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Evaluating Clinical Features, Progression, Complications, and Outcomes of Scorpion Sting Envenomation in Children Aged 0-15 in Rural Konkan

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ABSTRACT

Background: The following study has discussed about the Scorpion stings (SS) affect over 1.2 million people per year, among children, the elderly, and those with pre-existing conditions. It is mostly found in tropical regions; SS can cause severe local and systemic effects. It includes neurological, cardiovascular, and respiratory issues. Rural areas such as Konkan, India, face high incidence rates and significant challenges in diagnosis, treatment, and healthcare awareness which increase the risk of complications and deaths. To study the clinical features, course, complications & outcome of scorpion sting envenomation in rural parts of Konkan from birth to 15 years of age.

Methods: This retrospective study was conducted at BKL Walawalkar Rural Medical Hospital, Ratnagiri which assessed scorpion sting envenomation in children (0 to 15 years) over one year. Hospital records were reviewed to analyze clinical features, treatment, and outcomes, focusing on prazosin's role in preventing complications. The study compared early versus delayed interventions to understand their impact on patient recovery in the Konkan region.

Results: The study revealed that children aged 0-3 years, particularly males, are most vulnerable to scorpion stings, predominantly occurring at night. Pain, sweating, and tachycardia were the most common symptoms. Prazosin was the most frequently used treatment, followed by dobutamine and ASV. Early Prazosin administration within 8 hours reduced complications, emphasizing its importance in managing scorpion envenomation.

Conclusion: The study has concluded that early intervention, particularly with prazosin, significantly reduces complications and improves outcomes.

Key-words: Scorpion stings, Envenomation, Prazosin, Rural healthcare and Pediatric complications

INTRODUCTION

Scorpion stings (SS) are a health risk, sometimes fatal especially for vulnerable populations like children and the elderly and especially those that have pre-existing respiratory or cardiac conditions.

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SS account for an annual total of more than 1.2 million cases and occur mostly in tropical and subtropical regions around the world. Out of nearly 1,500 species of scorpions existing in the world, 50 species can produce venoms dangerous to humans [1]. The Buthidae family is considered to be the most dangerous species of scorpions. Clinical impacts of scorpion envenomation (SE) are sometimes serious, producing local and systemic effects. It has a complex composition containing neurotoxic proteins, salts, acidic proteins, and organic compounds leading to a host of harmful consequences like neurological, cardiovascular, hematological, and

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renal disturbances besides the localized symptoms such as pain, redness, swelling, and burning [1].

The incidence of SS varies and is prevalent all over the world. About 79,000 SS are reported every year in Eastern/Southern Africa, causing 245 deaths [2]. Three deaths have been reported due to black SE within 12 months in Guyana [3]. The cumulative incidence of SS in Iran was 2.23% [4]. Clinical manifestations vary with age, gender, and geographic location [4]. SS is still an important health concern in India, especially among children, and it is particularly serious in rural areas like Konkan. The burden of SS in India varies with region, as some states report a higher incidence, especially in tropical regions such as Andhra Pradesh, where red scorpions are common. Although the issue is very important, epidemiological data on SS in Asia, including India, is very limited [5,6].

The National Poison Information Center (NPIC) documented 995 cases, out of which 6 were related to SS. Peak SS incidences in endemic regions like Western Maharashtra, Karnataka, Andhra Pradesh, Saurashtra, and Tamil Nadu are usually seen during the hot months of March to June and September to October when more agricultural activities are also carried out. Severe stings from the *Mesobuthus tamulus* species are more frequently encountered in the Konkan region, where there is an immediate call for research studies into the patterns, complications, and outcomes of SE [5,6]. SS may lead to serious complications, including cardiotoxicity, neurotoxicity, and respiratory dysfunction, resulting in deaths. The lack of medical facilities in rural areas has increased the death rate. There is a need for proper education of health workers regarding management. First aid, antivenom, and intensive care should be considered in reducing the death toll [7-9].

Children between birth and 15 years are especially sensitive to the effect of the sting from SE due to small body size, lower level of awareness concerning hazards, greater level of curiosity with increased chance of accidental encounter, and lesser ability to combat any infection resulting in higher risks and complications arising due to the sting as compared to adults [10-12]. Clinical features of SSE can vary and include local signs like pain, edema, and redness and systemic symptoms like respiratory distress, cardiac dysfunction, and neurological complications. More severe complications are acute pulmonary edema, heart failure, and multiple organ failure (Fig. 1) [1,13]. Diagnosing and managing SS in rural areas like Konkan, India, poses several critical challenges, largely because of less health infrastructure, inadequate medical facilities, and delayed diagnosis that can lead to very serious complications. Lack of awareness within the healthcare community and in the general population [14,15].

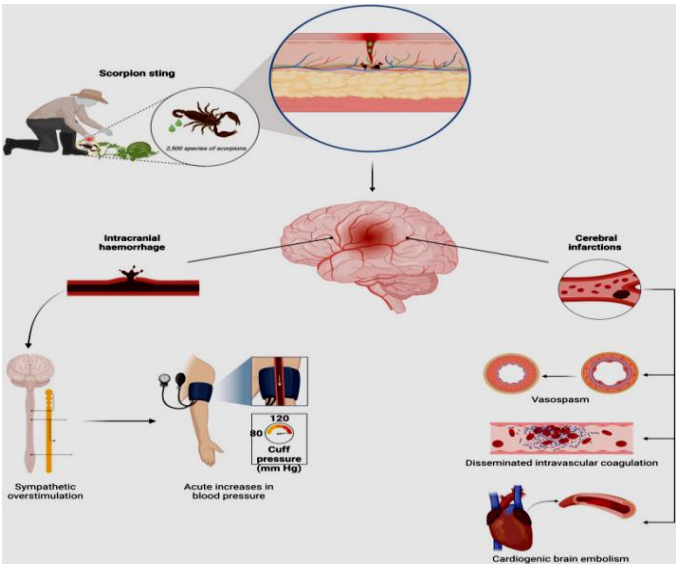

Fig. 1: Clinical presentation of SSE (source: https://www.google.co.in/url?sa=i&url=https%3A%2F%2Fwww.sciencedirect.com%2Fscience%2Farticle%2Fpii%2FS2590171024000225&psig=AOvVaw185D9FyPPQYJOKRWaxapU8&ust=1736680902724000&source=images&cd=vfe&opi=89978449&ved=0CBcQjhxqFwoTCOCzk9bG7YoDFQAAAAAdAAAAABAK)

The time course of SSE is characterized by the development of symptoms in hours after the sting, though the severity depends on the patient and the type of scorpion. Younger children, ≤12 years, have been associated with poorer outcomes [16]. The delay in giving medical care is a strong predictor of poor outcomes, especially when antivenom administration is postponed beyond six hours. In addition, the grade of SSE is important, as it relates to the seriousness of the situation, and thus higher grades more often require aggressive treatment and care [16]. In rural areas, the severity of SS in children is mainly categorized as mild (68.6%), moderate (26.8%), and severe (4.6%). Antivenom is given in most cases (91.6%), though severe envenomation's can cause complications like pulmonary edema, myocardial failure, and hypertension [17]. Mortality rates may vary, with some reports showing a fatality rate as high as 13.6% [18]. Rural settings had a greater likelihood of envenomation, which is correlated with poorer outcomes, such as organ failure and death (Table 1) [19].

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Table 1: Overview of scorpion sting envenomation

Definition	Envenomation is caused by the sting of a scorpion, leading to the injection of venom into the victim's body.
Prevalence	Scorpion stings are common in tropical and subtropical regions, with varying prevalence based on local species.
Common Scorpion Species	Red scorpions, Buthidae family (e.g., Hottentotta, Androctonus), which are more likely to cause severe reactions.
At-Risk Groups	Children, elderly individuals, and those with pre-existing health conditions such as heart disease or asthma.
Clinical Features	Localized pain, swelling, and numbness; systemic effects like tachycardia, hypertension, seizures, or myocarditis.
Time to Onset of Symptoms	Symptoms typically appear within minutes to hours after envenomation, with severe effects manifesting in 1-2 hours.
Complications	Myocarditis, pulmonary edema, shock, encephalopathy, and anaphylaxis are among the most severe complications.
Diagnosis	Based on clinical presentation, history of exposure, and sometimes laboratory tests to confirm severity.
Management	Symptomatic treatment, prazosin administration, anti-venom in severe cases, and supportive care like oxygen therapy.
Prognosis	Timely intervention usually leads to full recovery, though delayed treatment can result in higher mortality and long-term complications.
Mortality and Morbidity	Mortality is higher in severe cases, particularly with delayed treatment or lack of access to antivenom.
Preventive Measures	Public awareness, environmental control, and distribution of antivenom in endemic areas are key strategies for prevention.
Treatment Challenges in Rural Areas	Limited healthcare infrastructure, delayed access to medical care, and lack of awareness among the public complicate treatment efforts.

Rural Konkan has particularly venomous species and health care challenges that necessitate research on SS to improve the treatment and prevention of envenomated children. The current research will fill data gaps and guide future public health strategies and protocols in the region.

MATERIALS AND METHODS

Research Design- The study employed a retrospective design to evaluate the clinical features, course, complications, and outcomes of scorpion sting envenomation in children. The primary focus was to assess the epidemiology and clinical impact of scorpion stings in rural settings, particularly in the Konkan region. This design involved the review and analysis of hospital records, enabling the researchers to gather detailed clinical data on a large number of paediatric cases. This approach allowed the identification of common trends, treatment modalities, and outcomes without requiring prospective data collection, which could have been more time-intensive.

The study targeted children aged 0–15 years who presented with confirmed or probable scorpion envenomation. The researchers utilised clinical records

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to extract information about the timing of the sting, presenting symptoms, administered treatments, and outcomes. A special emphasis was placed on understanding the role of prazosin, a widely used therapeutic agent in managing scorpion sting envenomation, in preventing complications and improving patient outcomes. The retrospective design enabled the team to compare outcomes between those who received early intervention and those treated later.

Inclusion Criteria- The study employed strict inclusion and exclusion criteria to ensure the accuracy and relevance of the data. Children aged 0–15 years who had a confirmed history of scorpion stings were included. Confirmation was based on either visual identification of the scorpion by the patient or caregivers or the presence of classical clinical manifestations of scorpion sting envenomation, such as severe pain at the sting site, profuse sweating, vomiting, excessive salivation, restlessness, cold extremities, tachycardia, and hypotension. These criteria ensured that only cases directly related to scorpion stings were analyzed.

Exclusion Criteria- Exclusion criteria were equally stringent. Patients older than 15 years were excluded to maintain a focus on the paediatric population. Cases of bites from unknown insects or those without clinical manifestations consistent with scorpion envenomation were also excluded. This helped eliminate confounding factors and ensured that the analysis specifically addressed the effects and outcomes of scorpion stings. Additionally, incomplete records that lacked critical clinical or treatment details were not considered. This rigorous selection process enhanced the study's reliability and helped draw meaningful conclusions about the impact of scorpion stings on children in rural areas.

Evaluation- The evaluation process involved a detailed review of patient records to gather comprehensive information about each case. Demographic data such as age, gender, and geographical location were noted to identify patterns in the affected population. Clinical data included the timing of the sting, presenting symptoms, and the anatomical site of the sting. Most stings were reported during nighttime and were predominantly located on the lower extremities, aligning with the nocturnal nature of scorpions and their habitat.

The clinical course of each patient was meticulously documented. The severity of symptoms, the occurrence of complications, and the response to treatment were evaluated. The study focused on identifying the most common complications, such as peripheral circulatory failure, pulmonary oedema, and myocarditis, which often result from autonomic storms triggered by scorpion venom. The timing and frequency of interventions were recorded, with particular attention given to the administration of prazosin.

Prazosin, a selective alpha-blocker, was administered to most patients as part of the standard treatment protocol. The timing of its administration—whether within the first 8 hours or later correlated with the occurrence of complications and overall outcomes. Supportive treatments, including fluid resuscitation, inotropic support, and the use of anti-scorpion venom (ASV), were also evaluated. The researchers noted the effectiveness of these interventions in managing complications and improving survival rates.

Outcomes were categorized into recovery, morbidity, and mortality. Recovery was defined as the resolution of symptoms without long-term effects. Morbidity refers to cases with significant complications requiring prolonged hospitalization or intensive care. Mortality was recorded in cases where patients succumbed to severe complications. One case resulted in death, highlighting the life-threatening nature of scorpion envenomation when complications such as myocarditis and cardiogenic shock occur.

Statistical Analysis- The data underwent statistical analysis to identify significant patterns and correlations. Descriptive statistics highlighted demographic and clinical characteristics, including a higher incidence of stings during the rainy season and vulnerability in children aged 0–3 years. Inferential analysis showed that early administration of prazosin (within 8 hours) significantly reduced complications, emphasizing its effectiveness as a critical intervention. Statistical tests confirmed the strong association between early treatment and improved outcomes.

Ethical Approval- Ethical approval was obtained from the hospital's ethics committee before initiating the research.

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RESULTS

Table 2 presents the demographic and baseline characteristics of children affected by scorpion stings, highlighting certain trends and features of the patient population. Notably, children in the youngest age group (0-3 years) account for the highest incidence of stings, suggesting increased vulnerability among the very young. This vulnerability may be linked to higher exposure or activity levels in environments where scorpions are prevalent. The data also show a higher prevalence of scorpion stings among males (60%), which could indicate that boys are either more exposed to or engage more frequently in activities that increase their risk of encountering scorpions. The timing of the stings predominantly at night (80%) aligns with the nocturnal nature of scorpions, emphasizing the need for heightened awareness and preventive measures during these hours.

Table 2: Baseline and demographic characteristics of the patients

Characteristic	Total Patients (N=100)	Details
Age Group		
0-3 years	30	Most vulnerable, highest incidence of stings
4-7 years	25	
8-11 years	20	
12-15 years	25	
Gender		
Male	60	Higher incidence in males
Female	40	
Geographical Location		Predominantly rural
Timing of Sting		
Nighttime	80	Aligns with nocturnal activity of scorpions
Daytime	20	

The clinical features observed in children up to 15 years of age following a scorpion sting highlight significant involvement of the nervous and cardiovascular systems. Pain is the most common symptom, affecting 96% of cases, followed by profuse sweating, which occurs in 88% of cases. Tachycardia is observed in 66% of cases, indicating rapid heart rate as a frequent cardiovascular response. Vomiting is reported in 64% of cases, showing gastrointestinal distress in a majority of patients. Cold extremities are experienced by 54% of children, likely due to vasoconstriction or poor circulation. Hypotension, or low blood pressure, affects nearly half of the cases (48%), posing a potential risk of shock if left untreated. Priapism, a result of autonomic dysfunction, is seen in 32% of cases, while increased salivation is noted in 24% of patients, reflecting parasympathetic overactivity. Nausea is the least common symptom, affecting 16% of cases. These findings underscore the importance of early recognition and management of scorpion envenomation to prevent severe complications (Fig. 2).

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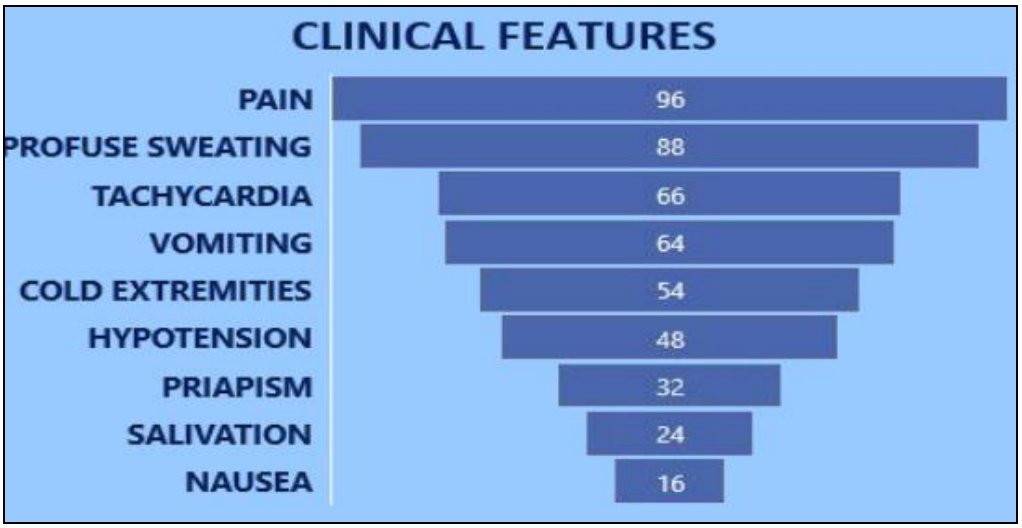

Fig. 2: Clinical Features of the patients with scorpion sting

The clinical management of children up to 15 years of age who experienced scorpion stings, focuses on three treatments: prazosin, ASV (anti-scorpion venom), and dobutamine. Among the patients, prazosin was the most commonly used treatment, with over 20 children receiving it. This suggests that prazosin is a primary choice in managing the cardiovascular effects of scorpion envenomation, particularly for addressing autonomic disturbances. Dobutamine, used in about 15 patients, indicates its role in managing cardiac complications, such as heart failure or hypotension, which are common following a sting. ASV, administered to approximately 10 children, appears to be used less frequently, likely reserved for cases where venom neutralisation is critical. This distribution highlights the preference for symptomatic and supportive treatment over antivenom in managing scorpion stings in this age group. The data underscore the importance of tailored management strategies based on the severity of symptoms (Fig. 3).

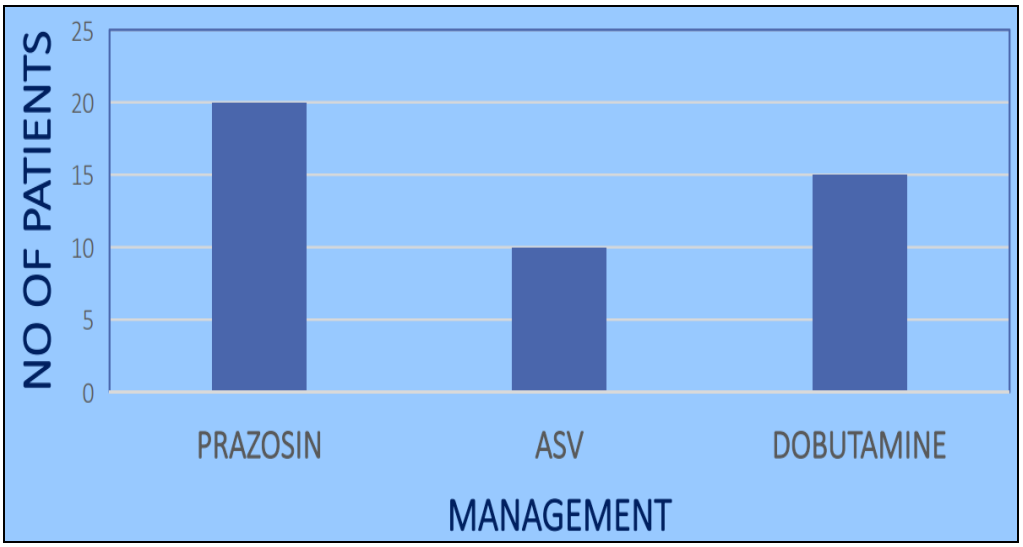

Fig. 3: The management of the patients with scorpion sting

Fig. 4 illustrates the complications observed in patients, categorized into three primary outcomes: circulatory failure, pulmonary oedema, and convulsions. The figure shows that circulatory failure was the most prevalent complication, affecting 14 individuals. Pulmonary oedema was the second most common complication, occurring in 7 individuals. Convulsions were the least frequent complication, reported in only 2 patients. This distribution highlights that circulatory failure significantly outweighs the other complications in frequency, emphasizing its prominence as a clinical concern.

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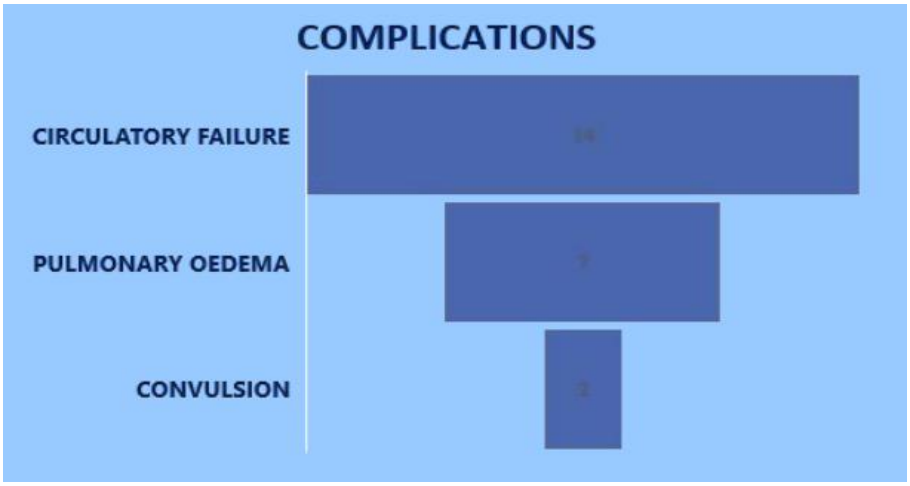

Fig. 4: Complications of the patients

Fig. 5 demonstrates the association of Prazosin administration with complications observed in patients following a scorpion sting, categorized based on the timing of administration. The data compares the outcomes between patients who received Prazosin within 8 hours of the sting and those who received it after 8 hours. Among patients treated within 8 hours, a significant proportion experienced no complications, as indicated by the larger segment of the bar representing "No complications." In contrast, patients who received Prazosin after 8 hours showed a noticeable increase in complications, as represented by the larger segment of the bar labeled "Complications seen in." This comparison highlights the importance of early administration of Prazosin in minimizing complications following scorpion stings.

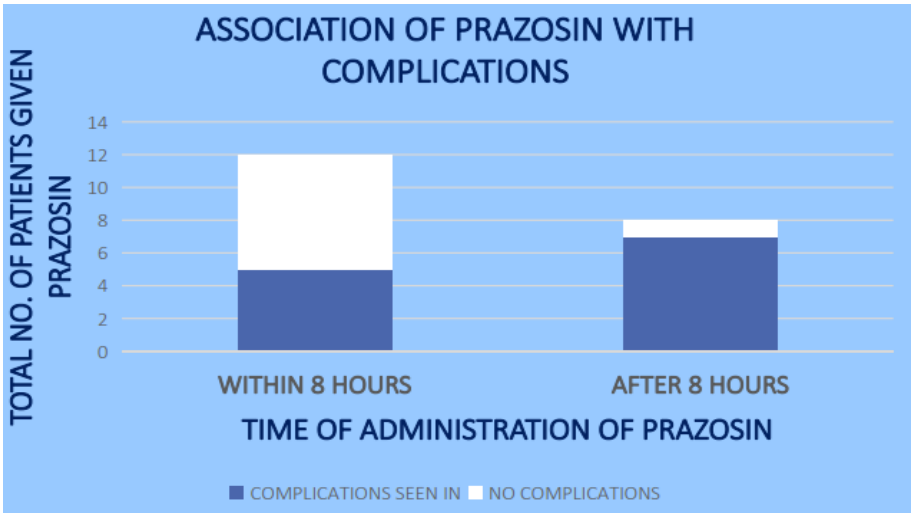

Fig. 5: Complication of the patients for the Prazosin administration after scorpion sting

DISCUSSION

Scorpion sting envenomation in children represents a significant medical emergency because it can be severely severe. This condition can take the form of local effects in the form of intense pain, redness, itching, and swelling at the point of the sting. Systemic involvement may occur in the form of excessive salivation, profuse sweating, nausea, vomiting, increased BP, increased heart rate, and increased restlessness or irritability.

These neurological complications are severe, including muscle contraction without control, eye movement problems, slurred speech, and in critical cases, coma [13,14].

Bosnak *et al.* [8] presented critical pediatric health priority issues, SSE in children. This study assessed the demographic, clinical, laboratory, treatment, anoutcome characteristics of 52 pediatric cases from southeast Turkey. The mean age of the patients was 7.7 years, and

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about 60% of the cases were rural dwellers, a particular risk for severe envenoming. Stings occurred most commonly during summer on the foot or lower limb (48%), with features of tachycardia and coldness of extremities in 38.4%. Severe envenomation was noticed in 38.5%, and all patients were admitted into PICU for management. With one death with pulmonary edema, the common laboratory parameters elevation included hemoglobin and liver enzymes as noted in case of severity.

Bawaskar and Bawaskar [7] evaluated the clinical progression of SSE in 293 pediatric patients in Maharashtra. Hypertension was detected in 38% of children admitted within 1–10 hours following the sting. Tachycardia was reported in 29.6% of those who were admitted within 1–24 hours with a mean duration of 6.7 hours. Acute pulmonary edema developed in 24.5% of cases 6–24 hours post-sting. Six children were brought dead, and 17 (6%) succumbed later due to multiorgan failure, convulsions, and loss of consciousness, predominantly in cases reporting more than 24 hours after envenomation. The study emphasized that morbidity and mortality were highly dependent on the time elapsed between the sting and the initiation of treatment (Table 3).

Table 3: Studies related to the clinical features and outcomes of SSE

Study	Total Children	Age of Children	Clinical Features	Course of Disease	Complications	Outcomes
Mohamad *et al.* [19]	111 (69M, 42F)	5 years	Local reactions, mild systemic manifestations, and severe complications noted (pulmonary edema, cardiogenic shock, neurological issues)	Retrospective review from bite to symptom progression	Pulmonary edema, cardiogenic shock, neurological involvement	55.8% discharge w/o sequelae, 26.1% w/ sequelae, 18.1% death
Pradeep *et al.* [20]	1	19 years (male)	Intense pain, nausea, vomiting, abdominal pain, sweating, respiratory and cardiovascular symptoms, myocarditis	Immediate cardiogenic shock and hypoxia treatment, an improvement over 6 days	Scorpion venom-induced myocarditis, cardiogenic shock, pulmonary edema	Recovery, improved LV function, stable at discharge after 7 days
Reddy *et al.* [6]	41	2 months - 15 years	Pain, diaphoresis, restlessness, swelling, vomiting, dyspnea, salivation	Stings more common during the day; hospital stays up to 14 days	Peripheral circulatory failure, pulmonary edema, myocarditis, encephalopathy	Majority recovered, 2 deaths from pulmonary edema
Kumar *et al.* [5]	36	0-3 years	ECG changes, myocarditis, echocardiographic abnormalities	Day 1 severe, improvement by Day 14, normal function by 6 months	Myocarditis, decreased ejection fraction	Significant recovery, no long-term damage by 6 months

Prasad *et al.* [21]	90	Not specified	Perspiration, cold extremities, shock, myocarditis, encephalopathy, priapism	Treatment with prazosin, higher mortality if treatment delayed over 6 hours after the sting	Acute pulmonary edema, myocarditis, encephalopathy, priapism, metabolic issues	8.9% mortality, no significant difference in recovery metrics

Management of SSE is specific to children. The typical treatments include administration of antivenom and prazosin. In such severe cases, dopamine and Na-nitroprusside may be given. Early hospitalization is very crucial because delays delay the effectiveness of treatment. Tightly monitored admissions in a PICU are indispensable for timely interventions. Aggressive medical management at the level of affected organ systems can be potent. Complications such as myocarditis and pulmonary edema deserve prompt treatment that reduces mortality [5,21-23].

The rural areas lack proper facilities for medical service delivery, which further complicates the management of SSE. Inadequate knowledge on the part of the healthcare provider is another challenging aspect. Diagnosis and treatment get delayed, thus causing complications and fatalities [24]. Largely suboptimal care results from insufficient training among healthcare workers, lack of antivenom, and reliance on traditional remedies. Upgrade healthcare provider education with the availability of antivenom and increase public awareness to reduce the incidence in rural areas where SS are common [9,24].

The role of environmental factors in SSE calls for effective public health measures. Preventive strategies should be aimed at educating people on the dangers of SS, the symptoms, and protective practices [3]. Community initiatives should be aimed at identifying areas with a high prevalence of stings and encouraging preventive actions. In addition, the availability of antivenom in vulnerable areas should be available promptly to reduce the impact of envenomation and improve the outcome of the treatment. The efforts highlight targeted approaches to minimize the frequency and severity of SS cases [13,25].

Validation of such findings would call for larger multicenter studies. More research about the species present in the Konkan region and the toxicity of their venom is essential for a full understanding. Proposals for health care reforms included training medical personnel, educating the populace, and standardizing treatment so that mortality and morbidity could be minimized in the rural areas of India [5,7].

CONCLUSIONS

The study concludes that early intervention with prazosin significantly reduces complications and improves outcomes in pediatric scorpion sting cases, particularly in rural settings where such incidents are prevalent. Younger children are at higher risk, emphasizing the need for focused preventive strategies. Prazosin, as a first-line treatment, effectively manages cardiovascular and autonomic symptoms, with early administration being crucial for better outcomes. The study also highlights the importance of tailored treatment strategies, including selective use of anti-scorpion venom and dobutamine, based on the severity of envenomation.

CONTRIBUTION OF AUTHORS

Research concept- Gauri Parab, Pracheta Gupta
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Critical review- Suryakant Ingale
Article editing- Gauri Parab, Akash Narayane
Final approval- Suryakant Ingale

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