Vasodilators and Hypertensive Encephalopathy following Scorpion Envenomation in Children*

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Twenty-three children were admitted to a pediatric intensive care unit for scorpion envenomation with severe hypertension. The hypertension responded to analgesics and sedatives in 15 (65 percent) of the 23. The remaining eight children required specific antihypertensive therapy, and their condition promptly responded to intravenous hydralazine and sublingual nifedipine; rebound hypertension was observed in one. Hypertension is a frequent complication of a scorpion's sting in children, and specific antihypertensive therapy is indicated in severe cases. Hydralazine and nifedipine are effective and safe in such instances. (Chest 1990; 97:118-20)

Scorpion envenomation is not an uncommon event in various parts of the world. Clinical and experimental studies have shown that scorpion venom affects the cardiovascular system, causing heart failure and pulmonary and systemic hypertension. Hypertension may be associated with respiratory failure, shock, and death.

In this study, we investigated the frequency and the behavior of hypertension in children following scorpion envenomation, and we herein report our experience with hydralazine and nifedipine in this situation.

MATERIALS AND METHODS

All children admitted to the Pediatric Intensive Care Unit of the Soroka Medical Center during the 16-month period from July 1, 1987 to Oct 31, 1988 with scorpion envenomation were included in our study. All exhibited the symptoms of scorpion envenomation, including signs of CNS dysfunction (anxiety, drowsiness, or agitation), vomiting, excessive salivation, sweating, and cardiac rhythm disturbances (bradycardia or tachycardia).

In the present study, significant or severe hypertension was defined according to the specifications of the Task Force on Blood Pressure Control in Children. Since BP in children is dependent upon a multitude of factors, a normal BP was defined as systolic and diastolic pressures less than the 90th percentile for age and sex. Measurements of BP between the 95th and 99th percentile for age and sex were considered significant hypertension, and those persistently at or above the 99th percentile were considered severe hypertension. Hypertensive encephalopathy was believed to be present if alterations in the neurologic state such as confusion, agitation, lethargy, and seizures were observed in the presence of severe hypertension. Blood pressure was recorded in all children with a Dinamap 1846 vital signs monitor.

Although the study was not prospectively designed, the 23 patients were assigned to three different groups for treatment.

Fifteen agitated children with altered mental status and severe hypertension were treated with analgesics or sedated (usually diazepam and meperidine [Demerol]). If elevated BP persisted, intravenous hydralazine (0.2 mg/kg) or sublingual nifedipine (0.5 mg/kg) was given. Blood pressure was monitored every five minutes during the first hour after admission and then on an hourly basis until the patient's recovery or death. Hydralazine or nifedipine was added if hypertension persisted. Those patients with respiratory failure in addition to severe hypertension were managed by a combination of antihypertensive drugs and mechanical ventilation.

Two nonagitated children with severe hypertension were started on therapy with antihypertensive drugs without prior sedation or analgesic drugs.

Six patients with significant, but not severe, hypertension were only sedated.

RESULTS

During the 16-month period of the study, 30 children, ranging in age from 10 months to 14 years, were admitted to the pediatric intensive care unit with scorpion envenomation.

Severe or significant hypertension was observed

![Figure 1. Behavior of BP on arrival and subsequent follow-up.](image-url)
Table 1—Recording of BP and Therapy in Eight Children

<table>
<thead>
<tr>
<th>Case</th>
<th>Age, yr</th>
<th>Initil*</th>
<th>Peak*</th>
<th>Sedatives; Analgesics</th>
<th>Antihypertensive Drugs†</th>
<th>BP after Therapy‡</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>148/111</td>
<td>150/130</td>
<td>+</td>
<td>Hydralazine</td>
<td>105/59 (N)</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>110/87</td>
<td>113/100</td>
<td>+</td>
<td>Hydralazine</td>
<td>96/45 (N)</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>118/109</td>
<td>160/120</td>
<td>–</td>
<td>Hydralazine</td>
<td>125/95 (N)</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>108/105</td>
<td>145/112</td>
<td>–</td>
<td>Hydralazine</td>
<td>107/65 (N)</td>
</tr>
<tr>
<td>5</td>
<td>12</td>
<td>140/90</td>
<td>160/110</td>
<td>+</td>
<td>Hydralazine</td>
<td>120/79 (N)</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>140/90</td>
<td>150/100</td>
<td>+</td>
<td>Hydralazine</td>
<td>116/99 (N)</td>
</tr>
<tr>
<td>7</td>
<td>4</td>
<td>136/87</td>
<td>136/87</td>
<td>–</td>
<td>Nifedipine (0.25 mg/kg)</td>
<td>137/92 (N)</td>
</tr>
<tr>
<td>8</td>
<td>5</td>
<td>150/110</td>
<td>150/110</td>
<td>+</td>
<td>Nifedipine</td>
<td>120/80 (N)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>130/100</td>
<td>–</td>
<td>Nifedipine</td>
<td>96/49 (N)</td>
</tr>
</tbody>
</table>

*Severely elevated BP for age.
†Hydralazine, 0.2 mg/kg intravenously; and nifedipine, 0.5 mg/kg sublingually.
‡N, Normal BP for age.

in 21 children (70 percent); nine were normotensive initially; however, two developed severe hypertension later. The other seven remained normotensive during the entire period of observation. There were two groups of patients depending upon the severity of hypertension (Fig 1); six children had significant hypertension (one became severely hypertensive later), and 18 patients presented with or subsequently developed severe hypertension. Eight children required specific antihypertensive therapy (Table 1). The condition of all eight patients responded promptly either to hydralazine (patients 1 to 5) or to nifedipine (patients 7 and 8), and one patient (patient 6) required the addition of nifedipine following a partial response to administration of hydralazine. Patient 8 required a second dose of nifedipine after developing rebound hypertension. Normal BP was achieved in all patients within five hours and was associated with marked improvement of agitation, irritability, and mental status and normalization of the respiratory pattern. In 16 children, normal BP was recorded within an hour, in five within two hours, and in two cases within three and five hours after arrival.

Twenty-nine children recovered completely and left the intensive care unit within one day. One patient died. He had a normal BP on arrival and, on subsequent measurements, developed a sudden severe bradyarrhythmia and cardiorespiratory arrest two hours after admission. This child responded initially but died later from brain damage. Autopsy was not performed.

Discussion

Hypertension is frequently present in children with scorpion envenomation. Significant or severe hypertension was noted in 77 percent (23) of our 30 patients. This figure is much higher than the 17.5 to 30 percent previously reported,1,7,13 commonly accompanied by pulmonary edema, myocardial damage, and rhythm disturbances.1,7,13 Occasionally, a sudden severe elevation of the BP and functional alteration in the neurologic status predominate the clinical picture.9 We had difficulty in measuring the BP in restless infants and children14,15 with scorpion sting, especially in those in whom CNS disturbance dominated the clinical picture. We believed that some of the cerebral symptoms following scorpion stings, such as agitation, decreased level of consciousness, and convulsion, in addition to hypertension, are the clinical counterpart of acute hypertensive encephalopathy induced by the excessive levels of circulating catecholamines.9

Experimental and human studies suggest that α-adrenergic and β-adrenergic blocking agents should be used for the treatment of hypertension and related cardiovascular events induced by scorpion envenomation; however, only a few sporadic reports have appeared describing the use of adrenergic blockers in this situation.2,3,13 The use of prazosin has recently been reported in the treatment of hypertension and pulmonary edema in patients with scorpion sting.16

Participation of the renin-angiotensin system has also been implicated in the development of hypertension following scorpion envenomation.17 A recent study18 in dogs showed elevated plasma angiotensin induced by the Indian red scorpion (Buthus tamulus). In the same report, reduced insulin levels were found, and the authors reported reversal of hypertension and metabolic and electrocardiographic changes after treatment with insulin and tolazoline hydrochloride.19 The excellent results obtained in these reports and in our current study suggest that afterload-reducing agents are a valuable adjunct to the treatment of severe scorpion envenomation in children.

We found both intravenous hydralazine and sublingual nifedipine to be highly effective in the management of hypertension and its sequelae in scorpion...
envenomation. Both resulted in a significant decrease of systemic BP within minutes, with normalization in all cases within an hour. Nifedipine has also been recommended in the treatment of other causes of childhood hypertension.20

Nifedipine may be given sublingually, and this route has several advantages, particularly in severely anxious agitated children with poor peripheral perfusion. In addition, nifedipine, a calcium-channel blocker, might protect the heart muscle from the toxic effect of the scorpion venom. Studies have shown that myocardial damage following a scorpion sting results from calcium ionic influx into heart muscle cells.21

In conclusion, afterload reduction with vasodilators should be advised as first-choice therapy in those patients with scorpion envenomation in whom the clinical picture is dominated by signs of pulmonary edema and severe hypertension or those with hypertensive encephalopathy.

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