Unilateral Spinal Anesthesia with Hyperbaric Bupivacaine Versus Hyperbaric Articaine in Out-Patient Knee Surgery

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✔ Hemodynamic alterations due to sympathetic blockade during spinal anesthesia should be minimized. Restriction of sympathetic blockade during unilateral spinal anesthesia causes minimal hemodynamic alterations. The aim of this study was to compare the effect of hyperbaric bupivacaine and hyperbaric articaine on hemodynamic parameters and the level of sensory blockade for unilateral spinal anesthesia in outpatient knee arthroscopy.

Twenty-seven patients undergoing elective lower extremity arthroscopy were included in this study. After spinal anesthesia in the lateral decubitus position, 15 patients in the bupivacaine group (Group B) were given 2 ml 3.5% hyperbaric bupivacaine and 12 patients in the articaine group (Group A) were given 1 ml 0.5% hyperbaric articaine. After the lateral position was maintained for 10 min, the final segmental blockade level and the degree of motor blockade on both the operated and unoperated sides were evaluated. Hemodynamic alterations and complications were also noted.

There was no statistical difference between the groups with regards to hemodynamics, maximum sensorial blockade level, complications and number of patients in whom third degree motor blockade was achieved. However, two patients in the articaine group required general anesthesia due to inadequate surgical analgesia.

In conclusion, unilateral spinal anesthesia could not be achieved with both of these techniques. However, both of these techniques can be safely used in outpatient arthroscopy for hemodynamic stability.

Key words: Anesthesia, spinal, unilateral; local anesthetics, bupivacaine, articaine; knee arthroscopy; outpatient.

✔ Ayaktan Gelen Diz Cerrahisi Hastalarında, Hiperbarik Bupivakain ve Artikain ile Yapılan Tek Taraflı Spinal Anestezinin Karşılaştırılması

Spinal anestezide sırasında semptatik bloğu bağlı olarak gelişen hemodinamik değişiklikler minimal olmalıdır. Tek taraf spinal anestezi, semptatik bloğun daha sürücü bir bölgeye sağlanması sonucunda çok az hemodinamik değişikliklere neden olmaktadır. Bu çalışmanın amacı, ayaktan gelen ve diz artroskopisi planlanan hastalarda tek taraf spinal anestezi uygulamasında hiperbarik bupivakain ve hiperbarik artikain kullanılarak hemodinamik ve bloğun seviyesine olan etkilerini karşılaştırmaktır. All ekstremite elektrikli diz artroskopisi planlanan 27 hasta çalışmaya alındı. Lateral dekubitus pozisyonunda spinal anestezide çalışırken, bupivakain grubundaki (Grup B) 15 hastaya 2 ml %0.5 hiperbarik bupivakain ve artikain grubundaki (Grup A) 12 hastaya 1 ml %0.5 hiperbarik artikain olarak verildi. Hastalar bu pozisyonda 10 dk bekletildikten sonra, maksimum sensoryal blok seviyeleri ve motor blok dereceleri her iki bacakta aynı ayı değerleridir. Hemodinamik değişiklikler ve komplikasyonlar kaydedildi.

Hemodinamik değişiklikler, maksimum sensoryal blok yükseklüğü, 3. derecede motor blok sağlanan hasta sayıları ve komplikasyonlar bakımından gruplar arasında fark sap-
BACKGROUND AND OBJECTIVES

Ambulatory surgery requires anesthesia methods that allow rapid recovery and safe discharge of the patient. For minimal hemodynamic consequences, and faster recovery and discharge it would be optimal to limit the spread of spinal anesthesia only to the area, which is necessary for surgery. High dose local anesthetics change the hemodynamic stability and prolong the motor blockade time and discharge of the patient from hospital[1].

The aim of this study was to compare the effects of the use of hyperbaric bupivacaine (2 ml, 0.5%) and hyperbaric articaine (1 ml, 5%) on the hemodynamic stability, sensorial and motor blockade and postoperative analgesia in unilateral spinal anesthesia.

METHODS

With the written approval of the local Ethics Committee, twenty-seven patients (ASA I-II), aged 20-40 years, scheduled for elective knee arthroscopy were recruited to the study after obtaining informed consent. None of the patients were given premedication, intravenous solution and prophylactic vasopressors before the intrathecal injection. Patients were assigned to one of the two groups: bupivacaine and articaine groups.

After electrocardiographic monitorization, patients were placed lateral flexed decubitus position. Using the midline approach, lumbar puncture was performed between L3-4 or L4-5 interspaces through the anesthetized skin (2-3 ml 2% lidocaine) using a 25-gauge spinal needle.

In all patients, the lumbar punctures were performed by the same anesthesiologist. After free flow of cerebrospinal fluid was obtained, the patients were assigned to receive either 2 ml 0.5% hyperbaric bupivacaine (Group B, n=15) or 1 ml 5% hyperbaric articaine (Group A, n=12). The time of the spinal injection was noted. The patients were kept in the lateral flexed decubitus position for 10 minutes, operation side undermost and were turned supine and 30 degree head-up position during the operation.

The systolic and diastolic arterial pressures, heart rates and oxygen saturation were recorded before and 5, 10, 15, 20, 25, 30 min after spinal injection. Hypotension and bradycardia were treated with intravenous fluids, vasopressors or atropine as appropriate. Maximum decrease in systolic and diastolic pressures and its timing were also recorded.

The final segmental level of the subsequent block by pinprick test and motor block by bromage scale (0=no motor block; 1= hip blocked; 2= hip and knee blocked; 3= hip, knee, and foot blocked) were tested at 15 min after spinal injection on both operated and unoperated sides.

During the operation, oxygen was administered at flow rate of 2 L/min via a mask. Pain and discomfort were treated with intravenous midazolam, fentanyl or general anesthesia.
The patients were observed in the recovery room for 2 h. The motor blockade time (the time span extending from spinal injection to the return of finger movement), the first analgesic requirement time and complications were recorded.

Successful unilateral spinal block was defined as surgical anesthesia (loss of pinprick sensation > T12 and complete motor block) on the operated side only, while the nonoperated side maintained both somatic sensibility to the pinprick test and motor block less than first degree.

Statistical analysis was performed using Mann Whitney-U test for quantitative data and the Chi square test for qualitative data. p>0.05 was considered as significant.

**RESULTS**

The two groups were well matched for age and weight (Table I).

**Table I. Physical Characteristics and Duration of Operation in Groups (Mean±SEM).**

<table>
<thead>
<tr>
<th></th>
<th>Group B</th>
<th>Group A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year)</td>
<td>29.0±3.56</td>
<td>28.2±2.08</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>74.0±2.41</td>
<td>76.9±3.48</td>
</tr>
<tr>
<td>Sex (F/M)</td>
<td>12/3</td>
<td>11/1</td>
</tr>
<tr>
<td>Length of operation (min)</td>
<td>34.6±6.45</td>
<td>25.2±3.84</td>
</tr>
</tbody>
</table>

**Table II. Distribution of Systemic Hemodynamic Data in Groups.**

<table>
<thead>
<tr>
<th></th>
<th>Preop.</th>
<th>5 min</th>
<th>10 min</th>
<th>15 min</th>
<th>20 min</th>
<th>25 min</th>
<th>30 min</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group B</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td>118.7±6.4</td>
<td>110.0±6.4</td>
<td>111.6±5.8</td>
<td>114.1±5.2</td>
<td>115.0±5.9</td>
<td>114.1±5.4</td>
<td>112.1±5.2</td>
</tr>
<tr>
<td>HR (bpm)</td>
<td>74.7±3.9</td>
<td>69.7±3.4</td>
<td>65.9±4.1</td>
<td>67.7±3.6</td>
<td>69.4±4.0</td>
<td>65.7±3.5</td>
<td>64.7±2.5</td>
</tr>
<tr>
<td>SaO2</td>
<td>98.1±0.2</td>
<td>97.5±0.2</td>
<td>97.9±0.1</td>
<td>97.4±0.4</td>
<td>97.0±0.5</td>
<td>97.4±0.3</td>
<td>97.6±0.3</td>
</tr>
<tr>
<td><strong>Group A</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SBP (mmHg)</td>
<td>116.5±4.4</td>
<td>115.5±4.2</td>
<td>114.6±3.6</td>
<td>112.6±3.9</td>
<td>115.0±3.8</td>
<td>114.0±3.9</td>
<td>113.0±3.8</td>
</tr>
<tr>
<td>HR (bpm)</td>
<td>83.2±3.7</td>
<td>81.8±3.1</td>
<td>80.6±2.4</td>
<td>79.0±2.5</td>
<td>75.9±2.8</td>
<td>75.4±2.6</td>
<td>76.5±2.2</td>
</tr>
<tr>
<td>SaO2</td>
<td>97.8±0.2</td>
<td>97.6±0.1</td>
<td>97.5±0.1</td>
<td>97.3±0.2</td>
<td>96.5±1.0</td>
<td>96.2±1.1</td>
<td>96.6±1.2</td>
</tr>
</tbody>
</table>

SBP: systolic blood pressure, HR: heart rate, SaO2: peripheral oxygen saturation, bpm: beats per minute.
Table III. Distribution of Cardiovascular Effects in Groups.

<table>
<thead>
<tr>
<th></th>
<th>Group B</th>
<th>Group A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean (±SEM) decrease in systolic arterial pressure from initial value (%)</td>
<td>12.9±2.5</td>
<td>13.9±1.6</td>
</tr>
<tr>
<td>Mean (±SEM) decrease in diastolic arterial pressure from initial value (%)</td>
<td>16.6±1.9</td>
<td>18.8±5.2</td>
</tr>
<tr>
<td>Mean time from spinal injection to maximum decrease in systolic arterial pressure (min)</td>
<td>11.1±2.9</td>
<td>11.8±2.3</td>
</tr>
<tr>
<td>Bradycardia requiring atropine (%)</td>
<td>-</td>
<td>8%</td>
</tr>
</tbody>
</table>

Table IV. Distribution of Height of Blockade.

<table>
<thead>
<tr>
<th></th>
<th>Group B</th>
<th>Group A</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Operated side</td>
<td>Unoperated side</td>
</tr>
<tr>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>T3·4 or above</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T5-6</td>
<td>4</td>
<td>26.7</td>
</tr>
<tr>
<td>T7-8</td>
<td>6</td>
<td>40</td>
</tr>
<tr>
<td>T9-10</td>
<td>2</td>
<td>13.3</td>
</tr>
<tr>
<td>Below T12</td>
<td>3</td>
<td>20</td>
</tr>
<tr>
<td>Mean height of blockade</td>
<td>T9-10</td>
<td>Below T12</td>
</tr>
</tbody>
</table>

Table V. Motor Blockade Scores 15 min after Spinal Injection in Groups.

<table>
<thead>
<tr>
<th>Score</th>
<th>Group B</th>
<th>Group A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operated side</td>
<td>Unoperated side</td>
<td>Operated side</td>
</tr>
<tr>
<td>No.</td>
<td>%</td>
<td>No.</td>
</tr>
<tr>
<td>0</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>1</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>T2</td>
<td>6</td>
<td>26.6</td>
</tr>
<tr>
<td>T3</td>
<td>11</td>
<td>73.4</td>
</tr>
</tbody>
</table>

Table VI. The Duration of Motor Blockade and First Analgesic Requirement Time (Mean±SEM)

<table>
<thead>
<tr>
<th></th>
<th>Group B</th>
<th>Group A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration of motor blockade</td>
<td>95.6±5.4</td>
<td>82.2±10.1</td>
</tr>
<tr>
<td>First analgesic requirement time</td>
<td>384.5±51.4</td>
<td>281.6±97.8</td>
</tr>
</tbody>
</table>

The duration of motor blockade and first analgesic requirement time were shown in Table VI. There were no statistically significant differences in the two study groups (p>0.05).

Although one patient in the articaine group required atropine 0.5 mg during the operation, but no vasopressors were used.
There was no statistically significant
difference in complications. No serious side
effects and headache was noticed on
postoperative period in both groups.

DISCUSSION

Our study indicates that for unilateral
spinal anesthesia in lower extremity
operations, the administration of 2 ml 0.5% hyperbaric bupivacaine and 1 ml 5%
hyperbaric articaine solutions and keeping the
patients for 10 min in the lateral flexed
decubitus position were found to be safe.
However, it was found that duration of the
blockade in the articaine group was lower
than the bupivacaine group. The blockade
was more intense and prolonged with
bupivacaine as two patients in the articaine
group needed supplemented analgesic or
general anesthesia because of pain. It is
suggested that, only quicker onset time favors articaine over bupivacaine[2].

The unilateral distribution of spinal
anesthesia is advantageous in surgical
procedures involving one leg because the
hemodynamic effects of spinal anesthesia are
reduced[3,4]. Casati et al.[6] found that 8 mg
0.5% hyperbaric bupivacaine in unilateral
spinal anesthesia provided minimal effects on
cardiocirculatory homeostasis. Similarly, in our
study, with the exception of one patient in
the articaine group, all patients remained
cardiocirculatory stable throughout the
operation. The extremely low incidence of
hypotension and bradycardia noted is
probably related to this relatively restricted
sympathetic blockade coupled with the
localized anesthetic technique.

We failed to achieve pure unilateral
sympathetic blockade in any patient by
injection either 2 ml 0.5% bupivacaine or 1
ml 5% articaine and keeping the patient in
the lateral decubitus position for 10 minutes
postinjection. Various studies have failed to
demonstrate the feasibility of unilateral
blockades[6,7]. Pittoni et al. showed a strict
correlation between the dose of anesthetic
used and lateralization of sensory blockade[4].
It was also suggested that the extreme
reduction of the dose and flow rate are the
critical factors and a dose of bupivacaine less
than 0.05 mg/cm of patient height was
associated with a high incidence of unilateral
sensory blockade[4]. In the present study,
very small doses of local anesthetics and
low-flow injection techniques were not used.
In addition, keeping the patients for 10
minutes in the lateral decubitus position
might have been short for achieving pure
unilateral spinal anesthesia. It was found that
the use of 2 ml 0.5% hyperbaric
bupivacaine solution for operations above the
knee and 1.5 ml 0.5% hyperbaric
bupivacaine solution for operations below the
knee and than keeping the patients for 10
minutes in the lateral decubitus position is
appropriate[8]. To the best of our knowledge,
unilateral spinal anesthesia with articaine
was not reported in the literature.

In our study, two patients in the articaine
group needed general anesthesia because the
duration of operation was longer than spinal
anesthesia. Cowan[8] suggested that quality of
articaine is not good enough compared with
lidocaine, mepivacaine and prilocaine for
the same dosage and areas. Hauenschild[10]
found that, advantages of articaine in spinal
anesthesia include very short time of onset
and low toxicity. Articaine is a good and
reliable analgesic in only short operations
but in operations longer than one and a half
hours catheter techniques of longer duration
ought to be used.

In conclusion, unilateral spinal
anesthesia could not be achieved with both of
these techniques. However, both of these
techniques can be safely used in outpatient arthroscopy for hemodynamic stability. Further studies are needed to investigate whether smaller volumes of articaine and bupivacaine and slow rate injection techniques achieve unilateral spinal anesthesia.

Geliş tarihi : 14.02.2000
Yayında kabul tarihi : 29.06.2000
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