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Original Research

Comparison of the Effects of Two Different Low-Doses of Isobaric Bupivacaine on Intraoperative Hemodynamics under Spinal Anaesthesia during Caesarean Section: A Randomized Controlled Trial

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Abstract

Background: The objective of this study was to conduct a randomized controlled trial in order to examine the hemodynamic impacts of two different doses of intrathecal isobaric bupivacaine (5 mg and 7 mg) when combined with 15 µg fentanyl in the context of patients undergoing caesarean section under combined spinal epidural anesthesia. **Methods**: Eighty patients with American Society of Anesthesiologists physical status I and II, aged between 16–50 years, who would undergo elective caesarean section under combined spinal epidural anaesthesia were randomly allocated to Group A and Group B (n = 40, for each group). Group A patients received a solution containing 5 mg isobaric bupivacaine + 15 µg fentanyl (1.3 mL), while Group B patients received a solution containing 7 mg isobaric bupivacaine + 15 µg fentanyl (1.7 mL) intrathecally. Incidences of hypotension, intraoperative systolic blood pressure, diastolic blood pressure, heart rate, motor block resolving time, and analgesia duration were recorded. **Results**: Group A had a substantially lower incidence of hypotension than Group B ($p = 0.022$). Patients in Group B had significantly lower systolic blood pressure values at the 6th, 8th, 10th, 12th, 14th, 15th, and 30th minutes of the surgery compared to Group A ($p = 0.012$, $p = 0.014$, $p = 0.005$, $p = 0.016$, $p < 0,001$, $p = 0.002$, and $p = 0.011$; respectively). Both groups had similar diastolic blood pressure and heart rate values during surgery ($p > 0.05$). The motor block resolving time and analgesia duration were longer in Group B compared to Group A ($p < 0.001$ for both). Two (5%) patients in Group A and ten (25%) patients in Group B experienced postoperative itching ($p = 0.012$). **Conclusions**: We concluded that combining 5 mg isobaric bupivacaine with 15 mcg of fentanyl administered intrathecally provides adequate anaesthesia while maintaining better hemodynamic stability in patients undergoing caesarean section. **Clinical Trial Registration**: The study has been registered with registration number NCT05136040 on https://classic.clinicaltrials.gov/ct2/results?cond=&term=+NCT05136040&cntry=&state=&city=&dist=.

Keywords: caesarean section; hemodynamics; low dose bupivacaine; spinal anaesthesia

1. Introduction

Many neuraxial techniques are used in caesarean section (CS) operations. Combined spinal-epidural anaesthesia (CSEA) is one of the most commonly used method. This technique's advantages are avoiding maternal respiratory complications, guarding the baby against depressant agents, and allowing the mother to be awake and experience the birth [1–3]. The occurrence of hypotension induced by spinal anesthesia continues to be a prevalent issue among patients undergoing caesarean delivery [4,5].

The spread of local anaesthetics into the subarachnoid space, aortocaval compression caused by the gravid uterus, or decreased sympathetic tone due to spinal anaesthesia (SA) may cause hypotension [6]. Hypotension can be hazardous because it reduces maternal cardiac output and uteroplacental blood flow. Several techniques have been implemented to prevent the occurrence of hypotension. These include the utilization of prophylactic intravenous fluid administration of crystalloids and colloids, the implementation of protective leg wraps, and the initiation of prophylactic infusions of ephedrine or phenylephrine [7]. High doses of intrathecal local anaesthetics may cause high sensory and motor block levels and hypotension. Adding opioids increases the analgesic activity by reducing the local anaesthetic dose and prolonging the sensory block duration without increasing the motor and sympathetic block [8–11].

Bupivacaine is commonly used in spinal anaesthesia for CS [12]. The lowest dose of bupivacaine for CS is un-

known. The administration of bupivacaine at lower dosages has been seen to potentially decrease the occurrence of hypotension, while it may concurrently elevate the likelihood of encountering intraoperative pain [13].

Studies have been conducted comparing different low-dose bupivacaine regimens in CS [14–19]. However, randomized clinical trials comparing the effects of two low-dose isobaric bupivacaine on maternal hemodynamics are quite limited [20–22].

This randomized controlled trial was designed to compare the hemodynamic effects of 5 mg and 7 mg intrathecal isobaric bupivacaine combined with 15 µg fentanyl in patients undergoing CS with CSEA.

The H0 hypothesis is that there is no significant difference in intraoperative systolic blood pressure (SBP; mmHg) between the groups (5 mg and 7 mg).

The primary outcome was intraoperative SBP. The secondary outcomes were diastolic blood pressure (DBP; mmHg), heart rate (HR), intraoperative ephedrine consumption, intraoperative nausea and vomiting, the Bromage scores before and at the end of the surgery, and resolution time of the motor block.

2. Methods

This prospective randomized study was conducted between 15 October 2018 and 15 June 2019 on 80 patients with American Society of Anesthesiologists (ASA) physical status II, aged between 16–50 years, with body mass index (BMI) <40 kg/m^2, and 150–180 cm in height, who would undergo elective CS under CSEA. The study excluded individuals who had hypertension, significant systemic disease, multiple pregnancies, fetal or placental abnormalities, a history of hypersensitivity or allergy to the drugs used in the study, any contraindications for neuraxial anesthesia, infection at or around the puncture site, coagulation abnormalities, and those who were unable or unwilling to participate in the study.

When the patient arrived in the operation room, an intravenous (IV) line was inserted using a 20-gauge needle, and routine monitoring of electrocardiogram (ECG), peripheral oxygen saturation (SpO_2), and non-invasive blood pressure measurements were done. Before the anaesthesia procedure, the patient's weight, age, height, ASA physical status, BMI, and baseline values of SBP, DBP, and HR were recorded. Isolyte® S (Braun, Bethlehem, PA, USA) was infused at 10 mL/kg/h during surgery. The statistician randomly allocated the patients into two groups using a computer-generated sequence of numbers and prepared them in opaque envelopes in the order of their randomization codes. Before the operation, the primary researcher performing the combined spinal-epidural anaesthesia opened the randomization information envelope. An investigator blinded to the study group recorded the intraoperative and postoperative data. The patients and obstetricians were also blinded for the study group. Combined spinal-epidural anaesthesia was performed in the sitting position using the needle-inside-needle technique. After the skin preparation, local anaesthetics infiltration was performed with 2% lidocaine. The epidural space was determined between the L3–L4 or L4–L5 interspinous distance and at the midline using a 16 gauge Tuohy needle (Set for CSEA, Braun, Melsungen, Germany) using the loss of resistance. Then, the 27-gauge pencil-point needle was passed through the Tuohy, and dural puncture was performed. Following the observation of cerebrospinal fluid flow, patients in Group A were administered a solution consisting of 5 mg isobaric bupivacaine and 15 µg fentanyl, with a total volume of 1.3 mL. Conversely, patients in Group B received a solution comprising 7 mg isobaric bupivacaine and 15 µg fentanyl, with a total volume of 1.7 mL. These solutions were administered intrathecally within a duration of 30 seconds. After the spinal needle was removed, the epidural catheter was placed 3 cm in the epidural space via the Tuohy needle, and the catheter was stabilized. The participants were positioned in a supine position, with the left uterine displacement (LUD) technique applied. This involved placing a support under the right buttock, inclined at a 15° angle to the left. The purpose of this positioning was to reduce the risk of aortocaval compression. Room temperature was maintained at 24 °C throughout the operation. Warming blankets were used to conserve the patient's body temperature, and all fluids used during surgery were delivered at 37 °C. During the surgical procedure, the patients were administered oxygen via a face mask at a flow rate of 4 L/min.

After the spinal anaesthesia, hemodynamic parameters were recorded every 2 minutes (min) in the first 20 minutes and then every 5 minutes until surgery was completed. Hypotension was defined as a decrease in SBP below 20% of the baseline. Hypotension was treated with ephedrine (initial dose 10 mg, intravenous) and rapid colloid or crystalloid infusion until the blood pressure reached baseline. If hypotension persisted, vasopressor treatment was repeated every minute. Bradycardia was defined as a heart rate of 50 beats/min or less and treated with 1 mg IV atropine.

After the patient was placed in the supine position, the level of sensory block was tested at 2-minute intervals until T6 was reached. Then, the loss of cold sensation was tested bilaterally using ice blocks at 5-minute intervals until the maximal block level was reached. If the sensory block did not reach the T6 level before surgery or if there was severe pain during skin incision SA was considered unsuccessful. This condition was defined as inadequate analgesia. In this case, 5 mL of a solution containing 15 mL of 2% lidocaine + 2 mL bicarbonate + 2 mL fentanyl + 1 mL 1/200,000 adrenaline was given via epidural catheter, and the patient was excluded from the study.

The failed block was defined in which there is no evidence of either motor or sensory block after spinal anaesthesia. The assessment of anaesthesia effectiveness was

conducted based on the following parameters: motor block in the lower extremities, muscular relaxation, pain experienced during skin incision, and discomfort encountered during abdominal exploration. Motor block was determined according to the modified Bromage scale [23]: 0 = Subject is able to lift the leg straight and move the hip, knee and ankle 1 = Subject is unable to lift the leg straight but is able to flex the knee and ankle freely; 2 = Subject is unable to flex the knee and hip, but is able to flex the ankle; 3 = Subject is unable to flex the ankle, knee, and hip, but is able to move toes; 4 = No movement in the lower extremity. Muscle relaxation was assessed using a subjective scale based on the surgeon's statements: good (satisfactory), bad (inadequate, but the operation is possible), and insufficient (more anaesthetic intervention is needed to maintain the procedure). The assessment of pain experienced during the process of making a skin incision and abdominal exploration was categorized into three levels: absence of pain, moderate pain (which was regarded as tolerable), and severe pain (which was considered intolerable). After the delivery of the baby, all groups received an intravenous infusion of 20 IU oxytocin in 500 mL saline [24].

Intraoperative nausea, vomiting, hypotension, bradycardia, the need for ephedrine and atropine, operation time, the time between spinal injection and supine position, the time between spinal injection and delivery, duration of analgesia (time from spinal injection until the first analgesic requirement), parameters such as motor block degree (Bromage score) immediately before and at the end of the operation, resolution time of the motor block (time for the patient to move both legs), maximum block level, the time of the sensory block reaching the T6 dermatome after spinal injection, the need for additional epidural medication, as well as variables such as postoperative nausea and vomiting were recorded. Also, neonatal Apgar scores obtained at 1 and 5 min were recorded.

Statistical Analysis

It was calculated that at least 31 patients should be included in each group at an 80% power and 95% confidence level to make a statistically significant comparison between the groups, given that 5% of the 5 mg group and 35% of the 7 mg group would develop hypotension [15]. Considering potential dropouts, each group was designed to have 40 patients.

The analyses were conducted using the IBM SPSS 20 statistical software package (SPSS Inc., Chicago, IL, USA). The data were provided in terms of mean, standard deviation, percentage, and numerical values. The normal distribution of the continuous variables was assessed using both the Shapiro-Wilk test and the Kolmogorov-Smirnov test. The independent samples *t*-test was employed for comparing two independent groups when the normal distribution assumption was met, but the Mann-Whitney U test was utilized when the normal distribution assumption was met. Categorical variables were compared with the Pearson Chi-square test, the Chi-square Yates test, or the Fisher's Exact test, depending on the expected values. In multivariate analysis, predictive risk factors between groups were examined using the logistic regression analysis. Logistic regression model results were presented with odds ratio (OR) and 95% confidence intervals of OR. $p < 0.05$ was considered statistically significant.

3. Results

The flow chart of the study participants is shown in Fig. 1. A total of 83 patients were assessed for their eligibility to take part in the trial. Two participants were eliminated from the study due to their refusal to participate and failure to meet the inclusion criteria. As a consequence, a total of 81 individuals were recruited for the study. One patient in Group B was excluded from the analysis after randomization due to failed block. The final analysis contained a total of 80 patients.

No patient was excluded because of inadequate analgesia. Distributions of the demographic data and Apgar scores are shown in Table 1. Both groups had similar demographic data ($p > 0.05$), Apgar score at 1 min ($p = 0.293$), Apgar score at 5 min ($p = 0.267$).

Intraoperative anaesthesia characteristics in groups were presented in Table 2. In Group A, the incidence of hypotension was considerably lower than in Group B ($p = 0.022$). The number of patients requiring ephedrine was higher in Group B than in Group A, but this difference was not statistically significant ($p = 0.065$). The incidences of intraoperative nausea ($p = 0.705$), vomiting, and bradycardia ($p = 0.675$) were similar between groups.

In the multivariate logistic regression analysis (Table 3), basal HR ($p = 0.006$) and the local anaesthetic dose administered in the groups ($p = 0.011$) were found to be effective on hypotension. After performing an HR-adjusted analysis of covariance (ANCOVA) analysis, it was found that the administered dose was associated with the risk of developing hypotension regardless of heart rate ($p = 0.016$). Patients in Group B had significantly lower systolic blood pressure values at the 6th, 8th, 10th, 12th, 14th, 15th, and 30th minutes of the surgery compared to Group A ($p = 0.012$, $p = 0.014$, $p = 0.005$, $p = 0.016$, $p < 0.001$ $p = 0.002$, and $p = 0.011$; respectively) (Fig. 2). Both groups had similar DBP values during surgery ($p > 0.05$) (Fig. 2). Both groups had similar heart rate values during surgery (Fig. 2).

No statistically significant differences were seen between the groups in relation to maximal block levels ($p > 0.05$) (Table 4).

Bromage scores are shown in Table 4. At the start of surgery, there were statistically significant differences between groups regarding a Bromage score of 1 ($p = 0.033$). Eleven patients in Group A and three in Group B had a Bromage score of 1. At the end of the surgery, there were statistically significant differences between groups as regards

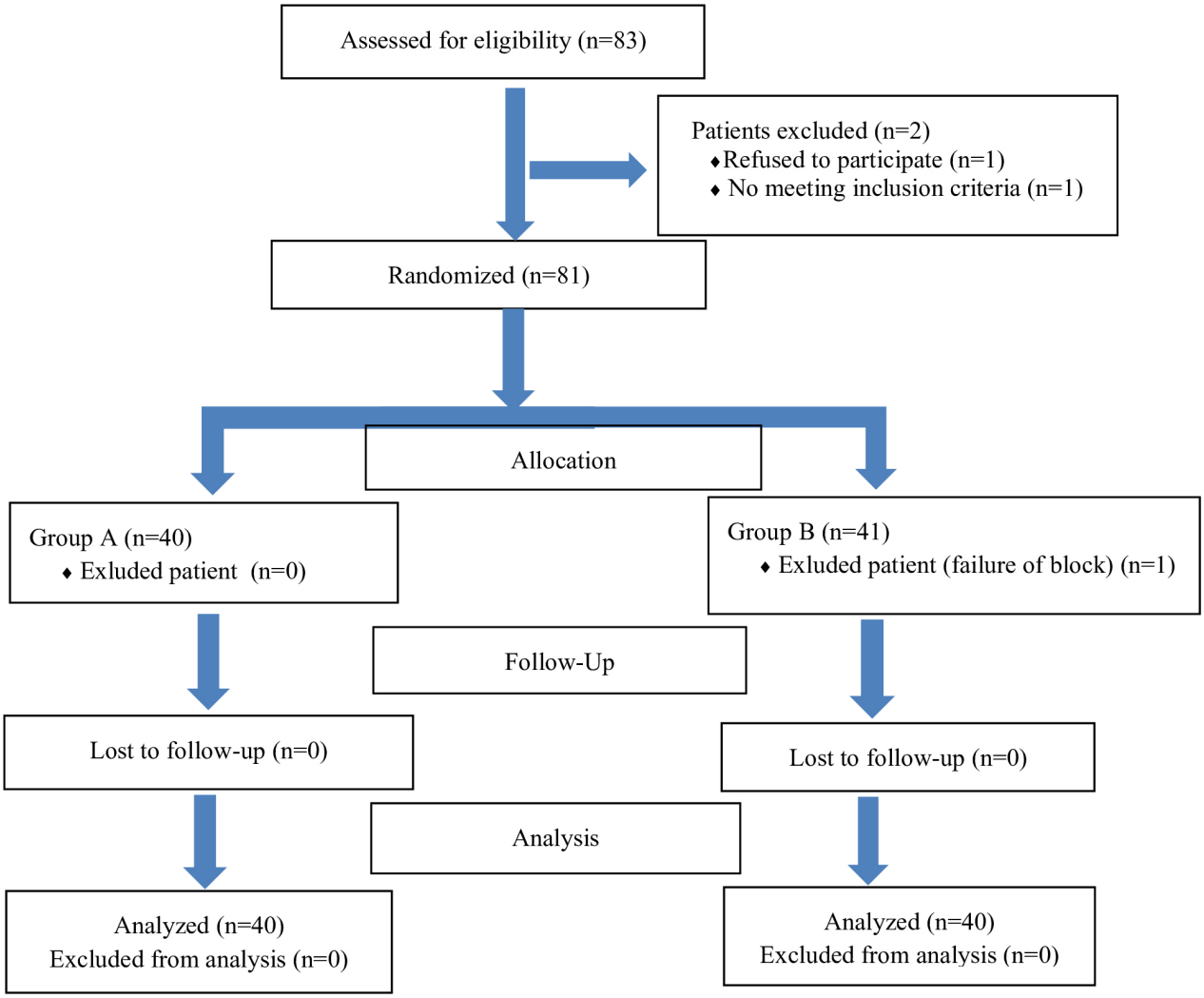

Fig. 1. The flow chart of the study participants.

Bromage scores of 0, 1, and 4 ($p = 0.02$, $p = 0.008$, and $p < 0.001$, respectively). Eight patients in Group A and one patient in Group B had Bromage scores of 0, twelve patients in Group A and two patients in Group B had a Bromage score of 1 and one patient in Group A and seventeen patients in Group B had a Bromage score of 4.

There were no significant differences between groups in terms of postoperative nausea and vomiting. However, postoperative itching was significantly lower in Group A than in Group B ($p = 0.012$) (Table 5).

The anaesthesia characteristics of the groups are presented in Table 6. The motor block resolving time and analgesia duration was longer in Group B than in Group A ($p < 0.001$ for both).

4. Discussion

In this study, we reported that intrathecal administration of 5 mg isobaric bupivacaine combined with 15 µg fentanyl provided adequate anaesthesia in patients undergoing CS, reduced hypotension, decreased the amount of vasopressor used, and shortened motor block resolving time compared to intrathecal 7 mg isobaric bupivacaine with 15 µg fentanyl. In addition, the administered dose was independently associated with the hypotension risk. Different low dose bupivacaine regimens at caesarean section have been published, but a comparison of low dose isobaric bupivacaine doses has not been widely researched. This present study is the first in the literature comparing the effects of two different low-dose intrathecal isobaric bupivacaine (5 mg and 7 mg bupivacaine with 15 µg fentanyl) on intraoperative hemodynamics in women undergoing elective caesarean surgery.

The incidence of severe hypotension in patients receiving SA for caesarean delivery has been reported as 20–100% [13–18]. To guarantee adequate anaesthesia during CS, an intensive block including S2–S4 sacral dermatomes is required, and the sensory block level should reach the T4 dermatome. This extensive block causes hypotension by blocking sympathetic fibres 8. The likelihood of experiencing significant arterial hypotension resulting from cardiac

Table 1. Comparison of demographic data and Apgar scores between groups.

	Group A (n = 40)	Group B (n = 40)	*p*
Age (years)	31 ± 4.00	31 ± 4.22	0.813
Weight (kg)	80 ± 11.00	77 ± 10.00	0.265
Height (cm)	163 ± 6.00	162 ± 5.00	0.233
BMI (kg/m^2)	30.19 ± 3.73	29.50 ± 3.61	0.396
Gestational age (weeks)	39.08 ± 0.47	39.00 ± 0.55	0.518
Basal SBP (mmHg)	131.32 ± 14.35	128.95 ± 15.62	0.870
Basal DBP (mmHg)	77.6 ± 9.15	78.37 ± 11.19	0.958
Basal HR (bmp/min)	96.15 ± 10.49	96.00 ± 13.17	0.567
Operation time (min)	46 ± 15.45	50 ± 11.46	0.117
Apgar score at 1 min	8.32 ± 0.76	8.46 ± 1.10	0.293
Apgar score at 5 min	9.84 ± 0.58	9.95 ± 0.62	0.267

Data are given as mean ± standard deviation (SD), BMI, body mass index; SBP, systolic blood pressure; DBP, diastolic blood pressure; HR, heart rate.

Table 2. The comparison of intraoperative anesthesia characteristics in groups.

	Group A (n = 40)	Group B (n = 40)	*p*
Hypotension	11 (27.5%)	21 (52.5%)	0.022*
Bradycardia	2 (5%)	4 (10%)	0.675
Ephedrine need	11 (27.5%)	21 (47.5%)	0.065
Atropine need	1 (2.5%)	3 (7.5%)	0.615
Intraoperative nausea	4 (10.0%)	3 (7.5%)	0.705
Intraoperative vomiting	0 (0.0%)	2 (5.0%)	NA
Muscle relaxation: very bad/bad/good	0/4/36	2/3/35	0.548
Pain during skin incision and abdominal exploration: none/moderate/severe	39/1/0	38/2/0	1.000

Values are given in numbers (n) and percentages (%). NA, Not applicable. * $p < 0.05$; Statistically significant between the groups.

sympathetic blockade is higher when the sensory levels are at or above T2 [25]. In the study, the block level reached T2 dermatome in more patients in the group in which we applied high-dose local anaesthetic, and accordingly, hypotension was more common in this group.

Our institution used 5 or 6 mg isobaric bupivacaine with 15 µg fentanyl in women undergoing CS with CSEA. Our clinical experience was that this dose caused less hypotension with adequate anaesthesia compared to conventional doses. Using 10 mg of bupivacaine alone or 8 mg in combination with an opioid has been reported as a low dose [8]; some authors considered only 8 mg of bupivacaine as a low dose [18].

Arzola and Wieczorek [18] conducted a meta-analysis that demonstrates a clear reduction in the incidence of hypotension when a low dose (≤8 mg) of bupivacaine is administered, as opposed to the usage of a conventional dose (>8 mg).

Three studies were conducted using intrathecal low-dose isobaric bupivacaine in CS. One was performed with CSEA and the other with single-shot SA.

Turhanoglu *et al*. [21] reported that the incidence of hypotension was 75% when isobaric bupivacaine (4 mg) with fentanyl (25 µg) was used. In comparison, it was 100% with isobaric bupivacaine (10 mg), and total ephedrine doses were significantly lower with low dose (4 mg) bupivacaine. Mebaza *et al*. [22] found the incidences of hypotension with 10 mg and 7.5 mg of isobaric bupivacaine, with 25 µg of fentanyl and 100 µg of morphine, were 88% and 68%, respectively. In the study conducted by Ben-David *et al*. [20], a comparison was made between the administration of 10 mg of isobaric bupivacaine and 5 mg of the same local anaesthetic combined with an additional 25 µg of fentanyl. The group administered with a dosage of 5 mg had a comparatively reduced occurrence of arterial hypotension in comparison to the group administered with a dosage of 10 mg (31% *vs*. 94% respectively). In all three studies, as in ours, the incidence of hypotension decreases as the dose of local anaesthetic is reduced. Although the local anaesthetic dose used by Turhanoglu *et al*. [21] was lower than our study, and the dose used by Ben-David *et al*. [20] was the same as ours, the incidence of hypotension was higher in both of them. This could be because the total drug volume (2 mL) administered in both studies was higher than that in our study (1.3 mL).

Despite contradictory findings in the literature, it is claimed that factors such as BMI [26] basal SBP [27], and basal HR [28] affect the development of hypotension due

Table 3. Multivariate logistic regression analysis for hypotension.

	OR	95% CI for OR		(*p*)	ANCOVA adjusted HR (*p*)
		Lower	Upper		
BMI (kg/m^2)	1.136	0.974	1.324	0.104	
Basal SBP (mmHg)	0.968	0.927	1.010	0.135	
Basal HR (bmp/min)	1.086	1.024	1.151	0.006	
Dose of bupivacaine	4.086	1.376	12.133	0.011	0.016
Constant	0.000			0.069	

OR, Odds Ratio; 95% CI, 95% Confidence Interval; ANCOVA, analysis of covariance.

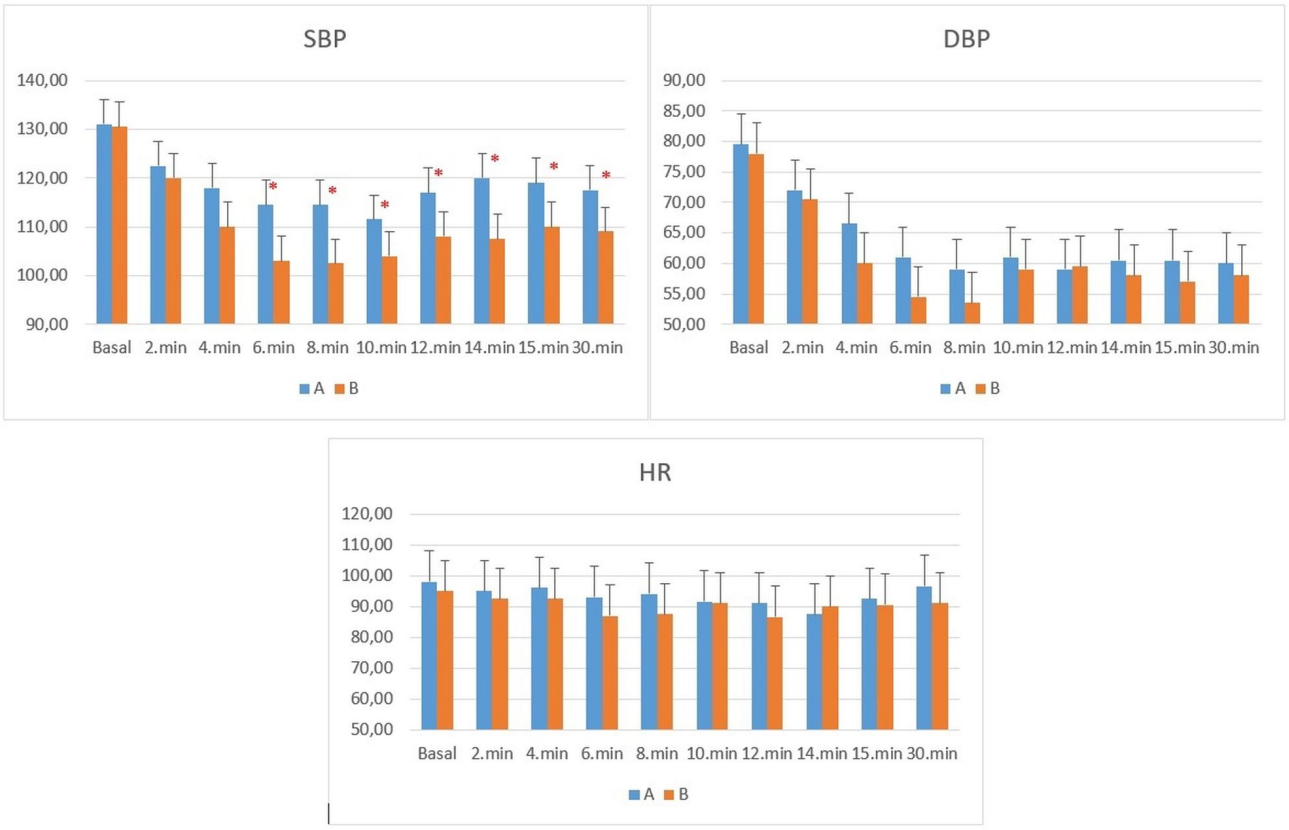

Fig. 2. The variations in systolic blood pressure, diastolic blood pressure, and heart rate measurements across groups. *, $p < 0.05$: statistically significant between the groups.

to spinal anaesthesia in pregnant women. The multivariate logistic regression analysis we conducted for this purpose determined that basal HR and the dose of local anaesthetic administered were significant predictors of hypotension development. We found that although HR was a confounding factor, the dose of local anaesthetic used was an independent risk factor for the incidence of hypotension when we performed an HR-adjusted analysis to determine the relationship between hypotension in patients and the dose of local anaesthetic administered. This result was consistent with our study's primary objective.

In addition to reducing the incidence of hypotension, one of the advantages of using low-dose local anaesthetics is that the motor block duration can be reduced, and the patient can be mobilized earlier. In a study, 44 women scheduled for CS under CSEA were randomized into two groups. The patients received intrathecal 3.75 mg or 9 mg hyperbaric bupivacaine with fentanyl 25 µg, morphine 100 µg, and epidural 1.5% lidocaine 3 mL. In the low-dose (3.75 mg) group, more rapid resolution of the motor block, less ephedrine consumption, and significantly less hypotension was reported [16]. This current study's results align with the results of the above study [16]. In this study, only one patient in the low-dose group had a complete motor block at the end of the surgery, and the time it took for the motor block to resolve after surgery was shorter in the low-dose group than in the high-dose group. This helped the earlier mobilization of patients in this group.

Table 4. Comparison of maximal block levels and Bromage scores between groups.

		Group A (n = 40)	Group B (n = 40)	*p* value
Maximal block level	T2	5 (12.5%)	13 (32.5%)	0.059
	T3	17 (42.5%)	15 (37.5%)	0.724
	T4	18 (45.0%)	9 (22.5%)	0.083
	C3	0 (0.0%)	1 (2.5%)	NA
	T6	0 (0.0%)	1 (2.5%)	NA
	T5	0 (0.0%)	1 (2.5%)	NA
Bromage score (at the start of surgery)	0	1 (2.5%)	0 (0.0%)	NA
	1	11 (27.5%)	3 (7.5%)	0.033*
	2	18 (45.0%)	19 (47.5%)	0.869
	3	6 (15.0%)	12 (30.0%)	0.157
	4	4 (10.0%)	6 (15.0%)	0.527
Bromage score (at the end of surgery)	0	8 (20.0%)	1 (2.5%)	0.020*
	1	12 (30.0%)	2 (5.0%)	0.008*
	2	12 (30.0%)	10 (25.0%)	0.670
	3	7 (17.5%)	10 (25.0%)	0.467
	4	1 (2.5%)	17 (42.5%)	<0.001*

Values are given in numbers (n) and percentages (%). NA, Not applicable. *$p < 0.05$.

Table 5. Comparison of postoperative side effects between groups.

	Group A (n = 40)	Group B (n = 40)	*p* value
Postoperative nausea	1 (2.5%)	1 (2.5%)	NA
Postoperative vomiting	0 (0.0%)	1(2.5%)	NA
Postoperative itching	2 (5%)	10 (25.0%)	0.012*

Values are given in numbers (n) and percentages (%). NA, Not applicable. *$p < 0.05$.

Table 6. The comparison of anesthesia characteristics in groups.

	Group A (n = 40)		Group B (n = 40)		*p* value
	Mean ± SD	Med (Min–Max)	Mean ± SD	Med (Min–Max)	
Time between spinal injection and supine position (sec)	191 ± 62	178 (120–360)	200 ± 62	185 (115–420)	0.318
Time between spinal injection and delivery (sec)	877 ± 254	845 (180–1510)	953 ± 235	905 (577–1970)	0.261
Time of sensory block to reach T6 after spinal injection (sec)	415 ± 162	395 (180–780)	384 ± 147	336 (175–780)	0.366
Analgesia duration (min)	119 ± 43	120 (60–240)	226 ± 72	210 (120–480)	<0.001*
Motor block resolving time (min)	99 ± 50	90 (30–210)	198 ± 80	188 (90–559)	<0.001*

Values are given as mean ± SD (standard deviation), median (min–max). *$p < 0.05$.

The literature reported that lowering the dose of bupivacaine to less than 10 mg without an epidural catheter may be potentially unsafe, as it may happen in prolonged surgery or increased need for intravenous analgesic agents due to inadequate blockade [29]. In a study comparing different doses of bupivacaine alone under caesarean section with spinal anaesthesia, 35% pain incidence with an 8 mg dose, 20% pain incidence with a 10 mg dose, and no intraoperative pain with 12 mg dose was reported [29]. In a study [30] conducted on 94 pregnant women, one group was given 12.5 mg bupivacaine with 80 µg morphine. The other group received intrathecally 80 µg morphine and 5 µg sufentanil added to 10 mg bupivacaine. Lowering the dose and adding sufentanil provided similar anaesthesia quality and intraoperative pain incidence between the two groups. Canan *et al.* [31] reported that adding lipophilic opioids to local anaesthetics reduces local anaesthetics dose, maintains the quality of analgesia, and significantly reduces intraoperative pain. In this current study, 15 µg fentanyl with a low dose of local anaesthetics was used. Although the dose of the medication was low, in all patients, we provided adequate analgesia.

There are certain limitations related to our investigation. One of the biggest limitations of this study related to its relatively limited sample size of patients and single-centre design.

Another limitation is that blood pressure was not invasively measured to follow the changes in systolic arterial pressure better. However, invasive arterial monitoring is not in our routine practice in uncomplicated pregnancies.

Third, the temperature of local anaesthetic agents is also important in the diffusion of local anaesthetics. All the local anaesthetics we used in the study were at room temperature.

5. Conclusions

We found that intrathecal administration of 5 mg isobaric bupivacaine combined with 15 mcg fentanyl in patients undergoing CS can provide adequate anaesthesia while preserving hemodynamic stability better and motor block resolution time can be shortened significantly. We suggest that this dose can be safely used in patients undergoing CS under CSEA. In addition, we also think that the dose of local anesthetic used intrathecally is an independent risk factor for hypotension.

Further studies with different doses of intrathecal bupivacaine are needed to support our results.

Abbreviations

SBP, systolic blood pressure; DBP, diastolic blood pressure; HR, heart rate.

Availability of Data and Materials

The dataset of the current research can be available from the corresponding author.

Author Contributions

KK, MA and AD did statistical analysis and the interpretation of data for the study. AD, OO and TK designed the research study. AD, CA, OEY ANA and GNCS did data collection. II and TK performed the research. AD and II did manuscript writing. All authors contributed to editorial changes in the manuscript. All authors read and approved the final manuscript. All authors have participated sufficiently in the work and agreed to be accountable for all aspects of the work.

Ethics Approval and Consent to Participate

All subjects gave their informed consent for inclusion before they participated in the study. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Ethics Committee of Ataturk University (approval number: B.30.2.ATA.0.01.00).

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Conflict of Interest

The authors declare no conflict of interest.

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