

Myocardial Dysfunction in Children with Scorpion Sting Envenomation

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Scorpion sting envenomation with systemic manifestations is a life threatening emergency and poses a significant health problem in children. *Mesobuthus tumulus* or Indian red scorpion, the most toxic species in India, is abundantly found in coastal areas and para-Gangetic regions. In envenomed children, serum venom concentration peaks at about 2 hours, and its level is directly related to clinical manifestations [1] which also depend upon the age of the patient, the season of the sting and the time lapse between the sting and the hospitalization. Children are more likely to develop rapid deterioration because of their lesser body weight. The critical time period in cardiopulmonary dysfunction ranges from two to several hours after the sting.

Mesobuthus tumulus venom is a potent sodium channel activator which results in autonomic storm. It initially leads to a transient cholinergic phase followed by sustained adrenergic hyperactivity, which is a venom dose-dependent phenomenon. The severity of envenomation and mortality are related to hemodynamic and cardio-respiratory dysfunctions with cardiac failure and pulmonary edema. The myocarditis is due to the direct effect of venom on the myocardium, hypoxia in the presence of increased catecholamines, and altered permeability of myocardial cell membrane affecting electrical properties and abnormalities in electrolytes fluxes. Coronary microvascular spasm due to catecholamine overstimulation may be the underlying pathophysiology triggering the myocardial perfusion derangement [2]. Pulmonary edema may be due to direct effect of the toxin on the myocardium and impairment in the clearance of alveolar fluid mediated by epithelial sodium channel and sodium-potassium pump (Na^+/K^+ -ATPase) [3]. Furthermore, α -toxin causes a massive release of vasoactive peptide hormones, including endothelin-1, which impairs the clearance of alveolar fluid.

Prazosin has been reported to be effective in reducing preload and improving left ventricular function. However, cardiotoxicity is due to sustained beta-receptor stimulation leading to exhaustion of the heart, consequent to a decrease in left ventricular function. Dobutamine is required in order to improve cardiac function until catecholamine stores are replenished [4,5]

Specific scorpion antivenom (SAV) therapy is a widely accepted and is still the single major therapeutic strategy against the envenomation. The late administration of SAV may not be effective as the venom might have already reached the target site and not accessible to the antivenom for neutralization [5]. However, apart from the action on neutralizing circulating unbound venom, antivenom also creates a concentration gradient between plasma and target tissue. The venom bound to antivenom gets excreted and the toxin in the tissues moves down the concentration gradient into the blood and gets bound by the antivenom. Therefore, even if the venom is not immediately neutralized by antibodies, its removal from tissue may cause relief in symptoms [6].

Ananda Kumar, *et al.* [7], in a study published in this issue of *Indian Pediatrics*, observed an increase in cumulative proportion of children without myocardial dysfunction after combined administration of SAV and prazosin therapy. They also reported that late admission to hospital (>4 hours) after the sting, hypotension at admission, and not using SAV in grade-2 envenomation were significantly associated with myocardial dysfunction. On multivariate logistic regression analysis, the independent predictors of myocardial dysfunction were longer time between sting and admission and hypotension. However, the main limitation of study was lesser number of patients in higher grades of envenomation and non-availability of a test to detect venom antigen to find out the dose-response relationship in these cases.

Echocardiography is a useful tool for evaluating the various parameters of cardiac function. It has been used to document myocarditis in scorpion sting envenomation. Left ventricular systolic dysfunction is the predominant finding along with left ventricular dilatation, and regional wall motion abnormalities have been described infrequently. However, its routine use in emergency is limited by non-availability [8]. Cardiac troponin (cTn I) has become an important diagnostic and prognostic tool in acute coronary syndromes as well as myocarditis. Its measurement and benefits in scorpion sting envenomation has been reported by Meki, *et al.* [8]. It showed 100% specificity and sensitivity for the diagnosis of myocardial injury in relation to the echocardiographic findings in the envenomed victims. In severe cases, cTnI was found to be

positively correlated with left ventricular ejection fraction (LVEF). The normal levels of cTnI is an important indicator of non-involvement of myocardium, when echocardiography is not available. Left ventricular global hypokinesia, LVEF less than 30% and right ventricular dysfunction contribute to hypotension in envenomed patients. These patients are benefitted by the early use of vasopressors and inotropes. The normal echocardiography and serum level of cTnI also favor an early discharge from hospital [8,9]. Echocardiography should be done routinely in all patients with grade 2-4 envenomation to predict outcome and discharge from hospital. Moreover, early hospitalization after sting, and administration of SAV are the key factors in reducing the myocardial dysfunction, and hence related morbidity and mortality.

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