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Research Article

Araştırma

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Comparative Analysis of the Impact of Continuous Spinal Anesthesia and Single-Dose Spinal Anesthesia Techniques On Hemodynamics, Sensory and Motor Block Levels in Transurethral Surgery Cases

Transüretral Cerrahi Vakalarında, Sürekli Spinal ve Tek Doz Spinal Anestezi Tekniklerinin Hemodinami, Duyusal ve Motor Blok Seviyesi Üzerine Etkilerinin Karşılaştırılması

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ABSTRACT

Aim: In this study, it was aimed to compare in patients undergoing transurethral resection surgery: 1- The effectiveness of single-dose and continuous spinal anesthesia techniques, 2- Hemodynamic chang-es, sensory-motor block levels and durations, anesthetic drug doses and side effects.

Method: Forty American Society of Anesthesiology I–III patients in the age group of 40–75 years who were scheduled for transurethral surgery were randomly divided into two groups: single dose spinal anes-thesia (Group 1) (n = 20) and continuous spinal anesthesia (Group 2) (n = 20). The patients' hemo-dynamic data, analgesia status and motor block levels were evaluated.

Results: With regard to the hemodynamic parameters, the mean values of systolic–diastolic blood pressure and heart rate were found to be significantly lower in the single dose spinal anesthesia group (Group 1) than in the continuous spinal anesthesia group ($p < 0.05$). In terms of sensory and motor block levels, the maximum block level was T9 in the continuous spinal anesthesia group, while it was T8 in the single dose spinal anesthesia group ($p < 0.05$). Upon reaching T10, two-segment regression and sensory and motor block termination times were found to be significantly lower in the continuous spinal anesthesia group when compared to the single dose spinal anesthesia group ($p < 0.05$). There was no difference between the two groups in terms of Bromage score values ($p > 0.05$). In the con-tinuous spinal anesthesia group, the mean dose and volume of the local anesthetic required to achieve analgesia in the T10 dermatome were found to be 7.12 ± 1.46 ml and 1.4 ± 0.29, respective-ly. Furthermore, the amount of fluid administered intraoperatively was found to be significantly lower in the continuous spinal anesthesia group than in the single dose group ($p < 0.05$).

Conclusion: With the continuous spinal anesthesia method, it can be titrated and by using lower doses of local anesthetic, a level of sensory-motor blockade close to the single-dose spinal anesthesia method and a more stable hemodynamics can be achieved.

Key Words: Continius spinal anestesia, Single dose spinal anestesia, Transuretral surgery

ÖZET

Amaç: Bu çalışmada transüretral rezeksiyon cerrahi yapılacak hastalarda: 1- Tek doz ve sürekli spinal anestezi tekniklerinin etkinliğinin 2- Hastalardaki hemodinamik değişikliklerin, duyu-motor blok dü-zeylerinin ve sürelerinin, anestezik ilaç dozlarının ve yan etkilerin karşılaştırılması amaçlanmıştır.

Yöntem: Transüretral cerrahi planlanan 40-75 yaş arası ASA I-III grubu 40 hasta tek doz spinal anestezi (Grup 1)(n:20) ve sürekli spinal anestezi (Grup 2) (n=20) olarak rastgele iki gruba ayrıldı. Hastaların he-modinamik verileri, analjezi durumları ve motor blok seviyeleri değerlendirildi.

Bulgular: Hemodinamik parametreler açısından, uygulama öncesine göre tek doz spinal anestezi grubu (grup 1) sistolik-diastolik kan basıncı ve kalp hızı ortalama değerleri sürekli spinal anestezi grubuna göre anlamlı olarak düşük bulundu ($p<0,05$). Duyusal ve motor blok seviyelerine bakıldığında; tek doz spinal anestezi grubunda maksimum blok seviyesi T8 iken sürekli spinal anestezi grubunda T9 ola-rak bulundu ($p<0,05$). T10 'a ulaşma, iki segment gerileme, duyusal ve motor blok sonlanma zaman-ları sürekli spinal anestezi grubunda, tek doz spinal anestezi grubuna göre anlamlı olarak düşük bu-lundu ($p<0,05$). Her iki grup arası bromage skor değerleri açısından fark yoktu ($p>0,05$). Sürekli spinal anestezi grubunda, T10 dermatomunda analjezi sağlamak için gerekli olan lokal anestezik dozu ortalama 7,12±1,46 ml, hacmi ise 1,4±0,29 olarak bulundu. Yine intraoperatif verilen sıvı mikta-rı, sürekli spinal anestezi grubunda anlamlı olarak düşük bulundu ($p<0,05$).

Sonuç: Sürekli spinal anestezi yöntemiyle, titre edilebilir ve daha az dozda lokal anestezik kullanılarak, tek doz spinal anestezi yöntemine yakın bir duyusal-motor blok seviyesi ve daha stabil bir hemodinami sağlanabilir.

Anahtar Kelimeler: Sürekli spinal anestezi, Tek doz spinal anestezi, Transüretral cerrahi

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Introduction

Transurethral resection (TUR) surgery is an endoscopic surgical technique employed for diagnosing and treating symptomatic problems of the lower urinary tract and bladder. It is commonly favored in medical practice, particularly for cases of prostatic hyperplasia.[1] Spinal anesthesia is commonly favored in TUR because it has a quick onset of effect and is easy to administer.[2,3] Nevertheless, the administration of a solitary dosage of spinal anesthetic can result in hemodynamic alterations, including hypotension and bradycardia, as well as potential problems such as post spinal headache, nausea, and vomiting. These adverse effects pose significant hazards to the patient's well-being and can lead to major morbidity and mortality both during and after the surgical procedure.[3-5] Continuous spinal anesthesia offers the same benefits as single-dose spinal anesthesia while ensuring hemodynamic stability and is the recommended choice for individuals at high risk.[4-6] However, the outcomes may not consistently align with expectations due to factors such as the specific characteristics and concentration of the local anesthetic drug, as well as the particular technique employed.[2,6] On the other hand, in recent years, it is advisable to prioritize anesthetic procedures and medicines that have low side effects in order to facilitate quick recovery compared to surgery.[7]

Hence, Our study questions are: 1-Does the continuous spinal anesthetic technique demonstrate efficacy and safety? 2- Are the outcomes of single-dose and continuous spinal anesthesia methods similar in terms of the parameters investigated?

The objective of this study were 1- Effectiveness of single dose and continuous spinal anesthesia techniques 2- Comparison of hemodynamic changes in patients, sensory-motor block levels and durations, anesthetic drug doses and side effects.

Patients and Method

Following the approval of Ankara Türkiye Yüksek İhtisas Training and Research Hospital, Educational Planning and Coordination Board (December 2008), the study was planned prospectively, between 2019-2010. Patients whom ASA 1-3 group according to the American Society of Anesthesiologists (ASA) classification, aged between 40 and 75, who would undergo transurethral surgery and had no contraindications for spinal anesthesia, were included in the study. Patients underwent preoperative evaluation one day before to the surgery, during which standard and hematologic examinations were conducted. The patients were provided with information regarding the procedure and their consent was acquired. A total of forty patients, were randomly assigned to two groups: group 1, receiving a single dose of spinal anesthetic (n=20), and group 2, receiving continuous spinal anesthesia (n=20).

Prior to the patients being transported to the operating table, a 10ml/kg isotonic NaCl solution was administered within a 30-minute timeframe in the premedication room. Following the patient's transfer to the operating table, a premedication dose of 0.03 mg/kg midazolam intravenously was delivered. Following the normal monitoring procedures for general anesthesia, which included electrocardiogram (ECG), non-invasive blood pressure measurement (TA), and pulse oximetry, demographic information along with systolic and diastolic blood pressures, and pulse rate in minutes were recorded. Conditions have been created to switch to general anesthesia at any time. The study utilized Levobupivacaine, a well-established and safe local anesthetic.[8,9]

Patients were positioned in a seated posture on the surgical table, and the targeted area was cleansed with a disinfectant and then covered with a sterile, perforated green cloth. Following the insertion of a 22G spinal (Quicke) needle through the median approach at the L3-L4 distance and confirmation of cerebrospinal fluid (CSF) flow, the first group of patients (Group 1) received 3 ml of 15 mg levobupivacaine (chirocaine®) 0.5%. In Group 2, the dura mater was perforated with a 27G Quinke needle placed into a 22G catheter (Spinocath® Braun) after locating the epidural space by penetrating it with a 20G Touhy needle. Following the monitoring of cerebrospinal fluid (CSF) flow between the needle and catheter, the catheter was inserted into the spinal space by advancing it 2-3 cm beyond the needle. CSF flow was controlled, and the catheter was retracted 1-1.5 cm. Following the connection of the connector and bacterial filter, a volume of 1 ml of levobupivacaine (chirocaine®) with a concentration of 0.5% and a dosage of 5 mg was injected into the subarachnoid space. Subsequently, an additional volume of 0.5 ml of levobupivacaine with a concentration of 0.5% and a dosage of 2.5 mg was provided at 5-minute intervals until the desired surgical level (T10) was achieved. The total dose of medication administered was recorded. The patients were initially seated for a duration of 3 minutes, after which they were positioned in a supine posture with their heads raised at a 30-degree angle.

Sensory block levels were checked every 30 s with a pinprick test. The time from the time of intrathecal injection until the T10 level was reached was considered as "time to T10 level". The "maximum sensory block level" reached after spinal block was recorded. The time from the maximum sensory block level reached until two segments regressed was considered as "two-segment regression time". The duration from the pinprick test in the postoperative recovery unit until the reaction was observed is referred

to as the "sensory block end time". The motor functions of the patients were assessed at 30-second intervals using the bromage score. The time when the bromage score of the patients decreased from three to zero was considered as "motor block termination time".

The operation was started after adequate analgesia was achieved. Throughout the case, patients were given O_2 from mask at 2 L/min. Preoperative, 0, 5, 10, 15, 15, 30, 60, 60, 90, 120, 180 minutes systolic, diastolic blood pressures and pulses, sensory and motor block levels were noted. When the patient had hypotension during the surgery (defined as a fall in systolic arterial pressure of more than 30% from the baseline value), a fast infusion of 200 ml of isotonic solution was supplied within a 10-minute timeframe. If there was no improvement, a 5 mg dose of ephedrine was administered intravenously. When bradycardia (pulse rate below 45/min) developed, 0.5 mg atropine was administered i.v.

No analgesic agent was planned to be administered to any patient in the intraoperative period under normal conditions. Nevertheless, a dose of 0.5-1µg/kg fentanyl intravenously was given to patients who had pain as a result of bladder distension caused by the introduction of irrigation fluid during a transurethral operation and/or at the initiation of resection. In the postoperative period, patients were graded with VAS pain score. NSAIDs (diclofenac sodium; dichloron® 75 mg ampoule i.m) were administered to patients with a score of 4 and above and doses were recorded. The spinal catheters of the patients in the second group were withdrawn when leaving the recovery unit and sent for culture. The present study analyzed the effects of single dose spinal anesthesia (Group 1) and continuous spinal anesthesia (Group 2) on hemodynamic parameters, sensory-motor block levels, dose-volume of local anesthetic utilized, amount of intraoperative fluid administered, and occurrence of side effects.

Statistical analysis: Data were evaluated by a statistical expert using the statistical package program SPSS for windows 14.0. Paried t test was used for comparisons within groups, Mann Whitney U test was used for comparisons of means between groups, and Chi square test was used for comparisons of categorical variables. $p<0.05$ was considered significant. Bonferroni correction for ordinal variables was used to control Type I error in all possible multiple comparisons. Fisher's exact test was used for categorical variables. In comparisons of intra-group hemodynamic measurements, results were considered statistically significant for $p<0.025$ according to Bonferroni Correction.

Results

No statistically significant difference was observed between Group 1 and Group 2 patients in terms of age, sex, and mean body mass index (BMI) values ($p>0.05$, Table 1).

A statistically significant difference was observed between group 1 preoperative and 0 min and 5,10,15,30,60,90,120,180 min systolic arterial pressure values ($p<0.025$, Table 2). A statistically significant difference was observed between group 1 preoperative and 0 min and 5,10,15,30,60,90,120,180 min systolic arterial pressure values ($p<0.025$, Table 2).

A statistically significant difference was observed between group 1 preoperative and 0 min and 5,10,15,30,60,90,120,180 min diastolic arterial pressure values ($p<0.025$, Table 3). In group 2, no statistical difference was observed between preoperative and 0 min and 5,10,15,30,60,90,120,180 min diastolic arterial pressure values ($p>0.05$, Table 3).

In Group 1, a statistically significant difference was observed between preoperative and 0 min and 5,10,15,30,60,90,120,180 min diastolic heart rate values ($p<0.025$, Table 4). In contrast, there was no statistically significant difference between preoperative and 0 min and 5,10,15,30,60,90,120,180 min heart rate values in Group 2 ($p>0.05$, Table 4).

Table 1. Demographic Characteristics of Patients

Variables	Group I (n=20)	Group II (n=20)	p value*
Age	62,9±8,8	59,3±13,2	0,318*
Gender			0,507**
Man	12 (%60,0)	14 (%70,0)	
Woman	8 (%40,0)	6 (%30,0)	
ASA			0,864**
I	2 (%10,0)	3 (%15,0)	
II	12 (%60,0)	12 (%60,0)	
III	6 (%30,0)	5 (%25,0)	
Body Mass Index	24,0±3,4	23,2±3,6	0,316*

*Mann-Whitney U test
**Chi Square Test

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Table 2. Systolic arterial pressure values and intra-group evaluation according to monitoring time

Time	Group I	p value***	Group II	p***
Pre-op	162,4±25,3	-	154,7±25,6	-
0.min	152,5±21,7	-	151,6±21,7	-
5. min	129,2±17,7 a;b	p<0,001;p<0,025	150,2±22,4	p>0,05
10. min	114,5±20,3 a;b	p<0,001;p<0,025	150,2±20,3	p>0,05
15. min	114,4±22,8 a;b	p<0,001;p<0,025	152,8±24,5	p>0,05
30. min	120,7±16,5 a;b	p<0,001;p<0,025	151,3±20,0	p>0,05
60. min	121,7±17,0 a;b	p<0,001;p<0,025	152,3±20,0	p>0,05
90. min	127,1±16,7 a;b	p<0,001;p<0,025	153,6±22,1	p>0,05
120. min	131,9±19,5 a;b;d;e	p<0,001;p<0,025;p<0,025;p<0,025	154,3±21,5	p>0,05
180. min	136,8±21,2 a;b;c;d,e;f	p<0,001;p<0,025;p<0,025;p<0,025;p<0,025;p<0,025	154,0±20,3	p>0,05

a-Pre Op ; b-0.min ; c-10.min ; d-30.min ;e-60.min and f-90.min with in them the statistical difference between. ***Paried T test

Table 3. Diastolic arterial pressure values and intra-group evaluation according to monitoring time

Time	Group I	p value***	Group II	p value***
Pre-op	89,1±12,7	-	90,7±8,0	-
0.min	83,7±12,0	-	87,8±6,9	-
5.min	68,1±09,9 a;b	p<0,01;p<0,01	86,9±7,1	p>0,05
10.min	69,2±10,6 a;b	p<0,01;p<0,01	86,4±7,1	p>0,05
15.min	63,9±11,3 a;b	p<0,01;p<0,01	87,4±7,8	p>0,05
30.min	72,1±10,4 a;b	p<0,01;p<0,01	88,3±7,3	p>0,05
60.min	70,5±13,1 a;b	p<0,01;p<0,01	87,0±7,5	p>0,05
90.min	73,3±10,2 a;b	p<0,01;p<0,01	89,1±6,7	p>0,05
120.min	75,5±10,6 a;b	p<0,01;p<0,01	88,8±7,2	p>0,05
180.min	77,8±13,3 a;c	p<0,01;p<0,025	87,5±8,5	p>0,05

a-Pre Op ; b-0.min and c-15.min with in them the statistical difference between.***Paried T test

Table 4. Heart rate values and intra-group evaluation according to monitoring time

Time	Group I	p value***	Group II	p value***
Pre-op	76,9±15,0	-	72,6±6,2	-
0.min	74,0±13,1	-	73,0±9,1	-
5.min	63,4±12,4 a;b	p<0,025; p<0,01	73,7±8,4	p>0,05
10.min	61,2±9,3 a;b	p<0,025; p<0,01	71,3±9,0	p>0,05
15.min	62,1±9,7 a;b	p<0,025; p<0,01	70,7±7,3	p>0,05
30.min	64,9±8,2 a	p<0,025	70,7±8,3	p>0,05
60.min	65,2±11,3 a	p<0,025	69,8±8,1	p>0,05
90.min	66,0±10,5 a;b	p<0,025; p<0,01	71,2±9,4	p>0,05
120.min	67,2±9,4	p>0,05	71,1±8,2	p>0,05
180.min	68,2±9,4	p>0,05	71,5±8,3	p>0,05

a-Pre Op ; b-0.min with in them the statistical difference between ***Paried T test

There was a significant difference between the groups in terms of systolic and diastolic arterial blood pressure values ($p<0.05$, Graph-1A). Similarly, a significant difference was observed between the groups in terms of heart rate values ($p<0.05$, Graph-1B)

A statistically significant difference was observed between Group 1 and Group 2 in terms of mean sensory block levels at 5,10,15,30,60,90,120 minutes ($p<0.0012$, Table 5). Additionally, a significant difference was observed between the groups in terms of sensory block levels at 5, 10, 15, 15, 30, 60, 90 and 120 minutes ($p<0.05$, Graph-2)

No significant difference was found between the groups in terms of Bromage score values ($p>0.05$, Table 6).

In Group 1, the time to reach the T10 level, two-segment regression time, sensory and motor block times, and maximum sensory block level were longer than in Group 2 ($p<0.05$, Table 7, Graph-3A,B,C,D).

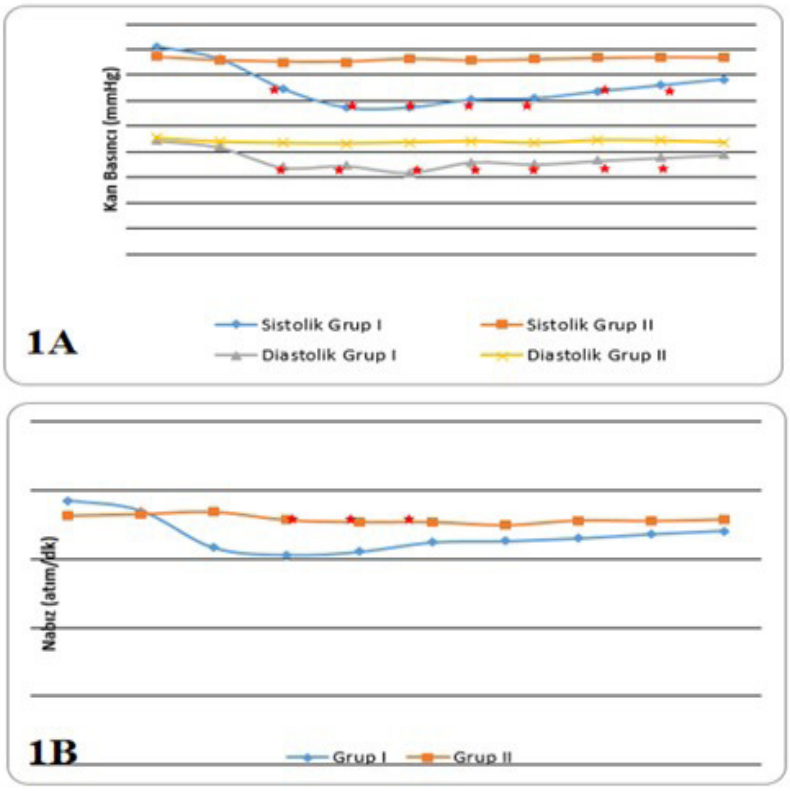
The dosage and quantity of levobupivacaine administered to Group 1 were considerably greater than the dosage and quantity of levobupivacaine administered to Group 2 ($p<0.05$, Graph-4A). In contrast, Group 1 received a considerably greater volume of fluid throughout the intraoperative time compared to Group 2 ($p<0.05$, Table 8, Graph-4B).

No statistically significant difference in side effects was found between the groups ($p>0.05$, Table 8). Both groups did not require any additional medication during and after the surgery (Table 8).

Discussion

The main outcomes of this study indicate that continuous spinal anesthesia can achieve a sensory-motor block level similar to that of single-dose spinal anesthesia. Furthermore, it maintains more stable hemodynamics at adjustable doses, while requiring a smaller amount of local anesthetic.

Currently, there is a growing population of middle-aged and older patients who are undergoing surgery. These patients often experience hemodynamic abnormalities when receiving spinal anesthetic, which is typically regarded an optimal approach for them. As a result, there is a need to explore other methods. This search has highlighted the utilization of continuous spinal anesthetic techniques as a means to promote prompt recovery, successful outcomes, and the maintenance of stable hemodynamics. The hemodynamic effects of spinal anesthesia are determined by the suppression of preganglionic sympathetic



Graph 1. A: Systolic – Diastolic Arterial Pressure Values and Evaluation Between Groups, B: Changes in He-art Rate of Groups

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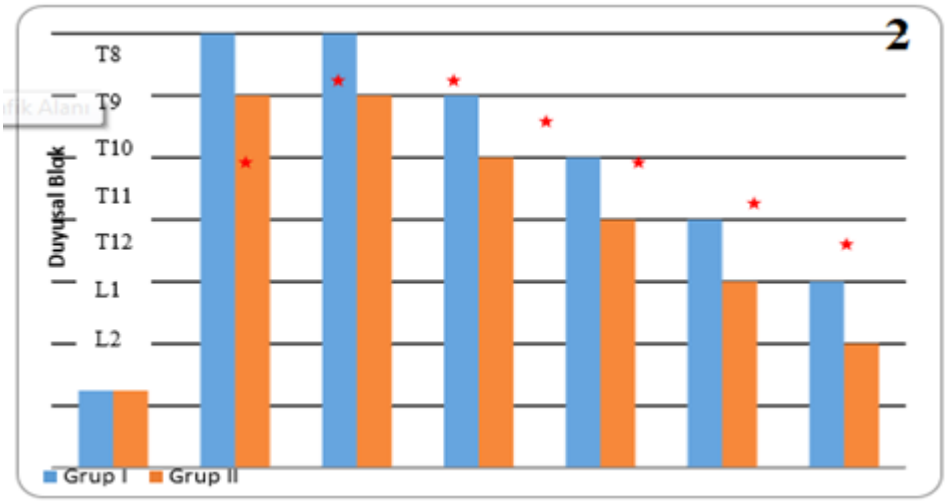
Table 5. Sensory block (Dermatome) levels and intra-group evaluation according to monitoring times

Time	Group I	p value***	Group II	p value***
5.min	T11 (T9-L2)		T12(T8-L1)	
10.min	T8 (T7-T12)		T9 (T8-T11)a	
15.min	T8 (T7-T10)		T9 (T8-T11)a	
30.min	T9 (T8-T11)		T10 (T8-T11)	
60.min	T10 (T9-L1) b;c;d	p<0,0012; p<0,0012; p<0,0012	T11 (T9-L1) b;c;d	p<0,0012; p<0,0012; p<0,0012
90.min	T11 (T9-L1) b;c;d; e	p<0,0012; p<0,0012; p<0,0012; p<0,0012	T12 (T10-L3)b;c;d;e	p<0,0012; p<0,0012; p<0,0012; p<0,0012
120.min	T12 (T10-L3)a;b;c; d;e;f	p<0,0012; p<0,0012; p<0,0012; p<0,0012; p<0,0012; p<0,0012	L1 (T11-L3) a;b;c;d;e;f	p<0,0012; p<0,0012; p<0,0012; p<0,0012; p<0,0012; p<0,0012

a-5.min ; b-10.min ; c-15.min ; d-30.min ;e-60.min and f-90.min with in them the statistical difference between. **Paried T test



Graph 2. Sensory Block Levels by Groups

Table 6. Bromage Score mean values according to monitoring times

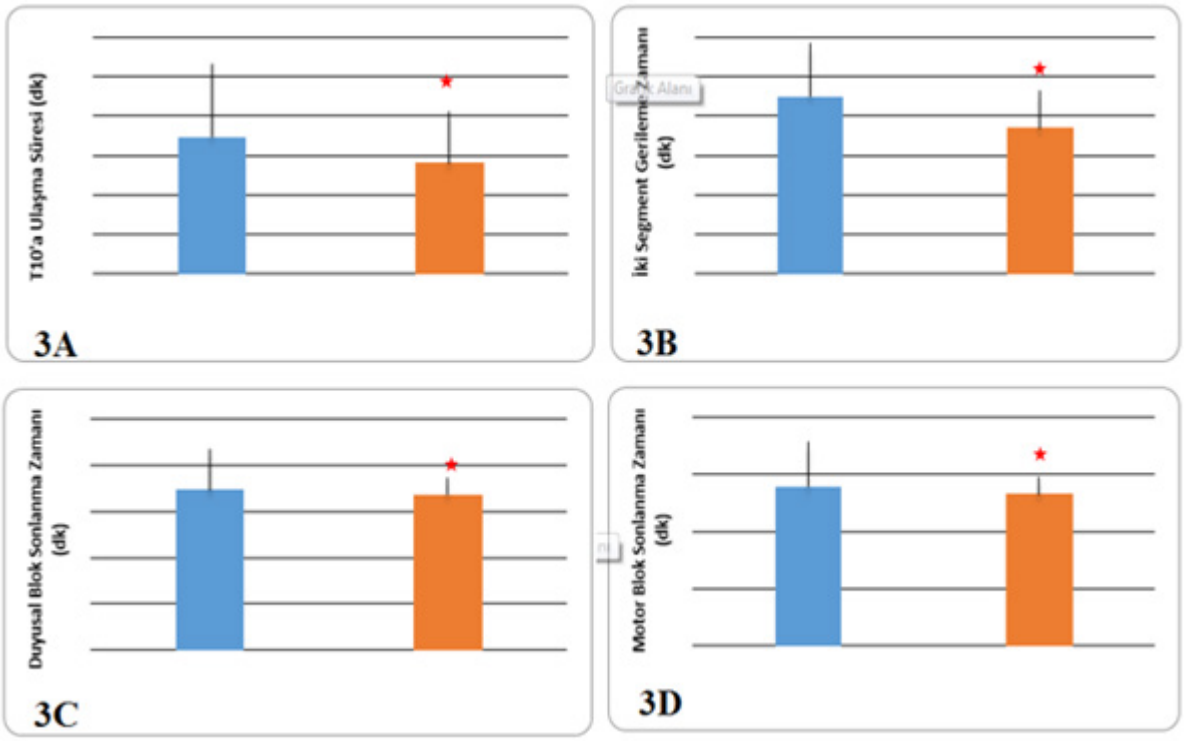
Time	Group I	Group II	p value*
Pre-op	0 (0-0)	0 (0-0)	1,000
0.min	0 (0-0)	0 (0-0)	1,000
5.min	2 (1-2)	2 (1-2)	0,108
10.min	3 (2-3)	3 (2-3)	0,602
15.min	3 (3-3)	3 (3-3)	1,000
30.min	3 (2-3)	3 (2-3)	0,799
60.min	3 (2-3)	3 (2-3)	0,108
90.min	2 (1-3)	2 (1-3)	0,165
120.min	1 (0-2)	1 (0-2)	0,698
180.min	0 (0-2)	0 (0-0)	0,602

*Mann-Whitney U test

Table 7. Reaching T10 Level, Two-Segment Regression, Sensory-Motor Block End Times and Maximum Sensory Block Level

Variables	Group I (n=20)	Group II (n=20)	p value*
Time to Reach T10	6 (3-16)	9 (3-11)	0,021
Segment Regression	68,5±20,2	53,5±13,9	0,039
Sensory Block End Times	172 (120-300)	167,5 (130-210)	0,037
Engine Block End Time	135 (100-270)	130,5 (110-180)	0,038
Maximum Sensory Block Level	T8 (T7-T10)	T9 (T8-T11)	0,041

*Mann-Whitney U test



Graph 3. Blue: Group 1 and Orange: Group 2. A: Time to Reach T10 Level, B: Two-Segment Regression Times, C: Sensory Block End Time, D: Motor Block End Time

Table 8. Comparison of complications and additional drug use distribution by groups

Variables	Group I (n=20)	Group II (n=20)	p value**
Nausea	2 (%10,0)	1 (%5,0)	1,000
Nerve Root Pain	0(%0,0)	1(%5,0)	1,000
Headache	1 (%5,0)	1 (%5,0)	-
Allergic Reaction	0(%0,0)	0(%0,0)	-
Additional Fentanyl Use	0(%0,0)	0 (%0,0)	-
Additional NSAID Use	0(%0,0)	0(%0,0)	-
Intraoperative Fluid Replacement	509±101	329±75	0,000

** Chi Square Test

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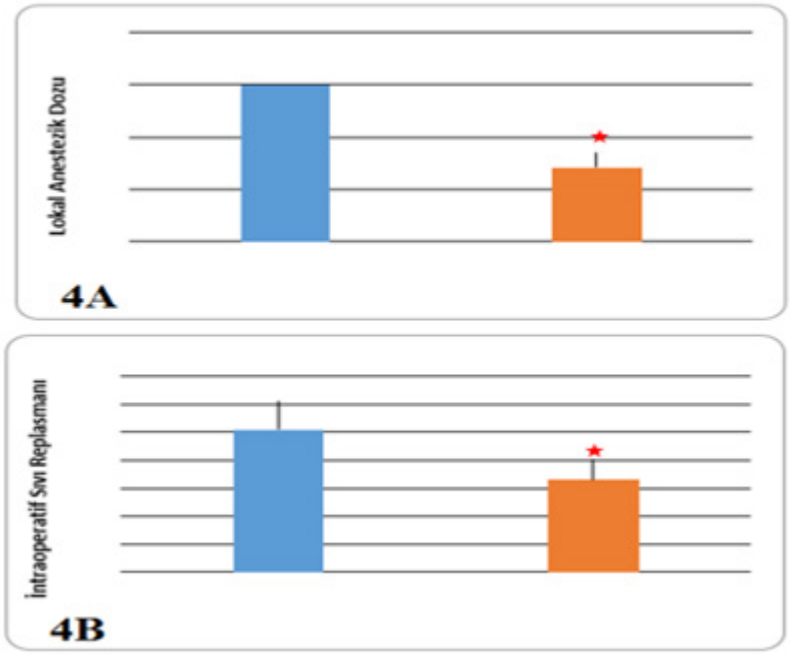

Graph 4. Blue: Group 1 and Orange: Group 2. A: Average Local Anesthetic Doses Applied in the Groups, B: Intraoperative Fluid Replacement in the Groups

activity. As the level of sympathetic block increases, the severity of the resulting hypotension increases. Excessive distribution of the local anesthetic drug in the head region might lead to multisegmented sympathetic blocking, resulting in adverse hemodynamic alterations.[3,10] Our results indicate that in the continuous spinal anesthesia group, administering the local anesthetic drug in small doses resulted in a slower spread of the drug within the spinal cord, leading to a more controlled and stable effect on the sympathetic nerves. On the other hand, in the single dose spinal anesthesia group, the local anesthetic agent was distributed too widely in the upper body, causing a more extensive and unpredictable effect on the sympathetic nerves, which in turn impaired hemodynamic stability.

Previous studies have shown that 80% of patients who received a single dose of spinal anesthesia experienced a reduction in both systolic and diastolic blood pressure values compared to their pre-anesthesia levels. Additionally, the single dose group exhibited significantly more impaired hemodynamics compared to the continuous spinal anesthesia group.[11-13] Similarly, we observed a significant decrease in the single dose spinal anesthesia group compared to the pre-administration values in our study, whereas no significant hemodynamic difference was observed in the continuous spinal anesthesia group compared to the pre-administration values. In our study, which was similar to previous studies[14-18], we also observed that intraoperative heart rate measurements were significantly lower in the group receiving a single dose of continuous spinal anesthesia compared to their preoperative values. However, in the group receiving continuous spinal anesthesia, there was no significant difference between intraoperative heart rates and preoperative values.

A study comparing the effects of isobaric, hypobaric, and hyperbaric bupivacaine in continuous spinal anesthesia revealed that the hyperbaric bupivacaine group experienced a 30% decrease in mean arterial pressure, while the isobaric bupivacaine group had an 18% decrease, and the hypobaric bupivacaine group had a 14% decrease. The study concluded that the use of isobaric bupivacaine in spinal anesthesia allows for better control of hemodynamics.[19] Our study concluded that the patient group who received a single dosage of spinal anesthetic experienced a reduction in systolic and diastolic blood pressure as well as heart rate. This decrease typically occurred between the 10th and 15th minutes, when the sensory block level was at its peak. This phenomenon was believed to be caused by the insufficient adaptation of cardiovascular compensatory mechanisms to the sudden inhibition of sympathetic activity resulting from the administration of a single dose. This finding is consistent with Schnider's segmental block level theory. Schnider et al. conducted a trial including 50 patients, where they delivered 2.5 - 5 mg (0.5 - 1 ml) of 0.05% isobaric bupivacaine and 20 mg (4 ml) of 0.05% isobaric bupivacaine through a 28 G catheter for single dose spinal anesthesia. In the study, it was observed that six patients who had continuous spinal anesthesia and seventeen patients who received a single dose spinal anesthesia had a spinal anesthesia level above T6. Additionally, it was noted that the level of preganglionic

sympathetic block was adjustable in the group of patients who had a catheter inserted. No excessive deterioration in hemodynamic values was found in the group under continuous spinal anesthesia.[20]

Continuous spinal anesthesia, as opposed to single dose spinal anesthesia, offers hemodynamic stability due to its capacity to reduce segmental block and vary the onset of block. It was reported that the main purpose of the spinal catheter is to shape the block step by step and safely to closely monitor hemodynamic changes.[21] However, there are also studies reporting different results in the literature.[22,23] Lundorff et al. conducted a study on 60 patients who were undergoing lower extremity vascular grafting. They administered 17.5 mg of 0.5% isobaric bupivacaine to the group receiving a single dose of spinal anesthesia, and 5 mg of 0.5% bupivacaine to the group receiving continuous spinal anesthesia. In the continuous spinal anesthesia group, they administered 2.5 mg of 0.5% isobaric bupivacaine every 10 minutes until the T 11 sensory block was achieved. There was no difference between the two groups in terms of hemodynamic changes and the dose of ephedrine used. It was stated that inadequate physiological compensatory mechanisms of the patients included in the study due to their advanced age group and comorbidities may cause hemodynamic effects seen at high doses even at low doses. In a trial conducted with 40 patients undergoing orthopedic surgery, Pitkaren M. et al[24] delivered 3 ml of 0.5% bupivacaine to the group receiving single dose spinal anesthesia, and 1 ml of 0.5% bupivacaine followed by a continuous infusion of 2 ml/hour to the group receiving continuous spinal anesthesia. No statistically significant difference was seen in the invasive hemodynamic follow-up between the two groups. However, bradycardia was noted in 6 patients in the single dose spinal anesthesia group and in 4 patients in the continuous spinal anesthesia group. The authors posited that the outcomes could be attributed to intervention at the early stage of hemodynamic deterioration, fluctuations in sympathetic blocking caused by spinal anesthetic, and the impact of catheter location. Furthermore, they indicated that the advanced age of the patients, inadequate premedication fluid administration, and excessive bleeding may lead to hemodynamic instability in the cohort utilizing low dose local anesthetics.

Our study revealed a notable disparity among the groups in relation to all three metrics, namely sensory block achievement, motor block cessation, and segment regression time. Lower doses of local anesthetic agent in continuous spinal anesthesia were believed to be more successful than the single dose spinal anesthesia approach in reducing the time it takes for patients to recover. There was no discernible disparity in the intraoperative and postoperative bromage score values between the two groups. While the duration of motor block termination was longer in the single dose spinal anesthesia group compared to the continuous spinal anesthesia group, there was no variation in the quality of motor block between the two groups. The findings of our study shown congruity with previous study conducted by different scholars.[10, 17] Another study found no disparity in the length of time it took for motor block termination between the groups that received a single dose of spinal anesthesia and those that received continuous spinal anesthesia. The authors attributed this phenomenon to the utilization of elderly patients in their study, who exhibited heightened sensitivity to local anesthetic drugs.[25]

In our study, the continuous spinal anesthesia group received a lower amount of fluid replacement during the surgery compared to the single dose spinal anesthetic group. In the group receiving continuous spinal anesthesia, the stability of hemodynamics was significantly higher compared to the group receiving a single dose spinal anesthesia. This suggests that there was a reduced requirement for fluid in the continuous spinal anesthesia group. Based on our data, it has been reported that the continuous spinal anesthesia method can achieve sufficient anesthesia levels for the operation by using a smaller amount of local anesthetic agent. This is particularly effective in elderly patients. Furthermore, the amount of local anesthetic agent used in continuous spinal anesthesia is lower compared to single dose spinal anesthesia.[11,17,21,26] On the other hand, pain due to nerve root damage may occur after spinal anesthesia.[27] In our study, nerve root pain was observed in only one patient.

Post spinal headache (PSBA) due to CSF leakage in the dura mater during spinal anesthesia is more common especially in young patients. The occurrence of post-spinal backache (PSBA) in continuous spinal anesthesia has been documented in many studies, with reported rates ranging from 0.0% to 9.2%.[28,29] In contrast, certain studies reported the absence of PSBA in a series of continuous spinal anesthesia.[19] Our study found no statistically significant disparity between the two groups in relation to PSBA. PSBA was seen in one patient in each group. Furthermore, cauda equina syndrome and neurologic sequelae were not observed in our study. Our study found that two patients in the single dose spinal anesthesia group and one patient in the continuous spinal anesthesia group experienced nausea. The occurrence of nausea in two patients from the single dose spinal group was linked to a decline in hemodynamics, while the nausea observed in one patient from the continuous spinal group was attributed to the patient's anxiousness. The results were compatible with previous literature.[4-6, 30-32] Lastly, no allergic reaction was observed in our study.

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Limitions: This study has some limitations. Firstly, some references may not be up to date. However, this is understandable considering the date when the study was conducted. On the other hand, since the graphs were taken from the original version of the thesis study, some expressions in the graphs had to be presented in Turkish. Finally, it may be considered a disadvantage that in some tables we present them as statistically significant or insignificant, smaller or larger than the threshold value ($p<0.05$ or $p>0.05$). Despite some limitations, we think it is important to publish this study in English literature too, which it is in the gray literature.[33]

Conclusion: In this study, in the continuous spinal anesthesia method, the time to reach the T10 sensory block level and the termination of sensory-motor block were found to be longer than in the single-dose spinal anesthesia method. However, it was evaluated to be a safer method because it provides hemodynamic stability and the need for intraoperative fluid replacement is significantly lower. Continuous spinal anesthesia; It may be an anesthesia technique that can be safely used to prevent hemodynamic disorders that may develop due to high sympathetic block due to spinal anesthesia, especially in high-risk patient groups that are hemodynamically unstable. In addition, this method may allow the appropriate drug dose to be titrated according to the surgical duration and procedure, resulting in less drug use and a shorter and complication-free recovery period for patients.

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