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CLINICAL PROFILE AND OUTCOME OF SNAKE BITE PATIENTS AT TERTIARY CARE CENTRE IN KUMAON REGION OF UTTARAKHAND

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Abstract:

Context: Snake bites pose a considerable public health challenge, especially in rural India. This study intends to assess the clinical characteristics, seasonal patterns, and outcomes of snakebite cases managed at a tertiary care facility in Uttarakhand.

Methods: An observational study was done in a hospital setting over 18 months, encompassing 102 patients admitted due to snake bites. Demographic information, clinical presentations, complications, and treatment results were examined.

Results: The majority of patients were aged 16 to 40 years (65.7%), exhibiting a little female predominance (54.9%). The Rural and Plains regions accounted for 81.4% and 80.4% of cases, respectively. Snake Bite rates were highest during the monsoon season, especially in August (19.6%), and the most common biting site was the lower limbs (62.7%). Non-venomous bites represented 59.8% of cases, but hematotoxic and neurotoxic bites comprised 20.6% and 18.6%, respectively. Hematotoxic bites resulted in coagulopathy (12.7%), whereas neurotoxic bites induced neuroparalysis (10.8%). Prompt intervention, with 65.6% of patients arriving at the hospital within 6 hours, resulted in a recovery rate of 90.2%. The mortality rate was 1.9%, with severe envenomation and treatment delays being the main causes.

Conclusion: Snake bites in the Kumaon region primarily impact rural women engaged in agricultural activities. Timely medical intervention is essential for minimizing problems and enhancing outcomes. The results underscore the necessity for increased awareness, prompt treatment protocols, and targeted preventative strategies in rural regions.

Keywords: Snake Bite, Uttarakhand, Monsoon, Clinical Profile, Envenomation, Snake bite management.

INTRODUCTION

Snake bites constitute a significant public health issue in India, accounting for the highest global incidence of morbidity and mortality resulting from envenomation. India endures an estimated 35,000–50,000 fatalities each year, with a mortality rate of 4.1 per 100,000 people, reflecting a significant burden from this neglected tropical illness (Kasturiratne et. al., 2008). Rural regions, especially those engaged in significant agricultural and forestry practices, are predominantly impacted by frequent human-snake encounters. The Kumaon region's foothills, marked by its Terai and Bhabar belts, illustrate this trend, with a high prevalence of snake bites intensified by inadequate healthcare facilities and delayed treatment access.

India hosts 216 species of snakes, comprising 52 venomous varieties (Bhattacharya et al., 2007). The "Big Four" snakes—Indian cobra (Najanaja), Russell's viper (Daboiarusselii), common krait (Bungaruscaeruleus), and saw-scaled viper (Echiscarinatus)—constitute the majority of envenomations. Nonetheless, dependence on the "Big Four" paradigm constrains epidemiological research and the advancement of more comprehensive anti-snake venoms (ASVs) (Simpson & Norris, 2007). Manifestations of snake bites vary from localized consequences, including edema and tissue necrosis, to systemic issues such as coagulopathy, neurotoxicity, and renal failure, with severity determined by species, venom dosage, and promptness of treatment.

Although ASV constitutes the fundamental approach to treatment, it possesses numerous limitations. It is only effective against the Big Four species, and its dose lacks standardization. Furthermore, severe reactions to ASV can complicate treatment management (Karunarathne & Anandadas, 1973). The aforementioned obstacles, along with insufficient awareness among the public and healthcare practitioners in rural regions, result in elevated death rates. Despite the challenges, extensive research delineating the demographic, clinical, and geographical characteristics of snakebite incidents are limited, particularly in underrepresented areas such as Kumaon.

This study seeks to examine the clinicoepidemiological characteristics of snake bite incidents in the Kumaon foothills, emphasizing demographic trends, clinical manifestations, treatment results, and related difficulties. The findings seek to inform targeted actions to mitigate the mortality and morbidity linked to snake bites by addressing these gaps.

Snakebite envenomation is a major public health concern, with studies highlighting regional variations in clinical manifestations and outcomes. Singh et al. (2008) reported neurotoxic symptoms in 21 of 33 envenomated patients, all recovering with timely ASV and neostigmine. Haleshaet al. (2013) observed predominantly hemotoxic bites (60%) and a 3.8% mortality rate among 180 cases in Southern India. Menon et al. (2016) documented hemotoxicity in 56% of 1051 cases, with renal failure and respiratory distress as major complications. Wang et al. (2014) found early presentation reduced complications in Chinese

cobra bites, with improper first aid linked to worse outcomes. Kumar et al. (2018) associated viper bites with coagulopathy and severe outcomes in 1500 cases in Kerala. Chaudhari et al. (2014) highlighted early mortality predictors like respiratory failure in 260 Central Indian cases. Jarwani et al. (2013) observed low mortality (2.2%) due to prompt ASV administration in 156 Gujarat cases. Negi et al. (2023) reported seasonal and gender-related patterns, with coagulopathy in 77.9% of Himalayan cases. Narvencar et al. (2020) found early ASV reduced complications in hemotoxic bites among 156 cases in Goa. Samprathil et al. (2020) identified age as a risk factor, with higher mortality (13.7%) in pediatricneuroparalytic cases. Collectively, these studies underscore the need for prompt intervention, species-specific management, and public education on first aid.

MATERIALS & METHODS

This hospital-based cross-sectional observational study was conducted in the Medicine Department of Dr.SusheelaTiwari Government Hospital. The study was carried out over a period of 18 months, starting from the date of approval by the Institutional Ethics Committee (IEC).

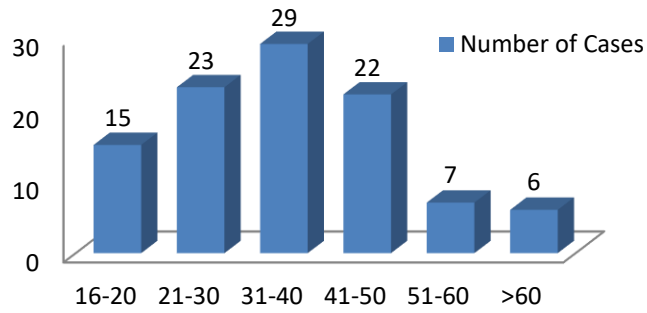
The study population included all patients presenting with a definitive history of snake bite. Inclusion criteria required patients to demonstrate a clinical picture consistent with snake bite, characterized by the presence of fang marks, cellulitis, coagulopathy, or neuroparalysis. Only individuals aged 16 years and above were included in the study. Patients were excluded if they were below the age of 16 or if they did not provide informed consent to participate. Detailed demographic, clinical, and laboratory data were collected from all eligible participants during their presentation to the hospital.

This structured approach ensured that the study adhered to ethical guidelines and focused on obtaining clinically relevant information to evaluate the presentation and outcomes of snake bites in this population.

RESULTS

This study analyzed 102 cases of snake bites admitted to a tertiary care hospital in the Kumaon region of Uttarakhand, offering insights into their clinical profile, geographic distribution, seasonal trends, and outcomes. The majority of patients (65.67%) belonged to the 16–40 years age group, making this the most affected demographic. The mean age of the patients was 37.49 ± 13.95 years for females and 36.45 ± 14.14 years for males, with the youngest patient aged 16 years and the oldest 75 years. This finding aligns with the active, outdoor lifestyles of young adults in rural areas, who are more likely to encounter snakes during agricultural or domestic activities.

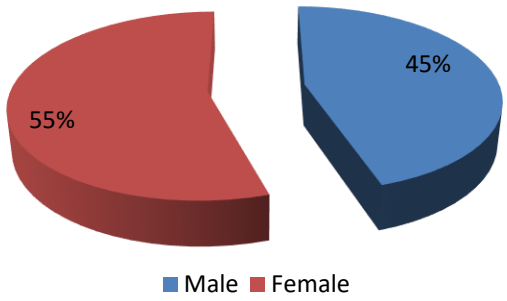
Figure 1: Distribution of Patients According to Age



Source: Author's Calculation

There was a slight predominance of females, accounting for 54.9% of cases, with a male-to-female ratio of 1:1.2. Most of these women were housewives involved in tasks such as cutting grass or collecting firewood, which are high-risk activities in rural settings.

Figure 2: Distribution of Patients According to Gender



Source: Author's Calculation.

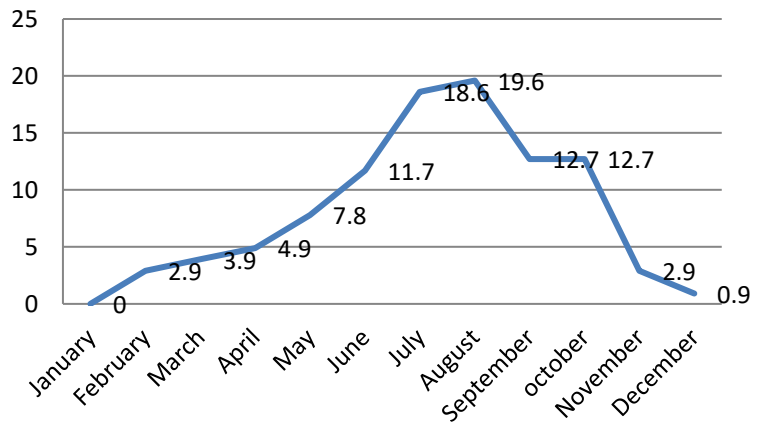
In our study it was observed that maximum number of cases were from Plains region i.e., 82 cases (80.39%) followed by Hilly region 20 cases(19.61%).

The occupational distribution of snake bite patients highlights significant risk factors tied to rural and agricultural activities. Housewives, accounting for the largest group (**38.23%**), are particularly vulnerable due to frequent engagement in high-risk tasks like grass-cutting and firewood collection. Farmers (**26.47%**) also faced substantial exposure, likely during fieldwork, while students (**14.70%**) and laborers (**9.80%**) were also notably affected, reflecting the occupational and lifestyle hazards in rural areas. Isolated cases among businessmen, cooks, factory workers, government employees, nurses, shopkeepers, and snake rescuers (**0.98% each**) suggest occasional risks unrelated to occupation. These findings emphasize the critical need for targeted preventive strategies, such as protective gear, public education on snake habitats, and timely first-aid measures, especially for those in high-exposure occupations.

Table 1: Distribution of Patients According To Occupation		
Occupation	**Frequency**	**Percentage**
Bussinessman	1	0.98
Cook	1	0.98
Factory Worker	1	0.98
Farmer	27	26.471
Govt. Job	1	0.98
House Wife	39	38.23
Labourer	10	9.80
Nurse	1	0.98
Private Job	4	3.92
Shopkeeper	1	0.98
Snake Rescuer	1	0.98
Student	15	14.70

Seasonal analysis revealed a significant peak in cases during the monsoon months, particularly in August (19.6%) and July (18.6%). This seasonal trend reflects increased agricultural activity during the rainy season, combined with the heightened movement of snakes during this period. No snake bite cases were reported in January, suggesting a significant reduction in snake activity during colder months.

Figure 3: Monthly Frequency of Bite (in %)



Source: Author's Calculation

Table 2: Monthly Frequency of Bite		
Month	**Frequency**	**Percentage**
January	0	0.00
February	3	2.94
March	4	3.92
April	5	4.90
May	8	7.84
June	12	11.76
July	19	18.62
August	20	19.60
September	13	12.74
October	13	12.74
November	3	2.94
December	1	0.98

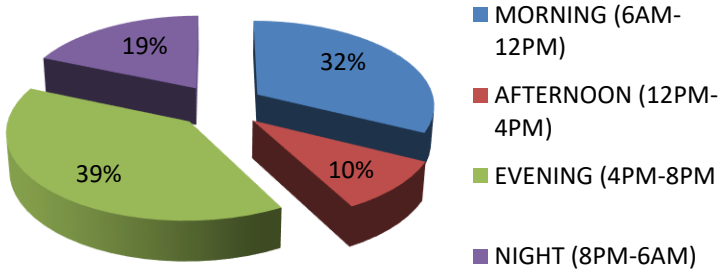
The symptom distribution among snake bite patients demonstrates a wide range of clinical presentations. Pain (85.29%) was the most prevalent symptom, occurring across all bite types, followed by swelling (22.54%)**,** commonly associated with hematotoxic envenomation. Neurotoxic symptoms were significant, with ptosis (17.64%)**,** diplopia (12.74%)**,** dysarthria (11.76%), and dysphagia (9.80%) frequently observed. Hematotoxic effects included bleeding (9.80%) and cellulitis (8.82%)**,** with rare cases of necrosis (0.98%) indicating severe local tissue damage. Life-threatening complications like paralysis (5.88%) and dyspnoea (8.82%) reflect the severity of delayed or untreated neurotoxic bites. These findings emphasize the need for timely and appropriate treatment to address the diverse and potentially fatal manifestations of snake envenomation. This has been presented in Table 3.

The presence of systemic symptoms such as dyspnoeaand paralysishighlights the progression of neurotoxic envenomation, potentially leading to respiratory failure if untreated. Additionally, local effects like cellulitis and necrosis**,** though less common, underscore the destructive nature of hematotoxic venom on soft tissues, necessitating early medical intervention.

Table 3: Distribution of Patients According to Symptoms		
Symptom	**Frequency**	**Percentage**
Swelling	23	22.54
Pain	87	85.29
Cellulitis	9	8.82
Necrosis	1	0.98
Bleeding From Any Site	10	9.80
Diplopia	13	12.74
Dysphagia	10	9.80
Dyspnoea	9	8.82
Dysarthria	12	11.76
Ptosis	18	17.64
Paralysis	6	5.88

Speaking about the Clinical Characteristics, Snake bites occurred predominantly in the evening (39.21%) and morning (32.35%), with a smaller percentage occurring at night (18.62%) and in the afternoon (9.8%). This has been depicted in Figure 4. This temporal distribution corresponds to the daily routine of rural communities, where outdoor activities peak during these hours.

Figure 4: Distribution of Patients According to Time of Bite

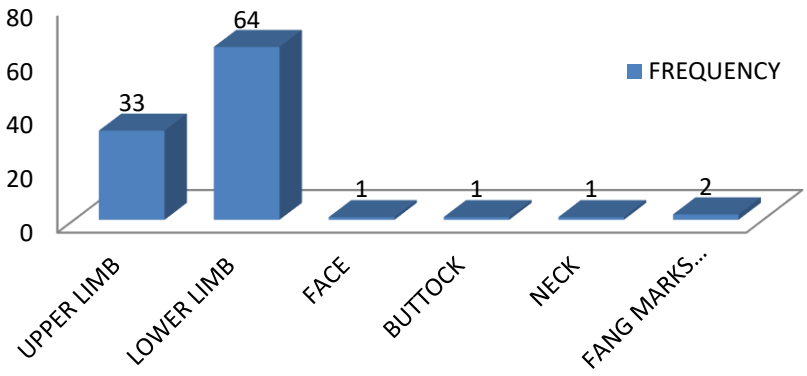


Source: Author's Calculation.

The lower limbs were the most common bite site, representing 64 cases i.e 62.74% of the sample size, followed by the upper limbs representing 33 cases i.e., 32.35% of the population. This pattern highlights the accidental nature of encounters during fieldwork or walking

barefoot in areas with dense vegetation. Snake bite cases at other body parts were almost negligible. Detailed picture of this has been presented in Figure 5.

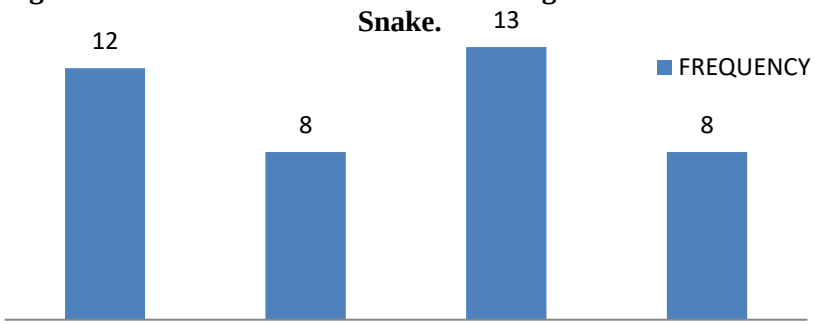
Figure 5: Distribution of Patients According to Site of Bite



Source: Author's Calculation.

Among the 102 cases, 59.8% were non-venomous bites, while venomous bites included hematotoxic (20.58%), neurotoxic (18.62%), and mixed hematotoxic-neurotoxic (0.98%) envenomation. Hematotoxic bites were primarily caused by Russell's Vipers and Green Pit Vipers, while neurotoxic bites were attributed to Kraits and Cobras. Identification of snake species was reported in 47% of cases, with Krait bites (12.74%) being the most common venomous bites, followed by Green Pit Vipers (11.76%), Russell's Vipers (7.84%), and Cobras (7.84%). This has been presented in Figure 6.

Figure 6: Distribution of Patients According to Identification of Snake.



Source: Author's Elaboration

The study observed that most common symptom was pain in 85.29% of cases (common in all kind of snake bites) , followed by swelling in 22.54% of cases(hematotoxic snake bite).Most common symptom in neurotoxic snake bite was ptosis 17.64%, followed by diplopia 12.74% and dysarthria 11.76%. The most common complication in Hematotoxic snake bites was coagulopathy seen in 12.74% of case followed be acute renal failure 7.84%. Most common complication in neurotoxic snake bite was neuroparalysis seen in 10.78% of cases followed by respiratory failure 8.82%.

The complications observed among snake bite patients underscore the serious systemic effects of envenomation. This is presented in Figure 7. Coagulopathy emerged as the most frequent complication, reflecting the hematotoxic venom's impact on the coagulation system and its potential to cause life-threatening bleeding disorders. Neuroparalysis, a hallmark of neurotoxic bites, highlights the venom's effect on neuromuscular transmission, which, if untreated, can progress to respiratory failure, a critical and often fatal outcome. Additionally**,** acute renal failure, primarily associated with hematotoxic venom, indicates significant systemic toxicity and potential for multi-organ involvement. These complications reinforce the urgency of early diagnosis and prompt administration of antivenom to mitigate severe and potentially fatal outcomes.

Table 4: Distribution of Patients According To Complications		
Complication	**Frequency**	**Percentage**
Coagulopathy	13	12.74
Acute Renal Failure	8	7.84
Respiratory Failure	9	8.82
Neuroparalysis	11	10.78

Figure 7: Distribution of Patients According To Complications

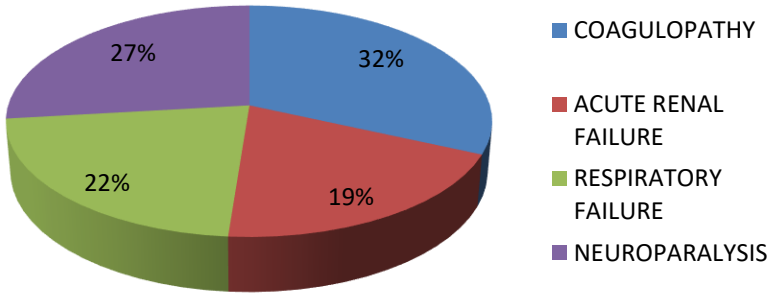


Table 5 illustrates the distribution of outcomes among patients treated for snake bites, providing a clear picture of the effectiveness of medical interventions and associated challenges. The majority (90.19%) of patients showed improvement, highlighting the success of antivenom therapy and supportive care in mitigating the effects of envenomation. A small percentage (1.96%) succumbed to the condition, reflecting the potential severity of complications like coagulopathy and organ failure. An equal proportion (1.96%) were referred to higher centers for advanced treatment, emphasizing the need for a robust referral system in managing complex cases. Notably, 4.90% of patients left against medical advice (LAMA), which raises concerns about treatment adherence and the necessity of improved patient counseling. A minimal fraction (0.98%) absconded, underscoring the importance of monitoring systems to ensure patient compliance. This distribution underscores the critical

role of timely interventions, patient education, and strengthened healthcare systems in achieving better outcomes.

Table 5: Distribution of The Patients According to Final Outcome

Final Outcome	Frequency	Percentage
Improved	92	90.19
Expired	2	1.96
Referred	2	1.96
Lama	5	4.90
Absconded	1	0.98

Laboratory parameters play a crucial role in assessing the severity of envenomation, monitoring organ dysfunction, and guiding treatment decisions, including the administration of antivenom and supportive care. This study evaluated key hematological, biochemical, and coagulation markers among patients with hematotoxic, neurotoxic, and non-venomous snake bites. The comparative analysis provides insights into the clinical impact of different venom types and highlights critical markers associated with poor outcomes. The findings are summarized in the following table (Table 6).

The laboratory parameters in the study reveal significant differences between hematotoxic, neurotoxic, and non-venomous snake bite groups. Hematotoxic bites exhibited the most severe disruptions, with significantly prolonged prothrombin time (50.4 ± 35 sec) and elevated INR (2.45 ± 1.59), indicating coagulopathy. The study emphasizes the importance of early detection and monitoring of coagulation parameters, as they are pivotal in predicting hemorrhagic complications in hematotoxic envenomation. These bites also showed marked liver (SGOT: 314.5 ± 174.4 U/L, SGPT: 70.5 ± 22.3 U/L) and renal dysfunction (creatinine: 1.8 ± 2.6 mg/dL, urea: 63.4 ± 42.5 mg/dL), as well as elevated muscle damage markers (CK-NAC: 2123.3 ± 976.5 U/L). Renal and liver dysfunction markers, such as elevated creatinine and SGOT levels, are critical in assessing multi-organ damage in severe envenomation cases.

Neurotoxic bites demonstrated relatively milder disruptions in coagulation but still had elevated CK-NAC (651.3 ± 448 U/L), amylase (62.6 ± 25.9 U/L), and lipase (36.6 ± 15.2 U/L), suggesting systemic muscle involvement. Neurotoxic bites also exhibited elevated amylase and lipase levels, highlighting potential pancreatic involvement as a systemic effect of envenomation. Non-venomous bites showed normal ranges for most parameters, with significantly higher platelet counts (2.14 ± 0.8 lacs) compared to venomous bites. These findings underscore the critical role of specific laboratory markers in assessing envenomation severity and guiding targeted interventions. The marked differences in laboratory profiles between venomous and non-venomous bites underscore the need for precise diagnostic tools to guide appropriate treatment strategies.

Table 6: Correlation of Lab Parameters with Outcome of Patients According to Type of Snake Bite						
LAB PARAMETERS	**HAEMATO- TOXIC SNAKE BITE (GROUP 1)**	**NEURO-TOXIC SNAKE BITE (GROUP 2)**	**NON-VENOMOUS SNAKE BITE (GROUP 3)**	**P VALUE (G1 vs G2)**	**P VALUE (G1 vs G3)**	**P VALUE (G2 vs G3)**
Hb (g/dl)	12.95(+/-6.7)	12.46(+/-3.5)	13.46(+/-1.8)	0.246	0.004	0.264
TLC cumm/10^3	10991 (+/7218)	8985 (+/3985)	6953 (+/1843)	0.156	<0.001 ***	0.196
Platelet (lacs)	1.17 (+/-0.8)	1.19 (+/-0.7)	2.14 (+/-0.8)	<0.05	0.007	0.168
PT (sec)	50.4(+/-35)	18.31 (+/5.42)	13.2(+/-2.3)	<0.001	<0.001***	0.425
INR	2.45(+/-1.59)	1.39 (+/-0.40)	1.2(+/-0.1)	<0.001	<0.001***	0.224
SGOT(U/L)	314.5 (+/-174.4)	67.8(+/-37.5)	26.3(+/-8.1)	<0.001	<0.001***	0.136
SGPT(U/L)	70.5(+/-22.3)	39.1(+/-19.17)	20.4(+/-6.7)	<0.001	<0.001***	0.198
S.Creatinine (mg/dl)	1.8(+/-2.6)	0.96 (+/-0.47)	0.94(+/-0.3)	<0.001	<0.001***	0.246
B.Urea (mg/dl)	63.4(+/-42.5)	36.3(+/-19.8)	32(+/-4.2)	<0.001	<0.001***	0.368
CK-NAC (U/L)	2123.3(+/-976.5)	651.3(+/-448)	86.4(+/-18.6)	<0.001	<0.001***	<0.001
S.Amylase(U /L)	82.6(+/-44.7)	62.6(+/-25.9)	34.5(+/-8.4)	<0.001	<0.001***	<0.001
S.Lipase (U/L)	51.1(+/-28.8)	36.6(+/-15.2)	28(+/-6.7)	<0.001	<0.001***	<0.05

CONCLUSION

This study provides a comprehensive overview of the clinical profile, laboratory findings, and outcomes of snake bite patients in the Kumaon region of Uttarakhand. The majority of cases were observed among young adults, with a slight female predominance, particularly in rural areas where agricultural activities increase the risk of snake encounters. Seasonal trends highlighted a surge in bites during the monsoon months, especially in July and August, reflecting heightened human-snake interactions during this period.

The study demonstrated the distinct clinical and laboratory profiles of hematotoxic and neurotoxic envenomations. Hematotoxic bites were associated with significant coagulopathy, renal dysfunction, and liver impairment, whereas neurotoxic bites primarily resulted in neuromuscular complications. Non-venomous bites, while frequent, exhibited better clinical outcomes and normal laboratory parameters.

Prompt medical intervention played a crucial role in achieving a high recovery rate of 90.19%, with the mortality rate limited to 1.96%. Delayed treatment, particularly beyond six hours after the bite, was associated with severe complications and poorer outcomes, emphasizing the importance of early hospital access.

The findings underscore the need for targeted public health strategies, including educational campaigns on first aid, faster access to healthcare facilities, and the development of region-specific management protocols. Future efforts should focus on improving awareness, reducing bite-to-needle times, and enhancing the capacity of rural healthcare systems to further minimize the burden of snake bite envenomation.

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