Curr Pediatr Res; 2021,25 (4): 578-582 *ISSN 0971-9032*
www.currentpediatrics.com

Acute myocarditis in children with scorpion sting envenomation.

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Abstract

Objective: Prospective observational analysis of all children admitted with scorpion sting and identifying acute myocarditis in these children.

Methods: All children admitted at Pediatric ICU in the period between Jan 2018– Dec 2019 with scorpion sting were included in the study after taking informed consent from parents. History noted in detail. They were evaluated with complete hemogram, serum electrolytes, urea, creatinine, cardiac markers (CPKMB, Troponin-T), Electrocardiography (ECG), X-ray chest and 2D echocardiography. Data of Children who developed cardiovascular complications, positive cardiac markers and positive ECHO findings were studied. Children were managed as per the standard treatment protocol.

Results: During the study period from Jan 2018–Dec 2019 total 61 children were admitted with scorpion sting. Forty five were male and 16 were female, mean age 6.9 ± 3.9 years. Among 61 cases, 21 (34.4%) of them developed myocarditis. In children with myocarditis Troponin-T was positive in 16 (76.2%) children, CPK–MB high in all (100%) the patients, mean CPK MB found to be 55.05 ± 4.52, ECG changes in four patients (19.04%) and X-ray chest changes in 7 (33.3%) cases. All these 21 cases showed varied abnormal ECHO findings. Ten (47.6%) patients required inotropes. Four children (19%) were on mechanical ventilation support. Twenty (98.36%) patients improved, 1(4.8%) patient had mortality. Repeat ECHO was done in all these cases before discharge which showed return of normal cardiac function.

Conclusion: Scorpion venom can have a potent cardiotoxic effect. Hence ECG, cardiac markers and echocardiography must be included in all cases with scorpion sting which helps in early diagnosis and treatment of acute cardiac complications.

Keywords: Children, Scorpion sting envenomation, Myocarditis.

Accepted on April 15, 2021

Introduction

Children presenting with Scorpion sting is quite common in tropical and sub-tropical countries. Scorpions live in warm dry regions throughout India. Members of families Buthus and Scorpionidae are known to cause inflicting fatal stings in humans. Most of the scorpion stings cause mainly localised pain and sometimes can result in systemic envenomation in the form of Autonomic storm. It can result in cardiac and pulmonary involvement which are life threatening and can even result in death. Chippaux JP et al. found that incidence of scorpion stings is higher in adults but children are particularly sensitive to scorpion envenoming, where the case fatality rate is ten times higher than in adults [1]. The scorpion venom has neurotoxins which can cause rapid release of neurotransmitters from autonomic nervous system leading to autonomic storm and sometimes myocarditis, pulmonary edema and death as well. The etiology of cardiovascular manifestations is related to the toxic effect of the venom on myocardium.

We studied the clinical and laboratory profile, complications of children presenting with Scorpion sting. And we found significant number of children developed cardiac complications. Children with scorpion sting are lethal as there is high chance going for severe complications and death. We emphasize to workup thoroughly in children presenting with scorpion sting envenomation which can help in identification of complications at the earliest.

Objective

Primary objective

Prospective analysis of all children admitted with scorpion sting and identifying acute myocarditis in these children.

Secondary objective

Clinical and laboratory analysis in children with scorpion sting myocarditis

Materials and Methods

We did prospective observational analysis of children with scorpion sting admitted at BLDE (Deemed University) Shri B M Patil Medical College Hospital, tertiary care centre at Vijayapur, India from Jan 2018–Dec 2019. A total of 61 cases of scorpion sting were registered over the 24 months. Children presenting with scorpion sting are noted with age, gender, sting site, local symptoms and any systemic symptoms. Children were included in the study after taking written consent from parents. All children were evaluated with complete hemogram,

serum electrolytes, urea, creatinine, cardiac markers (CPKMB, Troponin-T), Electrocardiography (ECG), X-ray chest and 2D echocardiography. Data of Children who developed any cardiovascular complications including tachycardia, hypotension or hypertension and S3 gallop or positive cardiac markers and positive ECHO findings were noted. We could identify 21 children who had features suggestive of myocarditis. We analysed these children's data with respect to requirement of inotropes, requirement of mechanical ventilation, duration of PICU stay, total duration of hospital stay and outcome. Children were managed as per the existing departmental protocol for management of scorpion sting envenomation including Prazosin, IV fluids and in selected cases with inotrope Dobutamine.

Statistical analysis

All characteristics were summarized descriptively. For continuous variables, the summary statistics of mean ± Standard Deviation (SD) were used. For categorical data, the number and percentage were used in the data summaries and diagrammatic presentation. Data were analysed using SPSS software v.23.0 and Microsoft office 2007.

Results

In the study period over one year from Jan 2018 to Dec 2019, a total of 61 children were admitted with scorpion sting. Baseline characteristics were noted in all these children. Forty five were male and 16 were female children. Presenting symptoms and lab evaluation were charted (Table 1). Among 61 cases, 21 (34.4%) of them developed myocarditis. In children with Scorpion sting myocarditis Troponin-T was positive in 16 (76.2%) children, CPK–MB was found to be high in all (100%) the patients. Mean CPK MB found to be 55.05 ± 4.52. ECG changes were seen in four patients (19.04%). X-ray chest changes were seen 7(33.3%) cases (Table 2). All these 21 cases showed abnormal ECHO findings depicting impairment in cardiac function. Hypokinesia of left ventricle, decreased LVEF, myocarditis, PAH, and Grade I TR were common ECHO findings. Ten (47.6%) of these 21 patients required inotropes. Dobutamine was commonly used inotrope in these cases. Three children required Milrinone as well. Four children (19%) were on mechanical ventilation support. Mean stay in PICU was 2.9 ± 1.6 days. Twenty (98.36%) patients improved, 1(4.8%) patient had mortality. Mean hospital stay was 4.4 ± 1.8 days. Repeat ECHO was done in all these cases before discharge and after 1 week at follow up.

Characteristic	No. (%)
Male	45 (70.49)
Female	16 (26.22)
Local pain	50 (83.3)
Vomiting	24 (39.34)
Sweating	43 (70.49)
Salivation	12 (19.67)
Cold extremities	51 (83.60)
Priapism	19 (31.14)
Bradycardia	04 (6.5%)
Tachycardia	23 (37.7)
Hypotension	05 (8.19)
Hypertension	14 (22.9)
Seizures	0 (0)

Table 1. Baseline characteristics in children with scorpion sting envenomation (N61).

	Myocarditis (21)	No myocarditis (40)
Trop T positive	16 (66.6%)	9 (22.5%)
CPK MB (mean ± SD)	55.05 ± 4.52	32.80 ± 3.25
X-Ray changes	7 (33.3%)	6 (15%)
ECG changes	4 (19.04%)	0
Inotropes	10 (47.61%)	0
Ventilation	04 (19.04%)	0
Mortality	01(4.7%)	0

Table 2. Characteristics in children with myocarditis (21) and without myocarditis (40).

Discussion

Scorpion sting envenomation is still poses significant environment health problem in tropical and subtropical regions. There are many species of scorpions all over the world and some of these are species are lethal. It is found that there are more than 1500 species of scorpions; about 100 species are found in India. Two species: *Mesobuthus tamulus*–the red scorpion and *Palmaneous gravimanus* the black scorpion are important medically [1,2]. The scorpion venom is a clear, colourless toxalbumen and is water soluble antigenic complex mixture of neurotoxin, cardiotoxin, nephrotoxin and hemolysins. The venom also has enzymes like phosphodiesterases, phospholipase, hyaluronidases, histamine and other chemicals that act on trypsinogen. The venom vesicle is surrounded by a striated muscular layer which regulates the ejection of venom; thus the sting can be complete, partial or dry. It is found that scorpion venom delays the inactivation of sodium channels of autonomic nervous system resulting in autonomic storm. The clinical manifestations are believed to be primarily due to sympathetic and parasympathetic stimulation. Initially there will be transient cholinergic symptoms like vomiting, sweating, bradycardia, priapism in males; sometimes there can be premature ventricular contraction and hypotension (Figures 1 and 3). Later there will be prolonged sympathetic stimulation leading to hypertension, tachycardia, pulmonary edema, cold extremities and shock [3].

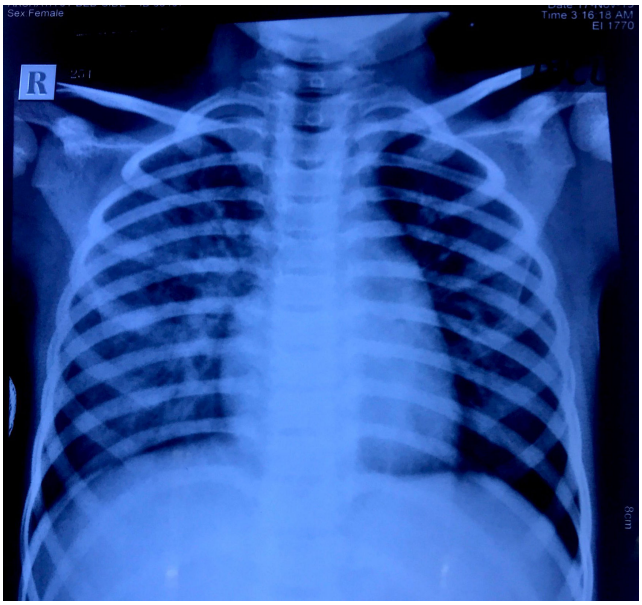

Figure 1. X-ray chest showing pulmonary edema in a child with Scorpion sting envenomation.

Yarom et al. studied the scorpion venom effects on the cardiovascular system and they found that the mortality in scorpion sting envenomation is primarily due to toxic effects of venom on myocardium. The resulting cardiac failure and pulmonary edema are attributed to venom induced cardiorespiratory dysfunction. Catecholamine overstimulation can cause coronary microvascular spasm leading to myocardial perfusion derangement [4].

Asmaekhattabi et al. developed a consensus on classification of clinical consequences of scorpion sting. They included four classes. Grade-I envenomation-local manifestations, caused by a "dry" sting, sting with no venom injection. Grade II minor systemic manifestations attributed to autonomic storm like tachycardia, sweating, fever and vomiting without life threatening. Grade III-major systemic manifestations (mainly of circulatory and respiratory system) and Grade IV –lethal envenomation [5].

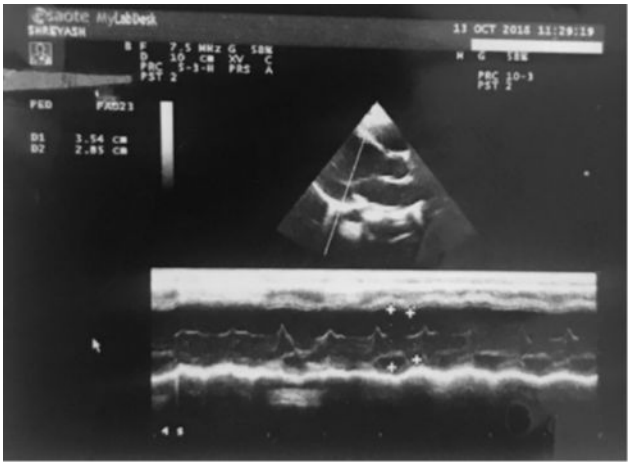

Figure 2. 2D ECHO showing severe LV dysfunction in a child with scorpion sting myocarditis.

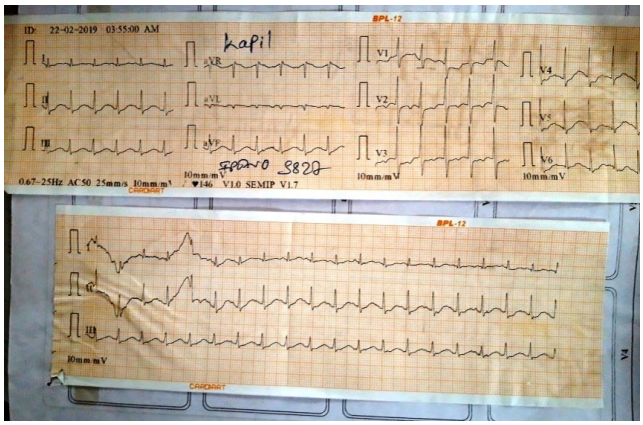

Figure 3. ECG changes in a child with scorpion sting envenomation.

Bahloul et al. have explained that both hemodynamic mechanism and vascular permeability mechanisms will lead to pulmonary edema following scorpion sting envenomation [6]. The presence of circulating inflammatory and coagulation factors as in sepsis and septic shock suggest that there will be alveolar capillary leak similar to acute lung injury and ARDS (Acute Respiratory Distress Syndrome) [7]. Yarom et al. reported histopathological changes resembling ischemic disease in the left ventricle in dogs injected with L. quinquestriatus venom [8]. Several studies have showed that there will be increased serum concentrations of Creatine Phosphokinase (CPK) [9], troponin [10] and natriuretic peptides [11] after scorpion envenomation. Sofer et al. studied the CPK MB activity, in children with scorpion sting envenomation and concluded that CK-MB activity is specific and highly sensitive in detecting myocardial damage in children following scorpion envenomation [9].

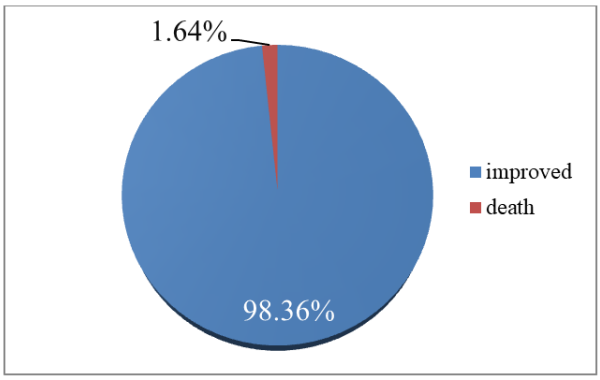

Figure 4. Overall Outcome in children with scorpion sting envenomation (Total no 61).

Cupo et al. studied TnI levels in children with scorpion sting cases and they found that TnI levels were elevated in severe envenomation with scorpion sting cases [10].

Suresh et al. found out that the mean levels of Pro BNP found to be high in children with scorpion sting induced myocarditis children [11]. In our study we found that out of 61 children with scorpion sting 21 children developed features suggestive of myocarditis. In these children with myocarditis Troponin-T

was positive in 16 (76.2%) children, CPK–MB was found to be high in all (100%) the patients. Mean CPK MB found to be 55.05 ± 4.52. (Table 2).

The studies have shown that the main clinical features of severe scorpion sting envenomation include severe LV and RV dysfunction with recovery within a few days after appropriate supportive care. Gueron et al. studied the echocardiographic and radionuclide angiograms in children with scorpion sting children. They found poor contractility and low ejection fraction in children with severe scorpion sting envenomation. They attributed these changes to catecholamine induced myocardial ischemia [12]. In our study among 21 patients with myocarditis ECG changes were seen in four patients (19.04%). X-ray chest changes were seen 7(33.3%) cases. All these 21 cases showed varied abnormal ECHO findings. Hypokinesia of left ventricle, decreased LVEF, myocarditis, PAH, and Grade I TR were common ECHO findings.

Fekri et al. explained the pathophysiology related to scorpion envenomation. They have explained the pathophysiology in two phases. The Vascular phase related to profound catecholamine-related vasoconstriction leading to an increase in Left Ventricular (LV) afterload, thereby impeding LV emptying, and increasing LV filling pressure. Following this vascular phase, a 'myocardial phase' occurs, characterized by altered LV contractility and decreased cardiac output, and hypotensive state. This phase is unique in that it is reversible spontaneously or under inotropic treatment [13].

Scorpion myocardiopathy is characterized by a profound and reversible biventricular dysfunction caused by increased circulating catecholamines. Scorpion-related myocardiopathy shares the characteristics of the takotsubo myocardiopathy (or stress myocardiopathy) which is related to massive release of catecholamines leading to severe LV dysfunction, predominantly apical or mid segments of LV and sparing LV basis [14,15].

The lack of coronary vessel abnormalities in envenomated patients is consistent with ischemia due to microvascular dysfunction [16].

The successful treatment in scorpion envenomation is mainly attributed to symptomatic treatment. Scorpion sting envenomation associated acute heart failure and pulmonary edema or both needs appropriate supportive care. The standard intensive care treatment for acute pulmonary edema and cardiogenic shock appears to be appropriate supportive measures and often includes oxygenation, ventilation, use of inotropes [17], and specific vasodilators [18,19]. Elatrous et al. documented the effects of Dobutamine in severe scorpion envenomation cases and concluded that in severe scorpion envenomation, dobutamine infusion improves the cardiac function and tissue oxygenation as well [17]. In our study 10 (47.6%) patients required inotropic support. Dobutamine was commonly used inotrope in these cases. Three children required Milrinone as well. Four children (19%) were on mechanical ventilation support. Mean stay in PICU was 2.9 ± 1.6 days. Dobutamine remains the drug of choice in the most severe forms of scorpion envenomation manifested by acute heart failure.

Bawaskar et al. recommend prazosin as specific treatment for severe scorpion envenomations caused by the Indian scorpion (*M. tamulus*), which is found to be very effective [18,19]. All these studies showed the importance of appropriate supportive care in severe scorpion envenomation which can bring favourable outcomes.

In our study among 21 children who developed myocarditis twenty (98.36%) patients improved, 1(4.8%) patient had mortality. Mean hospital stay was 4.4 days ± 1.8 days. Repeat ECHO was done in all these cases before discharge and after 1 week of discharge which showed normal cardiac function with nil morbidity.

Conclusion

Scorpion venom can have a potent cardiotoxic effect which can lead to myocardial dysfunction. It is advisable to get thorough evaluation including cardiac evaluation in children with scorpion sting envenomation. The children with scorpion sting myocarditis can be effectively managed at pediatric ICU with timely administration of inotropes and other supportive measures which can reduce mortality and morbidity in these children and brings favourable outcome.

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