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Study of Electrocardiographic Findings on Admission to Correlate With the Final Outcome in Children with Scorpion Sting

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ABSTRACT

Background: Scorpion sting in pediatric age groups is a life-threatening emergency especially in dry, hot environment of tropical and subtropical countries. ECG is one of the easily available tools and ECG changes are well established in scorpion envenomation.
Aims and Objectives: To correlate electrocardiographic findings at the time of admission with the final outcome in children with scorpion sting.
Material and Methods: This prospective cohort study was conducted over a period of two years. A total of 92 pediatric patients with confirmed scorpion sting of age between two months to 18 years were included.
Results: Mean age of the cohorts was 6.57±3.92 years; mean duration of stay was 3.9±1.59 days. Total 7 (7.6%) children died, and 57.14% were stung by brown scorpion. The duration between sting and PICU admission, and the need of inotrope on admission were significantly correlated with poor outcome ($p < 0.05$). Most common ECG characteristic finding was change in rate (tachycardia). Abnormal rate and rhythm, abnormal ST changes, and abnormal QRS Axis are the ECG findings that significantly correlated with poor outcome of the cohorts ($p < 0.05$).
Conclusion: Irrespective of cause of death in scorpion sting, ECG findings including rate, rhythm, ST changes, and QRS axis were found to be associated with poor outcome in pediatric patients.

Keywords: Electrocardiographic changes, Scorpion sting

INTRODUCTION

Scorpion stings are a major public health problem in pediatric practice in many tropical countries including India. For every person killed by poisonous snake, around ten are killed by a poisonous scorpion. [1] Although, 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 populations at risk world-wide. [2]

There are about 1500 scorpion species worldwide out of which 50 are dangerous to humans. Almost all of lethal scorpion belongs to Buthide family. [3] There are about 86 species of scorpions are found in India. [4,5] Only three scorpions found in India are poisonous viz. (i) Mesobuthus tamulus. (ii) Palamneus swammerdami and (iii) Heterometrus bengalensis. In India, they are commonly found in Karnataka, Maharashtra, Madurai, Madras, Pondicherry, Madhya Pradesh, Ganjam and West Bengal. [6] Though there are various species of scorpions, not all are found in all geographic location. Despite of this difference, there is no difference in symptomatology following envenomation.

Envenomation due to scorpion sting results in various clinical manifestations and they ranged from mild local pain to diffuse irresistible pain of whole limb and body to systemic manifestation involving almost all system, predominantly cardiovascular and may sometimes lead to death. [7] Most of the manifestations of scorpion envenomation

are due to stimulation of autonomic nervous system either directly or indirectly; especially is autonomic storm. [8]

Cardiovascular complications are the most important manifestations of Indian red scorpion envenomation. A full spectrum from hypotension and peripheral circulatory collapse to hypertension leading to stroke has been observed. Initially within 1–2 hours of sting hypotension and bradycardia are encountered followed by hypotension and tachycardia between 4 and 48 hours due to severe left ventricular dysfunction and hypotension alone with good volume pulse and warm extremities is observed later in the recovery stage. Acute pulmonary edema complicates around 3–24.5% of all scorpion stings and is a leading cause of mortality in these patients, accounting for around 30% of fatalities. The clinical profile evolves within 30 minutes to 6 hours after the sting. Hypertensive stress, direct toxic effects of the venom on the myocardium and catecholamine-induced myocardial injury; all contribute to rhythm disturbance and left ventricular failure. The myocardial injury is exacerbated by free fatty acid and free radical accumulation and hyperkalemia. [9-11] Incidence of myocarditis has been reported to be around 22–33%. [12]

Symptoms vary depending on the species and geographical area. The most frequently encountered symptom is excruciating local pain. Early symptoms include vomiting, profuse sweating, piloerection, alternating bradycardia 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. [13]

Various treatment modalities are available for scorpion sting, which are broadly classified in to local measures and systemic measures. Locally Xylocaine infiltration, Systemic is O_2 inhalation, insulin glucose infusion atropine, nifedipine, captopril, serotherapy and recently prazosin, which is used almost as pharmacological antidote for scorpion sting. [14]

The present study was conducted as an observational study to note the electrocardiographic findings on admission and their correlation with the final outcome in children suffering from scorpion sting over a period of two years.

MATERIAL AND METHODS

The present prospective cohort study was conducted in the Department of Pediatrics, Shyam Shah Medical College, associated Gandhi Memorial Hospital, Rewa, Madhya Pradesh, a tertiary care hospital in Central India over a period of two years. A total of 92 pediatric patients with confirmed scorpion sting admitted in PICU. All children aged between two months to 18 years with scorpion sting admitted in Pediatric Intensive Care Unit after obtaining informed written consent. Those children whose ECG not recorded at the time of admission, having unknown insect bite, suspected scorpion sting and lost to follow up for one or more reasons were excluded from the study.

A total of 110 children were assessed for their eligibility to include in the present study. Out of 110 children, 18 children were excluded due to various reasons viz. refusal to participate in the study, left against medical advice and not meeting inclusion criteria of the study. Finally, a total of 92 children were included in the study for data analysis after ECG was recorded at the time of admission and a predesigned proforma was fulfilled. Every patient was treated as per Institutional treatment protocol for scorpion sting with regular vitals monitoring. ECG findings were correlated with the final outcome of individual patient.

Demographic features like age, sex, time since sting to the arrival to the hospital and clinical parameters like pain at the site of sting, swelling, paresthesia, profuse sweating, excessive salivation and hypotension and ECG changes were studied. All patients were received tetanus toxoid

depending on immunization status. All patients with local pain were treated with 2% Xylocaine local infiltration and repeated if necessary. I.V fluids, diuretics, O_2 inhalation and ionotropic supports were given whenever required. Patients were followed up at regular intervals, at 1 hour, 6 hours, 12 hours and 24 hours and if necessary till the patients were discharged from the hospital.

All the children were followed up. Twelve-lead ECG was performed at the time of admission to hospital due to scorpion sting. The studied parameters were: age, gender, location of scorpion sting in the body, symptoms, and findings and treatment; and the heart rate (HR), Rhytm, P wave, QRS complex, T-wave, PR interval, QT interval, ST segment and axis.

Treatment was given to them as per our hospital protocol. Final outcome of the study showed that a total of 85 children discharged from the hospital and 7 expired.

STATISTICAL ANALYSIS

Data analysis was done by SPSS software version 22.0 by applying non-parametric Mann-Whitney U-Test, independent t-tests and Chi-square tests for variable attributes at 95% confidence level. A value of $p<0.05$ was considered as statistically significant. Categorical variables were represented by frequency and percentages and quantitative variables by mean ± SD.

OBSERVATIONS AND RESULTS

In the present study, mean age of the children was 6.57±3.92 years. Mean duration of PICU stay was 3.9±1.59 days. A total of 7 (7.6%) children died, and 57.14% were stung by brown scorpion as shown in Figure 1.

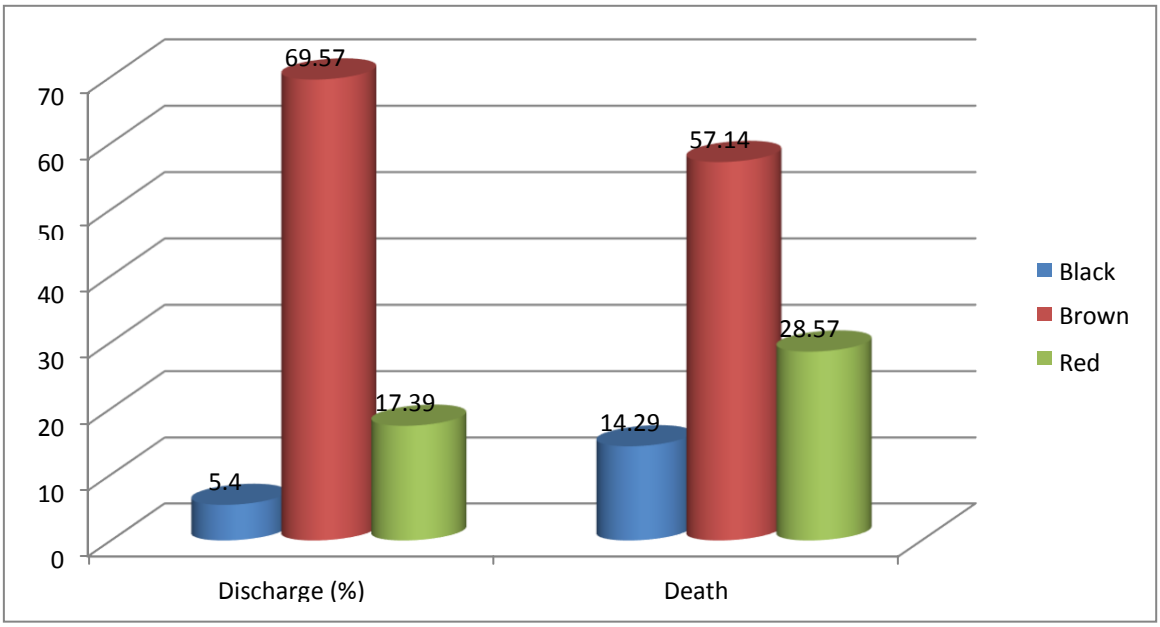

FIGURE 1: FINAL OUTCOME OF THE PATIENTS WITH DIFFERENT TYPES OF SCORPION

Out of total 92 children, 53 (57.60%) were male and 39 (42.40%) were female. Out of 53 male, 49 discharged from the hospital after treatment and 4 died. Similarly, out of 39 female, 36 females discharged and 3 died. On statistical analysis, the difference among male and female children were found to be comparable and thus statistically insignificant ($p>0.05$).

A total of 44 children had age <6 years at the time of presentation out of which 2 died and 42 discharged from the hospital and 48 children had age >6 years, of whom 43 discharged from the hospital and 5 died. Statistical comparison of the children with

regard to their age, shows insignificant relationship (p>0.05).

In the present study, we noted duration from sting till admission in PICU of all the patients. A total of 60 children were admitted in PICU for <12 hours duration and 32 were admitted to PICU for more than 12 hours. The statistical difference among both the groups found to be significant (p <0.05).

In 36 cases, need of inotropes were indicated at the time of admission out of which 30 children discharged from the hospital and six died. Similarly, from rest 56 children, 55 discharged and 1 expired. Statistical analysis shows highly significant difference among these two groups (p <0.01).

Mean PR interval was 116.61±39.88 ms, QRS duration was 73.46±13.86 ms and QTc interval was 376.49±69.01 ms.

Most common ECG characteristic finding was change in rate (tachycardia). Abnormal rate and rhythm, abnormal ST changes, and abnormal QRS Axis are the ECG findings that significantly correlated with poor outcome of the cohorts (p< 0.05) as shown in Table 1.

Table 1: ECG characteristics and final outcome of the patients

ECG characteristics		Discharge	Death	Total	P value
1) Rate	Normal	49	1	50(54.34%)	0.044
	Abnormal	36	6	42(45.65%)	
2) Rhythm	Regular	70	2	72(78.26%)	0.0049
	Irregular	15	5	20(21.73%)	
3) P wave	Normal	59	6	65(70.65%)	0.66
	Abnormal	26	1	27(29.34%)	
4) QRS complex	Normal	52	2	54(58.69%)	0.120
	Abnormal	33	5	38(41.30%)	
5) T wave	Normal	34	2	36(39.13%)	0.7
	Abnormal	51	5	56(60.86%)	
6) PR interval	Normal	51	2	53(57.60%)	0.12
	Abnormal	34	5	39(42.39%)	
7) QT interval	Normal	40	4	44(47.82%)	0.7
	Abnormal	45	3	48(52.17%)	
8) ST segment	Normal	55	1	56(60.86%)	0.0132
	Abnormal	30	6	36(39.13%)	
9) Axis	Normal	76	2	78(84.78%)	0.0007
	Abnormal	9	5	14(15.21%)	

DISCUSSION

The scorpion venom is a water soluble antigenic complex mixture of neurotoxin, cardiotoxin, nephrotoxin, hemolysins, phosphodiesterases, phospholipase, hyaluronidases, histamine, and other chemicals. [15] The primary target of scorpion venom is voltage-dependent ion channels. The venom produces both local as well as systemic reactions. Local reactions consist of itching, edema, and ecchymoses with burning pain. [16] The cardiovascular manifestations comprise successively of giddiness, bradycardia, a fall of body temperature; restlessness and tachycardia; and finally pulmonary edema. [17]

Age of the patients in this study ranged from 2 months to 18 years, with mean age of 6.57±3.92 years. There is no difference in mean age for male and female patients. In this study most (53 male children) of 6-10 years, accounting for total of 57.60% of patients. This may be due to the fact that the scorpion envenomation is purely an accidental phenomenon, associated with increased children activity which is common during this age group.

Sixty patients in this study presented to emergency department within 12 hours (65.21%) and 32 (34.79%) presented after 12 hours. There was statistical correlation between the time lag in attending to emergency department (p <0.05). In contrary to the present study, previous studies by Bawaskar HS and Mahadevan S reported that delay in hospital presentation was associated with severe manifestation, which is not noted in present study. [5,14] This is because the milder case presented to hospital only when there was no relief of

symptoms but most of the moderate to severe envenomation presented relatively early because of early development of annoying symptoms. Present study did not observed time delays in hospital presentation to severity of envenomation. This difference may be due to increased health awareness and awareness regarding the dangers of the disease. On personal enquiry with the patients and their relatives, it was learnt that they have seen and heard of serious cases of scorpion sting envenomation hence they didn't take chance and tried to arrive to the hospital as early as possible. On enquiry, it is learnt that majority of patients who presented after 12 hours of sting are from rural areas and reason for delay in them being initial use of various local remedies such as (i) attending the hospital only if the symptoms did not subside or if in case the condition worsens and (ii) lack of adequate transportation facilities.

In the present study, most common ECG characteristic finding was change in rate (tachycardia). Abnormal rate and rhythm, abnormal ST changes, and abnormal QRS Axis are the ECG findings that significantly correlated with poor outcome of the cohorts ($p< 0.05$) (Table 1).

Cheema et al [18] reported that epinephrine and norepinephrine extended the maximum period of P wave. It was also reported by Tukek et al [19] that, the increase in sympathetic activity causes increasing in P dispersion. The P wave of the electrocardiogram may show alterations that can be associated with atrial arrhythmias. [20] Behcet Al et al reported significant difference between P wave dispersion and minimum P wave period which found to be related to both increased early atrial beat number and also increased sinus arrhythmia. This condition related to the sympathetic activity that caused by scorpion venom. [21]

Bouaziz et al [22] reported that, the most observed abnormalities in electrocardiogram were sinusal tachycardia (84.8%) (>120/min in children and 90/min in adult patients) and T-Wave changes (17.8%). Other ECG abnormalities were also observed including ST segment depression or elevation (15%), and sinusal bradycardia (0.4%). Also, it was determined in this study that 61.5% patients had a pulmonary edema, while 20.5% patients had a cardiogenic shock.

Bahloul and his colleagues [23] conducted a study to determine the myocardial ischemia in six patients with severe scorpion envenomation. They reported most common abnormality in ECG was tachycardia (>110 beat/min) (100%) and one third patients improved cardiogenic shock. Other ECG abnormalities were also observed, including ST segment depression or elevation observed in two patients, T-wave change was observed in four patients and right bundle branch block in one. In our study, the most common ECG abnormality was change in rate (tachycardia), abnormal rate, rhythm, abnormal ST changes, and abnormal QRS Axis.

In Blum and colleagues [24] study the ECG demonstrated a normal sinus rhythm. There were deep large inverted T waves in leads II, III, and AVF, with huge U waves in precordial leads V1-V4. Study reported by Bentar et al [25] showed cardiac problems rate and ECG abnormalities as 23.1% and 13.7% respectively.

CONCLUSION

This prospective observation cohort study was done over a period of two years. Study included 92 patients of scorpion sting. Patients of age group 2 months to 18 years were involved in this accidental environmental and occupational hazard. Male population was predominantly affected in the present study with 53 male and 39 female. Sixty (65.21%) of the patients reached hospital within first 12 hours after sting. Most common clinical presentation was pain and profuse sweating as the commonest symptom. Most common ECG characteristic finding was change in rate (tachycardia). Abnormal rate and rhythm, abnormal ST changes, and abnormal QRS Axis are the ECG findings

that significantly correlated with poor outcome of the cohorts ($p< 0.05$).

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