Subarachnoid Anaesthesia: Comparison of Hyperbaric Solutions of Bupivacaine and Amethocaine

P. Skretting, P. Vaagenes, K. O. Sundnes, H. H. Edström and B. Lind

Summary

Hyperbaric solutions of 0.5% bupivacaine and 0.5% amethocaine (2 and 3 ml) were compared in a double-blind study of 40 patients receiving subarachnoid anaesthesia for urological surgery. The drugs produced similar and satisfactory analgesia in the tested concentrations and volumes. Motor blockade was more profound and longer lasting with amethocaine.

The use of isobaric solutions of bupivacaine for subarachnoid anaesthesia has been described previously (Hengesbach and Matthes, 1977; Nolte et al., 1977; Nolte and Stark, 1979; Nightingale and Marstrand, 1981). Although solutions can be made hyperbaric, by the addition of glucose, the anaesthetic profile of the drug is altered (Brown et al., 1980; Chambers, Edström and Scott, 1981). Studies comparing the effects of hyperbaric solutions of bupivacaine and amethocaine have been undertaken previously (Ekblom and Widman, 1966; Pflug, Aasheim and Beck, 1976; Moore, 1980). However, in these particular studies concentrations of 0.75% and volumes ranging from 1 to 2 ml were used. In this study we have compared 2 and 3 ml of bupivacaine and amethocaine in 0.5% solutions.

Patients and Methods

Forty patients (38 male) undergoing urological surgery (mainly transurethral resection of the prostate) were studied. Their ages ranged from 50 to 75 yr, they had neither spinal deformity nor neurological disease. Informed consent was obtained.

Premedication, diazepam 10 mg, was given by mouth 45–60 min before the induction of anaesthesia and all the patients received lactated Ringer's solution 400–500 ml i.v. The patients were allocated randomly to four groups to receive 0.5% bupivacaine with 8% glucose (sp. gr. 1.026 at 20°C) or 0.5% amethocaine with 6% glucose (sp. gr. 1.020 at 20°C), 2 or 3 ml.

Lumbar puncture was performed with a 22-gauge spinal needle using a midline approach with the patient in the lateral recumbent position. The 3rd or 4th lumbar interspace was chosen for the puncture and, when a free flow of clear cerebrospinal fluid was obtained, the local anaesthetic solution was injected at a rate of 0.2–0.25 ml s⁻¹ without barbotage. Immediately after the injection the patients were positioned in the supine horizontal position, and 15–20 min thereafter in the lithotomy position.

Nerve blockade was assessed before, during and after operation by one of the authors, who was unaware of the drug and dose given. The cephalad spread of analgesia (loss of sensation to pin-prick) was determined with a short-bevelled needle every 2 min for 30 min after induction of the blockade. Thereafter the blockade was assessed every 15 min until analgesia had disappeared totally or for a maximum of 5 h after injection.

Motor blockade was assessed following each determination of analgesia by recording the function of the lower limb (Bromage, 1965): 0 = no paralysis (full flexion of knees and feet); 1 = inability to raise the extended leg (just able to move knees); 2 = inability to flex knees (able to move feet only); 3 = inability to flex the ankle joint (unable to move feet or knees).

Heart rate and arterial pressure (upper arm sphygmomanometry) were recorded before, and 2, 5, 10, 15, 20 and 30 min after the injection, and thereafter every 30 min until normal sensation had returned (maximum 3 h after injection). Hypotension (systolic arterial pressure < 100 mm Hg) was treated with ephedrine. If anaesthetic supplementation was required during the operation, pethidine was given to increase analgesia and diazepam was given for sedation.

The quality of surgical anaesthesia as judged by operating conditions and analgesia, was registered...
as adequate or inadequate. We did not use routine bed rest for 24 h after the lumbar puncture. The patients were allowed to move around once the anaesthesia had disappeared, but were observed for 72 h for possible signs of post-analgesic complications.

The differences between means were analysed with Student's *t* test, and the differences between proportions by the Fischer exact test. Statistical evaluation was performed by O. Stockman, Department of Statistics and Data Evaluation, ASTRA Läkemedel AB.

**RESULTS**

There were no statistical differences between the four groups in relation to the characteristics of the patients or the durations of the operations (table I).

**Sensory spread**

Maximum spread (T6-9), time of onset and segmental spread at different time intervals were similar regardless of drugs and volumes used (table II, fig. 1).
The mean time for maximal spread of analgesia was around 20 min for the bupivacaine groups and 15 and 30 min for amethocaine 2 and 3 ml.

Amethocaine 3 ml produced a significantly higher cephalad spread of analgesia than 2 ml 1.5–3 h after injection. There were no statistically significant differences between bupivacaine 2 and 3 ml.

In two patients (one bupivacaine, one amethocaine) maximum sensory spread was delayed for about 60 min.

Motor blockade

Onset times to different degrees of motor blockade were similar in all groups.

Amethocaine gave a higher frequency of degrees 1 and 2 of motor blockade ($P < 0.05$). Complete motor blockade (degree 3) occurred in four and six patients in the bupivacaine 2 and 3 ml groups, and eight and nine patients in the respective amethocaine groups (n.s.) (table III).

Duration

The total duration of analgesia was similar in all groups (fig. 1). Duration of analgesia at L2 was about 2–3 h, and at T10 about 1 and 1.5 h for the 2- and 3-ml groups, respectively. Significant differences were found between amethocaine 2 and 3 ml at L2 and T8 levels.

Duration of complete motor blockade in the lower limbs (table III) was shorter for bupivacaine compared with amethocaine, and was also shorter for 2 ml compared with 3 ml of amethocaine. The difference between bupivacaine 3 ml and amethocaine 3 ml (123.2 ± 13.6 min vs 195.7 ± 20.5 min) was significant ($P < 0.05$).

<table>
<thead>
<tr>
<th>TABLE III. Duration (min) and frequency (n) of different degrees of motor blockade (mean ± SEM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of motor block</td>
</tr>
<tr>
<td>1</td>
</tr>
<tr>
<td>Bupivacaine 2 ml</td>
</tr>
<tr>
<td>(n = 9)</td>
</tr>
<tr>
<td>Amethocaine 2 ml</td>
</tr>
<tr>
<td>(n = 10)</td>
</tr>
<tr>
<td>Bupivacaine 3 ml</td>
</tr>
<tr>
<td>Amethocaine 3 ml</td>
</tr>
<tr>
<td>(n = 6)</td>
</tr>
<tr>
<td>Bupivacaine 3 ml</td>
</tr>
<tr>
<td>(n = 10)</td>
</tr>
<tr>
<td>P</td>
</tr>
</tbody>
</table>

Quality of anaesthesia

Both drugs, in the doses given, were sufficient to produce adequate analgesia and operating conditions for urological surgery. Two patients (one in the bupivacaine and one in the amethocaine group) required analgesic supplementation because of insufficient surgical anaesthesia. Three patients were given diazepam for sedation.

Arterial pressure and heart rate

Arterial pressure and heart rate did not differ significantly between the groups before the blockade. The mean decreases in systolic and diastolic pressures were 5–10%, and the differences were not significant. Mean heart rate varied by around 10%.

Significant differences in changes of heart rate were found between bupivacaine 2 ml and amethocaine 2 ml 10–30 min after injection (bupivacaine increased and amethocaine decreased the heart rate). One patient (bupivacaine 2 ml) had a sudden decrease in systolic arterial pressure to 60 mm Hg after 60 min associated with delayed spread of analgesia. Seven patients (17.5%) developed hypotension (AP < 100 mm Hg) during anaesthesia. Five patients given bupivacaine and one patient given amethocaine received ephedrine because of hypotension, and one patient given bupivacaine 3 ml received atropine on account of bradycardia and hypotension.

All of those patients who required ephedrine or atropine had a cephalad spread of analgesia up to, or above, T7.

Complications

Post-spinal headache was encountered in two patients (5%). Another three patients complained of headache which was not attributable to the anaesthetic. Two patients complained of moderate backache at the site of injection, and two patients complained of nausea or vertigo, or both. All complications were distributed equally between the groups.

DISCUSSION

For urological surgery, subarachnoid injection of 2 or 3 ml of a 0.5% "heavy" solution of bupivacaine or amethocaine gave satisfactory and adequate analgesia.

The maximum spread of analgesia, the time to achieve this, the total duration and segmental spread at different time intervals, were similar. The only difference between the two anaesthetics was that...
amethocaine provided a complete motor blockade in a larger number of patients (eight and nine or four and six in the 2- and 3-ml groups), and a more profound and longer lasting motor blockade.

These results are in agreement with Pflug, Aasheim and Beck (1976), and Moore (1980) who studied 0.75% solutions of the same drugs. Ekblom and Widman (1966) using hyperbaric 0.75% solution of bupivacaine and 1% solutions of amethocaine found better motor blockade with amethocaine. In addition, the degree of sensory blockade was inferior with bupivacaine compared with amethocaine. This difference in sensory blockade may be ascribed to different concentrations of the solutions.

The difference in motor blockade may be attributable to different properties of the two drugs. Whether 0.75% bupivacaine would be more suitable than 0.5% in view of the low frequency of complete motor blockade obtained with the latter, may be questionable in clinical practice. Comparisons of 0.75% solutions of bupivacaine and amethocaine have shown that amethocaine is superior with regard to complete motor blockade. If good muscle relaxation is desirable, amethocaine may be preferred. However, profound muscle relaxation is often unnecessary and may even be undesirable. Thus, bupivacaine may be the drug of choice under these circumstances.

In two patients maximum sensory spread was delayed for about 60 min, and one patient developed concomitant hypotension. We have no explanation of this phenomenon.

The mean changes in arterial pressure (5–10%), and heart rate (±10%) were small. Seven patients (17.5%) developed hypotension and were given ephedrine or atropine. The differences between the two drugs were not significant, except the differences in heart rate between bupivacaine 2 ml and amethocaine 2 ml 10–30 min after injection, at which point bupivacaine increased and amethocaine decreased the heart rate.

Post-spinal headache was encountered in two patients (5%). In this study the patients did not stay in bed for 24 h, but were allowed to move around once the anaesthesia had disappeared. In a previous study (Sundnes et al., 1982) with the patients staying in bed for 24 h, the frequency of post-spinal headache was similar (6.8%). This is in accordance with the study of Carbaat and Crevel (1981) which showed that routine bed rest for 24 h does not prevent post-lumbar puncture headache.

References

Anesthésie intratécale: comparaison de solutions hyperbères de bupivacaine et d'amethocaine

Résumé
Des solutions hyperbères de bupivacaine 0,5% et d'amethocaine 0,5% (2 et 3 ml) ont été comparées dans une étude en double insu chez 40 patients recevant une rachianesthésie en chirurgie urologique. Les agents ont produit une analgésie comparable et satisfaisante aux concentrations et volumes testés. Le bloc moteur était plus intense et de durée plus longue avec l'amethocaine.

Subarachnoidale anaesthesie: Vergleich hyperbarer Losungen von Bupivacain und Amethocain

Zusammenfassung
Hyperbare Lösungen von 0,5% igem Bupivacain und 0,5% igem Amethocain (2 und 3 ml) wurden bei 40 Patienten in einer Doppelblindstudie miteinander verglichen, die Spinalanästhesie für urologische Operationen erhielten. Die Präparate zeigten ähnliche und genügende Analgesie in den getesteten Konzentrationen und Volumina. Nach Amethocain ergab sich eine tiefer und länger andauernde motorische Blockade.
Se procedió a una comparación de soluciones hiperbáricas de bupivacaina al 0,5% y de ametocaina al 0,5% (2 y 3 ml) en un estudio doble-ciego en 40 pacientes a los que se administraba una anestesia subaracnoidea con fines de cirugía urológica. Las substancias produjeron una analgesia similar y satisfactoria con las concentraciones y los volúmenes ensayados. El bloqueo motor fue más profundo y duró más tiempo con la ametocaina.