HYPOTENSION AFTER INTERCOSTAL NERVE BLOCK DURING THORACOTOMY UNDER GENERAL ANAESTHESIA

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SUMMARY

Intercostal nerve block during thoracotomy under general anaesthesia resulted in hypotension and a decrease in heart rate in five of 30 blocks performed. We attribute this to paravertebral spread of the local anaesthetic drug affecting sympathetic nerve fibres.

Intercostal nerve block is a well-known method for pain relief after thoracotomy (Moore and Bridenbaugh, 1962). Commonly the block is performed after operation and repeated when required. The first block, however, may be performed by the surgeon using an internal approach while the chest is still open. This may be the better technique (Loder, 1962), and it has been used in our department for 2 years.

Hypotension is said not to occur after intercostal nerve block alone (Moore and Bridenbaugh, 1962). This paper describes five patients in whom hypotension occurred after peroperative intercostal nerve block performed before the closure of the chest. To our knowledge, this has not been reported previously.

PATIENTS AND METHOD

Under general anaesthesia thoracotomy was performed by an incision through the 4th or 5th intercostal space. Before closing the chest cavity the surgeon blocked 4–5 intercostal nerves near the angle of the rib. Bupivacaine (Marcain) 0.5% 4–5 ml was injected to each intercostal space, the total dose amounting to bupivacaine 20 ml. Intravascular injection was avoided by careful aspiration before injection. Blood and fluid losses were replaced during operation. Arterial pressure was recorded with a sphygmomanometer. One or more drains were placed before closing the chest.

Twenty-five patients received 30 intercostal nerve blocks. The average age of the patients was 50 yr (range 19–73 yr). Surgery was performed for the treatment of pulmonary tumour or pneumothorax. The patients who subsequently developed hypotension were otherwise healthy, except one patient who was receiving digoxin and quinidine for the management of supraventricular arrhythmia. Two patients had moderate arterial hypertension not necessitating drug therapy. Hypotension was defined as a decrease in systolic pressure of 30% or more during operation.

During the period of study, thoracotomy was performed in 10 patients who did not receive intercostal nerve block. The indications for operation were the same except for two patients in whom unilateral thoracic sympathectomy (T2–4) was performed for treatment of Raynaud’s syndrome. The average age in this group was 41 yr (range 28–68 yr).

RESULTS

In five patients, a considerable decrease in arterial pressure occurred between 3 and 20 min (mean 11.6) after the block. The average decrease in pressure was 50 mm Hg (38.7%; range 35–80 mm Hg). The operations were otherwise uncomplicated.

Hypotension did not follow intercostal nerve blocks in the remaining 20 patients. The block was repeated in two patients in the hypotensive group without recurrence of hypotension.

The arterial pressures before and after nerve block, the decrease in arterial pressure and heart rate, the time interval between injections and hypotension, and treatment are shown in table I. Ephedrine was given to two patients.

There was a moderate decrease in heart rate (mean 11 beat min⁻¹; 13.7%) associated with the reduction of arterial pressure.

Two of the patients who did not receive intercostal nerve block became hypotensive because of haemorrhage. Neither hypotension nor brady-
TABLE I. Changes in arterial pressure and heart rate in five men exhibiting hypotension after nerve block. S = systolic, D = diastolic arterial pressure (mm Hg); HR = heart rate (beat min⁻¹)

<table>
<thead>
<tr>
<th>Patient</th>
<th>Age (yr)</th>
<th>Operation</th>
<th>Before block</th>
<th>After block</th>
<th>% Change</th>
<th>Interval block to change (min)</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>64</td>
<td>Lobectomy</td>
<td>140 90 85</td>
<td>100 85 75</td>
<td>28 12</td>
<td>3</td>
<td>Ephedrine</td>
</tr>
<tr>
<td>2</td>
<td>54</td>
<td>Pleurodesis</td>
<td>110 70 80</td>
<td>75 60 70</td>
<td>31 12</td>
<td>20</td>
<td>I.v. fluid</td>
</tr>
<tr>
<td>3</td>
<td>63</td>
<td>Pneumonectomy</td>
<td>150 100 75</td>
<td>90 60 65</td>
<td>40 13</td>
<td>5</td>
<td>Atropine + i.v. fluid</td>
</tr>
<tr>
<td>4</td>
<td>19</td>
<td>Pleurodesis</td>
<td>110 70 80</td>
<td>75 60 65</td>
<td>32 19</td>
<td>15-20</td>
<td>Fluid</td>
</tr>
<tr>
<td>5</td>
<td>63</td>
<td>Pneumonectomy</td>
<td>130 60 80</td>
<td>50 — 70</td>
<td>80 12</td>
<td>10-15</td>
<td>Ephedrine + i.v. fluid</td>
</tr>
<tr>
<td>Mean</td>
<td>52.6</td>
<td></td>
<td>128 78 80</td>
<td>78 66 69</td>
<td>38.7 13.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SEM</td>
<td>8.6</td>
<td></td>
<td>8.0 7.4 1.6</td>
<td>8.5 6.3 1.9</td>
<td>6.2 1.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cardia was noted in the two patients who underwent thoracic sympathectomy.

DISCUSSION

A combination of general anaesthesia and intercostal nerve block resulted in hypotension in five of 30 blocks performed. Hypotension occurred between 3 and 20 min after the block, and there was an associated reduction in heart rate.

Safar (1954) noted moderate hypotension in 10 of 40 patients undergoing abdominal operations when general anaesthesia was combined with intercostal nerve block. The decrease in arterial pressure occurred about 30 min after the block, and was attributed to a general systemic reaction to the anaesthetic drugs, in this case U-0045 lactate and novocain. Hypotension was not encountered following injection of lignocaine.

Moore and Bridenbaugh (1962) claim that simultaneous block of the coeliac plexus and intercostal nerves increases the risk of hypotension.

Intercostal nerve block is intended primarily to block the pain-conducting fibres. In the medial aspect of the upper intercostal spaces the nerves run through the subpleural space (Nunn and Slavin, 1980), which is directly connected with the paravertebral space, and hence with the extradural space (Atkinson, Rushman and Lee, 1977). The injection of anaesthetic agents too close to the vertebrae increases the risk of spread to the paravertebral space and block of the sympathetic fibres. Telivuo and Perttala (1966) have shown that, during intercostal nerve block, the anaesthetic drug may spread 7 cm along the rib. Nunn and Slavin (1980) have found that an injection of 3 ml at a point 7 cm from the posterior midline spread medially to the paravertebral space of the same intercostal space, presumably blocking the sympathetic chain. Spread of the anaesthetic round the internal aspect of the rib and into the intercostal spaces above and below may occur (Nunn and Slavin, 1980). Gravitational factors will further enhance the likelihood of spread medially in the paravertebral space if the patient is placed in the lateral position. The anaesthetic may also spread from one paravertebral space to another or to the opposite side through the extradural space (Atkinson, Rushman and Lee, 1977).

Both general anaesthesia and thoracotomy considerably increase sympathetic activity (Guyton, 1977). An unintentional sympathetic block will more or less eliminate this defence reaction. The decrease in arterial pressure is variable and depends on the extent of the block. Of particular importance in this context is blockade of the major splanchnic nerves (T5-10) (Moore and Bridenbaugh, 1962; Brodal, 1964). Blockade of the sympathetic fibres to the adrenal medulla (T5-10) (Brodal, 1964), will abolish the stress-induced release of catecholamines (Keel and Neil, 1965). These are factors which will cause vasodilatation, venous pooling, reduced arteriolar resistance, hypotension and reduced cardiac output. The abolition of sympathetic stimulation of the heart (T1-4) (Brodal, 1964), during thoracotomy and general anaesthesia reduces the heart rate and cardiac output (Otton and Wilson, 1966). The capacity for compensatory increase in heart rate and contractility is disputed, however (Ottesen, 1978).

We suggest that hypotension and a decrease in...
heart rate are attributable to a sympathetic block in thoracic nerve fibres. The period of time between the decrease in arterial pressure and the administration of the block indicates spread of the anaesthetic drug to the paravertebral space, and the effectiveness of ephedrine may support this theory.

Surgical sympathectomy in two patients did not result in hypotension. This may be explained by the fact that only three ganglia were affected (T2–4).

Other factors may cause hypotension during the operation. We excluded hypovolaemia. General anaesthesia may impair vasomotor reflexes, although little is known about these mechanisms (Wylie and Churchill-Davidson, 1972). The circulatory changes associated with the open chest are complex, but venous return may be decreased. Positive pressure ventilation has the same effect (Atkinson, Rushman and Lee, 1977). We excluded the possibility of toxic reactions by careful technique, and by injecting moderate doses of the local anaesthetic drug. However, we cannot deny that these factors could have contributed to arterial pressure changes in these patients by reducing the capacity to compensate for the hypotension caused by the autonomic block.

REFERENCES


