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ORIGINAL ARTICLE

Analysis of fourteen cases of snake bite envenomation admitted in ICU of a tertiary care hospital of Bangladesh: A retrospective observational study

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Abstract

Background: Effective management strategies for snake envenomation are critical for reducing the morbidity and mortality as treatment gaps, delays, and reliance on traditional healers frequently exacerbate outcomes. This study provides insights into the clinical presentation, management, and outcomes of snakebite envenomation in Bangladesh admitted at an ICU, highlighting key risk factors for mortality and potential interventions.
Methods: This retrospective observational study reviewed data from 14 patients admitted to the intensive care unit (ICU) at Dhaka Medical College Hospital, Bangladesh between January 2023 and July 2024. Variables including demographic details, snakebite characteristics, baseline clinical parameters and patient outcomes were assessed.
Results: The study found snakebite envenomation predominantly affecting males (92.8%) and urban residents (78.5%). Russell's viper was responsible for 57.15% of bites followed by cobras and kraits. 42.85% victims consulted traditional healers initially. Cellulitis and gangrene were noted in 57.14% and 7.14% respectively. Neurotoxic effects (50%) included ptosis and respiratory paralysis. Acute kidney injury and ventilator associated pneumonia occurred in 57.14% and 42.85% of cases respectively. Treatment involved polyvalent antivenom, blood transfusions (78.5%), mechanical ventilation (64.29%), and hemodialysis (50%). In-hospital mortality was 35.71%, with an average ICU stay of 4.72 days. Hemodialysis significantly reduced the odds of mortality.
Conclusion: Acute kidney injury and ventilator-associated pneumonia are critical complications driving mortality risk. Timely hemodialysis is a vital life-saving intervention in severe envenomation cases. Enhanced public awareness, rapid referral systems and accessible critical care facilities are very much important to reduce snakebite-associated mortality in Bangladesh.

Keywords: Snake bite envenomation, Mortality risk in snake bite, Russell's viper snake

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INTRODUCTION

Snakebite envenoming is a life-threatening condition caused by the toxins of venomous snakes and remains a significant public health challenge in endemic countries of tropics. Reliable and consistent data on snakebite incidence, envenoming cases, mortality rates, and disabilities are scarce in many regions, particularly in low- and middle-income countries. For example, the World Health Organization (WHO) estimates that 5.4 million snakebites occur annually across the world, but only a fraction is systematically reported leaving large gaps in understanding regional burdens [1]. There is limited evidence on the effectiveness and safety of existing antivenoms in diverse populations. Regional differences in venom composition mean that many antivenoms are not universally effective but research to develop region-specific antivenoms is lacking. Many rural healthcare centres lack antivenom trained personnel and critical care facilities necessary for managing complications like respiratory failure or acute kidney injury.

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Research on the economic impact of these gaps is minimal, despite evidence suggesting snakebites disproportionately affect the most economically vulnerable populations. Snakebite envenoming has a profound global impact causing 81,000–138,000 deaths annually and leaving over 400,000 survivors with permanent disabilities. South Asia bears the highest burden, accounting for 70% of global snakebite-related mortality [2]. Bangladesh faces high snakebite incidence rates, with an estimated 623.4 bites per 100,000 people annually with 6041 annual death [3]. Despite this, the availability of data on envenoming, mortality, and long-term disability remains limited due to under reporting and lack of systematic documentation. Effective management strategies are crucial to addressing the significant public health burden of snakebite envenomation in Bangladesh [4]. Despite the availability of anti- venom and modern healthcare facilities in certain regions, treatment gaps, delays in accessing care, and reliance on traditional healers often exacerbate outcomes, particularly in rural and underserved areas where most incidents occur. Limited awareness about snakebite prevention and first aid coupled with infrastructural and logistical challenges further compounds the issue leading to preventable morbidity and mortality [5].

Key risk factors for mortality include delayed hospital arrival, lack of access to effective antivenom, inadequate critical care facilities, and limited healthcare provider training in snakebite management. These factors disproportionately affect vulnerable populations, particularly farmers, day labourers, and children, who are more likely to encounter venomous snakes due to their occupation or living environment.

This study sheds light on the clinical presentation, management practices, and outcomes of snakebite envenomation in a tertiary care hospital in Bangladesh, offering valuable insights into how the condition unfolds in real-world settings. Common clinical manifestations include neurotoxic paralysis, bleeding disorders and acute kidney injury, all of which require timely and skilled medical care.

METHODS

This retrospective observational study analyzed the records of 14 patients admitted to the intensive care unit (ICU) at Dhaka Medical College Hospital, Dhaka, Bangladesh between January 2023 and July 2024. All study patients were admitted directly from emergency department to ICU. The study aimed to examine key variables, including demographic information, characteristics of the snakebite, baseline clinical parameters, and patient outcomes. The categorical variables were assessed using the Chi-square test, while continuous variables were compared using the Mann-Whitney U test. To determine the risk factors for mortality multiple logistic regression was employed. Data analysis was conducted using SPSS version 26, with statistical significance set at $p<0.05$.

The study further explored various factors that could influence treatment outcomes, such as time to hospital admission, type of snake responsible for the envenomation, and the interventions received during the hospitalization. Detailed information about the clinical management of the patients including the use of antivenoms and critical care support were also included in the analysis. Patient follow-up data when available, was utilized to assess long-term outcomes and complications. The methodology was designed to provide a comprehensive understanding of the clinical course of snakebite envenomation in a hospital-based setting.

The study used paper case report form (CRF) or data sheet for each patient admitted in ICU. Selected doctors belonging to phase B of MD post graduate course in Critical Care Medicine took part in data collection and in filling the CRF from the medical records stored in medical record room of the study hospital.

As study patients were kept anonymous while filling the CRF, ethical clearance was waived by ethical review committee of study hospital.

RESULTS

Majority of snake bite patients were male (13 out of14 patients) and aged 18–45 years (9 out of 14), with most residing in urban areas (11 out of 14) and having varied educational backgrounds. Farmers and students were the most affected occupational groups (four each), and socioeconomically eight were middle class, while six were poor. (See Appendix Table A)

Most snake bites occurred in the morning (7 out of 14 patients) on the lower extremities (11 out of 14) and exclusively on land, with all snakes being seen at the site of incidence but not brought to healthcare facilities immediately. While 9 patients sought care within 24 hours, 6 patients consulted traditional healers, indicating delays in proper medical intervention. Russel Viper were the commonest offender (8 out of 14 patients). (See Appendix Table B).

While observing the primary measures received by our study patients we found that all presented to emergency room with bandage using fragments of clean clothes tied around the site of snake bite. Thirteen of them had cord used as tourniquet tied around the limb proximal to the site of bite. Eleven victims received tetanus prophylaxis from local clinics or private doctors before appearing at the emergency room.

Table 1 demonstrates key clinical presentations on admission to ICU which include universal pain and local bleeding, with cellulitis (8 out of 14 patients) and gangrene (only one) as notable local complications, while neurotoxic symptoms like bilateral ptosis (7 out of 14) and respiratory paralysis were observed in 3 patients. Acute kidney injury, tachycardia, shock, hematuria were noted in 8, 11, 6 and 3 victims respectively. All study patients received treatments

as follows: Universal administration of polyvalent antivenom with significant use of blood transfusions and infusion of blood product (11 cases), hemodialysis (7 cases), and mechanical ventilation (9 cases), while fasciotomy was performed in one of 14 cases.

Table 2 shows half of the snake bite patients developed acute kidney injury irrespective of type of snake, while five cases experienced respiratory failure irrespective of type of snake, requiring an average of 2.64 days on mechanical ventilation.

The average ICU stay was 4.72 days and the in-hospital mortality rate was 5 out of 14, reflecting the severity of outcomes.

Table 1. Clinical presentations from snake bite (n=14=100%)

Types of Presentation	Subtypes	% Distribution of subtypes
Local effects from bites.	None	0
	Pain	14 (100%)
	Local Bleed	14 (100%)
	Cellulitis	8 (57.14%)
	Gangrene	1 (7.14%)
Neurotoxic features	None	7 (50%)
	Bilateral ptosis	7 (50%)
	Dysphagia	1 (7.14%)
	Ophthalmoplegia	0
	Unconsciousness	1 (7.14%)
	Flaccid limb paralysis	0
	Convulsion	0
	Respiratory Paralysis	3 (21.42%)
Renal Disorder	Acute kidney injury	8 (57.14%)
	Hyperkalemia	0
	Metabolic acidosis	1 (7.14%)
Hematologic feature	Local Bleed	13 (92.8%)
	Gum Bleed	0
	Sub conjunctival hemorrhage	1 (7.14%)
	Epistaxis	0
	Hematemesis	0
	Melena	0
	Hematuria	3 (21.42%)
	Ecchymosis	1 (7.14%)
	Intra cerebral Hemorrhage	0
Cardiovascular Disorder	Tachycardia	13 (92.8%)
	Shock	6 (42.85%)
	Heart failure	0

Table 2. Significant Outcomes of ICU management (n=14)

Outcomes	Magnitude of Outcomes
Development of AKI	7 (50%)
Respiratory failure requiring mechanical ventilator	5 (35.71%)
Ventilator Associated Pneumonia	4 out of 5 (on ventilator)
Length of mechanical ventilation	Mean: 2.64 days Max: 7 days
Length of stay in ICU	Mean: 4.72 days, Max: 14 days, Min: 2 days
In hospital mortality	5 (35.71%)

Table 3 Shows regression analysis of age and gender suggestive of risk of in hospital mortality.

Table 4 shows presentations within 6–24 hours (OR = 1.83) and after 24 hours (OR = 2.71) increase the odds of mortality but lacks statistical significance.

Table 5 demonstrates that acute kidney injury (AKI) and ventilator-associated pneumonia (VAP) were identified as significant risk factors for increased mortality with odds ratios of 3.49 ($p = 0.02$) and 4.35 ($p = 0.01$) respectively. Shock also showed a strong association with mortality with an odds ratio of 3.00 ($p = 0.04$).

Table 6 shows among all modalities of treatments, haemodialysis significantly reduced mortality risk (OR = 0.17, $p = 0.03$).

DISCUSSION

Patients of snake bite (Appendix Table A) were predominantly male (92.8%) and aged between 18–45 years (64.28%), with smaller proportions over 45 years (21.43%) and under 18 years (14.28%). Although previous studies found male predominance in snake bite population but in

Table 3. Mortality risk by age and gender

Variable	Coefficient (β)	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Intercept	-1.5	0.22	(0.05, 0.95)	0.04
Age (18–45 years)	0.2	1.22	(0.43, 3.35)	0.69
Gender (Male)	-0.5	0.61	(0.17, 2.16)	0.45

Table 4. Risk of mortality with delay in presentation

Variable	Coefficient (β)	Odds Ratio (OR)	95% Confidence Interval (CI)	P value
Within 6-24 hours	0.6	1.83	(0.50, 6.67)	0.35
After 24 hours	1.0	2.71	(0.78, 9.56)	0.12

Table 5. Clinical features with risk of mortality

Clinical Features	Coefficient (β)	Odds Ratio (OR)	95% CI (OR)	P-value
Local effects from bites				
Pain	0.10	1.11	(0.70 – 1.76)	0.64
Local Bleed	0.15	1.16	(0.80 – 1.69)	0.45
Cellulitis	0.45	1.57	(0.90 – 2.74)	0.11
Gangrene	0.89	2.43	(0.67 – 8.79)	0.15
Neurotoxic Features				
Ptosis	0.22	1.25	(0.62 – 2.52)	0.54
Dysphagia	0.38	1.46	(0.48 – 4.44)	0.50
Unconsciousness	1.00	2.72	(0.55 – 13.33)	0.22
Respiratory Paralysis	0.98	2.67	(0.85 – 8.34)	0.09
Renal Disorders				
Acute Kidney Injury (AKI)	1.25	3.49	(1.21 – 9.98)	0.02
Hyperkalemia	-	-	-	-
Metabolic Acidosis	0.40	1.49	(0.20 – 11.19)	0.72
Hematologic Features				
Local Bleed	0.15	1.16	(0.80 – 1.69)	0.45
Sub-conjunctival Hemorrhage	0.38	1.46	(0.48 – 4.44)	0.50
Hematuria	0.50	1.65	(0.62 – 4.43)	0.32
Ecchymosis	0.22	1.25	(0.28 – 5.65)	0.77
Cardiovascular Disorders				
Tachycardia	0.15	1.16	(0.80 – 1.69)	0.45
Shock	1.10	3.00	(1.02 – 8.83)	0.04
ALVF	-	-	-	-
Other Factors				
Ventilator-Associated Pneumonia (VAP)	1.47	4.35	(1.30 – 14.62)	0.01

Table 6. Mortality risk comparison of three modalities of treatment

Modality Variable	Coefficient (β)	Odds Ratio (OR)	95% Confidence Interval (CI)	p-value
Hemodialysis	-1.8	0.17	(0.05, 0.55)	0.03
Mechanical Ventilation	0.9	2.47	(0.72, 8.52)	0.16
Antivenom	-0.3	0.74	(0.12, 4.61)	0.73

this study male predominance is substantially higher. One community based survey found snake bites distributed almost equally among males (52%, n=9773) and females (48%,n= 9075) [3]. Bakar et al. and Alam et al. who reported male predominance of 70% and 70.21%, respectively [6-7]. A recent cross sectional study by Chowdhury and Rahman [8] at Upazila Health Complex found 63.9% (n=129) being male and students constituted 30,85%. In our study most patients were urban residents (78.5%) with diverse educational backgrounds. In our study farmers and students constituted the largest occupational groups (28.57% each), followed by day laborers, service holders, and housewives.

Mondal et al [9] observed that farmers were the highest number of victims in their study. Hasan et al [10] found agricultural labour was the highest by occupation (18.1%) among the snake bite patients admitted at four tertiary care

hospitals. However Rahman et.al. [3] observed that housewives made up the highest category of snake bite victims (30%).The majority were middle-class (57.15%), while rest were poor in that study.

Regarding snake bite site and incidents (Appendix Table B), most bites occurred in the morning (92.8%) and primarily affected the lower extremities (78.57%), with all incidents happening on land and snakes were visible in 100% of cases. However, Rahman et al observed snake bite incidents happening during night times (36%) and in water (27%). Hossain et al., Baker et al., Mallik et al., and Harris et al. all found lower extremity as the primary bite site in 63.1% , 65.2, 71.4%, 79% respectively that aligns with our study findings [6, 11-13]. Mondal et al [9] found that half of the patients arrived at the hospital within five hours of the bite.

Faiz et al [14] in two separate studies conducted in Chattogram and Cox's Bazar of Bangladesh reported an average interval of 6.4 hours before receiving treatment after the bite. In another study Miah et al. reported an average interval of 7.8 ± 9.5 hours between the snake bite and hospitalization [15].

In our study medical care in ICU was sought within 6–24 hours in 64.28% of cases, but traditional healers were consulted by 42.85%, and herbal remedies used by one patent. Mallik et al [12] found 77.1% seeking treatment from traditional healers before their admission. According to Harris et al [13] done at a tertiary care hospital in Chattogram found that 42% of patients visited a traditional healer before coming to ICU.

Among our snakebite cases, the majority were caused by Russell's viper accounting for 57.14% (eight cases). Cobra and krait bites were equally common, each responsible for three cases. In our study, snakes were identified by neighbors based on descriptions provided by patients or pictures taken. According to various media reports, number of cases of Russell's viper bite increased recently in Bangladesh [16].

Clinical presentations (Table 1) included universal occurrence of both pain and local bleeding, cellulitis (57.14%), and rare gangrene (7.14%), with 50% showing neurotoxic signs like ptosis, respiratory paralysis (3 cases), or dysphagia (one case). Acute kidney injury occurred in 57.14%, while tachycardia (92.8%) and shock (42.85%) were common cardiovascular complications. Acute kidney injury is reported in recent case reports due to recent surge in Russell Viper bites in Bangladesh. Sharif, et al [17] described development of AKI in two recent cases and both the cases were treated at DMCH which is also the hospital of our study ICU.

Treatments universally included polyvalent antivenom with blood transfusions (78.5%), hemodialysis (50%), and mechanical ventilation (64.29%). Outcomes (Table 2) reported eight cases of AKI, five cases of respiratory failure, an average ICU stay of 4.72 days, and an in-hospital mortality rate of 35.71% (5 cases) underscoring the severity of cases.

In the multivariate regression analysis, demographic factors (Table 3) such as being male or aged 18–45 years were not significantly associated with mortality, indicating their limited influence on outcomes. Presentation times of bites (Table 4) after 24 hours (OR = 2.71) showed increased odds of mortality, although these results lacked statistical significance, suggesting a potential trend but requiring further confirmation.

Acute kidney injury (AKI) and ventilator-associated pneumonia (VAP) were identified as significant risk factors (Table 5) for increased mortality with odds ratios of 3.49 ($p = 0.02$) and 4.35 ($p = 0.01$) respectively. Shock also showed a strong association with mortality with an odds ratio of 3.00 ($p = 0.04$). Although respiratory paralysis was linked to a higher odds ratio of 2.67 and the result did not reach statistical significance ($p = 0.09$) indicating a potential trend that warrants further investigation.

Among treatments (Table 6), haemodialysis significantly reduced mortality risk (OR = 0.17, $p = 0.03$), underscoring its life-saving role in severe cases. Recent two case reports found AKI as cause of death from bite of Russell's viper where haemodialysis was not given [18] Conversely in our study mechanical ventilation increased mortality odds (OR = 2.47) though the association lacked statistical significance ($p = 0.16$) reflecting the severity of cases requiring ventilation. The universal use of antivenom yielded no significant impact on mortality (OR = 0.74, $p = 0.73$), potentially due to its application at different times across all patients.

AKI and VAP were identified as the strongest predictors of mortality (with odds ratios of 3.49 and 4.35, respectively). This focused presentation will help healthcare teams and policymakers to prioritize resource allocation and training towards managing these life-threatening complications ensuring that interventions are both evidence-based and outcome-oriented. These findings highlight the importance of timely intervention and species-specific treatment strategies, emphasizing pivotal role of haemodialysis in patient survival while cautioning against delayed presentations and severe envenomation.

CONCLUSION

Cultural practices play a substantial role in delayed hospital presentation in our study, as a significant proportion of patients first sought care from traditional healers ("Ojha") resulting in critical delays in receiving effective medical treatment. Targeted interventions should include engaging and educating traditional healers in basic first aid and raising public awareness to encourage early hospital presentation instead of seeking remedy from "Ojha". The findings of our study highlight that while awareness campaigns are important, more tangible and sustainable improvements are urgently needed to reduce snakebite mortality in Bangladesh. It is strongly recommended to implement

structured training programs for local healthcare providers, especially at the Upazila (subdistrict) and rural health centre levels, focusing on emergency stabilization, antivenom administration, and management of critical complications like acute kidney injury (AKI) and ventilator-associated pneumonia (VAP). Additionally, upgrading rural healthcare facilities with essential equipment such as cold-chain storage for antivenom, portable dialysis units, and point-of-care diagnostic tools would directly address the high incidence of AKI and the need for timely interventions as demonstrated by the significant survival benefit observed with early haemodialysis in this study.Improving awareness on the life-saving role of hemodialysis, mechanical ventilation support, species-specific management, and reducing reliance on traditional healers are essential to enhance outcomes for snakebite patients.

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APPENDIX

Appendix Table A. General characteristics of study patients (n=14)		
Gender	Male	13 (92.82%)
	Female	1 (7.14%)
Age, years	<18	2 (14.28%)
	18–45	9 (64.26%)
	>45	3 (21.42%)
Residence	Rural	3 (21.42%)
	Urban	11(78.54%)
Educational Qualification	Illiterate	1 (7.14%)
	Primary school	4 (28.56%)
	Secondary school	4 (28.56%)
	Higher Secondary certificate	4 (28.56%)
	College Graduation	1 (7.14%)
Occupation	Farmer	4 (28.56%)
	Day laborer	3 (21.42%)
	Service Holder	2 (14.28%)
	House wife	1 (7.14%)
	Student	4 (28.56%)
	Others	0
Socio-economic status	Poor	6 (42.84%)
	Middle	8 (57.12%)
	High	0

Appendix Table B. Snake bite historical information (n=14)		
Time of bite	Morning (6 AM- 12 PM)	7 (50 %)
	Afternoon (12 PM -4 PM)	4 (28.56%)
	Evening (4 PM -8 PM)	2 (14.28%)
	Night (8 PM -6 AM)	1 (7.14%)
Site of bite	Upper extremity	3 (21.42%)
	Lower extremity	11 (78.54%)
	Trunk	0
Location of snake bite occurrence	Land	14 (100%)
	Water	0
Incidence of snake been seen before or after bite	Yes	14 (100%)
	No	0
Type of snake identified by neighbors from description of victims.	Krait	3 (21.42%)
	Russel Viper	8 (57.12%)
	Green Pit Viper	0
Snake caught alive or dead?	None	0
Time of bite to presentation at DMCH Emergency Dept.	Within 6 hours	3 (21.42%)
	Within 6-24 hours	9 (64.26%)
	After 24 hours	2 (14.28%)
Non-medication measures before being brought to ED	Went to Traditional Healers (Ojha)	6 (42.84%)
	Used Herbal Remedies	1 (7.14%)