Original Article

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Clinico-Epidemiological Characteristics and Outcomes of Snakebite in Pediatric Patients at a Tertiary Care Hospital

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Abstract

Background: Snakebite is a neglected public health problem in Bangladesh having one of the highest incidence in the world. Demography, epidemiology, clinical features, treatment seeking behavior and outcome of snake bite were well studied in adult population of Bangladesh but none of the studies were solely done in pediatric patients. This study aimed to investigate the demographics, clinical characteristics, pre-hospital management and outcomes of envenomed children in a tertiary-level hospital in Bangladesh.

Materials and methods: This prospective observational study was conducted in the Snakebite Clinic of Chittagong Medical College Hospital (CMCH) from April 2022 to March 2023. The facility admitted 1055 patients, including 128 (12.13%) snakebitten children under 18. A standardized questionnaire was used covering demographics, snake bite details, pre-hospital care and clinical outcomes. Admitted individuals were monitored daily.

Results: The 128 snake bite victims were 98 (76.7%) males and 30 (23.4%) females. Nearly half (46.9%) of snake bites happened in 13–18-year-olds. 71% of bites occurred in May–October, with 81% in the afternoon or evening. 17 (13.3%) of 128 patients sought pre-hospital treatment, most from indigenous healers called "Ohzas" (76.5%). No patients were immobilized after ligation (92.2%). Hospitalized patients (77.3%) had non-poisonous snake bites. Snakebites caused local envenomation (21.1%) neurotoxic symptoms (1.6%) abnormal coagulation (2.3%) and one patient aided artificial breathing. Unfortunately, one child died due to a snake bite.

Conclusion: Safe and effective antivenom, supportive treatment and skilled local health professionals can prevent snakebite deaths and severe health issues. However, snakebite envenoming affects rural low-income communities disproportionately, making treatment challenging. To address this, the community needs prehospital first-aid and traditional medicine risk education.

Key words: Clinico-epidemiology; Children; Snakebite.

Introduction

Venomous snake bites can result in severe local tissue destruction, shock, paralysis, bleeding, acute renal injury and other acute medical issues that, if untreated, can be fatal or result in permanent impairment.[1] By having prompt access to safe and efficient antivenoms, mostdeaths and severe effects from snakebite envenomation can be avoided.[1,2] An estimated 5.4 million snakebites occur annually worldwide, resulting in 1.8 to 2.7 million cases of Snake Bite Encephalitis (SBE) 81,000 to 138,000 fatalities and 400,000 survivors with permanent physical and psychological disabilities.[3] Three times as many snake bite victims do survive, but they are left with lasting deformities and amputations.[4] Envenomation and snakebite mortality are frequently unreported in the field of global health.[5-7] Since reporting is not always required, snakebites frequently go undetected. Currently, no thorough investigation on the frequency of snake attacks has been conducted on a national or global scale. However, in 2019, the World Health Organization (WHO) introduced a strategy to prevent and manage snakebite cases and added snakebite poisoning to its priority list of neglected tropical diseases aims to reduce the number of deaths and instances of serious clinical impairment by 2030.[8]

Like other Southeast Asian tropical countries, Bangladesh has a relatively high rate of

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snakebites.[7,9] It is the single most important toxin-related damage, contributing significantly to mortality and morbidity in Bangladesh, particularly in rural sites.[10] The incidence density of snakebite in rural Bangladesh is 623 per 100,000 person-years, with an estimated 6,041 deaths yearly, according to national community-based epidemiological research on snakebite and its socioeconomic consequences in Bangladesh.[9,10] Snakebites have a substantial negative impact onhuman health and the economy due to the cost of medical care and lost productivity.[11,12] Children are more likely to get bitten by snakes than adultsbecause of their interest in strange animals, harmless intrusion into the reptile's territory and propensity to go barefoot, especially at darkness.[13,14] When bitten by a snake, children do not respond the same way that adults do. Since children's bodies receive more venom per square meter of surface area, this incident always affects them more severely.[15] Several studies evidenced that venom affects children more easily than it does adults[16] and different snake species have unique forms of venom that cause various symptoms, such as intravascular hemolysis, neurotoxicity, myotoxicity, renal failure and oedema.[1,17]

Numerous cross-sectional studies regarding snake bites have been performed and well documented on adults; however, studies on pediatric victims are rarely conducted.[9,18-20] To the best of our knowledge, there have been some field surveys on pediatric patients, but the specifics need to be thoroughly recorded. Although pediatric age groups have gotten special attention in elsewhere in the world, snake bite issues are still infrequently addressed in Bangladeshi pediatric age groups.[10] As a result, pediatricians and general care physicians have relatively limited knowledge about the pattern of snake bites among pediatric age group. In this context, this hospital based prospective observational study was designed to ascertain the clinical-epidemiological profiles and outcomes of pediatric patients admitted with snakebite in a tertiary care hospital in Bangladesh. In this context, this hospital based prospective observational study was designed to determine the clinico-epidemiological profile and outcome of pediatric patients admitted due to snakebite in a tertiary care hospital of Bangladesh.

Materials and methods

This prospective observational cohort study was conducted in the Snakebite Clinic (Medicine Unit III, Ward 16) of CMCH from April 2022 to March 2023. Ethical approval was obtained from the Ethical Review Committee of Chittagong Medical College (CMC/PG/2022/488). Informed written consent was obtained from guardians and assent from children over 11 years old. Measures were taken to ensure patient anonymity and privacy. This Snakebite Clinic established about 20 years ago, has wide catchment area covering most of the south-east region of Bangladesh and dedicated for inpatient care and management of all snakebite victims irrespective of their age. Consecutive sampling technique was followed in this study.

The pediatric patients up to 18 years of age with a history of snake bite included in the study whereas patients over 18 years or refused to give assent excluded from the study. A structured questionnaire containing all the variables of interest was filled up by interviewing the guardian/ patient followed by physical examination or clinical investigation. Each patient was followed up dailytill they were discharged or passed away toobserve any issues and hospital outcomes. The offending snake was identified according to the victim's history and description of the snakeby showing the victim pictures of other snakesor by looking at the snake's body that had been brought along with the victim. Following admission, a complete medical examination and detailed history were obtained. An area inspectionwas conducted, paying close attention to fang marks, swelling, discomfort and blisters. The maximum level of edema was used to describe the severity of localized swelling. According to the "National Guideline of Management of Snake Bite," patients with local or systemic symptoms indicating envenomation were recognized as cases of poisonous snakebite, and other snake species were also suspected of this diagnosis following bedside test for whole blood coagulation was done in all patients for 20-minutes. Patients were monitored daily during their hospital stay till discharge/death to observe the complications and outcomes. Patients were managed by a special group of trained health professionals.

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Following collection, all the data were examined and updated. The Statistical Package for Social Sciences (SPSS) version 23.0 was then utilized to carry out the statistical analysis once the data wereimported into a Microsoft Excel spreadsheet. Only, descriptive statics were used in the results. Based on the facts, continuous variables were statistically defined as the mean (Standard deviation) or median with aninterquartile range. Frequencies and proportions were used to characterize qualitative or category variables.

Results

Age range from 1.3 to 18 years with a mean age of 11.29 ±4.42 years in this study with 46.9% of patients in the age group of 13-18 years, followed by 48 (37.5%) in 7-12 years and 20 (15.6%) in the 0-6 years age group. The male to female ratio was 3.27:1. Majority (84.4%) of the patients were from rural area. January was the month with the lowest incidence of bites (1.6%). Then it rose incrementally, achieving its highest peak in October (18%). The majority of incidents (70.3%) occurred between May and October, while the fewest bites (14.9%) occurred between November and March.

Only one-third of cases involved an identified snake (34.4%) while most victims could not identify the species (65.6%). Among identified cases (n=44) identification was primarily based on victims' descriptions (79.5%) with fewer confirmed through picture matching (13.6%) or direct observation of the specimen (6.8%). In terms of snake type (n=44) green pit vipers were most frequently reported (50.0%) followed by keelbacks (18.2%) and yellow snakes (11.4%). Water snakes accounted for 9.1%, while dog-faced water snakes, cobras and kraits were uncommon (Each ≤4.5%).

Table I summarizes the environmental context and circumstances of snakebites among 128 patients. Most bites occurred on dry days (85.9%) with patients presenting to hospital after a median of 3 hours (IQR 2–4, range 1–26). Bites were most frequent from noon to 6 pm (44.5%) followed by 6 pm to midnight (36.7%). The lower extremity was the predominant bite site (79.7%) while upper extremity (18.0%) and face/head/buttock (2.3%) bites were uncommon. Bites occurred mainly in or near water (28.9%) and on open ground (25.0%) with fewer incidents on unpaved roads (16.5%) inside houses (14.1%) shrubs (10.9%) and forests (4.7%). All victims were awake at the time of bite, and in most cases the snake had been disturbed (79.7%) trodden snakes accounted for 17.2% of bites and catching the snake was rare (3.1%).

Table I Environmental and circumstances of snake biting (n=128)

Variables	Frequency (percentage)*
Weather condition of the day of bite	
Dry	110 (85.9)
Rainy	18 (14.1)
Time lapse from bite to presentation to hospital (Hrs)	
Median (IQR)	3 (2-4)
Range	1-26
Time to bite	
Midnight to 6 am	2 (1.6)
6 am to 12 noon	22 (17.2)
12 noon to 6 pm	57 (44.5)
6 pm to midnight	47 (36.7)
Site of bite	
Upper extremity	23 (18.0)
Lower extremity	102 (79.7)
Face/head/buttock	3 (2.3)
Bite location	
In or near water	37 (28.9)
Open ground	32 (25.0)
Unpaved road	21 (16.5)
House	18 (14.1)
Shrub	14 (10.9)
Forest	6 (4.7)
Activity of victim during bite	
Awake	128 (100)
Interaction with snake	
Snake was disturbed	102 (79.7)
Snake was Trodden	22 (17.2)
Snake was caught	4 (3.1)

*Data are expressed as frequency (Percentage) if not otherwise mentioned. IQR: Interquartile Range.

Table II presents the pre-hospital care practices among 128 snakebite victims. Only a small proportion received any pre-hospital treatment (13.3%), and among those, care was predominantly provided by traditional healers (Ohzas, 76.5%) rather than medical personnel (23.5%). Despite this, ligature use was very common (92.2%) among those who applied ligatures (n=118), multiple ties were frequent (two ligatures in 39.8% and ≥3 in 37.3%), with a median duration of 3 hours (IQR 2–4). No victim received immobilization or used herbal remedies, while incision at or near the bite site was rare (2.3%). For patients who consulted Ohzas (n=13), the median time spent was 1 hour (IQR 0.5–2).

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Table II Pattern of pre-hospital cares received by the snakebitten victims (n=128)

Variables	Frequency (Percentage)*
Receive prehospital treatment	
Yes	17 (13.3)
No	111 (86.7)
Pre-hospital treatment provider (n=17)	
Medical person	4 (23.5)
Ohzas	13 (76.5)
Application of ligature	
Yes	118 (92.2)
No	10 (7.8)
Number of ligature (n=118)	
1	27 (22.9)
2	47 (39.8)
≥3	44 (37.3)
Duration of ligature (n=118)	
Median (IQR)	3 (2-4)
Immobilization done	
No	128 (100)
Incision bite site/vicinity	
Yes	3 (2.3)
Applied/ingested herbal medicine	
No	128 (100)
Time spent with Ohzas, hours (n=13)	
Median (IQR)	1 (0.5-2)

Data are expressed as frequency (Percentage) if not otherwise mentioned. IQR: Interquartile Range.

Table III summarizes the clinical presentation at hospital arrival among 128 snakebite victims. Most patients reported only a history of bite without any observable signs or symptoms (75.0%). When present, local manifestations were mainly pain (16.4%) and swelling (14.8%) with less frequent fang marks (9.4%) discoloration (7.0%) and bleeding (3.1%) local infective complications were rare (≤0.8% each) (Figure 1). Evidence of coagulopathy was uncommon, with a positive whole blood clotting time (WBCT) in 5.5%. Overall complications were infrequent, including neuroparalysis and respiratory paralysis (each 1.6%) cellulitis (3.1%) hypotension (1.6%) coagulation failure (2.3%) and a single death (0.8%) while vasculotoxicity and acute renal failure were not observed.

Table III Signs, symptoms and complications of envenomation at the time of appearance (n=128)

Characteristics	Frequency (Percentage)
Signs and symptoms of envenomation	
H/O bite only (No symptoms/sign)	96 (75.0)
Pain	21 (16.4)
Fang mark present	12 (9.4)
Swelling	19 (14.8)
Discoloration	9 (7.0)
Bleeding	4 (3.1)
Local infection + Necrosis+ blister	1 (0.8)
Local infection and abscess only	1 (0.8)
Positive WBCT	7 (5.5%)
Complications of envenomation	
Neuroparalysis	2 (1.6)
Respiratory paralysis	2 (1.6)
Cellulitis	4 (3.1)
Hypotension	2 (1.6)
Coagulation failure	3 (2.3)
Death	1 (0.8)

WBCT: Whole Blood Clotting Time.

Figure 1 Image (A, B): (A) Envenomed kid following (B) local infection and necrosis in right hand (C, D): (C) Envenomed kid following (D) discoloration or ecchymosis in left leg (E, F): (E) Envenomed kid following (F) blister or bulla in left hand (G, H): (G) Fang mark in envenomed kid (H) Application of ligature in left leg

Clinical features of envenomation were observed in less than one fourth of cases (22.7%). The majority of symptoms are local (27, 21.1%) which includes swelling and inflammation at the puncture site. Only two cases (1.6%) showed neurotoxic properties. Table IV outlines in-hospital management and length of stay among 127 children with snakebite. Use of advanced interventions was uncommon, with anti-snake

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venom administered to 1.6% and mechanical ventilation required in 0.8%. Most children had short hospitalizations, with 64.6% discharged within 1–2 days, while 22.8% stayed 3 days and 12.6% required admission for ≥4 days.

Table IV Clinical care details of the children with snake bites (n=127)

Mode of treatment		Frequency (percentage)
Anti-snake venom		2 (1.6)
Mechanical ventilation		1 (0.8)
Duration of hospital stay	1 day	36 (28.3)
	2 days	46 (36.3)
	3 days	29 (22.8)
	≥4 days	16 (12.6)

Discussions

Tropical countries record snakebites frequently as medical emergencies. Working youth are more prone to it. Due to underreporting, fatalities,and illnesses tend to remain unresolved. Thus, the WHO's South East Asian Region continues to attempt to recognize it as a reportable illness.[14] This study conducted in a Snake Bite Clinic of tertiary care hospital of Bangladesh explored the profile of 128 snakebite victims of pediatric age group and analyzed their socio-demographic, clinical details and outcome. Mean age of the patients were 11.29 ±4.42 years and about half of the patients (46.9%) were in 13 years to 18 years of age group. Previous community based survey conducted in rural Bangladesh reported that, the majority of the snake bite victims were of a younger age indicating that, an active population is at higher risk of snake bites.[9] A survey community-based conducted by Hossain et al. in Bangladesh showed that children between the ages of 10 and 19 are more likely to experience snake bites than other age groups.[21] According to the current study, more than three-quarters of the hospitalized patients with snake injuries were male. These demographic characteristics may be explained by the fact that males spend more time engaging in outdoor activities and that children of this age are very active and curious. Earlier hospital-based examinations in Sri Lanka, Malaysia, and Nepal yielded comparable results.[22-24] Regarding seasonal snake bite patterns, the present study revealed that from May to October, during the summer and monsoon season, 70.3% of snake bites occur. The incidence of bites was lowest in the month of January (1.6%) and progressively increased to its peak in the month of October (18%). To fully understand why snake bites are increasing in Bangladesh, especially in October, more local studies and research are needed. Our study revealed that November to March, the incidence of bites declined to 14.9%. A large proportion of patients (84.6%) were from rural areas and the majority of agricultural activities in those areas occurred during this season, which may account for the higher incidence of snake bites. An increased snake activity during warm temperatures and monsoon rainfall which may due to prey availability, breeding opportunity, migration or habitant preference, or thermoregulation. Furthermore, these environmental conditions may force snakes to abandon their hiding places in search of refuge in relatively high and dry regions, which may be largely responsible for the elevated risk of snake bites during the monsoon season. Similar findings from other studies were reported.[9,22,25,26] Although previous research has demonstrated that snake attacks are more common during the summer and monsoon seasons, the exact relationship between monthly snake bites, temperature and precipitation remains unclear. The majority of snake bites occurred outside, presumably due to children playing or engaging in other activities, whereas only 14.1% occurred inside the home.[21,22] However, snake bites can occur at any time of the year, so it is important to be cautious and familiar with snake habitats and behavior to reduce the risk of getting bitten. When encountering snakes or being in areas where they may be present, it is best to be cautious and keep a safe distance to avoid any potential conflicts.

As a result of an unintentional stampede when moving or playing in the dark, snake bites frequently occur in the lower limb, near the ankle. Similar to previous research, mostpatients in this study (70.7%) had lower extremity snake injuries.[27] We found 2.3% of wounds were on the face, head or buttock comparable to the findings as described previously.[28] However, agriculture laborers frequently bite their faces because the face has become the closest target when harvesting rice, vegetables, and fruits.[21] According to our analysis, the most significant period for snakebites occurred between noon and six p.m.

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followed by six p.m. and midnight, which is consistent with other reports.[22] Approximately one-third of injuries (28.9%) in the present study occurred in or near a body of water. Children typically visited water sources and played outside between noon and six o'clock in the afternoon, as this was their free time. At dusk, snakes leave their dens in quest of prey and become active. Due to reduced visibility at dusk and night, individuals may step on snakes, resulting in stings.[28] Due to the lengthier travel distance and subpar transportation, 25% of patients arrived at the hospital after 4 hours had passed since the bite incidence, which was found to be the median time (3 hour) from bite incidence to arrival at the snake bite clinic. In the current investigation, one patient's delay in receiving primary care led to death; in these cases, non-licensed traditional healers provided care, delaying hospitalization. Over 90% of the victims had a tourniquet as a ligature, however a sizeable percentage of patients employed tight, numerous tourniquets, which was far from scientific and safe practice.[29] It is to be noted that just 10% of the children in the current study received any traditional first aid from Ohzas, no victim had their injured limb immobilized. A higher percentage of snake bite victims sought assistance from the Ohzas, according to studies done decades ago.[9,30] More than half of the snake bite victims received pre-hospital care from Ohzas, according to Chakraborty et al.[30] According to Rahman et al. snake charmers' or "Ozhas'" recitation of mantras was the most common pre-hospital treatment (60%) for patients.[9] An alarmingly high percentage of instances involve potentially hazardous techniques, including several cuts surrounding the bite site and oral blood sucking from the numerous cuts.[31] According to the current study results, these dangerous behaviors are declining. Our observation is supported by the fact that most snakebite sites were in the lower limbs (79.7%) of the victims, which is a result of human activities like walking or unintentional contact with snakes.[32] All snake bite victims were awake when they were bitten and the majority of times (79.7%) the snake was disturbed. 17.2% of cases, a snake was trampled. Snakebites are linked to a variety of activities, including cleaning brush, picking flowers, strolling along unpaved roads, working in rice fields with others, using ponds and playing near ponds and open spaces, among others[33]. Identification of the snake's species can help in predicting potential victim symptoms. However this is not possible all the times. In the current investigation, roughly 66% of the victims' snake bites could not be positively identified. This incident points to either children's ignorance of snakes or reduced visibility brought on by nocturnal bites while strolling in the dark or underwater. Only three victims carry the snake's corpse to the hospital with them. In other instances, we categorized the snakes mostly using descriptions or illustrations. This is consistent with the results of numerous other pediatric age-group studies[23,34-36]. Only 22.7% of the 128 children admitted with snake bites in the current study displayed toxic characteristics, while 77.3% had no evidence of envenomation. Compared to the earlier report in the literature, the number of patients with envenomation-like symptoms was significantly reduced in the current study where one-third of the cases reported by Hanumanna et al. were nonvenomous.[37] In their 80 cases, Meshram et al. observed that only 22% were caused by non-venomous snake bites.[38] Due to its inclusion criteria, the current study's low frequency of venomous bites may have been prevented. The present study's inclusion criteria were flexible. The investigation included any suspected bite, whether it had fang markings or not. Therefore, it was impossible to rule out bites or injuries caused by sources other than snakes in the present investigation. Local consequences such as local oedema, cellulitis and bleeding from the local site were present in most venomous bites. Hypotension (1.6%) and coagulation failure (2.3%). Respiratory failure, ptosis, drooling, the broken neck sign and nasal voice were observed in two individuals who had had a neurotoxic bite. One of them became paralyzed from the chest down and needed a ventilator. Numerous hazardous aspects, from hemotoxic to neurotoxic, were seen in other trials on juvenile patients.[24,32,34,35,38]

Most patients had satisfactory consequences accordance to our study populations having reduced toxic appearances and complications. Only one patient passed away, and he was admitted dead (Expired before getting any formal

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treatment from the hospital). In two cases, anti-snake venom was given, and mechanical ventilation was required for one case. Most of the time, hospital stays lasted three days or less. Other investigations revealed a higher mean hospital stay duration, at 10.1±3.04 days.[28] This low prevalence of envenomation-related symptoms and low death were potentially caused by the inclusion criteria used in the current investigation. The study included patients with a questionable bite but no clear history or acute onset signs and symptoms of envenomation. Because of the hospital's policy, patients with suspected snake bites must be kept for at least 24 hours of observation. Previous studies on adult patients in other tertiary care hospitals found proportionally fewer cases of venomous snake bites as well as lower hospital mortality.[28,30,39] The study sought to determine the epidemiology, bite-related data, typical clinical presentations, complications, and outcomes of snake envenomation in Bangladeshi children of the relevant age group. It will support the understanding of policy planning on awareness, snakebite prevention and first aid, clinical management, and the early recognition of warning indicators of envenomation. The results of the current study would be valuable in establishing focused prevention and treatment strategies that could assist Bangladesh in achieving the WHO aim of halving the mortality and morbidity rates from snakebites by 2030.

Limitations

The study was conducted in a single tertiary-level hospital in Bangladesh, therefore, the findings may not be fully generalizable to the broader population or to patients managed in primary and secondary care settings. The exact snake species could not be identified in most cases, limiting species-specific interpretation of clinical patterns and outcomes. Finally, the inclusion criteria were relatively broad, based mainly on a reported history of snakebite without requiring confirmed bite marks or objective features of envenomation which may have introduced misclassification and affected estimates of signs, symptoms, and treatment needs

Conclusion

This study conclude that the majority of snakebite envenomed kids were taken to the hospital only had bite histories and didn't exhibit any symptoms of systemic envenomation. Additionally, compared to previous studies done in our country's pediatric and adult age groups, the morbidity and death caused by snake bites were much lower. Treatment seeking behavior following snake bite was found to be optimal in most of the cases with some gap in first aid practice as evidenced by unsafe practice of giving ligature was common instead of keeping the affected part immobilized which was not done in any of the patients.

Recommendations

It is highly recommended that the community's acquaintance of the first aid measures to take in snake bite incidence be strengthened. Unquestionably, a nationwide study focused on the case with definitive criteria, biting patterns, and clinical consequences is necessary.

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Contribution of authors

AD-Conception, acquisition of data, drafting & final approval.

RS-Design, interpretation of data, critical revision & final approval.

SMSA-Data analysis, dafting & final approval.

SDB-Acquisition of data, interpretation of data, critical revision & final approval.

KB-Data analysis, drafting & final approval.

ND-Interpretation of data, critical revision & final approval.

Disclosure

All the authors declared no competing interest.

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