

Factors determining poor prognosis in scorpion sting in coastal Andhra Pradesh

Chandra Mohan Kumar¹, Naveen S V Prasad²

From ¹Department of Pediatrics, Hamdard Institute of Medical Sciences and Research, Jamia Hamdard, New Delhi, ²Department of Neurology, Sri Venkateswara Institute of Medical Sciences, Tirupati, Andhra Pradesh, India

Correspondence to: Chandra Mohan Kumar, Department of Pediatrics, Hamdard Institute of Medical Sciences and Research, Jamia Hamdard, New Delhi, India. E-mail: cmkumar1@rediffmail.com

Received – 16 July 2016

Initial Review – 30 July 2016

Published Online – 29 August 2016

ABSTRACT

Introduction: Scorpion stings are a major public health problem and a common emergency in India and other tropical countries. In India, red scorpions are more prevalent, and their venom is more likely to cause cardiovascular complications and mortality.

Objective: There are very few studies regarding predictors of poor prognosis. Hence, this study was designed which aimed to identify these factors. **Materials and Methods:** In this hospital-based, prospective study, children admitted to scorpion sting between December 2009 and November 2010 were included. Relevant information was collected and analyzed. **Results:** Scorpion stings account for 1 in every 36 admissions. Maximum cases were in 0-3 and 7-9 years age groups with mean of 6.78 years. Red scorpion stings were more common and are associated with more severe presentations. There was considerable variation in sting-prazosin interval (SPI) ranging from 2 to 28 h. If the child's age was below 6 years, red scorpion sting and SPI >8 h were very significantly associated with a higher incidence of complications such as peripheral circulatory failure, congestive cardiac failure, myocarditis, and acute pulmonary edema. **Conclusion:** Younger age, red scorpion, and delay in administration of prazosin are predictors of poor prognosis in scorpion stings in children, a common and fatal medical emergency in India.

Key words: *Scorpion sting, Red scorpion, Prazosin, Myocarditis, Acute pulmonary edema*

Scorpion stings are one of the most common and fatal medical emergencies on the Indian subcontinent and many tropical countries. Although snake bites are commoner, scorpion stings account for a higher death toll. Although numerous cases of stings remain unreported and the exact incidence of scorpion stings is not known, it is estimated that the annual number of scorpion stings exceeds 1.2 million with 2.3 billion people at risk, worldwide [1,2]. The reported case fatality rate due to scorpion sting varies from 3% to 22% among hospitalized children in various studies from India and other countries [3-5]. Various factors have been suggested as predictors of outcome in cases of scorpion stings. Complications such as myocarditis, congestive cardiac failure (CCF) and peripheral circulatory failure (PCF), acute pulmonary edema (APE), and encephalitis have been associated with higher mortality and morbidity rates [5-8].

Clinical manifestations of scorpion sting depend on dose of venom, age of affected child, season of sting, and most importantly time lapse between sting and hospitalization. Several other factors such as sex of the child, pre-hospitalization first aid, interval between sting and prazosin administration have also been suspected to play an important role in the development of complications and subsequently adverse outcome [9,10]. However, there is a paucity of information regarding evidence-based validated predictors of poor prognosis and outcome in the scorpion sting cases.

Scorpion sting is common in the coastal belt of Andhra Pradesh, the area catered by our Medical College Hospital. This study aimed at identifying predictors of poor prognosis and outcome in the scorpion sting cases so that the management strategies can be designed to minimize mortality and morbidity of scorpion sting.

MATERIALS AND METHODS

This hospital-based, prospective study was conducted between December 2009 and November 2010, in a tertiary care teaching hospital in coastal Andhra Pradesh, and was designed to know the descriptive epidemiology of scorpion sting. The study was approved by Institutional Ethics Committee. All cases aged 1-18 years presenting to the emergency with history of scorpion sting and the presence of sting mark were included in this study. Unknown bites or stings and cases where the clinical manifestations are not compatible with the scorpion sting were excluded.

On admission, detailed clinical history, including the time of sting, symptoms, and details of treatment received before admission and description of the scorpion obtained. All patients were subjected to thorough clinical examination at admission and frequent intervals thereafter. Hourly monitoring of heart rate, respiratory rate, blood pressure, urine output, cardiovascular, and respiratory status was done. Routine investigations such as

complete blood counts, peripheral smear, urinalysis, bleeding time, clotting time, blood sugar, chest X-ray, and electrocardiogram were done in all cases.

All the enrolled patients, admitted in the pediatric ward and Pediatric Intensive Care Unit, were treated with pre-approved treatment protocol and received a dose of prazosin (30 µg/kg/dose). Children with PCF were treated with prazosin, intravenous fluids, and intravenous diazepam (0.2 mg/kg). Prazosin doses were repeated if needed, every 4 h, till peripheries became warm and urine output improved. Myocarditis with CCF was treated with oxygen (0.5-2 L/min), maintenance IV fluids, prazosin 30 µg/kg/dose (nasogastric tube/oral), and dobutamine infusion (5-15 µg/kg/min). Pulmonary edema was treated with oxygen, prazosin, dobutamine infusions, furosemide, and by mechanical ventilation when indicated. All the cases were closely monitored for complications and managed accordingly.

The severity of manifestations of stings was graded [11] as follows: (1) Grade I: Isolated pain (local effects); (2) Grade II: Systemic manifestation (autonomic storm). PCF/hypertension/sweating/vomiting/priapism/fever/shivering; (3) Grade III: Life-threatening manifestations such as myocarditis/cardiogenic shock/APE and altered consciousness. Myocarditis and APE were diagnosed using standard diagnostic criteria.

Analysis of the data was done using MS Excel software. The following statistical values were determined. (1) Mean and standard deviation to describe quantitative data. (2) Levene's test for equality of variances was used to compare means between children with complications versus without complications in quantitative data to determine the p (significance 2 tailed) values. (3) On the basis of binary regression model, we found predicted value for dependent variables (age, sex, types of scorpion, and sting-prazosin interval [SPI]) and goodness of fit Hosmer and Lemeshow tests were applied. (4) For all tests, a probability $p < 0.05$ was considered as significant and $p < 0.01$ was considered highly significant.

RESULTS

Scorpion sting cases constituted 50 out of 1830 admissions (2.7%) during the study period. Maximum cases were in the age groups of 0-3 years and 7-9 years. The mean age at admission was 6.78 ± 4.42 years, and mean hospital stay was 4.51 ± 2.23 days (mode 7 days). There was slight male preponderance 58% versus 42% with male to female ratio of 1.38:1. Almost all (96%) cases came from rural areas. Red scorpion stings (54%) were more frequent than black scorpion stings (42%), whereas, in 4% cases, it remained undetermined. There was a considerable disparity in administering the first dose of prazosin, interval ranging from 2 to 28 h. As seen in Table 1, only 8% received a dose of prazosin within 4 h of sting and by 8 h, only 28% children had received the first dose.

While 46% cases reported with Grade III severity, Grades I and II were reported in 28% and 26% cases, respectively. Individually, the most common presenting symptoms were pain at the sting site, diaphoresis, and restlessness. The common physical signs were restlessness, cold extremities, tachycardia

with hypotension and tachypnea. Priapism was noted in 14% and 6% had hypertension. Time required for recovery was inversely proportional to the grade of severity. The mean duration of hospital stay varied from 2 days in cases with Grade I envenomation to 7 days in cases with Grade III envenomation (Table 2).

Complications such as myocarditis, CCF, and APE were more commonly observed in children younger than 6 years and were evenly distributed across both the sexes (Table 3). Two children expired giving a case fatality rate of 4%. As shown in Table 4, an association of red scorpion sting with cardiac complications as well as APE was statistically significant ($p < 0.008$). Table 5 shows the relationship between complications and SPI. In comparison with cases receiving prazosin within 8 hours of sting, cardiac complications (CCF and myocarditis) were more in cases who did not receive it within 8 h ($p < 0.003$).

DISCUSSION

Prognosis of cases depended on the incidence of certain complications such as myocarditis, PCF, CCF, hypertension,

Table 1: Sex, geographical area, and age and type of scorpion and sting-prazosin interval of cases

Category	Cases (%)
Sex	
Male	29 (58)
Female	21 (42)
Geographical area	
Rural	48 (96)
Urban	2 (4)
Age group (years)	
0-3	14 (28)
4-6	11 (22)
7-9	13 (26)
10-12	8 (16)
13-18	4 (8)
Type of scorpion	
Red scorpion	27 (54)
Black scorpion	21 (42)
Unclassified	2 (4)
Sting-prazosin interval	
0-4	4 (8)
5-8	10 (20)
9-12	6 (12)
13-16	9 (18)
17-20	9 (18)
>20	12 (24)

Table 2: Distribution of severity grades

Severity	Number of cases (%)	Mean duration of stay (days)
Grade I	14 (28)	2
Grade II	13 (26)	5
Grade III	23 (46)	7

Table 3: Complications in relation to age and sex groups

Complications	Age≤6 year (N=28)	Age>6 year (N=22)	Sig. 2-tailed	Males (N=29)	Females (N=21)	Sig. 2-tailed
PCF	27	9	0.000 HS	21 (72)	15 (71)	0.786 NS
Myocarditis	17	4	0.000 HS	12 (41)	9 (43)	0.849 NS
CCF	16	4	0.001 HS	12 (41)	9 (43)	0.651 NS
APE	9	2	0.010 S	7 (24)	4 (19)	0.968 NS
Hypertension	2	1	0.610 NS	1 (3)	2 (10)	0.054 NS

PCF: Peripheral circulatory failure, CCF: Congestive cardiac failure, APE: Acute pulmonary edema, HS: Highly significant, NS: Not significant, S: Significant

APE, and encephalopathy. Complications were encountered more frequently in younger children, with cardiovascular complications being more common in children below 6 years. The differences in incidence of PCF, myocarditis, and CCF were statistically very highly significant. Similar findings were observed by Bawaskar and Bawaskar [12] and Biswal et al. [13]. The dose of the venom relative to the weight is obviously higher in younger children; thus, rendering them susceptible to more severe envenomation and greater risk of complications. The other explanation of this phenomenon may also be related to delayed presentation due to inability of younger children to give a correct description of events, and sometimes, scorpion sting cases remain unrecognized leading to delayed presentation and consequently delayed initiation of treatment. As Graph 1 shows the predictability of myocarditis trendline, and the chances of having myocarditis decrease with increasing age and beyond 6 years, it becomes <50%.

There was no significant difference in the incidence of complications in males and females in our study. Furthermore, sex difference has no significant impact on complications, whereas Bawaskar and Bawaskar [9] has reported an increased risk of pulmonary edema and hypertension in males compared to females. Although, no other data in published literature has reproduced this finding and there is no evidence to suggest that there is a variable effect of the venom on males and females.

In our study, the cardiovascular complications were more common in stings by red scorpion (*Mesobuthus* spp) than black scorpion (*Palamneus* spp). As evident from Table 5, CCF, myocarditis, and APE were more commonly associated with red scorpion. This is in line with studies done by Dutta and Deshpande [14]. However, in our study, the identification of species was based on information provided by the bystanders and the victim, which may not always be reliable. A more objective study of the species of scorpion would be necessary before drawing any conclusion. Still, our study concurs with the observation made by Ismail that mesobuthus tumulus (red scorpion) is the most lethal among all poisonous species of scorpions [15].

Severe stings (Grade III) in small children needed up to 5-6 doses of prazosin. Cardiovascular complications (PCF, myocarditis, and CCF) were noted less frequently in children who received a dose of prazosin early (i.e. within 8 hrs of sting). The differences in complication rates among two sub-groups of children, between SPI <8 and >8 h were highly significant. This finding is comparable to previous studies [12,13,16], which show that early and effective administration of prazosin significantly reduced the incidence of complications and mortality. Prazosin,

Table 4: Comparison of cardiovascular complications with relation to scorpion species (red or black by physical description)

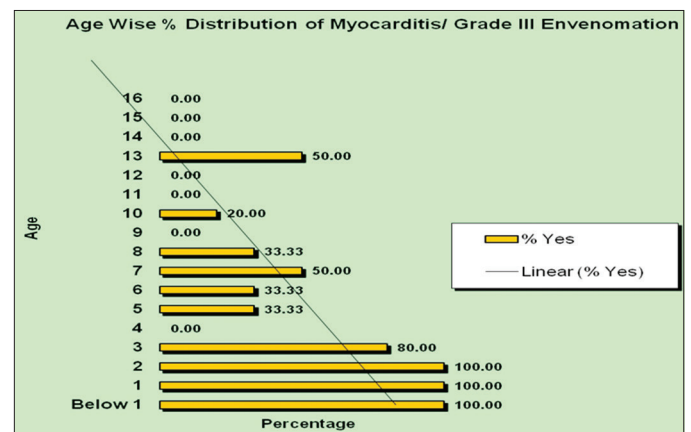
Complications	Red scorpion (N=27)	Black scorpion (N=21)	p value
PCF	24 (89)	12 (57)	0.068 NS
Myocarditis	18 (67)	3 (14)	0.000 HS
CCF	17 (67)	3 (14)	0.000 HS
APE	10 (37)	1 (5)	0.008 HS
Hypertension	0	3 (14)	

PCF: Peripheral circulatory failure, CCF: Congestive cardiac failure, APE: Acute pulmonary edema, HS: Highly significant, NS: Not significant

Table 5: Comparison of complications in relation to sting-prazosin interval

Complications	< 8 h, (N=14)	>8 h, (N=36)	p value
PCF	5 (27)	30 (94)	0.000 HS
Myocarditis	1 (5)	20 (63)	0.001 HS
CCF	1 (5)	19 (63)	0.003 S
APE	2 (10)	9 (28)	0.422 NS
Hypertension	2 (10)	1 (3)	0.63 NS

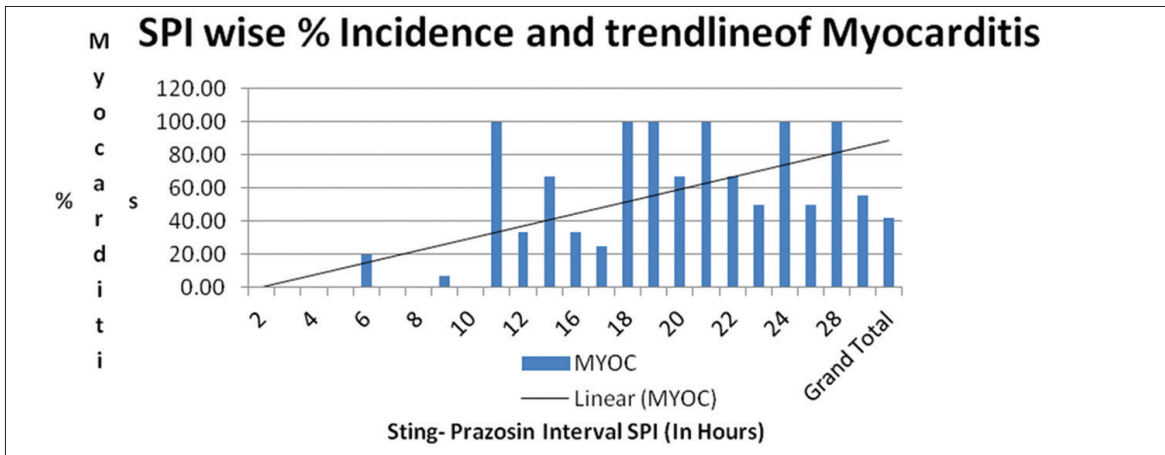
PCF: Peripheral circulatory failure, CCF: Congestive cardiac failure, APE: Acute pulmonary edema, HS: Highly significant, NS: Not significant, S: Significant



Graph 1: The trendline shows a decreasing possibility of myocarditis with increasing age and the chance becomes <50% beyond 6 years

an alpha-adrenoceptor antagonist, is a physiological and pharmacological antidote of scorpion venom. Cardiovascular morbidity and mortality depend on the time interval between sting and administration of prazosin. A consensus regarding the early use of prazosin in all cases of scorpion sting has been established.

Prazosin has revolutionized the management of scorpion sting envenomation. Administration of prazosin, as early as possible, is probably the single most effective intervention for



Graph 2: The linear trendline for myocarditis shows increasing probability with increasing sting-prazosin interval

preventing cardiovascular complications following scorpion stings. Early and effective prazosin therapy, good supportive care, close monitoring, and management of complications can limit the resulting morbidity and mortality significantly. As evident from myocarditis likelihood trendline (Graph 2), the delay in administration of prazosin (more than 18 h) increases the likelihood of development of severe complications. Here, it must be mentioned that we did not use antivenin in the treatment as it was not available in our city at the time of this study. Although various studies have demonstrated excellent reports with scorpion antivenin [17-19], antivenom alone against the toxins of *Mesobuthus tamulus* (red scorpion) has not been found effective [10]. In another study, same authors established that if used along with prazosin, antivenom reduces time required in reversal of autonomic storm significantly, thus increases likelihood of better survival and improves prognosis [20].

In our study, 2 of 50 cases expired, giving a case fatality rate of 4%. Both the deaths occurred in younger children due to complications such as myocarditis, cardiogenic shock, APE, and encephalopathy (2 out of 2). There was a significant delay in seeking medical care and both had not received prazosin even after 24 h of the sting. Association of encephalopathy with higher mortality was reported in earlier studies by Biswal et al. [13] (6 out of 14 cases) and Singhal et al. [21] (2 out of 2). A mortality rate of 20% is reported in untreated infants and toddlers, 10% in untreated school-aged children, and 1% in untreated adults [1]. Deaths occur mainly due to massive pulmonary edema, CCF with cardiogenic shock or recurrent seizures. However, mortality has dramatically declined over the years from up to 30% to less than 1% [8]. Improved management practices and early administration of prazosin are the important factors responsible for the decline.

Low number of cases, reliance of species bases on description of patients and attendants, non-availability, and hence, non-evaluation and use of antivenin were the main limitations of our study.

CONCLUSION

This study shows that the age below 6 years, sting by red scorpion, and sting to prazosin interval more than 8 hours are the most

significant predictors of poor prognosis in scorpion sting cases in rural coastal India.

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Funding: None; Conflict of Interest: None Stated.

How to cite this article: Kumar CM, Prasad NSV. Factors determining poor prognosis in scorpion sting in coastal Andhra Pradesh. *Indian J Child Health.* 2016; 3(4):293-297.