Severe Troponin I Elevation and Myocardial Dysfunction in a Child with Scorpion Sting

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Abstract

Keywords

- ▶ child
- ▶ scorpion
- ▶ high troponin
- ▶ three doses of antivenom
- ▶ severe systolic dysfunction

Background Scorpion sting is a common medical problem and major cause of mortality and morbidity in many countries. The symptoms of envenomation are more severe in the pediatric population. The clinical manifestations of scorpion envenomation appear by activation of sympathetic and parasympathetic nervous system. Envenomation can cause multiorgan dysfunction and death.

Case Presentation and Findings In this case report, we present a pediatric patient from Adana, Southeast Anatolia, with severe scorpion envenomation with *Leiurus abduhbayrami* which is an especially dangerous species for children. Severe systolic dysfunction was detected by echocardiography. Troponin I levels elevated significantly and rapidly responded to three doses of antivenom therapy.

Conclusion Early echocardiographic examination is an important procedure for patients with scorpion envenomation. Troponin I is a significant parameter to monitor the degree of cardiac injury. Antivenom therapy is the only recommended specific therapy for children with severe scorpion envenomation due to *Leiurus abduhbayrami*. Abnormal echocardiography findings may require repeated doses of scorpion antivenom.

Introduction

Scorpion sting is a common cause of human envenomation in various parts of the world especially in tropical areas.¹ Scorpionism has been reported as the most common envenomation after snake bites in the literature and can cause severe morbidity and mortality.² Scorpionism-associated mortality rate is higher in the pediatric population.^{3,4} Clinical findings may vary from mild local symptoms such as pain and paresthesia at the sting site to severe systemic symptoms such as pulmonary edema, myocarditis, circulatory disorders, and neurological complications.^{5,6} Deaths from scorpion stings are usually due to cardiogenic shock

and pulmonary edema. Cardiomyopathy leading to fatal acute heart failure is a risk following scorpion envenomation. Heart damage can result from several mechanisms including adrenergic myocarditis with massive release of catecholamines, toxic myocarditis, or myocardial ischemia.⁷ *Leiurus abduhbayrami* is a newly described scorpion species in Southeast Anatolia, and can cause severe symptoms of the autonomic and central nervous systems, and cardiorespiratory dysfunction.^{8–10} In the present case report, we describe a scorpion envenomation in 7-year-old child from Cukurova, Turkey, with extremely high troponin I levels and systolic dysfunction which required repeated dosage of antivenom.

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Fig. 1 Cardiomegaly and acute pulmonary edema in chest X-ray at hour 5 of admission.

Case Presentation

A 7-year-old girl was referred to the pediatric emergency care service in July, 2017 because of a yellow scorpion (*Leiurus abdullahbayrami* [Scorpiones: Buthidae; previously identified as *Leiurus quinquestriatus*]) bite on the left foot 3 hours before. She complained of pain at the sting area and vomiting. On first physical examination, Glasgow Coma Score (GCS) was 11 (E3M5V3), the patient was lethargic, arterial pressure was 130/80 mm Hg, heart rate was 148/min, respiratory rate was 28/min, body temperature was 36°C, and the pulse oximeter was 97% saturation in room air. Capillary refill time was 4 seconds with cold lower extremities and there was swelling and hyperemia on the bite site on the dorsal face left foot. The patient had involuntary extremity movements, sweating, vigorous restlessness, and hypersalivation. Electrocardiogram revealed sinus tachycardia. Bedside chest X-ray at the fourth hour of envenomation revealed bilateral

infiltrates suggestive of pulmonary edema and cardiomegaly (►Fig. 1). Tetanus vaccine and 1 vial scorpion antivenom were administered. The antivenom used was purified polyvalent antiscorpion serum produced by the Refik Saydam Hygiene Center vaccine production in Turkey. Doxazosin was given with a dose of 0.05 mg/kg for peripheral circulatory disorder. Blood tests revealed hemoglobin: 11 g/dL, platelets: 430.000/mm³, white blood cell: 31700/mm³, glucose: 278 mg/dL, alanine aminotransferase: 21 IU/L, aspartate aminotransferase: 49 IU/L, amylase: 174 U/L, prothrombin time: 11 second, international normalized ratio: 1.04, blood urea: 16 mg/dL, and blood creatinine: 0.75 mg/dL. Arterial blood gas analysis showed pH: 7.11, PaO₂: 68 torr, PaCO₂: 56 torr, HCO₃: 16, BE: -7. Lactate level was 3.9 mmol/L and serum troponin I: 0.12 ng/mL ($n = 0.02\text{--}0.06$) versus CK-MB: 6.4 ($n < 6.22$). She was transferred to our pediatric intensive care unit (PICU) after 5 hours following the scorpion sting and at the second hour of admission to the hospital. In the PICU physical examination GCS was 13 (E4M5V4), arterial pressure was 100/70 mm Hg, heart rate was 164/min, respiratory rate was 26/min, body temperature was 36.3°C, and the pulse oximeter was 98% saturation in room air. Capillary refilling time was 3 seconds. Ten liters of oxygen were given to the patient via a reservoir mask. M-mode, two-dimensional color-flow Doppler echocardiogram showed left ventricular systolic dysfunction. Ejection fraction (EF) was 56% and left ventricular fractional shortening was 30% (►Fig. 2). Dobutamine infusion was started (10 µg/kg/min) when troponin I level increased from 0.12 to 9.4 ng/mL within 3 hours. A central venous catheter was placed via left internal jugular vein for vasoactive inotrope drug infusion. An arterial line was placed to the right radial artery for invasive blood pressure monitoring. Because of the rapid increase in troponin I level, a second dose of scorpion antivenom (1 vial) was applied. Furosemide treatment (0.1 mg/kg/hour) was started for pulmonary congestion. The patient was monitored twice a day with troponin analysis and echocardiography. On the second day of

Fig. 2 Echocardiographic measurements at admission to pediatric intensive care unit and before dobutamine infusion.

Fig. 3 Acute decline in ejection fraction in echocardiography measurement on day 4 of hospitalization.

hospitalization, echocardiography showed a systolic EF of 54%. The patient's troponin I values gradually increased to reach a maximum of 17.9 ng/mL at the 36th hour following the scorpion bite. Dopamine (10 µg/kg/min) and adrenaline (0.05 µg/kg/min) were added to the inotropic treatment of the patient. However, on the fourth day of hospitalization, while the troponin I value was down to 8 ng/mL, echocardiography EF measured 36% and left ventricular fractional shortening was 18% (►Fig. 3). Therefore, the dosage of adrenaline was increased to 0.1 µg/kg/min. A third dose of scorpion antivenom (1 vial) was administered to the patient. The EF measured 58% 12 hours after the third dose of antivenom. Troponin I levels turned to normal level at day 7 and vasoactive inotropes were discontinued. The patient was discharged on day 9 of hospitalization. Chest X-ray at hospital discharge is shown in ►Fig. 4. Clinic echocardiographic findings were completely normal at 20 days after the patient's hospitalization. Troponin levels and daily EF measurements are shown in ►Table 1.

Fig. 4 Resolution of chest X-ray findings at hospital discharge.

Discussion

Scorpion envenomation is a common, life-threatening medical problem in many countries including Turkey and some scorpion species cause significant morbidity and mortality.^{1,11} Important public health scorpion species in Turkey are identified as *Androctonus crassicauda*, *L. quinquestriatus*, *Mesobuthus gibbosus*, and *M. eupeus* of Buthidae family.¹⁰ In Southeastern Anatolia, *L. quinquestriatus*, *A. crassicauda*, *M. eupeus*, *M. caucasicus*, *M. nigrocinctus*, and *Hottentotta saulcyi* from the Buthidae family are found.¹² The scorpion species responsible for our case was *L. abdullahbayrami*.

Scorpion venom is composed of a mixture of various toxins and enzymes. It contains neurotoxin, cardiotoxin, nephrotoxin, hemolytic toxin, phosphodiesterase, phospholipase, hyaluronidase, glycosaminoglycan, histamine, serotonin, and tryptophan.¹³ The neurotoxin stabilizes voltage-dependent sodium

Table 1 Troponin levels, ejection fraction measurements, and antivenom administration times

Time	Troponin I level (ng/mL)	Ejection fraction (%)	Antivenom
Hour 2	0.12		First dose
Hour 5	9.44	56	Second dose
Hour 10	14.60		
Hour 36	17.9	54	
Hour 48	14.20		
Day 3	11.30	55	
Day 4	8.00	36	Third dose
Day 5	6.60	58	
Day 6	2.80		
Day 7	0.06		
Day 8	0.04		
Day 9	0.04		

channels in the open position and blocks potassium channels. Continuous, prolonged, and recurrent somatic, sympathetic, parasympathetic neurons cause deformation and excessive stimulation. As a result, excessive neurotransmitter release (epinephrine, norepinephrine, acetylcholine, glutamate, aspartate) occurs and an autonomic storm develops with activation of both the sympathetic and parasympathetic nervous system.¹⁴ Severe systemic manifestations of scorpion bite can occur as a result of this autonomic storm.¹⁵

Patients with scorpion envenomation are classified into three groups by the Scorpion Consensus Expert Group according to clinical severity.¹⁶ Class I involves local manifestations such as pain, erythema, and bullous eruption; Class II exhibits systemic involvement such as sweating, salivation, mydriasis, priapism, hypertension, hypotension, cold extremities; and Class III portrays cardiovascular, respiratory, or neurological symptoms such as cardiogenic shock, pulmonary edema, altered consciousness, and convulsive crisis.¹⁶ Our case was evaluated as Class III with serious cardiovascular, pulmonary, and neurological involvements.

The clinical spectrum has a wide range from local findings such as pain, numbness, hyperemia to severe systemic findings such as hypersalivation, tachycardia, hypertension, acute respiratory distress syndrome, myocardial dysfunction, arrhythmia, seizure, encephalopathy, aphasia, disseminated intravascular coagulation, intracerebral hemorrhage, hypertensive encephalopathy, brain ischemia, hyperglycemia, involuntary limb movements, priapism, and pulmonary edema.¹⁶ Symptoms generally start within the first 5 minutes to 4 hours.¹⁷ The catecholamine storm causes cardiogenic pulmonary edema as a result of decreased cardiac contractility.¹⁸ The present case admitted to the hospital 3 hours following envenomation and she had hypersalivation, tachycardia, involuntary limb movements, and pulmonary edema as the local and systemic symptoms. Severe myocardial dysfunction developed at clinical follow-up of the patient.

An important cause of death related to scorpion sting is cardiac dysfunction and it may be treated with vasoactive inotropes and scorpion antivenom. Serious envenomations require invasive monitoring in the PICU. There are a few hypotheses about the cardiac effect of scorpion toxin. Some researchers hypothesize that cardiac damage is associated with the massive release of catecholamines.¹⁹ Others suggest a possible direct toxic effect of the venom on cardiac fibers causing toxic myocarditis.²⁰ The last mechanism proposed is myocardial ischemia.²¹ Echocardiography is beneficial for evaluating cardiac function. Frequently left ventricular systolic dysfunction has been described. Mishra and Prasad suggest routine echocardiographic assessment for patients with Grade 2 to 3 scorpion envenomation.²²

In the last few years, troponin I has become an important marker for diagnosis and prognosis in myocarditis. Meki et al report benefits in scorpion sting envenomation. Troponin has 100% specificity and sensitivity for the diagnosis of myocardial injury in relation to the echocardiographic findings in the scorpion envenomation.²³ When echocardiography is not available, normal troponin I levels are an important indicator for normal myocardial function.²⁴

Troponin values may be normal initially and reach maximum levels at 24 to 36 hours.²⁵ In our present case, the troponin I level peaked at 36 hours. Sagarad et al measured troponin I level between 1 and 6 hours after arrival showing that values were higher than 10 µg/L in 7.1% of the patients.²⁶ In our present case, extreme troponin I elevation rising to 17.9 ng/mL occurred. The serum troponin level in this case was increased by 300 times the normal value. Cupo and Hering reported a case series in (YEAR?) consisting of eight patients and in one patient the troponin value was increased to 32.1 ng/mL. To the best of our knowledge, our case had the highest troponin value reported in the next 15 years in the pediatric age group on the PubMed literature search.²⁵ We believe the high level of troponin is due to toxin causing catecholamine discharge and direct myocardial damage. With antitoxin and vasoactive inotropes, troponin levels of the patient declined from the second day of admission to the normal range on day 7.

Another interesting aspect of our patient was the severe systolic dysfunction (EF 34%) which occurred on the fourth day following the scorpion sting when the troponin I level declined to 8 ng/mL. This late severe systolic dysfunction was treated with scorpion antivenom. Scorpion antivenom is the only specific treatment and is widely used in many countries. Early antivenom administration diminishes the severity and duration of sympathetic activity^{27,28} and improves the left ventricular systolic functions.²² There is no report in the literature indicating that antivenom is effective in prevention or abolition of cardiovascular morbidity.²⁹ However, in our case, we detected a rapid improvement in systolic function with the third dose of antivenom.

Catecholaminergic storm causes increased sympathetic activity and α receptor overstimulation.³⁰ This stimulation plays an important role in the development of cardiac manifestations.¹⁵ Left ventricular contractility is affected and capillary pulmonary permeability increases. Prazosin and doxazosin are postsynaptic, selective α adrenergic receptor blockers that can antagonize the metabolic, hemodynamic, and hormonal effects of scorpion venom and reduce preload and left ventricular functions.²¹ We administered the first dose of doxazosin on hospital admission 3 hours after envenomation.

In conclusion, scorpion sting is an important envenomation etiology of life-threatening cardiopulmonary involvement. Our case is the highest troponin I value in the literature for children reported in the past 15 years. Another important aspect of this case is systolic dysfunction which persisted when troponin I values dropped and responded rapidly to repeated dosage of antivenom therapy. *Leiurus abduhbayrami* is a newly defined scorpion species in recent years and causes severe cardiomyopathy and pulmonary edema especially in children. This case is presented with the aim of raising scorpion envenomation awareness for physicians working in pediatric emergency and intensive care units.

Conflict of Interest
None.

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