The Duration of Intrathecal Bupivacaine Mixed with Lidocaine

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BACKGROUND: Although spinal bupivacaine may have too long duration to be useful in the ambulatory setting, recent animal data suggest that lidocaine added to spinal bupivacaine may reduce the duration of bupivacaine spinal anesthesia. We explored whether lidocaine added to spinal bupivacaine could shorten the duration of bupivacaine spinal anesthesia in humans similarly to what has been reported in animals.

METHODS: Ninety patients presenting for transurethral resection of bladder tumor or prostate were assigned to one of three groups by double blind randomization to receive intrathecal 1.5 mL of hyperbaric 0.5% bupivacaine, plus 0.6 mL of one of three solutions: saline (Group I, n = 30, control), 1% lidocaine (Group II, n = 30), and 2% lidocaine (Group III, n = 30). Peak sensory block level, time to peak sensory block, times to two-segment, L1, and S2 regressions from peak sensory block, motor blocks at peak sensory block, L1, and S2 regressions, and postanesthesia care unit stay time (PACU time) were measured.

RESULTS: Times to peak sensory block were similar in all three groups. Times to two-segment, L1, and S2 regressions from peak sensory block, and PACU time were significantly reduced in Group II compared to Group I. Times to L1, S2 regressions, and PACU times in Group III were significantly prolonged.

CONCLUSIONS: We conclude that lidocaine (6 mg) mixed to spinal bupivacaine (7.5 mg) can shorten the duration of bupivacaine spinal anesthesia, therefore provide more rapid recovery from the spinal anesthesia compared to the same dose of bupivacaine (7.5 mg) alone.

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bupivacaine. The dose of 0.5% bupivacaine (7.5 mg) was identical in all study groups, and all patients received the identical drug volume of 2.1 mL.

Group sizes of 30 were determined by power analysis based on standard deviation data from previously published report\textsuperscript{23} \( P \leq 0.05 \), and the assumption of a 90% power to detect a 50 min difference in mean time to complete sensory recovery.

After confirming free flow of clear cerebrospinal fluid, the assigned mixture of spinal anesthetic was slowly injected into the subarachnoid space over 30 s. The spinal needle was removed, and the patient was placed in supine horizontal position on the operating table. Oxygen (4 L/min) was administered via face mask if \( \text{SpO}_2 \) decreased to <95%. Blood pressure was measured at 2.5 min intervals. If the mean arterial pressure decreased by more than 20% of the initial baseline value, or the systolic blood pressure became lower than 100 mm Hg, 4 mg of IV ephedrine was administered.

The sensory block was determined by pinprick at 1 min intervals for the first 15 min, then 2.5 min intervals for the next 15 min. Onset time was defined as the time from intrathecal administration to peak sensory block. The degree of motor block was evaluated by Bromage scale,\textsuperscript{9} and measured at the peak level, L1 regression, and S2 regression of sensory block. Bromage scales of motor blockade were defined as follows: 0 = full flexion of knees and feet; 1 = just able to flex knees, full flexion of feet; 2 = unable to flex knees, but some flexion of feet possible; 3 = unable to move legs or feet.

Surgery was allowed to start when the sensory block level was higher than T10. After the initial 30 min of anesthesia, the test for sensory block was conducted every 5 min until the conclusion of surgery. After the surgery, evaluation of sensory block was performed at 10 min intervals until regression to the S2 dermatome level. We calculated the interval from peak sensory block to two-segment, L1, and S2 regression. Dermatome testing was performed by an anesthesiologist who was blinded to the patient group. If patients complained of pain or discomfort during surgical manipulation, they were excluded from the study population and surgery continued under general anesthesia.

Patients were transferred to the post anesthesia care unit (PACU) following surgery. The discharge criteria from the PACU included stable vital signs (no more or <20% of the initial MAP and HR values), oriented mental state, no active bleeding, no severe pain, and S2 regression of sensory block. Voiding ability was not included to the discharge criteria from the PACU because all patients had urinary catheters for continuous bladder irrigation until the second or third postoperative day. Also, precise times to ambulate were not evaluated because the subjects were inpatients. The duration of stay in the PACU (PACU time) was determined for each patient. For 2 days after surgery, an anesthesiologist visited the patients once a day to assess complications such as postdural puncture headache or TNS (defined by pain or dysesthesia in the buttocks or legs after recovery from uncomplicated spinal anesthesia).

All values are mean \( \pm \text{sd} \), except for peak sensory block levels, which are medians. Statistical analysis was performed using SPSS version 11.5 (SPSS Inc, Chicago, IL). The median values of peak sensory block level and the degrees of motor block were analyzed by Mann-Whitney \( U \)-test. Other variables were compared by analysis of variance. \( P \) value <0.05 was considered as statistically significant.

**RESULTS**

There were no significant differences in the demographic data of the three groups (Table 1). Table 2 summarizes the time course of spinal anesthesia in the three groups. The median height of peak sensory block in Group III was higher than in Groups I or II \( (P < 0.05) \). The onset times of sensory block and the degrees of motor block at the time of peak sensory block were not statistically different among the three groups.

Two-segment regression, L1 regression, and S2 regression were significantly faster in Group II compared to Groups I and III. The times from peak sensory block to L1 and S2 regression in Group III were significantly prolonged in comparison with the other groups. The PACU times were significantly reduced in Group II compared to Group I \( (P < 0.01) \). The PACU time in Group III was significantly prolonged compared to those in Group I and II \( (P < 0.01) \).

No significant difference was detected in the degrees of motor block at the time of sensory regression to L1 and S2 dermatome levels among the three groups.

From the time of preinduction to anesthetic recovery, blood pressures and heart rates of all patients were tolerable within \( \pm 15\% \) of initial values. The mean arterial pressures and heart rates at peak sensory block level were lower in Group III than in Group I and II \( (P < 0.05) \) (data not shown). The numbers of patients who developed hypotension after the spinal block were 1, 0, and 4 in Group I, II, and III, respectively. All of them were treated with single IV administration of 4 mg ephedrine.

**Table 1. Demographic Data**

<table>
<thead>
<tr>
<th>Group</th>
<th>( n = 30 )</th>
<th>( n = 30 )</th>
<th>( n = 30 )</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (yr)</td>
<td>71 ( \pm ) 3</td>
<td>70 ( \pm ) 3</td>
<td>70 ( \pm ) 4</td>
</tr>
<tr>
<td>Gender ratio (M/F)</td>
<td>28/2</td>
<td>28/2</td>
<td>29/1</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>67 ( \pm ) 6</td>
<td>66 ( \pm ) 6</td>
<td>67 ( \pm ) 7</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>171 ( \pm ) 4</td>
<td>170 ( \pm ) 5</td>
<td>169 ( \pm ) 5</td>
</tr>
<tr>
<td>Surgery time (min)</td>
<td>57 ( \pm ) 11</td>
<td>56 ( \pm ) 13</td>
<td>57 ( \pm ) 12</td>
</tr>
</tbody>
</table>

Values are mean \( \pm \text{sd} \) or numbers. No significant differences among the groups \( (P > 0.05) \).
Intrathecal Bupivacaine with Lidocaine

Table 2. Onset and Recovery Profiles of Sensory and Motor Block

<table>
<thead>
<tr>
<th></th>
<th>Group I (n = 30)</th>
<th>Group II (n = 30)</th>
<th>Group III (n = 30)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Onset profile</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peak sensory block level (range)</td>
<td>T8 (T5–9)</td>
<td>T8 (T5–10)</td>
<td>T6 (T4–8)*†</td>
</tr>
<tr>
<td>Motor block at peak block</td>
<td>0–1–2–27</td>
<td>0–1–2–27</td>
<td>0–1–2–27</td>
</tr>
<tr>
<td>Onset time (min)</td>
<td>11 ± 3</td>
<td>11 ± 4</td>
<td>10 ± 6</td>
</tr>
<tr>
<td><strong>Recovery profile</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Time to two-level regression (min)</td>
<td>48 ± 12</td>
<td>43 ± 11*</td>
<td>51 ± 9‡</td>
</tr>
<tr>
<td>Time to L1 regression (min)</td>
<td>138 ± 24</td>
<td>112 ± 34‡</td>
<td>169 ± 26§</td>
</tr>
<tr>
<td>Motor block at L1 regression</td>
<td>1–6–23–0</td>
<td>1–3–26–0</td>
<td>2–3–25–0</td>
</tr>
<tr>
<td>Time to S2 regression (min)</td>
<td>203 ± 45</td>
<td>153 ± 33‡</td>
<td>268 ± 33§</td>
</tr>
<tr>
<td>Motor block at S2 regression</td>
<td>30–0–0–0</td>
<td>30–0–0–0</td>
<td>30–0–0–0</td>
</tr>
<tr>
<td>PACU time (min)</td>
<td>145 ± 33</td>
<td>97 ± 29‡</td>
<td>209 ± 31§</td>
</tr>
</tbody>
</table>

The onset time, time to two-segment regression, time to L1 regression and time to S2 regression refer to the time from administration of the drug to peak sensory block level, from peak sensory block level to two-segment regression, L1 regression, and S2 regression, respectively. The degree of motor block was measured via Bromage scale: 0 = full flexion of knees and feet; 1 = just able to flex knees; full flexion of feet; 2 = unable to flex knees; but some flexion of feet possible; 3 = unable to move legs or feet. And values are expressed as the number of patients pertaining to each Bromage scale from 0 to 3 with increasing manner. PACU time = postanesthesia care unit stay time.

Values are mean ± SD or numbers, except the peak sensory block levels described with median (range).

All times are presented in minutes rounded off to the nearest whole minute.

* P < 0.05.
† P < 0.05.
‡ P < 0.01 compared to Group I.
§ P < 0.01 compared to Group II.

No patient required general anesthesia. No patients experienced postdural puncture headache or TNS for 2 days after the surgery.

DISCUSSION

The ideal spinal anesthetic anesthesia has a fast onset and an appropriate duration of sensory and motor block for surgery.10–12 The onset of block was not affected by the addition of lidocaine to intrathecal bupivacaine. Intrathecal lidocaine (6 mg) added to bupivacaine (7.5 mg) produced a more rapid recovery from the spinal block compared to the same dose of bupivacaine (7.5 mg) alone, but a larger dose of lidocaine delayed recovery. The mechanism of the accelerated recovery is not clear. The additional lidocaine might have induced vasodilation of spinal blood vessels, increasing the clearance of bupivacaine from the intrathecal space. This is in agreement with the results of Clement et al.7,8 Since larger doses of lidocaine prolonged recovery, perhaps the effect of lidocaine on recovery reflects a balance between vasodilatory effects at low doses, and direct local anesthetic action at higher doses.

The factors that influence the height of spinal anesthetic block include volume, concentration, baricity, site of injection, and patient position.13 The specific gravities of 1% and 2% lidocaine are almost equivalent to saline,14 minimizing the effects of baricity. Since the 0.6 mL of saline or lidocaine was mixed with 0.5% bupivacaine in 8% dextrose solution, the baracities of the spinal injectates were indistinguishable among the groups.

We conclude that the intrathecal addition of 0.6 mL of 1% lidocaine to 1.5 mL of 0.5% hyperbaric bupivacaine can shorten the duration of bupivacaine spinal block, therefore providing more rapid recovery. Although this study was not performed in an ambulatory setting, the results suggest that the mixed drug technique has potential for improving the utility of spinal anesthesia in ambulatory patients.

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14. Richardson MG, Wissler RN. Densities of dextrose-free intrathecal local anesthetics, opioids, and combinations measured at 37°C. Anesth Analg 1997;84:95–9