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Effects of different bupivacaine injection speeds on hemodynamic and some other parameters during spinal anesthesia for cesarean section

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Abstract

Bupivacaine-induced spinal anesthesia is the most commonly used method for cesarean section. However, maternal hypotension may develop as a significant side effect. In this study, we aimed to investigate the effects of different injection speeds on maternal hypotension and other side effects. Patients undergoing spinal anesthesia for cesarean section were administered isotonic bupivacaine at three different injection speeds: 10 seconds, 15 seconds, and 20 seconds. Non-invasive systolic and diastolic blood pressure, mean arterial pressure, heart rate, oxygen saturation, and the incidence of nausea, vomiting, and the need for ephedrine were recorded. Parameters for the quality of anesthesia were assessed by monitoring the time to reach sensory block at T4 and T10 levels, sensory and motor block onset time, regression time to T10, and regression time from Bromage score 3 to 1. A longer time for the sensory block to reach T4, longer T10 regression time, and a longer time for regression from Bromage 3 to 1 were observed with the 15-second injection speed compared to the 10-second injection speed ($p<0.05$), but not with the 20-second injection speed ($p>0.05$). A higher incidence of nausea and vomiting, as well as a higher need for ephedrine, was also noted with the 15-second injection speed compared to the 10-second injection speed ($p<0.05$), but not with the 20-second injection speed ($p>0.05$). The results suggest that different speeds of isotonic bupivacaine injection cause minimal changes in hemodynamic parameters and side effects.

Keywords: Bupivacaine, spinal anesthesia, hemodynamic parameters, speed of injection

Introduction

Spinal anesthesia is the most commonly used regional anesthesia technique for cesarean sections. It is the preferred technique due to its simplicity, low cost, quick onset, effective sensory and motor block, and minimal complications for the fetus. However, maternal hypotension may develop as a result of spinal anesthesia in more than 90% of cases [1]. Hypotension, along with dizziness, nausea, and vomiting, is most commonly observed in the mother and may contribute to neonatal bradycardia and acidosis [2]. There is no clear definition of intraoperative hypotension, although systolic blood pressure <92 mmHg or a drop greater than 24% from the preoperative baseline has been suggested as assessment criteria [3]

Bupivacaine is the most commonly used local anesthetic for inducing spinal anesthesia in both obstetric and non-obstetric surgeries. It is often administered at a dose of 10.0-12.5 mg for pregnant mothers, though high doses may cause hypotension and other complications in the fetus, while low doses may result in insufficient anesthesia [4]. Bupivacaine is used in either isobaric or hyperbaric solutions, with the hyperbaric solution being the most commonly chosen for cesarean sections. However, the isobaric solution may cause fewer complications compared to the hyperbaric solution [5]. Therefore, the use of prophylactic vasopressors during cesarean sections is recommended as an international consensus [6]. For cesarean sections, bupivacaine with fentanyl as an analgesic is the most commonly used combination in practice [7].

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The spread of the block is not influenced by the concentration or volume of the anesthetic agents [8]. The speed of injection and duration have been suggested as factors that affect the outcome of anesthesia. In this study, we investigated how the speed of intrathecal bupivacaine administration at three different rates affects maternal hemodynamic parameters, sensory and motor block characteristics, ephedrine use, and the incidence of nausea and vomiting.

Material and Methods

The study was approved by the Local Clinical Research Ethics Committee Presidency (Protocol No: E2-21-1109). Sixty participants with American Society of Anesthesiologists (ASA) physical status (PS) class I–II, singleton pregnancies, and aged between 18 and 35 years, scheduled for elective cesarean section, were included in the study. Participants with vertebral column deformities, neurological diseases, coagulopathy, allergies to local anesthetics, infections at the injection site, and contraindications for regional anesthesia were excluded from the study. Patients were informed about the procedure, and their consent was obtained. Preoperatively, hematological parameters were routinely monitored. Demographic information, ASA classification, Mallampati score, and gestational age were recorded. Patients who met the inclusion criteria were randomly selected.

Before the spinal anesthesia, vascular access was established, and approximately 500 cc of crystalloid solution was administered. After the patients were positioned on the operating table, standard monitoring for ECG, non-invasive blood pressure (NIBP), and pulse oximetry was performed. Systolic and diastolic blood pressures, heart rate, and oxygen saturation values were recorded. While the patients were in a sitting position, the anesthesia site was cleaned with disinfectant, and the subarachnoid space was entered at the L3-L4 interspace using a median approach with a 22 G spinal needle, which was available in our hospital. The cerebrospinal fluid (CSF) flow was observed. Anesthesia was performed with isobaric 0.5% bupivacaine (Marcaine® AstraZeneca, Zentiva Health Products, Lüleburgaz / Kırklareli). 2-10 mL of Marcaine 5 mg/mL (10-50 mg bupivacaine hydrochloride) was administered according to the patient's height and weight. The patients were randomly divided into three groups based on the duration of anesthetic administration: Group 1: Anesthetic administered in 10 seconds, Group 2: Anesthetic administered in 15 seconds, and Group 3: Anesthetic administered in 20 seconds. The times were determined using a chronometer.

The patients were then placed in the supine position with a 30-degree left lateral tilt. Sensory block levels and Bromage scores were checked at 30-second intervals. After the intrathecal injection, the time to reach Bromage scores 2-3 was accepted as the motor block initiation time. The cesarean operation was allowed once the sensory block reached the T4 level. During the operation, pain was evaluated using the Visual Analog Scale (VAS) (0: No pain, 10: Severe pain). If VAS ≥3, 50 µg of fentanyl was administered to the patients.

Systolic and diastolic blood pressure, mean arterial pressure, heart rate, oxygen saturation, nausea or vomiting, and the need for ephedrine were monitored intraoperatively at 1, 3, 5, 10, 15, 20, 30, 40, 50, and 60 minutes. The sensory and motor block initiation times, time for sensory block to reach T4, time for sensory block to reach T10, maximum sensory block level, time for sensory block regression to T10, motor block level, time for motor block regression from Bromage score 3 to 1, and the operation time were recorded.

All patients were checked for post-spinal headache 1-3 days postoperatively. Sensory block was evaluated using a “pinprick” test (needle tip) along the bilateral midclavicular line. Motor block was evaluated using the modified Bromage scale. According to the scale: 0=no motor block, 1=knee flexion possible, no hip flexion, 2=no knee joint motion, toes mobile, 3=no lower extremity motion possible. Maximum analgesia level was defined as the highest dermatome determined by this test. Surgery was permitted once the sensory block reached the T4 level in all three groups.

Statistical analysis was performed using SPSS version 22 for Windows. Categorical data are presented as n and/or percentages, while continuous data are presented as means ± standard deviation (SD). The Pearson chi-square test was used for comparison of categorical data. Other data were tested for normal distribution using the Kolmogorov–Smirnov test. For comparison of more than one variable, one-way ANOVA was used. A Receiver Operating Characteristic (ROC) curve was drawn to assess the time to reach sensory block at the T4 level. Differences were considered significant if the P value was less than 0.05.

Results

There was no difference between the patients' ages, weights, gestational weeks and ASA scores. The results regarding systolic and diastolic blood pressures, mean blood pressure, heart rate, and oxygen saturation are presented in Table 1. Systolic blood pressure was significantly different at 20 minutes between Group 1 and Group 2 ($p=0.027$). It was higher in Group 2 compared to Group 1, while no difference was observed in Group 3 compared to the other groups. Diastolic blood pressure did not show any differences among the groups across all time intervals. Mean blood pressure, similar to systolic blood pressure, was significantly different between Group 1 and Group 2 ($p=0.037$), while no difference was observed in Group 3 compared to the other groups. Heart rate at the 10th, 15th, 20th, and 30th minutes was significantly different between Group 1 and Group 2, while no difference was noted in Group 3 compared to the other groups. Heart rates at these time points were significantly higher in Group 2 compared to Group 1 ($p<0.05$). Oxygen saturation values did not differ among the groups at any time point.

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Table 1. Comparison of the hemodynamic parameters among the groups, mean±SD*

	Systolic blood pressure				Diastolic blood pressure			
	Group 1	**Group 2**	**Group 3**	**p**	**Group 1**	**Group 2**	**Group 3**	**p**
0 min	129.9±13.7	131.6±17.2	131.8±13.8	0.908	75.0±10.8	74.4±10.0	80.6±11.5	0.144
1 min	121.1±16.8	120.6±15.7	129.4±16.2	0.170	68.1±15.3	70.8±14.7	77.1±13.7	0.144
3 min	108.2±23.3	102.4±24.5	117.2±10.5	0.079	57.5±21.5	54.9±16.8	64.0±14.3	0.253
5 min	104.2±20.9	104.4±16.8	107.0±14.4	0.854	58.0±15.2	59.7±15.4	59.5±13.5	0.923
10 min	106.8±24.3	114.0±13.7	108.6±17.8	0.472	56.8±15.4	63.3±9.9	58.4±15.2	0.305
15 min	107.9±14.8	113.3±18.1	116.9±16.6	0.233	57.3±11.2	61.3±10.6	58.6±10.7	0.497
20 min	**110.1±11.0[a]**	**121.1±16.2[b]**	**117.3±10.2[a,b]**	**0.027**	57.1±12.8	65.3±11.7	58.2±10.7	0.065
30 min	113.7±13.5	115.3±12.5	113.2±11.9	0.866	57.0±14.2	57.5±11.4	58.8±11.6	0.897
40 min	117.3±13.8	120.5±19.2	115.6±10.0	0.661	62.3±13.0	61.1±15.6	59.3±9.7	0.835
50 min	114.0±11.7	117.3±10.0	120.0±10.1	0.573	62.6±8.5	61.7±10.5	63.3±6.7	0.937
60 min	115.8±11.7	120.0±7.5	118.8±14.4	0.844	63.5±8.2	66.3±4.7	64.5±12.2	0.890
	Mean blood pressure				**Heart rate**			
	Group 1	**Group 2**	**Group 3**	**p**	**Group 1**	**Group 2**	**Group 3**	**p**
0 min	93.3±10.1	93.4±10.3	97.7±10.8	0.330	90.5±16.6	97.1±13.5	99.1±13.6	0.160
1 min	85.7±14.2	87.4±13.7	94.5±13.6	0.114	92.4±13.2	92.7±23.4	92.9±13.0	0.995
3 min	74.4±19.6	70.7±18.4	81.7±12.6	0.127	93.6±15.8	90.7±23.3	99.3±19.1	0.380
5 min	73.4±16.4	74.6±15.1	75.3±13.0	0.918	87.2±16.4	94.5±21.2	96.7±17.3	0.243
10 min	73.4±17.1	80.1±10.5	75.1±14.3	0.307	**79.6±13.2[a]**	**101.7±18.0[b]**	**91.0±16.9[a,b]**	**<0.001**
15 min	74.2±10.2	78.6±12.0	78.0±10.6	0.382	**84.5±16.1[a]**	**98.9±18.3[b]**	**92.2±13.9[a,b]**	**0.023**
20 min	**74.8±11.3[a]**	**83.9±12.1[b]**	**77.9±9.8[a,b]**	**0.037**	**85.0±12.2[a]**	**99.7±14.7[b]**	**94.8±12.8[a,b]**	**0.003**
30 min	75.9±12.6	76.8±11.0	76.9±11.1	0.958	**84.1±10.7[a]**	**100.4±14.9[b]**	**94.3±9.7[a,b]**	**0.001**
40 min	80.6±11.9	80.9±15.7	78.1±8.5	0.801	88.2±9.8	95.4±16.8	92.7±6.8	0.295
50 min	79.7±8.8	80.2±6.3	82.2±5.0	0.770	88.3±13.2	95.7±17.4	90.4±10.5	0.535
60 min	80.9±8.9	84.2±5.5	82.6±12.2	0.863	86.8±10.5	82.3±9.7	85.8±13.4	0.819
	Oxygen saturation							
	Group 1	**Group 2**	**Group 3**	**p**				
0 min	97.9±2.0	98.1±2.7	98.5±1.4	0.712				
1 min	98.1±1.4	98.3±1.6	98.2±1.7	0.921				
3 min	97.5±1.9	98.8±1.0	98.1±2.3	0.099				
5 min	97.8±2.1	98.6±1.1	98.1±1.8	0.256				
10 min	97.1±4.6	98.5±1.0	98.7±1.1	0.149				
15 min	98.0±2.0	98.9±1.0	98.8±1.4	0.139				
20 min	97.3±4.1	99.0±1.1	98.5±1.2	0.093				
30 min	96.7±8.1	99.3±0.8	98.5±1.5	0.235				
40 min	97.6±2.4	98.9±1.1	98.4±1.6	0.150				
50 min	97.3±2.0	98.8±1.2	98.7±1.5	0.143				
60 min	97.2±2.8	98.8±1.0	99.5±0.6	0.204				

*One Way ANOVA test; Groups with different superscript letters (a, b) within the each investigated parameter are significantly different for that parameter ($p<0.05$)

Nausea and vomiting scores and ephedrine requirements of the patients are shown in Table 2. Nausea and vomiting scores at the 3rd minute were significantly higher in Group 2 compared to Groups 1 and 3 ($p=0.039$). No significant difference was observed among the groups at other time points. The need for ephedrine at the 3rd minute was significantly higher in Groups 1 and 2 compared to Group 3 ($p=0.029$), and no difference was observed at other time points.

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Table 2. Incidence of nausea and vomiting, and ephedrine need, n (%)*

	Nausea and vomiting				Ephedrine need			
	Group 1	Group 2	Group 3	p	Group 1	Group 2	Group 3	p
0 min	0 (0.0)	0 (0.0)	0 (0.0)	-	0 (0.0)	0 (0.0)	0 (0.0)	-
1 min	0 (0.0)	0 (0.0)	0 (0.0)	-	1 (5.0)	2 (10.0)	0 (0.0)	0.766
3 min	1 (5.0)[a]	5 (25.0)[b]	0 (0.0)[a]	**0.039**	5 (25.0)[a]	6 (30.0)[a]	0 (0.0)[b]	**0.029**
5 min	3 (15.0)	2 (10.0)	0 (0.0)	0.353	6 (30.0)	3 (15.0)	4 (20.0)	0.630
10 min	3 (15.0)	1 (5.0)	0 (0.0)	0.310	5 (25.0)	2 (10.0)	3 (15.0)	0.572
15 min	1 (5.0)	1 (5.0)	0 (0.0)	0.596	3 (15.0)	1 (5.0)	1 (5.0)	0.603
20 min	0 (0.0)	1 (5.0)	0 (0.0)	0.362	3 (15.0)	0 (0.0)	0 (0.0)	0.100
30 min	1 (5.0)	0 (0.0)	0 (0.0)	0.362	0 (0.0)	0 (0.0)	1 (5.0)	0.362
40 min	0 (0.0)	1 (5.0)	0 (0.0)	0.362	0 (0.0)	0 (0.0)	0 (0.0)	-
50 min	0 (0.0)	0 (0.0)	0 (0.0)	-	0 (0.0)	0 (0.0)	0 (0.0)	-
60 min	0 (0.0)	0 (0.0)	0 (0.0)	-	0 (0.0)	0 (0.0)	0 (0.0)	-

*Chi-square test. Groups with different superscript letters (a, b) within the each investigated parameter are significantly different for that parameter (p<0.05)

The time to reach sensory block at T4 and T10, sensory and motor block initiation times, T10 regression time, regression time from Bromage 3 to 1, and birth time are shown in Table 3. The time to reach sensory block at T4 was significantly longer in Group 2 compared to Groups 1 and 3 ($p<0.001$) (Figure 1). However, there was no significant difference among the groups in terms of time to reach sensory block at T10. T10 regression time was significantly longer in Group 2 than in Group 1. Regression time from Bromage 3 to 1 was also significantly longer in Group 2 than in Group 1 ($p<0.05$). Birth time was similarly longer in Group 2 compared to Group 1. These differences were not significant in Group 3 when compared to the other groups.

The degree of Mallampati was found to be 1 in 70% of Group 1, 80% of Group 2, and 25% of Group 3. There was a significant difference among the groups in terms of Mallampati score ($p<0.001$) (Table 3).

Table 3. Comparison of some of the parameters among the groups, mean±SD

		Group 1	Group 2	Group 3	p*
Age		31.2±6.9	28.9±5.7	28.2±3.6	0.201
Height		160.9±3.9	160.3±3.7	160.3±3.2	0.808
Weight		78.3±7.9	81.0±15.0	77.7±9.4	0.613
Gestational week		37.8±1.6	38.5±.8	38.7±.9	0.051
Time for sensory block to reach T4 (min)		5.9±3.2[a]	9.5±3.1[b]	6.5±1.9[a]	**<0.001**
Time for sensory and motor block onset (min)		1.6±.6	1.8±1.2	1.8±1.1	0.808
Time for sensory block to reach T10 (min)		4.1±3.0	4.6±1.6	4.0±1.5	0.616
Time for T10 regression (min)		56.5±17.4[a]	74.2±21.3[b]	66.6±24.2[a,b]	**0.035**
Time for bromage regression from 3 to 1 (min)		115.6±23.6[a]	146.0±32.6[b]	126.7±31.3[a,b]	**0.007**
Time for fetal emergence (min)		10.7±4.9[a]	17.3±6.8[b]	13.7±3.7[a,b]	**0.001**
Mallampati, n (%)	**1**	14 (70.0)	16 (80.0)	5 (25.0)	**<0.001****
	2	6 (30.0)	3 (15.0)	15 (75.0)	
	3	0 (.0)	1 (5.0)	0 (.0)	
ASA, n (%)	**1**	1 (5.0)	1 (5.0)	0 (.0)	0.596**
	2	19 (95.0)	19 (95.0)	20 (100.0)	

*One Way ANOVA test, **Chi-square test. Groups with different superscript letters (a, b) within the each investigated parameter are significantly different for that parameter (p<0.05)

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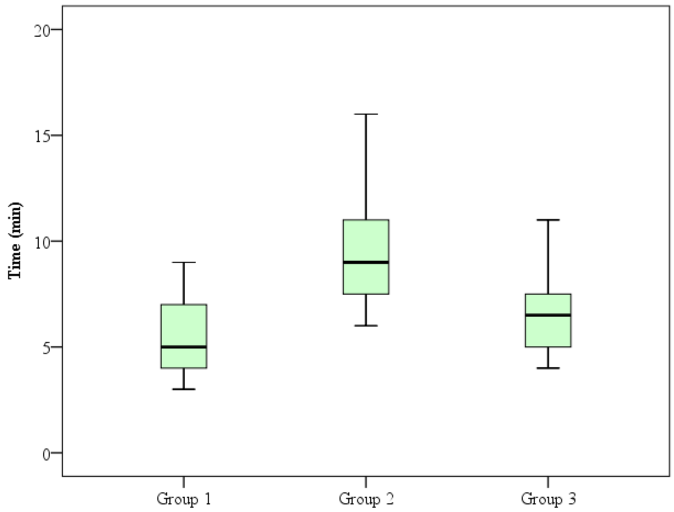

Table 1. Comparison of the time for sensory block to reach T4 between groups

ROC analysis for the time to reach sensory block at T4 indicated that the cut-off value is 5 when Groups 1 and 2 were evaluated. At this point, the sensitivity and specificity were 55% and 100%, respectively. The area under the ROC curve for this cut-off value was 0.853 (p<0.001). When Groups 2 and 3 were evaluated, the cut-off value was 7. At this point, both sensitivity and specificity were 75%. The area under the ROC curve for this cut-off value was 0.823 (p<0.001). Thus, the AUC value for Group 1-Group 2 is higher than that for Group 2-Group 3 (Table 4, Figure 2).

Table 4. ROC analyses of time to reach sensory block to T4 among groups

	Group 1-Group 2	Group 1-Group 3	Group 2-Group 3
Cut-off value	≤5	≤4	>7
Sensitivity	55%	35%	75%
Specificity	100%	90%	75%
Positive predictive value	100%	77.9%	75%
Negative predictive value	69%	58.1%	75%
AUC	0.853	0.624	0.823
AUC (95% confidence interval)	0.705-0.944	0.457-0.772	0.669-0.925
AUC p value	**<0.001**	0.169	**<0.001**

AUC: aarea under the curve

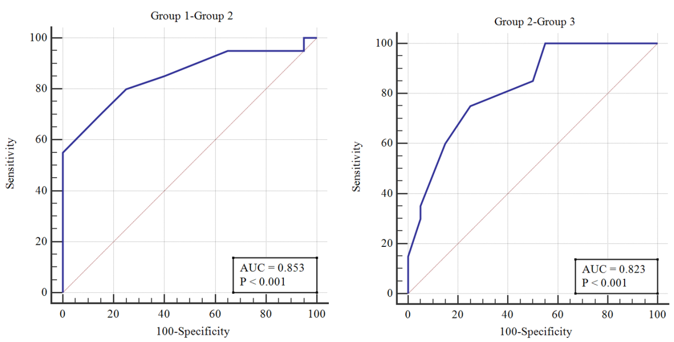

Figure 2. ROC curve of the time for sensory block to reach T4 according to groups

Discussion

The effectiveness and safety of spinal anesthesia for cesarean section have been extensively studied; however, no consensus has yet been reached. The combination of bupivacaine with fentanyl, an opioid, is the most commonly used method. However, the development of maternal hypotension remains one of the most significant drawbacks of this method. Various approaches have been explored to improve the safety and efficacy of anesthesia while minimizing side effects. In this study, we investigated the effects of the speed of bupivacaine injection for spinal anesthesia during cesarean section.

Several measures and methods have been used to evaluate the effects of spinal anesthesia for cesarean section and the associated side effects. The baricity of bupivacaine has been suggested as a factor affecting maternal hemodynamics during spinal anesthesia for cesarean section [5]. Hyperbaric bupivacaine, with different doses and injection rates, has been commonly studied to assess both the effectiveness of anesthesia and its effects on hypotension, as well as other maternal and neonatal parameters [9]. Levobupivacaine versus bupivacaine was also studied, and it was suggested that 10 mg of levobupivacaine combined with 15 µg of fentanyl provides shorter motor block time and fewer side effects, such as hypotension, bradycardia, and nausea, compared to 10 mg of hyperbaric bupivacaine with 15 µg of fentanyl [10]. Most studies investigating the effects of spinal anesthetics focus on hyperbaric bupivacaine, and studies on isobaric solutions are limited. Although isobaric bupivacaine is not commonly used for spinal anesthesia, it has been suggested as a good alternative to the hyperbaric solution for obstetric patients, as it causes fewer complications [5]. There are also reports indicating that no significant difference may be observed between hyperbaric and isobaric bupivacaine [11,12].

Dose is one of the most critical parameters in the safety of anesthesia. A study showed that a lower dose of bupivacaine (8 mg combined with 25 µg fentanyl) compared to a higher dose (10 mg combined with 25 µg fentanyl) resulted in better outcomes, including reduced hypotension risk and longer analgesia during spinal anesthesia for cesarean section (2). Different doses of fentanyl were also studied, with 10 mg of 0.5% hyperbaric bupivacaine combined with three different fentanyl doses (7.5, 10, and 15 µg), showing that 10 mg of hyperbaric bupivacaine with 15 µg of fentanyl provides good analgesia and a lower incidence of adverse effects [13]. While lower doses of bupivacaine are safer, they carry the risk of insufficient analgesia. Doses of 10.0–12.5 mg of bupivacaine are most commonly used for spinal anesthesia during cesarean section [4].

Volume, rather than concentration, of intrathecal hyperbaric bupivacaine has been reported to have a more significant impact on maternal blood pressure, suggesting that the use of smaller volume, higher concentration bupivacaine results in fewer adverse effects during cesarean section [14]. Ephedrine use is another factor that significantly influences anesthesia outcomes. Ge et al. reported that 6 mg of bupivacaine combined with 15 mg of ephedrine, compared to non-ephedrine patients, resulted in more stable maternal hemodynamics, prolonged sensory block, and reduced incidence of side effects, such as tachycardia, hypotension, nausea, vomiting, and acidosis [15]. The combination of prophylactic crystalloids or crystalloids with ephedrine was also investigated, showing that hypotension occurred significantly more frequently in the crystalloid-only group compared to the crystalloid-ephedrine group [16]. A height-based dosing algorithm for bupivacaine in spinal anesthesia for cesarean section was also suggested, as it provides the necessary criteria for cesarean sections while reducing the incidence of maternal hypotension, without the need for prophylactic fluid preloading or vasopressors [17].

In our study, the drug volumes were given according to weight and height. Since the patients were statistically similar in weight and height, the drug volumes given were similar. In this study, we investigated the effects of three different injection speeds (10, 15, and 20 seconds) of similar volume of isobaric bupivacaine during spinal anesthesia for cesarean section. Maternal hemodynamic parameters and the adverse effects of anesthesia were compared among the groups. The results showed that similar volume of isobaric bupivacaine injection speed did not affect the initiation time of sensory and motor block or the time for the sensory block to reach T10. A significant difference was observed in the sensory block time to reach T4, with longer times required for patients receiving the injection in 15 seconds compared to those receiving it in 10 seconds. However, no such effect was observed for patients receiving the injection in 20 seconds. In general, longer regression times to reach T10 and from Bromage 3 to 1 were noted with longer injection speeds, with the difference being more significant with 15 seconds compared to the other speeds tested. In a study comparing 3.2 mL of 0.5% heavy bupivacaine injected over 15 seconds versus 60 seconds, it was found that faster injection speed led to a faster block but required higher doses of vasopressors [18]. Another study reported that slow injection of bupivacaine (0.5%) 9 mg with 10 μg of fentanyl over 100 seconds (0.02 mL/sec) delayed the onset of hypotension and required less ephedrine, suggesting that slow injection of local anesthetic is an effective method for maintaining cardiovascular stability during cesarean section under spinal anesthesia [19].

In this study, mean blood pressure was significantly different only at the 20-minute mark, at which point the heart rate was higher in patients given similar volume of isobaric bupivacaine in 15 seconds compared to the other groups. No significant differences were observed at other time points. Heart rates were significantly higher at the 10th, 15th, 20th, and 30th minutes for patients receiving the injection in 15 seconds compared to those receiving it in 10 seconds, with no difference observed for the 20-second injection speed. Nausea and vomiting, as well as the need for ephedrine, did not show significant differences among the groups except at 3 minutes, where patients receiving the injection in 15 seconds showed higher nausea, vomiting, and ephedrine needs compared to those receiving the injection in 10 seconds, with no such effects seen for the 20-second injection. Tugcugil and Besir compared the effects of local anesthetic injection speed (150 seconds vs. 15 seconds) and found that prolonged anesthetic injection duration led to a shorter time for maximum sensory block level and a slower onset of hypotension [20]. No such significant difference was observed in our study, likely due to the closer proximity of the tested speeds compared to the previous study.

Although there are few studies directly related to our research, Nihan and colleagues evaluated 30- and 60-second injection speeds of local anesthetics to assess the effect of speed on hemodynamics during spinal anesthesia for cesarean section. They found that doubling the injection speed did not result in any significant differences in maternal hypotension, ephedrine doses, or motor and sensory block [21].

Conclusion

In conclusion, we compared three different injection speeds for isobaric bupivacaine in spinal anesthesia for cesarean section. Overall, the results indicated that a 15-second injection speed, compared to 10 seconds, led to a longer time for the sensory block to reach T4, longer T10 regression time, and longer time for regression from Bromage 3 to 1. However, these changes were not observed with a 20-second injection speed. Additionally, the 15-second injection speed led to a higher incidence of nausea, vomiting, and ephedrine need only at the 3rd minute, but not at other time points, as well as the 20-second injection speed. Therefore, it can be suggested that the different injection speeds tested in this study cause limited changes in hemodynamic parameters and side effects. One limitation of the study was the close duration between the injection speeds. Larger differences in time would likely yield more meaningful results. Our primary conclusion in our study was that no significant difference was seen between the durations. But the fact that some differences in 15 seconds were not seen in 20 seconds brought to our mind the question is ‘20 seconds the ideal duration?' Including more patients would further clarify the findings.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
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Ethical Approval
The study was approved by Ankara City Hospital No. 2 Clinical Research Ethics Committee Presidency (Protocol No: E2-21-1109, Date: 04.01.2023).

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