Bupivacaine has been used successfully for spinal anaesthesia for more than 10 years [1, 2]. In most centres in Denmark, 3–4 ml of 0.5 % plain solution of bupivacaine (without adrenaline) is preferred for spinal anaesthesia. The extent and duration of sensory block following subarachnoid injection of local anaesthetic are thought to depend on several factors, such as total dose [3, 4], site of injection [5, 6], position of the patient [6, 7] and volume of solution [3, 6, 8, 9].

To our knowledge, solutions of 0.5% and 0.25% plain bupivacaine have not been compared for spinal analgesia. We have therefore evaluated the effects of plain bupivacaine 15 mg given as 3 ml of 0.5% or 6 ml of 0.25% solution.

**PATIENTS AND METHODS**

We studied 40 men (age range 60–79 yr) scheduled to undergo transurethral resection of the prostate under spinal anaesthesia. None of the patients suffered from neurological disease or deformity of the spine, and no patient had a history of hypersensitivity to local anaesthetics. Informed consent was obtained from all patients and the study was approved by the local Ethics Committee.

The patients were allocated randomly to two groups: group 1 received plain 0.5% bupivacaine 3 ml without adrenaline (Marcaine, Astra Läkemedel Ab, Sweden); group 2 received 0.25% bupivacaine 6 ml. Premedication consisted of diazepam 5–10 mg by mouth 1–2 h before operation. Isotonic saline 500 ml was infused i.v. rapidly before lumbar puncture was performed. All lumbar punctures were performed using a 25-gauge spinal needle and a midline approach at the L3/4 space with the patient in the sitting position. Injection time was 30 s. The patient was kept sitting for 2 min, supine for 5 min and then placed in the lithotomy position. Arterial pressure and heart rate were measured every 5 min and ECG was monitored continuously.

Segmental spread of sensory loss was tested in the midline with the pin-prick technique using a 20-gauge needle. Motor blockade was assessed by the "Bromage Scale" (scores 3–0) [10]. Testing was performed every 5 min for the first 30 min after administration of bupivacaine, and thereafter every 30 min until sensory blockade at L1 level had recovered and motor blockade was regressing (Bromage scale ≤ 2). The investigator undertaking these tests was unaware of the volume of local anaesthetic used.

Side effects were noted, and ephedrine 5 mg
PLAIN BUPIVACAINE: 0.5 % OR 0.25 %?

TABLE I. Patient data (mean (SD))

<table>
<thead>
<tr>
<th></th>
<th>0.5 % Bupivacaine 3 ml</th>
<th>0.25 % Bupivacaine 6 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>70.4 (5.9)</td>
<td>70.8 (6.4)</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>171.5 (5.4)</td>
<td>173.4 (7.6)</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>73.9 (13.4)</td>
<td>75.1 (12.5)</td>
</tr>
</tbody>
</table>

was administered i.v. if systolic arterial pressure decreased by more than 25%.

Statistical analyses using Student’s t test or the Mann–Whitney test were performed as appropriate. \( P < 0.05 \) was considered significant.

RESULTS

There was no significant difference between the two groups in respect of patient age, height or weight (table I).

Cephalad spread

Mean cephalad spread of analgesia was T7.5 in both groups. Maximal extent of analgesia was T3 in group 1 and T4 in group 2. Analgesia above T6 was reached by 5/20 in group 1 and 6/20 in group 2. There were no significant differences between the groups (fig. 1).

Onset time

Onset time to T12 level was 7.8 and 8.5 min and onset to T10 level was 9.7 and 10.5 min in the 3-ml (group 1) and 6-ml (group 2) groups, respectively (\( P > 0.05 \)). Maximal extension of analgesia was reached in 26 min in the 3-ml group and, insignificantly faster, in 21 min in the 6-ml group. However, some patients exhibited a maximum cephalad spread in 5 min, others in 60 min, independent of the volume used.

Duration of analgesia

Approximate duration of analgesia above T12 was 165 min, and above T10, 100 min. There was no significant difference between the two groups (table II).

Motor blockade

All patient experienced degree 3 blockade. Mean onset time to degrees 2 and 3 is shown in

![Fig. 1. Spread of analgesia after intrathecal injection of plain bupivacaine 15 mg. Solid vertical bars represent SEM, dotted vertical lines represent SD. ○...○ = 0.25% plain bupivacaine 6 ml, •••••••• = 0.50% plain bupivacaine 3 ml.](image)
TABLE II. Duration of analgesia (mean (SD))

<table>
<thead>
<tr>
<th>Analgesia</th>
<th>0.5% Bupivacaine 3 ml</th>
<th>0.25% Bupivacaine 6 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; T12</td>
<td>20/20 165 (48.8)</td>
<td>20/20 163 (43.5)</td>
</tr>
<tr>
<td>&gt; T10</td>
<td>19/20 115 (52.0)</td>
<td>19/20 109 (45.7)</td>
</tr>
<tr>
<td>&gt; T8</td>
<td>13/20 75 (37.9)</td>
<td>10/20 91 (34.8)</td>
</tr>
</tbody>
</table>

TABLE III. Onset time (min) of motor blockade (mean (SD))

<table>
<thead>
<tr>
<th></th>
<th>0.5% Bupivacaine 3 ml</th>
<th>0.25% Bupivacaine 6 ml</th>
</tr>
</thead>
<tbody>
<tr>
<td>To degree 2</td>
<td>8.9 (3.9)</td>
<td>10.3 (7.5)</td>
</tr>
<tr>
<td>To degree 3</td>
<td>14.2 (3.8)</td>
<td>17.3 (12.6)</td>
</tr>
</tbody>
</table>

Complete paralysis was seen after 20 min in all patients except one in each group. Duration of total motor blockade was approximately 175 min in both groups. Regression of blockade was not complete in all patients until 6.5 h after injection. Duration of sensory block with simultaneous total motor blockade lasted approximately 2.5 h at T12, 1.6 h at T10 and 1.2 h at T8. The differences between the groups were small and not significant (table IV).

**Cardiovascular effects**

The decrease in mean systolic arterial pressure was minimal, and there was no significant difference in heart rate between the groups. Two patients in each group received ephedrine 10 mg i.v.

**DISCUSSION**

Earlier studies on the effects of change in volume, concentration and dose of plain bupivacaine have investigated only 0.5% and 0.75% solutions. By comparing the effects of bupivacaine 15 mg given as 0.25% and 0.5% solutions, we created a difference in volume of 100%, which is considerably greater than in former studies, and investigated the use of a 0.25% solution of plain bupivacaine for spinal anaesthesia.

Onset time, duration and spread of analgesia in the present study are comparable to the results of an earlier study using 15 mg of plain 0.5% or 0.75% bupivacaine [4], although an insignificantly longer duration and shorter onset time were observed with the more concentrated solution. In a study using bupivacaine 22.5 mg, no differences were noticed between volumes of 3 or 4.5 ml, although onset time was shorter and duration longer than in our groups, probably because of difference in total dose [11].

We found no differences in any of the variables investigated when comparing 0.5% bupivacaine 3 ml with 0.25% bupivacaine 6 ml. This is not in accord with the conclusions of Logan, McClure and Wildsmith [6], who claimed that a larger volume would produce a greater displacement of CSF and contribute to the unpredictability of spinal analgesia with plain bupivacaine. However, the two studies examined different doses, concentrations and positioning of the patient.

Motor blockade was total in both our groups and onset was insignificantly faster in group I. Duration of total paralysis and time to total resolution of blockade were independent of the concentration used. The cardiovascular effects were small and the degree of hypotension and change in heart rate were similar in both groups.

As has been noted [9], local anaesthetics should not be used in higher concentrations than is
indicated clinically, because of the possible neurotoxicity of bupivacaine. In this respect the 0.25% solution may be preferable to the 0.75% and 0.5% solutions.

In conclusion, we found no differences in onset time, spread and duration of analgesia or in quality of motor blockade when plain 0.5% bupivacaine 3 ml was compared with plain 0.25% bupivacaine 6 ml.

ACKNOWLEDGEMENTS

The authors thank Dr Jens Dørup, University of Aarhus for statistical advice and Astra Denmark for financial support.

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7. Tourinen M, Kalso EE, Rosenberg PH. Effects of posture on the spread of spinal anaesthesia with isobaric 0.75% or 0.25% bupivacaine. *British Journal of Anaesthesia* 1982; 54: 313–318.


