

## Original Research Article

# A study on the clinical spectrum and electrocardiographic changes in scorpion sting envenomation

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## ABSTRACT

**Background:** Scorpion stings, though not a big problem in many developed countries, it is a major public health problem in underdeveloped and in some developing countries all over the world. Objectives was to study on the clinical spectrum and electrocardiographic changes in scorpion sting envenomation.

**Methods:** This study was conducted in a tertiary care institute after obtaining the IEC clearance and informed consent from the patients for a period of 6 months from January 2018 to June 2018. All the patients admitted to the toxicology ward and general ward with scorpion envenomation during the study period were included in the study. A total number of 53 cases of scorpion envenomation and 20 healthy patients from the outpatient department of General medicine, were taken as controls.

**Results:** Fifty-nine percent of the patients presented with Grade 1 envenomation, seven percent with Grade 2 and thirty four percent with Grade 3 envenomation. Local pain (83%) and tachycardia (19%) were the commonest presenting symptom and sign respectively. Sinus tachycardia (6%) was the commonest ECG abnormality seen in the study. There was statistical significance in the relationship between ECG change and biochemical marker CK-MB.

**Conclusions:** Scorpion envenomation in adults needs to be studied to identify the high-risk groups and to assess the morbidity caused it. There was no mortality due to scorpion sting in the study period and significant correlation between the time delay and severity of envenomation was found which indicates a need for immediate medical care following scorpion sting.

**Keywords:** ECG changes, Scorpion envenomation, Scorpion sting, Scorpion venom

## INTRODUCTION

Scorpion stings, though not a big problem in many developed countries, it is a major public health problem in underdeveloped and in some developing countries all over the world. In India, many people are stung by the red scorpion (*Mesobuthus tamulus*) with recorded fatalities in both adults and children. Scorpion sting is considered as a life threatening medical emergency of

villagers in India.<sup>1</sup> Numerous envenomations go unreported. Hence, true incidence is frequently unavailable. Among the eighty six scorpion species in India, *Mesobuthus tamulus* and *Palamneus swammwedami* are of medical importance.<sup>2</sup> Scorpions live in warm, dry regions throughout India. Scorpion stings are primarily due to accidental contact with scorpion. The scorpions use their stings only when roughly handled or trodden on. Scorpion does not always inject venom when

it stings, thus the sting may be total, partial, or non-existent.<sup>3</sup> Scorpions capable of inflicting fatal stings in humans are all members of the families Buthus and Scorpionidae.<sup>2</sup> Fatalities due to sting by Buthidae have been reported from Chennai, Rayalaseema, Pondicherry and rural Maharashtra.<sup>4,5</sup> Scorpion venoms are species-specific complex mixtures of shortneurotoxic proteins that targets mainly the sodium, potassium, calcium and chloride channels causing direct effects and the release of neuro transmitters such as acetylcholine and catecholamine resulting in indirect effects.<sup>6</sup> Various factors like species difference, venom dose/weight relationship determines the toxicity level and the clinical picture. In countries like India, Israel, Brazil and Mexico, cardiac manifestations are quite common.<sup>7</sup> Symptoms after scorpion sting progress to a maximal severity in about five hours and subside in a day or two. Alpha receptor stimulation by the toxin plays a major role, resulting in tachycardia, hypertension, myocardial dysfunction, pulmonary edema and cool extremities.<sup>8</sup> Excess catecholamine release causes accumulation of endothelins and vasoconstriction. Central nervous system manifestations are infrequently encountered in stings due to *Mesobuthus tamulus*. This is found to occur mainly in children. Symptoms vary depending on the species and geographical area. The most frequently encountered symptom is excruciating local pain. Early symptoms include profuse sweating, vomiting, piloerection, alternating brady and tachycardia, abdominal colic, diarrhoea, loss of sphincter control and priapism. Later severe life threatening cardio respiratory effect may appear: hypertension, shock and bradyarrhythmias, ECG changes and pulmonary edema with or without myocardial dysfunction.<sup>9</sup> Literature on the manifestation of scorpion envenomation are lacking due to lacunae in reporting and there is no universally accepted protocol for the treatment of scorpion envenomation, although hospitals in Saudi Arabia follow a national protocol for the management of scorpion sting cases.<sup>10</sup>

The primary aim of the research was to study the clinical spectrum and electrocardiographic changes caused by scorpion envenomation. However, the secondary aim and the objective of the study was to study the severity of scorpion envenomation.

## METHODS

This study was carried out in the Department of General Medicine, Thanjavur Medical College. This study was done with the collaboration of the Department of Biochemistry. This is a single centre prospective study. This study was carried out from January 2018 to June 2018. Informed consent was obtained in all cases.

All the patients admitted to the toxicology ward and general ward with scorpion envenomation during the study period were included in the study. A total number of 53 cases of scorpion envenomation were included in the study.

20 healthy patients from the out patient department of General medicine, were taken as controls.

### *Selection of study materials*

The patients admitted to the Department of General medicine who fitted the inclusion criteria were taken as study subjects.

### *Selection of controls*

The patients who attended the out patient department for other ailments and who were healthy were taken as control subjects.

### *Inclusion criteria*

Patients with history of scorpion sting in the age group of 15 to 65 yrs.

### *Exclusion criteria*

Below patients are excluded from study.

- Valvular heart disease
- Ischemic heart disease
- Congenital heart disease
- Pregnant women
- Diabetes and chronic kidney disease.

### *Details of study subjects and controls*

A detailed history was obtained from the patients admitted for scorpion envenomation and the following findings were recorded in the proforma-1.time of envenomation, 2.nature of the incident, 3.description of the scorpion, 4.local and systemic symptoms, 5.number of stings, 6.site of envenomation.

The cases of scorpion envenomation and controls were subjected to clinical examination, complete blood count. Blood urea, blood glucose, serum creatinine, serum creatinine kinase-MB were measured. The routine investigations were repeated twenty-four hours after admission for the study subjects. Chest X-ray and electrocardiogram were taken for both study and controls. The serial electrocardiogram was taken for the study subjects at twelve hours and twenty-four hours after admission. The study and control subjects also underwent echocardiography. The victims of scorpion envenomation were evaluated and graded according to the severity of envenomation.

### *Grade description*

- Local pain and/or erythema and/or paraesthesia at site of envenomation.

- Pain and/or paraesthesia remote from the site of the sting and/or tachycardia and mild hypertension in addition to local findings.
- Cranial nerve or somatic skeletal neuromuscular dysfunction or cardiovascular dysfunction (moderate to severe hypertension, dysrhythmias, myocardial ischemia, pulmonary edema)
- Any combination of cranial nerve dysfunction, somatic skeletal neuromuscular dysfunction.

### Details of materials

The complete blood count, serum CK, serum CK-MB, routine biochemical analysis was done using semi- auto analyser.

### Statistical analysis

Data obtained from the records of the study were analysed with SPSS software, using analysis of Pearson's chi-square method and student t-test.

## RESULTS

A total of 53 patients studied of which 30 were males and 23 were females, majority of them were belonging to 21 to 40 years of age. According to the time of admission 28 were between 6 pm to 6 am and the remaining 23 were got admitted between 6 am to 6 pm. Of the fifty three patients, 31 patients (58.5%) had grade one envenomation. Four patients (7.5%) were classified as grade two and eighteen patients (34%) fitted the criteria for grade three envenomation.

In the six month period of study, from first week of January 2016 to the last week of June 2016. The highest number of admissions was recorded in the month of June and lowest in January, majority of the patients presented with local pain and swelling at the site of sting. Frequency of signs of scorpion envenomation: Majority (66%) presented with profuse sweating, followed by tenderness at sting site (30%), tachycardia (19%), hypotension and hypertension (11%). Pulmonary edema was present among 5.66% of the study participants (Table 1).

**Table 1: Frequency distribution of signs in scorpion envenomated cases.**

Signs	Number of patients	Percentage (%)
Tachycardia	10	18.87
Hypotension	6	11.32
Hypertension	6	11.32
Profuse sweating	3	66
Cold peripheries	4	7.55
Tenderness at sting site	16	30.19
Pulmonary edema	3	5.66

**Table 2: Analysis of CK-MB.**

Grade	Mean	SD	P value
1	16.19	12.39	<0.001**
2	31.75	8.06	<0.001**
3	74.44	46.23	<0.001**

Note: \*\* denotes significance at 1% level

**Table 3: t-test for independent samples of group.**

Variable	number	Mean	SE of Mean
Study Group	53	401.5472	80.237
Control Group	20	41.9000	4.210

Levene's Test for equality of variances: P=<0.001\*\*

The mean CK values among three grades 105, 212, and 952 with SD compared and showed statistically significant ( $p < 0.001$ ). Similarly, the mean CK-MB, among three grades 16, 31 and 74 and the difference found to be highly statistically significant ( $p = 0.001$ ). Similarly, the mean difference between study (402) and control (42) group were also statistically significant. (Table 2 and 3). Most of the patients presented with marked ECG changes from Sinus tachycardia, ST elevation, ST depression, ST depression with T inversion, right bundle block, Tall T waves and complete heart block (Table 4).

**Table 4: Scorpion envenomation: relationship between various factors.**

Variables	P value
Symptoms and age group	0.20447NS
Symptoms and gender	0.44008NS
Variation between gender	0.8091NS
Variation between age group	0.90198NS
Grade and time interval	<0.001**
Grade and CK	<0.001**
Grade and CK MB	<0.001**
Grade and leucocytosis	<0.001**
Ck and ECG changes	<0.001**
CK MB and ECG changes	<0.001**

\*\*denotes significance at 1% level, NS denotes Not Significant at 5% level

## DISCUSSION

In our study, a total of fifty three patients were studied of which thirty patients (56.2%) were male and twenty three (43.8%) were female. Majority of the patients were in the age group of twenty-six to forty years (49.3%). In epidemiological studies done in different regions of Morocco, male preponderance of scorpion sting was seen in southwest regions and high incidence of scorpion stings in females in the rest of the regions.<sup>13,14</sup> In a ten year retrospective study of scorpion stings in Saudi Arabia which included both adults and children, seventy-three patients of the patients were thirty years or younger.<sup>15</sup> In our six month period of study, from first

week of January 2016 to the last week of June 2016. The highest number of admissions was recorded in the month of June and lowest in January. The study from Kurnool GGH showed the incidence of scorpion stings was high between July and December.<sup>16</sup> The study from Saudi Arabia states that the six months from May through October are responsible for 75% of the ER visits.<sup>15</sup> In another study from Saudi Arabia by Mahaba, the frequency was highest in the summer months from June to September.<sup>10</sup> Twenty-eight patients (52.8%) were admitted to the ward in the time period 18.00 hrs to 06.00 hrs. Twenty-five patients (47.2%) were admitted in the time period 6.00hrs to 18.00hrs. In the study carried out at Kurnool Medical College, Kurnool, India, 72% of scorpion stings occurred during day at work, while the rest took place at night as the subjects were sleeping on the floor.<sup>14</sup> In the Saudi Arabian study, 59% of patients

presented to the emergency room between the hours of 8pm and 2 am.<sup>13</sup> This shows the nocturnal predatory pattern of the scorpion. In another study by Mahaba HMA, most of the stings (60%) occurred at night.<sup>10</sup> Local pain was the commonest symptom on presentation in this study. Forty-four patients (83%) presented with pain at the sting site during admission. Twenty-three patients (43%) presented with swelling at the sting site. Twenty-two patients (41%) presented with parasthesias like tingling sensation at the sting site. Redness was present at the sting site in approximately 20% of the patients. The other symptoms were sweating, palpitations, breathlessness, giddiness, chest pain and vomiting in the frequency of 7.55%, 7.55%, 9.43%, 7.55%, 5.66% and 3.77% respectively. Cardiovascular and autonomic symptoms dominated the clinical presentation in this study.

**Table 5: Studies that contradicts the findings in the present study.**

Authors	Clinical Presentations observed in the study	Year
Dittrich K et al <sup>15</sup>	Pain (92%), Radiation on Pain (7%), Redness (51%), Swelling (28%), Tenderness (12%)	1995
Mahaba MA et al <sup>10</sup>	Pain (98.3 %), Vomiting, Sweating, restless, tachycardia, hypertension	1997

The commonest abnormality observed in this study was sinus tachycardia which occurred in six patients. Three of those patients presented with sinus tachycardia alone, while three had sinus tachycardia associated with ST depression. The second commonest in frequency was ST elevation which was observed in two patients. Tall 'T' waves were noted in two patients with ECG changes. An equal number of cases had ST depression. Two of the scorpion sting cases had right bundle branch block. One patient had complete heart block and another patient had Left anterior hemi block. In a study in Kurnool GGH, India, ECG changes were studied in 25 scorpion sting patients (age range: 13 to 57 years), sinus tachycardia was the commonest abnormality noted. This is similar to the present study. It was noted in 80% of patients. Sinus bradycardia was noted in 10%. Supraventricular tachycardia was present in 8%. ST depression and ST elevation in 55% and 10% of the patients studied in Kurnool. 'T' wave inversion was found in 50% of the patients. Tall 'T' waves in 20%. This study too demonstrates the increased frequency of ST and 'T' wave changes in scorpion envenomation indicating myocarditis. Gueron et al, hypothesized that catecholamine storm post envenomation may cause cardiac dysfunction by catecholamine-induced hypoxia and death might result from myocarditis and congestive cardiac failure. Some authors suggested that cardiac dysfunction in scorpion envenomation may be due to a direct effect of scorpion venom evoking the so called scorpionic myocarditis characterized by non-specific ultra-structural changes. In a study carried out by Kumar AR, Jayarajah M et al, in Sri Ramachandra Medical

College and Research Institute, Chennai, nine cases were studied (mean age-42.6 years). On presentation all of them had tachycardia, 7 had diaphoresis, 6 had severe hypertension, 2 had persistent chest discomfort and 2 had palpitations. All the patients with ECG changes in this study were found to have elevated creatine kinase isoenzyme-MB. Statistical analysis showed it to be significant at 1% level. This indicates the presence of myocarditis in these patients of the study group. ECG changes produced by scorpion sting are found to persist up to 12 days before normalizing. In studies done in paediatric age group in JIPMER, by Das S, Nalini P et al, ECG changes were observed in 63% of the envenomated children.<sup>17</sup> A study was done at the King Edward Memorial Hospital, Bombay, India, by DR Karnad to assess the hemodynamic patterns in patients with scorpion envenomation.<sup>18</sup> From the study it was concluded that two hemodynamic patterns were observed, a predominantly vascular effect and a predominantly myocardial effect. One patient in the study had intense vasoconstriction and tachycardia which caused hypertension. The cardiac output, pulmonary artery pressure, pulmonary wedge pressure, and right atrial pressures were normal. The predominant myocardial dysfunction resulting in acute left ventricular failure was observed in the rest of the patients in the study. These patients either presented as pulmonary edema if the hydration status was good or hypovolemic shock if there was dehydration.<sup>19</sup> In this study there was statistical significance in the relation between the serum levels of CK-MB patients and the electrocardiographic manifestations. Those with ECG changes were found to



have high levels of serum CKMB. Adams et al, stated that the increases in cTnI don't occur despite severe acute or chronic muscle injury even when level of creatine phosphokinase and CPK-MB isoenzyme are increased unless cardiac injury is present. Troponin I could not be estimated in our study due to technical reasons. The authors have concluded that cTnI is the most specific marker for diagnosis of myocardial injury. In the study at Kurnool, India, the authors have noted the increasing severity of clinical manifestations as the time delay between sting and admission is increased. In the study by Dittrich K et al, the average time delay was not more than 2hrs. The patients in the study group were symptomatically managed with analgesics, local infiltration of lidocaine, prazosin and antibiotics. The patients were given anxiolytics-diazepam/alprazolam if it was needed. Serial blood pressures were taken in those presenting with hypertension. Dittrich K et al, have noted that with grade 1 and grade 2 envenomation, pain management is the main stay of therapy. Patients with tachycardia or hypertension should be observed until vital signs return to normal. Grades 3 and 4 envenomation requires full supportive measures as necessary. All these patients should be admitted to the hospital and followed in an intensive care setting until their condition stabilizes.<sup>15</sup>

## CONCLUSION

Scorpion sting is common in tropical countries like India and have been found to cause significant morbidity, especially in children. Scorpion envenomation in adults needs to be studied to identify the high risk groups and to assess the morbidity caused by it. In this study eighteen out of 53 cases had ECG changes. Three of the patients presented with pulmonary edema. There was no mortality due to scorpion sting in the study period. There was significant correlation between the time delay and severity of envenomation. This indicates a need for immediate medical care following scorpion sting.

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