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Original Research Article

COMPARISON OF ADMISSION CHARACTERISTICS AND MORBIDITY OUTCOMES AMONG SNAKEBITE ENVENOMATION PATIENTS WITH AND WITHOUT CELLULITIS: A PROSPECTIVE OBSERVATIONAL STUDY

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ABSTRACT

Background: Snakebite envenomation is a major public health problem in India, particularly affecting rural and agrarian populations. Although mortality has declined due to improved access to anti-snake venom (ASV), morbidity related to local complications such as cellulitis continues to impose a significant burden on patients and healthcare systems. The objective is to compare socio-demographic characteristics, admission-related factors, and morbidity outcomes among snakebite envenomation patients with and without cellulitis. **Materials and Methods:** A prospective observational study was conducted over one year at a tertiary care government hospital in Tamil Nadu. Five hundred patients aged ≥13 years admitted with snakebite envenomation were included. Patients were categorized based on the presence of cellulitis. Socio-demographic variables, time to hospital admission, clinical features, ASV requirement, procedures performed, and morbidity outcomes were analyzed. **Result:** Cellulitis was observed in 351 (70.2%) patients. Most patients were males (57%) and residents of rural areas (82%). Delayed admission beyond 24 hours was significantly associated with the development of cellulitis. Patients with cellulitis required higher ASV doses, experienced longer hospital stays, and had a significantly greater burden of local morbidity including swelling, lymphadenopathy, and need for surgical intervention. **Conclusion:** Cellulitis is a common complication following snakebite envenomation and is strongly associated with delayed admission and increased morbidity. Early referral, prompt ASV administration, and timely management of local complications are crucial strategies to reduce morbidity.

INTRODUCTION

Snakebite envenomation is recognized by the World Health Organization as a neglected tropical disease and remains a key contributor to morbidity, disability, and socioeconomic loss in low- and middle-income countries. Globally, millions of snakebites occur annually, with a substantial proportion resulting in envenomation and long-term complications. India bears a disproportionate share of this burden due to its large rural population, dependence on agriculture, favorable ecological conditions for venomous snakes, and inequitable access to healthcare services.[1,2]

In India, snakebite predominantly affects individuals in the productive age group who are engaged in agricultural and outdoor occupations. These individuals are often the primary earners for their families, and morbidity following snakebite can therefore have devastating consequences on household income, food security, and educational opportunities for dependents. Prolonged hospital stays, repeated outpatient visits, and surgical procedures further exacerbate the economic burden.[3]

While improvements in emergency medical services, wider dissemination of national snakebite management protocols, and improved availability of ASV have led to a reduction in mortality, morbidity remains substantial. Local tissue complications are particularly important contributors to this morbidity. Among these, cellulitis is one of the most frequent and clinically significant complications encountered in clinical practice.[4,5]

Cellulitis following snakebite results from a complex interplay of venom-induced cytotoxic effects,

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increased vascular permeability, local tissue ischemia, and secondary bacterial infection. Delayed presentation to healthcare facilities further worsens tissue injury and increases the risk of severe complications such as compartment syndrome, necrosis, gangrene, and secondary sepsis. These complications often necessitate invasive procedures including fasciotomy, surgical debridement, and prolonged antibiotic therapy, leading to long-term functional impairment.

From a family medicine and primary care perspective, early recognition of snakebite severity, appropriate first aid, timely referral, and early initiation of definitive care are critical steps in preventing morbidity. Primary care physicians often serve as the first point of contact for snakebite victims, particularly in rural areas. Understanding the socio-demographic determinants and admission-related factors associated with cellulitis can inform targeted preventive and therapeutic strategies.[6–8]

This study was undertaken to compare socio-demographic characteristics, admission patterns, and morbidity outcomes among snakebite envenomation patients with and without cellulitis in a tertiary care setting in South India.[6,7] Snakebite envenomation also represents a significant challenge to health systems due to underreporting and lack of robust surveillance mechanisms in many endemic regions. Many victims do not reach formal healthcare facilities, leading to an underestimation of the true burden of disease. This hidden burden particularly affects rural and marginalized populations, where access to emergency care and trained personnel is limited.[9,10] Strengthening surveillance and reporting systems is therefore essential for informed policy-making and resource allocation.

In addition, inappropriate first aid practices such as tourniquet application, incision, suction, and use of herbal remedies continue to be widely practiced in rural India. These practices can worsen local tissue injury, increase the risk of secondary infection, and contribute to the development of cellulitis and necrosis.[11] Public health interventions focusing on community education and behavioral change are crucial components of comprehensive snakebite control programs.

MATERIALS AND METHODS

This prospective observational study was conducted at Government Medical College Hospital, Namakkal, Tamil Nadu, over a one-year period from June 2022 to June 2023. The hospital serves as a major tertiary referral center for several rural and semi-urban districts in the region.

A total of 500 consecutive patients aged 13 years and above admitted with a history of snakebite envenomation were included after obtaining informed written consent. Patients with pre-existing ulcerative skin lesions, chronic wounds, or active skin infections at the site of bite prior to envenomation were excluded to avoid confounding of local morbidity outcomes.

Data were collected using a structured and pre-tested proforma. Socio-demographic variables included age, sex, occupation, and place of residence (rural or urban). Clinical variables included type of snake when identified, site of bite, time interval between bite and hospital admission, presence of cellulitis, local and systemic clinical features, ASV requirement, procedures performed, duration of hospital stay, and morbidity outcomes.

Cellulitis was diagnosed clinically based on the presence of pain, swelling, erythema, warmth, tenderness, and associated lymphadenopathy at or around the bite site. Patients were categorized into cellulitis and non-cellulitis groups for comparative analysis. Data were entered into Microsoft Excel and analyzed using SPSS software. Categorical variables were expressed as frequencies and percentages and compared using the chi-square test. A p-value of less than 0.05 was considered statistically significant. Ethical approval for the study was obtained from the Institutional Ethics Committee prior to initiation of the study.

RESULTS

Table 1: Socio-demographic profile of snakebite patients in a tertiary care teaching Hospital in Tamil Nadu

Variable	Cellulitis (n=351)	No cellulitis (n=149)	Total (n=500)
Male	205 (58.4%)	80 (53.7%)	285 (57.0%)
Female	146 (41.6%)	69 (46.3%)	215 (43.0%)
Rural residence	290 (82.6%)	120 (80.5%)	410 (82.0%)
Urban residence	61 (17.4%)	29 (19.5%)	90 (18.0%)

Cellulitis was more commonly observed among male patients and those from rural areas. A large majority of snakebite victims in both cellulitis and non-cellulitis groups belonged to rural settings, reflecting higher exposure risk in agricultural populations. There was no marked gender or residence-based difference between the two groups, suggesting that socio-demographic factors alone did not independently predict cellulitis development.

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Table 2: Admission characteristics of snakebite patients in a tertiary care teaching Hospital in Tamil Nadu

Characteristic	Cellulitis (n=351)	No cellulitis (n=149)	p-value
Admission >24 hours	86 (24.6%)	17 (11.4%)	<0.05
Lower limb bite	210 (59.8%)	75 (50.3%)	<0.05

Patients presenting more than 24 hours after the bite had a significantly higher proportion of cellulitis compared to those without cellulitis ($p < 0.05$). Lower limb bites were also significantly associated with cellulitis development. These findings indicate that delayed hospital admission and bite location play an important role in the occurrence of local inflammatory complications.

Table 3: Morbidity outcomes among snakebite patients in a tertiary care teaching Hospital in Tamil Nadu

Outcome	Cellulitis (n=351)	No cellulitis (n=149)	p-value
Prolonged hospital stay	Significantly higher	Lower	<0.05
Surgical intervention	Required	Not required	<0.05

Snakebite patients with cellulitis experienced significantly higher morbidity, including prolonged hospital stay and a greater need for surgical interventions, compared to those without cellulitis ($p < 0.05$). This highlights cellulitis as a key contributor to increased healthcare burden and adverse clinical outcomes following snake-bite envenomation.

DISCUSSION

The present study demonstrates a high burden of cellulitis among snakebite envenomation patients and highlights its strong association with delayed hospital admission and increased morbidity. The incidence of cellulitis observed in this study is comparable with several other reports from India and South Asia, which consistently show that local tissue complications remain a major cause of morbidity following snakebite.[6]

The predominance of males and rural residents observed in this study reflects occupational exposure patterns and socioeconomic determinants of snakebite envenomation. Agricultural activities, barefoot fieldwork, outdoor sleeping habits, and poor housing conditions increase the risk of snakebite in rural communities. These findings emphasize the need for targeted preventive interventions in high-risk populations.[4]

Delayed presentation to healthcare facilities emerged as a key determinant of cellulitis and subsequent morbidity. Factors contributing to delayed admission include lack of transportation, long distances to healthcare facilities, financial constraints, and continued reliance on traditional healers. Delayed admission allows continued venom activity at the local site, resulting in progressive tissue damage and secondary infection.

From a family medicine and primary care perspective, early identification of snakebite severity, provision of appropriate first aid, and prompt referral to higher centers are critical steps in preventing complications. Primary care physicians play a pivotal role in community education, discouraging harmful traditional practices, and facilitating early access to definitive care.[13]

Although mortality was low in the present study, the increased morbidity associated with cellulitis has important implications. Prolonged hospitalization, surgical interventions, and functional impairment result in loss of productivity and increased healthcare expenditure. Addressing morbidity should therefore be a central focus of snakebite management programs.[10]

The findings of the present study also highlight the broader public health implications of snakebite-related cellulitis. Beyond immediate clinical outcomes, local tissue complications can result in long-term disability, chronic pain, and reduced quality of life. Studies from endemic regions have documented persistent functional impairment and socioeconomic consequences among snakebite survivors, particularly those who develop severe local complications.[16]

Furthermore, the increased need for surgical interventions among patients with cellulitis underscores the importance of early wound assessment and standardized protocols for managing local envenomation effects. Early identification of patients at risk for progressive cellulitis at the primary care level could facilitate timely referral and reduce the need for invasive procedures.[15,17] Integrating snakebite management training into primary healthcare curricula may therefore yield substantial benefits in reducing morbidity.

Recommendations: Based on the findings of this study, several recommendations can be made to reduce morbidity associated with snakebite envenomation. Community education programs should be strengthened to improve awareness regarding early hospital presentation following snakebite and to discourage harmful traditional practices. Primary healthcare providers should be trained in early recognition of envenomation severity, proper first aid measures, and timely referral to higher centers. Strengthening referral transport systems, particularly in rural areas, can reduce delays in hospital admission and prevent progression of local tissue damage. Standardized protocols for early management of local wound complications, including cellulitis, should be emphasized at primary and secondary care levels. Future research should focus on long-term functional outcomes and quality of life among snakebite survivors to better understand the full impact of morbidity.

Strengths and Limitations: The strengths of this study include its prospective design, adequate sample

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size, and detailed assessment of socio-demographic and morbidity-related variables. Limitations include its single-center setting and absence of long-term follow-up to assess functional disability and quality of life.

CONCLUSION

Cellulitis is a common and clinically significant complication of snakebite envenomation and contributes substantially to morbidity. Delayed hospital admission is a key modifiable risk factor. Early presentation, timely ASV administration, and prompt management of local complications are essential strategies to reduce morbidity and improve patient outcomes.

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