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Spinal anesthesia and combined sciatic nerve/lumbar plexus block techniques in lower extremity orthopedic surgery

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Objective: In lower extremity orthopedic surgeries, central and peripheral regional anesthesia techniques can be used along with general anesthesia, mainly in elderly patients with accompanying maladies. This study investigates the efficiency of spinal anesthesia and combined sciatic nerve/lumbar plexus block techniques in lower extremity orthopedic surgery in terms of patient-surgeon satisfaction.

Methods: Fifty consecutive patients (age range: 50-90 years), with an ASA score of 2-3 were scheduled for lower extremity orthopedic surgery. The patients were randomly divided into two groups according to anesthesia type. Group 1 (25 patients) received spinal anesthesia (SA) and Group 2 (25 patients) a combined sciatic/lumbar plexus nerve block (CSLPB). Spinal anesthesia was performed with 3 ml of 0.75% ropivacaine, and the combined sciatic/lumbar plexus nerve block was obtained with 10 ml 0.75% of ropivacaine and 10 ml of normal saline (20 ml in total). We recorded the time elapsed during the administration of the anesthesia and the initiation of its effect. Evaluation was made on patient-surgeon satisfaction.

Results: Regional anesthesia duration was significantly longer in the CSLPB group ($p<0.0001$). The time required to prepare the patients for surgery was statistically and significantly shorter in the SA group ($p<0.001$). Values of patient and surgeon satisfaction did not significantly correlate ($p>0.05$).

Conclusion: Both standard anesthesia and combined sciatic/lumbar plexus nerve block were effective in lower extremity orthopedic surgeries. Although surgery preparation time was longer in the CSLPB group, patient-surgeon satisfaction was similar in both groups.

Key words: Low extremity; orthopedic surgery; peripheral nerve block; ropivacaine; spinal anesthesia.

Use of regional anesthesia (RA) techniques offer many advantages, such as the ability to keep patients conscious during surgery, the maintenance of spontaneous respiration, the preservation of protective reflexes, early postoperative mobilization and the shortening of hospitalization.[1-3]

The elderly form the majority of patients who undergo orthopedic lower extremity surgery (OLES). The presence of cardiac, endocrine, renal, cerebral and respiratory diseases in these patients increases the perioperative and postoperative morbidity.[4] RA methods are often preferred in the presence of these diseases due to the increased risk of complications in the application of general anesthesia (GA).[5,6] Spinal anesthesia (SA) is the most frequently used RA technique in OLES and is more

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advantageous when compared to epidural and GA.[7,8] However, RA technique should not negatively affect the patient's hemodynamic balance. Another problem results from the length of the surgery as a single dose of SA does not usually last long enough, leading to the perioperative shift to GA, which creates an additional risk factor for patients.[9]

Despite their lower morbidity and fewer cardiovascular side effects, peripheral blocks have not been widely used because of the difficulties in their application.[10,11]

In our study, our aim was to compare the SA technique with a combined sciatic nerve/lumbar plexus block (CSLPB) in regards to the time elapsed during the administration of the anesthesia and the initiation of its effect, and the satisfaction levels of the patient and surgeon in patients undergoing OLES.

Patients and methods

Fifty consecutive patients (age range: 50-90 years) with an ASA score of 2-3 who underwent surgery due to various lower extremity pathologies between May and September 2006 were included in the study. The study was approved by the institutional review board of our hospital. Patients with allergies against local anesthetics, morbid obesity, hypotension, anti-thrombolytic treatment, neurological diseases, infections in the intervention site, alcoholism or addiction to narcotics and those who were unable to cooperate, who had undergone or were undergoing psychiatric treatment or did not accept the procedure were excluded from the study. Explanations regarding the procedure were provided to the patients and their written consent was obtained. Patients were divided into a spinal anesthesia (SA) group (Group 1) and a combined sciatic nerve/lumbar plexus block (CSLPB) group (Group 2). Both groups consisted of 25 patients.

All patients received a standard premedication of 1 mg midazolam. Patients' arterial blood pressures –systolic (SABP), diastolic (DABP) and mean (MABP)– were monitored by non-invasive methods. Heart rate (HR) and rhythm were monitored by ECG and peripheral oxygen saturation (SpO_2) was monitored by pulse oxymeter. Peripheral IV access was ensured using a 16G or 18G IV cannula and 500 ml of 0.9% NaCl solution was infused within 30-40 minutes for pre-hydration purposes. In the SA group, the patients were positioned in lateral decubitus. The region was aseptically cleaned and draped. In the selected intervertebral space (L4-L5 or L3-L4) injection site, 3-5 ml of 1% lidocaine was injected into the skin, subcutaneous tissue and the interspinous ligament using a 25G Quincke spinal needle (Braun®). After ensuring that dura was passed and the spinal space was entered, the plunger was drawn back and the free flow of the spinal fluid was observed. 3 ml of 0.75% ropivacaine (Naropin®) was injected to the subarachnoid space at a rate of 1 ml/10 sec. When this procedure was completed, the patient was immediately placed in the supine position. In the CSLPB group, sciatic block was applied using the classical technique. The patients were again placed in the lateral decubitus position on their contralateral side. The extremity of the upper side was left free with 40° of flexion and 20°-30° of abduction of the hip joint. The knee (of the extremity of the upper side) that was to be blocked was placed in 90° of flexion. The spina iliaca posterior superior and trochanter major were palpated and marked. These two points were connected with a straight line. The midpoint of this line was then determined and a perpendicular line was drawn downward from this point. On this perpendicular line, the point at the distance of 4 cm was marked. The region was aseptically cleaned and draped. To ensure local anesthesia on the injection point, an intradermal bulla was created with 1-2 ml of 1% lidocaine. A block needle, 10 cm in length, (Stimuplex A; B. Braun®, Melsungen AG, Germany) was connected to the nerve stimulator (Multiplex; Pajunk®, Germany) (initial current: 1.5-2 mA) and the approach was made through the intradermal bulla, perpendicularly to the skin. Upon determining stimulation of the foot with 0.4 mA or lower currents with the stimulation of the sciatic nerve stimulation at a 5-6 cm depth from the skin, 10 ml of 0.75% ropivacaine and 10 ml of saline (20 ml in total) were injected following the aspiration tests. Lumbar plexus application was then started. The position of the patient was not changed. A straight line was drawn between the iliac crests. Then, a vertical line was drawn on the midline, passing through the spinous processes of the lumbar vertebras. The injection point was determined as the point at 4 cm from the interception point of these two lines on the horizontal line. The region was aseptically cleaned and draped. Intradermal local anesthesia was provided with 1% lidocaine (3-5 ml). The block needle, 10 cm in length and connected to the nerve stimulator, was advanced perpendicularly to the skin and parallel to the floor, and was advanced till either the transverse process was felt or the stimulation of the lumbar plexus (twitching of the quadriceps muscle), whichever occurred first. When the needle touched the transverse process at 4-5 cm under the skin, the needle was drawn back and was re-directed to the caudal to pass by the transverse process. The needle was advanced till the twitching of the quadriceps muscle occurred at a current of 0.5 mA or less. When the rhythmic twitching of the patella was obtained, 10 ml of 0.75% ropivacaine and 10 ml of saline (20 ml in total) were injected following the aspiration test. Following the procedure, the patient was placed in the supine position. Like the SA group, the patients in the CSLPB group were also monitored throughout the procedure, and arterial blood pressures, heart rate and respiration rate, and O_2 saturation were followed closely. Hypotension was considered to be a MABP equal to 20% or less of the basal value, and bradycardia as an HR of less than 50 bpm.

Application times for both techniques were recorded in minutes. The level of analgesia was evaluated with a pinprick test and the motor block level was evaluated with a modified Bromage scale (0: No block, 1: Hip flexion blocked when knee in extension, 2: Knee flexion blocked, 3: Full motor block). The measurement of the hemodynamic parameters and sensory and motor block evaluation were performed every 5 minutes in the period after the drug application and surgery began following the development of full block.

The time required for the development of full block was recorded as the motor block time, and the time from the start of the surgical incision to the completion of the last suture was recorded as the operation time. Intraoperatively, the effectiveness of the anesthesia and analgesia was assessed by the surgeon and the patient as; very good, good, medium or poor. Postoperatively, the reversal time of the full motor block and the onset of pain in any region of the extremity (sensory block time) were recorded and evaluated.

SPSS 14 and INSTAT statistical package programs were used in statistical analysis. The Student's t-test and Fisher's exact tests were used to calculate the intergroup differences. ANOVA was used to calculate intragroup differences. Significance level was set at $p<0.05$.

Results

The demographic characteristics of the patients are given in Table 1. No statistical differences were found between the groups in regards to personal characteristics, such as age, gender, body weight, height, ASA score, or presence of additional diseases ($p>0.05$). Table 2 shows a list of the performed operations.

Statistically, no significant differences were found between the groups in regards to the operation times (75.84±16.37 minutes and 75.84±24.59 minutes in the SA and CSLPB groups, respectively) ($p>0.05$). A significant difference was found, however, between the application times of the techniques. While the application time of the technique was 3.94±0.93 minutes in the SA group, it was 13.84±2.62 minutes in the CSLPB group ($p<0.0001$) (Table 3).

The time needed to hand over the patient to the surgical team was 21.28±4.44 minutes in the SA

Table 1. The demographic characteristics of the patients. No statistically significant difference was found between the groups in regards to personal characteristics, such as age, gender, body weight, height, ASA score, or presence of additional systemic disorders ($p>0.05$).

	Spinal (n=25)	Combined sciatic/lumbar plexus nerve block (n=25)	p
Age	62.59±9.01	64.32±13.66	0.59
Weight (kg)	72.04±8.18	73.80±8.05	0.44
Height (cm)	171.72±5.54	171.38±9.55	0.84
F/M	5/20	7/18	0.74
ASA score 2/3	17/8	14/11	0.15
Other systemic disorders			
HT	14	12	0.77
DM	6	9	0.53
IHD	10	8	0.76
COPD	1	3	0.60
CRI	3	6	0.46

COPD: Chronic obstructive pulmonary disorder, CRI: Chronic renal insufficiency, DM: Diabetes mellitus, HT: Hypertension, IHD: Ischemic heart disease.

Table 2. Types of surgeries.

	SA group (n=25)	CSLPB group (n=25)
Amputation (below-knee/above-knee/metatarsal)	12	16
Ankle fracture	9	7
Tibial mass	3	1
Achilles tendon rupture	1	1

Table 3. Operation times, application times of the techniques, the time needed to hand over the patient to the surgical team, the mean time to obtain full motor block, total motor block and sensory block times.

	Spinal block (min.)	CSLPB (min.)	p
Operation time	75.84±16.37	75.84±24.59	1
Application time of the technique	3.94±0.93	13.84±2.62	<0.001*
Time for handing over to surgical team	21.28±4.44	20.04±4.03	<0.001*
Time for full motor block development	18.40±4.12	17.92±3.81	0.67
Time for motor block (total)	284.00±109.26	349.00±111.46	0.04*
Time for sensory block (total)	185.20±65.78	224.40±96.36	0.09

*Statistically significant difference (p<0.05).

group and was 33.84±5.26 minutes in the CSLPB group. This difference between the groups was statistically significant (p<0.0001) (Table 3).

The mean time to obtain full motor block was 18.40±4.12 minutes in the SA group and 17.92 ±3.81 minutes in the CSLPB group. The difference between these values was not significant (p>0.05) (Table 3).

There was a significant difference between the total motor block time of the two groups. While the motor block time in the SA group was 284.00 ±109.26 minutes, this time in the CSLPB group was 349.00±111.46 minutes (p<0.05) (Table 3). Although a significant difference was found for the motor block time, there was no significant difference between the sensory block times which were 185.20 ±65.78 minutes in the SA group and 224.40±96.36 minutes in the CSLPB group (p>0.05) (Table 3).

When evaluating the MABPs, the MABP values 25 minutes after the block (starting time of the surgery) and at the 5th minute of the surgery were significantly higher in the CSLPB group than in the SA group. In the intragroup evaluation, a significant decrease was seen in MABP values in the SA group at the 5th and 15th minutes of the surgery when compared with the pre-block value (p<0.05) (Fig. 1).

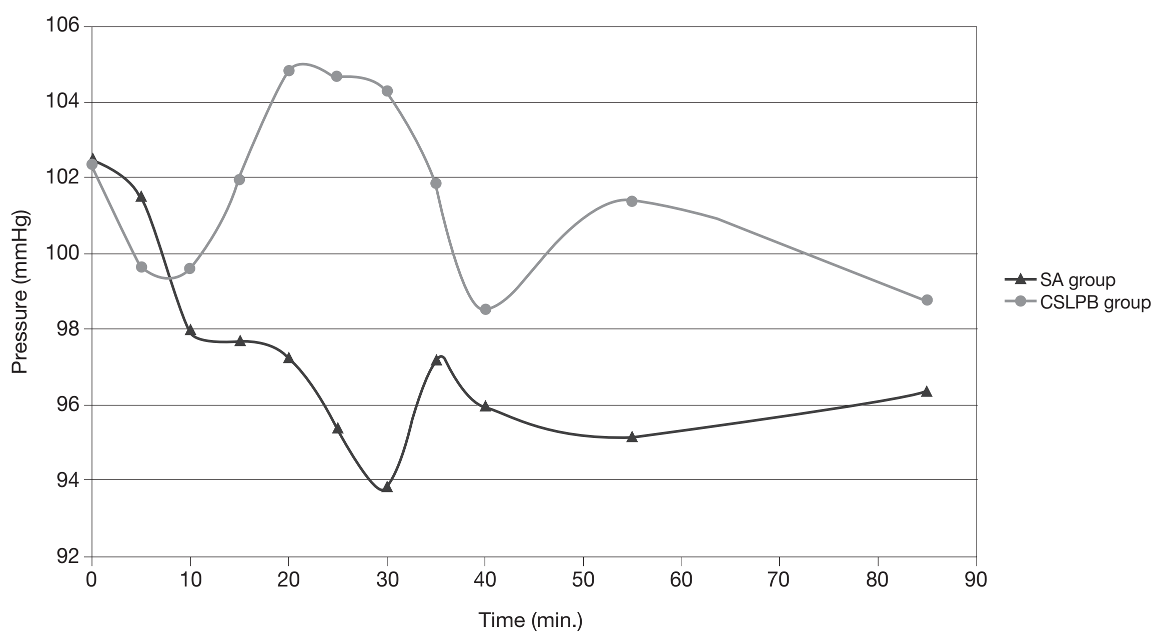

Fig. 1. Patient's MABP values. When evaluating the MABPs, the MABP values 25 minutes after the block (starting time of the surgery) and at the 5th minute of the surgery were significantly higher in the CSLPB group than in the SA group. In the intragroup evaluation, a significant decrease was seen in MABP values in the SA group at the 5th and 15th minutes of the surgery when compared with the pre-block value (p<0.05).

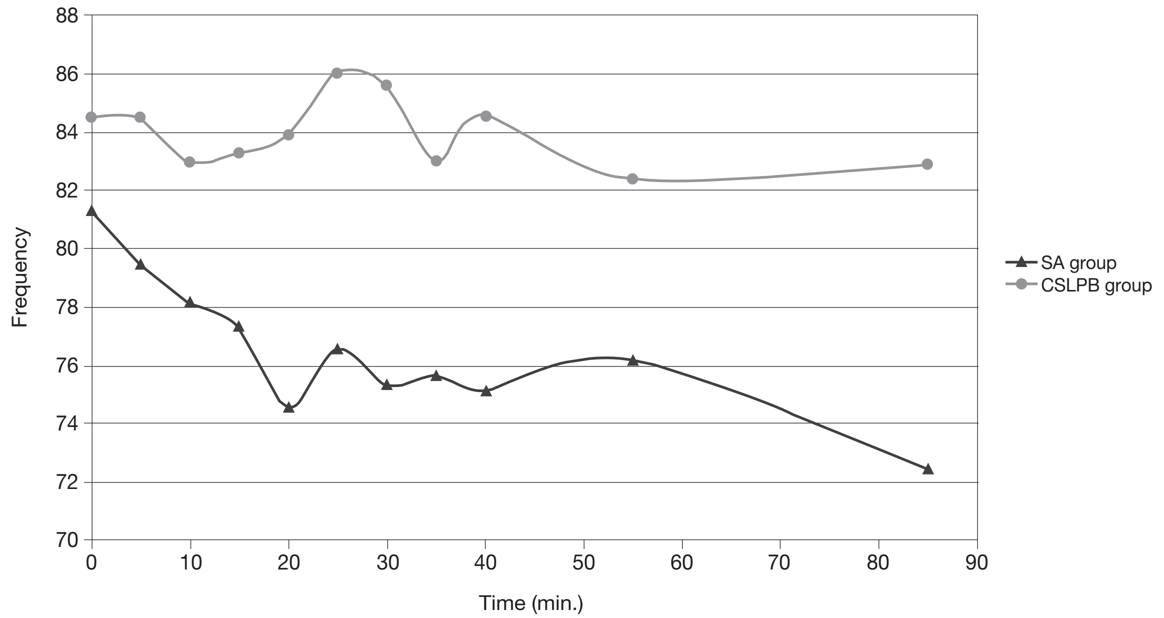

Fig. 2. Patients' heart rates.

The HR in the CSLPB group was statistically higher at the 20th ($p<0.05$), 25th ($p<0.05$) (start of the surgery), 30th ($p<0.05$) (5th minute of the surgery), 40th ($p<0.05$) and 85th ($p<0.05$) minutes. In the intragroup examination of the SA group, the pre-block HR decreased significantly after the 20th minute following the block ($p<0.05$), and was low during all the stages of the operation (Fig. 2).

Peripheral oxygen saturation values of the patients (SpO_2) did not fall below 98%. No statistically significant intra- or intergroup differences were found in SpO_2 values ($p>0.05$) (Fig. 3).

Another finding compared in our study was that of patient satisfaction. No significant differences were found between the two groups; the satisfaction rate in both groups was 76% ($p>0.05$) (Table 4).

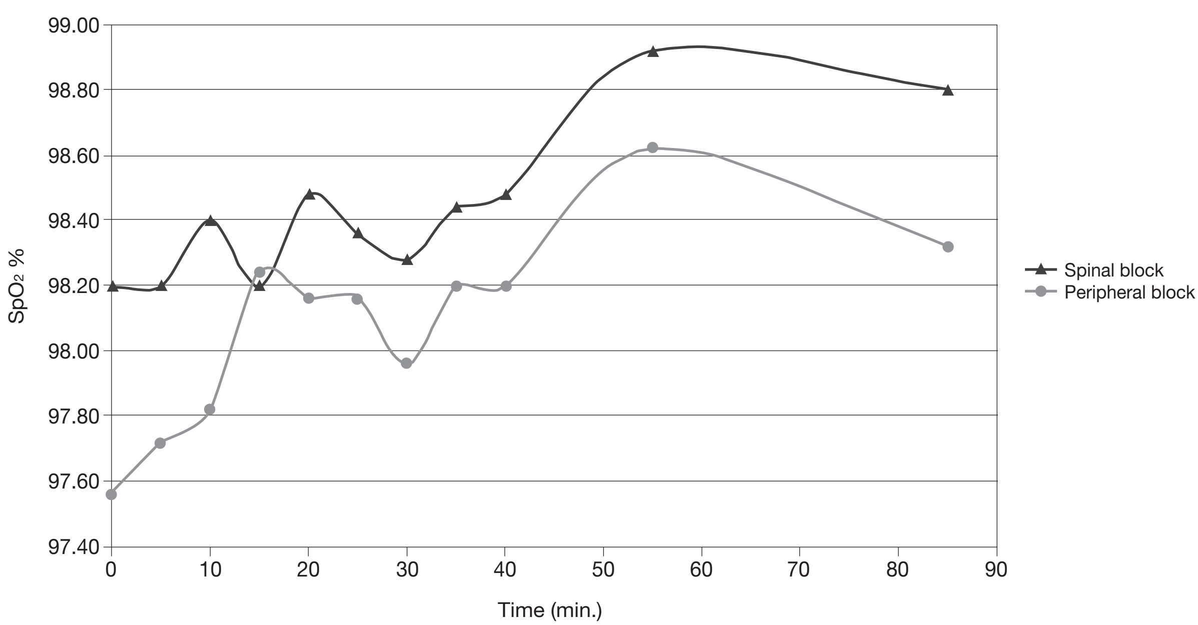

Fig. 3. Oxygen saturation (SpO_2) values of the patients.

Likewise, the satisfaction of the surgeons with the anesthesia method was included in the evaluation. Similar results were obtained in both groups and no statistically significant differences were found (p>0.05) (Table 5).

In two patients (8%) in the SA group in which 3 ml of %0.75 ropivacaine was used intrathecally, additional intravenous analgesic (fentanyl 50 µg) was needed. Likewise, we had to use additional analgesic of the same dosage in 3 patients (12%) in the CSLPB group. No patient required general anesthesia because of insufficient sensory block.

In our study, hypotension related to perioperative anesthesia was seen in 8 patients (32%) in the SA group and in 5 patients (20%) in the CSLPB group. No statistically significant differences were found between the groups in regards to the frequency of perioperative hypotension (p>0.05). The number of patients in which bradycardia was observed during the operation was 3 (12%) in both the SA and CSLPB groups.

Table 4. Patient satisfaction.

	Spinal block (n=25)	CSLPB (n=25)	p
Very good	19 (%76)*	19	1.25
Good	6	6	1.25

*Percent of all patients.

Table 5. Surgeon satisfaction.

	Spinal block (n=25)	CSLPB (n=25)	p
Very good	19 (%76)*	19	1.25
Good	6	6	1.25

*Percent of all patients.

Discussion

Peripheral blocking techniques or central blocking techniques, such as single-dose SA, epidural anesthesia and continued SA can be used in OLES.[12] Most patients on whom such surgical operations are performed are elderly. In this age group, accompanying diseases, such as hypertension or coronary artery disease are frequent. Therefore, it is important to select RA techniques that will not have negative effects on hemodynamics.[13] RA techniques used for pain control in the postoperative period are considered more advantageous than GA. An effective postoperative analgesia can ensure early mobilization of the patient and reduce morbidity.[1,14,15]

In our study, although CSLPB techniques required a longer application time, compared to the SA technique, we found similar motor and sensory block times. The time to hand the patient over to the surgical team was also significantly shorter in the SA group. In the study of Casati et al., comparing two different RA techniques in lower extremity surgery, the application and preparation stages in the peripheral nerve blocks were longer than those in SA. However, they did not find any difference in the handover time (spinal group: 14±5 min., combined sciatic nerve/lumbar plexus block group: 15±6 min.), or in the quality of anesthesia and analgesia.[16] The handover time for patients receiving CSLPB in Sansone et al.'s study was 23±5 minutes.[17] We handed over our patients after 20.04±4.03 minutes, following the application of CSLPB. However, when the block application time is added to this period, the handover time was much longer (33.84±5.26 minutes). Considering the possible co-morbidities, such as hypertension (HT), diabetes mellitus (DM), ischemic heart disease (IHD), chronic obstructive pulmonary disorder (COPD) or chronic renal insufficiency (CRI), the safety of this anesthesia method appears to eliminate the disadvantage of time loss.

In 2006, when we performed our study, the 7.5 mg/ml isobaric formula of ropivacaine was available. For the CSLPB group, we used the 3 ml 0.75% ropivacaine preparation with the same bar value used in the SA group. Kallio et al. showed that hyperbaric solution ensures a much more rapid onset and effective analgesia in the T10 dermatome level, as well as a much more rapid reversal motor block, when compared to 15 mg isobaric ropivacaine in SA in lower extremity procedures.[18] Wong et al. used 0.75% ropivacaine in volumes of 3.5 ml and 4.5 ml, and reported that both doses had the same efficacy and safety and no observable differences in side effects and hemodynamics.[19] In our study, we positioned the patients in the lateral decubitus position, with the extremity to be operated on the lower side. This position eased the application of SA and was more comfortable for our patients with extremity problems (ischemia, gangrene, fractures, immobilized extremity, or presence of plaster/splint). However, since we used isobaric ropivacaine, we positioned the patients in supine position after the SA application and monitored both the block levels and the hemodynamic changes. Although the application period of the SA was rather short in our study (3.94±0.93 minutes), the period required to hand the patient over to the surgical team was 21.28±4.44 minutes. We believe that this difference arises from the use of isobaric ropivacaine. Van Kleef et al. discovered that higher dosages ensured anesthesia with longer periods and created high levels of motor block in their study of 40 patients who had surgeries on the lower extremities with 3 ml of 0.75% intrathecal ropivacaine. The sensory block obtained with this dosage and concentration of ropivacaine was adequate for the operation without additional analgesia in only 32% of the patients.[20] However, McNamee et al. found that intrathecal ropivacaine in the same dosage and concentration ensured sufficient block in all the patients operated on for hip fractures.[21]

CSLPB causes limited hemodynamic effects compared to central RA techniques as it minimally effects the hemodynamic balance and does not affect the regional blood circulation in the extremity.[22,23] In their study on hip fracture surgery, Naja et al. observed less intraoperative hypotension with CSLPB compared to other anesthetical techniques. They also reported that CSLPB significantly reduced the need for postoperative intensive care.[24] In our study, we concluded that the hemodynamic stability without a statistically significant difference in perioperative hypotension and bradycardia can be due to the use of ropivacaine. A greater decrease in MABP and HR was observed in the SA group than in the CSLPB group. However, this decrease was observed in the 25th minute of the application and was less than 12%, not affecting the hemodynamic stability significantly. Considering the time of the occurrence, we attributed this hypotension and lower HR in the SA group at the 25th minute of the application to the sympathetic effect of SA. In the study performed by McNamee et al., hypotension requiring treatment with ephedrine was seen in 24% of the patients during and after SA performed with 2.5 ml of 0.75% ropivacaine. The rate of hypotension was 32% in the perioperative period and 20% in the postoperative period. Hypotension was seen especially in elderly patients and this was attributed to the sedation with propofol used in addition to spinal anesthesia. In the same study, McNamee et al. reported that in the group in which they used 3 ml intrathecal 0.75% ropivacaine, the patients were cardiovascularly stable and the percentage of bradycardia was rather low (about 10%).[21] We performed our study on ASA 2-3 group elderly patients and none receiving CSLPB required intensive care in the postoperative period.

Femoral nerve blocks, combined or not combined with sciatic nerve blocks, have been successfully used in OLES.[10,25] In Sansone et al.'s study, patient satisfaction with CSLPB techniques were lower compared to the spinal block, and only 73% of 601 patients stated that they would accept to be operated on by this technique again.[17] In our study, however, it was seen that patient satisfaction was equal in both applications (76%). Like in patient satisfaction, surgeon satisfaction was also equal in both groups (76%). We attributed dissatisfaction with the anesthesia type in the non-satisfied surgeon group (24%) to the surgeon's familiarity with general anesthesia and foreseeing of an insufficiency of the level of anesthesia in the case of any extension of the operation time, the patient's ability to move his/her other extremity and other body parts with only one extremity blocked, and the patient's inquiries during the course of the operation when sedation was inadequate.

Our study's limitation was that the period of full motor block in the postoperative period in both groups was longer than the sensory block periods. We found that the full block reversal time was extraordinarily long, particularly in the CSLPB group (349.00±111.46 minutes). We believe that this results from three factors. In the first place, it is related to the high level of ropivacaine in the 0.75% concentration we used in the block applications. Secondly, it is related to our evaluation with the Bromage scale which was originally designed for the evaluation of the peripheral nerve block and defines the motor block period on a scale between fully motionless and a completely free use of the extremity.[26] The third and most important factor may be the subjective indirect information on the motor block time taken by the surgery ward's nurses and patient relatives.

With the increasing development of the practice of RA, this technique will rapidly become more popular. RA ensures less nausea and vomiting in patients undergoing orthopedic surgery and provides shorter periods of hospitalization, better postoperative analgesia and quicker mobilization. It reduces the need for postoperative intensive care and is more cost-effective.[27] In conclusion, as ropivacaine has some vasoconstrictor effect and little effect on the cardiovascular system, it is advantageous in the practice of RA.[28] Both RA methods using ropivacaine are safe and effective in lower extremity orthopedic intervention.

Conflicts of Interest: No conflicts declared.

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