



## Clinical Profile and Antivenom Utilization in Snakebite Patients at a Tertiary Care Center in Northern India

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### Article Info

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### Abstract

Snakebite envenomation remains a significant public health concern in India, particularly in rural areas, contributing to substantial morbidity and mortality. This cross-sectional observational pilot study evaluated the clinical profile of snakebite patients and the impact of anti-snake venom (ASV) dosing on outcomes at a tertiary care center in northern India. A total of 51 patients admitted between September and October 2022 were included. Most patients were males (62.7%) and belonged to the 20–40-year age group, with a predominance from rural areas (84.31%). The majority of bites occurred during nocturnal hours and at home. Neurotoxic envenomation was the most common presentation, with ptosis, visual disturbances, and respiratory distress frequently observed. A large proportion of patients were referred from peripheral centers, often after receiving incomplete or no ASV, and harmful first-aid practices such as tourniquet application were common. The mean ASV dose administered was 22.18 vials, with no significant difference between

neurotoxic and hemotoxic cases. Mechanical ventilation was required in 31.37% of patients. Most patients recovered without disability, while mortality was 7.84%. The study highlights gaps in early management, inappropriate first-aid practices, and variability in ASV use, emphasizing the need for improved peripheral care, timely intervention, and standardized treatment protocols.

**Keywords:** Snakebite, Anti Snake venom, Neurotoxic envenomation, Rural health

### Introduction

Snakebite envenoming remains a significant yet under-recognized public health problem, particularly in low- and middle-income countries. In 2017, the World Health Organization (WHO) reclassified snakebite as a neglected tropical disease, underscoring its global health importance.[1] It is estimated that approximately 1.8–2.7 million snakebites occur annually worldwide, resulting in 81,000–137,880 deaths each year.[2]

India bears a substantial share of this burden due to its extensive agricultural activity, diverse population of venomous snakes, and gaps in prevention and healthcare access. Snakebite-related mortality is particularly high in rural areas, where underreporting is common and healthcare-seeking behavior is often influenced by reliance on traditional healers.[3]

Snake venom is a complex mixture of enzymes, polypeptides, glycoproteins, and low-molecular-weight compounds. Its toxic effects arise from both protein and non-protein components, including phospholipase A2, hyaluronidase, and neurotoxins, which contribute to a wide range of clinical manifestations.[3] These may include local tissue damage, neuromuscular paralysis, coagulopathy, hemorrhage,

inflammation, and cardio-vascular disturbances. [4]

The clinical presentation of snakebite varies depending on the species involved, geographic region, and several host- and bite-related factors. These include the quantity of venom injected, site and number of bites, season, time elapsed before treatment, and patient characteristics such as body weight. [5,6] Variability in venom delivery further complicates the clinical picture, and in some cases of minimal envenomation, symptoms may be absent. [7]

Envenomation by viper species is typically associated with hemotoxic effects, including mucocutaneous bleeding, hemolysis, renal failure, and shock. In contrast, bites from cobras and kraits are predominantly neurotoxic, leading to neuromuscular paralysis affecting ocular, bulbar, and respiratory muscles. Acute neuroparalysis is a major contributor to morbidity and mortality in such cases [4]. However, neurotoxicity has also been reported in envenomation by Russell's viper, particularly in parts of southern India. [8,9]

Anti-snake venom (ASV) remains the only specific treatment for snakebite envenoming. The optimal dosage depends on the amount of venom injected, which is often difficult to estimate, especially when the offending species is not identified. Although standardized protocols have been proposed by WHO and national guidelines, their implementation is frequently challenged by variability in clinical presentation and limitations in early species identification. [11,14] Consequently, ASV may be underutilized in some cases and overutilized in others, increasing the risk of adverse reactions, including anaphylaxis. Additional challenges include high cost, limited availability, and insufficient evidence regarding optimal dosing strategies. [11,14] Furthermore, supportive care such as mechanical ventilation and blood product transfusion remains critical in the management of severe envenomation [6].

Given these challenges, there is a need for region-specific data to guide clinical management and optimize ASV utilization. The present study was conducted at the Department of Emergency Medicine and Medical Emergency (METC) at King George's Medical University (KGMU), Lucknow. It aims to evaluate the clinical profile of snakebite patients, examine patterns of ASV administration, and assess associated outcomes,

including therapeutic benefits and adverse effects.

### **Aims and Objectives**

To evaluate the clinical profile of snakebite patients and assess the impact of varying doses of anti-snake venom (ASV) on patient outcomes at a tertiary care centers to assess the impact of different doses of antivenom serum (ASV) on patient outcomes.

### **Subjects and Methods**

This pilot cross-sectional observational study was conducted at a tertiary care teaching institute, King George's Medical University (KGMU), and included patients admitted to the Department of Emergency Medicine and Department of Medicine.

The study was approved by Institutional Ethics committee. This study included all patients of snakebite admitted to the Medicine Emergency, during the period of September 2022 to October 2022, and a total of 51 patients were included in the study.

Information on demographics, kind and severity of snake bite, specifics of ASV administration, premedication, occurrence of early adverse reactions to ASV, clinical outcomes, and other relevant factors were extracted from the medical records of the enrolled patients. The aforementioned data was subsequently entered into a documented proforma attached as Annexure-1

Patient identifiers were anonymized and not linked to study data. Their information was kept secure in the institution's database. The data was entered into a Microsoft Excel and statistical analyses were conducted using IBM SPSS version 2023 (IBM, Chicago, IL, USA). Due to the small sample size (n=51), descriptive statistics were employed to analyse the data. The data are shown as the median along with the range, and the mean and standard deviation are provided where applicable.

### **Observations and Results**

A total of 51 snakebite cases were included in the study. Of these, 32 (62.7%) were males and 19 (37.3%) were females. The majority of patients (54.9%) belonged to the 20–40-year age group. The overall mean age was 33.39 years, with 33.09 years in males and 33.89 years in females.

The highest proportion of bites occurred

in the 31–40-year age group (29.41%), followed by the 21–30-year group (25.49%) and patients aged above 40 years (23.52%). The lowest incidence was observed in individuals below 20 years of age (21.56%).

A significant disparity was observed in the distribution of residence, with the majority of cases (84.31%) originating from rural areas, while only 15.68% were from urban regions. Among the victims, housewives (29.41%) constituted the largest occupational group, followed by farmers (27.45%). Students accounted for 19.60% of cases, laborers for 9.80%, and individuals engaged in other occupations, such as shop keeping and vending, comprised 13.72%.

More than half of the bites (52.94%) occurred during the early hours, between 12 am and 6 am suggesting a potential association with nocturnal activity. The remaining cases were distributed across the day, with 25.49% occurring between 6 am and 6 pm and 21.56% happening between 6 pm and 12 am.

The majority of the bite (78.43%) occurred when the victims were at home, where only 21.56% took place at workplaces.

Prior to hospital presentation, several patients reported using various first-aid measures. The most common intervention, employed by 64.7% of patients (n=33), was the application of a tourniquet. The median duration of tourniquet use was 1 hour (range: 10 minutes to 4.5 hours). Additionally, 23.5% (n=12) of patients resorted to incision at the bite site, a practice that is not only ineffective but also potentially harmful. Traditional remedies, including neem leaves, cold baths, herbal applications, and ritualistic practices, were used by 29.4% (n=15) of patients. Notably, none of the patients utilized splint immobilization. Encouragingly, 25.5% of patients (n=13) presented directly to the hospital without attempting any first-aid measures.

Of the 51 patients admitted, 13 presented directly to our hospital, while the remaining 38 were referred from peripheral healthcare facilities. Among the referred patients, 63.2% (n=24) had received anti-snake venom (ASV) prior to referral. The remaining 36.8% (n=14) did not receive ASV; of these, 11 patients received only symptomatic management, while 3 received no treatment prior to referral.

A majority of patients (64.7%, n=33) sought initial medical attention within two hours

of the suspected snakebite, while 27.5% (n=14) presented between 2 and 8 hours, and a small proportion (7.8%, n=4) presented after more than eight hours. The median time from suspected bite to first medical contact was 1.5 hours (range: 10 minutes to 15 hours). However, a delay was observed in definitive management, with the median time to administration of the first dose of anti-snake venom (ASV) being 3 hours (range: 30 minutes to 16 hours).

Envenomation most commonly involved the lower limbs (50.98%, n=26), followed by the upper limbs (33.33%, n=17), with relatively few cases affecting the trunk or head and neck (7.84%, n=4). Clinically, pain at the bite site was the predominant presenting complaint (90.19%, n=46), frequently accompanied by gastrointestinal symptoms such as nausea and vomiting (90.19%, n=46). Local inflammatory signs were observed in 74.5% (n=38) of patients. Systemic features included dryness of the mouth (80.39%, n=41) and headache (52.94%, n=27), indicating a substantial burden of both local and systemic manifestations.

Among the 51 snakebite cases, species identification was possible in 21 cases: 13 were attributed to krait bites, 6 to Russell's viper, and 2 to cobra. In the remaining 30 cases, the species could not be determined. Fang marks were identified in 94.1% of cases.

Neurological manifestations predominated, consistent with the high proportion of neurotoxic envenomation. Ptosis was observed in 68.6% (n=35) of patients, while blurring of vision was reported in 70.6% (n=36). Speech abnormalities were present in 66.7% (n=34), with dysphonia noted in 31 patients. Respiratory distress was a major complication, affecting 66.7% (n=34) of cases, highlighting the severity of neuroparalytic involvement.

In contrast, hematological manifestations were relatively infrequent. Bleeding complications, including bleeding from the bite site, epistaxis, and hematemesis were observed in 9.8% (n=5) of patients. Renal involvement was also limited, with hematuria reported in 13.7% (n=7). Gastrointestinal involvement was primarily characterized by abdominal pain, reported in 66.7% (n=34) of patients.

The mean dose of anti-snake venom (ASV) administered was 22.18 vials (n=49), with a median dose of 20 vials. Patients with hemotoxic envenomation received a mean of 22.5

vials (n=6), while those with neurotoxic envenomation received a mean of 22.14 vials (n=43). Notably, two patients (3.9%) recovered without the administration of ASV.

Sixteen patients (31.4%) required mechanical ventilation for respiratory support. The median duration of ventilation was 30 hours (range: 16–70 hours), with a mean duration of

35.5 hours.

Adverse reactions to ASV were observed in two patients (3.9%).

Of the 51 patients admitted to KGMU, 46 (90.2%) were discharged without any residual disability. One patient (2.0%) was discharged with persistent paralysis, while four patients (7.8%) died.

**Table 1: Distribution of snake bite cases by site of bite (n=51)**

Site of Bite	Number (n)	Percentage (%)
Head and neck	4	7.84
Trunk	4	7.84
Upper limb	17	33.33
Lower limb	26	50.98

**Table 2: First aid measures adopted by snakebite patients (n=51)**

First Aid Measure	Number (n)	Percentage (%)
Tourniquet	33	64.71
Traditional remedies	15	29.41
Incision at bite site	12	23.52
Splint immobilization	0	0.00
No first aid	13	25.49

**Table 3: Clinical features of snakebite patients (n=51)**

Clinical Feature	Number (n)	Percentage (%)
<b>Local manifestations</b>		
Pain	46	90.20
Inflammation	38	74.51
<b>Neurological manifestations</b>		
Ptosis	35	68.63
Visual abnormalities	36	70.59
Headache	27	52.94
Dryness of mouth	41	80.39
Speech abnormalities	34	66.67
Dysphagia	35	68.63
Dysphonia	31	60.78
Respiratory distress	34	66.67
<b>Gastrointestinal manifestations</b>		
Nausea and vomiting	46	90.20
Abdominal pain	34	66.67
<b>Hematological manifestations</b>		
	6	11.76
<b>Renal manifestations (Hematuria)</b>		
	7	13.73

**Table 4: Patient referral and pre hospital management (n=51)**

Category	Subcategory	Number (n)	Percentage (%)
Direct presentation	–	13	25.49
Referred patients	Received ASV	24	47.0
	Symptomatic management without ASV	11	21.57
	No management	3	5.88

**Table 5: Average dose of ASV according to predominant symptom**

Type of Envenomation	Number of Patients (n)	Mean ASV Dose (vials)
Hemotoxic	6	22.50
Neurotoxic	43	22.14
No envenomation	2	0

**Table 6: Time interval between Snake bite and first medical contact (n=51)**

Time Interval	Number (n)	Percentage (%)
Within 30 minutes	11	21.57
30 minutes to 1 hour	10	19.61
1–2 hours	12	23.53
2–4 hours	8	15.69
4–8 hours	6	11.76
More than 8 hours	4	7.84

**Table 7: Final outcome of snakebite patients (n=51)**

Outcome	Number (n)	Percentage (%)
Discharged without disability	46	90.20
Discharged with disability	1	1.96
Expired	4	7.84

## Discussion

Snakebite envenoming in India remains a critical public health challenge, contributing substantially to morbidity and mortality among neglected tropical diseases. This under-recognized burden results in significant economic loss and social disruption, particularly in vulnerable rural communities.[15–18] The National Mortality Survey (2001–2003) reported the highest number of snakebite-related deaths in Uttar Pradesh, with an estimated 8,700 fatalities. Consistent with previous studies,[15,16,18] the majority of victims in our study belonged to the 20–40-year age group, likely reflecting increased

occupational exposure due to outdoor and agricultural activities. A marked rural predominance was also observed, which can be attributed to ecological and behavioral factors, including proximity to natural snake habitats, increased human–snake interaction during agricultural work, and environmental conditions that favor snake habitation. [16,19,20]

Snakebite incidents in our study showed a distinct temporal pattern, with a peak during early morning hours and a secondary rise in the evening to midnight period. This corresponds with the known activity patterns of snakes during cooler, low-light conditions, as well as reduced visibility

leading to inadvertent encounters.[19–21]

In contrast to earlier reports[22], the majority of bites in our study occurred at home. This finding may be explained by the high proportion of nocturnal bites and the common practice of sleeping on the floor in rural settings, which increases vulnerability to snake encounters.

Clinically, neurotoxic envenomation predominated, in line with previous observations from northern India [6,22]. This pattern is further supported by the high burden of neurological manifestations and the relatively lower frequency of hematological complications.

A substantial proportion of patients were referred from peripheral healthcare facilities, many of whom had received no or only incomplete ASV prior to referral. This highlights gaps in early management at primary care levels, including inconsistent adherence to treatment protocols and inadequate observation practices. Strengthening peripheral healthcare systems through training, protocol standardization, and ensuring adequate ASV availability is essential to improving outcomes.

Although the median time to initial medical contact was relatively short, delays in definitive treatment were evident. Variability in healthcare-seeking behavior suggests that while awareness and access may have improved compared to earlier reports, disparities persist. Contributing factors likely include reliance on traditional healers, transportation barriers, and the often painless nature of certain envenomations, particularly krait bites, which may delay symptom recognition.

The widespread use of inappropriate first-aid measures, including tourniquets, incision, and traditional remedies, reflects persistent misconceptions in the community. These practices not only delay hospital presentation but may also contribute to local tissue damage and worse clinical outcomes. Public health interventions should focus on community education to discourage harmful practices and promote evidence-based first aid.

The predominance of lower limb bites observed in this study is consistent with occupational exposure and ground-level interaction with snakes, particularly in individuals working barefoot. Upper limb bites, more frequently observed in females, were associated with domestic activities and handling

objects in low-light conditions.

The average ASV requirement did not differ significantly between neurotoxic and hemotoxic envenomation in our study. However, variability in dosing practices may reflect differences in clinical response and physician preference, particularly in neurotoxic cases where delayed or incomplete reversal of symptoms may prompt additional dosing. Existing literature presents conflicting evidence regarding ASV requirements across envenomation types, underscoring the need for standardized treatment protocols.[7,24,25]

A significant proportion of patients required mechanical ventilation, primarily due to respiratory paralysis. The requirement for ventilatory support was closely associated with delayed presentation & severity of envenomation. All fatalities in this study occurred among patients requiring ventilation, highlighting the critical importance of early recognition and timely intervention.

### **Limitations**

This study is limited by its small sample size, short duration, and single-center design, which may affect generalizability. Additionally, the inability to identify the snake species in a majority of cases limits species-specific analysis.

### **Conclusion**

Snakebite envenomation remains a significant cause of morbidity and mortality in rural northern India, with a predominance of neurotoxic manifestations. A large proportion of patients were unable to identify the offending species, necessitating the use of polyvalent anti-snake venom (ASV). Delays in presentation, inappropriate first-aid practices such as tourniquet application and incision, and inconsistent management at peripheral healthcare centers continue to adversely affect outcomes.

Although a relatively lower proportion of patients sought traditional healers, harmful first-aid practices remain common, indicating gaps in awareness. The absence of a significant difference in ASV requirements between neurotoxic and hemotoxic envenomation suggests variability in dosing practices and highlights the need for standardized treatment protocols.

Improving early management at peripheral centers, ensuring adequate availability and rational use of ASV, and promoting

community awareness regarding appropriate first aid and timely medical care are essential to reduce morbidity and mortality. Further large-scale studies are required to optimize ASV dosing strategies and explore the potential for region-specific antivenom formulations

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