bites occurred during rainy season. Mean duration of hospital stay was 2 days. Majority85% were relieved or cured and 13.5% mortality was recorded.

Bawaskar H S[15] conducted a three years prospective study of snake bite cases admitted to Bawaskar Hospital and Research Centre, Mahad , Raigad, Maharashtra from January 1998 to January 2001. Most 29.7% of victims were less than 20 yrs followed by 25.3% belonged to 21-30 yrs age group. Most 65.9% of bite occurred during monsoon season. Of the 91 cases, 46 (50.5%) were envenomated of which 43.5% showed haemotoxic symptoms and 56.5% showed neuroparalysis. Mortality of 10.9% was recorded and all were due to neurotoxic envenomation.

Chauhan S et al[16] conducted a five years retrospective study with aim of studying pre-hospital treatment received by snakebite victims admitted to PGIMER Hospital, Chandigarh from January 1997 to December 2001. First aid was given in 70.8%of cases prior to hospitalization, of which 41.4% received first aid from Quacks. 12.7% of victims directly went to PGIMER Hospital. ASV was given in 41.4%, tourniquet in22.86%, Incision and drainage in 20%, Teatanus toxoid in 7.14% and local remedies in5.7% of cases. 43.2% victims needed mechanical ventilation and 6.95 days was the average duration of Hospital stay.

Whitekar R[17] in his thirty six years retrospective study of data collected from Pappinisseri Vishachikilsa Society, Kannur, Kerala, observed that adult males were the highest risk group 64%. Month of May had highest incidence of snakebites. Maximum 90% of victims preferred local remedies. 27% bites were envenomated with2% mortality.

Ganneru B & Sasidhar RB[18] conducted a five years retrospective study from 1999 to 2003 in University College of Science, Osmania University, Hyderabad. They observed that majority of the cases 71% belonged to 21 to 50yrs age group. Males76% were predominant over females with male to female ratio of 3:1. Most of the bites50% were recorded in rainy season during June to September.[18]

Bawaskar HS et al[19] conducted one year prospective study of snakebite victims admitted to five hospitals of five different districts of rural Maharashtra. 26.9%victims belonged to 21-30 yrs age group followed by 19.2% victims in 11-20 yrs age group. 48.4% of bites occurred between June to October. 60.4% victims had bites on lower limbs. Maximum 90 (49.5%) bites occurred between 6 AM to 6 PM and 75% of bites that occurred during this time period were by viper species and all the 45 cases that occurred between 12.01 AM to 6AM were due to elapid species. 71.9% of victims had fang marks with oozing of blood at the site of bite. Bite by big four species was estimated to be 30.2% by Saw-scaled viper, 20.8% by Russell's viper, 26.3% by Krait and 22.7%by Cobra.

Suchithra N et al[20] carried out a prospective study of snakebite cases admitted to Kottayam Medical College, Kerala for a period of one and half year from May 2005 to December 2006. Of the 586 cases, 34% cases had envenomation; 58%ofvictims were males and 52% belonged to 31-50 yrs age group. 93% of bites occurred outdoor

and in 34.5% of venomous bites the snakes were identified. 93.5% had local signs of envenomation. Morality of 3% was recorded. Capillary leak syndrome, respiratory paralysis and intracerebral bleeding were risk factors for mortality.

Singh J et al[21]in his study of snakebites in North Indian Military Hospital reported that 63.6% cases were envenomated and all were neurotoxic in nature. Median age group was 24years and all were men. Neurological symptoms like abdominal pain (91%), dysphagia(86%), ptosis(77%), dyspnoea (67%) and vomiting (62%) were noted. Average time of recovery was 16 hours after ASV administration. ASV required ranged from 90- 320ml with mean ASV of 180ml.

Nuchhi UC et al[22] 329 cases of snakebite poisoning were studied between September 2000 to August 2005. Males 197 (59.88%) were affected more than females 132 (40.12%) in the ratio of 1.5:1. The most common age group is 20–29 years of age 89 (27.05%). Snakebite is the common health problem in rural areas 277 (84.19%) in rural areas, the most vulnerable occupation group being the people involved in agricultural work i.e., agriculturist 92 (27.96%) and field labourers 97 (29.48%). The male population was mostly bitten outdoor 134 (68.02%) whereas females were bitten mostly in indoor 79 (58.85%). Poisonous snakebites were 70.20% and non-poisonous (17.33%), the rest were unidentified.

The lower limb was the most preferred site of bite 233 (70.82%) with peak incidence of snakebite recorded between 6 PM to 12 midnight 108 (32.83%). Almost all the cases were given first aid 323 (98.18%), and post cases were rushed to the hospital within 6 hours of the time of bite i.e., 196 (59.57%). Out of 329 cases of snakebite poisoning, only 63 (19.14%) were proved to be fatal.

Monteiro NP et al[23]in his prospective study conducted in KMC, Manipal from August 2003 to November 2005 observed female victims to be predominant with male to female ratio of 1:1.5. 80% of the victims were farmers. 55% received first aid before hospitalization.80% of bites occurred during day time, 55% bites in outdoor settings. 40% bites were on lower limbs.70% had fang marks.

Shetty AK &Jirli SP[24]in their one year prospective study on snakebite cases admitted to District Hospital, Belgaum from September 2000 to August2001,observed that male to female ratio was 3:2. 72.5% of victims were from rural region and maximum 28% belonged to 21-40yrs age group. 75% of victims had bite on lower limbs, 77.5% were agricultural workers, 62.5% bites occurred in monsoon season from June to September. 62.5% cases had envenomation.

Alirol E et al[25]observed that 90% and 98% of snakebite victims were given tourniquet application as first aid in Nepal and Bangladesh respectively. 28% and20% of victims were given incision in and around bite site as first aid in Bangladesh and North East India respectively.

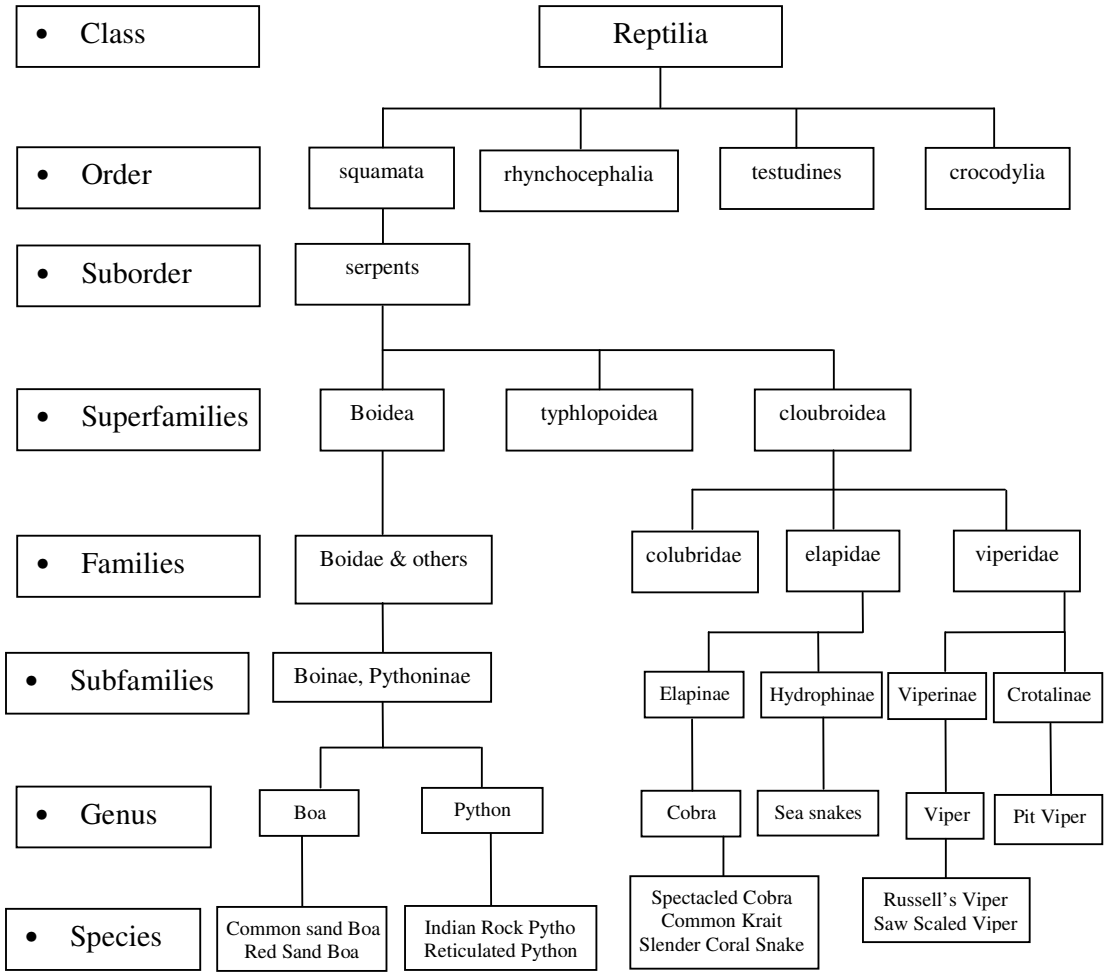
Mohapatra B et al[26]conducted a survey in India with nationally representative study of 1, 23,000 deaths from 6,671 randomly selected areas in 2001-03.Snakebite was found to be more common among rural population with male predominance. Maximum victims belonged to 15-29 years age group and the bite was more common during monsoon season.0.47% of mortality was assigned to snakebite.

Ahmed et al[27] retrospectively reviewed59 snake-bite victims admitted to the intensive care unit Krait was the most common type of snakebite reported. There was a male preponderance (69.4%) with age ranging between 20 and 40 years (52.5%). The mean lag time (time elapsed between bite and first dose of anti--snake venom) was 5.3 ± 1.4

h and the mean anti-snake venom dose was 12.3 ± 2.4 vials. There was a positive and significant correlation between lag time and total dose of anti--snake venom (correlation coefficient =0.956,P<0.0001). The overall mortality was 5.1%.

Yogesh C & Satish KV[28] in their 18 months study about 54 %occurred at the age group of 20 – 39yrs. Male Predominance were noted in 20-29yrs and female predominance in age group of 30-39yrs. 30.69% of victims were farmers. Of the male victims maximum 43.85% were farmers. Similarly in female victims 84.81% were housewives, followed by 18.96% labourers. Among the study group, 7.22% of the subjects were illiterate and 92.78% were literates of which 43.34% had primary education, 37.02% had secondary education, 10.08%were at PUC level and 1.58% was graduates. Maximum victims 62.75% belonged to rural region.

Chart 1: Classification of snakes found in India[10, 11]



General features of snakes[11]

Snakes range in size from 10mm to 10m in size. A vast majority of the snakes fall within the range of 45- 200 cms in length. In India, the largest species found is King Cobra(4.8m) and Indian rat snake (3.5m).

Teeth[10, 12, 29]

Snakes are primarily predators and have evolved special tools to aid them in hunting. In majority of the snakes the teeth are present on the Maxillary, Palatine, Pterygoid and Mandibular bones. The primitive families may have teeth upon Premaxilla. The teeth are not implanted in true sockets but simply ankylose to the bone, leaving a shallow impression when detached. From evolutionary view point the main changes indentition has occurred on the maxillary bone and this change is of great taxonomical importance. Three types of teeth are known and they are solid, grooved and canaliculated. There is continuous succession of teeth. Those which are lost are replaced by new ones immediately by the successor teeth lying below. Teeth in all snakes are curved backwards to prevent the prey from escaping and to aid in swallowing the prey.

Tongue and Jacobson's organs[10, 11]

Snakes can smell from their nostrils. But they rely on a combination of tongue and Jacobson's organs as well. The forked tongue is protruded through the lingual fossa, flickered and then withdrawn. Thus, picks up the minute particles of scent from the air and transfers them to Jacobson's organ which is situated at the roof of the mouth through the Naso-palantine ducts. The organ is lined by Olfactory membrane and innervated by Vomero-nasal nerve, which transmits the information to brain via olfactory duct.

Venom apparatus[10, 11, 12, 29]

The venom apparatus consists of the fangs (modified teeth) and the ducts which convey the venom from the glands to the fangs and Duvernoy's glands. Venom is transported from the venom gland (Duvernoy's gland) via the duct which is surrounded by muscle tissue that regulates the flow of venom, thus snakes can control the amount of venom delivered at per bite. The amount secreted varies with age, vitality and temper of the snake

Snakes such as Checkered Keelback, Wolf snakes, Rat snakes, Cat snakes & Vine snakes have rear fangs. These snakes chew venom into the prey with the help of these large grooved teeth present in the back of upper jaw. Venomous snakes like Cobras, Kraits, Coral snakes and Vipers are front fanged i.e. fangs are placed in the front of the upper jaw, one on each side. Kraits and Sea snakes have very short fangs (2-4mm or 1/8 -1/4 in). Cobras and King Cobra have little longer fangs (5-10mm or ¼-1/2 in). Fangs in these species are fixed (immobile) and grooved.

Vipers have fangs of length up to 25mm (1in). Fangs in Vipers are hinged and hollow like a hypodermic needle. The fangs are enclosed in a membranous sheath and can be folded upwards and backwards against the roof of mouth. This is a more intricate and most evolved system that allows the snake to instantaneously strike, inject venom and withdraw the fangs without injuring itself by the struggling prey. Fangs as well as teeth are shed in cycles as short as 10 days and as long as 70daysdepending upon the species and health of the snake. Some African and Southeast Asian species of Cobra use fangs to spray venom i.e. "spitting" up to 2.5m (9ft). This is a defensive mechanism and none of the Indian Cobras are known for 'spitting'.

Scales[29]

Snake's skin has scales all over the body. The scales on the body are imbricate and form straight longitudinal and oblique-transverse series. They help the snakes to protect themselves from desiccation in dry environment, wear and tear associated with friction and also help in locomotion. The scales are part of the skin which is formed from localized thickened areas. The scales differ considerably in shape and size. Different areas of the snake's body are covered with different types of scales. In most species, the scales on the head are large and irregular in shape except for few snakes like vipers where the head scales are small. The scales on the dorsal surface are small, diamond shaped and overlap with each other. The scales on the ventral surface are wide and are arranged in a single row from chin to vent. Scales on undersurface of the tail may be single or paired.

Three types of scales are known. They are

1) **Keeled (rough) scales -** These scales have ventrally placed ridges. They can be feebly or strongly keeled. The keels are usually stronger in males than in females and stronger in the posterior part of the body than the anterior part in both sexes. Keeling helps for better grip on loose ground like sand. E.g. Saw Scaled viper.
2) **Smooth scales -** Smooth scales enable the subterranean snakes to move easily through narrow crevices. E.g. Cobra.
3) **Warty scales** - The scales are raised and resemble the teeth on a file. They help to grip slippery prey such as fish. E.g. Sea snakes.

The number of scale-rows round the body varies considerably. In majority of the snakes maximum number of scale-rows is at mid-body. In most species, there is a reduction in number of scale-rows as the vent is approached. The arrangement of

scales on head, the number of scales on dorsal surface at mid-body (has great importance than any other part of the body), the number of ventral & sub caudal scales remain fairly constant in each species. Thus, the pattern of arrangement of scales helps to recognize the species. Male snakes have longer tails, thus have more number of sub caudal scales than their counter parts.

Moulting or Sloughing[10]

The scientific term for this process is 'ecdysis'. It is a lifelong continuous process of periodic shedding of a layer of dead skin cells and replaced by new ones. 'Molt or moult' is a layer of dead skin which is semi-transparent and appears like a white sheath. The entire body appears whitish during this process due to a thin layer of lymph like fluid between the skin and the molt. A thin whitish layer covers the eyes and thus the snake cannot see clearly. Due to the opacity of the brille, the snake stops feeding, becomes extremely irritable, ready to strike even on the slightest suspicion of danger. Prior to shedding, the restless snake moves about rubbing its body against any rough surface such as rock or bark of a tree. This friction results in rupture of the molt usually near the mouth. The head is freed first and then the snake slowly wriggles out. The molt is turned inside out like an inverted sock. It takes 10days for the entire process to be completed and occurs once in every two months. During unfavorable conditions, the molt is shed bit by bit. The exact frequency depends to some extent on the age, growth rate and metabolism of the concerned individual. Young snakes grow more rapidly and therefore shed more frequently than older ones. The process ceases during hibernation.

Sense Organs

Eyes[10, 12, 30]

Snakes have inefficient eyes. The eyes differ greatly in size even among the species that belong to the same genus. Snakes cannot see colors and are near sighted. The main limitation is the inability to focus by changing the shape of the lens.11 Thus, their perception of details is poor. They also have difficulty in noticing stationary objects. This is compensated by the keen sense of smell and the heat detecting pits. The eyes are placed on either side of the head in most snakes. Thus they have poor binocular vision. In Vine snakes, owing to the pointed character of its snout it is said to be the only species to have binocular vision.

Wall[12]discovered an interesting feature about vision of snakes. He discovered that the lens of the eye was yellow in certain species and colorless in others. He correlated the difference in colour with diurnal or nocturnal habits and concluded that yellow coloration is an adaptation for the improvement of visual acuity in daylight.

Size of eyes[29]- Generally the burrowing, secretive and nocturnal snakes have small eyes. The diurnal species have large eyes due to their inability to constrict the pupils.

Shape of pupils[29]- In predominantly diurnal species the pupils are round in shape and in nocturnal species they are either vertically slit or elliptical in shape. Some sea snakes have light sensors in their tails.

According to M Smith[12]in his book 'Fauna of British India', the shape ofthe pupils cannot be correlated to its diurnal or nocturnal habits.

Ears[10, 12, 30]

Snakes lack external auditory meatus, external auditory canal, tympanum, tympanic cavity and Eustachian tube. The auditory apparatus consists of a bony or

semicartilagenous rod, the Stapes or Columella auris. Hearing in snakes is mainly through the vibrations received from the surface on which they rest. Recent studies in USA have shown that snakes can also pick up some air borne vibrations via their lungs. They can hear very low frequency sounds of range 200 to 500 Hz. Sounds like talking or music are not heard by snakes. The low frequency sound waves which hit the sides of the skull are transferred to the inner ear through the jaw muscles and ear bone.

Heat sensitive pits (Thermo-receptors)[10, 12, 30]

They are small depressions present near the nostrils or around the mouth which are heat sensitive and extremely specialized sense organs. They are exceedingly sensitive to temperature changes as small as 0.20 Celsius. By comparing the information received from right and left side pits, the exact location of warm blooded prey can be deduced. This enables the snakes to strike the prey accurately even in the dark. Pits are found in snake belonging to two families i.e. Boidae and Viperidae. Jacobson's organ described earlier serves as sense organ.

Pain[10, 30]

Snakes are acutely sensitive to pain and suffer from changes in temperature and humidity. The snakes' main pursuit is optimum body temperature. Snakes are exothermic i.e. there is no internal mechanism to regulate the body temperature. Its temperature tolerance limit is between 20C and 440C. Only when the body temperature is in just the right range, snakes feed, mate and produce off springs. When it is too cold, the snake's metabolic rate slows down and it becomes too sluggish to pursue its prey or escape its enemies. When it is too hot, it becomes torpid, dehydrates and dies.

Hemipenis[12]

Is a pair of copulatory organs which lie on either side of the base of the tail. Each organ consists of a tube of erectile tissue, which can be everted like the finger of a glove. Cope (1893) arranged a classification of snakes based on the characters of hemipenis. As a specific character, hemipenis is remarkably constant in many genera, thus is most valuable feature.

Eggs and Offsprings[10, 12, 31]

Majority of the snakes lay eggs. The eggs are oval in shape and usually are about twice as long as broad. Viviparity or giving birth to young ones is seen in sea snakes (Hydrophiidae), Fresh water snakes (Homalopsinae) and Vipers (Viperidae). Oviparity or viviparity has no taxonomical significance. It has been observed that the spermatozoa can be retained viable in uterus of female snakes for several months. Because of this, it is possible for snakes to have successive layings of fertile eggs without remitting.

Locomotion[10, 11]

Snake travel fast unhampered by the absence of limbs. Different species move about using different mechanism with help of different groups of scales. In 'rectilinear motion', the snake uses ventral scales by moving them forward in a continuous series of waves and hitching their edges over irregularities. Then using this grip it pulls itself along by muscular efforts. Pythons and Boas use this method. In 'serpentine manner' of motion, the dorsal scales especially those on the lower flanks, help to propel the snake. The peculiarity of this type of locomotion is whole of the snake's body and tail follows the same course as its head. This type of locomotion is seen in aquatic species. In 'sidewinding' type of locomotion the flank scales are used along with ventral scales. This type is favored by snakes living on unstable substrate such as sand

in deserts. These species travel at angle of 45 degrees to the line of their body. They leave a characteristic 'J' shaped markings on the sand. Saw scaled vipers use this type of locomotion.

Structural adaptation to the environment[10]

The external appearance of snakes depends on the environment in which they live. Many species are adaptable i.e. they can climb, swim and burrow. The family colubridae is the largest family and occurs in the greatest diversity of habitats. Burrowing snakes have cylindrical bodies with shiny scales and wedge shaped or pointed snout and blunt tails. Snakes in desert region are short and stout in shape and are covered with heavily keeled scales which give plenty of grip against an unstable surface like sand. Most of them are cryptically colored to match the substrate on which they live. Aquatic snake are usually stout and their bodies are often flattened from side to side enabling them to push against a greater volume of water. The tails are paddled shaped. Arboreal snakes are long, slender and many have prehensile tails. They possess large efficient eyes and sharply pointed snout. They are usually of green or brown color.

Camouflage (crypsis)[10]

Vast majority of snakes have colour resemblance to the environment in which they live. This helps them blend into the environment. Hence, most terrestrial species are some shades of brown or grey, arboreal species of green shades and desert species vary from yellow to red depending on the soil type. Camouflaged snakes may be plain colored or blotched or mottled depending on their habits and habitats and thereby become less conspicuous to predators.

Snakes found in Karnataka[32, 33]

Only 47 of all the Indian species are found in Karnataka. The venomous (13species) and mildly-venomous (8 species) snakes found in Karnataka are listed in Table-1. The non-venomous snakes (26) found in Karnataka are enumerated below.

These snakes distribution can be categorized as follows.

a) Snakes found all over Karnataka – These species are found in Mainland, Coastal and Western ghat regions.

b) Snakes found exclusively in Coastal region and

c) Snakes found exclusively in Western ghat.

Table1:Venomous and mildly-venomous species found in Karnataka of Elapidae

Name of the family	Common name	Scientific name	Region found	Severity of envenomation
Elapidae	1)Common Krait	Bungaruscaeruleus	All over	Venomous
	2)Spectacled Cobra	Najanaja	All over	Venomous
	3) King Cobra -	Ophiophagus Hannah	Western Ghats	Venomous
	Slender Coral Snake	-Callophis melanurus.	All over	Venomous
	Striped Coral Snake	Calliophis nigrescens	Western Ghats	Venomous

Table 2: Venomous and mildly-venomous species found in Karnataka Hydropidae

Name of the Family	Common name	Scientific name	Region found	Severity of envenomation
Hydrophidae	1)Hook nosed Sea Snake	Enhydrinaschistose	Coastal region	Venomous
	2)Many toothed Sea Snake	Hydrophiscaerulescens	Coastal region	Venomous
	3)Short Sea Snake	Lapemiscurtus	Coastal region	Venomous

Table 3: Venomous and mildly-venomous species found in Karnataka of Viperidae

Name of the family	Common name	Scientific name	Region found	Severity of envenomation
Viperidae	1)Russell's Viper	Daboiarusselii	All over	Venomous
	2) Saw scaled Viper	Echiscarinatus-	All over	Venomous
	3)Hump nosed Pit Viper	Hypnalehypnale	Western Ghats	Venomous
	4) Malabar Pit Viper	Trimeresurus malabaricus	Western Ghats	Venomous
	5) Bamboo Pit Viper	Trimeresurus gramineus	Western Ghats	Venomous

Table 4: Venomous and mildly-venomous species found in Karnataka of Colubridae

Name of the family	Common name	Scientific name	Region found	Severity of envenomation
Colubridae	1)Common Vine snake	Ahaetullanasuta	All over	-Mildly venomous
	2)Brown Vine snake	- Ahaetulla pulverulenta	Western Ghats	Mildly venomous
	3) Common Cat snake	Boigatrigonata	All over	Mildly venomous
	4) Ceylon Cat snake	Boigaceylonensis	Western Ghats	Mildly venomous
	5) Forsten's cat snake	Boigaforsteni	Western Ghats	Mildly venomous
	6) Leith's sand snake	psammophis lethii	All over	Mildly venomous
	7)Dog faced Water snake	Cerberus rynchops	Coastal region	Mildly venomous
	8) Glossy Marsh Snake	Gerarda prevostiana	Coastal region	Mildly venomous

Non -venomous species found all over Karnataka:

1) Brahminy Worm snake (Ramphotyphlopsbraminus).
2) Beaked Worm snake (Grypotyphlopsacutus).
3) John's Sand Boa (Eryxjohnii).
4) Elliot's Shield Tail (Uropeltisellioti).
5) Buff Striped Keelback(Amphiesmastolatum).

6) Common Indian Trinket snake (Coelognathushelenahelena).
7) Variegated Kukri snake (Oligodontaeniolatus).
8) Olive Keelback(Atretiumschistosum).
9) Green Keelback(Macropisthodonplumbicolor).
10) Banded Kukri snake (Oligodonarnensis).
11) Bronzeback Tree snake (Dendrelaphistristis).
12) Dumeril's Black-Headed snake (Sibynophissubpunctatus).
13) Checkered Keelback Water snake (Xenochrophispiscator).
14) Banded Racer (Argyrogenafasciolata).
15) Indian Rat snake (Ptyas mucosa).
16) Barred Wolf snake (Lycodonstriatus).
17) Common Wolf snake (LycodonAulicus).
18) Common Sand Boa (Gongylophisconicus).
19) Indian Rock Python (Python molurusmolurus).

Non-venomous snakes found in Western ghats:

1) Montane trinket snake (Coelognathushelenamonticollaris).
2) Beddome'sKeelback(Amphiesmabeddomei).
3) Lesser Stripe-Necked snake (Liopeltiscalamaria).
4) Travancore Wolf snake (Lycodontravancoricus).
5) Olive Forest snake (Rhabdopsolivaceus).
6) Whitaker's Boa (Eryxwhitakeri).

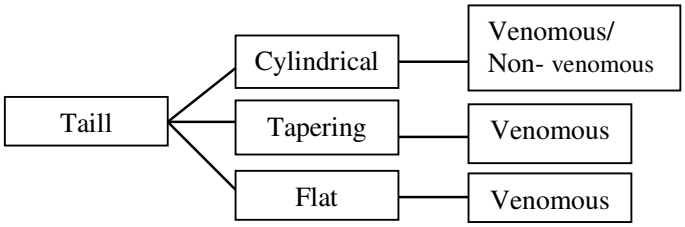
Non-venomous Snakes found in Coastal region:

1) 1)File snake (Acrochordus granulates)
2) 2)Whitaker's Boa (Eryxwhitakeri)

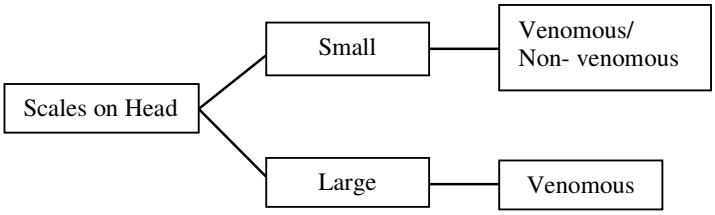
Morphological distinction between venomous and non-venomous snakes[34]

a. Differentiation based on tail morphology; (Chart 2)
b. Difference in scales present on the Head; (Chart 3)
c. Difference in scales present on the ventral surface for non-venomous and venomous;(Chart 4)
d. Difference in the side profile of the faces for venomous snakes(Chart 5)

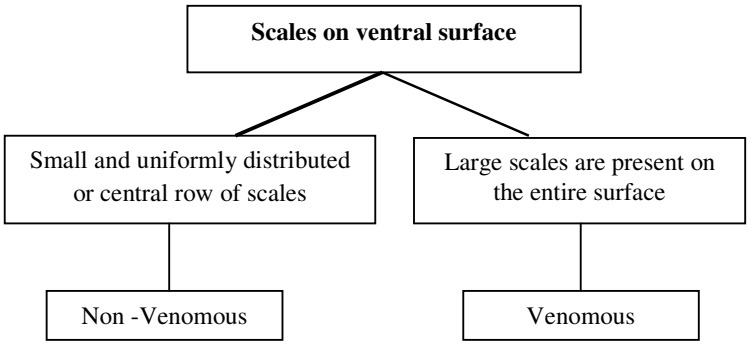
a) Chart 2



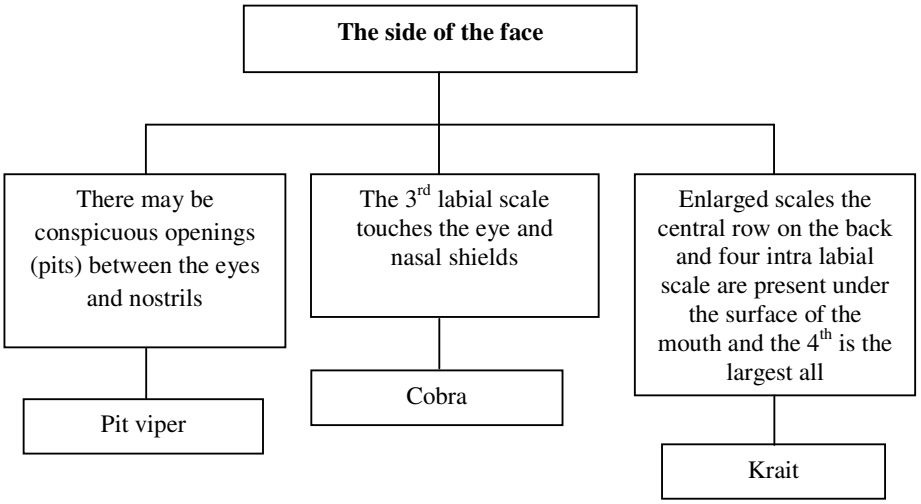
b) Chart 3



c) Chart 4



d) Chart 5



BIG FOUR

Photograph 1.Spectacled Cobra (Naja Naja)

Photograph 2.Common Krait (Bungarus Caeruleus)

Photograph 3.Russels Viper (Daboia Russelii)

Photograph 4.Saw Scaled Viper (Echis Carinatus)

Description of venomous and mildly-venomous species found in mainland of Karnataka.

Cobra[35]

There are four species of cobra in India namely- Spectacled Cobra, Monocled Cobra, Central Asian Cobra and Andaman Cobra. Only Spectacled cobra is found in Karnataka.

Spectacled Cobra (*Naja Naja)*[12,30, 31, 32, 35]

Local name –NaagaraHaavu (Kannada), Naag (Hindi).

Average length - 100cms, maximum length - 220cms.At hatching - 25-30cms.

Colour – They have extremely variable colour pattern even in individuals from same region. It can be of shades of brown, yellow, grey or black colour. Undersurface is usually white.

Identification features

- Head is broad and distinct from neck.
- Has large nostrils which are vertically elliptical and moderate sized black eyes with round pupils. Diameter of the eye is equal to or a little less than its distance from the mouth.
- Has 'binocellate' marking on the hood which makes the identification easy. There is tendency of the markings to become obliterated as age advances. Sometimes the marking may be absent in the melanistic phase of the cobra and can be confused with Central Asian Cobra.
- Has two black spots one on each side, on undersurface of hood. Two or three wide black bands on the undersurface of the neck suppose to be characteristic feature of cobra.[28]

Scales - Smooth, glossy and oblique.

Head scales- Frontal scale has breadth more than width, with truncate anterior margin.

- Preocular-1, usually in contact with the inter-nasals; Postoculars-3 (rarely 2).
- Supralabials-7 with 3rd being tallest touching the eye and nasal shield. Supralabial 4th touches the eye.
- Temporal - 2+3; Infralabials 4th and 5th are largest and a small 'cuneate' scale is present between the two scales.
- Genials - 2 pairs, the anterior is a little larger than the posterior and in contact with four infralabials. The posterior pair is partly or completely separated by a scale. Genial are scales present on the undersurface of the head. They are mostly in two pairs.
- **Body scales** - Has 25- 35 scales across the neck, 21- 25 at mid-body and 15-17infront of the vent; 171 to 197 ventral scales and 53 to 67 paired subcaudal scales. Outer 2 or 3 rows of dorsal scales are larger than the other dorsal scales.

Hood[31]- The hood of the Cobra is formed by elongated ribs of the 3rd vertebra and the ribs of following 27 vertebrae. The 9th rib on the left and the 10th rib on the right side are the longest. The succeeding and the preceding ribs shorten progressively, giving an oval outline to the expanded hood. When the hood is formed, the dorsal skin is stretched making the underlying marking conspicuous and the head is bent strongly at atlas at right angles to the hood.

Distribution - Found throughout the mainland except in Northeast India. Not seen in arid deserts. Found up to 2000m above sea level.

Habitat - Cobras have wide range of habitat and found anywhere i.e. heavy jungles, open cultivated land, old masonry construction refuge, white ant nests, holes in the ground and the tangle of roots at the base of a tree. It is frequently found near water.

Habits - It is a strong swimmer, extremely fond of water, exceedingly timid and nonaggressive. When disturbed usually escapes rapidly and becomes aggressive only on provocation. It is observed that Cobra by day and Cobra by night can be very different creature. Acton and Knowles[6]observed that the Cobra strike was ineffective with bad aim and closed mouth during day time. They also observed Cobra to have better vision during night and determined to strike with intention of gripping the prey. Despite of this finding, Cobra is mostly not nocturnal and it searches for food during late afternoon and early evening. Young ones are more dangerous than adults as they are more easily excited and ready to strike repeatedly with determination. When provoked, it erects its fore body and spreads hood. The snake when poised sways backwards and forwards 'hissing' in an explosive manner which is brief and high pitched. It is very active during rains. The bite of Cobra is often a mere snap but it can sometimes bite and hang on.

Food - Rats, frogs, toads, eggs of invertebrate animals.

Breeding – It is oviparous. Mating occurs in January. Gestational period is about 69-84 days and the eggs are laid in April or May. The pair remains together until the young ones are hatched out. The eggs are guarded by one or both parents. Both the parents are known to incubate the eggs. Venom glands of the hatchlings are active since birth and the young ones grow very rapidly during the first year.

Fangs – Short, grooved fangs of 5-10 mm in length.

Venom - Mainly neurotoxic in action. Cobra venom has been extensively researched. At Tata Memorial Cancer Institute, Bombay, it has been found that the fractions of Cobra venom destroy certain cancer cells in mice. Effective Pain killers are made of the venom such as 'Cobixin' and 'Nyloxi'.

Krait There are seven species of Krait in India. Only two are common and they are Common Krait and Banded Krait. Only Common Krait is widely spread in India and found in Karnataka.

Common Indian Krait (*Bungarus caeruleus)* [12,30, 31, 32, 35]

Local name - Karait (Hindi), Godchi Haavu or Kere Haavu (Kannada).

Average length - 100cms, maximum length- 175cms.At hatching - 25-28 cms.

Colour- Glossy black or steel blue or bluish grey or dark brownish black.

Underside is glossy white or yellowish in colour.

Identification features

- Head is indistinct from neck.
- It has small or moderate, entirely black eyes (iris is black in colour) with round pupils.
- Body is long and cylindrical. Tail is short.
- On the dorsum of the body, narrow white bands (which are paired sometimes)are present up till pointed tip of the tail i.e. approximately 40 white bands. The first one third of the body may have white spots on vertebral line instead of bands in old individuals and in young ones the bands are present throughout the body. A white preocular spot is usually present. The upper and lower lips are white.

Scales - Smooth and glossy scales. Kraits have remarkably highly polished scales.

Head scales – Preocular-1, in contact with posterior nasal; Postocular-2; Temporals-1+2. Loreal absent and Supralabials7, the 3rd and 4th touch the eye, 6th usually largest.The4th Infralabial is largest and is in contact with or just separated from the anterior pair of Genials. Anterior Genials are larger than the posterior. Nostril present between the two nasal shields; Rostral width more than length; Internasal shorter than prefrontals.

Body scales - 17 rows of scales at midbody. Scales on the vertebral line are enlarged and hexagonal in shape (helps to differentiate Krait from Wolf snakes). It has 200 to 217ventral scales, 1 undivided anal scale and 33 to 52 subcaudal scales which are entire (unpaired). The male grows to a larger size than the female. Hemipenis extends to 6th –9th caudal plate.

Distribution - Found throughout mainland of India except Northeast.

Habitat - Seen in fields, frequently found near or in water, rock piles, trees, granaries and grain shops. Often lives in rat holes or termite moulds. It is commonly seen in the vicinity of human habitation and is known to get inside the house during nights.

Status - Common in its range.

Habit - Good swimmer and nocturnal. It is of placid temperament. It is very shy and timid during day and rarely bites or bites only on great provocation but during night it is very active and quick to react. Mark O' Shea rightly called it "the Dr. Jekyll and Mr. Hyde of the snake world".[32]Many instances are on record of people sleeping on the floor being bitten. Especially in cold season, the snake may snuggle close to a sleeping person or curl up on the mattress to seek warmth and the sleeping person

unknowingly may roll on or place a limb on the krait provoking it to bite. Generally, the bite is painless and the sleeping person may not become aware of it.

Food - Feeds mainly on snakes including other kraits (Cannabilistic). Young ones feed on blind snakes of Typhlopidae family.

Breeding - It is oviparous. Mating is seen in February and March and lays 6-10 eggs. Eggs hatch out in May to July. Females are known to stay with their eggs. Wall[12] in his book states that 'the adults retire about September to mate and do not dissolve their matrimonial relationship until young are launched upon the world in March.

Fangs – short, grooved fangs of 2-4mm in length.

Venom - Krait venom is mainly neurotoxic and is considered to be the most potent among the 'Big four'.

Russell's Viper (*Daboia Russelii)*[12, 30, 31, 32,35]

Local name – Mandalatha Haavu, Baliwadak Haavu (Kannada), Kander (Hindi).

Average length - 100cms, maximum length - 180 cms. At birth – 24 cms.

Colour- It is of brown or yellowish brown shades with three rows of large oval spots i.e. one vertebral and two flank rows. The spots are brown at the centre with black, white or buff colored margins. The spots may have pointed ends and may form a chain like pattern. Two dark colored triangular streaks are present behind and below each eye. Lips scales are mottled with brown. Underside is white or speckled with semilunar black spots. An inverted 'v' shaped mark is present on the head. Two light colored streaks unite at the tip of the snout and diverge behind to reach the angle of the jaw.

Identification

- Head is flat, triangular in shape and broader than neck.
- Three rows of brown spots forming chain like pattern are seen on the dorsum.
- Inverted 'v' shaped mark on head.
- Has large, gold flecked eyes with vertical pupils and very large nostrils.
- Body is stout or massive, cylindrical with narrowing at both ends and has short tail.

Scales - Strongly keeled and rough in appearance.

Head scales - Scales on top of the head are small, imbricate and strongly keeled. 2 or 3on a line across the tip of the snout. 6 to 9 scales are present between the Supraoculars. Supraoculars are very narrow, 10 to 15 small scales round the eye. Temporal scales small. The lower most row scales are largest and smooth, the upper rows strongly keeled. Supranasal scale is crescentric in shape. Has 10 to 12 Supralabials, 4th and 5th are largest. Posterior Genials are smaller than anterior and are separated from them by small scales.

Body scales - Has 25 to 29 scales across neck, 27 to 33 at mid-body, 21 to 23 in front of vent on the dorsum. Strongly keeled except for the outer row which are smooth. 153 to 180 ventral scales and 41 to 64 divided subcaudal scales. Hemipenis extends up to 10^{th}caudal plate.

Distribution - It is seen throughout India, usually in plains but is also recorded up to2,100m above Sea level in South India and 1,800 m in Western Himalayas. It is commonly seen in some parts and rare in other parts of the country within its distribution. It is very abundant in Punjab and South India.

Status - It is the common source of skin industry in South India.

Habitats - Found in open grassy areas, scrub jungles, forest edges, rocky hillocks, dense horny hedgerows and in and around mangroves.

Habits - It is nocturnal and normally sluggish in behavior and does not strike readily unless irritated. Its movements are slow, never exceeding a crawl. When provoked, it often prefers to maintain its ground angrily hissing with heaving sides. The hissing is loud 'like a pressure cooker' which once heard is not easily forgotten. It strikes only as a last resort. While striking, it hurtles itself forwards and may even leave the ground. The bite is a snap and strikes with great force and determination.

Food - Mainly feeds on Murid rodents and Indian Gerbil. Young ones are often cannibalistic.

Breeding – It is Viviparous. The fertilized eggs develop a white envelope like eggs of other snakes and the envelope in advanced stages becomes a transparent membrane which ruptures prior to delivery or the young may be born in a caul. The envelope in unfertilized eggs remains white as in the early stages and these eggs are frequently voided along with the young, giving rise to the belief that these snakes are both oviparous and viviparous. The young are born in June and July. The gestational period exceeds 6months and 20 to 63 young ones are produced at a time.[24]

Fangs - Hinged, hollow, long fangs upto 25mm

Venom - Mainly haemotoxic.

Saw-scaled Viper (*Echis Carinatus*) [12, 30, 31, 32,35]

Local name –Kallu Haavu (Kannada), Afai (Hindi) Phoorsa (Marathi).

Average length - 40cms, maximum length- 80cms.At birth – 8cms.

Colour- Colour and pattern varies considerably. It is pale brown or grayish or sandy with blackish marking in the form of spots on the vertebral line, connected to light colored inverted 'U' shaped or 'V' shaped marks forming a wavy flank line like zigzag pattern. Undersurface is whitish, either uniform or spotted with brown.

Identification

- The body is cylindrical, stout and short.
- The neck is distinctly constricted and the tail is short and thin.
- Head has distinct arrow-head mark on top of the head.
- The eyes are large, its diameter greater than its distance from mouth, with golden yellow iris and vertical pupil.
- The nasal is divided into a large anterior and small posterior portion, the nostril being perforated just in front of the suture.

Scales - Strongly keeled and rough in appearance.

Head scales - Small and strongly keeled. Shields are absent on head. Supralabials 10-12,4th usually largest. Has a pair of internasals which are in contact with one another. Scales on top of the head are small, elongated, imbricate, 8-12 on a line between the Supraoculars; 10- 15 small scales round the eye exclusive of the Supraoculars. Has 3-4scales between the nasal and the eye. Temporal scales are small, keeled, except for the lowermost row. Anterior Genials are variable in size and are followed by 2-3 pairs of smaller shields.

Body scales - The dorsum has 25 to 29 scale-rows across the neck, 27 to 37 at mid body,21 to 27 rows of scales in front of the vent. The lowermost 4-7 rows adjacent to the ventrals are oblique with serrated keels. The ventral scales cover the entire belly and are 132 to 185 in number. The anal scale is entire (undivided) and the Subcaudals

are 23 to 39 in number and entire (unpaired). Hemipenis is deeply forked and spinose throughout.

Distribution - These snakes mainly inhabit arid areas. They are seen throughout the mainland of India except West Bengal and the Northeast. Found in abundance in some parts of the Deccan.

Status - Abundant throughout their range. They are more abundant in Ratnagiri district of Maharashtra.

Habitat - It is seen in open dry, sandy or rocky terrain in the plains and hills. It is also seen in open, rocky regions of heavy rainfall areas. They rest under rocks, behind barks, at the base of thorny plants during the day time.

Habit - Mainly nocturnal and is a good. climber. It is usually seen on the roads or paths basking in the morning sun after rainy or cold nights. It moves fast by side-winding type of locomotion and is dangerous because of the readiness with which it bites even on smallest provocation and is extremely fast while striking. The striking posture is characteristic. A double coil is formed in the shape of '8' with head in the centre. The serrated keels on the flanks produce hissing noise by friction and inflated lungs producing 'rasping sound'. Saw-scaled viper is more vicious and the venom is more toxic as compared to Russell's viper. The incidence of 'dry bites' is much rarer in case of the

Saw-scaled viper.[35]

Food - Feeds on mice, lizards, frogs, scorpions and insects.

Breeding - Viviparous. Records of breeding habits are meager. Mating is seen in cold weather. The young ones are born in April to August and they produce 3 to 15 young ones at a time.

Fangs- Hinged, hollow fangs upto 25mm length.

Venom- Mainly haemotoxic.

Slender Coral Snake (*Calliophis Melanurus*) [12, 30, 31, 32,35]

Local name – PatalaMoonga Saanp (Hindi), LahanPowla Saap (Marathi).

Average length - 25-35 cms, maximum length- 35cms.

Colour - This snake has light brown dorsum with each scale speckled with brown at the centre. Head is black and undersurface is Coral red in colour. The tail is brown with two black rings- one at the base, the other near the tip and the underside of the tail is bluish gray in colour.

Identification-

- Head not distinct from neck.
- It is small and extremely slender snake.
- The body is smooth. It has blunt head and short tail.
- Eyes are small and entirely black with round pupils.
- The head has two yellow spots on its top.

Scales- It has smooth and shiny scales.

Head scales- Preocular -1, which touches the nasal scale, Postocular-2, Temporals - 1+1and Supralabials 6 (the 3rd and 4th touch the temporal scales). 5th and 6th Supralabials in contact with the temporal; 2 pairs of Genials, 3 or 4 Infralabials touch the anterior Genial pair.

Body scales - Has 13 rows of dorsal scales; 249-277 ventral scales. The anal scales are divided and Subcaudal scales 33-37 in males, 24-27 in females and paired.

Distribution - Seen in most parts of Indian plain except Central and Northwestern India. It is a rare snake found in the hills and plains at low altitudes.

Habitat - Seen in Coastal shrub jungles, under leaves, bricks and rubble piles and sandy patches.

Habits - It is mainly nocturnal and is a good burrower in sandy soil. The captive specimens spend most of the time under the soil. When provoked, these snakes curl their tail up and wave it, detracting attention from the head. It is poorly known snake.

Status - It is described in literature as rare snake.

Food - Captive specimens feed on worm snakes.

Breeding - Nothing is known about reproduction except that they are oviparous.

Fangs - Short fangs of 5-10 mm in length.

Venom - Nothing much is known. It is known to cause neurotoxic symptoms.

Common Vine snake (*Ahaetullanasuta)*[12, 30, 31, 32,35]

Local name – Lata saanp (Hindi).

Average length -100cms, maximum length- 200 cms.At birth - 20-42.5cms.

Colour - Bright uniform parrot green back and head, with a thin white or yellow line along the outer margin of the ventrals which separates upper body scales from belly scales. Underside is light green or yellow colour. Chin and throat is white in colour with sky blue and yellow mottling. Tongue is pale pink with white tip. Lips are sometimes yellowish.

Identification

- Green colored, long and very slender snake with elongated snout narrowing rapidly and terminating in a projecting dermal appendage of variable length.
- It has a median groove on the head formed entirely by the Rostral.

- Large eyes with horizontal pupils and golden iris. It has binocular vision due to markedly concaved Loreal region.
- It has very long and slender tail.

Scales

Head scales- No Loreal. The Internasals and Prefrontals touch the Supralabials;Preocular-1, large and touches the frontal shield; Postoculars-2; Temporals 1+2 or 2+2.Supralabials-8, 3rd or 4th divided to form 1 or 2 Presuboculars; 5th touches the eye. Anterior pair of Genials shorter than the posterior pair.

Body scales - Has 15 rows on dorsal surface and 166 to 207 scales on ventral surface. The anal scale is divided and subcaudal scales are 156 to 180 in number and are paired.

Distribution - Seen in whole of peninsular India except Gangetic basin and Northwest.

Habitat - Found on low bushes or trees in jungles and gardens and Mangroves in populated areas.

Status - Common in its range.

Food- Feeds mainly on lizards, frogs, small birds, mice and other snakes.

Habit - It is diurnal. Usually reclines on the topmost branches of the bushes and escapes notice because of its cryptic coloration. It is usually a gentle snake and can be very fierce when caught. When alarmed, it rears its head and fore body and dilates its fore body which makes the black and white chequering of the skin prominent. If further provoked, opens the jaws widely and the lower jaw is expanded laterally by

separation of the mandible by strong muscular action. Wall mentions in this book that "the snake never commences to swallow its prey until all signs of life have ceased".[12]

Breeding- Ovoviviparous. Mating is seen in June. The gestational period is about 172 days and the young ones are born between March and December. The number of young ones varies from 3 to 23.

Fangs - Fangs on the back of upper jaw and are grooved.

Venom - Mildly venomous.

Leith's Sand Snake (*Psammophisleithii)* [33]

Local name - Leith Feeta Saanp, Patti Saanp (Hindi).

Average length - 76cms, maximum length- 89cms.

Colour- It has yellowish brown colored body with four dark brown lines from head to tail. On the middle of the head, it has an elongated dark mark. The median pair of stripes are present on either side of vertebral line, conspicuous, bordered on each side by black spots and extend forwards on to head as far as the eyes. The outer pair extend forwards on each side of the head up to the nostrils. Upper lip scales are light yellow in colour and the underside is faint yellowish white.

Identification

- Head is distinct from the neck.
- It has a long, thin body with elongated head which tapers to the front.
- Has large eyes with round pupils, the diameter of eye is much greater than its distance from the mouth. The mouth is also elongated.
- The head has a distinct ridge between the top and side of the head.
- The tail is long.

Scales- Smooth scales.

Head scales- Posterior nasal is sometimes divided by longitudinal suture. Frontal scale is long and narrow and in contact with the Preocular; Temporals 1+2; Supralabials-8, 4thand 5th touching the eye; Preocular-1.

- **Body scales-** 17 scale-rows across neck, 17 at mid body and 13-15 rows in front of the vent. Ventrals are rounded: males 159-175 scales, anal scale is entire and paired subcaudals: 104- 109. The outer edges of the belly scales are rounded i.e. not keeled/ not angulated laterally/ not sharply upturned. Long and extremely slender hemipenis.

Distribution - Found in Jammu & Kashmir, Rajasthan, Punjab, Uttar Pradesh, Gujarat, Maharashtra and Karnataka.

Habitat - Muddy lands, marshes, grasslands, deserts.

Habits - Diurnal and is found on the ground as well as trees.

Food - Feeds on lizards, small birds, raids bird nests.

Breeding - The female lays 4-10 eggs in March- June.

Fangs- Rear end of upper jaw.

Venom - Mildly venomous.

Common Indian Cat snake (Boigatrigonata) [12, 33]

Local name- Manjra (Hindi).

Average length- 65cms, maximum length-125cms.At hatching- 25cms.

Colour- Ground colour or yellowish brown or sandy, uniform or mottled with darker shades. Dorsally has a vertebral series of large, light, black edged inverted 'v' or 'y' shaped spots which meet at the centre and resemble arrow heads. The lower parts are

whitish, uniform or with small black spots on the outer margins of the ventrals. Head has light symmetrical markings sometimes black edged. A median stripe is present which starts from the frontal shields and diverges at the posterior end of the parietals, the two arms extend on to the neck. A light stripe from above the eye to the angle of the jaw is also present.

Identification

- Slender body and large triangular head. Cat like eyes with vertical pupils.
- Has brownish; light to dark brown zigzag markings.
- Brown arrow shaped mark on head and has a brown streak behind each eye.

Scales

Head scales are larger, smooth and of different shapes. Preocular-1, not reaching the upper surface of the head; Temporals-2+3. The posterior Genials are as long as or longer than the anterior, separated from one another by small scales.

- **Body scales -**Has 21 scale-rows across the neck, 21 at mid-body, 15 in front of the vent. Vertebral scales are larger than adjacent scales and are 206-256 in number. Anal scale entire and Subcaudals paired, 75-96 in number. Hemipenis extends upto 10th -12th caudal plate.

Distribution - All over India except Kashmir.

Habitat - Forests, paddy fields, villages and towns, arid and rocky areas. Arboreal and found on trees, in bushes and also in grasslands.

Food- Frogs, geckos, lizards, small birds and mice.

Breeding behavior- Lays 3-10 eggs in holes and tree hollows. Female appears to grow much longer than male.

Habits- **Nocturnal**. Gets provoked with sudden disturbance and assumes the attitude of defiance. It acts boldly on the offensive. It adopts a characteristic attitude. The head and fore body is raised from ground and thrown into loops, more or less in figure of 8 with head poised at the centre. Before striking, the body is inflated and deflated with agitation and the tail is vigorously vibrated. It strikes with great malice and widely opened jaws and strikes repeatedly.

Fangs- Rear end of upper jaw.

Mallaca Sea Snake[34]

Scientific Name: *Hydrophiscaerulescens*

Hindi- Samudra sarp

Marathi Samudra sarp

Distribution – All over India

Length- 820 mm

Distinctive character-

1. The snakes are faint, sky blue above and white on ventral side.
2. There are about 50-60 broad dark cross bands dorsally which taper down the ventral side.
3. The body is compressed posteriorly.
4. The flat tail is shaped like a paddle.

Glossy Marsh Snake[34]

Scientific Name- *Gerarda Prevostiana*

Distribution – All over India

Length- 525mm

Distinctive character-

1. Colour dark olive above.
2. Three outer rows of scales whitish, upper lip white.
3. Rostral dark olive, ventrals and sub caudals whitish, with dark edges.

Snake venom.

Snake venoms are the most complex of all natural venoms and poisons.[36,37] The venom of any species might contain more than 100 different toxic and non-toxic proteins and peptides, and also non-protein toxins, carbohydrates, lipids, amines, and other small molecules. Venomous animals and their venoms have evolved to take full advantage of many ecological niches and prey species that include a range of animals and their eggs i.e., annelids, onychophorans, molluscs, arthropods, amphibians, reptiles, fish, birds, and mammals.[38, 39]

Snake venom is toxic saliva secreted by modified parotid glands which are located in the snake's mouth, below and behind the eye. The purpose of venom is two folds. Firstly to immobilize or kill the prey before it is swallowed and secondly, to aid digestion by breaking down the prey's tissues. Often, when the snakebites it prey, the enzymes present in its venom start breaking down the prey's tissues even before the prey is dead or swallowed. For snakes, venom is not a weapon of mass destruction nor is targeted at human race.

Venom is a clear, amber colored fluid when fresh. It is most complex of all poisons and contains more than 20 different components. The venom mainly consists of proteins which includes variety of enzymes, non-enzymatic polypeptide toxins and non-toxic proteins. Other than proteins, the venom also consists of carbohydrates, metals, lipids, free amino acids, nucleotides and biogenic amines. Of the components, the more lethal and deleterious fractions are peptides and proteins of low molecular

weight (6000 to30,000). The polypeptide toxins (non enzymatic proteins) are categorized into neurotoxins and hemorrhagens. The neurotoxins are most abundantly found in elapid (Cobra, Krait) and hydrophid (sea snakes) venom. They are also present in lesser quantities in some vipers such as Russell's viper of South India and Srilanka.

Neurotoxins act either at pre-synaptic or post-synaptic levels. The Krait venom acts pre-synaptically on the nerve terminals. It causes initial release of acetylcholine but then damages the nerve terminal and prevents further release. It is for this reason that Krait envenomation victims do not respond to Anticholinesterase therapy and often take longer time to recover than Cobra envenomation victims.[15,18] Cobra venom acts postsynaptically by competing with acetylcholine for receptors at neuromuscular junction and leads to curare like paralysis. The earliest sign of neurotoxic paralysis is ptosis followed by external ophthalmoplegia. Paralysis involves the proximal muscles first and then the distal muscles and recovery occurs in the reverse order. The internal ophthalmoplegia is attributed to autonomic dysfunction. Hemorrhagins (Zinc metalloproteinases) damage the endothelial lining of blood vessel walls causing spontaneous systemic haemorrhage. The enzymatic components of venom consists of enzymes such as Phospholipases, Hyaluronidase, Hydrolases, Procoagulant enzymes, Acetylcholinesterase. The pathophysiological manifestations of these enzymes are clearly evident in case of viper venom.

The procoagulant enzymes present in Russell's viper which stimulate the blood clotting cascade are

a. RVV-X—A glycoprotein activates factor X by calcium dependent reaction, factor IX and protein C.

b. RVV-V— An arginine ester hydrolase activates factor V.

Saw scaled viper venom contains a Zinc metalloprotein i.e. ecarin which activates Prothrombin. The procoagulant enzymes activate clotting cascade and result in formation of fibrin in the blood stream. Most of this is immediately broken down by the body's own fibrinolytic system. Eventually, within 30 minutes of the bite, the levels of clotting factors become so depleted that the blood will no more clot. Deciding the potency of the venom is problematic. It is obviously not possible to determine this by experiments on humans. Experiments conducted on mice by Ernest and Zug indicate venom of Hook nosed sea snake and Russell's viper are more potent. But when we consider the land snakes, these do not confirm to the general experience in this two snakes. Whitekar and Captain while dealing with Common Krait, describe it as producing "the most potent venom of all our land snakes". Going by findings elsewhere also, this observation has to be expected as correct.

One of the curious features of venom is that its composition not only differs from species to species, but differs even among individuals of the same species inhabiting different geographical areas and even among the individuals of same litter. Thus, ASV needs to be prepared from species prevalent in the particular region.[25, 35, 40]

Potency of the venom differs depending on various factors such as age and health of the individual snake. New-born and very young snakes have more potent venom than adults. This is Nature's way of compensating for lesser quantity in the new born and the very young. There may be seasonal variation in the quantum and potency of the venom. Venom produced soon after hibernation is very potent whereas that produced during moulting phase is less toxic. Male snakes produce more venom than female snakes.[35]

Signs and symptoms[41,42]

The symptoms with which the patient presents depends upon the composition of the venom. Depending upon the species, the following symptoms may be seen.

Local symptoms

- Puncture marks of the fangs.
- Pain
- Oozing from the bite wound.
- Swelling
- Discoloration
- Necrosis.

Systemic symptoms

The symptoms may vary in different individuals and with different species of snake but it can be classified into neurotoxic, haemotoxic and myotoxic based on predominant symptoms.

General - nausea, vomiting, malaise, abdominal pain, weakness, drowsiness, prostration.

Cardiovascular system - dizziness, faintness, shock, hypotension, cardiac arrthymias, pulmonary oedema.

Hemostatic disturbances - Bleeding from bite site, I.V. lines and old partly healed wounds. Spontaneous bleeding from gums, epistaxis, bleeding into tears, hemoptysis, hematemesis, rectal bleeding or melaena, hematuria, bleeding pervaginum, bleeding into skin, mucosa, intracranial hemorrhage (meningism from subarachnoid hemorrhage, lateralizing signs and/ or coma from intracerebral bleed). These symptoms are seen in viper envenomation.

Neurological symptoms such as drowsiness, paraesthesiae, taste and smell abnormalities, ptosis, ophthalmoplegia (external and internal), facial muscle paralysis, aphonia, difficulty in deglutition, respiratory and generalized flaccid paralysis are seen in elapid snakes and also in Russell's viper bite found in South Indian and Srilanka.

Myotoxic symptoms such as skeletal muscle breakdown (rabdomyolysis) is seen in Sea snakes. It is characterized by generalized pain, stiffness and tenderness of muscles, trismus, myoglobinuria, hyperkalemia, cardiac arrest, acute renal failure.

Renal system is often involved in Russell's viper bites, Sea snakebites and causes loin pain, hematuria, hemoglobinuria, myoglobinuria, oliguria/anuria, uraemia (acidotic breathing, hiccups, nausea, pleuritic chest pain). Saw scaled viper is not known to cause renal failure unlike Russell's viper.

Gastro intestinal system - Acute abdomen in Krait bite is due to neuromyositis[19]and in Viper bite due to gastro intestinal and/or retro peritoneal bleeding.

Ophthalmic – Ptosis is the earliest sign indicative of neurotoxiciy followed by Ocular muscle palsy. Hemorrhages into conjunctiva, anterior chamber, vitreous or retina, lid edema, conjuctival chemosis, retinal and optic nerve oedema, opticneuritis, optic atrophy and rarely cortical blindness can be seen.[43,44]

Endocrine (Acute pituitary/ adrenal insufficiency) system – It is often reported with Russell's viper envenomation. It has two phases -Acute phase is characterized by shock, hypoglycaemia and Chronic phase (months to years after bite) manifests with weakness, loss of secondary sexual characters, amenorrhoea (Sheehan's syndrome), testicular atrophy, hypothyroidism.

Table 5: Signs and symptoms manifested in Cobra, Krait and Viper.[12, 15]

SYMPTOMS	COBRA	KRAIT	VIPER
Pain	Some pain at bite site	Mild pain at bite site or nil	Burning pain at bite site. Generalized pain, pain in the lower back and loins
Haemorrhage	Mild	Mild	Massive external and internal.
Drowsiness	Yes	Yes	Not likely
Inflammation	Moderate	Very little or nil	Severe to very severe
Edema	Rare and light	Rare and light	Rapid swelling of bitten parts
Breathing difficulty	Yes	Yes	No
Abdominal pain	Not noticeable	Severe	Not noticeable
Eyes	Ptosis, double vision	Ptosis, double vision	Ptosis in Russell's viper. No ptosis in saw scaled viper
Swallowing	Difficult	Difficult	Nil
Breathing problem	Yes	Yes	Occasional
Necrosis	Severe	Not severe	Very severe
Paralysis	Yes	Yes	No
Frothing in mouth	Yes	Occasionally	Yes
Nausea	Yes	Yes	Yes
Renal complications	No	No	Yes in Russels Viper

Other complications which can occur in snakebite patients are - Acute pulmonary oedema, extensive necrosis requiring amputation of the limb, chronic ulceration, osteomyelitis with malignant transformation and neurological sequelae.

First aid[45]

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

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

Do not apply a tourniquet.[46] Do not wash the bite site with soap or any other solution to remove the venom. Do not make cuts or incisions on or near the bitten area.[47]Do not use electrical shock.[48]Do not freeze or apply extreme cold to the area of bite. Do not apply any kind of potentially harmful herbal or folk remedy. Do not attempt to suck out venom with your mouth.[49] Do not give the victim drink, alcohol or other drugs. Do not attempt to capture, handle or kill the snake and patients should not be taken to quacks. There has been some initial research which suggests that a "Pressure Pad" at the site of bite may be of benefit.[50]This, however, needs to be evaluated in field in India to assess its efficacy.Every case of snakebite should be taken to doctor. The victim must be admitted and observed for at least 24hrs for signs and symptoms and treated accordingly. Even in known cases of non-venomous snakebite, victim should be taken to doctor for administration of Tetanus toxoid.

Precautions against snakebite[35]

'Prevention is always better than cure'

Snakebites can be prevented by simply learning the type of snake inhabiting in respective regions and learning their behavior and habitat.

- Carry a torch while walking in the dark and 'mind the step'.
- Clothing covering the legs such as full pants and protective foot ware such as shoes or gum boots act as barrier and minimize the venom injected**.**
- In snake infested areas, make sure that snakes don't refuge in shoes, pockets of coats, trousers before they are worn.
- Tea, coffee plantation workers should be vigilant while working as bushes are favorite habitat of Pit vipers.
- In areas where Common Krait occurs, sleeping on the floor should be avoided.
- Never provoke a snake. Generally, snakes avoid confrontation with human beings. Learn to recognize the warning sign given by the snake before it strikes such as stopping of flickering of tongue, hissing (Russell's viper), hood raising (Cobra), coiling of body into 'S' shape (Saw-scaled viper), vibration of tail (Bamboo pit viper). Further provocation of snake on displaying warning sign leads to bite and envenomation.
- If the snake is likely to strike, keep yourself at a safe distance. When a snake is poised to strike, it strikes with tremendous speed.
- Moulting snakes have foul temper and are very aggressive.
- Younger snakes are more easily irritable and quicker to strike than an adult. Newborns of venomous species have fully operational fangs and enough venom to cause severe envenomation in humans.

- Do not indulge in bravado while handling or dealing with venomous snakes. Even a moments carelessness even by an experienced and careful person can prove to be a terrible mistake.
- If a snake has bitten any person, neither he nor anyone else should remain at the site as the snake keeps lurking around in the vicinity due to its peculiar mode of hunting its prey at leisure.
- Do not venture out alone into terrains where snakes are likely to be found. Go at least in pairs. Both the companions should be well informed about snakes as they can take care of each other during emergency.

Management of a snakebite case[41, 42]

Management includes diagnosis and treatment of the patient. Diagnosis is based on history, clinical examination and laboratory examination.

A. History- A precise history regarding the circumstances of the bite and progression of local and systemic symptoms is very important.

- **When and where did the incident take place?** This helps in assessing the severity of envenomation and impending complications.
- **Site of bite** – Helps in assessing the fang marks and extent of local signs and symptoms.
- **Details regarding the snake** - Was the snake seen by the victim or anybody? If the snake is seen or killed and brought along with the victim, helps in identification of the snake as to venomous or non-venomous and administration of ASV (ASV available in India is effective against only the big four).

- Determine if any traditional medicines have been used, they can sometimes cause confusing symptoms. Sometimes, the patient is brought with history of unknown bite and can be mistaken with bites of rodents, lizards, thorn injury and cactus injury. Common krait is known for entering the house in night and biting the person sleeping on floor. Since the bite is painless the patient is not aroused from sleep but wakes up with complaints of acute abdomen which is mistaken for acute appendicitis or paralysis which is mistaken as Cerebrovascular accident or stroke.[19]

Early morning presentation of a patient to health center with history of sleeping on the floor, complaint of acute abdomen and neurological signs such as ptosis should be considered as Krait bite unless proved otherwise.

B) Physical examination- Includes local and systemic examination.

a) Local examination- If the bite site is known, careful examination of the site of fang marks should be done for broken fangs.

Puncture marks -Bite marks are of no use in identifying if the species is venomous or not as many non-venomous species leave just two fang-like marks e.g. Wolf snake.

Some venomous species like Krait leave no fang marks at all. Presence of more than one bite site indicates the severity of envenomation.

Swelling - The extent of swelling of the bitten limb should be assessed. Bitten limb maybe tensely oedemtaous, immobile with impalpable arterial pulses due to intravascular thrombosis and/or compartmental syndrome.

Necrosis - Signs of necrosis such as blistering, demarcated darkening of skin, loss of sensation and smell of putrefaction should be looked for.

b) General examination- Blood pressure, Pulse rate and Heart rate assessment help in diagnosis of hypovolemia and shock.

- Look for evidence of spontaneous bleeding at different sites. Abdominal tenderness indicates neuromyositis (Krait) and gastrointestinal or retroperitoneal bleeding (Viper bite). Lion pain and tenderness suggests acute renal ischaemia (Russell's viper). Intracranial bleeding is indicated by lateralizing neurological signs, asymmetrical pupils, convulsions, impaired consciousness (Viper bite).Spitting and coughing may bring out blood.

Tests for neurotoxic envenomation

Neurological envenomation is mainly assessed on clinical signs and symptoms.

- Test the eye movements and retraction for upper eyelids for external ophthalmoplegia and ptosis respectively. Check the size and reaction of pupils for bulbar palsy and/or internal ophthalmoplegia .
- Check for trismus (ask patient to open mouth widely). Trismus is seen in seasnake envenomation.
- Assess all the cranial nerves.
- Flexor muscles of neck may be paralysed giving impression of 'Broken neck sign'.[25]
- Difficulty in swallowing and/or accumulation of secretions is early signs of bulbar paralysis. Paradoxical respiration indicates paralysis of intercostal and accessory muscles of inspiration.

Laboratory investigations[41,42]

Laboratory investigations help in knowing the type of envenomation (haemotoxic or myotoxic) and complications such as acute renal failure (if any).

20 minute Whole Blood Clotting Test (20WBCT)

This test is considered most reliable for testing coagulation. It is a simple test which can be carried out at the bedside without specialist training and with most basic settings. It is superior to the 'capillary tube' test.

Procedure - 1-2 ml of blood is placed in a new, clean, dry, small glass test tube(not plastic bottles, syringes as they give false readings).The tube should not be washed with detergent as it inhibits the contact element of the clotting mechanism. The tube is left undisturbed in ambient temperature for 20 minutes. Then the tube is gently tilted or tipped and not shaken. If the blood is liquid, then the patient has coagulability disturbances of blood due to venom induced consumption coagulopathy. The test is repeated every 30 mins for the first 3 hours after admission. If haemostatic disturbances are discovered, the test is done every 6th hourly to assess the requirement for repeat doses of ASV.

Note: In case of doubt, the test can be repeated in duplicate, including control blood (healthy person's blood).

Hemoglobin concentration/ hematocrit: A transient increase in the values indicates hemoconcentration due to generalized increase in capillary permeability (Russell's viper bite). Decrease in the values indicates intravascular hemolysis.

Platelet count: Thrombocytopenia is seen in viper bites (due to excessive fibrinolysis sand defibrination).

WBC count: Neutrophilic leucocytosis indicates systemic envenomation (from any species).

Blood film: Helmet cells or schistocytes are seen in microangiopathic hemolysis.

Coagulation factors: Prolonged Bleeding time, Clotting time, Partial prothrombin time and depressed Fibrinogen levels & elevated FDP are seen in viper bite cases.[51]

Biochemical abnormalities:

- Creatinine, Urea and Blood urea nitrogen are raised in renal failure (viper and sea snakebite).
- Muscle enzymes (Creatine Kinase, Aldolase) and Aminotransferases – if raised indicate severe local damage or generalized muscle damage (sea snake and Russell's viper).
- Hyperkalemia indicates extensive rabdomyolysis (sea snakebite).
- Low bicarbonate levels indicate metabolic acidosis (renal failure).
- Arterial blood gases and pH: show evidence of respiratory failure (neurotoxic envenomation) and acidaemia (respiratory and metabolic acidosis).

Urine analysis: RBC cast indicate glomerular bleeding and massive proteinuria indicates generalized increase in capillary permeability (Russell's viper bite).

- Urinary NAG (N acetyl-beta-delta-glucosaminidase) estimation is found useful in early diagnosis of renal damage by Russell's viper envenomation.

Chest X-ray: May reveal pulmonary oedema, intrapulmonary hemorrhages and pleural effusion.

X-ray of bitten part: If the bite site is tender, plain x-ray when taken may reveal the presence of embedded snake tooth/fang fragments.

Immunodiagnostics: Immunological detection of venom antigens in body fluids can be done by ELISA. This method is highly sensitive but specificity is inadequate for

different species. IgY- based sandwich ELISA and indirect competitive inhibition ELISA have been developed for cobra and krait venom detection.[18]

Treatment[41,42]

Rapid clinical assessment and Cardiopulmonary resuscitation should be done once the patient arrives at the hospital or dispensary. Once diagnosis of snakebite by venomous species is made, ASV should be administered. ASV is the only specific antidote for snake venom.

Anti snake venom (ASV, antivenin, antivenom)[35]Antivenom is immunoglobulin purified from the serum of a horse or sheep that has been immunized with the venoms of one or more species of snake (usually of the enzyme refined F(ab)2 fragment of IgG type).

In 1887, Henry Sewell of the University of Michigan, USA, conducted experiments on snake venoms and laid foundations for anti toxin therapy. Albert Calmette, a student of Louis Pasteur (founder-Director of Pasteur Institute in Saigon, Vietnam) followed up the research done in US and discovered ASV in 1891. The first antivenin became commercially available in 1927 in US.

ASV in India[35]

ASV can be of monovalent (specific to venom of single species) or polyvalent type (specific to venom more than one species). In India, only polyvalent ASV is available. It's effective against only the 'Big four' species. ASV is ineffective against other species like Hump nosed pit viper and others. One ml of polyvalent ASV can neutralize 0.6 mg of Cobra and Russell's viper venom and 0.45 mg of Krait and Saw-scaled viper venom. One vial of ASV (10 ml) can neutralize 6mg of Russell's viper and Cobra venom.

In India, ASV is manufactured in public sector by Haffkine Biopharmaceuticals Ltd, Mumbai; Bharat Serums and Vaccines Ltd, Mumbai; King Institute, Chennai. M/s. Vins Bio-products Ltd, Hyderabad; Serum Institute, Pune and Biological 'E' Ltd, Hyderabad in private sector also produce ASV.

In an Indian study, it has been found that the Specific venom neutralizing property of ASV depends upon the geographical origin of the snakes used for procuring venom for immunization. It was observed that the dose of ASV required to treat victims at Pondicherry was double the dose required for victims at Maharashtra. The ASV used for treatment was obtained from Pune and Mumbai respectively where the Saw scaled viper venom is procured from the snakes caught in Western Maharashtra.[33]The effectiveness of ASV produced in India is also questionable against venom of Sochurek's Sawscaled viper found in Rajasthan.[28] Thus, it is advised to prepare ASV from venom procured from snakes from same geographical areas. ASV is very valuable and should be used judiciously.

Administration of ASV[41,42]

Administration of ASV to any patient with history of snakebite without any signs and symptoms of envenomation should be strongly discouraged as the patient is unnecessarily exposed to ASV which has risk of life threatening reactions and sensitization apart from ASV being scarce.

Indications[41,42]

ASV should be administered only if and when the patient has proven signs of either systemic or local envenomation. Only unbound venom present in the blood stream or tissue fluid is neutralized by ASV.

Systemic envenomation

a. Evidence of Hemostatic abnormalities: spontaneous systemic bleeding (clinical), coagulopathy (20WBCT or other laboratory) or thrombocytopenia.
b. Evidence of Neurotoxic envenomation: ptosis, external ophthalmoplegia, muscle paralysis, inability to lift the head etc.
c. Evidence of Cardiovascular abnormalities: hypotension, shock, cardiac arrhythmia, abnormal ECG.
d. Acute renal failure: oliguria/anuria, increased blood Creatinine/ Urea.
e. Persistent and severe vomiting or abdominal pain.

Local envenomation

a. Local swelling involving more than half of the bitten limb (in the absence of a tourniquet) or severe swelling of the digits (toes and finger).
b. Rapid extension of the swelling within few hours of bite (beyond ankle or wrist when bite on hands or feet).
c. Development of an enlarged tender lymph node draining the bitten limb.

Route of administration of ASV[41, 42]

ASV can be administered in two ways:

a. **Intravenous injection:** Reconstituted or liquid ASV (each vial has 10ml of ASV) is administered by slow intravenous injection at a rate of 2ml/min.
b. **Infusion:** Liquid or reconstituted ASV is diluted in 5-10ml/kg body weight of isotonic saline or glucose. ASV should be administered over 1 hr at constant speed and the patient should be monitored closely for 2hrs.

Local administration of ASV should not be done as it is proved to be ineffective, painful and raises the intracompartmental pressure, particularly in the digits.

ASV dosage in Neurotoxic envenomation

An initial dose of 8-10 vials should be given. If the initial dose has been unsuccessful in reducing the symptoms or if the symptoms have worsened or if the patient has gone into respiratory failure, a next dose of ASV should be administered after 1-2 hours. The next dose should be same as that of initial dose i.e. if 10 vials are given as initial dose then the same number of vials (10 vials) should be given as successive dose. 20 vials is the maximum dose of ASV given to a patient of neurotoxic envenomation. If the patient is in respiratory failure and has received 20 vials, then the patient should be put on ventilator support and no further dose of ASV should be given. This recommendation is based on the assumption that with 20 vials of ASV, all the circulating venom would be neutralized.

In case of pre-synaptic neurotoxicity (Krait), reversibility is possible in first few hours only. After which the body recovers by using its own mechanisms. Large doses of ASV over a long duration have no benefit in reversing envenomation. Rather ancillary treatment with mechanical ventilation till patient recovers should be given. In postsynaptic neurotoxicty (Cobra), patient may recover faster if ASV is administered along with anticholinesterase. Additional vials to prevent recurrence is unnecessary unless a proven recurrence of envenomation is established.

Anticholinesterase test (Tensilon test/ Edrophonium test)[41, 42]

Anticholinesterase such as Neostigmine, Prostigmine, Distigmine, Pyridostigmineor Edrophonium prolong the life of acetylcholine and can reverse the respiratory paralysis particularly that of postsynaptic type (Cobra venom). Its usefulness against presynaptic neurotoxins such as Krait or Russell's viper is doubtful. But the test is worth trying. Patients responding to acetylcholinesterase can be maintained on a long acting drug such as Neostigmine with 0.5 mg IM half hourly and Atropine 0.6 mg IV over an 8 hr period by continuous infusion.

ASV dosage in Haemotoxic envenomation

The initial dose is same as that for neurotoxic envenomation i.e. 10 vials. This initial dose of 10 vials is based on the calculation – Russell's viper injects 5 mg- 147 mg of venom and the average is 63 mg. Each vial of ASV neutralizes 6mg of Russell's viper venom, thus requiring 10 vials to neutralize 63 mg of venom and 25 vials of ASV to neutralize 147 mg of venom. Here, the ASV strategy is based on 6 hrs time period i.e. when the initial blood test reveals a coagulation abnormality, initial dose of ASV (10 vials) is given over 1 hour. No additional ASV should be given until next clotting test is done. After 6 hrs a further coagulation test is done and if it again reveals coagulation disturbance, the next dose of ASV (10 vials) is given over 1 hr. The clotting test and ASV are continued on 6 hourly basis until coagulation is restored or maximum dose (30 vials) are given or the species of snake is identified as one against which ASV is not effective.

If the coagulation disturbances persist even after administration of 30 vials of ASV (neutralizes 180 mg of Russell's viper venom), at this stage administration of fresh frozen plasma or coagulation factors should be done if available. The reason for persistent coagulation disturbances or non-responsiveness to ASV would be

envenomation by other species of snake against which ASV is not effective. In Hump nosed pit viper coagulopathy persists for 3 weeks and ASV in ineffective.

ASV in children and pregnancy

Children should be given the same ASV dosage as adults as snakes inject the same amount of venom in adults and children. It has been reported that snakebite during pregnancy has resulted into spontaneous abortions. There is no clear evidence as to whether venom can cross the placental barrier. Pregnant women with snakebite should be given same amount of ASV as in other victims.

Prophylactic regimes for prevention of reactions

There is no statistical, trial evidence of sufficient statistical power to show that prophylactic regimes are effective in prevention of ASV reactions. Administration of ASV under cover of steroids and antihistaminics without testing for sensitivity to ASV would save time and life. Two regimes are recommended.

1. 100 mg of Hydrocortisone and H1 antihistaminic such as 10mg of Chlorpheniramine maleate or 25mg Promethazine hydrochloride IM) are given 5 minutes before administration of ASV (dosage for children: 0.1- 0.3mg/kg of antihistamine IV, 2mg/kg of Hydrocortisone IV).
2. 0.25-0.3mg of adrenaline 1:1000 given subcutaneously.

ASV reactions[41,42]

Though ASV is the only specific treatment for snakebite, we are aware of the anaphylactic reactions. 20% of the patients exposed to ASV develop reactions either as early reaction or late reaction. The reactions are due to direct complement activation, effects of contaminating pyrogens or reactions to immune complexes.

Treatment for ASV reactions[41,42]

Anaphylaxis can be rapid in onset and life threatening. Adrenaline should always be kept available before administration of ASV. The patient should be closely monitored and with the first sign of anaphylaxis such as urticaria, itching, fever, shaking chills, nausea, vomiting, diarhhoea, abdominal cramps, tachycardia, hypotension, bronchospasm and angioedema, ASV should be discontinued and 0.5mg of 1:1000 adrenaline should be given IM (for children adrenaline dose: 0.01mg/kg body weight; antihistaminics should be used with caution in children). Observe the patient for 10-15 mins. If the condition of patient doesn't improve or worsens, second dose of adrenaline 0.5mg is given IM (IV adrenaline carries the risk of cardiac arrythmias). If needed, third and final dose can be given. After recovery from anaphylaxis, ASV can be restarted slowly for 10-15mins under close observation.

Late serum sickness can be treated with oral steroids such as Prednisolone 5mgevery 6th hourly (pediatric dose 0.7mg/kg/day) and oral H1 antihistaminics for additional symptomatic relief.

Recurrent envenomation[40,42]

In some cases of viper envenomation, after initial response to ASV, signs of systemic envenomation may recur within 24-48hrs. Many theories have been proposed in literature such as temporary fall in ASV levels, rapid elimination of ASV from circulation resulting in return of venom antigenemia. It has also been observed that recurrence of symptoms is more in patients receiving Haffkine Polyspecific ASV. Larger molecules of viper venom are taken up more slowly through lymphatics unlike neurotoxins. The most plausible explanation suggested by Boyer et al[43] is "Theory of depot of unneutralized venom at the bite site". Often the depot requires additional dosage of ASV. Oedema and circulatory injury at the bite site may result in decreased

delivery of ASV to venom depot preventing or delaying the neutralization of venom. Another reason is the reversible binding of ASV to venom proteins and if this complex circulates for a longer duration, it results in reappearance of free venom constituents. Recurrence is mostly seen in Viper bites but also observed with Cobra bites.

Prophylaxis to prevent recurrent envenomation- Prophylactic ASV for recurrent envenomation is not needed as Indian polyvalent ASV is of F(ab)2 type and has half life of 90 hours.

Handling tourniquet[41,42]

Though application of tourniquet is not advised, in event a victim is brought with tourniquet following procedure should be done. Sudden release of tourniquet is never to be done as it leads to massive surge of venom into systemic circulation causing sudden deterioration or rapid development of life threatening systemic envenomation such as neurological paralysis, hypotension due to sudden generalized vasodilatation. Doctor must be prepared to handle the complications. Before removal of the tourniquet, presence of pulse distal to the tourniquet should be tested. Lifesaving drugs and apparatus such as mechanical ventilator should be kept ready. If the tourniquet has occluded the distal pulse, then a blood pressure cuff can be applied to reduce the pressure slowly.

Follow up[45]

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

METHODOLOGY

The study was a hospital based prospective study conducted for duration of one year from 1st january 2014 to 31stdecember 2014. The subjects for the study comprised all of 68 patients of snakebite admitted to Shri B M Patil medical College, Hospital and Research center.

Source of data:

The data for this study was collected from following.

1) Proforma which was designed to collect information regarding the incidence.
2) History elicited from snakebite victims and their attenders.
3) In-patient medico-legal case records of snakebite victims.

Inclusion criteria:

1) The study includes cases of snakebite of both sex groups of all ages with history of snakebite admitted to Shri B M Patil medical College, Hospital and Research center.

Exclusion criteria:

Cases of unknown bite were excluded from the study.

Methodology

1) A proforma was designed to collect relevant information regarding the incident, the snake (if seen), first aid measures and primary treatment taken and socio demographic profile from snakebite victims and their attenders.
2) Signs and symptoms by general physical examination and systemic examination of snakebite victims.
3) Information regarding the management of the cases was collected from hospital inpatient records.

From Hospital records, following information was noted.

- Laboratory Investigations and other investigations.
- Treatment given to the victim in the hospital.

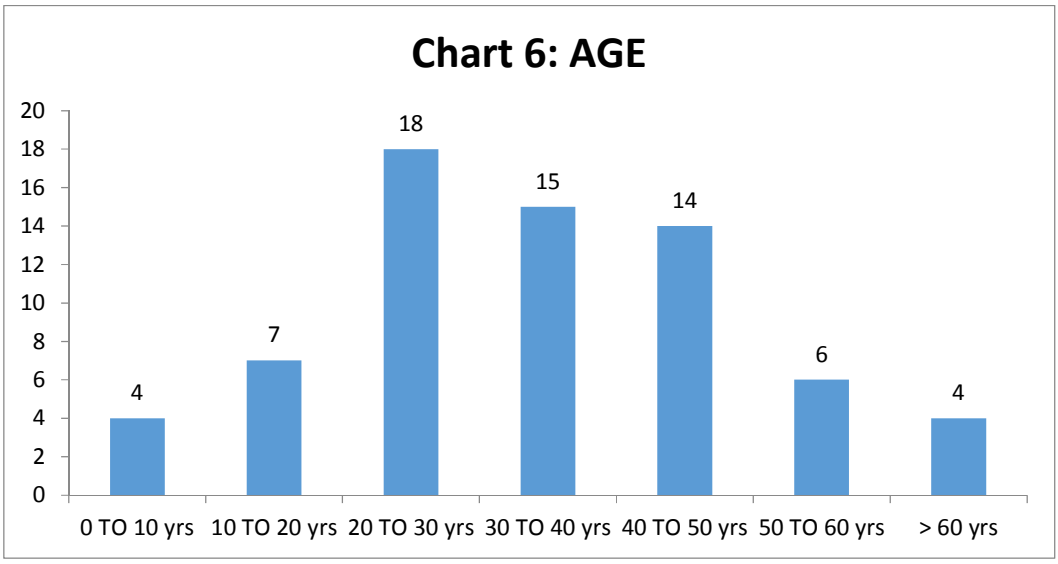
4) The patient was followed up till discharge from hospitals (or death) to know the outcome and morbidity the patient suffered due to snakebite.

5) Follow up was done of the patients who went against medical advice or who were referred to other centers.

RESULTS

Table 6: Age wise distribution of cases

AGE in years	N	%
0 TO 10	4	5.9
10 TO 20	7	10.3
20 TO 30	18	26.5
30 TO 40	15	22.0
40 TO 50	14	20.6
50 TO 60	6	8.8
> 60	4	5.9
TOTAL	68	100



Out of 68 cases maximum were between the age group of 20-30 years, (26%) followed by age group of 30-40 years(22%) and age group of 40-50 years(20%), 47 of 68 (69%) victims belonged to age group of 20-50 years. Bite victims belonging to extremes of age groups (0-10 years and >60 years) were minimum of only 10%.

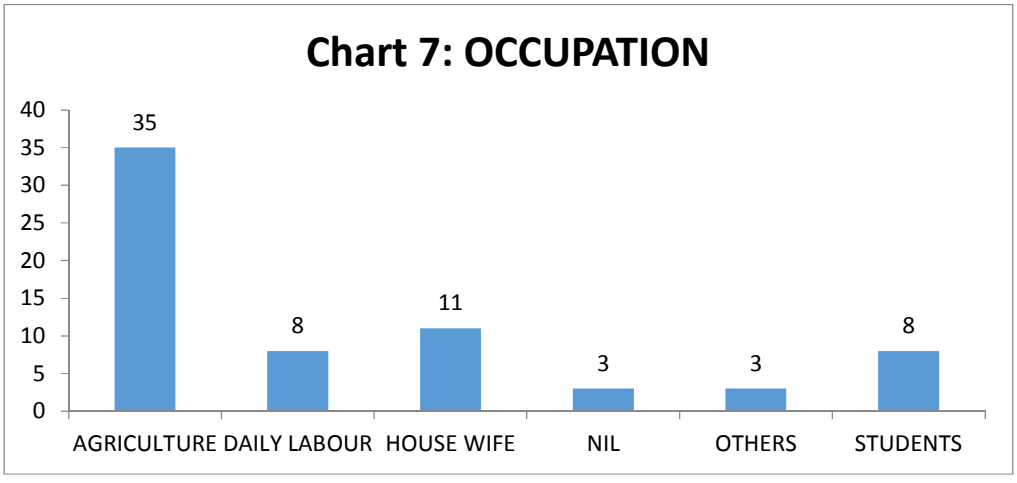
Table 7: Sex wise distribution of cases

GENDER	N	%
MALE	47	69.1
FEMALE	21	30.9
TOTAL	68	100

47 OF 68 (69%) victims were male and 31% victims were females.

Table 8: Occupation wise distribution of cases

OCCUPATION	N	%
AGRICULTURE	35	51.5
DAILY LABOUR	8	11.8
HOUSE WIFE	11	16.2
NIL	3	4.4
OTHERS	3	4.4
STUDENTS	8	11.8
TOTAL	68	100



More than half of the victims are farmers. Among 3 others two were in stationary business, one was panchayat bill collector, and among 3 of Nil 2 were kids of 3 year old and one was 70 year old lady.

Table 9: Distribution of cases as per Socio-economic status according to modified B G Prasad classification

Socio-economic status	N	%
UPPER CLASS	3	4.4
UPPER MIDDLE	4	5.9
MIDDLE CLASS	9	13.2
LOWER MIDDLE	13	19.1
LOWER CLASS	39	57.3
TOTAL	68	100

39 of 68 (> 57%) victims belonged to lower class of socioeconomic status.

Table 10: Education wise distribution of cases

EDUCATION	N	%
ILLITRATE	16	23.5
PRIMARY	11	16.1
UPPER PRIMARY	16	23.5
LOWER SECONDARY	12	17.6
HIGHER SECONDARY	7	10.2
POST SECONDARY	4	5.9
NA	2	2.9
TOTAL	68	100

2 victims were below the age of schooling

Among the study group, 23% of the subjects were illiterate and 77% were literates of which 39% had primary education, 27% had secondary education and 5% were above secondary education.

Table 11: Region wise distribution of cases

REGION	N	%
URBAN	6	8.8
RURAL	62	91.2
TOTAL	68	100

91 % (62 out of 68) victims belonged to rural area, and only 9% victims belonged to urban area.

Table 12: Distribution of cases according to time of incident

TIME OF BITE	N	%
0 TO 06 HRS	9	13.2
06 TO 12 HRS	15	22.0
12 TO 18 HRS	19	27.9
18 TO 24 HRS	25	36.7
TOTAL	68	100

Maximum bites 65% were between 12 noon to 12 midnight

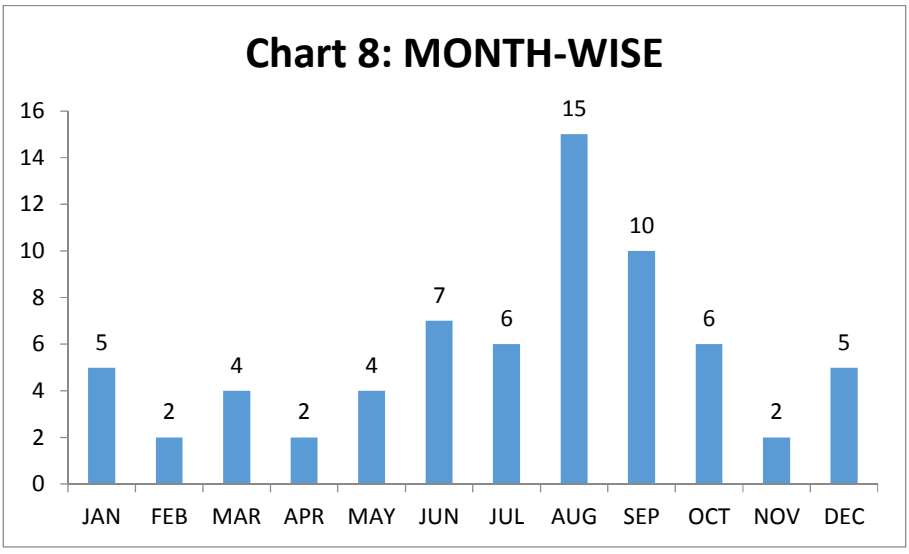
Table 13: Distribution of cases based on Place of occurrence of the incident

PLACE	N	%
FIELDS	46	67.6
HOUSE	13	19.1
ROAD	6	8.8
CATTLE SHELTER	3	4.4
TOTAL	68	100

46 of 68 (>65%) snakebites were occurred while working at fields.

Table 14: Distribution of cases based on month-wise

MONTH	N	%
JAN	5	7.4
FEB	2	2.9
MAR	4	5.9
APR	2	2.9
MAY	4	5.9
JUN	7	10.2
JUL	6	8.8
AUG	15	22.0
SEP	10	14.7
OCT	6	8.8
NOV	2	2.9
DEC	5	7.3
TOTAL	68	100



Maximum bites occurred on the month of august (22%) followed by September (14%).

Table 15: Distribution of cases according to site of bite

SITE	N	%
FOOT	38	55.9
LEG	7	10.3
HANDS	19	27.9
ARM	1	1.5
INFRASCAPULAR	1	1.5
AXILLA	1	1.5
FLANK	1	1.5
TOTAL	68	100

Of the 68 cases, 38 cases had bites on foot accounting to 55%, followed by bites on hands in 19 cases accounting to 27%. No bites were recorded on head, face and thighs.

Table 16: Distribution of cases based on victim's knowledge of First aid to be given

KNOWLEDGE OF FIRSTAID	N	%
NIL	7	10.3
PARTIAL	5	7.3
WRONG INFORMATION	56	82.4
TOTAL	68	100

82 % of victims were having wrong information, 7 % were having partial information and 10% were denied of having any information about knowledge of first aid for snakebite.

Table 17: Distribution of cases based on First aid given

FIRST AID	N	%
YES	23	33.8
NO	45	66.2
TOTAL	68	100

Out of 68, 45 were not given first aid and 23 were provided with first aid.

Table 18: Distribution of cases based on First aid given by

FIRSTAID GIVEN BY	N	%
TRAINED	10	43.5
UNTRAINED	13	56.5
TOTAL	23	100

Out of 23 who were provided first aid, 10 by trained medical personnel and 13 by untrained personnel.

Table 19: Distribution of cases based on type of First aid given

TYPE OF FIRST AID	N	%
TOURNIQUET	8	34.8
TETANUS TOXOID	7	30.4
TOURNIQUET AND IMMOBILISATION	5	21.7
IMMOBILISATION AND TETANUS TOXOID	3	13.0
TOTAL	23	100

Out of 23 who were provided first aid, 8 patients were tied tourniquet above the bite site, and 7 were given tetanus toxoid injection.

Table 20: Distribution of cases based on First approach of patient

BITE VICTIM FIRST TAKEN TO	N	%
PHC	14	20.6
CHC	9	13.2
SECONDARY/TERTIARY	19	27.9
PRIVATE HOSPITAL	4	5.9
QUACK	22	32.4
TOTAL	68	100

22 snakebite victims were first taken to quacks, 19 snakebite victims were taken to secondary or tertiary centres.

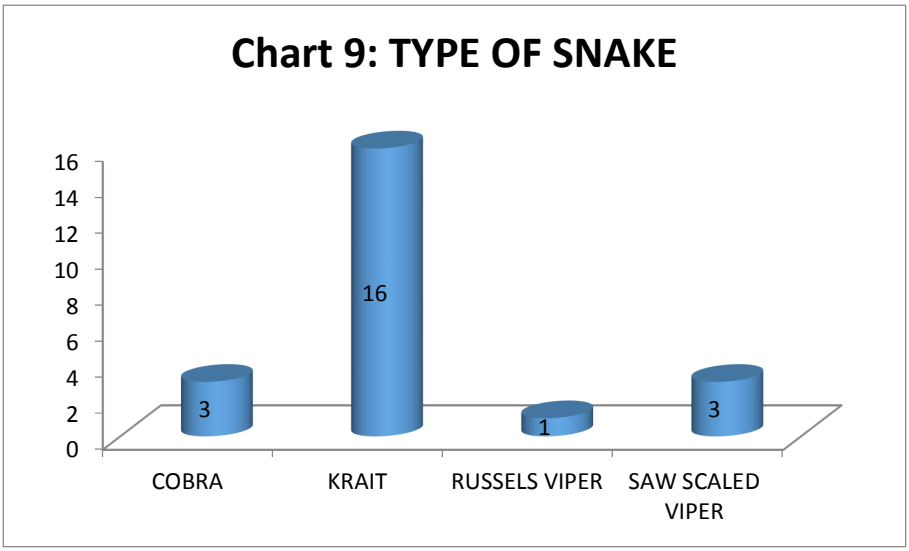
Table 21: Distribution of cases based on reason for delay to approach hospital

REASON FOR DELAY	N	%
TREATMENT BY QUACK	20	60.6
LACK OF TRANSPORTATION	13	39.4
TOTAL	33	100

Among 33 snakebite victims who reached with a delay of 2 hours to hospital after snakebite gave reason of delay due to treatment by quacks (61%) and lack of transportation (39%)

Table 22: Distribution of cases based on type of snake

TYPE OF SNAKE	N	%
COBRA	3	13.0
KRAIT	16	69.6
RUSSELS VIPER	1	4.3
SAW SCALED VIPER	3	13.1
TOTAL	23	100



Among the snakes identified(23 cases) snakebite due to krait was maximum of 70% followed by cobra and saw scaled viper each 13% and only one snakebite was due to Russels viper.

Table 23: Distribution of cases based on ASV

ASV	N	%
NOT GIVEN	8	11.8
GIVEN	60	88.2
TOTAL	68	100

Among 68 cases ASV was given in 88% cases and 8 were not given ASV as they included those who approached hospital very late and those who were not having envenomation symptoms.

Table 24: Distribution of cases based on amount of ASV given

AMOUNT OF ASV	N	%
0 TO 10 vials	5	8.3
10 TO 20 vials	50	83.4
>20 vials	5	8.3
TOTAL	60	100

Of the 60 cases who received ASV 83% needed 10 -20 vials.

Table 25: Distribution of cases based on type of envenomation

TYPE OF ENVENOMATION	N	%
HAEMOTOXIC	18	26.5
NEUROTOXIC	38	55.9
NON VENOMOUS	12	17.6
TOTAL	68	100

Among 68 cases 38 were neurotoxic, 18 were haemotoxic and 12 were non venomous.

Table 26: Distribution of cases based on number of days of hospitalization of patients.

DAYS OF HOSPITALISATION	N	%
0-5 days	44	64.7
5-10 days	18	26.5
10-15 days	5	7.3
>15 days	1	1.5
TOTAL	68	100

64% of the snakebite victims needed hospital stay for <5 days, 26% needed 5-10 days and only one patient needed stay for more than 15 days.

Table 27: Distribution of cases based on number of days of admission in ICU of patients.

DAYS IN ICU	N	%
NO ICU ADMISSION	14	20.6
0 TO 4 DAYS	45	66.2
4 TO 8 DAYS	7	10.3
> 8 DAYS	2	2.9
TOTAL	68	100

Out of 68 cases 54 needed ICU admission, out of them 45 needed ICU care for < 4 days.

Table 28: Distribution of cases based on outcome of patients.

OUTCOME	N	%
AGAINST MEDICAL ADVICE	16	23.5
IMPROVED	46	67.7
EXPIRED	6	8.8
TOTAL	68	100

Out of 68 cases 6 cases expired, and 46 cases improved and discharged and 16 went against medical advice.

Table 29: Distribution of cases based on immobilisation of patients.

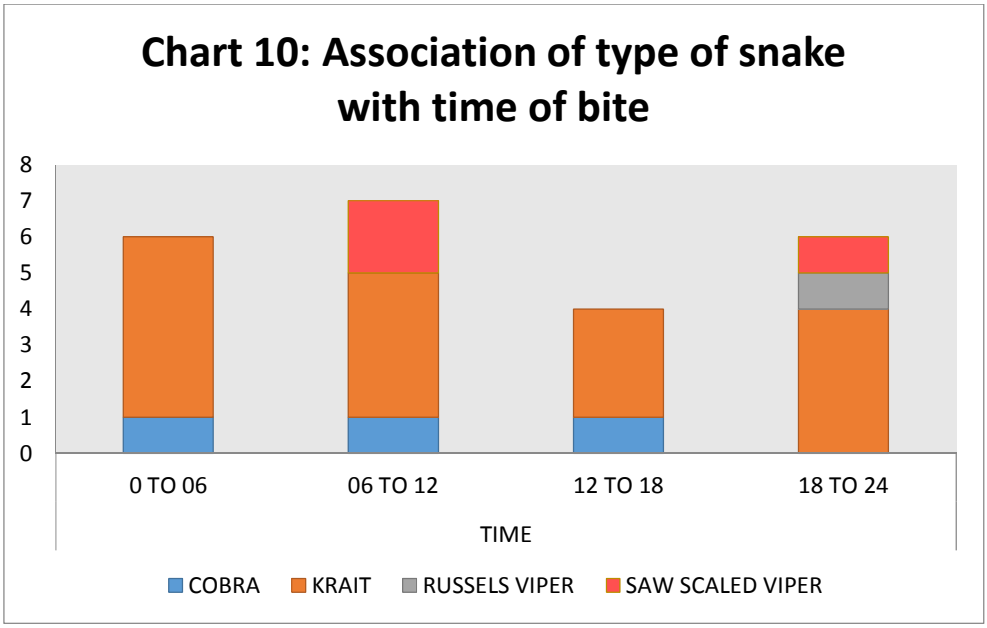
IMMOBILISATION	N	%
YES	8	11.8
NO	60	88.2
TOTAL	68	100

Immobilisation of snakebite victim was done in 8 cases.

Table 30: Association of type of snake with time of snakebite

	TIME			
TYPE	**0 TO 06**	**06 TO 12**	**12 TO 18**	**18 TO 24**
COBRA	1	1	1	0
KRAIT	5	4	3	4
RUSSELS VIPER	0	0	0	1
SAW SCALED VIPER	0	2	0	1

X2=7.125 P=0.674 Not Significant

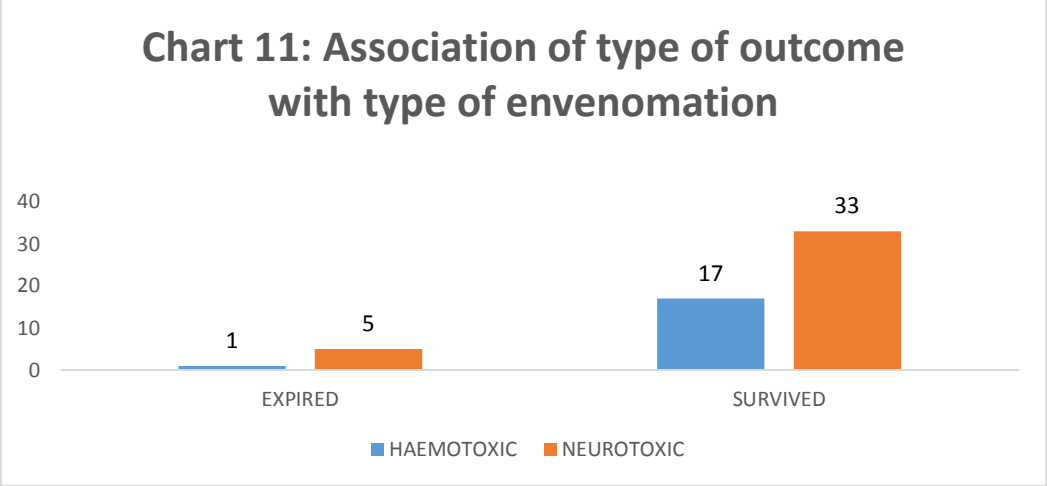


There is no statistically significant association of time of occurrence of cases with type of snake.

Table 31: Association of type of outcome with type of envenomation

TYPE OF ENVENOMATION	EXPIRED	SURVIVED
HAEMOTOXIC	1	17
NEUROTOXIC	5	33

X2=0.7379 P=0.3903 Not Significant



There is no statistically significant association of outcome of cases with type of envenommation

Table 32: Association of mortality with type of snake

	MORTALITY	
TYPE	**EXPIRED**	**SURVIVED**
COBRA	1	2
KRAIT	4	12
RUSSELS VIPER	1	0
SAW SCALED VIPER	0	3

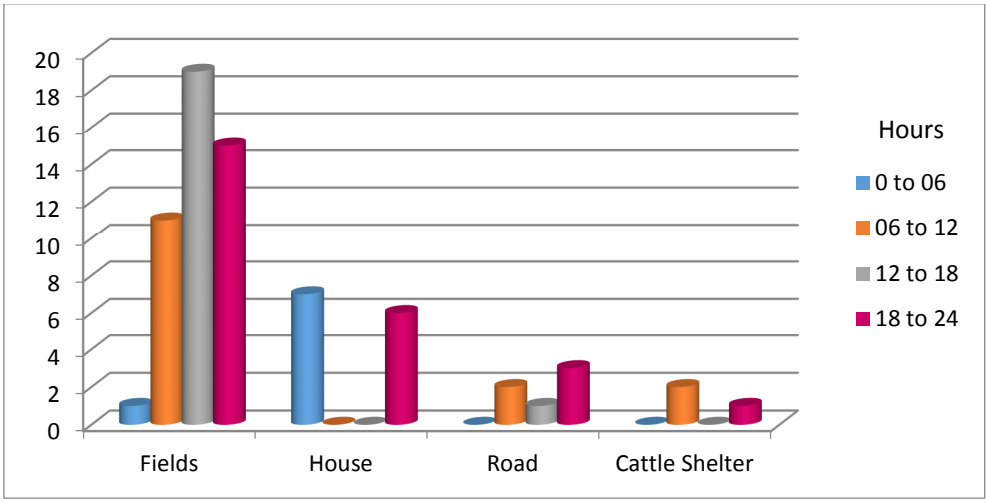
X2=3.984 P=0.2632 Not Significant

There is no statistically significant association of outcome of cases with type of snake.

Table 33: Association of place of occurrence with time of snakebite

	TIME IN HOURS			
PLACE	**0 TO 06**	**06 TO 12**	**12 TO 18**	**18 TO 24**
FIELDS	1	11	19	15
HOUSE	7	0	0	6
ROAD	0	2	1	3
CATTLE SHELTER	0	2	0	1

X2=38.287 P<0.0001 Highly Significant



There is a high significance of occurrence of snakebite in fields with association of time of snakebite

Table 34: Distribution of cases based on Symptoms

SYMPTOMS	N	%
NO SYMPTOMS	14	20.6
FRIGHT	4	5.9
FROTHING	4	5.9
PAIN ABDOMEN	6	8.8
DIFFICULTY IN BREATHING	4	5.9
BODY ACHE	13	19.1
PAIN AT BITE SITE	17	25
VOMITING	11	16.1
WEAKNESS	10	14.7

20% victims had no symptoms. Most common symptom was pain at the site of snakebite.

Table 35: Distribution of cases based on local manifestations

LOCAL MANIFESTATION	N	%
NO LOCAL SIGNS	15	22.0
FANG MARK	25	36.8
SWELLING	6	8.8
SWELLING & DISCOLOURATION	8	11.8
SWELLING & OOZING	2	2.9
SWELLING & CELLULITIS	1	1.4
FANG MARK & SWELLING	2	2.9
FANG MARK, DISCOLOURATION & OOZING	1	1.5
FANG MARK, DISCOLOURATION & SWELLING	2	2.9
FANG MARK CELLULITIS & SWELLING	1	1.4
FANG MARK OOZING & SWELLING	3	4.4
SWELLING, CELLULITIS, DISCOLOURATION & BLISTERS	1	1.5
FANG MARK, SWELLING, CELLULITIS, DISCOLOURATION & BLISTERS	1	1.5

Number one local manifestation victims presented was fang mark, but only in 36% of cases, and in 22% of cases there were no local signs.

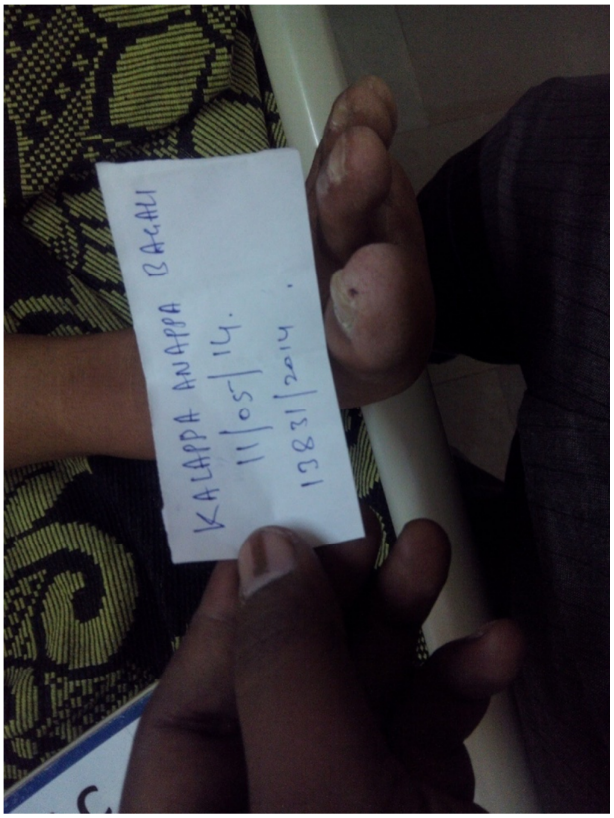
Table 36: Distribution of cases based on systemic manifestations

SYSTEMIC MANIFESTATIONS	N	%
NIL	26	38.2
DYSPNOEA	13	19.1
TACHYCARDIA	4	5.9
PTOSIS	25	36.8
DYSPHAGIA	6	8.8
DIFFICULTY IN SPEECH	9	13.2
WEAKNESS OF LIMBS	8	11.8
BLEEDING GUMS	3	4.4
HEMATURIA	13	19.1
MALENA	1	1.5
HEMATEMESIS	4	5.9
OLIGURIA	3	4.4
ANURIA	1	1.5

38% of victims had no systemic manifestations, 36 % presented with ptosis, and 19 % presented with haematuria.

PHOTOGRAPHS

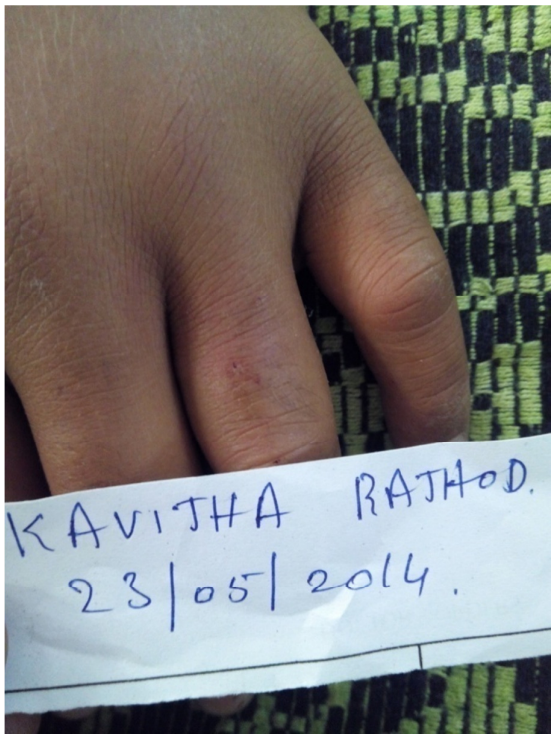
Photograph 5.Fang mark over left ankle with oozing of blood



Photograph 6.Fang mark over left great toe

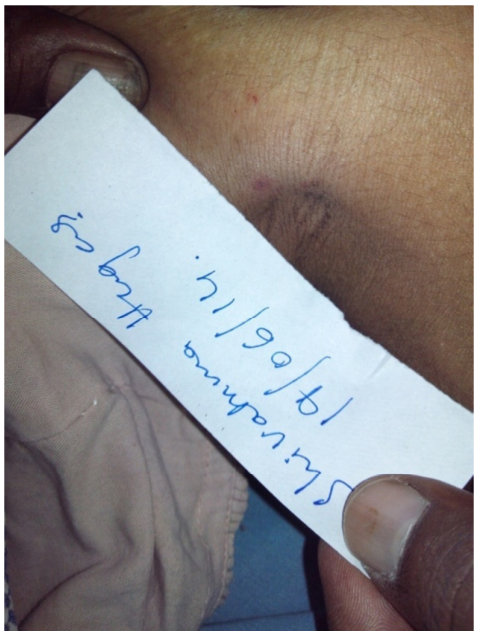
Photograph 7.Common krait snake bought by patient attenders

Photograph 8.Fang mark over right flank area with discoloration and swelling.



Photograph 9.Fangmark over dorsal aspect of left ring finger with swelling

Photograph 10.Fang mark over medial aspect of right foot with swelling



Photograph 11.Fang mark over lateral aspect of left knee

Photograph 12.Fang mark over right infrascapular area with discolouration and blister

DISCUSSION

Age

In the present study, maximum victims 69% belonged to 20 – 50 yrs age group. Maximum were between the age group of 20-30 years, (26%) followed by age group of 30-40 years(22%) and age group of 40-50 years(21%), Snakebite victims belonging to extremes of age groups (0-10 years and >60 years) were minimum of only 10%.

Similar observations were made in studies conducted by Ganneru B &Sasidhar RB[18] in Andra pradesh and Nuchhi U Cetal[22] in Gulbarga. The probable reason for predominance of 20-50 yrs age group is they constitute most active and major working force among these individuals.

Gender

Males were predominant 69% as compared to females 31%, with male to female ratio of 2.2:1.

Similar observations were made in studies conducted by Kulkarni ML &Anees S [13] in Karnataka, Ganneru B & Sasidhar RB[18] in Andra Pradesh, Lal P et al[14] in JIPMER Hospital Pondicherry, Nuchhi U C et al[22]in Gulbarga and Shetty AK &Jirli SP[24].

This observation is not consistent with the findings recorded in the study conducted by Monterio NP et al[23] in Manipal, where female predominance was recorded with male to female ratio of 1:1.5.

The probable reason for predominance in males is increased agricultural activity among these individuals.

Occupation

In present study, maximum victims 63% were farmers and daily laborers by occupation.

The above observations made in the study are consistent with the studies conducted by Lal P et al[14] in JIPMER Hospital Pondicherry, Nuchhi U C et al[22]in Gulbarga and Shetty AK &Jirli SP[24] in Belgaum.

The predominance of farmers can be attributed to increased frequency of human confrontation with snakes in agricultural fields owing to the snakes habits, habitat and prey preferences.

Socioeconomic status

57% of the victims belonged to lower class of socioeconomic status, probable reason for this can be most of them were farmers and daily laborers by occupation.

There was no published literature in relation with socio economic status of snakebite victims to compare with our findings.

Education

In this study, 2 victims were below the age group of schooling, hence among rest 66 cases 24 % were illiterates and 76% were literates having different levels of education. Majority 41% had primary education followed by 29% had secondary education and 6% were graduates. There was no published literature in relation with education status of snakebite victims to compare with our findings. The above observation depicts that victims with non-technical (unskilled) knowledge are more involved in agricultural works, hence more exposed to snakebites. The low literacy level also leads to lack of knowledge regarding precautions to be taken to avoid snakebites.

Region

In our study, maximum victims 91% belonged to rural region. This finding is consistent with the observations in the studies made by Kulkarni ML &Anees S[13]in Karnataka, Nuchhi UC et al[22]in Gulbarga and Shetty AK &Jirli SP[24]in Belgaum and Mohapatra et al[26] in India.

Place of occurrence

In this study, maximum victims 68% had snakebites in the fields followed by 19% snakebites at home. Similar finding was noted in the study conducted by Kulkarni ML &Anees S[13] in Karnataka,

Time of occurrence

In this study, Maximum snakebites 65% were between 12 noon to 12 midnight of which, 37% of snakebites occurred between 18.00 hrs to 24.00 hrs followed by 28% between 12.00 hrs to 18.00 hrs. There was no published literature in relation with time of bite in snakebite victims to compare with our findings.

Relationship between Place of occurrence and Time of occurrence of the incident

In this study an effort was made to correlate the place of occurrence and the time of occurrence. Of the 46 snakebites that occurred in the field, maximum 65% occurred during 06.00 hrs to 18.00 hrs. Of the 13 snakebites that occurred at home, all snakebites occurred during 18.00 hrs to 06.00 hrs. There is statistically high significance of snakebites occurring in fields during day hours and snakebites occurring at home during night hours.

Site of bite

In the present study, majority of the victims 45.3% had snakebites on foot followed by snakebites on hands in 22.7%. No snakebites were noted on head, trunk and thighs. This observation is consistent with the studies conducted by Kulkarni ML

&Anees S[13]in Karnataka, Nuchhi UC et al[22] in Gulbarga and Shetty AK &Jirli SP[24] in Belgaum and Bawaskar HS et al[19] in rural Maharashtra.

The above observation is not consistent with that made by Monteiro NP et al[23] where upper limb was the most common site of bite.

Seasonal variations in the incidence of snakebite

In this study, maximum snakebites 56% occurred during June to September (monsoon season) followed by 26% during October to January (winter season).

Similar observations were made in the study conducted by Lal P et al[14] in JIPMER Hospital Pondicherry, Bawaskar HS[15] in Mahad region of Maharashtra, Bawaskar HS et al[19] in rural Maharashtra, Shetty AK &Jirli SP[24] in Belgaum and Mohapatra B et al[26] in India.

Whitekar R[17] in his study conducted in Kerala, observed that the month of May had highest incidence of snakebite. However in our study, the highest incidence of snakebite was in the month of August 22 %.

Knowledge regarding First aid

First aid to be given in snakebite victims has a major influence on the outcome. Correct First aid such as reassurance, masterly immobility and immediate shifting of the patient to health care centers are important to decrease the mortality and morbidity in snakebite cases.

In this study, the victim's knowledge regarding the First aid to be given was assessed. Unfortunately, 82 % of victims had wrong information regarding First aid in the form of approaching quacks for medication, sucking out venom from bite site tourniquet application, stone application to bite site etc. only 7% had partial information and 10% had no idea of first aid in snakebite victims. There was no

published literature in relation with knowledge regarding first-aid of snakebite victims to compare with our findings.

First Aid

Of the 68 victims, first aid was given in 23 cases (34%). Among these who received first aid, the same was given by untrained people (the victim himself, bystanders, co-workers and or quacks) in 57% victims. This observation is not consistent with the findings recorded in the study conducted by Kulkarni ML &Anees S[13]in Karnataka where only 12% were provided with first aid. This shows only a little increase in awareness about importance of first aid in snakebite victims.

First approach of the victim

In our study of 68 cases 22(32%) were taken to quacks first, and 46(68%) were taken to medical setup, this suggests even in this era of evidence based medicine people are approaching quacks, this may be due to lack of awareness in health care and non-availability of qualified medical personal in rural areas. There was no published literature in relation with first approach of snakebite victims to compare with our findings.

Reason for delay in approaching health care setup

Among 33 snakebite victims who reached with a delay (2 hours to hospital after snakebite) gave reason of delay due to treatment by quacks (61%) and lack of transportation (39%). There was no published literature in relation with socio reason for delay in approaching health care setup of snakebite victims to compare with our findings.

Type of snake

Coloured photographs of the 'big four' snakes were shown to the victims and asked to identify the snake. Among the snakes identified (23 cases) snakebite due to krait was maximum of (16 cases)70% followed by cobra and saw scaled viper each (3 cases)13% and only one snakebite was due to Russels viper.

Association of type of snake with time of bite

Of the 68 victims, only 23 victims saw the snake that bit them. Of these 23 cases, there was no statistical significance of type of snake with time of bite with P value of 0.674

ASV

Among 68 cases ASV was given in 88% cases, of the 60 cases who received ASV 83% needed 10 -20 vials. Average amount of ASV given was 14.3 vials. No allergic reactions were seen in all the cases administered with ASV

Type of envenomation

Among 68 cases 38 were neurotoxic, 18 were haemotoxic and 12 were non venomous.

Number of days of hospitalization and ICU care

64% of the snakebite victims needed hospital stay for <5 days, 26% needed 5-10 days and only one patient needed stay for more than 15 days. Mean duration of hospital stay is 4.6 days.

This observation is similar to that conducted by Chauhan S et al[16] in PGIMER Hospital Chandigarh. Mean duration of Hospital stay was less in the study conducted by Lal P et al[14] in JIPMER Hospital Pondicherry as compared to this study.

Out of 68 cases 54 needed ICU admission, out of them 45 needed ICU care for < 4 days. Mean duration of ICU care is 2.3 days

Clinical manifestations

Symptoms

Among the 68 cases, the most common presenting symptom was pain at local site constituting 25% followed by body ache which constituted 19%.but this observation is of less importance as some snakebites are painless like in cases of krait bites.

In our study, the pain abdomen was seen in 9% cases and vomiting in 16% cases This observation is not consistent with the study conducted by Singh J et al[21] in North Indian Military Hospital where pain abdomen 91% and vomiting 62% were seen most commonly.

Local signs

Of the 68 victims, fang marks were seen in 36%, but no local signs were seen in 22% of cases.

The above observation emphasizes that fang marks are not a consistent finding in all the cases of snakebite. A snakebite patient can present with other local signs without fang marks or there can be no local signs at all.

Similar observations were noted in the study conducted by Bawaskar HS et al[19] in rural Maharashtra and Monterio NP et al[23] in Manipal.

Systemic manifestations

In this study, of the 68 cases, maximum cases presented with neurotoxic signs and symptoms such as ptosis which constituted 36% followed by haematuria and

dyspnoea which constituted 19 % each. Similar observation of manifestations were noted in the study conducted by Singh J et al[21] in North Indian Military Hospital.

Outcome

68% of the snakebite victims improved, 23% went against medical advice and 9% was the mortality in our study. Similar observation was made in study conducted by Lal P et al[14] in JIPMER Hospital Pondicherry and Bawaskar HS[15] in Mahad region Maharahtra.

Type of envenomation and outcome

Among 68 cases 38 were neurotoxic, of which mortality rate was 13% (5 0f 38 cases) and 18 were haemotoxic of which mortality rate is 5%(1 out of 18 cases) and there was no statistical significance in association of type of outcome with type of envenomation with P value 0.3903.

Similar observation was made in the study conducted by Bawaskar HS[15] in Mahad region Maharashtra and Singh J et al[21] in North Indian Military Hospital.

Whereas, haemotoxic envenomation was more in the studies conducted by Kulkarni ML &Anees S[13] in Karnataka and Bawaskar HS et al[19] in rural Maharashtra.

Limitation of the study

1. Incidence of snakebite of our study region cannot be determined by this study due to following reasons.

    a. Cases those consulted doctors practicing other medicinal systems (Homeopathy, Ayurveda) and in other hospitals were not recorded.
    b. Victims having non-venomous snakebite or dry bites by venomous snakes those visited quacks, traditional healers and did not resort to modern medicine were also not recorded.

SUMMARY

The study was a hospital based prospective study conducted for duration of one year from 1st january 2014 to 31st december 2014. The subjects for the study comprised all of 68 patients of snakebite admitted to Shri B M Patil medical College, Hospital and Research center.

The objectives of the study is to know the Socio-demographic profile of snakebite victims, to know the first aid methods practiced and type of snake species prevalent in this region and the morbidity and mortality due to snakebite.

Observations noted in the study are:

In the present study maximum 69% (47 of 68) victims belonged to age group of 20-50 years.

Maximum number of victims 69 % were males. The male to female ratio was 2.2:1.

Farmers and daily laborers were most common victims to snakebites 63%.

Maximum victims 57 % belonged to lower class.

Maximum number of victims 91 % were from rural region.

Of the 68 cases, 38 cases had snakebites on foot accounting to 55%, followed by snakebites on hands in 19 cases accounting to 27%. No snakebites were recorded on head, face and thighs.

Out of 68, 45 were not given first aid and 23 were provided with first aid.

82 % of victims were having wrong information, 7 % were having partial information and 10% were denied of having any information about knowledge of first aid for snakebite.

Out of 23 who were provided first aid, 10 by trained medical personnel and 13 by untrained personnel.

32 % snakebite victims were first taken to quacks, 68% snakebite victims were taken to health care setup.

Among the snakes identified (23 cases) snakebite due to krait was maximum of 70% followed by cobra and saw scaled viper each 13% and only one snakebite was due to Russels viper.

Maximum 56% of snakebites occurred during June to September (monsoon season).

Of the 46 snakebites that occurred in the field, maximum 65% occurred during 06.00 hrs to 18.00 hrs. Of the 13 snakebites that occurred at home, all snakebites occurred during 18.00 hrs to 06.00 hrs. There is statistically high significance of snakebites occurring in fields during day hours and snakebites occurring at home during night hours.

64% of the snakebite victims needed hospital stay for <5 days, Mean duration of hospital stay is 4.6 days.

9% was the mortality rate in our study.

CONCLUSION

This study included snakebite cases admitted to Shri B M Patil Medical college, Hospital and Research Center Vijayapur city. In this part of world people are mostly into agricultural occupation and coming in contact with snakes is a natural scenario. The above study clearly showed that snakebites were more common in rural adult males were more prone to snakebites as they are more commonly involved in agricultural activities. 9 % mortality was observed which is considerably high when compared to other studies.

Lack of transportation facilities, lack of easy accessibility to health care centers, more faith in traditional treatments, unaffordable cost of ASV, lack of knowledge about ancillary treatment modalities in snakebites among the medical faculty are the reasons observed for high mortality in this study. Incidence and mortality due to snakebite can be prevented by following simple precautionary measures like keeping the surrounding of the house premises clean, avoiding children play in between woods or leafy areas, avoid walking in areas of tall grass, do not disturb snakes intentionally, etc. Education of the rural population about the snake species prevalent in the respective regions, their habits and public health education regarding the recommended first aid could reduce the incidence of snakebite among rural population.

Training of medical faculty about correct methods of management of snakebite cases can be under taken. Prompt hospitalization and specific treatment and prior first aid measures may be responsible for preventing systemic envenomation and reducing the mortality. As neurotoxic envenomation was seen more commonly in this region, emphasis on management of patients with respiratory failure should be done

such as assisted with ambu bag or mechanical ventilators without administration of ASV. Strengthening of snakebite surveillance throughout the nation gives us an accurate perception of the magnitude of the problem which would help in framing the snakebite control programmes.

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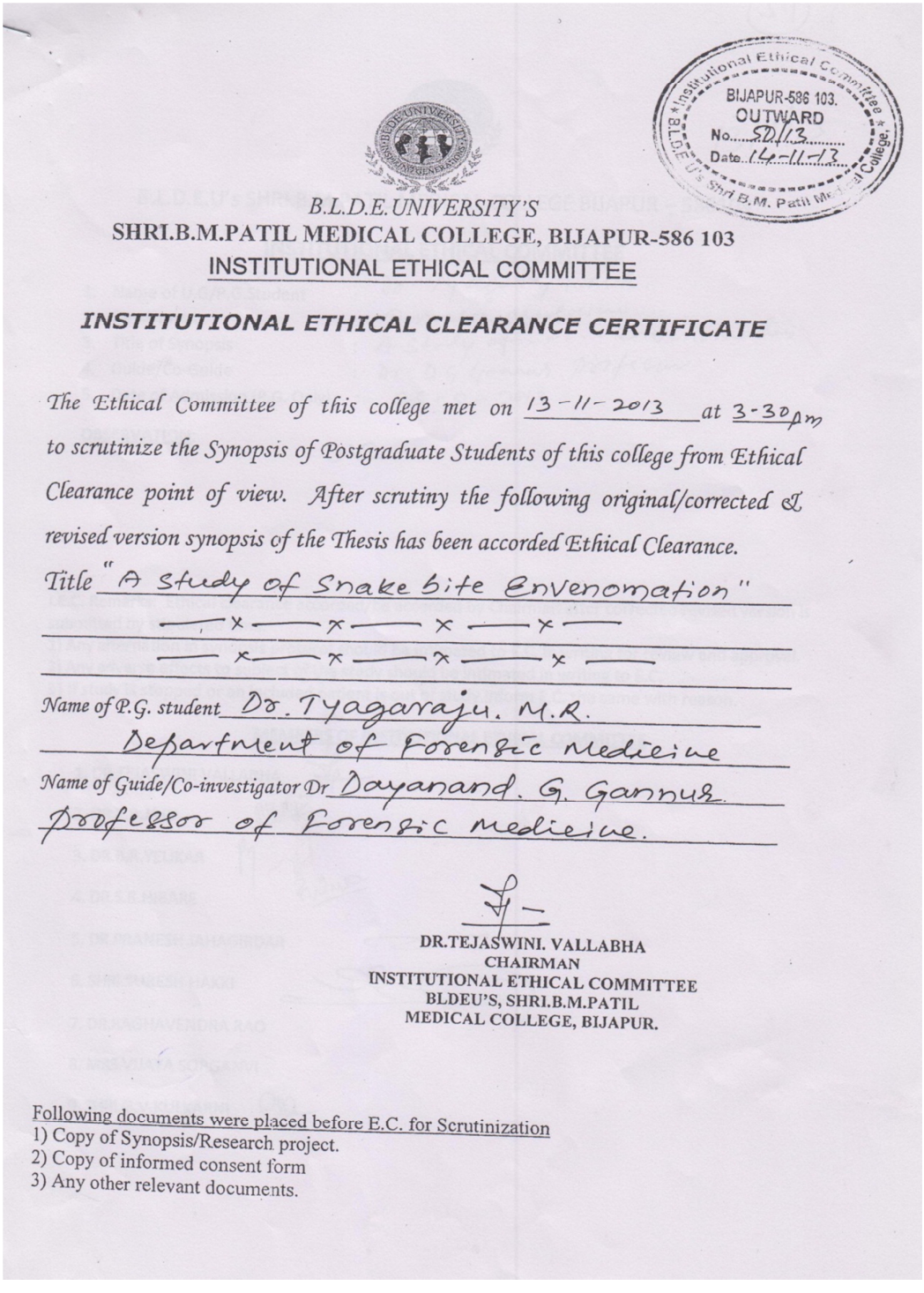
ANNEXURES



Institutional Ethical Committee
BIJAPUR-586 103.
OUTWARD
No. 50/13
Date 14-11-13
B.L.D.E.U's Shri B.M. Patil Medical College,

B.L.D.E. UNIVERSITY'S
SHRI.B.M.PATIL MEDICAL COLLEGE, BIJAPUR-586 103
INSTITUTIONAL ETHICAL COMMITTEE

INSTITUTIONAL ETHICAL CLEARANCE CERTIFICATE

The Ethical Committee of this college met on 13-11-2013 at 3-30pm to scrutinize the Synopsis of Postgraduate Students of this college from Ethical Clearance point of view. After scrutiny the following original/corrected & revised version synopsis of the Thesis has been accorded Ethical Clearance.

Title "A Study of Snake bite Envenomation"

—x—x—x—x—

—x—x—x—x—

Name of P.G. student Dr. Tyagaraju. M.R.

Department of Forensic Medicine

Name of Guide/Co-investigator Dr Dayanand. G. Gannur

Professor of Forensic Medicine.

DR.TEJASWINI. VALLABHA
CHAIRMAN
INSTITUTIONAL ETHICAL COMMITTEE
BLDEU'S, SHRI.B.M.PATIL
MEDICAL COLLEGE, BIJAPUR.

Following documents were placed before E.C. for Scrutinization
1) Copy of Synopsis/Research project.
2) Copy of informed consent form
3) Any other relevant documents.

INFORMED CONSENT FORM

I undersigned ……..aged …….years R/O……..……..…….. on this day……..…… at ……..……. am/pm on date / / do hereby voluntarily state that Dr.Tyagaraju.M.R, postgraduate in department of forensic medicine and toxicology, BLDEU's Shri B M Patil Medical College Hospital and Research centre, bijapur-586103, has informed me that he is doing a dissertation Study "A STUDY OF SNAKE BITE ENVENOMATION" for which complete details of history with complete examination is necessary. It is further informed to me that such an examination will be done in concurrence with life-saving medical measures. I have learnt that by volunteering in the study there is no harm to me.

The above study is being undertaken to save the life of mankind in snakebites. Hence under my/our full senses I/we agree to participate in the study and we know that the data collection and photograph taken is for dissertation purpose only.

Signature of subject……

Signature of investigator……..

Place:

Date:

CLINICAL PROFORMA

Name :

Age :

Sex :

Address :

Time and date of admission :

Time and date of discharge :

OPD/IPD NO :

Ward :

Education :

Occupation :

Marital status :

Socioeconomic status :

Religion :

Alleged h/o case :

- Time
- Date
- Place
- Type of snake
- Site of bite

First aid :

Primary treatment taken at :

Examination done at : : am/pm on / /

Symptoms started at :

Signs appreciated at :

Identification marks 1]

2]

General physical examination:

Local examination :

- Fang mark

Systemic examination :

Amount of ASV used :

ASV given :……..hours after snakebite

Duration of stay in Hospital :

Duration of stay in ICU :

Outcome of the patient :

Other details :

Follow up notes :

KEY FOR MASTER CHART

Yrs -Years
N -Number
AG -Agriculture
DL -Daily Labours
HW -Housewife
ST -Students
UC -Upper Class
UM -Upper Middle Class
MC -Middle Class
LM -Lower Middle Class
LC -Lower Class
NA -Not Applicable
IL -Illiterate
U -Urban
R -Rural
Hrs -Hours
FLD -Fields
HOU -House
RD -Road
CSH -Cattle Shelter
FT -Foot
LG -Leg
HN -Hand
IS -Infrascapular
AX -Axilla
FL -Flank
PI -Partial Information
WI -Wrong Information

TR -Trained
UTR -Untrained
TRQ -Tourniquet
TT -Tetanus Toxoid
IMB -Immobilisation
PHC -Primary Health Centre
CHC -Community Health Center
SEC - Secondary Health Center
TRI -Tertiary Health Center
PR - Private Hospital
QUK -Quacks
RXQ - treatment by Quack
LOT -Lack of Transportation
CB -Cobra
KR -Krait
RV -Russell's Viper
SSV -Saw Scaled Viper
NG -Not Given
G -Given
H -Haemotoxic
N -Neurotoxic
NV -Non venomous
DAMA- Discharge Against Medical Advice
IMP -Improved
EXP -Expired
S -Seen
NS -Not Seen