SAFETY AND EFFICACY OF A LOW VOLUME EXTRADURAL TEST DOSE OF BUPIVACAINE IN LABOUR

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The majority of extradural blocks performed in the U.K. are for analgesia in labour. Accidental intravascular and subarachnoid injections of local anaesthetic may occur if the catheter is misplaced. Intravascular injection of the therapeutic dose is unlikely to be dangerous provided it is fractionated, injected slowly and comprises less than 35 mg of bupivacaine [1].

Accidental intrathecal injection of the therapeutic dose may cause total spinal block. A test dose of local anaesthetic is widely recommended as a method of preventing this complication, but guidelines vary widely [2-4]. Large studies of obstetric and non-obstetric extradural blocks confirm that a test dose is often effective in preventing total spinal block. However, these same reports describe occasional instances where, despite use of the test dose, further injection of local anaesthetic has been administered intrathecally [5-7]. These cases suggest that misinterpretation of the extradural test dose is possible.

Ideally a test dose should produce clear evidence of subarachnoid injection rapidly and safely. Interpretation should be easy and false positive and false negative results should not occur.

Bupivacaine 0.5% has been used as an obstetric extradural test dose in a variety of volumes [8-10]. Kumar, Dennison and Panchal [8] have recommended a low volume (1.5 ml) bupivacaine test dose following their experience of spinal anaesthesia with 1.6 ml of 0.5% bupivacaine for Caesarean section [11]. This study was designed

SUMMARY

A low volume of bupivacaine has been recommended as a "test dose" before extradural injection of local anaesthetic in labour. In order to test the safety and efficacy of this test procedure, the effects of bupivacaine 1.6 ml given by extradural injection were compared with those following the same dose given by the intrathecal route. Various indices of motor, sensory and autonomic block were recorded after injection in two groups of 20 healthy pregnant patients. Complete inability to raise the foot from the bed by hip flexion with the knee held straight was the only definite sign of intrathecal injection. In 10% of patients the final diagnosis could not be made until 10 min after injection. In 25% of patients hypotension occurred within 5 min of intrathecal injection despite preload with 1 litre of fluid i.v.

to assess the safety and effectiveness of a 1.6-ml test dose in healthy pregnant females.

PATIENTS AND METHODS

All patients involved in the trial gave informed written consent for the investigation which was approved by the district Ethics Committee. Baseline data obtained in all subjects included age, weight on admission, height and parity, and arterial pressure and heart rate in the left lateral horizontal position. The behaviour of a 1.6-ml test dose of isobaric 0.5% bupivacaine was compared in the subarachnoid space (group I) and in the extradural space (group II) in pregnancy.

Group I comprised 20 healthy pregnant females requesting regional anaesthesia for elective Caesarean section. After premedication with ranitidine 150 mg by mouth 2 h before operation and
0.3-mol litre$^{-1}$ sodium citrate 30 ml given when the patient arrived in the theatre, an i.v. infusion was commenced and a preload of 1 litre of Hartmann's solution or normal saline was given. The patient was placed in the left lateral horizontal position and a needle inserted into the extradural space at the L2/3 or L3/4 space. A long 26-gauge spinal needle was passed through the extradural needle until the dura was penetrated. After a small volume for apparatus deadspace was allowed, isobaric 0.5% bupivacaine 1.6 ml was injected into the subarachnoid space and the spinal needle was removed. A catheter was then passed through the Tuohy needle into the extradural space and secured in the usual manner. The patient was turned to the supine position, but with a wedge under her back designed to produce 15° left lateral tilt. Onset of block was observed in the same way as in group I, with the single exception that final block height at 30 min after injection was not recorded as the therapeutic dose of local anaesthetic had already been injected by this time.

Baseline anthropometric data and cardiovascular changes were compared using Student's $t$ test, Mann–Whitney $U$ test and Chi-square test.

**RESULTS**

There were no significant differences between the two groups in mean age, weight and height, or systolic and diastolic arterial pressure, but parity and baseline heart rate were significantly higher in group I (table I).

**Onset of sensory block**

Sensory analgesia and anaesthesia occurred in both groups during the 10 min after injection, but were common and more extensive in group I. In both groups, analgesia was more widespread and occurred earlier than anaesthesia. Whilst analgesia was noted in all patients in group I within the 10-min test period, by 5 min at least one dermatome was analgesic in 40% of patients in group II (fig. 1). Analgesia in all four dermatomes tested was common 5 min after spinal injection and universal by 10 min (fig. 2). Two patients had analgesia to pinprick in all four dermatomes after extradural injection, at both 5 and 10 min. This was not associated with anaesthesia, failure to raise a straight leg or hypotension at any stage. Anaesthesia was far less common in group II patients, occurring in no patient within 5 min of

**Table I. Mean (SD) values for baseline physiological data.**

<table>
<thead>
<tr>
<th></th>
<th>Group I (Subarachnoid)</th>
<th>Group II (Extradural)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>27.5 (5.0)</td>
<td>25.0 (5.7)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>62.1 (9.2)</td>
<td>62.1 (10.1)</td>
</tr>
<tr>
<td>Height (m)</td>
<td>1.60 (0.07)</td>
<td>1.62 (0.05)</td>
</tr>
<tr>
<td>Parity</td>
<td>(0–4)$^\dagger$</td>
<td>(0–3)$^{**}$</td>
</tr>
<tr>
<td>Systolic AP (mm Hg)</td>
<td>127 (17)</td>
<td>124 (12)</td>
</tr>
<tr>
<td>Diastolic AP (mm Hg)</td>
<td>75 (11)</td>
<td>78 (13)</td>
</tr>
<tr>
<td>Heart rate (beat min$^{-1}$)</td>
<td>94 (19)</td>
<td>81 (11)*</td>
</tr>
</tbody>
</table>
EXTRADURAL TEST DOSE

extradural injection and in only 10% within 10 min. Sensory anaesthesia was not universal after spinal injection, with no anaesthetic dermatomes in 30% of group I patients at 5 min and 5% at 10 min after injection.

Maximum cephalad spread of block

Maximum cephalad spread of block was studied in group I (fig. 3). The mean maximum block height was T4 on the left and T5 on the right, but there was considerable variability between patients. The highest block attained was C4 on the left and C7 on the right and several patients had high thoracic blocks. No patients suffered difficulty with breathing, coughing or head lifting.

Onset of motor block

Patients in both groups complained of weakness of the legs when attempting to raise a straight leg, although this was commoner in group I. Total inability was present in at least one leg in 85% of patients in group I at 5 min and in all patients by 10 min after injection. All patients in group II could raise a straight leg at all times (fig. 4).
Cardiovascular changes

Significant reductions in systolic arterial pressure occurred in both groups after injection of local anaesthetic (Student's t test for paired data) (fig. 5), but those in group I were significantly larger than those in group II (P < 0.01, Student's t test) (fig. 6).

Hypotension (systolic arterial pressure < 90 mm Hg) occurred significantly more often in group I (P < 0.05, Chi-square test), affecting three patients within 3 min, five by 5 min and nine patients within the 10-min test period. In comparison, only two patients in group II were affected, both at the 3-min observation. Significantly more epinephrine was used in group I (4.5 (6) mg) than group II (0.5 (1.5) mg) (P < 0.05, Mann–Whitney U test) and additional fluid was necessary only in group I patients.

Heart rates varied widely in both groups. The baseline heart rate was lower in group II than group I, but there was no significant change in the heart rate in either group as a result of local anaesthetic injection.

Quality of analgesia

Following the period of observation all patients in group I underwent awake Caesarean section. In five the block was considered to be inadequate and supplementary doses of 0.5° bupivacaine were injected through the extradural catheter until analgesia was adequate.

In group II, extradural block was established and maintained effectively throughout labour using incremental injections of 0.25° bupivacaine.

DISCUSSION

In this study we have examined the effectiveness of various tests of motor and sensory loss in differentiating between subarachnoid and extradural injection of a 1.6-ml plain bupivacaine test dose in pregnant women.

Analgesia to pinprick and the presence of leg weakness were extremely sensitive signs of spinal block, but both also occurred in a significant minority of women within 5 min of extradural injection of the test dose. At first sight this may seem surprising, but it is probably a result of the subjective nature of the tests. This group almost certainly contains patients who have imagined, rather than genuine, sensory or motor deficit. False positive results may be common if these indices are used to confirm subarachnoid injection and the incidence may increase if interpretation is delayed further.

The presence of complete anaesthesia to pinprick or failure to raise a straight leg occurring within 5 min of injection was diagnostic of subarachnoid injection of the test dose, but use of
this time limit resulted in an incidence of false negative results of 30% (numbness) and 15% (raising straight leg), respectively. By 10 min, two patients in group II (10%) had developed pinprick anaesthesia at L2 and one patient in group I (5%) had no evidence of pinprick anaesthesia in any dermatome. Thus confusion can be expected even after a prolonged wait if the presence of sensory block is sought as evidence of spinal block.

Complete discrimination was possible using this test dose only if motor block was tested as late as 10 min after injection. At this time raising a straight leg was impossible in at least one leg in all patients in group I, but was possible in all patients in group II.

Although a 1.6-ml bupivacaine test dose may be used effectively in labour, it is clear that great care must be taken to avoid diagnostic error. Slow onset of spinal block in some patients after 0.5% bupivacaine [12] has been implicated as a reason for failure of the extradural test dose in non-obstetric patients [13]. Several patients in group I in this study exhibited delayed or patchy onset of block. By 5 min after injection, three patients were able to raise a straight leg; in two of them the associated sensory block was very limited. In one of these no dermatome was anaesthetic, although analgesia was widespread; in the second sensory block was limited to L5 and S2. In both of these patients, test dose failure could have occurred at 5 min, yet, by 30 min after injection, the maximum block height was T10 and T6, respectively. Avoidance of errors because of delayed onset of block is necessary when using bupivacaine test doses.

Reports of high and even total spinal blocks following intrathecal injection of isobaric bupivacaine 3–4 ml in late pregnancy [10,14,15] in the presence of aorto-caval compression [16] have led to concern over the safety of this agent as a test dose. The use of 0.5% bupivacaine 1.6 ml in a large series of Caesarean sections under spinal anaesthesia has been reported [8,11], and extensive block occurred in a small number of patients. Our results are consistent with that, since one patient developed sensory analgesia in the cervical dermatomes. However, no patient experienced difficulty with coughing or breathing or exhibited a significant decrease in grip strength.

Significant hypotension occurred in both groups. After extradural injection, hypotension resulted probably from the change of position from left lateral to supine. Despite the use of lateral tilt, some degree of aortocaval compression may have occurred. In group I, hypotension was greater (fig. 6) and more prolonged. Despite the use of preload with 1 litre of fluid, 25% of patients required ephedrine within 5 min of injection of the test dose. Systemic arterial pressures as low as 60 mm Hg systolic were recorded. Accidental subarachnoid injection of this test dose in a labouring mother after minimal fluid preload is likely, therefore, to produce severe hypotension and decrease in placental blood flow.

Various other local anaesthetic preparations have been proposed for use as test doses. Several authors have recommended lignocaine in preference to bupivacaine [2,17–19], but the only study which has investigated closely its use in obstetric practice in controlled circumstances used 1.5% hyperbaric lignocaine with adrenaline [20], a formulation which is not available in the U.K. Two millilitre of this preparation produced sensory block at S2 within 3 min of intrathecal injection in all patients and this did not occur after extradural injection; however, cardiovascular changes were not reported. In comparison, the 1.6-ml bupivacaine test dose investigated here was slower to exclude intrathecal catheter placement, but equally effective. On theoretical grounds, Casey [18] recommended 5% lignocaine 2 ml in 7.5% dextrose, but shortly afterwards Bembridge, MacDonald and Lyons [21] demonstrated that intrathecal injection of hyperbaric lignocaine 1.5 ml produced blocks involving the C2 dermatome in four of 30 pregnant women. Wilton [22] proposed a test dose of 0.5% bupivacaine 3 ml for obstetric use and McKeown, Littlewood and Wildsmith [17] have suggested 2% lignocaine 4 ml. These recommendations were made following experience with spinal anaesthesia in elderly male surgical patients. Clinical evaluation of these agents may fail to confirm their safety as test doses in pregnant females.

This study has shown that it is possible to differentiate between subarachnoid and extradural injection of 0.5% bupivacaine 1.6 ml in the obstetric patient. However, slow and patchy onset of spinal block may occur in some patients following subarachnoid injection. Thus it is necessary to wait for at least 10 min after extradural injection of this volume of 0.5% bupivacaine before inadvertent subarachnoid injection may be excluded.
REFERENCES