HYPERTENSION AFTER SURGICAL RELEASE FOR FLEXION CONTRACTURES OF THE KNEE

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We reviewed retrospectively 94 patients who had undergone soft-tissue release to correct flexion contracture of the knee to determine the incidence of postoperative hypertension. The cause of contracture in most patients was cerebral palsy (45) or old poliomyelitis (39).

Twenty patients developed persistent hypertension. Two of them were symptomatic, one developing hypertensive encephalopathy. Patients who had had poliomyelitis were at a higher risk than those with cerebral palsy; the risk increased with bilateral procedures. The amount of correction achieved had no influence on the incidence of hypertension.

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Hypertension may follow orthopaedic procedures such as leg lengthening (Wilk and Badgley 1963; Axer, Elkon and Eliahu 1966; Yosipovitch and Palti 1967; Whitehill and Hakala 1978), correction of knee flexion contracture (Harandi and Zahir 1974; Lander and Hardy 1986) and correction of club-foot deformity (Akbarnia et al 1990). Nonoperative orthopaedic procedures such as traction and immobilisation in a cast have also been reported to cause hypertension (Linshaw et al 1979; Turner et al 1979; Talab, Hamdan and Ahmed 1982).

There have been various explanations for this phenomenon. One is that hypertension is caused by stretching of the sympathetic nerves around the blood vessels (Harandi and Zahir 1974) or of the sciatic nerve (Whitehill and Hakala 1978). Turner et al (1979) showed that hypertension was more common in children treated in traction or a cast than in those not immobilised and related this to stretching of the sympathetic nerves and hypercalcaemia. Increased serum levels of ionised calcium have been shown to result in increased peripheral vascular resistance and to lead to hypertension (Berliner, Shenker and Weinstock 1972).

Prompted by our experience of one case of severe hypertensive encephalopathy in a child after correction of a knee flexion contracture, we aimed to determine the incidence of this complication and to identify any risk factors.

PATIENTS AND METHODS

Between 1983 and 1991, 96 patients underwent soft-tissue release for flexion contracture of the knee at the King Faisal Hospital in Riyadh, Saudi Arabia. Two patients who had had hypertension preoperatively were excluded from the study. Of the 94 which remained, 60 were male and their mean age was 12 years (7 to 22). Poliomyelitis (39) and cerebral palsy (45) were the causes of the contracture in most. Some clinical details are given in Table I.

The medical records were reviewed with particular attention to the charts documenting the blood pressure preoperatively, intraoperatively, in the recovery room and postoperatively. All patients had at least four recordings of blood pressure preoperatively, half-hourly recordings in the operating room and recovery room and four-hourly recordings for 48 hours postoperatively or until the blood pressure returned to normal. Small blood-pressure cuffs were used in children.

The blood pressure varies with the age, sex, height and weight of the child. Hypertension was defined according to the guidelines recommended by the Report of the Second Task Force on Blood Pressure Control in Children (Paediatrics 1987). The normal was defined as systolic and diastolic pressures below the 90th percentile for age and sex. The term ‘high normal’ was used for pressures between the 90th and 95th percentiles. ‘Significant hypertension’ meant a blood pressure above the 95th percentile and ‘severe hypertension’ that above the 99th percentile. For our purposes the category ‘normotensive’ included patients who developed hypertensive episodes during the operation and in the first 24 hours after surgery. During this period the blood pressure is influenced by several variables such as the anaesthetic and postoperative pain and the analgesics used to control it. Only patients

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whose blood pressure was recorded as high on at least three separate occasions after the first postoperative day were considered to have developed hypertension.

As far as we know, none of the patients had preoperative hypertension, renal disease, or any other condition which might affect the blood pressure and none received any medication known to cause hypertension preoperatively or intraoperatively.

Soft-tissue releases for hip contracture were performed in 28 patients (15 with cerebral palsy, 12 after poliomyelitis and one with spinal muscular atrophy) and tendo Achilles lengthening in 14 patients (5 with cerebral palsy, 8 after poliomyelitis and one with spinal muscular atrophy).

RESULTS

Of the 94 patients, 20 had persistent hypertension, 12 of whom were considered to have severe hypertension according to our criteria. Of these 20 patients, 18 were asymptomatic, one complained of severe headache and vomiting and the other developed hypertensive encephalopathy and seizures which required antihypertensive treatment. Hypertensive episodes occurred within the first 24 hours after operation in 43 patients.

Of the 39 patients with contracture after poliomyelitis, 13 (33%) developed persistent hypertension (11 asymptomatic and 2 symptomatic). Of the 45 with cerebral palsy, six (13%) developed persistent hypertension (Table II), all asymptomatic. This difference in the incidence between the two groups is significant (p = 0.028, chi-squared test). Hypertensive episodes were observed during the first 24 hours after operation in 21 patients (54%) in the poliomyelitis group and in 19 (42%) in the cerebral palsy group. In 13 patients in the first group the pressure returned to normal after 24 hours but in eight it persisted. In the second group only five of the 19 who had early hypertension developed persistent hypertension.

Table I. Clinical details of 94 patients treated by soft-tissue release for flexion contractures of the knee

<table>
<thead>
<tr>
<th>Diagnosis</th>
<th>Number of patients</th>
<th>Mean age (yr)</th>
<th>Mean flexion contracture (degrees)</th>
<th>Mean correction achieved (degrees)</th>
<th>Number with no effects on blood pressure</th>
<th>Number with asymptomatic hypertension</th>
<th>Number with symptomatic hypertension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poliomyelitis</td>
<td>39</td>
<td>12</td>
<td>38</td>
<td>28</td>
<td>26</td>
<td>11</td>
<td>2</td>
</tr>
<tr>
<td>Cerebral palsy</td>
<td>45</td>
<td>10</td>
<td>44</td>
<td>33</td>
<td>39</td>
<td>6</td>
<td>0</td>
</tr>
<tr>
<td>Familial spasticity</td>
<td>2</td>
<td>11</td>
<td>72</td>
<td>65</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Osteogenesis imperfecta</td>
<td>2</td>
<td>8</td>
<td>70</td>
<td>51</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Spinal muscular atrophy</td>
<td>2</td>
<td>8.5</td>
<td>30</td>
<td>25</td>
<td>1</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>TAR*</td>
<td>1</td>
<td>2</td>
<td>47</td>
<td>32</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Dermatomyositis</td>
<td>1</td>
<td>17</td>
<td>92</td>
<td>81</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Contracture after burns</td>
<td>1</td>
<td>5</td>
<td>70</td>
<td>50</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Arthrogryposis</td>
<td>1</td>
<td>5</td>
<td>60</td>
<td>47</td>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total</td>
<td>94</td>
<td></td>
<td></td>
<td></td>
<td>74</td>
<td>18</td>
<td>2</td>
</tr>
</tbody>
</table>

* thrombocytopenia and absent radius syndrome

Table II. The effects on blood pressure after surgical release of knee contracture secondary to poliomyelitis and cerebral palsy

<table>
<thead>
<tr>
<th>Poliomyelitis</th>
<th>Cerebral palsy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Normotensive</td>
</tr>
<tr>
<td>Number of patients (per cent)</td>
<td>26 (67)</td>
</tr>
<tr>
<td>Mean age in years</td>
<td>12</td>
</tr>
<tr>
<td>Male:Female</td>
<td>19:7</td>
</tr>
<tr>
<td>Mean flexion contracture in degrees (range)</td>
<td>37 (10 to 90)</td>
</tr>
<tr>
<td>Mean correction achieved in degrees (range)</td>
<td>28 (10 to 55)</td>
</tr>
<tr>
<td>Number of knees operated on</td>
<td>One</td>
</tr>
<tr>
<td>19</td>
<td>5</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
</tr>
</tbody>
</table>

* the incidence of hypertension in the two disease groups differed significantly (chi-squared test, p = 0.028)
In the poliomyelitis group, hypertension developed in five of the 24 patients who had soft-tissue release of one knee and in eight of the 15 patients in whom both knees were operated on (p = 0.36, chi-squared test). In the cerebral palsy group, hypertension developed in one of the five patients who had soft-tissue release on one knee and in five of the 40 who had bilateral operations (p = 0.67). When the two groups were combined no significant difference was found between patients with unilateral and bilateral procedures (p = 0.75).

The data were analysed separately, grouping patients according to the types of additional surgery performed. No significant conclusion could be drawn except that in the poliomyelitis group additional surgery increased the risk of hypertension.

The mean angle of flexion contracture of the knees in the poliomyelitis group was 38° (10 to 90). After surgery, a mean correction of 28° was achieved (10 to 70). In patients with cerebral palsy, the mean contracture was 44° (15 to 75) and the mean correction was 33° (15 to 70). The mean correction achieved in patients who developed hypertension and in those who did not was compared in the two groups separately. No significant differences were found.

Of the ten patients whose knee contractures were due to a variety of other causes, three developed early hypertensive episodes. One patient, a 12-year-old girl with spinal muscular atrophy developed severe hypertension which was asymptomatic. The correction achieved after surgical release of her knee contracture was 20°. No treatment was given.

DISCUSSION

Variations in blood pressure are well known to occur in children in hospital, but they seldom exceed the 90th percentile for the child’s age and sex. On admission, the blood pressure is usually slightly raised compared with that a few hours later. Most surgical procedures do not cause persistent postoperative hypertension (Clayton and Hughes 1952). Postanaesthetic hypertension is usually short-lived with a return to normal within a few hours (American College of Surgeons 1983). Postoperative hypertension is almost always caused by pain and it responds to analgesics (Gregory 1989). Persistent hypertension after surgery, particularly if it continues for more than 24 hours, is uncommon and should be investigated and treated.

The significance of the hypertensive episodes which we describe in the first 24 hours after surgery is unclear, since the immediate postoperative period is influenced by pain and the effects of narcotics and anaesthetic agents.

Harandi and Zahir (1974) reported two cases of severe hypertension after correction of flexion contracture of the knee and Lander and Hardy (1986) reported a similar experience after release of hip and knee flexion contracture secondary to poliomyelitis. In both the blood pressure returned to normal after the plaster cast was bivalved and the knee allowed to flex. One of our patients who developed severe symptomatic hypertension required antihypertensive medication as well as bivalving of the cast to allow the knee to flex. Yosipovitch and Palti (1967) showed in animal experiments that hypertension could be caused by a spinal reflex response to stretching of the sciatic nerve, and that it was mediated by sympathetic efferents which caused peripheral vasoconstriction. They also suggested that another mechanism for the slower rise of blood pressure was reflex renal ischaemia. Talab et al (1982) thought that both these mechanisms were responsible for hypertension observed in a three-year-old girl on traction for congenital dislocation of the hip. Whitehill and Hakala (1978) showed that stretching of any major nerves in a limb could cause elevation of the systemic blood pressure and that this response was mediated by the sympathetic nervous system. It should follow from these findings that the greater the correction achieved, the higher the risk. We found no such correlation. Nor did Akbarnia et al (1990) find any association between hypertension and the severity of the club-foot deformities which they corrected and Axer et al (1966) found no correlation with the rate of limb lengthening.

In our study the patients with contractures due to poliomyelitis were at greater risk than those with cerebral palsy. After poliomyelitis the fixed contractures develop slowly over time and the neurovascular structures also became shortened. When the flexion contracture is corrected, these neurovascular structures must be stretched. In cerebral palsy, however, the flexion deformity is largely due to increased tone in the hamstrings and the knee straightens when the hip is flexed, as demonstrated by Bleck’s test (1987). In these cases the neurovascular structures are probably not shortened and therefore undergo less stretching when the ‘contracture’ is released. The risk was increased when flexion contractures of both knees were released, an observation which may be explained by the model of stretch-induced hypertension, since the amount of stretch of the neurovascular structures would be proportionately increased.

Conclusions. The incidence of significant hypertension developing after correction of knee flexion contracture is higher than previously believed (21%). Patients with poliomyelitis are at greater risk than those with cerebral palsy. The risk increases further if both knees are corrected at the same time but the degree of correction achieved has no effect on the incidence of hypertension.

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