SUBARACHNOID BLOCKADE AND TOTAL HIP REPLACEMENT

Effect of Ephedrine on Intraoperative Blood Loss

J. THORBURN

Subarachnoid blockade is associated with a decrease in blood loss during operation, and may be advantageous in operations such as total hip replacement in which blood loss may be substantial. Although decreases in systemic arterial pressure frequently accompany subarachnoid blockade, the optimum reduction in arterial pressure is controversial, particularly in an elderly population, and the relationship between systemic hypotension and blood loss is not clear (Moir, 1968; Sculco and Ranawat, 1975). In the U.S.A. it is usual to prevent such hypotension - by the use of pressor agents, if necessary (Greene, 1969). Sculco and Ranawat (1975), using subarachnoid blockade and with active management of the hypotension noted a decrease in intraoperative blood loss of 50% when compared with that observed in patients receiving general anaesthesia for total hip replacement. However, this decrease was almost identical to that noted in a similar study, with the exception that the hypotension resulting from the block was not treated (Thorburn, Louden and Vallance, 1980).

This study was undertaken to examine the effect of the administration of ephedrine on intraoperative blood loss in patients undergoing total hip replacement under subarachnoid blockade.

PATIENTS AND METHODS

Patients admitted for total hip replacement were allocated randomly (by drawing a card without replacement) to either group A (n = 19; 15 female) or group B (n = 19; 17 female). Patients in group A received ephedrine i.v. to maintain the systolic arterial pressure at, or above 100 mm Hg. Patients in group B were managed in an identical way, but did not receive ephedrine. Significant differences in arterial pressure (P < 0.001), and heart rate (P < 0.005), but no significant difference in blood loss was observed in the two groups. This was confirmed by similar blood transfusion requirements and postoperative haemoglobin concentrations. The relevance of the use of pressor agents in spinal anaesthesia is discussed.

Apart from the injection of ephedrine, both groups of patients were treated identically. Informed consent was obtained and each patient was premedicated with nitrazepam 5–10 mg by mouth, 90 min and morphine 5–10 mg i.m., 60 min before the operation. In the anaesthetic room, the dose of sedation was adjusted using droperidol 1–3 mg and pentazocine 5–10 mg i.v. to render the patient drowsy but rousable. The heart rate and arterial pressure were recorded when the sedation was deemed to be adequate. The patient was turned to lie on the affected side, with a 10–15° head-up tilt. Using a midline approach, the spinal puncture was made with a 25-gauge needle. Clear CSF was obtained before and after the slow injection of cinchocaine 2–3 ml in 6% glucose, the dose depending on the height of the patient. This position was maintained for at least 6 min, until evidence of motor blockade was apparent. The patient was then placed in the modified supine position, with a wedge positioned under the affected hip, and the operating table level-

J. THORBURN, F.F.A.R.C.S., Department of Anaesthesia, Western Infirmary, Glasgow G11 6NT.
led after 5 min. When evidence of motor blockade had been obtained and a decrease in arterial pressure observed, ephedrine 5–10 mg was injected i.v. (group A), to achieve an arterial pressure of greater than 100 mm Hg. The maximum height of the blockade achieved could not be determined readily, as a laminar flow operating room was used, and this precluded easy access to the patient.

Arterial pressure was measured using an oscillogonometer and the ECG and heart rate (photoelectric probe) were monitored continuously. The arterial pressure was monitored frequently following institution of the block, but was recorded at 15-min intervals (as was heart rate). Ephedrine was injected as required to maintain the systolic arterial pressure at greater than 100 mm Hg.

Before surgery all patients had the following routine investigations performed: chest x-ray, electrocardiogram, and measurement of serum electrolyte, creatinine and haemoglobin concentrations. The biochemical and haematological investigations were repeated 72 h after surgery.

Only patients presenting for primary operations were selected; no patient who had previous operations on the affected hip was included in the study, and only Müller or Charnley arthroplasties were performed.

Blood loss during operation was measured gravimetrically and added to the blood loss measured in the suction bottles. The wound drainage was that obtained and measured from the wound suction drain following surgery.

Results were analysed using Student's t test, or Chi-squared test as appropriate.

**RESULTS**

There were 19 patients in each group, and table I shows the data obtained before operation in the two groups. No significant differences were observed between the two groups. The serum creatinine concentration was increased, but not significantly in group A. The population was predominantly elderly, with a mean age of 64 yr. Six of the patients were males. Considerable variation in preoperative systolic arterial pressures was noted, confirming the relative frequency of hypertension (Alexander and Barron, 1978).

Following the induction of subarachnoid blockade, patients in group A received a mean of ephedrine 23.7 mg i.v. (table II), and the mean systolic arterial pressure observed throughout surgery was 107 mm Hg. This was significantly greater than that observed in patients in group B (88 mm Hg) ($P < 0.001$), the percentage decreases in the systolic pressures from their preoperative values being 20.3% and 34.6%, respectively. The blood loss measured during surgery was not significantly different in the two groups (481 ± 136 ml in group A and 545 ± 226 ml in group B). The heart rate during operations in patients receiving ephedrine was 81 beat min$^{-1}$, a significant increase ($P < 0.005$), from that observed in patients who did not receive ephedrine (67 beat min$^{-1}$).

**TABLE I.** General details of the patients studied, including haematological and biochemical data (mean values ± SD). Differences between the groups are not significant

<table>
<thead>
<tr>
<th></th>
<th>Group A (ephe drine)</th>
<th>Group B</th>
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</thead>
<tbody>
<tr>
<td>Number of patients</td>
<td>19</td>
<td>19</td>
</tr>
<tr>
<td>Number of females</td>
<td>15</td>
<td>17</td>
</tr>
<tr>
<td>Mean age (yr)</td>
<td>65.31 ± 9.6</td>
<td>63.94 ± 10.15</td>
</tr>
<tr>
<td>Mean height (cm)</td>
<td>160.64 ± 10.03</td>
<td>159.08 ± 8.15</td>
</tr>
<tr>
<td>Mean wt (kg)</td>
<td>60.78 ± 10.08</td>
<td>58.87 ± 11.94</td>
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<tr>
<td>Hb (g dl$^{-1}$)</td>
<td>12.98 ± 0.89</td>
<td>13.41 ± 1.11</td>
</tr>
<tr>
<td>Serum creatinine concn</td>
<td>91.44 ± 29.9</td>
<td>79.37 ± 18.9</td>
</tr>
<tr>
<td>(μmol litre$^{-1}$)</td>
<td></td>
<td></td>
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<tr>
<td>Number of Müller</td>
<td>14</td>
<td>13</td>
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<tr>
<td>arthroplasties</td>
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In the period after operation, the volume of blood obtained from the wound suction drain was similar in both groups (table III); 607 ± 234 ml in patients in group A and 684 ± 228 in group B. No significant change was observed in the serum creatinine concentrations on the 3rd day when compared with those measured before surgery and between groups, but the haemoglobin concentration on the 3rd day had decreased substantially in both groups, to 10 ± 1.4 g dl$^{-1}$ in patients in group A, and to 10.3 ± 1.4 g dl$^{-1}$ in patients in group B (ns). Two patients in each group received a blood transfusion. One patient in each group received one unit of blood
No significant correlation was observed between either the percentage change in arterial pressure and blood loss \( (r = 0.3568) \) in patients in group B, nor between weight and blood loss \( (r = 0.1445) \).

**DISCUSSION**

These results demonstrate that there was no increase in blood loss during total hip arthroplasty under subarachnoid blockade in patients receiving ephedrine i.v., although substantial differences in cardiovascular haemodynamics were observed. The similarity of the volumes obtained from the wound suction drain, and of the haemoglobin concentrations measured following surgery confirm the absence of substantial differences in blood loss during surgery.

An attempt was made to decrease the number of variables in the study by limiting entry to patients having first operations, and only two types of operation were performed, the numbers of each type of operation being similar in each group. This ensured that the duration of surgery was also similar, as it has been claimed that blood loss is related to the duration and type of surgery (Amaranath et al., 1975).

With modest doses of anaesthetic agent, and a limited degree of blockade, an increase in lower limb blood flow was observed (Berenyi, Shimazato and Etsten, 1964). As the height of the blockade is increased, there is a progressive decrease in arterial pressure and at some point, equivalent to a systolic arterial pressure of 90 mm Hg (Greene, 1969), the venous return is decreased with a consequent decrease in cardiac output. Clearly, a possible explanation for a decrease in blood loss would be a decrease in cardiac output. Spinal blockade to T5 and ephedrine i.v., produces a 10% decrease in peripheral resistance and increase in cardiac output, indicating an increase in venous return (Ward et al., 1966). The 23% difference in arterial pressure and the 22% difference in heart rate observed between the two groups were the result of haemodynamic changes which might have, as a consequence, differing blood losses. Failure to demonstrate a significant correlation between the percentage change in arterial pressure and intraoperative blood loss suggests that the mechanism of the reduction in blood loss associated with subarachnoid blockade is not related to the haemodynamic changes in the cardiovascular system.

The precise reason for the decrease in blood loss with subarachnoid blockade is not clear. Individual differences in blood loss can be attributed to variables such as obesity, or to difficulties associated with the operation, and these can account for the relatively large standard deviation. Moir (1968) suggested that the decrease in blood loss was consequent upon the sympathetic block decreasing venous pressure, and permitting the slight gravitational forces to empty the veins. Clearly, the use of ephedrine does not influence this mechanism.

The safety of subarachnoid blockade has been noted in several North American studies (Vandam and Dripps, 1955; Noble and Murray, 1971), and current teaching is to prevent arterial hypotension (Cousins and Bridenbaugh, 1980; Miller, 1981). If subarachnoid blockade decreases the arterial pressure by 10–15%, measures should be taken to increase the pressure by adopting the Trendelenberg position, by increasing the rate of the infusion of fluids i.v., and by the use of pressor agents (Greene, 1969). It has been suggested that elderly patients do not withstand the decrease in arterial pressure as readily as younger patients. Comparable studies have not been undertaken in the U.K., but current teaching is less rigid in the approach to the control of arterial pressure (Churchill-Davison, 1978). When the blockade extends above T5, bradycardia is relatively common (Kennedy et al., 1970), and requires treatment. Although in the present study an attempt was made to limit the spread of anaesthetic agent by utilizing the position of the patient and time, the degree of hypotension would suggest that the block was extensive.

The safety of subarachnoid blockade has been questioned in an elderly population (Dennison, 1979). If the concomitant use of pressor agents is associated with the advantages of subarachnoid blockade, namely the decrease in blood loss, yet avoids the onset of bradycardia and profound arterial hypotension, it may be an advantage to use pressor agents more frequently in the treatment of hypotension.
INTRAOPERATIVE BLOOD LOSS

REFERENCES