Original Paper

Snake Envenomation: A Hospital-based Survey from Thiruvananthapuram, Kerala

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ABSTRACT

Objective: Analysis of the frequency of occurrence of different symptoms and complications in snakebite cases from a part of Kerala (Thiruvananthapuram), and to understand the demographic pattern of those cases.

Method: Retrospective analysis of all venomous snakebite cases (108 cases) admitted in Government Medical College, Thiruvananthapuram, during the year 2004, by scrutiny of hospital case sheets.

Results: Maximum number of paediatric cases were from the age group 7-9 years (52%). In adults, the most affected age group was 35-44 years (26%). Slight male preponderance was seen (59.3%). The time of bite was usually between 1700 hrs and 2000 hrs (49.1% cases). Time delay in seeking treatment was only up to 2 hours in 59.2% cases. The duration of stay in hospital was 1-4 days in 53.7% cases.

The species of the snake could not be identified in 54.6%, identified as viper in 35.2%, as cobra in 6.5%, and as krait in 3.7% cases. Bite mark could be located in 67.6% of victims. Severe form of local reaction with blistering and ulceration were seen in 13.9% and lymph node enlargement in 8.3% cases. Haematological symptoms were evident in 54.6%, nervous system involvement in 6.5% and both together in 9.3% cases. Cardiovascular system complications (toxic myocarditis, ventricular ectopics and neurogenic hypertension) were observed in 1 case, hypotension in 15%, and bradycardia in 1.8% cases.

Death occurred in 4.9% of older age group, and 11.1% in paediatric group, together constituting a frequency of 6.5%.

Key Words: Snakebite; Envenomation; Anti-snake venom

Introduction

Snakebite is an important public health problem in many countries, but agricultural and tropical regions report more snakebites than anywhere else. Since reporting is not mandatory, many snakebites go unreported. Consequently, no accurate study has ever been possible to determine the frequency of snakebites on a global level. However, some estimates put the number at 2.5 million bites, resulting in perhaps 125,000 deaths. While USA records 6,000 to 8,000 venomous bites per year, with mortality ranging from 5 to 15 deaths, India records about 200,000 bites, of which nearly 15,000 end in death![1,2]

Among the various states in India, Maharashtra records a high incidence of snakebite: more than 1000 bites per year. Other states with high incidence include West Bengal, Uttar Pradesh, Tamil Nadu and Kerala. According to some reports, most of the bites (almost two thirds) are due to vipers, and only a small number by common cobra, common krait, etc.[3]

The main purpose of this study was to determine the frequency of occurrence of such cases in a part of Kerala state, and to analyse the symptomatology and severity of poisoning.

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Materials and Methods

A retrospective analysis was done of all cases of venomous snakebites admitted in the Government Medical College Hospital, Thiruvananthapuram (Kerala), during the year 2004. The cases were located through the coding system of Medical Records Library of the hospital. A total of 108 cases were identified for the year 2004, consisting of 27 cases from the paediatric wards and 81 cases from other medical wards. The severity of envenomation was analyzed both qualitatively and quantitatively by using a modified version of the classification suggested by Reid[4]:

A - Nil (No local or general reaction)
B - Mild (Mild local reaction without systemic effects)
C - Moderate (Extreme local reaction with some systemic effects)
D - Severe (Severe systemic effects)
E - Fatality

The data were statistically analysed using the software SPSS.

Results

There was a slight male preponderance with 59.3% victims being male. Paediatric cases up to the age of 12 years were analysed separately with regard to age distribution, and it was found that the 7-9 year group was the most frequently affected (51.9%), followed by 4-6 year and 10-12 year groups (18.5% each), while children between the ages of 1-3 years accounted for 11.1% of paediatric cases. Of the age groups beyond 13 years, the maximum frequency was observed in the age group 35-44 years (25.9%) (**Table 1**). The youngest victim was 2 years old, while the oldest was 70 years.

Many cases of snakebite occurred between 1700 hours (5 PM) and 2000 hours (8 PM) (49.1%) (**Fig 1**). In 59.3 % of cases, the victim reached the hospital within 2 hours of the bite, while 29.6% could do so within 3-5 hours, and 5.6% within 6-8 hours. A few (4.6%) took 12 hours or more to reach a hospital. Average time taken for seeking treatment was 4.37 hours. The total duration of stay in the hospital was 1-4 days in 53.7% cases, and 5-8 days in 30.6%. A very small percentage (1.9%) had to remain in the hospital for more than 20 days. Mean duration of stay in the hospital was 5.22 days.

Table 1 Distribution of Non-paediatric Victims as per Age

Age group (yrs)	**No.**	**%**
15-24	18	22.2
25-34	18	22.2
35-44	21	25.9
45-54	10	12.3
55-64	11	13.6
65-74	3	3.7
Total	**81**	**100**

The species of the snake could be made out either by the patient or by-standers in 45.4% cases, though it could not be verified as to whether the identification was correct. Nevertheless, among the identified species, 35.2% were said to be viper (exact nature of viper not mentioned in most reports), 6.5% involved the common cobra, and 3.7% cases were bites by the common krait.

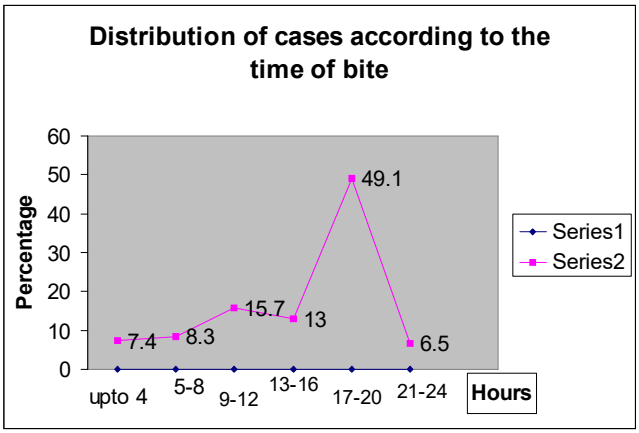

Fig 1

Bitemark (fang mark) was evident in 67.6% of cases. Local reaction in the form of swelling or redness was seen in 69.4% cases, while in a few cases, local reaction was present even without a visible bitemark. Severe form of local reaction with blistering, ulceration or extensive oedema was documented in 15 cases (13.9%); of which one was attributed to a krait bite, another to a viper, while the rest were unknown bites. Lymph node enlargement was observed in 9 cases (8.3%), out of which, 7 were due to viper bite and two were unknown bites.

Abnormal bleeding was noticed in 23 cases (21.3%), of which 43.5% had persistent bleeding from the site of bite, 21.7% had haematemesis, 26.1% had haematuria,

8.7% had malaena, 4.3% had subconjunctival bleeding, and 17.4% had gum bleeding. In 7 of these cases (30.4%) the bite was attributed to a viper, one (4.3%) to a krait, while the others were unknown bites. These figures must be viewed with some skepticism, since identification of the snake even where this was said to have been done, was not confirmed by an expert. Hypotension was recorded in 15% of cases.

Nervous system involvement was seen in 18 cases (16.7%). Ptosis was noted in 15 cases (cobra: 5, krait: 4, viper: 1, remaining unknown), and drowsiness in 15 cases (**Table 2**).

Cardiovascular system complications comprising toxic myocarditis, ventricular ectopics, and neurogenic hypertension were reported in one case (0.9%), while bradycardia was noted in 2 cases (1.8%) of viper bite. Toxic myocarditis also developed in an unknown bite presenting with both neurological and haematological manifestations. Ventricular ectopics developed in a 9-year-old female bitten by a cobra. Neurogenic hypertension occurred in a 10-year-old female child bitten by a krait.

Respiratory system complications were noted in a few cases: pneumonia (3 cases) and ARDS (2 cases). Cyanosis with stridor was observed in one victim allegedly bitten by a krait.

Table 2 Symptomatology Pattern in Neurotoxic Envenomation

Symptom	No. (n=18)	%
Ptosis	15	83.3
Drowsiness	15	83.3
Drooling of saliva	1	5.5
Tonic spasm	1	5.5
Dysarthria	5	27.8
Diplopia, twitching of circum-oral muscles	1	5.5
Blurred vision	3	16.7

Overall, no evidence of systemic envenomation was seen in 29.6% of cases, haematological manifestations alone in 54.6% (59 cases), nervous system involvement alone in 6.5%, and a combination of these in 9.3% cases. No signs of systemic envenomation were evident in 29.6% cases. Out of the 59 cases with haematological manifestations, 30.5% showed renal impairment. Of the 38 cases of alleged viper bite, 73.7% showed haematological manifestations alone, and 10.9% showed a combination with neurological symptoms. Of the 7 cases of cobra bite, 3 showed pure neurological findings, 3 showed combination with haematological manifestations, and one showed no systemic envenomation. Of the 4 krait bites, 3 showed a combination of symptoms, and one showed no systemic envenomation.

The severity of envenomation was based upon a modified version of Reid's criteria (*vide supra*), and the patients were placed in 5 groups with the maximum number of cases in the 'D' category (severe envenomation), i.e., 33.3% (**Table 3**). A statistically significant relationship between the age of the patient and severity of envenomation was observed (p=0.005) (**Table 4**). A similar relationship was observed between the presence of local reaction and severity of the envenomation (p=0.000) (**Table 5**). There was also statistical significance between the duration of stay in the hospital and the severity of envenomation (p=0.000) (**Table 6**).

Anti-snake venom (ASV) alone was needed as specific therapy in 52.8% patients, whole blood or blood components or dialysis along with ASV in 30.5%, and no specific treatment was necessary in 16.7% cases. Of the 90 cases that received ASV, 15.6% developed mild form of hypersensitivity reactions such as rashes or fever, which responded to treatment with antihistamines, steroids or adrenaline.

Death occurred in 11.1% cases in the paediatric age group, and 4.9% in the others, together constituting a frequency of 6.5%.

Table 3 Distribution of Cases as per Severity (Reid's Classification)

Grade of Severity	No.	Mean Age
A (Nil)	17	15.7
B (Mild)	28	25.9
C (Moderate)	20	18.5
D (Severe)	36	31.35
E (Fatal)	7	6.5
Total	**108**	**100**

Table 4 Relationship Between the Age of the Patient and Severity of Envenomation

Grade of Severity	No.	Mean Age
A (Nil)	17	15.94
B (Mild)	28	28.46
C (Moderate)	20	31.35
D (Severe)	36	34.14
E (Fatal)	7	29.54
Total	**108**	**—**

F=3.98 p=0.005

Table 5 Relationship Between Presence of Local Reaction and Severity of Envenomation

Grade of Severity	Local Reaction Absent	Local Reaction Present	Total
A (Nil)	14 (82.4%)	3 (17.6%)	17 100%
B (Mild)	4 (14.3)	24 (85.7%)	28 100%
C (Moderate)	5 (25%)	15 (75%)	20 (100%)
D (Severe)	6 (16.2%)	31 (83.8%)	37 (100%)
E (Fatal)	2 (33.3%)	4 (66.7%)	6 (100%)
Total	**31 (28.7%)**	**77 (71.3%)**	**108 100%**

X^2 – 29.77 p = 0.000

Table 6 Relationship Between Duration of Hospital Stay and Severity of Envenomation

Grade of Severity	No.	Mean Duration
A (Nil)	17	1.76
B (Mild)	28	3.57
C (Moderate)	20	6.25
D (Severe)	36	7.7
E (Fatal)	7	3.67
Total	**108**	**100**

Discussion

In the survey presented here, though the study itself is of a very limited nature, some interesting facts have emerged with regard to snakebites. To begin with, the well established fact that males are more commonly affected by snakebite,[4,5] is reflected in this survey also with a preponderance of 59.3%. This is because males are generally involved in outdoor activities and occupations that pose a high risk of snakebite.

In the paediatric age agroup, the highest incidence of bites was seen in the 7-9 year group, which is probably due to the increased activity of children outdoors in this age group. Among adults, the highest incidence was seen in the 35-44 year group (25.9%), followed by 13-24, and 25-34 groups, which are the age groups associated with the most active period of life. The youngest victim was 2 years old and the oldest 70 years, with a mean age of 29.3 years. Similar findings are reported in other studies.[6]

In a significant number of cases, the bite occurred during evening hours (1700 to 2000 hours). It is well known that snakes are usually active during warm nights, and some snakes such as the common krait are virtually nocturnal.[3]

The time lag between the bite and hospitalization was 2 hours or less in 59.3% cases, and 3-5 hours in 29.6%. In 4.6% cases, it took more than 12 hours to seek treatment from a hospital. It is possible, that in these cases, alternative systems of medicine were tried before the patient reported to a hospital. The duration of hospitalization was only 1-4 days in 53.7% cases, and the mean duration was 5.22 days.

The species of the snake could not be identified by the patient or relatives in 54.6% cases, and even among those that were, it is not certain that the identification was correct. It is well known that identification of snake species by lay persons is always fraught with errors.[3] Having said that, among the identified snakes, viper constituted 35.2% (exact type of viper not being specified in most cases), common cobra 6.5%, and krait 3.7%. Globally, the great majority of snake bites are said to be caused by the Crotalidae family of snakes (pit vipers and rattle snakes),[7] but the figures in this survey are in keeping with other local studies of this region.

Bite mark could be identified in 67.6% of cases only, which is in agreement with many other studies that report similar figures.[3]

Local reaction was evident in 69.4% of cases, mainly in the form of swelling and bruising of the bite area. This is due to the increased vascular permeability due to proteases, phospholipases, membrane damaging polypeptide toxins and endogenous autacoids like histamine, 5-HT and kinins released by the venom.[8] Severe form of local reaction with blistering, ulceration or extensive oedema was seen in 13.9% cases, and could be due to necrosis of skin and subcutaneous tissues, infection, etc.[9,10] Tissue necrosis is due to cytolytic or myotoxic factors. In some cases, ischaemia may be due to thrombosis, intracompartmental syndrome, or tight tourniquet.[8]

Lymph node enlargement was seen in 9 cases (8.3%). Out of these, 7 were due to viper bite and two were unknown bites. It is said that larger molecules of viperidae venom are taken up slowly through the lymphatics, whereas the elapidae venom is readily taken up through blood stream.[8] Lymphangitis and painful regional lymphadenopathy have been commonly reported in several studies.[3,10]

Of the bleeding manifestations seen in 23 patients, persistent bleeding from the site of bite was seen in 43.5% of cases. It is well known that the first evidence of haemostatic abnormality is usually in the form of persistent bleeding from the bite site, venepuncture or injection site.[3,4] Haemoptysis is described as a common manifestation by some investigators,[4] while others describe it as a relatively rare entity.[3] Other manifestations observed in the present series were haematuria (26.1%), haematemesis (21.75%), gum bleeding (17.4%), melaena (8.7%) and subconjunctival bleeding (4.3%), all of which are commonly reported in other studies, especially in viper bite cases. As per one study on the clinical effects of bites by Malayan viper, bleeding gums were observed in 46% cases, oozing from the site in 30%, haematemesis in 8%, and haematuria in 3%.[4] Hypotension was seen in 15% of cases in this study, which can be attributed to hypovolaemia due to capillary leak, vasodilatation and myocardial dysfunction.[8]

Of the neurological manifestations, ptosis was present in 83.3% cases, while drowsiness and dysarthria were also quite common. These features are generally more com-

mon in elapid bites. In the preparalytic stage, vomiting, ptosis, blurred vision, external ophthalmoplegia, paraesthesia, hyperacusis, headache, myalgia, vertigo and hypersalivation due to autonomic stimulation occur. Flaccid paralysis of facial muscles, palate, jaw, tongue, vocal cords, neck muscles and muscles of deglutition occur in the paralytic stage.[3,8]

Toxic myocarditis was a presenting symptom in one patient who showed mainly haematological symptoms. Electrocardiographic changes (ST elevation in II, III, aVF, and T wave depression in V2-V4) were noted in this case. Direct myocardial involvement in a viper bite often occurs, and is reflected by abnormal ECG or cardiac arrhythmias.[3,8]

Ventricular ectopics were observed in a 9-year-old female allegedly bitten by a cobra, which is not usually the case in cobra bites. Neurological manifestations together with increased clotting time were noticed in this case. It has been suggested that the neurotoxic venom of cobra can produce marked cardiac changes, and the Indian cobra venom has been shown to contain cardiotoxins.[8]

Neurogenic hypertension occurred in a 10-year-old female child bitten by a krait, in which neurological manifestations were predominant. Hypertension can result due to vasoconstrictive action of the venom.[11]

Renal involvement was seen in 18 out of 59 cases (30.5%) with haematological symptoms. Acute tubular necrosis can occur due to severe hypotension, disseminated intravascular coagulation, direct nephrotoxic effects of venom or myoglobinuria secondary to generalized rhabdomyolysis.[8]

Haematological manifestations alone were seen in 54.6%, nervous system symptoms only in 6.5%, and a combination of both in 9.3% cases. The venom of snakes is a complex mixture chiefly of proteins, many of which have enzymatic activities. The common practice of dividing snake venom into groups as neurotoxic, haemotoxic and myotoxic has led to much misunderstanding. Snake venom, whether colubrine or viperine, often has a haemolytic action on the blood.[12] The so-called neurotoxic venom producing marked cardiac or vascular changes may be due to a direct effect on blood. It is increasingly being realised that conventional classifications are both superficial and misleading.

No symptoms of envenomation were evident in 29.6% of victims. Absence of clinical manifestations in an alleged case of snakebite could be due to mistaken belief that it was actually snakebite when it may have been something else, or it may be a non-venomous snake that had inflicted the bite, or a venomous bite without release of venom (dry bite).[3] Other factors are also possible, such as superficial bites, or bites on areas protected by thick clothing, boots, etc.

Distribution of cases based on the severity of symptoms showed that 33.3% had severe features of envenomation, which is high when compared to the classical study by Reid (15%). Moderate envenomation was seen in 18.5% (Reid's series - 13%), and mild in 25.9% (Reid's series - 11%).[6] No sign of envenomation was seen in 15.7% in the present series. It has been suggested that 20 to 50% of venomous bites are not attended with serious toxicity. Some investigators claim that up to 80% may not show signs of significant envenomation.[13]

Antisnake venom (ASV) was given as specific treatment in 52.8% cases, and transfusion or dialysis along with ASV in 30.5%. Hypersensitivity reactions, including full-fledged anaphylactic shock may occur in 3-4% of cases, as per some sources.[13] In this series it was higher, i.e., 15.6%, even though most were only minor reactions.

The incidence of death in the paediatric age groups (11.1%) was higher when compared to other age groups (4.9%), together constituting a frequency of 6.5%. The over-all mortality due to snakebite is said to be around 10% in the Indian scenario, though there are several factors which can influence the outcome. Some investigators claim that the mortality is higher in children because of the larger dose of venom injected, relative to their body weight.[3]

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