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Original Article

A Clinico-Epidemiological Study on Green Pit Viper Bite Attending Chittagong Medical College Hospital

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Abstract

Background: *Snakebites are a neglected public health issue, particularly in rural tropical areas. In Bangladesh, Green Pit Viper bites are common, causing pain, swelling, and coagulopathy, leading to morbidity. Epidemiology of Green Pit Viper biting, frequency of coagulopathy and proper description of clinical features from Green Pit Viper bite is lacking. This study aims to describe clinical features, coagulopathy patterns, pre-hospital management, and outcomes of patients admitted with Green Pit Viper bite in Chittagong Medical College Hospital.*

Method: *This study was cross-sectional and observational, analyzing medical records and data from the Snakebite Clinic at Chittagong Medical College Hospital (CMCH) in Bangladesh from 1st May 2017 to 30th April 2018. Informed written consent was obtained from patients, and their epidemiological data and clinical findings were recorded in a predefined case report form. The swelling extent was measured by comparing it to the non-bitten limb, and a 20-minute whole blood clotting test (WBCT) was performed in all patients to detect and monitor coagulopathy. Lab coagulation profiles were used to confirm coagulopathy and its reversal. Statistical analysis was conducted using SPSS-23.*

Results: *The study included 112 patients with a median age of 32 years, predominantly adult males from rural areas. Bites commonly occur during outdoor activities. Pre-hospital management practices were widespread, with tourniquets and herbal remedies being common. Swelling was the primary local effect. Notably, 43% of patients developed coagulopathy, often with delayed onset. Most patients reached the hospital within 5 hours of the bite. Coagulopathy reversal was observed, and the majority of patients improved.*

Conclusions: *This study sheds light on Green Pit Viper bites in Bangladesh, emphasizing coagulopathy's significance and the need for specific antivenom.*

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Introduction

Throughout history, snakes have held a captivating place in human culture, either revered, dreaded, or featured prominently in myths and legends. Snakes are classified under the class "reptiles," which comprise approximately 2,978 species[1]. Snakebite is significantly neglected as a public health problem in the world, as evidenced by the lack of available incidence data from most of the rural tropics where snakebites occur frequently. It significantly impacts human health and the economy through mortality and morbidity, treatment-related expenditure and loss of productivity[2].

Globally, snakebite is estimated to affect around 500,000 individuals each year, resulting in mortality rates between 30,000 to 40,000 annually[2]. A national survey conducted by

Rahman et al. in Bangladesh sheds light on the gravity of this issue. Their study, encompassing 18,857 individuals from 24 out of 64 districts in Bangladesh, reported 98 snakebite cases, including one fatality. This yields an estimated incidence density of snakebites at 623.4 per 100,000 person-years (95% CI: 513.4–789.2/100,000 person-years). Bangladesh hosts approximately 82 snake species, of which 28 are venomous, including 12 species of sea snakes[3]. These medically important snakes fall into categories: Cobra, Krait, Russell's Viper, Green Pit Viper, and Sea Snakes. Each group presents unique venom compositions and clinical effects, ranging from neurotoxicity to hematological manifestations and myotoxicity[4].

Traditional treatments and a lack of awareness among medical professionals have led patients to receive inconsistent and sometimes ineffective care. Meanwhile, based on international guidelines, advanced scientific approaches for snakebite treatment have been implemented successfully in several parts of the world. In Bangladesh, Chittagong Medical College Hospital (CMCH) has been at the forefront of scientific snakebite treatment since 1994. The observed prevalence of snakebites in rural Bangladesh surpasses expectations driven by poor access to healthcare services.

This has resulted in increased morbidity and mortality rates. Consequently, there is an urgent need for improved public health interventions. A particular concern in the Chittagong area is the Green Pit Viper, a venomous snake that ranks as the most common cause of envenomation among patients admitted to the snakebite clinic at Chittagong Medical College Hospital (unpublished CMCH Snakebite clinic data). This viper belongs to the Viperidae family and is recognized by its bright green color and distinct triangular head. It is known as a Pit Viper due to a prominent pit, a heat-sensitive organ used in prey detection, located between the nostril and eye. Typically found in tall trees, shrubs, forests, and rainforests, the venom of the Green Pit Viper contains cytotoxins, hyaluronidase, and coagulopathy-inducing substances. The venom leads to systemic hypofibrinogenemia and thrombocytopenia, with snake venom metalloproteinases causing damage to vessel walls, contributing to systemic bleeding[5].

Following Green Pit Viper bites, patients often experience localized pain, swelling, and mild coagulation abnormalities. The swelling can persist for up to a week, confining patients to bed and resulting in lost work hours. Skin blisters, occurring in 25% of victims, are positively correlated with subsequent dermal necrosis and super-infection. In more than 6% of cases, patients may develop digital gangrene, necessitating prolonged daily dressing and potential surgical dermatome. Without treatment, the defibrinating syndrome following a Green Pit Viper bite can persist for over a week due to the continued circulation of thrombin-like enzymes in the snake venom. Some patients with Green Pit Viper envenomation experience severe local effects without significant coagulopathy.

The primary treatment for snakebite envenomation is polyvalent antivenom, specific for four snake species: Cobra, Krait, Russell's Viper, and Saw-scaled Viper. Unfortunately, this antivenom does not protect against Green Pit Viper bites. The systemic toxicity induced by Green Pit Viper venom resembles consumption coagulopathy, similar to disseminated intravascular coagulation (DIC). However, the government supplies no specific antivenom for Green Pit Viper bites or is available in Bangladesh. The extent of this issue has not been scientifically documented or reported. This study aimed to analyze the epidemiological aspects, prehospital management, clinical presentation, spectrum of coagulopathy, complication of hospital stays and outcome of envenomation following Green Pit Viper bite cases.

Methodology

Study Design

This study employed a cross-sectional design, analyzing medical records and data from the Snakebite Clinic at Chittagong Medical College Hospital (CMCH) in Bangladesh. We review Green Pit Viper bite case records from a specified period, focusing on demographics, clinical presentations, and coagulopathy development. Data was analyzed using statistical methods to gain insights into these bites' epidemiology and clinical aspects, aiding in formulating future interventions and treatment strategies.

Data Collection

Patients were included in this study upon confirmation of Green Pit Viper bite diagnosis. Informed consent was obtained from the participants after providing detailed information about the study. Patients who were unwilling to participate or those who were either dying or leaving the hospital before their information could be recorded were excluded. Data were meticulously gathered using a pre-designed semi-structured questionnaire administered by the investigator. The questionnaire encompassed a comprehensive range of data, including patient history, thorough physical examinations, anthropometric analyses, and prompt initiation of relevant investigations. All data collection procedures were conducted immediately after the patient's admission to ensure accuracy and reliability.

Data Analysis

The collected data were subjected to a rigorous analysis using SPSS (Statistical Package for the Social Sciences) version 23. Descriptive statistics were computed for various variables, including means, standard deviations, and frequencies. Inferential statistics assessed associations and

differences between groups, such as t-tests and chi-square tests with Yates correction. A p-value > 0.05 was considered statistically significant. The results were presented in tables and figures to facilitate comprehension and interpretation.

Ethical Considerations

Ethical considerations in this study were paramount. Informed written consent was obtained from all patients or their attendants after clearly explaining the study's objectives, procedures, risks, and benefits in the local language. Confidentiality of information and records was assured to protect patient privacy. This study adhered to ethical principles, prioritizing the well-being of patients and contributing to informed and rational case management. Ethical guidelines were followed diligently to uphold the rights and dignity of all participants.

Results

This study examined data from 112 patients admitted to the Medicine units of CMCH over a year from 1st May 2017 to 30th April 2018. Of these patients, 74.1% were males, and 25.9% were females (Figure 1). Age-wise, the victims spanned from 6 to 75 years, with a median age of 32 years (SD+19.5 yrs).

Table 1. Age group of the study patients

Age Group	Frequency	Percent
<20 years	16	14.3
21-30 years	35	31.3
31-40 years	28	25.0
41-50 years	11	9.8
51-60 years	12	10.7
>61 years	10	8.9

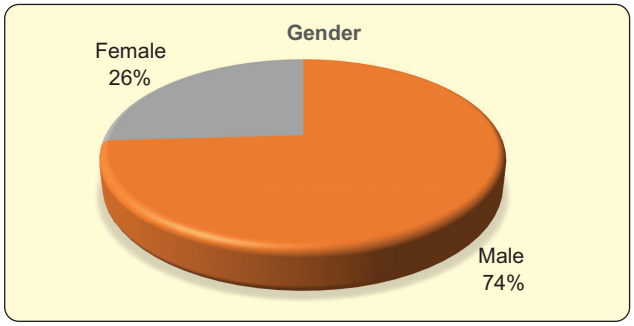

Figure 1: Demographic Distribution of Gender

The majority (31.3%) fell within the 21-30 age group, followed by 25% in the 31-40 years group. Those under 20 constituted 14.3%, while older people above 60 comprised 8.9% of the cases (Table 1).

Table 2: Epidemiological data and details of Snakebites (n=112)

Characteristics	Frequency	Percent
Activity of victim during bite		
Awake	111	99.1
Asleep	01	0.9
Weather conditions during bite		
Dry	87	77.7
Rainy	25	22.3
History of previous Snakebite	12	10.7

Most snakebites (99.1%) happened during various activities, with a history of previous snakebites in 10.7% of cases (Table 2). All snakes were identified. Bites commonly occurred outdoors, with walking on unpaved roads being the most frequent activity (21.4%). Home incidents (14.3%) primarily affected females engaged in household chores and gardening (Table 2).

Figure 2: Green Pit Vipers brought by the patients

Incision Application of Herbal Medication

Figure 3. *Pre-hospital Treatment*

Figure 4 shows a pattern of 20 minutes of whole blood clotting at different days after admission. In this study, out of 43% (n = 48) patients who developed coagulopathy, only 6.25% (N3) had so during admission, and the remaining 36.75% (n = 45) victims developed coagulopathy over ranging from 7-72 hours after hospital admission. Gradually, blood became coagulable, and only 8 patients recovered within eight days. 40 patients took their discharge without improving coagulopathy.

Table 3. Pre-hospital Measures and Effects

Variable	No. of Patients	Percentage
Pre-hospital Measures		
Tourniquet	109	97.3%
Incision at Bite site	10	8.9%
Applied or ingested herbal medication	14	12.5%
Recitation	12	9.5%
Effects		
Swelling	102	91.0%
Blister	16	14.3%
Necrosis	7	6.3%
Ecchymosis	1	0.9%
Spontaneous bleeding from Bite site	5	4.5%
Compartment syndrome	2	1.8%

Pre-hospital measures and effects in a snakebite were summarized in Table 3. Many patients used tourniquets (97.3%) and experienced swelling (91.0%) as a common effect. Incision at the bite site (8.9%), herbal medication (12.5%), and recitation (9.5%) were also observed. Less common effects included blisters (14.3%), necrosis (6.3%), spontaneous bleeding (4.5%), and compartment syndrome (1.8%).

Table 4. Time between bite and admission to primary or secondary level hospital (Other than CMCH)

Time Interval	Frequency	Percent
Within <5 hours	46	41.1
Within 6-15 hours	2	1.8
Within >16 hours	1	0.9
Total	49	43.8
Who didn't go to primary or secondary level hospital	63	56.3

Most cases reached the primary or secondary level hospital within <5 hours of a bite. The primary level hospital is the Thana Health Complex and the secondary is the Upazila Health Complex (Table 4).

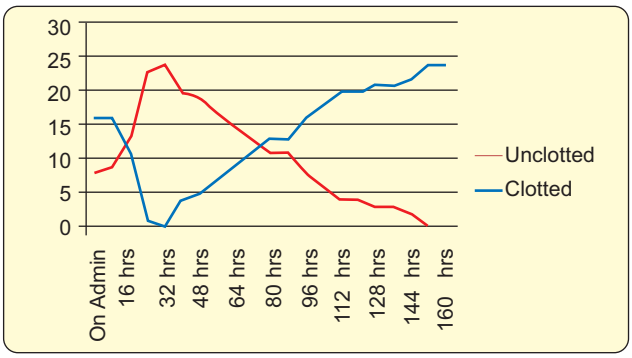

Figure 4: Progression of coagulopathy by 20min WBCT

Table 5. Lab Coagulation Profile (n=112)

Investigations	Frequency	Percent
APTT		
Normal	19	16.9
≤160s	34	30.35
In coagulable (>160s)	59	52.6
PT		
Normal	32	28.57
Prolonged >4s	80	71.42
Platelet Count		
>150000	68	60.71
<150000	44	39.28

Patients who had incoagulable blood on 20 min WBCT were advised to go through APTT, PT, and Platelet count and to confirm coagulopathy and its extent. Repeating these tests after blood had been found coagulable by 20 min WBCT also confirmed the reversal of coagulopathy (Table 5).

Table 6: Distribution of patient outcomes

Outcome	Frequency	Percent
Improved	79	70.5
Improved with persistent swelling, non-healing ulcer, etc.	1	0.9
Died	1	0.9
The patient took their discharge without improving coagulopathy	40	35.7

The majority (70.5%) showed improvement in their condition. One patient (0.9%) improved but still had persistent issues like swelling or non-healing ulcers. Sadly, one patient (0.9%) succumbed to the snakebite. A significant portion (35.7%) chose to leave the hospital on their own, even though their coagulopathy hadn't improved, indicating challenges in treatment adherence (Table 6).

Discussion

While the Green Pit Viper poses a significant health risk, particularly in the Chittagong division, there is a glaring absence of published data and clinical or epidemiological studies about this snake species in our country. Furthermore, the global literature on the Green Pit Viper is notably scarce, with most reports originating from Thailand, where Green Pit Viper bites are a recurrent issue. We enrolled 112 patients who met the inclusion and exclusion criteria throughout a year-long study. Examining the age distribution of snakebite victims, we noted that most fell within the 21-40 age range. However, individuals of all ages, from as young as 5 years to as old as 79 years, were affected. This demographic trend underscores that snakebites primarily afflict the active working-age population. This finding resonates with similar observations made in Nepal, Malaysia, and prior studies in Bangladesh[6]. The implications of this age distribution are substantial, given that the younger and more active portion of society faces a heightened risk of snakebites.

Our study also revealed a notable gender disparity, with males being more frequently affected than females, resulting in a male-to-female ratio of 4:1. This male preponderance can be attributed, in part, to snakebites occurring in outdoor work settings, such as paddy fields, where males are more commonly employed. Although women are gradually becoming more involved in agricultural and outdoor activities alongside men in various regions of Bangladesh, a gender imbalance in snakebite incidents persists[7]. Moreover, males may have higher hospitalization rates than females, a phenomenon frequently observed in developing countries.

The circumstances under which snakebite incidents occur were extensively examined in our study. The majority of bites took place on 'Katcha' roads (24; 21.4%), followed by open ground (18; 16.1%), areas around homes (16; 14.3%), forests (13; 11.6%), and paddy fields (13; 11.6%). Notably, many rural houses in the country are surrounded by homestead bushes, creating natural habitats for Green Pit snakes. This proximity increases the risk of snakebites when individuals venture outside for various activities, such as using outdoor toilets or engaging in domestic chores. Additionally, villagers often store grains, including paddy, within their homes, providing shelter for snakes and further elevating the risk of snakebites. Consequently, snakebite incidents are relatively common, even when people are in or around their homes, a phenomenon previously documented in Bangladesh[8].

Our study also delved into the anatomical location of snakebites, revealing that bites in agricultural fields were more likely to occur on the limbs, consistent with findings from Nepal, Bangladesh, Malaysia, and Hong Kong. This pattern aligns with Green Pit Vipers' natural habitat in trees, typically encountered in agricultural settings. Furthermore, the study discussed the timely arrival of snakebite victims at Chittagong Medical College Hospital, with 80.4% (90 out of 112) of victims seeking medical attention within 5 hours of being bitten. This observation reflects an increasing awareness among the younger population regarding the urgency of seeking prompt medical care for snakebites.

Nevertheless, this finding contrasts with a study by Rahman et al., where only 10% of victims sought immediate medical attention. The study posits that ongoing efforts to educate the community, coupled with the reliable services provided by the Snakebite Clinic at Chittagong Medical College Hospital over the past 25 years, may have contributed to this positive change in behavior.

The knowledge, attitude, and practices surrounding first aid management following snakebites were also addressed in our study. Traditional practices, such as applying tight tourniquets, recitation by 'ozha's,' bloodletting through incisions or suction, and using plant-based remedies, continue to prevail. Alarmingly, 97.3% (109 out of 112) of patients applied tourniquets, often using multiple tourniquets, despite the recognized harm, especially in the case of Green Pit Viper bites, where it can lead to compartment syndrome. Additionally, none of the bitten limbs were immobilized after the bite, and incisions were made in 8.9% (10 out of 112) of cases, a potentially dangerous practice, particularly in Green Pit Viper bites, due to the risk of coagulation abnormalities, excessive bleeding, and infection. However, the study did not address whether incisions led to more bleeding from the bite site or the incision site or resulted in complications such as infection. Herbal medicine was applied in 12.5% (14 out of 112) cases. From a scientific standpoint, these traditional methods are ineffective and may cause more harm than snake venom.

Nevertheless, the study indicates an improvement compared to previous studies, with only 30% of patients seeking traditional remedies before arriving at the hospital. This shift could signal a gradual change in cultural beliefs, potentially driven by community-level education and motivation. It could be attributed to the reliable services provided by the Snakebite Clinic at Chittagong Medical College Hospital over nearly 25 years.

Clinical manifestations of Green Pit Viper bites were extensively discussed, with swelling of the bitten area being the most common clinical presentation, affecting 91% (102 out of 112) of cases. Blisters were observed in 14.3% (16 out of 112) cases, while necrosis was noted in 6.3% (7 out of 112). The study mentioned that while the degree of swelling was assessed by comparing it to the contralateral limb, no clear relationship between these local effects and systemic manifestations (such as coagulopathy) could be established. This finding contrasts with a study in Thailand, where bleeding was inversely correlated with local effects[9]. Interestingly, our study uncovered cases where patients exhibited localized effects without coagulopathy and vice versa. These incidental findings warrant further evaluation.

Coagulopathy associated with Green Pit Viper bites emerged as a significant concern in our study, with 43% (48 out of 112) of patients developing this complication. To detect coagulopathy, a 20-minute whole blood clotting test (20-min-WBCT) was performed during admission and, if found normal, was repeated before discharge after 24 hours (if complications did not arise). Strikingly, only 6.25% (3 out of 48) of patients with coagulopathy exhibited it upon admission, while the remaining 36.75% (45 out of 48) developed coagulopathy over time, with onset ranging from 7 to 72 hours after admission, as detected by follow-up 20-min-WBCT performed every 12 hours. This delayed onset coagulopathy may have been previously underestimated. Hutton RA et al. also described delayed onset coagulopathy occurring between 9 to 47 hours in over half of their cases. The reasons behind this phenomenon remain poorly understood. Still, the study indicated that venom activity in citrated plasma samples from Green Pit Viper bite victims persisted for up to six days, as evidenced by decreased fibrinogen levels in normal plasma. Specific treatment may shorten coagulopathy's duration, although further research is required to confirm this[10].

Spontaneous bleeding from the bite site was observed in 4.5% (5 out of 112) of patients in our study. In contrast, a study by Chen et al. reported no systemic bleeding in any of their 18 patients with coagulopathy. Ecchymoses and bleeding from the bite or venipuncture sites were the main forms of spontaneous bleeding in our patients, with only 0.9% (1 out of 112) developing ecchymosis in the left calf muscle and 1% experiencing systemic bleeding. Specific treatment may play a role in preventing such complications and reducing morbidity.

One significant limitation highlighted in the study was the absence of specific antivenom for Green Pit Viper venom in Bangladesh[11]. Consequently, patients with Green Pit Viper envenomation are managed conservatively, relying on immobilization and prophylactic antibiotics. In our study, coagulopathy reversed in 7.2% (8 out of 112) of patients, while 35.7% (40 out of 112) chose to leave the hospital before coagulopathy resolution. The remaining 57.14% (64 out of 112) of patients who did not develop coagulopathy were closely monitored, with 20-min-WBCT performed every 12 hours for 48 hours before discharge, following counselling.

All patients who exhibited unclotted blood in the 20-min-WBCT were advised to undergo APTT, PT, and platelet count tests to confirm and quantify abnormal coagulation. A substantial portion of these patients, 43% (48 out of 112), displayed abnormal coagulation profiles[12]. APTT and PT were elevated in 59% and 80% of patients, respectively,

further supporting the presence of coagulation abnormalities. Thrombocytopenia, a hallmark hematological disturbance in envenomed patients due to increased platelet aggregating activity of Green Pit Viper venom, was observed in 39[13]. 28% (44 out of 112) of cases. Given that only 6.25% of patients presented with coagulopathy upon admission, while others developed it later on (within 7 to 72 hours), early prediction and intervention may play a critical role in decreasing morbidity[14].

Patients with coagulopathy experienced significantly longer hospital stays[15,16], with an even lengthier duration for those who developed spontaneous bleeding. Considering the socioeconomic status of these rural patients, each day of hospitalization imposed a substantial economic burden on both the individual and their family. This may explain why 35.7% of patients chose to leave the hospital before coagulopathy resolution despite being informed of the potential dangers. Unfortunately, the study did not provide information on the outcomes of these patients. One fatality was reported, attributed to sepsis and uncontrolled diabetes mellitus rather than the snake venom itself. The patient, a 75-year-old with a bite on the right hand, developed multiple blisters extending up to the wrist, some of which later became infected. Despite the administration of antibiotics and other medications, the patient eventually succumbed to septic shock on the fifth day of admission.

Limitations

This study has limitations to consider. The small sample size, non-randomized sampling method, single-center focus, and relatively short study duration are essential constraints. These factors may affect the generalizability and comprehensive understanding of the findings, emphasizing the need for larger, more diverse, and longer-term studies in the future.

Conclusion

This study gives an idea about the classical presentation of the Green Pit Viper bite in Bangladesh, similar to other reports from neighboring countries. Since snakebite is an occupational problem, it has important national and economic implications. The need to conduct a national-scale snakebite study, develop Green Pit Viper antivenom locally, and enhance public education and prevention efforts is warranted.

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