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A cross-sectional study on the clinico-biochemical profile of poisonous snakebite cases in the paediatric age group (1–12 years) in a tertiary care institute of West Bengal.

Dr Saurav Bar[1], Dr Sumanta Laha[2]

[1]Post Graduate Trainee, Dept Of Paediatrics, Burdwan Medical College.
[2]Associate Professor, Dept Of Paediatrics, Burdwan Medical College.

Correspondence:
Dr Saurav Bar
Post Graduate Trainee, Dept Of Paediatrics, Burdwan Medical College.
Email:
Barsaurav1996@gmail.Com

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Abstract

Background: Snakebite is a neglected tropical disease and a significant cause of morbidity and mortality in children, particularly in rural India. This study aimed to evaluate the clinico-biochemical profile of poisonous snakebite in paediatric patients (1–12 years) in a tertiary care hospital in West Bengal. ***Methods:*** A hospital-based cross-sectional study was conducted from July 2022 to June 2024, involving 116 children aged 1–12 years with clinical signs of snake envenomation. Data on demographic characteristics, clinical features, laboratory parameters, complications, and outcomes were recorded and analyzed using SPSS version 24.0. ***Results:*** The majority of patients were male (73.3%) and aged 5–8 years (43.1%). Most patients (63.3%) resided in villages, and 53.3% belonged to the upper-lower socioeconomic class. Viper envenomation (65.5%) was the most common, followed by krait (25.8%) and cobra (8.62%). Among vasculotoxic manifestations (n=86), bleeding from the injection site (84.9%) and hematuria (58.1%) were predominant, while among neurotoxic manifestations (n=40), ptosis (97.5%) and abdominal pain (75%) were most frequent. Among PICU-admitted patients (n=81), complications included septicemia (58.0%), respiratory paralysis (44.4%), and acute kidney injury (42.0%). The overall mortality rate was 5.2%, with respiratory failure (67%) and septicemia (33%) being the primary causes. ***Conclusion:*** Poisonous snakebite in children predominantly affects older boys from rural, lower socioeconomic backgrounds. Vasculotoxic envenomation is more common and is associated with significant renal and coagulation abnormalities. Delayed presentation remains a challenge. Early recognition, prompt administration of anti-snake venom, and intensive care support are crucial for improving outcomes.

Keywords: Snakebite, paediatric, envenomation, vasculotoxic, neurotoxic, antisnake venom.

INTRODUCTION

Snakebite is a major public health problem in India, which bears the highest burden of snakebite mortality globally, with an estimated 50,000 deaths annually, accounting for about 5% of all injury-related deaths and nearly 0.5% of all deaths [1, 2]. The risk of snakebite in children is particularly high due to their curious nature and tendency to spend more time outdoors [3].

Snakebite has long been a neglected public health problem and was recently included in the World Health Organization's list of neglected tropical diseases [4]. The incidence is likely underestimated due to lack of epidemiological data; official reports show only 985 deaths in 2010, contrasting sharply with the estimated 50,000 deaths per year [5]. Of the 216 snake species in India, 52 are venomous. The majority belong to the Elapidae family (cobra, krait), Viperidae family (Russell's viper, saw-scaled viper), and Hydrophidae family (sea snakes) [6]. The "Big Four"— Indian cobra, common krait, saw-scaled viper, and Russell's viper—are responsible for most envenomations [7, 8].

Snakebite accounts for 3% of all deaths in children aged 5–14 years. Notably, 97% of snakebite deaths occur in rural areas, with approximately 77% occurring outside healthcare facilities, often due to reliance on traditional healers [9]. Snakebite is thus an important medical emergency and a significant cause of hospital admission in rural settings [10].

Snake venom comprises enzymes, polypeptides, and proteins that cause pathogenesis through inflammation, coagulopathy, and organ-specific toxicities [11]. In children, accelerated physiological derangements occur due to a higher dose of antivenom per body surface area [12]. Clinical presentation includes local manifestations (fang marks, pain, swelling,

necrosis) and systemic manifestations involving gastrointestinal, neurological, coagulopathic, cardiovascular, renal, and endocrine systems [13].

The syndromic approach classifies snakebites based on clinical features: Syndrome 1 (local symptoms + coagulopathy + neurological signs) suggests Viperidae; Syndrome 2 (local symptoms + coagulopathy + shock + acute kidney injury) suggests Russell's viper; Syndrome 3 (local symptoms with paralysis) suggests cobra; Syndrome 4 (paralysis with minimal local signs) suggests krait; and Syndrome 5 (neurological signs, acute kidney injury, hematuria) suggests Russell's viper [14, 15].

Diagnosis can be challenging in children, who may present with paralysis, seizures, or coagulopathy of unknown etiology. A high index of suspicion and thorough examination for fang marks is essential, though these may be absent in krait envenomation [16, 17].

Management follows the "Do It RIGHT" mnemonic: Reassurance, Immobilization,
Get to Hospital, and Tell the doctor [18]. Harmful practices like incisions and tight tourniquets are not recommended [19]. Hospital management includes airway, breathing, circulation stabilization, and administration of anti-snake venom (ASV) when indicated [20]. The 20-minute whole blood clotting test (20WBCT) is a reliable bedside test for detecting viper-induced coagulopathy [21].

In India, polyvalent ASV against the "Big Four" is available. While some experts classify envenomation severity for dosing [22, 23], the National Snakebite Management Protocol recommends an initial dose of 8–10 vials, independent of age and weight [18].

Given the paucity of comprehensive data on the clinico-biochemical profile of paediatric snakebite in West Bengal, this study was conducted to evaluate the demographic characteristics, clinical features, biochemical derangements, and outcomes in children aged 1–12 years admitted to a tertiary care hospital.

METHODOLOGY

Study Design and Setting

A hospital-based cross-sectional study was conducted in the SNM ward of the
Department of Paediatrics at Burdwan Medical College & Hospital, Burdwan, West Bengal. The study was carried out over a period of 24 months, from July 2022 to June 2024.

Study Population

All patients aged 1 year to 12 years, including both sexes, attending the SNM ward of the Department of Paediatrics who fulfilled the inclusion and exclusion criteria were included in the study.

Inclusion Criteria:

- Patients who had clinical signs and symptoms of snake envenomation with or without having a bite mark
- Patients whose parents provided express consent for participating in the study

Exclusion Criteria:

- Patients who did not have clinical features of snake envenomation (including dry bite by poisonous snake and bite by non-poisonous snake)
- Patients who had clinical features of envenomation due to other poisonous creatures - Patients who did not give consent for the study

Sample Size Calculation.

The sample size was calculated using the formula: Z2PQ/L2
Where:

- P = 0.16 (incidence)
- Q = (1 - P) = 0.84
- L = precision of estimation = 0.07
- Z = 1.96 (constant for 95% confidence interval)

Thus, n = 105
Adding a 10% attrition rate, the final sample size was rounded to 116.

Data Collection and Interpretation

Patients who presented with clinical features of snakebite poisoning fulfilling the inclusion criteria and whose parents gave consent for participating in the study were recruited. Data collection involved:

1. Convenient sampling
2. Face-to-face interviews using a semi-structured close-ended questionnaire containing information regarding patient particulars, chief complaints, and clinical features at the time of admission
3. Clinical examination of the patient
4. Blood investigations to assess the biochemical profile of snakebite envenomation
5. Urine for routine and microbiological examination
6. Documentation of treatment modalities and outcome

All patients were clinically examined after thorough history taking. Tests were performed accordingly to establish envenomation. All patients were treated based on the diagnosis, and all information was recorded in the case record form.

Statistical Analysis

The data were tabulated in Microsoft Excel and analyzed with SPSS version 24.0 software. Continuous variables were presented as mean and standard deviation, while categorical variables were presented as frequency and percentage. The results were presented with appropriate tables and diagrams.

Ethical Considerations

The proposal with the interview schedule was submitted for ethical clearance to the Institutional Ethics Committee (IEC) of the college. Data collection was initiated only after receiving the Ethical Clearance Certificate. Informed written consent was obtained from the parents of each child. Strict privacy and confidentiality were maintained throughout the study, and the identity of participants was not disclosed.

RESULTS

A total of 116 children aged 1–12 years with clinical signs and symptoms of poisonous snake envenomation were included in the study over a period of 24 months.

Demographic Characteristics

The majority of children belonged to the 5–8 years age group (43.1%), followed by those aged >8 years (39.7%) and <5 years (17.2%). There was a clear male predominance (73.3%), with a male-to-female ratio of 2.74:1. Most children weighed more than 20 kg (46.6%).

In terms of socio-demographic characteristics, 66.7% of patients were Hindu and 33.3% were Muslim. A substantial proportion belonged to the upper-lower (53.3%) and lower (46.7%) socioeconomic classes. The majority of patients were from rural areas (63.3%), and 56.7% resided in pucca houses (Table 1).

Healthcare-Seeking Behaviour

A total of 63.3% of patients were referred from other healthcare facilities, while 36.7% presented directly. Most children (63.0%) reached the hospital within 6–12 hours of the snakebite, whereas only 13.8% arrived within 6 hours.

Among the 52 patients who received their first dose of anti-snake venom (ASV) at the study center, the majority (57.7%) received it within 6–12 hours, followed by

28.8% within 6 hours and 13.5% after 12 hours (Table 2).

Type of Envenomation and Clinical Pattern

Viper envenomation was the most common (65.5%), followed by krait (25.8%) and cobra (8.6%). Correspondingly, vasculotoxic manifestations were observed in 65.5% of cases, neurotoxic features in 25.8%, and mixed features in 8.6% (Table 3).

Clinical Manifestations

Among patients with vasculotoxic envenomation (n=86), the most common manifestation was bleeding from the injection site (84.9%), followed by hematuria (58.1%) and bleeding gums (22.0%). Other features included progressive swelling (19.8%), hematemesis (9.3%), epistaxis (4.7%), and hemoptysis (4.7%).

Among neurotoxic cases (n=40), ptosis was the most frequent finding (97.5%), followed by abdominal pain (75.0%) and altered sensorium (47.5%). Other manifestations included dysarthria (30.0%), pupillary dilatation (20.0%), respiratory paralysis (10.0%), and convulsions (10.0%) (Table 4).

Laboratory Findings

The mean hemoglobin was 10.76 ± 1.28 g/dL. The mean total leukocyte count was 13,093.10 ± 4,931.07/µL, and the mean platelet count was 1,726.33 ± 162.44
$\times 10^3$/µL. The mean serum creatinine was 0.96 ± 0.50 mg/dL, and mean urea was 33.05 ± 28.24 mmol/L. Coagulation parameters showed a mean prothrombin time of
18.25 ± 5.10 seconds, INR of 1.23 ± 0.21, and APTT of 32.91 ± 9.84 seconds. Among vasculotoxic cases, 69.8% had abnormal renal function tests and 54.7% had abnormal coagulation profiles. The 20-minute whole blood clotting test was prolonged in 65.5% of patients.

Complications and Outcomes

A total of 70.0% of patients required PICU admission. Among these, septicemia (58.0%) was the most common complication, followed by respiratory paralysis (44.4%), acute kidney injury (42.0%), and compartment syndrome (21.0%). The overall mortality rate was 5.2%. Among the deceased patients, respiratory failure (66.7%) and septicemia (33.3%) were the leading causes of death (Table 5).

Table 1: Demographic Characteristics of Study Population

Variable	Category	N	%
Age	<5 years	20	17.2
	5–8 years	50	43.1
	>8 years	46	39.7
Sex	Male	85	73.3
	Female	31	26.7
Weight	<15 kg	16	13.8
	15–20 kg	46	39.7
	>20 kg	54	46.6
Religion	Hindu	77	66.7
	Muslim	39	33.3
Socioeconomic	Lower	54	46.7
	Upper-lower	62	53.3
Residence	Rural	73	63.3
	Urban	43	36.7
House type	Kaccha	50	43.3
	Pucca	66	56.7

Table 2: Healthcare-Seeking Behaviour

Variable	Category	N	%
Prior referral	Yes	73	63.3
	No	43	36.7
Time to hospital	<6 hrs	16	13.8
	6–12 hrs	73	63
	>12 hrs	27	23.2
Time to ASV (n=52)	<6 hrs	15	28.8
	6–12 hrs	30	57.7
	>12 hrs	7	13.5

Table 3: Type of Snakebite and Clinical Pattern

Variable	Category	N	%
Type of snake	Viper	76	65.5
	Krait	30	25.8
	Cobra	10	8.6
Clinical pattern	Vasculotoxic	76	65.5
	Neurotoxic	30	25.8
	Mixed	10	8.6

Table 4: Clinical Manifestations

	Manifestation	N	%
A. Vasculotoxic (n=86)	Injection site bleeding	73	84.9
	Hematuria	50	58.1
	Bleeding gums	19	22
	Progressive swelling	17	19.8
	Hematemesis	8	9.3
	Epistaxis	4	4.7
	Hemoptysis	4	4.7
B. Neurotoxic (n=40)	Ptosis	39	97.5
	Abdominal pain	30	75
	Altered sensorium	19	47.5
	Dysarthria	12	30
	Pupillary dilatation	8	20
	Respiratory paralysis	4	10
	Convulsions	4	10

Table 5: Complications and Outcomes

Variable	Category	N	%
Renal dysfunction (n=86)	Yes	60	69.8
	No	26	30.2
Coagulation abnormality (n=86)	Yes	47	54.7
	No	39	45.3
20WBCT	>20 min	76	65.5
	<20 min	40	34.5
PICU admission	Yes	81	70
	No	35	30
Complications (n=81)	Septicemia	47	58
	Respiratory paralysis	36	44.4
	AKI	34	42
	Compartment syndrome	17	21
Outcome	Survived	110	94.8
	Died	6	5.2
Cause of death (n=6)	Respiratory failure	4	66.7
	Septicemia	2	33.3

DISCUSSION

Snakebite remains a significant yet neglected public health problem, particularly in rural regions of developing countries like India. It is a major cause of morbidity and mortality in children and has only recently been recognized as a neglected tropical disease by the World Health Organization. India bears the highest global burden, with an estimated 50,000 deaths annually [1,2]. Snakebite accounts for nearly 3% of all deaths in children aged 5–14 years [24], and underreporting remains a major challenge, emphasizing the need to make snakebite a notifiable disease [25]. In the present study, the majority of cases were observed in children aged 5–8 years (43.1%), followed by those >8 years (39.7%), which is consistent with previous studies reporting higher incidence in older children [10,12,26]. This trend is attributed to increased outdoor activity and environmental exposure. A marked male predominance (73.3%) was noted, aligning with findings from Meshram RM et al. [10], Suganthi et al. [26], Sood A et al. [27], Reddy et al. [12], and Kshirsagar VY et al. [11], likely due to greater outdoor engagement among boys.

Most patients belonged to lower socioeconomic strata, consistent with Sood A et al. [27] and Meshram RM et al. [10], highlighting the role of poor housing, lack of protective measures, and occupational exposure. A majority (63.3%) were from rural areas, similar to findings by Sood A et al. [27], Meshram RM et al. [10], and Surjit et al. [28], reflecting the environmental and occupational risk factors associated with snakebite.

A significant proportion of patients (63.3%) were referred from peripheral centers, indicating gaps in primary care management. Similar referral patterns and healthcare-seeking delays have been reported by Reddy et al. [12] and Sloan et al. [29], where reliance on traditional healers contributed to delayed treatment.

Most patients in this study reached the hospital within 6–12 hours (63.0%), with only 13.8% presenting within 6 hours. Comparable delays have been reported by Surjit et al. [28] and other studies [30,31]. Delay in administration of anti-snake venom (ASV), as observed in this study, is a critical determinant of poor outcomes. Previous studies have identified delayed presentation as a key predictor of mortality [14,34].

Vasculotoxic envenomation was the predominant presentation (65.5%), consistent with studies by Kshirsagar VY et al. [11] and Sangeetha et al. [16], reflecting the regional predominance of viper species. Neurotoxic and mixed presentations were less common.

Among vasculotoxic cases, bleeding from the injection site (84.9%) and hematuria (58.1%) were the most frequent manifestations, similar to findings by Reddy et al. [12] and Surjit et al. [28]. Injection site bleeding is an important early indicator of coagulopathy.

Among neurotoxic cases, ptosis (97.5%) was the most common feature, followed by abdominal pain and altered sensorium. These findings are consistent with previous studies [12,28] and reflect the characteristic descending paralysis seen in elapid bites. Abdominal pain, particularly in krait envenomation, is an important early clinical clue.
The study demonstrated moderate anemia and leukocytosis, findings comparable to Tejas et al. [32], reflecting systemic inflammatory response and possible infection. Although thrombocytopenia was less frequent, it remains a known feature of viper envenomation due to consumption coagulopathy.

A high proportion of vasculotoxic cases showed renal dysfunction (69.8%) and coagulation abnormalities (54.7%), emphasizing the nephrotoxic and hemotoxic effects of viper venom. Similar findings have been reported in previous studies, where renal failure significantly contributed to morbidity and mortality [14].

The 20-minute whole blood clotting test (20WBCT) was prolonged in 65.5% of cases, supporting its utility as a simple and reliable bedside test, as also highlighted by Tejas et al. [32] and Surjit et al. [28].

A large proportion of patients (70%) required PICU admission, indicating the severity of envenomation. Septicemia was the most common complication, followed by respiratory paralysis and acute kidney injury. Comparable complication patterns have been reported by Meshram RM et al. [10].
The mortality rate in this study was 5.2%, which is within the range reported in Indian studies [10,11,27,33]. Respiratory failure was the leading cause of death, followed by septicemia, highlighting the importance of early ventilatory support and infection control.

The findings of this study are consistent with existing literature regarding demographic patterns, predominance of vasculotoxic envenomation, and the impact of delayed presentation [10–12,26–28]. The high burden of renal complications and need for hemodialysis observed in this study further underscores the severity of viper envenomation, as also reported by Chakraborty et al. [14]. Delayed hospital presentation and delayed ASV administration remain key predictors of adverse outcomes, as supported by previous studies [14,34]. These findings highlight the need for improved awareness, early referral systems, and strengthening of primary healthcare infrastructure.

CONCLUSION

Snakebite contributes significantly to morbidity and mortality in children. This study revealed that paediatric snakebite predominantly affects male children aged 5–12 years from rural, lower socioeconomic backgrounds. Despite modern healthcare facilities, difficulties persist in identifying and managing snakebite at the primary care level, especially in krait bites, which present with minimal local signs but rapidly progressive neurotoxicity. Community education on pre-hospital first aid and awareness against traditional remedies are essential. Prompt identification of cases with poor prognosis and early referral to tertiary care are crucial, with swift referral to the Paediatric Intensive Care Unit being critical to mitigate complications such as respiratory failure, acute kidney injury, and mortality in this fundamentally treatable condition. A

well-maintained registry for paediatric snakebite cases is needed, and making snakebite a notifiable disease would significantly improve epidemiological surveillance and resource allocation for this neglected tropical disease.

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