

Nitroglycerine in Scorpion Sting with Decompensated Shock

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This study was designed to examine the effect of nitroglycerine infusion in children hospitalized for scorpion sting with severe myocardial dysfunction and decompensated shock. Children satisfying the inclusion criteria were started on nitroglycerine infusion under hemodynamic monitoring and other supportive measures. The effects of nitroglycerine, including improvement in oxygenation and decrease in pulmonary congestion and liver size were recorded. Seven out of 11 children responded well to nitroglycerine therapy and the clinical response was evident within 30-60 minutes. The first parameter to improve was oxygen saturation, followed by an improvement in the blood pressure and respiratory rate. Heart rate was the last parameter to improve after nitroglycerine infusion. The average duration of nitroglycerine infusion was 25 hours (12-36 hours). It was seen that the non-survivors had significant tachycardia at admission, and a greater need for assisted ventilation compared to the survivors. We conclude that nitroglycerine therapy could bring about significant improvement in myocardial function and hemodynamic parameters with a potential for improved survival.

Key words: Nitroglycerine, Scorpion sting, Shock.

Scorpion sting is a potential life-threatening medical emergency presenting to the children's Accident and Emergency in southern India. Cardiac toxicity dominates the clinical picture in these children. The usefulness of alpha blockade and additional cardiac support with inotropes and sodium nitroprusside for this condition have been earlier documented (1,2). Despite these measures, in some children myocardial dysfunction and hypotension persist. The usefulness of intravenous nitroglycerine along with inotropes for adults with severe left ventricular failure has been reported by Loeb, *et al.* (3) and Edwards, *et al.* (4). There are hardly any studies on nitroglycerine usage in cases of children with scorpion sting. Hence, the present communication.

Subjects and Methods

This interventional study was conducted

prospectively in the Pediatric Intensive Care Unit of JIPMER Hospital, Pondicherry between May 2001 to March 2003. Children below 12 years of age with scorpion sting-induced myocardial dysfunction with decompensated shock were studied. Decompensated shock was defined as presence of persistent hypotension and tachycardia even after the standard protocol outlined below. In these children, myocardial dysfunction was evident by the presence of gallop rhythm, tachypnea, raised jugular venous pressure (JVP), and hepatomegaly. Electrocardiographic evidence of abnormal Q waves along with ST-T wave changes were taken as additional criteria for myocardial dysfunction. These children with scorpion sting envenomation had initially received in the High Dependency Unit of the department standard alpha blockade therapy with Prazosin

(30 $\mu\text{g}/\text{Kg}/\text{dose}$ 4-6 hourly). Heart rate, blood pressure, respiratory rate, liver size, peripheral perfusion, central venous pressure (ventilated children only), electrocardiograph, oxygen saturation and blood gas were closely monitored in these children.

The children received inotropic support with dobutamine (5-15 $\mu\text{g}/\text{Kg}/\text{min}$) as per the standard dosage schedule(5). Clinical response was assessed as given below: improvement in oxygenation (>5% improvement in oxygen saturation), blood pressure (increase in mean arterial pressure by 10%), work of breathing, reduction of heart rate (decrease by 10%), hepatomegaly and JVP.

Nitroglycerine(NTG) was used as a rescue therapy prior to transfer to Intensive care unit. Nitroglycerine was started at a dose of 0.5 $\mu\text{g}/\text{kg}/\text{min}$ and titrated with clinical response with a maximum dose of 5 $\mu\text{g}/\text{kg}/\text{min}$. Children with type I respiratory failure with a FiO_2 greater than 0.6 and not improving with nitroglycerine therapy and those with type II respiratory failure were ventilated. Nitroglycerine and inotropic support were continued during ventilation till the children recovered. The study protocol had the approval of the local ethical standards committee. Data from standardized study forms were entered into a computer database for analysis.

Results

During the study period of twenty two months, 80 children brought for scorpion sting envenomation were triaged according to the criteria of Abrough, *et al.*(6). Thirty of these children developed pulmonary edema due to myocardial dysfunction and received standard alpha blockade therapy and inotropic support with dobutamine. Eleven of these children who developed decompensated shock were the subjects for this study. Six of them were girls and the rest were boys. Their mean (SD) age

was 8.3 (3.8) years, the youngest being 18 months of age. The clinical characteristics of these patients are shown in *Table I*. The mean (SD) time delay at presentation was 14.7 (4.9) hours for survivors and 12.8 (10.1) hours for non-survivors. The mean respiratory rate, mean arterial pressure and oxygen saturation among survivors was 34/min, 68 mm Hg and 92% and among non-survivors was 44/min, 60 mm Hg and 85% respectively. Four patients had no evidence of myocardial involvement at admission, but developed clinical features of myocardial dysfunction 6-24 hours after admission while on standard alpha blockade therapy.

Eleven children were started on nitroglycerine infusion, and the mean duration of infusion was 25 hours (12-36 hours). Five children improved with the nitroglycerine infusion only and did not require ventilation. The clinical response to NTG infusion was evident within 30-60 minutes. The parameters which showed improvement were in the following order: oxygen saturation, liver size, blood pressure respiratory rate heart rate and ECG. Two children showed marked improvement in ECG changes 1-2 hours after commencement of NTG infusion. Out of the remaining six children who required ventilation due to worsening respiratory status, two recovered well without any further complication. The seven survivors were discharged after mean (SD) hospital stay of 5.6 (3.1) days. No adverse reaction to NTG was noted in them.

Among the four fatal cases, one child developed sudden unexplained ventricular arrhythmia 6 hours after initial improvement. The others did not show consistent improvement in oxygenation even after ventilatory support due to ventilation perfusion mismatch. None of these four fatal cases had received prazosin prior to reaching our hospital.

TABLE I—Clinical Characteristics of Study Children on Nitroglycerine Infusion

Patient	Age (yrs)	Blood pressure (mmHg)			Heart rate		Electrocardiographic changes	Time taken for recovery
		At start of Nitro glycerine	4hrs	12hrs	At start of Nitro glycerine	12hrs		
1	10	70/30	78/36	84/44	148	136	T wave inversion in Lead II, III, aVL	36 hrs
2	12	70/36	92/60	98/60	170	136	ST elevation in Lead I and aVL, Hyper acute tented T waves, Prolonged QTc interval	48 hrs
3	9	76/30	96/55	90/60	160	148	Tented T wave and ST depression in inferiolateral leads. ST segment elevation in II, aVF V5-V6, Q in aVL	16 hrs
4	12	74/34	95/74	94/40	138	114	Q in aVL, Early ST elevation in Lead I and aVL	56 hrs
5	6	70/34	92/38	86/34	180	160	ST segment elevation in II, III, aVF V3-V6, Hyper acute tented T waves	12 hrs
6	4	68/30	87/48	82/62	176	160	Monophasic complex in aVL, Sinus tachycardia with ST segment depression in V3-V6	72 hrs
7	5	64/30	68/36	78/40	168	156	ST segment elevation in I, aVF V3-V6, sinus tachycardia	30 hrs
8	1½	60/28	66/42	81/29	172	167	Widened QRS, Low voltage pattern, Monophasic complex in aVL	Expired
9	12	70/40	70/50	50/0	194	182	Hyper acute tented T waves, Prolonged QTc interval. Sinus tachycardia with ST segment depression in V3-V6	Expired
10	7	66/30	85/40	86/38	186	170	Widened QRS, Low voltage pattern, Q in aVL	Expired
11	11	72/34	70/30	68/32	140	150	ST segment elevation in II, III, aVF V1, Hyper acute tented T waves	Expired

Key Message

- In children with scorpion sting and decompensated shock, nitroglycerin infusion could improve myocardial function and hemodynamic parameters.

Discussion

Cardiovascular involvement remains the major cause of mortality in scorpion envenomation(7). Ancillary pharmacological therapy with prazosin and dobutamine support with close monitoring resulted in favourable outcome in majority (86.25%) of the children admitted with scorpion envenomation.

Only a small subset (13.75%) of children had developed persistent hypotension inspite of myocardial supportive measures and were potential candidates for ventilatory support. Nitroglycerine was used as a rescue measure in these sick children and the response was evident within 30-60 minutes. Of the eleven children who received nitroglycerine, five had sufficient improvement in oxygenation and work of breathing so as to avoid the need for mechanical ventilation. This beneficial effect can be explained by the predominant venodilator action of nitroglycerine decreasing venous return to the heart, thereby reducing left ventricular end-diastolic pressure (preload). In addition, nitroglycerin improves intrapulmonary shunting thus bringing down ventilation perfusion mismatch(8,9). Nitrates also dilate epicardial coronary arteries and coronary collateral vessels, thereby increasing coronary blood flow(8). These beneficial effects on coronary circulation could explain the improvement in ECG among the survivors. The usefulness of nitroglycerine in left ventricular failure and pulmonary edema in adults is well established. However, its use in scorpion sting, where the hemodynamic instability is contributed by autonomic storm

resulting in intense vasoconstriction and myocardial injury was not reported earlier.

Four of our children did not have favorable outcome in spite of all the myocardial supportive measures. Continuing absorption of venom from depot sites can be hypothesized for late deterioration in such cases. Early administration of prazosin after the sting even in peripheral health facility could have favorably influenced the outcome in the non-survivors.

In our pilot study with NTG, the intervention and its measured effects appear clinically significant. Only an open controlled trial done in large number of patients will be able to conclude the benefits of NTG over other drugs. Such a study in the future can validate the magnitude and precision of treatment effects with NTG.

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