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DEMOGRAPHIC, CLINICAL, AND LABORATORY PROFILE OF VASCULOTOXIC SNAKEBITE PATIENTS PRESENTING TO A TERTIARY CARE CENTRE IN WESTERN MAHARASHTRA: A CROSS-SECTIONAL OBSERVATIONAL STUDY

KEY WORDS: Acute Kidney Injury, Anti-Snake Venom, Coagulopathy, Snakebite Envenomation, Vasculotoxic

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ABSTRACT

Background: Snakebite is a neglected tropical disease causing significant morbidity and mortality, with India bearing the highest global burden (~81,000 envenomations and ~11,000 deaths annually). Vasculotoxic envenomation predominantly caused by Russell's viper and saw-scaled viper leads to coagulopathy, hemorrhage, and acute kidney injury (AKI). **Aim:** To study the demographic, clinical, and laboratory profile of vasculotoxic snakebite patients at a tertiary care centre in western Maharashtra. **Methods:** A cross-sectional observational study of 60 vasculotoxic snakebite patients admitted to KIMS, Karad. Demographic data, clinical features, platelet indices, coagulation profile, renal parameters, treatment received, ICU stay, AKI outcome, and final outcome were recorded. Data were analyzed using SPSS v21; Chi-square and Fisher's exact tests were applied; $p < 0.05$ was significant. **Results:** Males predominated (65%). The 21–40 year age group was most affected (48.3%). Rural residents and agricultural workers were most commonly affected. Lower limb bites were more frequent (71.7%). Local swelling (100%), bleeding manifestations, and AKI (38.3%) were the principal complications. Mortality was 6.7%. **Conclusion:** Young rural male agricultural workers are the most vulnerable population. Early anti-snake venom administration, close renal monitoring, and timely ICU care are critical to reducing morbidity and mortality from vasculotoxic snakebite in western Maharashtra.

INTRODUCTION

Snakebite envenomation is a serious life-threatening medical emergency and a major neglected tropical disease (NTD), recognized by the World Health Organization in June 2017. Globally, an estimated 5.4 million individuals are bitten by snakes each year, of whom 1.8 to 2.7 million develop envenomation, leading to 81,410 to 137,880 deaths annually and three times as many amputations and permanent disabilities (1, 2). India bears the greatest burden, with approximately 81,000 envenomations and 11,000 deaths per year. Maharashtra ranked first in India for snakebite envenomation in 2020, recording 19,012 rural and 5,425 urban cases (3).

Vasculotoxic envenomation, primarily caused by Russell's viper (Daboia russelii) and saw-scaled viper (Echis carinatus), disrupts the coagulation cascade through Snake Venom Metalloproteinases (SVMPs) and Serine Proteases (SVSPs), leading to consumptive coagulopathy, hemorrhage, local tissue necrosis, and acute kidney injury (AKI) (4, 5). Snakebite-related AKI (SAKI) occurs in 8–43% of envenomated patients, of whom 15–55% may require renal replacement therapy and 8–39% may die (6). The 'Big Four' venomous species — saw-scaled viper, Indian cobra, common krait, and Russell's viper — account for approximately 90% of Indian snakebite deaths (7).

Despite the high burden, systematic regional data on the demographic, clinical, and laboratory profile of vasculotoxic snakebite from western Maharashtra are limited. Such data are essential to guide targeted prevention, optimal emergency triage, and evidence-based management protocols. This study was conducted to characterize the clinical epidemiology, laboratory derangements, AKI burden, and outcomes of vasculotoxic snakebite at a tertiary care centre in Karad, South-Western Maharashtra (8).

MATERIAL AND METHODS

Study Design and Setting: A cross-sectional observational study conducted at the Department of General Medicine, KIMS, Krishna Vishwa Vidyapeeth (Deemed to be University), Karad, Maharashtra, over a defined study period. Institutional Ethics Committee approval was obtained; written informed consent was taken from all participants or their legal guardians.

Study Population: All patients presenting with confirmed vasculotoxic snakebite based on clinical history, local examination, and Whole Blood Clotting Test (WBCT) were included. Patients with neuroparalytic envenomation or dry bites were excluded.

Data Collection: Demographic data (age, sex, residence, occupation), bite characteristics (site, time to presentation), clinical features (local and systemic), platelet indices and Mean Platelet Volume (MPV), coagulation profile (PT, aPTT, INR), renal parameters (blood urea, serum creatinine), treatment received (ASV vials, dialysis), ICU stay duration, AKI outcome, and final outcome (recovered/died) were recorded in a structured proforma.

Statistical Analysis: Data were entered in Microsoft Excel and analyzed using SPSS v21. Categorical variables were expressed as frequencies and percentages. Chi-square and Fisher's exact tests were used for associations. $p < 0.05$ was considered statistically significant.

RESULTS

A total of 60 vasculotoxic snakebite patients were studied. Males predominated (65%; n=39) versus females (35%; n=21). The 21–40 year age group was most commonly affected (48.3%), followed by 41–60 years (35%), and ≤60

years (16.7%). Rural residents constituted 78.3% of the cohort, and agricultural/outdoor workers represented the most common occupational group (56.7%). Lower limb bites were more frequent (71.7%) than upper limb bites (28.3%). The majority presented within 6 hours of the bite (61.7%). Most bites occurred during the monsoon and post-monsoon months (Table 1).

Local features at the bite site included swelling in all patients (100%), cellulitis (43.3%), local hemorrhage (31.7%), and necrosis (15%). Systemic features included bleeding manifestations in 56.7% (gum bleeding 33.3%, hematemesis 11.7%, hematuria 21.7%), oliguria/anuria in 38.3%, and altered sensorium in 8.3%. Key laboratory abnormalities on admission included thrombocytopenia (platelet count <150,000/μL) in 63.3%, prolonged PT/INR in 71.7%, elevated serum creatinine (≥1.5 mg/dL) in 43.3%, and elevated blood urea in 48.3%. Mean MPV was elevated at 11.8 ± 1.9 fL, and platelet distribution width (PDW) was also elevated, indicating platelet activation and consumption (Table 2).

Anti-snake venom (ASV) was administered to all patients; the mean number of vials used was 14.2 ± 6.4. Fresh frozen plasma (FFP) was required in 41.7%, and dialysis (hemodialysis or peritoneal dialysis) was needed in 21.7%. ICU admission was required in 45% of patients; mean ICU stay was 4.3 ± 2.8 days. AKI was confirmed in 38.3% (n=23) of patients, of whom 56.5% recovered renal function, 30.4% required dialysis, and 13% had persistent renal impairment at discharge. Overall mortality was 6.7% (n=4); all deaths were associated with AKI, severe coagulopathy, and delayed presentation (≥6 hours). Association between time to presentation >6 hours and mortality was statistically significant (p = 0.031). Platelet count <50,000/μL on admission was significantly associated with mortality (p = 0.018) (Table 3).

DISCUSSION

This cross-sectional study of 60 vasculotoxic snakebite patients in western Maharashtra demonstrates that young rural male agricultural workers are the most vulnerable demographic, with the 21–40 years age group constituting nearly half of all cases. This pattern is consistent with findings by Sharma et al. (2005), who also reported male predominance and agricultural occupational risk in snakebite envenomation across rural India (9), and with Mohapatra et al. (2011), whose Million Death Study confirmed young adults as the most affected age group (10).

The high prevalence of AKI (38.3%) in our cohort is consistent with published data: Chugh et al. reported SAKI in 14–32% of viper-bite patients in north India, while Sharma et al. recorded AKI rates of 29–43% following Russell's viper envenomation (11, 12). The pathophysiology involves direct nephrotoxicity from venom-induced tubular damage, microangiopathic hemolysis, and DIC-mediated renal ischemia. The high rate of coagulopathy (71.7% abnormal PT/INR) is attributable to SVMPs and SVSPs acting on fibrinogen and clotting factors, consistent with Warrell's comprehensive review of viper venom-induced consumptive coagulopathy (13).

All-cause mortality of 6.7% in our study compares favorably with reports ranging from 5–15% in similar Indian tertiary care settings, likely reflecting prompt ASV administration and ICU availability at KIMS. The significant association between delayed presentation (≥6 hours) and mortality (p = 0.031) underscores the critical role of community awareness and rapid transfer to healthcare facilities. This aligns with Agarwal et al. (2018), who demonstrated a 3.2-fold increase in mortality risk for every hour's delay in ASV administration (14). Platelet count <50,000/μL was significantly associated with mortality (p = 0.018), corroborating Suchithra et al. (2008), who found thrombocytopenia to be an independent predictor of adverse outcomes in vasculotoxic snakebite (15). The WHO's 2030 roadmap targets a 50% reduction in snakebite deaths and disability globally, making regional epidemiological data from high-burden areas like Maharashtra critically important for policy planning (16). Limitations include single-centre design, cross-sectional methodology, and inability to identify snake species in all cases.

CONCLUSION

Vasculotoxic snakebite in western Maharashtra predominantly affects young rural male agricultural workers during monsoon months. AKI (38.3%), coagulopathy (71.7%), and bleeding manifestations (56.7%) are the major complications. Delayed presentation and severe thrombocytopenia are significant predictors of mortality. Early and adequate ASV administration, prompt ICU triage, close renal monitoring, and renal replacement therapy when indicated are essential to reducing preventable morbidity and mortality. Community-level health education targeting agricultural workers and improvement in rural emergency transfer infrastructure are urgently required to address this neglected public health emergency in the region.

Table 1: Demographic Profile and Bite Characteristics (N = 60)

Parameter	Category	Frequency (n)	Percentage (%)
Sex	Male	39	65.0%
	Female	21	35.0%
Age Group	≤20 years	8	13.3%
	21–40 years	29	48.3%
	41–60 years	18	30.0%
	>60 years	5	8.3%
Residence	Rural	47	78.3%
	Urban	13	21.7%
Occupation	Agricultural/ outdoor worker	34	56.7%
	Homemaker	12	20.0%
	Other	14	23.3%
Site of Bite	Lower limb	43	71.7%
	Upper limb	17	28.3%
Time to Presentation	≤6 hours	37	61.7%
	>6 hours	23	38.3%

Majority were young rural male agricultural workers bitten on lower limbs presenting within 6 hours.

Table 2: Key Laboratory Abnormalities on Admission (N = 60)

Laboratory Parameter	Frequency (n)	Abnormal / Finding	Percentage (%)
Platelet Count <150,000/μL	38	Thrombocytopenia	63.3%
Platelet Count <50,000/μL	17	Severe thrombocytopenia	28.3%
Mean Platelet Volume (MPV)	45	Elevated (mean 11.8 ± 1.9 fL)	75.0%
PT/INR	43	Prolonged (INR >1.5)	71.7%
aPTT	38	Prolonged (>40 sec)	63.3%
Serum Creatinine ≥1.5 mg/dL	26	Renal impairment	43.3%
Blood Urea >40 mg/dL	29	Elevated	48.3%
WBCT >20 minutes	49	Coagulopathy (positive)	81.7%
Hemoglobin <10 g/dL	22	Anemia	36.7%

WBCT = Whole Blood Clotting Test; PT = Prothrombin Time;

aPTT = Activated Partial Thromboplastin Time; MPV = Mean Platelet Volume

Table 3: Treatment, ICU Stay, AKI Outcome, and Final Outcome (N = 60)

Parameter	Category / Finding	n (%)	p-value
ASV administered	All patients	60 (100%)	—
Mean ASV vials (Mean ± SD)	14.2 ± 6.4	—	—
FFP transfusion	Required	25 (41.7%)	—
Dialysis required	Yes	13 (21.7%)	—
ICU admission	Yes	27 (45.0%)	—
Mean ICU stay	4.3 ± 2.8 days	—	—
AKI confirmed	Yes	23 (38.3%)	—
AKI – Recovered	Yes	13/23 (56.5%)	—
AKI – Required dialysis	Yes	7/23 (30.4%)	—
AKI – Persistent at discharge	Yes	3/23 (13.0%)	—
Overall Mortality	Died	4 (6.7%)	—
Delayed presentation vs mortality	>6 hrs associated with death	4/4 deaths	0.031
Platelet <50,000 vs mortality	Severe thrombocytopenia → death	3/4 deaths	0.018

ASV = Anti-Snake Venom; FFP = Fresh Frozen Plasma; AKI = Acute Kidney Injury; $p < 0.05$ significant. All deaths were associated with delayed presentation, AKI, and severe coagulopathy.

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