Comparison of hemodynamic and postoperative analgesic effects and recovery of unilateral and bilateral spinal anesthesia

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ABSTRACT

Objectives: To compare unilateral with bilateral spinal anesthesia according to hemodynamic, postoperative analgesic effects and recovery.

Methods: This study took place in Ankara Numune Hospital, Ankara, Turkey, between March and July 2004. We accepted 60 patients undergoing elective lower extremity orthopedic surgery for the study, and randomly allocated the patients into 2 groups, bilateral and unilateral. We performed crystalloid preload spinal puncture at the L_{4-5} intervertebral space with a 25-gauge Quincke needle. Both groups received local anesthetic while lying in the lateral position, dependent on the side to be operated. All the patients had 10 mg 0.5% hyperbaric bupivacaine injected over 40 seconds. Only the patients in the unilateral group remained in the lateral position for 15 minutes. We measured noninvasive mean arterial blood pressure and heart rate before spinal blockade and then after 5, 15, 30, and 45 minutes. We also recorded motor block regression time and first analgesic need. We analyzed the data using Mann-Whitney U, Wilcoxon, and Chi-square tests, considering $p<0.05$ as significant.

Results: We observed no significant differences regarding height, age, and weight. In both groups, heart rate and mean arterial pressure showed a decrease after spinal blockade. Recovery time and the first analgesic need in the unilateral group were higher than the bilateral group.

Conclusion: Because of its long lasting analgesic effect without any hemodynamic change, we suggest unilateral spinal block for lower extremity orthopedic procedures.

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We usually perform orthopedic surgery concerning lower extremities under regional anesthesia. Spinal block is the most common choice. After the determination of the use of local anesthetics containing glucose intrathecally in 1907, different hyperbaric anesthetic solutions were used. One of the advantages of the use of hyperbaric solutions is the ability to control the distribution by positioning. Some authors found that in all volumes, maximum cephalic distribution is approximately 20 minutes and, they can obtain spinal analgesia and thoracic segment distribution by increasing volumes.[1] We can achieve unilateral spinal block by administration of hyperbaric local anesthetic into the subarachnoid space in a special position. The baricity of the local anesthetic, the position during the injection, the dose and the localization of the injection are the most effective components on the distribution of the local anesthetic agent.[2] However, some authors declare that the amount of the local anesthetic is not important on the unilateral block, but the important point depends on the period for the lateral decubitus position.[3-7] In this study, we aimed to compare the hemodynamic and postoperative analgesic effects and recovery of unilateral and bilateral spinal anesthesia by the usage of the same dose of hyperbaric bupivacaine.

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Methods. This study took place in Ankara Numune Hospital, Ankara, Turkey between March and July 2004. After approval of the Ethics Committee and patients' written consent, 60 American Society of Anesthesiologists I-II patients aged between 15-68 undergoing elective unilateral lower extremity orthopedic surgery were accepted for the study. Patients with a history of cardiac or pulmonary disease, with tachyarrhythmias, ECG alterations, diabetes, and neuropathies were excluded from the study. Patients were studied after an 8-hour period of fast. No premedication or prophylactic vasoconstrictors were given. Control hemodynamic parameters of the patients were recorded after their arrival to the operating room. All patients received 7 ml kg^{-1} saline solution as volume preload after the insertion of an 18 gauge intravenous cannula at the forearm. Patients were placed in the lateral position with the side to be operated dependent, and the vertebral column was kept in the suitable position by putting a cushion under the shoulder. Dural puncture was performed at the L_{4-5} intervertebral space using the midline approach with a 25 G Quincke needle. The patients were randomly allocated to 2 groups. In group I (bilateral, n=30), after a free flow of cerebrospinal fluid was observed, the needle bevel was turned towards the cephalic direction and 10 mg 0.5% hyperbaric bupivacaine Marcaine 0.5% heavy Astra, Sweden) was injected slowly. The patients were kept in the horizontal supine position. In group II (unilateral, n=30) after a free flow of cerebrospinal fluid was observed, the needle bevel was turned towards the dependent side of the spinal canal and 10 mg 0.5% hyperbaric bupivacaine was injected without barbotage with an injection rate of 40 seconds. The lateral position was maintained for 15 minutes, and then patients were turned back to the supine position. Noninvasive mean arterial blood pressure (MAP) and heart rate (HR) were recorded before spinal block, after spinal block and 5, 15, 30 and 45 minutes after local anesthetic injection. Loss of pinprick sensation and degree of motor block on both sides until 2 segment regression of sensory level on the dependent side was recorded. Motor block regression time (recovery time) and first analgesic demand time was recorded. Unilateral spinal anesthesia was considered as successful when an adequate sensory level (L_1 or higher) and motor (Bromage scale: 0=no motor block; 1=hip blocked; 2=hip and knee blocked; 3=hip, knee and ankle blocked) 2-3^o blocks were present on the operated side, without similar blocks on the non-operated one.

Statistical analysis was performed with SPSS software using Mann-Whitney U, Wilcoxon, and parametric Chi-square tests. A value of $p<0.05$ was considered significant.

Results. The mean age of patients in the bilateral spinal group was 44.23±12.85 years, weight 78.69±12.28 kg, and height 169±8 cm, and in the unilateral spinal group, age was 36±13.3 years, weight 72.27±10.12 kg, and height 165±10 cm. The 2 groups were demographically similar. In both groups, anesthesia was adequate for the surgical procedure, and none of the studied patients required intraoperative analgesics. In the unilateral group, a clinically relevant unilateral anesthesia was observed in 24 patients, 4 patients showed sensory level higher than L_2 and 2 patients showed motor block >1^o also on the non operated side, however the compared side sensorial level was lower. In both groups, although MAP and HR values were decreased, they were not statistically significant (**Tables 1 & 2**). In the bilateral group, MAP values of 30th and 45th minutes were significantly reduced compared to the values before spinal block (**Table 2**). The Bromage scale evaluation was higher in the unilateral group compared to the bilateral group (139±46 and 105±41 minutes) ($p=0.04$). Recovery and first analgesic demand times were longer in the unilateral group than the bilateral group and it was statistically significant (479±252 and 468±169 minutes) ($p<0.05$).

Discussion. Since Jonnesco[8] first described the use of localized spinal anesthesia in 1909, various

Table 1 - Heart rate (mean ± SD).

Groups	BB	AB	AB5	AB15	AB30	AB45
Bilateral	86.1±12	84.3±14	85.5±13	86.4±14	81.3±14	79.2±11
Unilateral	91±16	92.8±16	88±19	87±14	81±12	77±11

BB: before block, AB: after block, AB5: 5 minutes after block, AB15: 15 minutes after block, AB30: 30 minutes after block, AB45: 45 minutes after block

Table 2 - Mean blood pressure values (mean ± SD).

Groups	BB	AB	AB5	AB15	AB30	AB45
Bilateral	96.7±9	94.8±9	91.2±1	88.4±8	86±8*	83±10
Unilateral	95±16	94.3±11	87±11	95±17	92±17	91±11

BB: before block, AB: after block, AB5: 5 minutes after block, AB15: 15 minutes after block, AB30: 30 minutes after block, AB45: 45 minutes after block, *p=0.045 compared to before block value techniques restricted by the extent of somatic and sympathetic paralysis to the operative site have been described. The aim of all is to decrease the incidence of hypotension, and other complications related to spinal anesthesia.[9] The most significant finding of the present study is that slow intrathecal injection of 10 mg of 0.5% hyperbaric bupivacaine related to a 15 minutes lateral position, provided a spinal block relatively restricted to the operative side and minimal changes of cardiovascular parameters compared to the bilateral spinal anesthesia by the same amount of the same anesthetic solution. We observed successful unilateral block in 24 of 30 patients in the present study, while Salvaj et al,[9] Iselin-Chaves et al,[10] Tanasichuk et al[3] and Wildsmith et al[4] reported lower rates of success. However, Pittoni et al[11] observed 88% successful unilateral spinal block. These authors confirmed a differential spread of spinal block by a positive correlation between the duration of lateral decubitus position. Clinical experiences demonstrated that the duration of lateral decubitus position has to be not more than 15 minutes when we keep in mind the patient's comfort and the density of the operation room. In this study, patients stayed for 15 minutes in the lateral decubitus position. Fanelli et al[5] and Casati et al[6] reported successful unilateral blocks using the same time. When we turn the patient supine, the only portion of local anesthetic really free to diffuse to the other side of spinal canal, is that which is not already fixed to nervous tissue.[12]

Salvaj et al[9] reported unsuccessful unilateral spinal anesthesia with 12 mg tetracaine, due to the higher doses and quick intrathecal injection. Holman et al,[13] using an in vitro spinal canal model, demonstrated that transition from a laminar to a more turbulent flow occurs at an injection speed of 0.1 ml sec,$^{-1}$ suggesting that low speed of intrathecal injection is minimizing mixing of hyperbaric bupivacaine with cerebrospinal fluid, and improving unilateral distribution of local anesthetic solution. Accordingly, we carried out the intrathecal local anesthetic over 40 seconds (0.05 ml sec^{-1}) in the present study.

The cardiovascular effects of spinal anesthesia are basically due to the block of autonomic control of the peripheral vasculatory system.[14] A unilateral block probably produces less venous pooling by the help of a sufficient hemostatic vascular mechanism, and allows a greater part of the body to compensate for blood pooling in blocked areas compared to standard spinal anesthesia.[3,15-17] Casati et al,[6] reported a decrease in MAP values in the study when using higher doses of 0.5% bupivacaine in the bilateral spinal anesthesia group. In this study, as we used the same dose of local anesthetic solution in both groups, we observed no differences between MAP values. Also, Korhonen et al[18] reported that unilateral spinal anesthesia with hyperbaric bupivacaine provided less frequent side effects compared with general anesthesia with desflurane. Casati et al[19] found that unilateral spinal anesthesia performed with low doses of hyperbaric bupivacaine (8 mg) lead to diastolic arterial pressure, stroke volume index and cardiac index decrease in patients without crystalloid preload compared with patients receiving intravenous crystalloids. In this study, patients received 7 ml.kg^{-1} 0.9% saline as a preloading solution. As a result, we demonstrated no statistically significant differences in MAP and HR values after spinal block in the unilateral group.

Salvaj et al[9] found a positive correlation between duration of lateral decubitus and duration of sensory block on the dependent side. In our study, we found the unilateral block duration and first analgesic need time longer and significant compared to the bilateral spinal anesthesia group.

In conclusion, according to our results we can suggest low dose unilateral spinal block because of its long lasting analgesic effect without any hemodynamic change for lower extremity orthopedic procedures. In poor risk patients, this method appears to be a good alternative compared to the traditional spinal technique for surgery of the hip, inguinal or lower extremity regions. Many other studies can also be carried out for different groups of patients and procedures.

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