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RESEARCH

A COMPARISON STUDY OF SINGLE DOSE VERSUS CONTINUOUS SUBARACHNOID LEVOBUPIVACAINE FOR TRANSURETHRAL RESECTION

ABSTRACT

Introduction: Single dose and continuous spinal anesthesia with levobupivacaine were compared regarding quality of anesthesia, hemodynamic parameters, and potential complications in geriatric patients scheduled for transurethral resection.

Materials and Method: Sixty geriatric patients scheduled for transurethral resection were divided into two groups as single dose spinal anesthesia (n=30) and continuous spinal anesthesia (n=30). The single dose anesthesia group was administered 12.5 mg isobaric levobupivacaine (0.5%), and the continuous spinal anesthesia group was administered isobaric levobupivacaine (0.5%) at 2.5 mg doses intrathecaly subsequent to a starting dose of 5 mg, until the T10 level of analgesia was achieved.

Results: The amount of levobupivacaine was lower in the continuous spinal anesthesia group ($p<0.0001$). The median maximum level of sensory block was T8 and T9 in the single and continuous spinal anesthesia group respectively. The time to onset of sensory block at T10 and time to achieve maximum sensory block were longer in the continuous spinal anesthesia group ($p<0.0001$). During surgery, there was a decrease in heart rate starting from the 25th min in the single dose group and the 40th min in the continuous spinal anesthesia group ($p<0.05$). The systolic arterial pressure between 15 and 40 minutes was lower in the single dose group ($p<0.05$) than control values. Slower onset of sensory block in the continuous spinal anesthesia group prevented the development of hypotension. Paresthesia during intervention was significantly higher in the continuous spinal anesthesia group ($p<0.05$).

Conclusion: Continuous spinal anesthesia with levobupivacaine is safer than single dose spinal anesthesia in geriatric patients because it provides improved hemodynamic stability due to slower onset of sensory block.

Key Words: Transurethral Resection of Prostate; Anesthesia, Spinal; Levobupivacaine.

ARAŞTIRMA

TRANSÜRETRAL REZEKSİYONDA TEK DOZ VE SÜREKLİ SUBARAKNOİD LEVOBUPİVAKAİN UYGULAMASININ KARŞILAŞTIRILMASI

ÖZ

Giriş: Transüretral rezeksiyon planlanan geriatrik hastalarda anestezi kalitesi, hemodinamik parametreler ve olası komplikasyonlar açısından, intratekal levobupivakain ile tek doz ve sürekli spinal anestezi uygulamaları karşılaştırıldı.

Gereç ve Yöntem: Transuretral rezeksiyon planlanan 60 geriatrik hasta tek doz spinal anestezi (n=30) ve sürekli spinal anestezi (n=30) olarak iki gruba ayrıldı. Tek doz spinal anestezi grubuna 12.5 mg izobarik levobupivakain (%0.5), sürekli spinal anestezi grubuna 5 mg başlangıç dozundan sonra T10 düzeyinde analjeziye ulaşıncaya kadar 2.5 mg dozlarda izobarik levobupivakain (%0.5) intratekal uygulandı.

Bulgular: Levobupivakain miktarı sürekli spinal anestezi grubunda daha düşüktü ($p<0.0001$). Duyusal bloğun medyan maksimum düzeyi tek doz spinal anestezi grubunda T8, sürekli spinal anestezi grubunda T9 idi. T10'da duyusal blok başlama zamanı ve maksimum duyusal bloğa ulaşma zamanı sürekli spinal anestezi grubunda uzundu ($p<0.0001$). Ameliyat sırasında, tek doz spinal anestezi grubunda 25. ve sürekli spinal anestezi grubunda 40. dakikadan başlayarak kalp hızında azalma vardı ($p<0.05$). Tek doz spinal anestezi grubunda 15 ve 40'ıncı dakikalar arasındaki sistolik arter basıncı kontrol değerlerine göre düşüktü ($p<0.05$). Sürekli spinal anestezi grubunda duyu bloğunun yavaş başlaması hipotansiyon gelişmesini önledi. Girişim sırasında parestezi sürekli spinal anestezi grubunda yüksekti ($p<0.05$).

Sonuç: Geriatrik hastalarda levobupivakain ile sürekli spinal anestezi, duyusal bloğun daha yavaş başlaması nedeniyle daha iyi hemodinamik stabilite sağladığından tek doz spinal anestezideden daha güvenlidir.

Anahtar Sözcükler: Transüretral Rezeksiyon; Spinal Anestezi, Levobupivakain.

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Introduction

Levobupivacaine, the pure S (-) enantiomer of bupivacaine, has been shown to be as potent as bupivacaine; equal doses of levobupivacaine and bupivacaine have been shown to produce a similar sensory and motor block (1-3). Additionally, levobupivacaine has fewer central nervous system and cardiovascular side effects than bupivacaine (3-5). Therefore, it is considered to be a better option for a subarachnoid block in geriatric patients who have comorbid systemic diseases. Transurethral resection (TUR) of the prostate remains the gold standard treatment for surgical management of bladder outlet obstruction. TUR of the bladder is used to view the inside of the bladder, remove tissue samples, and/or remove tumors.

Spinal anesthesia, which has several advantages over general anesthesia, is the method of choice for TUR (6-9). It can be used in patients with significant respiratory disease; it provides good postoperative analgesia and may reduce the stress response to surgery. A spinal block to T10 is required to eliminate the discomfort caused by bladder distension. Single dose spinal anesthesia (SDSA) has some drawbacks, including hypotension and the inability to extend the block when anesthesia is inadequate. Continuous spinal anesthesia (CSA), performed by inserting a catheter into the intrathecal space, allows the use of a lower dose of local anesthetic; with this method, compensation mechanisms can be activated by gradual development of anesthesia. Also, anesthesia can be prolonged by repeated administration of small doses (10).

This study aimed to investigate and compare the quality of anesthesia, hemodynamic parameters, and potential complications between SDSA and CSA with intrathecal levobupivacaine in geriatric patients scheduled for TUR.

Materials and Method

The present prospective randomized comparative study was performed in the Department of Anesthesiology and Reanimation, Gazi Medical University, Ankara Turkey between August 2007 and January 2009. The Ministry of Health of Turkey General Directorate of Pharmaceuticals and Pharmacy Ethics Board approval was obtained. Sixty geriatric patients over the age of 65, who were classified in the American Society of Anesthesiologists (ASA) risk group II-III, scheduled for TUR, were enrolled in the study upon written informed consent. Patients with contraindications for regional anesthesia, preoperative motor or sensory loss, or anemia (hemoglobin<10 g/dL) were excluded. After at least 6 h of fasting, patients were taken to the operating room without any premedication. After intravenous cannulation, the patients received an IV infusion of 8 mL/kg lactated Ringer solution over 15 min. Then, during the surgery, they received 0.9% NaCl infusion at a rate of 4 mL/kg/h. Patients received O_2 at a rate of 4 L/min via a face mask throughout the procedure. Heart rate (HR), systolic arterial pressure (SAP), diastolic arterial pressure (DAP), mean arterial pressure (MAP), and peripheral oxygen saturation (SpO_2) were monitored noninvasively.

The patients were randomly assigned to 2 groups to receive either SDSA (Group SDSA, n=30) or CSA (Group CSA, n=30). Their baseline hemodynamic values were recorded. Spinal anesthesia was performed at the L3-4 or L4-5 interspinous space, in a sitting position. In both groups, 0.5% isobaric levobupivacaine (Chirocaine® 0.5% 10 mL flacon, Abbott, Norway) was used. In the SDSA group, a single dose of (2.5 mL) 0.5% levobupivacaine was injected into the intrathecal space in 30 s using a 25 G *Quincke* spinal needle. In the CSA group, an 18 G modified epidural needle (*Crawford* tip) in the Spinocath® (B. Braun Melsungen AG. Germany) was placed into the epidural space by the loss of resistance method. Then, the Spinocath® with a 22 G catheter over a 27 G spinal needle (*Quincke* tip) was advanced through the epidural needle until dural penetration was felt. The catheter was placed into the intrathecal space until 3 cm of the catheter remained inside. After the procedure was completed, the patients were placed in the supine position. In the CSA group, the catheter was filled with 0.1 mL of isobaric 0.5% levobupivacaine solution and a starting dose of 1 mL (5 mg) levobupivacaine was injected, after catheter placement. If the level of the sensory block did not reach T10 within 15 min, additional doses of 0.5 mL (2.5 mg) isobaric levobupivacaine were administered at 5 min intervals until T10 sensory level was achieved. When a T10 sensory level was achieved, patients in both groups were placed in the lithotomy position, and the surgery was initiated. Patients' HR, SAP, DAP, MAP, and SpO_2 values were recorded at 2.5 min intervals for 10 min following subarachnoid injection, at 5 min intervals for the following 60 min, at the end of the operation, and at 10 min intervals for one hour postoperatively. A decrease in SAP below 90 mmHg or a 20% decrease in MAP compared to baseline during the surgery was considered hypotension, and was treated with IV ephedrine at a dose of 5-10 mg.

The volume of fluid infusion and total volume of washing fluid during surgery were recorded. An HR under 50/min was considered bradycardia and treated with IV atropine at a dose of 0.01 mg/kg.

Level of sensory block was evaluated with the "*pinprick*" test, and motor block was evaluated using a modified Bromage scale (0= no paralysis, can move the thigh, leg, and feet; 1= cannot move the thigh, but can move the knee; 2= cannot move the knee but can move the ankle; 3= cannot move the lower extremities at all). The catheters of the SDSA group were removed 12 h after surgery. The patients were monitored for 48 h for potential complications.

Statistical analysis was conducted using the Statistical Package for the Social Sciences (SPSS, Inc., Chicago, IL, USA) version 12.0, and the data were expressed as mean±standard deviation, median, minimum-maximum, n, and percentages (%). The Kolmogorov-Smirnov test was used to test for normality. Student's t-test was used for normally distributed values and the Mann Whitney U-test was used for non-normally distributed variables. Chi-square or Fisher's exact Chi-square tests were used to compare variables including gender, ASA, paresthesia, perioperative side effects, and ephedrine or atropine use between the groups. A p value <0.05 was considered statistically significant.

RESULTS

The study included 60 patients, 30 patients in each group, and apart from 1 patient in the SDSA group, all patients were male. No statistically significant differences were found between the groups in terms of demographic data and the type of surgery (p<0.05) (Table 1).

Mean operation times, number of spinal puncture attempts, volume of fluid infusion before anesthesia, total fluid infusion and total volume of washing fluid were similar in both groups. The rate of paresthesia development during the procedure was significantly higher in the SDSA group (p<0.05) and the dose of levobupivacaine was significantly lower in the CSA group (p<0.0001) (Table 1). The maximum level of sensory block was T8 in the SDSA group and T9 in the CSA group. The time to reach T10 sensory block and the time to achieve maximum sensory block level were significantly longer in the CSA group (p<0.0001). The time to two-segment regression of sensory block, the time to full sensory recovery, and the time to onset of motor block and the time to full motor recovery were similar in both groups (Table 2).

The median dermatomal spread of sensory block at different time points was significantly different between the groups (p<0.05). Sensory block levels at different time points were higher in the SDSA group. In both groups, a significant increase in sensory block levels was observed at all times, compared with the values at 2.5 min after injection (p<0.05) (Table 3).

The mean motor block levels in the measurements obtained between 20 min and 40 min were significantly higher in the SDSA group than those in the CSA group (p<0.05). Mo-

Table 1— Demographic Characteristics and Parameters Associated with Anesthesia Procedure in the Study Groups.

	Group SDSA (n=30)	Group CSA (n=30)	p
Age (years)	70.1±6.5	69.8±4.3	0.796
Body Weight (kg)	74.0±8.9	72.4±10.1	0.516
Height (cm)	167.9±5.7	168.5±5.6	0.69
ASA (II/III)	20/10	27/3	0.057
Gender (Male/Female)	29/1	30/0	0.500
Surgery (TUR-P/TUR-Tm)	26/4	27/3	0.687
Operation time (min)	70.1±21.6	73.8±23.3	0.526
Number of spinal puncture attempts	1.3±0.6	1.1±0.3	0.171
Volume of fluid infusion before anesthesia (mL)	441.7±132.1	458.3±10	0.597
Total fluid infusion (mL)	1275.0±30	1271.7±3.0	0.969
Total volume of washing fluid (mL)	16266.7±864	16733.3±890	0.813
Paraesthesia during block	1 (3.3)	7 (23.3)[a]	0.023
Amount of local anesthetic (mL)	12.5±0.0	10.0±2.8[a]	<0.0001

Data are presented as mean±standard deviation or n/n or number (%), where appropriate.
[a]p<0.05 (compared with SDSA group). SDSA, single dose spinal anesthesia; CSA, continuous spinal anesthesia; ASA, American Society of Anesthesiologists; TUR-P, transurethral resection of the prostate; TUR-Tm, transurethral resection of tumor.

Table 2— Variables Related to Sensory and Motor Block.

	Group SDSA (n=30)	Group CSA (n=30)	p
Time to achieve T10 sensory level (min)	8.3±5.7	19.1±9.9a	<0.0001
Time to achieve maximum sensory block (min)	15.6±9.4	29.3±12.7[a]	<0.0001
Maximum level of sensory block	T8	T9[a]	0.020
Motor block development (min)	6.9±5.2	10.1±9.0	0.102
Two-segment regression of sensory block (min)	106.2±32.1	115.4±32.9	0.274
Time to full sensory recovery (min)	232.4±47.5	240.7±41.2	0.472
Time to full motor recovery (min)	176.9±47.9	180.6±41.7	0.747

[a]p<0.05 (compared with SDSA group).
Data are presented as mean±standard deviation.
SDSA, single dose spinal anesthesia; CSA, continuous spinal anesthesia.

Table 3— Sensory Block Levels According to Dermatomes.

Time	Group SDSA (n=30)	Group CSA (n=30)	p
2.5 min	L_1 ($-T_6$)	L_2[a] ($-T_{12}$)	0.003
5 min	T_{12}[b] (L_5-T_4)	L_1[a,b] (L_4-T_9)	<0.0001
7.5 min	T_{10}[b] (L_1-T_4)	T_{12}[a,b] (L_4-T_{10})	<0.0001
10 min	T_8[b] ($T_{12}-T_4$)	T_{12}[a,b] (L_4-T_8)	<0.0001
15 min	T_8[b] ($T_{12}-T_4$)	T_{12}[b] (L_4-T_8)	<0.0001
20 min	T_8[b] ($T_{12}-T_4$)	T_{10}[a,b] (L_1-T_8)	<0.0001
25 min	T_8[b] ($T_{10}-T_4$)	T_{10}[a,b] (L_1-T_7)	<0.0001
30 min	T_8[b] ($T_{10}-T_4$)	T_{10}[a,b] (L_1-T_6)	<0.0001
35 min	T_8[b] ($T_{10}-T_4$)	T_{10}[a,b] ($T_{12}-T_6$)	<0.0001
40 min	T_8[b] ($T_{10}-T_4$)	T_{10}[a,b] ($T_{10}-T_6$)	0.006
45 min	T_8[b] ($T_{10}-T_4$)	T9[a,b] ($T_{10}-T_6$)	0.033
60 min	T_8[b] ($T_{12}-T_4$)	T_9[a,b] ($T_{10}-T_6$)	0.035
End of operation	T_8[b] (L_2-T_4)	T_{10}[a,b] (L_1-T_6)	0.009

[a]p<0.05 (compared with SDSA group).
[b]p<0.05 (compared with the values at 2.5 min post-injection).
SDSA, single dose spinal anesthesia; CSA, continuous spinal anesthesia.

tor block levels were significantly higher at all measurement times compared with the values at 2.5 min after the injection in the SDSA group (p<0.05). However, compared to the levels at 2.5 min, motor block levels showed a significant increase starting from 7.5 min in the CSA group (p<0.05) (Table 4).

In the perioperative period, the HR of the SDSA group was lower than that of the control values after the 25th min, and the HR of the CSA group was lower than that of the control values from the 40th min onwards (p<0.05) (Figure 1A). The mean SAP between 15 and 40 minutes was lower in the SDSA group in comparison to that of the control values (p<0.05) (Figure 1B). Although the rates of hypotension and bradycardia were higher in the SDSA group (16.7% and 6.7%, respectively) than in the CSA group (6.7% and 3.3%, respectively), there was no statistically significant difference between the groups (p>0.05). Additionally, there was no nausea, vomiting, and depression of breathing in either group.

Discussion

In the present study, intrathecal administration of levobupivacaine was successful in providing qualified anesthesia in both groups. Compared to the SDSA group, a lower amount

Table 4— Motor Block Degree Values According to The Modified Bromage Scale at Different Time Points.

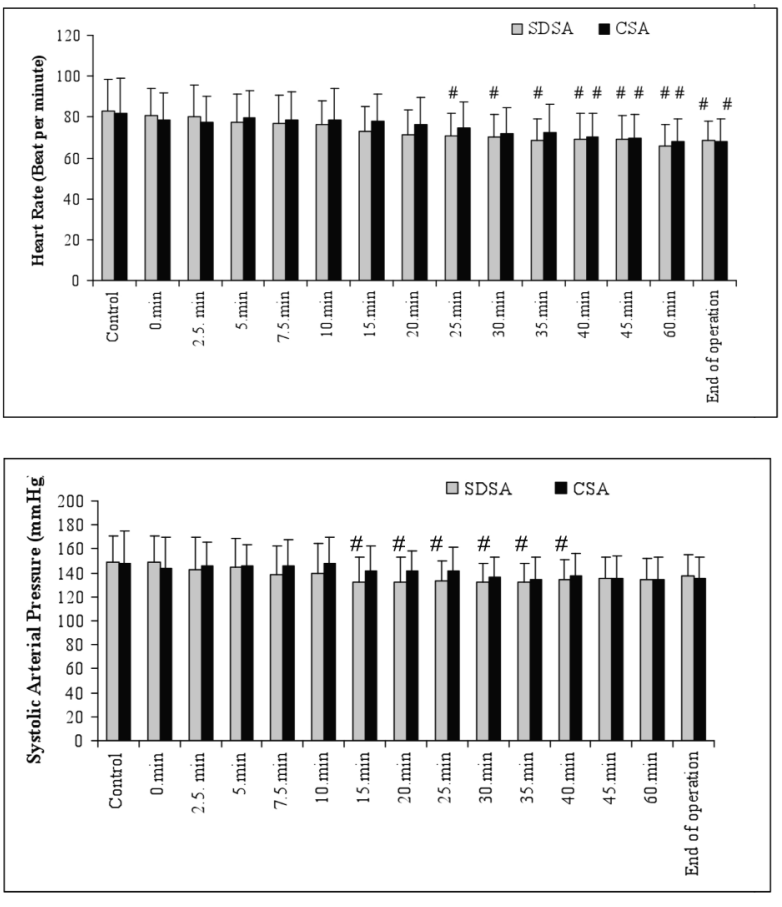
	Group SDSA (n=30)	Group CSA (n=30)	p
2.5 min	0.47±0.73	0.33±0.76	0.294
5 min	1.13±1.10[b]	0.70±0.91	0.125
7.5 min	1.60±1.19[b]	1.27±1.11[b]	0.261
10 min	2.03±1.19[b]	1.50±1.22[b]	0.089
15 min	2.37±0.96[b]	1.83±1.18[b]	0.057
20 min	2.73±0.52[b]	2.17±1.09[a,b]	0.029
25 min	2.90±0.31[b]	2.47±0.89[a,b]	0.036
30 min	2.93±0.25[b]	2.57±0.82[a,b]	0.032
35 min	2.97±0.18[b]	2.60±0.81[a,b]	0.021
40 min	2.97±0.18[b]	2.70±0.59[a,b]	0.023
45 min	2.97±0.18[b]	2.80±0.48[b]	0.085
60 min	2.88±0.44[b]	2.80±0.48[b]	0.365
End of operation	2.83±0.50[b]	2.86±0.46[b]	0.535

[a]p<0.05 (compared with SDSA group).

[b]p<0.05 (compared with the values at 2.5 min post-injection).

Data are presented as mean±standard deviation.

SDSA, single dose spinal anesthesia; CSA, continuous spinal anesthesia.



A

B

Figure 1— (A) Heart rate of the groups according to time; **(B)** Systolic arterial pressure of the groups according to time; #p<0.05 (compared to the control value); SDSA, single dose spinal anesthesia; CSA, continuous spinal anesthesia.

of local anesthetic agent was used in the CSA group. Furthermore, the gradual development of sensory block led to improved hemodynamic stability in the CSA group.

Spinal anesthesia using low doses of local anesthetics is a safe method of anesthesia in TUR (11). One of the potential complications of spinal anesthesia is hypotension due to sympathetic blockade. The reasons for severe and prolonged hypotension associated with spinal anesthesia are rapid onset of sympathetic blockade and failure of neurogenic and cardiovascular adaptation mechanisms, particularly in elderly patients (12,13). Rapid intravenous infusion of high amounts of fluid and vasopressors to prevent hypotension may pose risks in patients with cardiac dysfunction (11). CSA, using titrated doses of local anesthetics, is superior particularly in the elderly, in whom the hemodynamic effects of spinal anesthesia are difficult to tolerate (12). While some studies reported bradycardia and hypotension with intrathecal levobupivacaine (14-16), others did not (17).

In this study, HR of the patients was similar in both groups. However, in intra-group comparisons, a significant decrease in HR was observed, starting from the 25th min in the SDSA group, and from the 40th min in the CSA group. The decrease in HR was slower in the CSA group, which might have been due to gradual development of sympathetic block in this group. During the surgery, hypotension occurred in 5 patients (16.7%) in the SDSA group and 2 patients (6.7%) in the CSA group. The incidence of hypotension was similar between the two groups, probably because of the small sample size of the present study.

For TUR of prostate and bladder under spinal anesthesia, a sensory block at or above the T10 dermatome is required (18,19). In the present study, to achieve sensory block to the T10, 12.5 mg of 0.5% levobupivacaine was used in the SDSA group. This dose is similar to the doses used in the previous studies in TUR procedures (14-16,20). In our study, the mean dose of levobupivacaine used was 12.5 mg in the SDSA group and 10±2.79 mg in the CSA group; the use of titrated doses of levobupivacaine allowed for a reduced dose of levobupivacaine in the CSA group. In the SDSA group, the surgery was started after T10 sensory block was achieved and tested with the "*pinprick*" test, and none of the patients experienced pain during surgery. In the CSA group, 8 out of 30 patients suffered from pain after surgery was started and additional levobupivacaine administration was required. In this study, the mean time to achieve sensory block at the T10 level in the SDSA group (8.27±5.70 min) was consistent with the results of previous studies (14,16,20) and the maximum level of sensory block was T8 (T10-T4) in the SDSA group and T9 (T10-T6) in the CSA group. The time to achieve maximum sensory block level is as important as the level of maximum sensory block. In the present study, the time to reach maximum sensory block in the CSA group was 29.33±12.71 min, which was longer than that of the SDSA group (15.60±9.36 min). It is important to use titrated doses of levobupivacaine to extend the compensation time. Although a motor block is not needed for TUR, it is desirable that the patient remain motionless.

In our study, the modified Bromage Scale score of all patients in the SDSA group was 3, while the modified Bromage Scale score of one patient who received 7.5 mg levobupivacaine did not exceed 1 and that of one patient who received 10 mg levobupivacaine did not exceed 2 throughout the surgery in the CSA group. However, this did not lead to any problems. The contact of the spinal needle with spinal roots at its penetrating point to the subarachnoid area leads to temporary paresthesia. In earlier studies, paresthesia was reported by SDSA (21,22) and Spinocath use (4,23). In this study, one patient (3.3%) in the SDSA group and 7 patients (23.3%) in the CSA group developed paresthesia while the catheter was advanced. Paresthesia resolved upon slight withdrawal of the catheter in the CSA group and changing the direction of the needle in the SDSA group. In the postoperative period, none of these patients had nerve irritation or permanent neurological disorders.

Conclusively, the intrathecal administration of levobupivacaine was successful in providing quality anesthesia in groups receiving both SDSA and CSA. Although continuous spinal anesthesia is difficult to perform, more time consuming and expensive technique when compared to single dose spinal anesthesia, in the present study a lower amount of local anesthetic agent was used and the gradual development of maximum sensory block level led to improved hemodynamic stability in the CSA group. Thus, it can be concluded that levobupivacaine by continuous spinal anesthesia is a safer method than single dose spinal anesthesia in elderly patients.

Conflict of Interest: Authors have no conflict of interest.

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