INFLUENCE OF THE LUMBAR INTERSPACE CHOSEN FOR INJECTION ON THE SPREAD OF HYPERBARIC 0.5% BUPIVACAINE

S. M. LOWSON, J. BROWN AND C. J. WILKINS

SUMMARY
Forty patients undergoing elective Caesarean section were allocated randomly to receive hyperbaric 0.5% bupivacaine 2.5 ml at either the L2-3 (n = 20) or L4-5 (n = 20) interspace. Spinal injection was performed with a 29-gauge needle in 38 patients and a 25-gauge needle in two. The onset time to analgesia at T10 and T6 was significantly faster and the level of analgesia at 5 and 10 min after injection significantly higher after injection at L2-3. Maximum height and range of analgesia, the level of analgesia at 15 and 20 min after injection and the number of episodes of hypotension were not significantly different between the two groups. One case of post-dural puncture headache was recorded after use of a 29-gauge needle. Overall, the choice of lumbar interspace influenced the rate of onset of analgesia, but not the final dermatomal level (mean and range) of analgesia achieved.

KEY WORDS

Subarachnoid injection of local anaesthetic is an established method of providing regional analgesia for patients undergoing Caesarean section. As this is a single injection technique, it is vital to be able to predict reliably the spread of the injected local anaesthetic solution in the CSF and therefore the level of analgesia obtained. Spread of local anaesthetic in the CSF is dependent on several factors, one of which is the spinal interspace chosen for injection [1]. Studies on the influence of the lumbar interspace on the spread of plain 0.5% bupivacaine have produced contradictory results [2-4]. We decided, therefore, to investigate the influence of the lumbar interspace on the spread of hyperbaric 0.5% bupivacaine.

PATIENTS AND METHODS
We studied 40 patients (ASA I) undergoing elective Caesarean section with no contraindication to a regional technique. All patients were informed of the nature of the study, which was approved by the local Ethics Committee.

Patients were allocated randomly to receive hyperbaric 0.5% bupivacaine 2.5 ml at either the L2-3 (n = 20) or L4-5 (n = 20) interspace. On arrival of the patient in the anaesthetic room, a peripheral i.v. cannula was inserted and Hartmann's solution 1 litre was infused rapidly. In all but two patients, spinal injection was performed with a 29-gauge needle, by anaesthetists experienced in the use of such a needle. In the remaining two patients, insertion of the 29-gauge needle proved technically difficult and a 25-gauge needle was used. Free flow of CSF down the spinal needle was obtained before injection of the local anaesthetic solution. Hyperbaric 0.5% bupivacaine was injected via a midline approach, without barbotage, over a minimum of 30 s with the patient in the sitting position. Palpation of the iliac crest was performed to confirm the position of the 4th lumbar vertebra. Completion of the injection was taken as zero time and patients were immediately placed supine, horizontal with a left lateral tilt. Pinprick analgesia (with a 25-gauge needle) and motor block (Bromage scale 0–3 [5]), were tested at 1-min intervals for the first 10 min and 2-min intervals thereafter up to 20 min, at which time patients were taken into the operating room.
theatre. Routine testing of pinprick analgesia and motor block was not performed until completion of the operation, in order to avoid disturbing the mother during birth of her child.

Arterial pressure was measured with an automatic recorder (Datascope: Accutor). Three recordings were taken before the spinal injection, in order to obtain a mean baseline arterial pressure, and at 2-min intervals thereafter. Episodes of hypotension (systolic arterial pressure < 100 mm Hg) were recorded and treated with a further 500 ml of Hartmann's solution and administration of i.v. ephedrine. The dose of ephedrine required to treat hypotension was recorded.

Subjective sensation of discomfort or shortness of breath were noted. All patients were seen by a member of the anaesthetic team for a minimum of 3 days after operation and were questioned specifically for occurrence and nature of any headache experienced.

Data were analysed by Student's t test and Wilcoxon rank sum test; P < 0.05 was considered significant.

RESULTS

There was no significant difference between the two groups in age, height or weight (table I). There was no significant difference in the maximum height of pinprick analgesia or the extent of analgesia produced by injection of hyperbaric 0.5 % bupivacaine 2.5 ml at either L2-3 or L4-5 (table II). Spinal injection at L2-3 produced a significantly faster onset of analgesia at T10 and T6, and motor block (scale 1) and analgesia at a significantly higher level at 5 and 10 min after injection (fig. 1). There was no significant difference in the levels at which analgesia was obtained at 15 and 20 min after injection or in the onset time to complete motor block (scale 3) between the two groups. Despite the lateral tilt, no patient developed a block that varied by more than two segments between the two sides, the majority of blocks being symmetrical. There was no significant difference in the mean level of analgesia after operation.

Hypotension occurred in 14 patients in group L2-3 and 13 patients in group L4-5. The mean (sd) dose of ephedrine required to treat hypotension was 9.6 (8.0) mg for group L2-3 and 8.5 (9.2) mg for group L4-5 (not significant).

Episodes of discomfort were recorded in four patients in group L2-3 and six patients in group L4-5. All occurred after delivery, were associated with suturing of the uterus or abdominal wall and were relieved rapidly by alfentanil 0.25-0.5 mg i.v. Discomfort was not associated with lower levels of block. The range of blocks in patients who experienced discomfort was T3-6 in the L2-3 group and T3-5 in the L4-5 group.

Dyspnoea was noted by three patients in each group. The levels of block in patients complaining of dyspnoea were T2-5 in the L2-3 and T2-3 in the L4-5 group. It thus appeared that, provided an adequate and not excessive extent of analgesia was achieved, discomfort or dyspnoea occurred independently of block height.

Post-dural puncture headache occurred in two patients: one after the use of a 25-gauge needle

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<tr>
<th>Table I. Patient characteristics (mean (range or SD))</th>
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<td>Group L2-3 (n = 20)</td>
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<td>Age (yr)</td>
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<td>Weight (kg)</td>
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<th>Table II. Maximum cephalad spread of analgesia (mean (sd) [range]), time to onset of analgesia to T10 and T6, time to onset of motor block and extent of analgesia at the end of the operation. *Significant difference between the two groups (P &lt; 0.05)</th>
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<tbody>
<tr>
<td>Group L2-3</td>
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<tr>
<td>Maximum cephalad spread</td>
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<td>Onset time to T10 (min)</td>
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<td>Onset time to T6 (min)</td>
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<td>Onset of motor block (min)</td>
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<td>Extent of analgesia at end of operation</td>
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<td>Time to end of operation (min)</td>
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and one after a 29-gauge needle. Both were mild, non-disabling, had a maximum duration of 72 h and were relieved by oral analgesics.

DISCUSSION

The initial cephalad spread of hyperbaric 0.5% bupivacaine was faster after spinal injection at the L2–3 interspace as demonstrated by the difference in level of analgesia at 5 and 10 min after injection, onset time to block at T10 and T6 and onset time of motor blockade (scale 1). Thereafter, it appeared that the spread of the local anaesthetic solution injected at L4–5 was similar to that injected at L2–3, as demonstrated by the non-significant difference in the levels of analgesia at 15 and 20 min, the onset time to complete motor block (scale 3) and the maximum height and range of analgesia obtained. Although the level of pinprick analgesia was not examined routinely beyond 20 min after injection, there was no evidence to suggest that significant cephalad spread of analgesia occurred after this time. In two previous studies of the spread of hyperbaric 0.5% bupivacaine [6,7], the mean time to produce the maximum upper segmental level of analgesia was 15 min. Overall, it appeared from our study that the lumbar interspace chosen for spinal injection was of little importance to the height of the block produced.

A possible explanation for these findings is the position of the spinal interspace chosen for injection in relation to the maximum height of the lumbar curvature at L3. Spinal injection at the L2–3 interspace deposits the hyperbaric anaesthetie solution on the cranial side of the maximum height of the lumbar curvature at L3, where it spreads cephalad under the influence of gravity. However, a hyperbaric solution injected at L4–5 must first spread cephalad by bulk displacement of CSF, diffusion, or both, before gravity induces further cephalad spread. The mechanism whereby the spread of local anaesthetic solution at L4–5 "caught up" with that injected at L2–3 is not known. However, this catching up may explain the fact that the number of episodes of hypotension and the mean dose of ephedrine required to treat hypotension did not differ significantly between the two groups.

In an investigation of the spread of hyperbaric 0.5% bupivacaine in the CSF, Sundnes and colleagues [6] found that the lumbar interspace had no influence on the maximum upper segmental level of analgesia or the time taken to reach this level. These workers did not report the time taken to reach sub-maximal levels of analgesia, whereas in the present study we were particularly interested in the onset time to block at T6 and T10. T6 is the level of analgesia considered adequate to provide analgesia for Caesarean section, although it has been suggested [8] that a T10 level may be sufficient.

In the study by Russell and Holmquist [7], the injection of hyperbaric or plain 0.5% bupivacaine 2.5 ml with the patient in the lateral position produced maximum heights of analgesia greater than in the present study, with blocks rising to the cervical dermatomes in 25% of patients. In the present study no patient developed objective loss of pinprick analgesia above the T2 dermatome. Although one patient complained of a tingling sensation unilaterally along the ulnar border of the forearm, the sensation was short lasting (less than 10 min) and was not associated with loss of pinprick analgesia over this area. Our technique differed from that of Russell in two ways: the size of spinal needle and the position of the patient when the hyperbaric local anaesthetic solution was injected. We feel the latter is probably the significant factor. The slow injection of hyperbaric 0.5% bupivacaine with the patient in the sitting rather than the lateral position may limit cephalad spread of local anaesthetic, so reducing the incidence of blocks reaching the cervical dermatomes. Certainly, spinal injection with the patient in the sitting rather than the lateral position appears to limit the rate of cephalad spread of the hyperbaric local anaes-
thetic solution. At 5 min after injection the median level of block in the present study was T10 (L2–3) and T12 (L4–5), compared with T3 in the study by Russell [7].

In this study we found that one patient of 38 in whom spinal injection was performed with a 29-gauge needle developed a post-dural puncture headache and this was mild in nature. In two patients (5%) location of the subarachnoid space using a 29-gauge needle proved technically difficult; this is comparable to the 8% failure rate found by Flaatten and colleagues [9] in their study on the use of the 29-gauge spinal needle.

REFERENCES