Original Research Paper

Autopsy-Based Study of Snakebite Fatalities in Guntur Region: A Comprehensive Two-Year Analysis

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Abstract

Background: Snakebite envenomation remains a critical public health concern in India, with its substantial morbidity and mortality burden. Addressing this issue is imperative, as snakebite-related deaths are preventable and yet disproportionately affect vulnerable populations in rural India.

Materials and Methods: This autopsy-based study aimed to assess the prevalence and characteristics of lethal snakebite cases in the Guntur region, Andhra Pradesh by considering case data, autopsy findings and ancillary investigation findings. Additionally, an attempt was made to recommend preventive measures and raise awareness among the local population regarding snakebite prevention.

Results: Snakebite incidents were more common among males who belonged to the agricultural workforce. These bites predominantly occurred during the rainy season and during daylight hours. The majority of victims were from rural areas, and the incidence was higher among younger individuals. Most of the bites were localized on the lower extremities. Additionally, a significant number of victims experienced fatal outcomes within six hours of envenomation.

Conclusion: Snakebite is a highly neglected tropical disease but a preventable one. The Indian government is giving priority to snakebite venomics, proteomics, and the application of recombinant DNA technology for developing antivenoms, diverging from conventional animal-derived sources. Given the wide-ranging biogeographic distribution of venom type in venomous snakes, a re-evaluation of the 'big four' strategy is being advocated, promoting alternative methods for effective antivenom production.

Keywords: Snakebite, Envenomation Deaths, Autopsy, Toxicology

Introduction

Snakebite envenomation is a prevalent concern in both clinical and forensic toxicology settings in India. Strikingly, nearly half of the medical toxicology cases admitted to teaching hospitals are either agrochemical poisoning or snake bites in most parts of the country. The published statistics underscore the gravity of the

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situation, revealing that the annual snakebite-related fatalities in India range somewhere from 81,000 to 138,000 individuals. The consequences of snake bites, including mortality rates and enduring complications such as amputations and persistent neurological sequelae are huge causes of concern for our populace.

In India, the 'big four' snake species – common krait, Indian cobra, Russell's viper, and saw-scaled viper – are responsible for around 90% of all snakebite cases. The antivenom commonly used is prepared against the venom of all snakes mentioned above. However, the supply of antivenom to public health care institutions and education of the masses about the role of antivenom in management are two crucial interventions that can reduce snakebite mortality and morbidity.[1]

The present autopsy study primarily aimed to quantify the prevalence and profile the characteristics of fatal snake bite cases in and around Guntur region of Andhra Pradesh. Furthermore, the important objective of the study was to suggest feasible preventive measures and create awareness amongst the target population about the prevention of snakebite envenomation.

Materials and Methods

The study was conducted between January 2010 and August 2011 across various medico-legal facilities within the Guntur region, encompassing the Department of Forensic Medicine at Guntur Medical College, Andhra Pradesh. Data were collected from clinical case records, autopsy reports, histopathology reports, forensic science laboratory reports and other ancillary paraphernalia in crime investigation. The study included all reported snakebite envenomation-related fatalities among individuals of all ages and genders. Cases with questionable bite histories and those involving non-poisonous snake bites were excluded from the analysis.

Observations and Results

A total of 23 cases were analyzed as per the study criteria described above. 82.60% of the study cases were male and 17.39% of them were female. The age distribution of snake bite deaths is tabulated in Table 1. 86.95% of the study sample were married and 13.04% were unmarried. The geographical incidence of the cases was rural in 95.65% of cases, semi-urban in 4.34% of cases and there were no cases from urban areas. 78.26% of the cases belonged to the lower socioeconomic class, 21.73% of cases are of the middle class and no cases were reported from the higher socioeconomic class.

The seasonal incidence of cases is as follows, March-June (summer)-34.78%, July -October (Rainy)-43.47%, November-February (winter)-21.73%. The occupational profile of the cases studied is shown in Figure 1.

The time distribution of fatal snake bites in autopsy cases is shown in Figure 2.

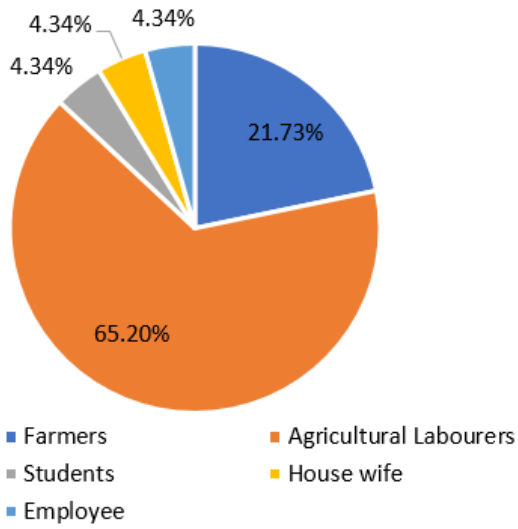

Figure 1: Occupation of Indiviuals who Died Due to Snake Bite in The Study Period

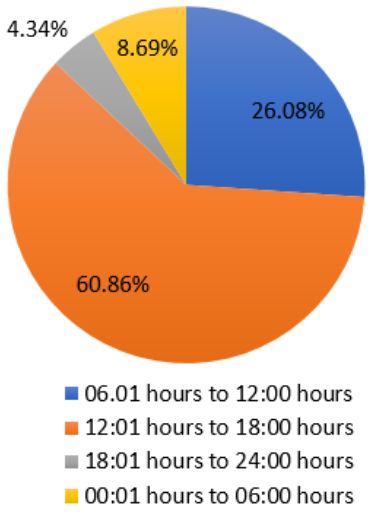

Figure 2: Time of Snakebite

Table 1: Age Distribution of Snake Bite Death Cases

S.No.	Age in Years	Percentage of Cases
1	1-10	4.34%
2	11-20	0
3	21-30	13.04%
4	31-40	39.13%
5	41-50	30.43%
6	51-60	13.04%
7	>60	0
Total	23 Cases	100%

In our study, the site of the bite is in the lower limbs in 91.30% of cases, upper limbs in 4.34% of cases, both lower limbs and upper limbs in 4.34% of cases, and 0% in head, neck, and trunk areas. In 82.60% of cases, the bites occurred during agricultural operations in the field, and in 17.39% of cases, the bites occurred at the deceased home dwellings. The period of survival after a snake bite in our cases is tabulated in Table 2.

Table 2: Period of Survival Between Snake Bite And Death

S.No.	Period of survival	Percentage
1	0-6 hours	65.23%
2	6-12 hours	8.69%
3	12-24 hours	13.04%
4	24-48 hours	8.69%
5	> 2 days	4.34%
	Total	100%

34.78% of the snake bite victims died even before receiving any treatment and another 34.48% died despite receiving first aid whereas 30.04% of victims died despite receiving institutional treatment which included anti-snake venom. Single bite mark was noticed in 17.39% of the cases, two bite marks were seen in 78.26% of cases and multiple bite marks were seen in 4.34% of cases.

The internal postmortem findings in snake bites included visceral congestion, hemorrhages, and epicardial hemorrhages. It was observed that generalized congestion of viscera was noticed in all the cases. However, only 13.04% of cases showed epicardial hemorrhages along with the above-mentioned findings.

Out of the total 23 cases examined, approximately 65.21% exhibited distinct signs indicative of neurotoxic snake bites, while the remaining cases demonstrated manifestations consistent with haemotoxic snake bites. Notably, all instances of haemotoxic bites (100%) were associated with local toxicity manifestations, ranging from swelling, ecchymosis, bruising, blistering, and gangrene formation at the bite site. In contrast, only 13.3% of neurotoxic bites exhibited local manifestations.

Discussion

About 70% of snakebite victims belonged to the age group 31-50 years indicating that the people in this age group are actively involved in the occupation of cultivation and thereby are at high risk for snake bite. About 86% of the victims were involved in agricultural activities. Male predominance in snakebite cases could be explained by the nature of work and place of work as the majority of the victims were involved in agricultural activities. 95.65% of them are from rural areas and the majority of bites occurred during the rainy season. 87% of bites occurred during the daytime from 06:00 AM to 06:00 PM and in 65.23% of cases, death occurred within 6 hours of bite.

In the current study, it was found that 83% of the individuals affected fell within the age range of 21 to 50 years. A comparable occurrence within the same age bracket was also observed in previous research by V. Paul and K. Narvencar. This heightened prevalence of snake bites among these age groups could be attributed to their greater engagement in outdoor pursuits, as opposed to indoor settings.[2,3] In the present study, 82% of the victims were males and the results are concordant with Hansdac SG et al wherein it was reported that snakebites were 4.6 times more common in males. The high incidence of snakebites during the rainy season could be explained by the fact that rainfall destroys the habitat of reptiles and compels them to come out. Our results in this aspect of more snakebites during the rainy season are similar to the findings reported by Manab Kumar Ghosh.[4]

V Paul et al reported an incidence of 88% in lower extremities and Srimannaryana et al reported that approximately 4 to 5 patients had a bite on one of the lower limbs similar to our study. The high incidence of bites in the lower extremities can be explained by

the fact that most bites are secondary to accidental contact with snakes while walking or working.[5]

Recommendations to prevent snakebite in and around Guntur Region:

- Lower socioeconomic groups living in rural parts of the region in Kacha dwellings are the most vulnerable group to snakebites, particularly at night. Hence they should be educated about the hazards of sleeping on the floor at night.
- Agricultural labor should be encouraged and incentivized to use gum boots and rubber gloves while at work.
- Makeshift snakebite management camps should be organized in areas of high incidence during the period between May to September.
- Availability of Anit Snake Venom (ASV) should be looked after by the Government on a priority basis during the peak incidence season.
- NGOs should try to be a part of the Government IEC (Information, Education, and Communication) campaign against faith healing and non-medical therapies for snake bites among the illiterate masses.
- Information on Do's and Don'ts in snake bite cases should be disseminated to all stakeholders like doctors, paramedics, target population, etc.
- The 108 Life-saving ambulance staff should be trained in administering ASV in sure shot cases with clarity on managing adverse reactions as well while transporting the case to a medical facility. This will save lives.
- WHO treatment protocol should be strictly adhered to in managing cases of snakebites.

In certain instances, individuals may falsely claim snakebite incidents to seek government insurance benefits. Forensic pathologists need to exercise caution when encountering such scenarios. Forensic Science Laboratories typically do not routinely conduct tests to detect components of snake venom, a fact that many forensic pathologists may not be aware of.

In our study, we preserved viscera only to rule out other common poisonings. From a medico-legal standpoint, it's important to note that currently, there is a lack of definitive laboratory tests to confirm snakebites during autopsy. However, there are potential tests that could be considered for confirmation, such as the ELISA (Enzyme-Linked Immunosorbent Assay) and Radio Immune Sorbent Assay. These tests could aid in detecting specific venom components or antigens in postmortem body fluids, helping to provide more accurate information about the cause of death and confirming the presence of snake venom.

Confirming snakebites as the cause of death in postmortem examinations is a complex challenge. While tests like ELISA (Enzyme-Linked Immunosorbent Assay) and Radioimmunosorbent assay can offer insights by detecting venom components or antigens, they have limitations such as potential false negatives due to low venom levels or metabolism, and false positives from cross-reactivity. Additionally, standardization, availability, and the impact of autolysis and decomposition can affect their reliability apart from the logistical difficulties of analyzing the samples in time while maintaining the cold chain at the same time. Therefore, a comprehensive approach that considers clinical history, postmortem findings, toxicological analysis, and the circumstance of the incident is crucial for accurate determination, as these tests, while useful, may not be solely conclusive.

Further studies are needed using techniques like histopathology, and immunohistochemistry for confirming snake bites. For instance, a study found acute tubular necrosis of the kidney and acute hemorrhagic infarction in endocrine glands including pituitary and adrenals is quite a common finding in snake bites histologically.[6]

The samples sent for toxicological analysis must include blood before administration of antivenom and after administration of antivenom if possible. Swabs from the bite site are of great value in the identification of the species of the snake using PCR by the wildlife forensics team. Numerous immunoassay methods can successfully detect venom, including immunodiffusion, immunofluorescence, haemagglutination, immunoelectrophoresis, radioimmunoassay, enzyme-linked immunosorbent assay (ELISA), optical immunoassay, liquid chromatography–mass

spectrometry with time-of-flight (LC–TOF/MS), DNA fingerprinting and antibody microarrays.[7]

Conclusion

Preventing acute, life-threatening snakebite emergencies involves eradicating rats, removing debris and cattle sheds from residential areas, wearing protective footwear, using lights and sticks while outdoors, and avoiding open toileting. Villagers need training to identify venomous snakes and should be advised not to fall prey to unqualified faith healers in the event of a venomous bite.

After a snakebite, patients should be immediately transported to well-equipped primary health centers close by. Medical officers at these centers must be trained to identify venomous bites, administer appropriate antivenom doses, and manage potential anaphylactic reactions. In the quest to reduce snakebite-related mortality and morbidity, research should explore alternative chemical antidotes to traditional antivenom, considering evolving animal rights concerns.[8-12]

Conflicts of Interest: None to declare.

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Ethics Committee Approval: Taken from the Institutional Ethics Committee, Guntur Medical College, Guntur, Andhra Pradesh.

References

1. Snake bite in India, WHO [Internet], [cited 05 Aug. 23], Available from: Snakebite envenoming India (who.int)
2. Paul V, Pratibha S, Prahlad KA, Earali J, Francis S, Lewis F. High-dose anti-snake venom versus low-dose anti-snake venom in the treatment of poisonous snake bites--a critical study. J Assoc Physicians India 2004;52:14–7.
3. Narvencar K. Correlation between timing of ASV administration and complications in snake bites. J Assoc Physicians India 2006;54:717–9.
4. Ghosh MK. Management of snakebite cases by national treatment protocol at Jalpaiguri District Hospital in West Bengal in the year 2010--a retrospective study. J Indian Med Assoc 2011;109:553–4, 559–60.
5. Srimannarayana J, Dutta TK, Sahai A, Badrinath S. Rational use of anti-snake venom (ASV): trial of various regimens in hemotoxic snake envenomation. J Assoc Physicians India 2004;52:788–93.
6. Sathish K, Shaha KK, Patra AP. Sree Rekha J Histopathological profile of fatal snake bite autopsy cases in a tertiary care center in South India. Egypt J Forensic Sci 2021;11.
7. Verma KL, Singh AP, Sinha S. New forensic challenges, and detection of snake venom. Forensic Toxicol 2018;36:537–9. https://doi.org/10.1007/s11419-018-0411-3.
8. Bawaskar HS, Bawaskar PH. Snakebite: prevention and management in rural Indian settings. Lancet Glob Health 2019;7:e1178. https://doi.org/10.1016/s2214-109x(19)30275-x.
9. Minghui R, Malecela MN, Cooke E, Abela-Ridder B. WHO's Snakebite Envenoming Strategy for prevention and control. Lancet Glob Health 2019;7:e837–8. https://doi.org/10.1016/s2214-109x(19)30225-6.
10. Gutiérrez JM, Calvete JJ, Habib AG, Harrison RA, Williams DJ, Warrell DA. Correction: Snakebite envenoming. Nat Rev Dis Primers 2017;3. https://doi.org/10.1038/nrdp.2017.79.
11. Gopal G, Muralidar S, Prakash D, Kamalakkannan A, Indhuprakash ST, Thirumalai D, et al. The concept of Big Four: Road map from snakebite epidemiology to antivenom efficacy. Int J Biol Macromol 2023;242:124771. https://doi.org/10.1016/j.ijbiomac.2023.124771.
12. Senji Laxme RR, Khochare S, de Souza HF, Ahuja B, Suranse V, Martin G, et al. Beyond the 'big four': Venom profiling of the medically important yet neglected Indian snakes reveals disturbing antivenom deficiencies. PLoS Negl Trop Dis 2019;13:e0007899. https://doi.org/10.1371/journal.pntd.0007899.