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Snakebite Envenomations in Rural Jaipur: A Comprehensive Study on Clinical Features, Patient Outcomes, and Epidemiological Insights

Dr Karan Cham[1], Dr Deepak Tiwari[1], Dr Janani A[1], Dr Jadeja Rahul J[1], Dr Saurabh Bhargava[1]*

1. Department of Emergency Medicine, National Institute of Medical Sciences & Research, NIMS University Rajasthan, Jaipur- 303121

** Corresponding Author: Dr Saurabh Bhargava, Department of Emergency Medicine, National Institute of Medical Sciences & Research, NIMS University Rajasthan, Jaipur- 303121*

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ABSTRACT:

Background: Snakebite envenomations present a substantial public health concern in rural Jaipur, necessitating a detailed examination of clinical manifestations, patient outcomes, and epidemiological patterns. This study aims to fill existing research gaps and contribute valuable insights to the management and prevention of snakebites in the region. A thorough investigation was conducted on 56 snakebite cases in rural Jaipur, focusing on demographic characteristics, toxicity presentation (neurotoxic, hematotoxic, and local), coagulation status, ASV (Antivenom Serum) triage, complications, and age distribution. The study employed rigorous methods, including a comprehensive analysis of hospital records and structured interviews with patients.

Results: The study revealed a male predominance among snakebite victims (58.9%) and distinct patterns of toxicity presentation. Neurotoxic symptoms were observed in 15 cases, hematotoxicity in 28 cases, and local toxicity in 13 cases. The 20-minute whole blood clotting test highlighted variations in coagulation status. ASV triage was deemed necessary in 76.8% of cases, underscoring the critical demand for effective antivenom therapy. Complications included 41 cases requiring ASV, 7 necessitating ventilation support, and 1 experiencing renal failure. Age distribution indicated vulnerability across different age groups, with 14 cases in the 1-23 age range, 30 in the 24-46 range, and 12 in the 47-70 range.

Conclusion: This study provides a comprehensive understanding of snakebite envenomations in rural Jaipur, emphasising the intricate clinical challenges and diverse outcomes faced by patients. The findings underscore the urgency of targeted interventions, public awareness programs, and healthcare strategies tailored to the unique epidemiological landscape of snakebites in the region. The identified complications emphasise the critical importance of early and effective intervention in snakebite cases to mitigate adverse outcomes. Overall, research contributes essential insights that can inform future public health initiatives and improve the management and prevention of snakebite envenomations in rural settings.

Keywords: Snakebite epidemiology, Rural healthcare, Venomous snake species, Geographic variations, Snakebite outcomes, Epidemiological factors, Snake venom composition, Antivenom therapy, Clinical presentation patterns, Preventive

BACKGROUND

Snakebite envenomations constitute a significant and often underestimated public health challenge, particularly in tropical and subtropical regions like rural Jaipur, Rajasthan. This introduction aims to provide an academic overview of snakebite envenomations, emphasizing their clinical features, patient outcomes, and associated challenges. This study seeks to contribute valuable insights to this critical area [1].

The Global Burden of Snakebites

Snakebite envenomations represent a substantial global burden, particularly in regions where venomous snakes are endemic. Acknowledged by the World Health Organization (WHO) as a neglected tropical disease, snakebites are prevalent in South Asia, Africa, and Latin America, often remaining underreported and inadequately addressed [2]. WHO estimates indicate between 81,000 and 138,000 snakebite-related deaths annually, with an additional 400,000

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cases resulting in permanent disabilities. The majority of these incidents occur in rural areas, underscoring the need for comprehensive studies in these regions [3].

Snakebites in India

In India, snakebite envenomations are a significant concern, given the country's rich snake fauna. With over 270 snake species, approximately 60 of which are venomous, India faces particular challenges. The "Big Four" venomous species, including the Indian Cobra, Common Krait, Russell's Viper, and Saw-scaled Viper, pose the most significant threats [4].
Viper, prevalent in Jaipur, contributes to complex clinical presentations, including coagulopathy, bleeding, and systemic manifestations

Clinical Features of Snakebite

Snakebite envenomations present diverse clinical features, ranging from local effects such as pain and swelling to systemic effects leading to life-threatening complications. Local effects can be profound in Russell's Viper envenomations, causing significant swelling and formation, often requiring surgical interventions [6]. Systemic effects include coagulopathy, neurotoxicity, and hematotoxicity, each associated with specific snake species [7]. Laboratory abnormalities, such as altered clotting parameters, further complicate the clinical picture [8].

Patient Outcomes

The outcomes of snakebite envenomations vary from complete recovery to severe morbidity and, tragically, death. Survival depends on factors like early presentation, timely administration of specific antivenom therapy, and supportive care [9]. In rural areas like Jaipur, limited access to healthcare facilities contributes to treatment delays, impacting patient outcomes [10].

Aims of the Study

The study titled "Snakebite Envenomations in Rural Jaipur: Clinical Features and Patient Outcomes" aims to address the challenges posed by snakebite envenomations in the rural context of Jaipur. By examining clinical features and patient outcomes, the research strives to provide insights informing better prevention, diagnosis, and treatment strategies [11]. This study's significance lies in its potential to improve patient care in rural settings, where the impact of snakebite envenomations is particularly pronounced

Epidemiology of Snakebites in Rural

Building upon the foundational introduction highlighting clinical features and patient outcomes, this section delves into the epidemiological aspects of snakebites in rural Understanding geographic, seasonal, demographic, and occupational factors influencing snakebites is crucial for devising effective preventive and therapeutic strategies

Geographic and Demographic

Jaipur's diverse landscapes, including arid deserts and rural agrarian communities, significantly influence snake prevalence. Russell's Viper, prevalent in Jaipur, poses a notable threat. Rural areas, characterised by agricultural activities, expose populations to snake contributing to a higher likelihood of encounters [15].

Seasonal Variations

Snakebite epidemiology in rural Jaipur exhibits notable seasonal variations. The monsoon season sees a surge in incidents due to increased snake activity and poor visibility. Agricultural activities during this period further elevate the risk, emphasising the need for targeted interventions [16].

Time of Day, Gender, and Age

Nocturnal bites and a gender disparity, with males more susceptible due to outdoor activities, contribute to snakebite variations. The age group of 11 to 30 years faces a higher risk, particularly in agricultural occupations [17]. Snake species identification, crucial for treatment decisions, is challenging, leading to a significant number of "unidentified" cases [18].

First Aid and Delayed Presentation

Victims often resort to ineffective first-aid measures, contributing to delayed medical measures. presentation. These delays exacerbate envenomation severity, emphasising the importance appropriate first-aid education and swift transfers to healthcare facilities

Complications and

Late presentations correlate with a higher incidence of complications, including renal failure, cellulitis, and the need for ventilator support. The study aims to provide comprehensive into these complications, emphasising the role of timely interventions and population awareness programs

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Understanding Snake Venoms and their

Snake envenomations present a medical challenge, with consequences ranging from discomfort to severe morbidity and mortality. Comprehending snake venoms is crucial for developing effective antivenom treatments, understanding pathophysiology, and guiding measures.

The Complexity of Snake Venoms

Snake venoms, biochemical cocktails evolved for prey capture and defence, comprise enzymes, neurotoxins, hemotoxins, cytotoxins, and cardiotoxins. Components vary among species, contributing to diverse effects on the human body [21]. Mechanisms of venom delivery, including solenoglyphous, proteroglyphous, opisthoglyphous, and aglyphous, influence envenomation severity [22].

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Effects on the Human Body

Local and systemic effects, including neurotoxic, hemorrhagic, cardiovascular, renal effects, and coagulopathy, manifest depending on venom composition. Antivenom therapy, though complex, is the cornerstone of snakebite management [23]. Prevention measures include appropriate attire, avoiding high-risk areas, first aid training, and early medical presentation [24].

The study titled 'Snakebite Envenomations in Rural Jaipur: Clinical Features and Patient Outcomes" aims to contribute to the understanding and management of snakebite envenomations in a rural setting. By exploring epidemiological factors, clinical manifestations, and the complexities of snake venoms, the research aspires to inform targeted interventions for improved prevention, diagnosis, and treatment. This comprehensive approach seeks to the intricate challenges posed by snakebite envenomations in rural Jaipur, ultimately
improving healthcare outcomes and minimising the impact of this significant public health concern

Method

Data

The data for this study, titled "Snakebite Envenomations in Rural Jaipur: Clinical Features and Patient Outcomes," was extracted from the medical records of patients who sought at NIMS Hospital in rural Jaipur. NIMS Hospital, serving as a tertiary healthcare center, caters primarily to the healthcare needs of the local rural population. The selected period for data collection spanned from June 2022 to October 2023, ensuring a representative and comprehensive sample of snakebite cases.

Inclusion Criteria:

1. **Snakebite Victims:** Individuals who have sustained a snakebite and sought medical attention at NIMS Hospital, rural Jaipur, during the specified study period.
2. **Study Period:** Data collected from January 2023 to September 2023, ensuring a comprehensive representation of snakebite cases over nine months.

Exclusion Criteria:

1. **Non-Snakebite Cases:** Patients presenting with conditions unrelated to snakebites during the study period.
2. **Incomplete Records:** Cases with insufficient or missing data necessary for comprehensive analy

3. Non-Consenting Patients: Individuals who did not provide informed consent for their medical records to be used in the
4. Cases Outside Designated Area: Snakebite victims treated at medical facilities other than NIMS Hospital or residing outside the rural Jaipur
5. Duplicate Entries: Ensuring each patient is represented only once in the dataset to prevent 3 duplication and data

These criteria are designed to ensure the relevance, reliability, and ethical conduct of the study by focusing on genuine snakebite cases within the specified context and timeframe, while excluding instances that might compromise the integrity of the data or deviate from the study's objective

Data Collection:

A meticulous and structured approach was adopted for data collection, encompassing various variables essential for a comprehensive analysis of snakebite envenomations.

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Demographic Information:

- **Age:** The age of each patient was recorded, enabling the identification of potential age-related patterns in snakebite incidents.
- **Gender:** Gender information was documented to assess any gender-based differences in both the occurrence and outcomes of snakebites.
- **Residence:** The rural or urban status of the patient's residence was noted to evaluate the impact of geographical location on snakebite incidents.
- **Occupation:** The patient's occupation was recorded to identify potential high-risk groups based on their daily activities.

Bite Details:

- **Type of Snake:** Whenever possible, the specific snake responsible for the bite was identified, **allowing for the categorization of snakebites into different venomous species.**

  - Time of Bite: The time of the snakebite incident was recorded to assess if there were temporal patterns associated with snakebite occurrences, with a particular focus on differentiating between day and night

  - Site of Bite: The location on the body where the snakebite occurred was documented to understand the variation in bite locations and their potential clinical

Clinical Presentation:

1 - Local Effects: The presence and severity of local symptoms such as pain, swelling, redness,
2 blister formation, cellulitis, necrosis, and local bleeding were assessed and recorded.
3 - Systemic Effects: The study evaluated the presence and severity of systemic anaphylactic reactions to antivenom, were documented.
- Mortality: Instances of patient mortality, along with the cause and contributing factors,were included in the

Data Analysis:
- Site of Bite: The location on the body where the snakebite occurred was documented to understand the variation in bite locations and their potential clinical implications.

Clinical Presentation:

1 - Local Effects: The presence and severity of local symptoms such as pain, swelling, redness,
2 blister formation, cellulitis, necrosis, and local bleeding were assessed and recorded.
3 - Systemic Effects: The study evaluated the presence and severity of systemic encompassing neurotoxic symptoms (muscle weakness, paralysis), hemorrhagic symptoms (bleeding from various sites), cardiotoxic effects (arrhythmias, cardiogenic shock), renal involvement (acute renal failure), and coagulopathy (abnormal clotting).

- **First Aid:** Information regarding any first-aid measures applied before hospital presentation, including specific techniques such as tourniquet application, was documented.

Treatment:

- **Antivenom Administration:** Details of antivenom administration, including the type and quantity of antivenom used, were meticulously recorded.
- **Supportive Care:** Any supportive care provided, such as mechanical ventilation, dialysis, or fasciotomy, was documented to understand the holistic management approach.

Outcomes:

- **Hospital Stay:** The duration of hospital stay for each patient was recorded, serving as an indicator of the seriousness and complexity of snakebite cases.
- **Complications:** Any complications that arose during the course of treatment, including anaphylactic reactions to antivenom, were documented.

- Mortality: Instances of patient mortality, along with the cause and contributing factors, were included in the data.

Data

The data analysis employed a combination of descriptive statistics and relevant statistical tests to explore clinical features and patient outcomes associated with snakebite envenomations in rural Jaipur.

Descriptive statistics, including mean, median, and standard deviation, were calculated for continuous variables like age and hospital stay duration. Frequencies and percentages were used to summarise categorical Statistical tests, such as chi-squared tests, t-tests, and non-parametric tests, were applied where applicable to assess associations and differences. These tests allowed for the examination of relationships between variables and the identification of significant findings, particularly variations in clinical features and outcomes among different patient groups.

The results of the data analysis were utilised to draw meaningful conclusions regarding

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the clinical features and patient outcomes of snakebite envenomations in rural Jaipur. These findings are anticipated to contribute significantly to the understanding of the impact of snakebites in the region, potentially informing strategies for improved management and prevention.

The comprehensive methods employed in this study aimed to provide a detailed and evidence-based exploration of snakebite envenomations, ensuring that the findings are both reliable and relevant to the context of rural Jaipur.

RESULTS:

Gender

Distribution

The study included a total of 56 patients who were bitten by snakes in rural Jaipur.Among these patients, 33 (58.9%) were male, while 23 (41.1%) were female as shown in Fig.1.The gender distribution in this study demonstrated a male predominance among snakebite Impact different segments of the population and may help guide tailored interventions and healthcare strategies.

This gender-based information provides an initial insight into the demographics of snakebite incidents in the rural Jaipur region. Further analysis will be conducted to assess whether gender has any significant associations with clinical features and patient outcomes related to snakebite envenomations.

The study's focus on gender distribution is an essential step in understanding how

The study revealed distinct patterns of toxicity presentation among the snakebite victims, including neurotoxicity, hematotoxicity, and local toxicity as shown in Fig.2. These findings shed light on the diverse clinical features observed in snakebite envenomations in rural Jaipur.

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Fig.1: Gender Distribution

Toxicity Presentation

The study revealed distinct patterns of toxicity presentation among the snakebite victims, including neurotoxicity, hematotoxicity, and local toxicity as shown in Fig.2. These findings 2 shed light on the diverse clinical features observed in snakebite envenomations in rural A subset of patients (15 cases) displayed neurotoxic symptoms, characterised by muscle weakness and paralysis. This form of envenomation, often associated with specific snake species, significantly affected the clinical outcomes and management of these

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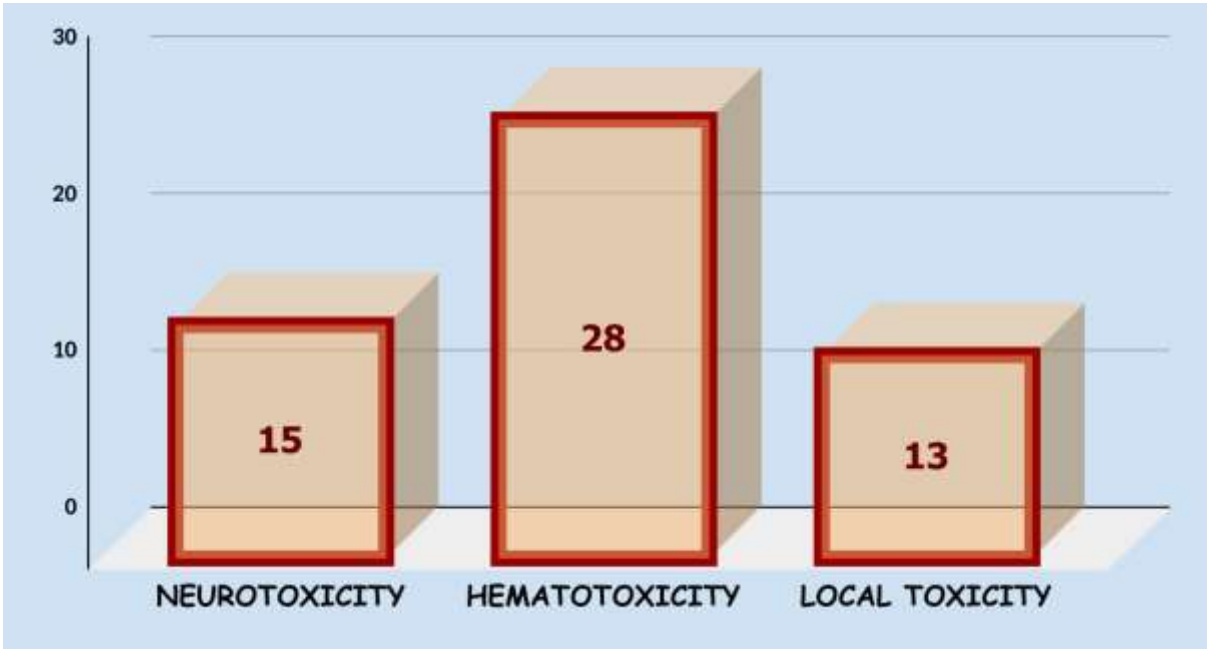

Fig.2: Toxicity

manifesting as bleeding from various sites and coagulopathies. The study explored the severity and implications of hematotoxic envenomations, providing insights into the challenges of managing these cases.

Local Toxicity (13 Cases)

Local toxicity, represented by symptoms such as pain, swelling, blister formation, cellulitis, necrosis, and local bleeding, was observed in 13 cases. The study examined the local effects of snakebites and their impact on patient outcomes.

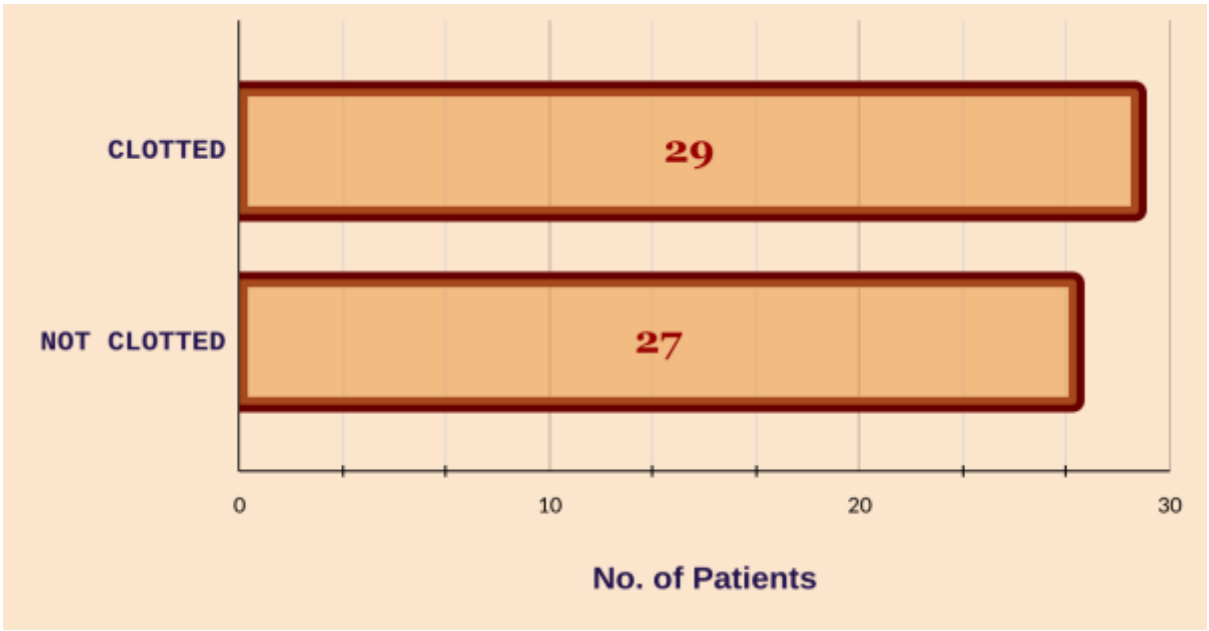

Fig.3: 20-min Whole Blood Clotting

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20-Minute Whole Blood Clotting Test

In the study, the 20-minute whole blood clotting test was performed on 56 patients to assess their coagulation status. The results revealed the following and shown in Fig.3:

- Clotted Samples: Among the tested samples, 29 (51.8%) showed evidence of clot formation within the 20-minute exmples: Conversely, 27 (48.2%) samples did not form clots within the 20- minute test period.

These findings provide insights into the coagulation status of snakebite patients in the study, indicating a roughly equal distribution between clotted and non-clotted samples during the 20-minute whole blood clotting test. The implications of these results in the context of snakebite envenomations will be further explored in subsequent sections.

Requirement of ASV

In the present study, the assessment of ASV (Antivenom Serum) triage revealed that 43 out of 56 cases (43/56, 76.8%) required the administration of ASV, while 13 cases (13/56, 23.2%) did not necessitate ASV treatment. The data pertaining to ASV triage is presented and analysed below(Fig.

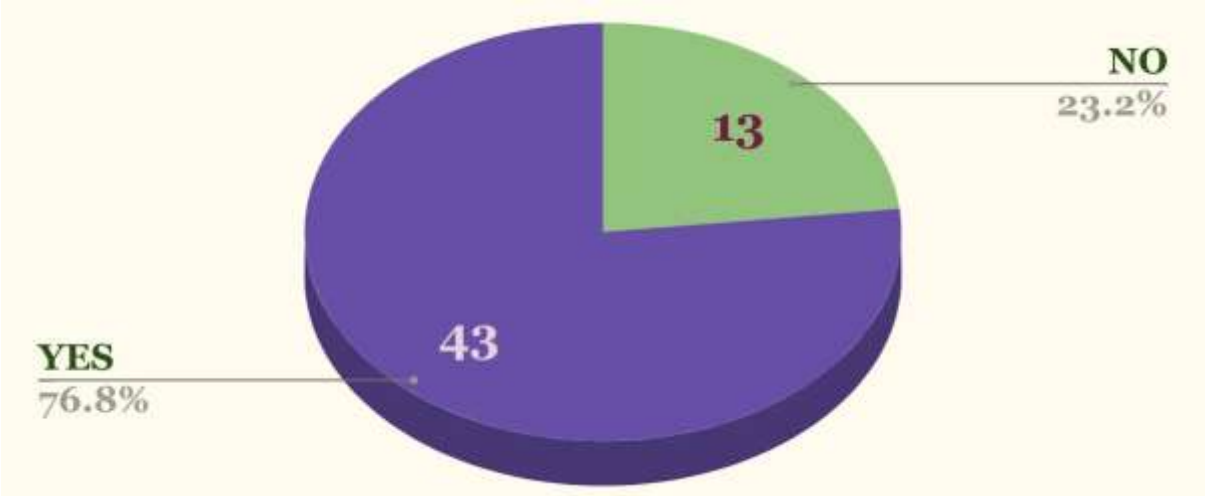

Fig.4: Requirement of ASV Triage

Complications

In this study, complications associated with snakebite envenomations were thoroughly examined, shedding light on the challenges and clinical outcomes faced by patients. Among the 56 patients included in the study, the following complications were observed (Fig.5):

1. ASV Triage: Of the patients, 41 individuals required the administration of Anti-Snake Venom (ASV) to counteract the effects of envenomation. This signifies the substantial demand for ASV therapy in snakebite management.
2. Ventilation Support: 7 patients required mechanical ventilation support due to the severity of their symptoms. These individuals faced respiratory challenges, emphasising the life-threatening nature of certain snakebite
3. Renal Failure: 1 patient experienced acute renal failure, necessitating urgent dialysis.

Renal complications are a serious concern in some snakebite cases, and this instance underscores the potential gravity of such outcomes.

The presence of these complications highlights the importance of early and effective intervention in snakebite cases. Timely administration of ASV and appropriate medical care can mitigate the risk of complications and improve patient

The study's findings underscore the need for continued public awareness programs, emphasising both prevention and early treatment, to address the significant health burden posed by snakebite envenomations in rural Jaipur.

These results provide valuable insights into the clinical challenges and patient outcomes related to snakebite envenomations in the region, contributing to a better understanding of the management and prevention of snakebites.

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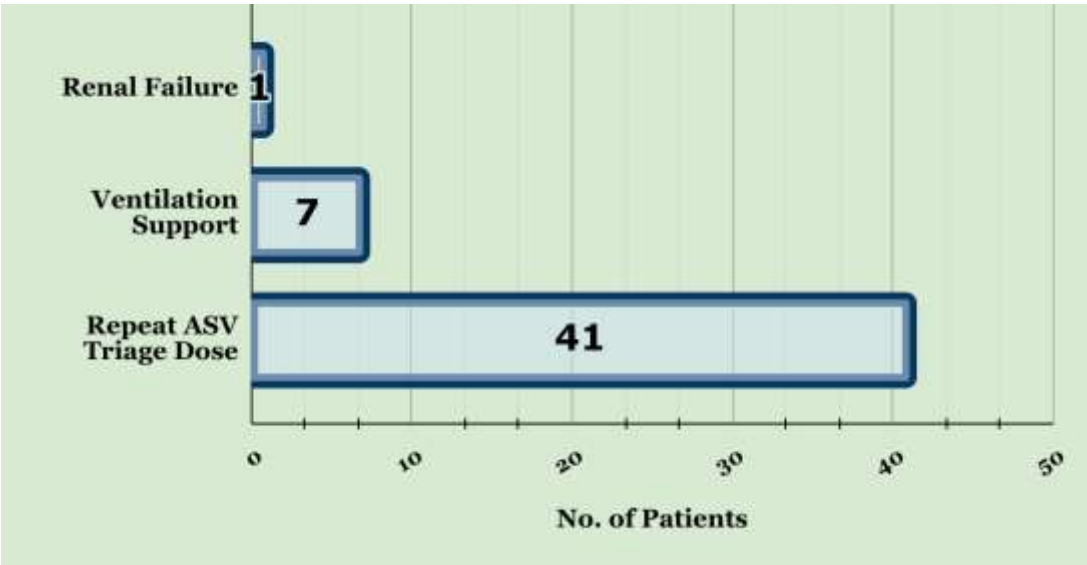


Fig.5: Other

The study examined the age distribution of the 56 patients included in the research, providing valuable insights into the demographics of snakebite envenomations in rural Jaipur (Fig.6).

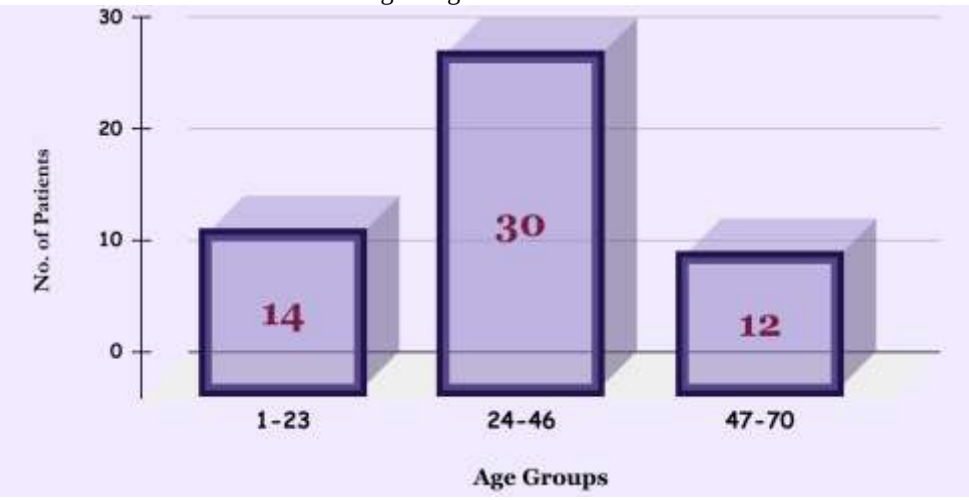
The following age groups were identified:

1. Age 1-23: Among the patients, 14 individuals fell within this age group, reflecting the vulnerability of young individuals to snakebite envenomations. This age category accounted for a notable portion of the
2. Age 24-46: A significant portion of the patients, 30 in total, were in the age range of 24-46 years. This age group demonstrated a substantial prevalence of snakebite cases.
3. Age 47-70: 12 patients belonged to the age category of 47-70 years, indicating that snakebite envenomations affect a wide range of age groups, including older individuals.

These age distributions provide essential demographic information, highlighting the need for snakebite prevention and intervention strategies that target a broad spectrum of age groups. Understanding the age-related patterns in snakebite cases is crucial for developing effective public health programs.

The study's results contribute to a comprehensive understanding of the epidemiology and clinical features of snakebite envenomations in rural Jaipur, which can guide future efforts in snakebite management and prevention.

Fig.6: Age Distribution



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DISCUSSION

The study, based on data collected from patients at NIMS Hospital in rural Jaipur, sheds light on various aspects of snakebites, including clinical presentation, treatment outcomes, and demographic patterns.

Clinical Presentation and Epidemiological Insights

The demographic information gathered in this study provides valuable insights into the population affected by snakebites in rural Jaipur. Analysing age-related patterns revealed that certain age groups might be more susceptible to snakebites, which has implications for targeted awareness and preventive measures. The gender-based differences in snakebite occurrences are more likely to occur can guide preventive measures and enhance community awareness during high-risk periods.

Clinical Presentation: Local and Systemic Effects

The analysis of local and systemic effects provides a detailed understanding of the clinical manifestations of snakebite envenomations. Local symptoms, such as pain, swelling, and necrosis, were assessed for severity. Systemic effects, including neurotoxic, hemorrhagic, cardiotoxic, renal, and coagulopathic symptoms, were also evaluated. This nuanced approach allows for a comprehensive characterization of snakebite cases, enabling healthcare professionals to tailor treatment strategies based on the severity and nature of symptoms.

First Aid Measures

The inclusion of data on first-aid measures is noteworthy. Understanding the first-aid practices adopted by snakebite victims before hospital presentations can inform public health campaigns. It becomes imperative to disseminate accurate information on effective first-aid measures and extended medical attention. The study meticulously documents complications, including anaphylactic reactions to antivenom, contributing to the understanding of treatment-associated risks. Instances of mortality are analysed in-depth, exploring the causes and contributing factors. This information is pivotal for enhancing the preparedness of healthcare facilities and developing protocols to mitigate mortality risks.

Data Analysis and Statistical Significance

The data analysis, employing a combination of descriptive statistics and relevant tests, strengthens the robustness of the study. The use of chi-squared tests, t-tests, and non-parametric tests allows for the identification of significant associations and variations. This statistical rigour ensures that the findings are not merely anecdotal but grounded in statistical significance. The study's approach to examining differences among patient groups bitten by different snake species or presenting with diverse symptoms adds granularity to the understanding of snakebite envenomations.

Conclusion

underscores the importance of community education, emphasising evidence-based interventions over potentially harmful traditional practices.

The study's exploration of treatment approaches and outcomes, including antivenom administration, supportive care, hospital stay duration, complications, and mortality, provides a holistic view of the challenges faced by healthcare professionals in managing snakebite cases. These insights are invaluable for optimising treatment protocols, improving healthcare delivery, and ultimately reducing the burden of snakebite-related morbidity and mortality.

In summary, this study bridges critical gaps in our understanding of snakebite envenomations in rural Jaipur, laying the groundwork for evidence-based interventions, public health campaigns, and further research. As snake bites continue to pose a significant health threat, especially in rural settings, the knowledge generated by this study has the potential to inform policies and practices aimed at mitigating the impact of snakebite envenomations on affected communities.

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Lastly, our appreciation extends to the broader scientific community for the wealth of knowledge that has paved the way for advancements in the field of snakebite envenomations. This research would not have been possible without the cumulative contributions of researchers and healthcare professionals committed to addressing the challenges posed by snakebites.

This work was made possible through the collective effort and support of many, and we are sincerely thankful for each individual and entity that played a role, no matter how small, in the realisation of this study.

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