



Original Research

Interscalene Block versus Posterior Suprascapular Block for Postoperative Analgesia on Arthroscopic Shoulder Surgery: Randomized, Controlled, Prospective Study

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Abstract

Objectives: This study aimed to compare the effects of interscalene block and posterior suprascapular nerve block on postoperative analgesia in the first 24 hours after unilateral arthroscopic shoulder surgery.

Methods: Ninety-eight adult patients aged between 18 and 65 years, with ASA (American Society of Anesthesiologists) physical status I-II, undergoing elective arthroscopic shoulder surgery were included in this prospective, randomized controlled study. All patients were randomized into two groups: the interscalene block group (Group ISB, n=48) and the suprascapular block group (Group SSB, n=50). Both groups received 10 mL of 0.5% bupivacaine. The duration of analgesia, total opioid consumption, complications, and Visual Analog Scale (VAS) scores were recorded at postoperative 0, 1, 4, 6, 12, and 24 hours.

Results: Statistical data were analyzed in 87 patients after 7 patients from Group SSB and 4 patients from Group ISB were excluded from the study. There was no significant difference between the two groups in analgesia duration, total opioid consumption, and patient satisfaction. While VAS values at 0 hours ($p<0.01$), 1 hour ($p<0.05$), 4 hours ($p<0.01$), and 6 hours ($p<0.01$) were lower in Group ISB, the VAS value at the 12th hour was similar between Group SSB and Group ISB ($p>0.05$). However, the VAS value at the 24th hour was lower in Group SSB ($p<0.01$). The complication rate was higher in Group ISB ($p<0.01$).

Conclusion: It was concluded that ultrasound-guided posterior SSB for postoperative pain after arthroscopic shoulder surgery is not equivalent to ISB, especially in the early postoperative period, but it is an effective alternative technique with fewer side effects.

Keywords: Arthroscopic shoulder surgery, arthroscopy, interscalene block, postoperative pain, shoulder surgery, suprascapular block

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Arthroscopic shoulder surgery triggers severe postoperative pain; therefore, postoperative pain treatment must be carefully considered. Postoperative pain has been associated with many complications, such as patient dis-

satisfaction, immobility, atelectasis, and chronic pain.^[1] Although opioid consumption is reduced with multimodal analgesia, opioid-related side effects such as nausea, vomiting, and drowsiness are still encountered.^[2,3]

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Regional anesthesia techniques utilized for postoperative pain treatment after arthroscopic shoulder surgery include suprascapular nerve block (SSNB), superior truncal brachial plexus block, interscalene block (ISB), and the combination of suprascapular and axillary nerve block.^[4-6] ISB is the most frequently used of these techniques; it has an 8-hour analgesic effect and a 12-hour opioid-sparing effect.^[7] However, it may result in adverse consequences such as diaphragmatic paresis, numbness in the arm, weakness, Horner's syndrome, and rebound pain because of the abrupt cessation of the strong analgesic effect.^[8,9]

The suprascapular nerve (SSN), which provides 70% of the sensory innervation to the shoulder joint and its capsule, originates from the superior trunk comprising C5 and C6 of the brachial plexus. Furthermore, it innervates the supraspinatus and infraspinatus muscles both motorily and sensorily. The branches of the axillary, supraclavicular, subscapular, and pectoral nerves constitute 30% of the sensory innervation of the shoulder.^[10] Both acute and chronic shoulder pain can be managed with SSNB, which can be used alone or in combination with other block techniques during surgical procedures.^[11,12] SSNB has become a widely used technique because it is easy to apply and is associated with fewer complications.^[13,14]

In this prospective randomized study, we aimed to compare the analgesic effects of ultrasound-guided ISB and SSNB on postoperative analgesia in patients undergoing arthroscopic shoulder surgery.

Methods

This study was conducted between December 2020 and April 2021, in accordance with the This study was approved by the Health Sciences University Sisli Hamidiye Etfal Training and Research Hospital Clinical Research Ethics Committee (Date: 24.11.2020, Decision no: 1708) and the Declaration of Helsinki. Written and verbal consent was obtained from all patients, and the study was designed as a randomized, single-center, prospective, single-blind study.

A total of 98 patients with ASA (American Society of Anesthesiologists) physical status classification system I-II who underwent unilateral arthroscopic shoulder surgery between the ages of 18 and 65 years were included in the study. Exclusion criteria were: not giving consent, ASA III-IV, local anesthetic allergy, infection, coagulation disorder, BMI>30, severe lung disease, organ failure, psychiatric disease, prior neurologic deficit, contralateral diaphragmatic paralysis, chronic pain history, and open shoulder surgery. Randomization was performed using the closed-envelope method after patients were admitted to the premedication unit (PU). Patients were divided into two groups: the inter-

scalene block group (Group ISB, n=48) and the suprascapular block group (Group SSB, n=50). One day prior to the procedure, all patients underwent a preoperative evaluation at the clinic, where they were informed about the use of the Visual Analog Scale (VAS) for pain assessment and the administration of both blocks.

On the day of surgery, the patients were admitted to the PU. Following standard monitoring (electrocardiogram, SpO₂, non-invasive blood pressure measurement), the patients' demographic information (age, gender, height, weight, and BMI) was documented. In both groups, all blocks were performed by the same experienced anesthesiologist. Under aseptic conditions, all blocks were applied using an Esaote CA631 high-frequency linear ultrasound probe and a Braun Stimuplex® Ultra 360® 0.9×80 mm needle with the in-plane technique.

Group ISB patients were placed in the supine position with their heads facing the opposite side of the shoulder to be operated on. The ultrasound probe was positioned over the cricoid cartilage and angled laterally until the carotid artery became visible at the level of the cricoid cartilage. Then, by moving the probe laterally and posteriorly, the brachial plexus between the anterior and medial scalene muscles was identified. Bupivacaine (10 mL, 0.5%) was injected around the nerve with controlled frequent aspirations.

Following placement in a seated position, Group SSB patients were instructed to use the arm to be treated to hold onto the opposing shoulder. A concave supraspinous fossa and a bright supraspinatus muscle were observed when the ultrasound probe was positioned on the spina scapula parallel to it and advanced laterally. In this fossa, below the hyperechoic transverse scapular ligament at the suprascapular notch, the SSN was observed next to the suprascapular artery. Bupivacaine (10 mL, 0.5%) was injected around the nerve in a controlled manner.

The patients in both groups were followed in the PU for 30 minutes, and then the sensory block was checked with a pinprick test using a 22-gauge needle applied to the posterolateral and superior deltoid area, asking the patient to compare the sensation with the opposite shoulder. Patients were asked to score the sensory stimulus as "no sensation 1, reduced sensation 2, normal sensation 3." At this stage, patients with a score of 3 points were considered to have an unsuccessful block and were excluded from the study. The anesthesiologist who evaluated the pinprick test was blinded to the groups.

Then, the patients were taken to the operating room and underwent surgery under general anesthesia. Fentanyl (2 mcg/kg), propofol (2-3 mg/kg), and rocuronium (0.6 mg/

kg) were used to induce general anesthesia. Maintenance of anesthesia was provided with a 50% O₂–50% air mixture and sevoflurane. During the operation, patients were followed under routine monitoring. All patients were routinely administered 4 mg ondansetron for postoperative nausea and vomiting prophylaxis. The awakened patients were observed in the postoperative anesthesia care unit for the first 1 hour and then in the inpatient service for 24 hours. All surgical procedures were performed by the same surgical team, and no local anesthetic was used.

The duration from induction until the patient was extubated was defined as the duration of anesthesia. Operation time was defined as the time from surgical incision to completion of the skin suture. VAS was used to evaluate postoperative analgesia. The VAS score was recorded at postoperative 0th minute, 1st hour, 4th hour, 6th hour, 12th hour, and 24th hour. Paracetamol 1 mg/kg (maximum dose of 4 g/day) was administered routinely four times a day to all patients. When the VAS value was found to be ≥ 4 at any time, tramadol (maximum dose of 400 mg/day) was administered intravenously and recorded. The duration until the first intravenous analgesic requirement after the block was defined as the “analgesia duration” and was recorded. Complications (dyspnea, deepening of voice, Horner’s syndrome, muscle weakness in the arm, numbness in the arm) were also recorded. At the end of the 24th hour, patient satisfaction was evaluated on a 4-point scale as follows and recorded: 4 excellent, 3 good, 2 not bad, 1 bad. The anesthesiologist who was blinded to the groups collected postoperative records.

Statistical Analysis

The NCSS (Number Cruncher Statistical System) statistical software program, based in Utah, USA, was used to perform the statistical analysis of the study data. Descriptive statistical methods such as mean, standard deviation, median, frequency, and ratio were used to evaluate the data. The variables’ conformance to a normal distribution was evaluated using boxplot graphics and the Shapiro–Wilk test. Groups of normally distributed variables were compared using the Student’s t test. When comparing non-normally distributed parameters between groups, the Mann–Whitney U test was used. Fisher’s exact test, Fisher–Freeman–Halton exact test, and Pearson’s chi-squared test were used to compare and analyze qualitative data. The significance level was set at $p < 0.05$.

In comparisons of analgesia duration, visual analog scale values, complications, and patient satisfaction between two independent study groups, the minimum number of cases required for our study—designed with a moderate effect size (0.3 for the Chi-square test, 0.5 for the t test),

a significance level of $\alpha = 0.05$, and a statistical power of 80%—was calculated using the G*Power 3.1.9.2 program. The analysis showed that 98 cases were required.

Results

A total of 98 patients were included in the study. Two patients in Group SSB were considered unsuccessful blocks, and conversion to an open procedure in a total of nine operations resulted in exclusion from the study. Statistical evaluation was performed with 44 patients from Group ISB and 43 patients from Group SSB (Fig. 1). There was no statistically significant difference between the two groups in terms of demographic data, operation time, anesthesia duration, or type of surgery ($p > 0.05$) (Table 1).

The mean duration of analgesia was significantly longer in the SSB group (891.9 minutes) compared to the ISB group (799.3 minutes) ($p < 0.05$). However, no statistically sig-

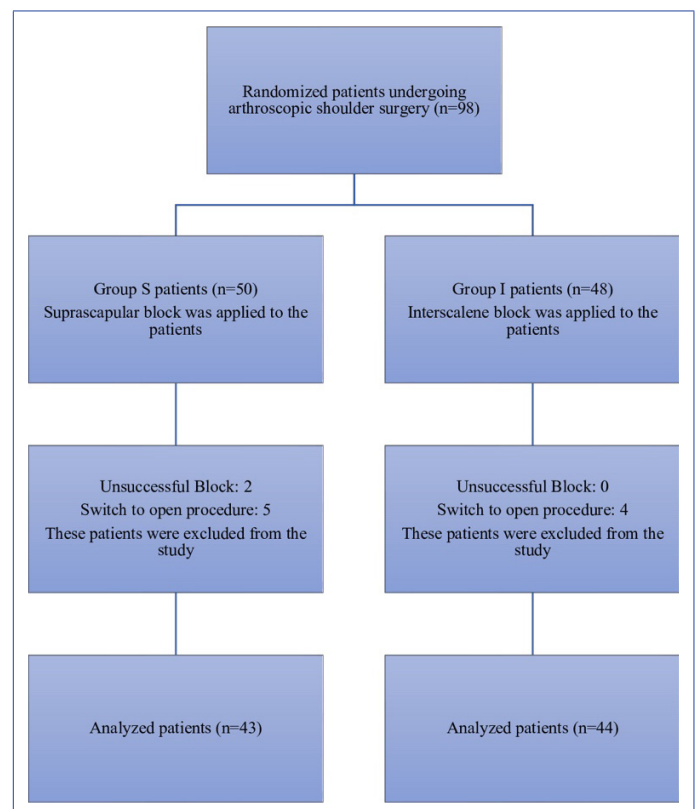
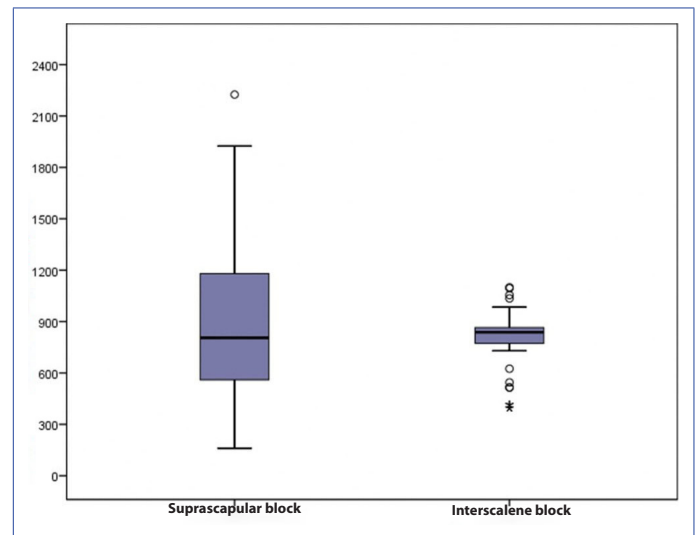


Figure 1. Patient flow chart: A total of 98 patients were included in this study. The patients were randomly divided into two groups as interscalene block group (Group ISB, $n = 48$) and suprascapular block group (Group SSB, $n = 50$). Two patients from the Group SSB, whose pinprick test was found to be 3 in the preoperative period, were considered to have unsuccessful block and excluded from the study. Five patients from Group SSB and 4 patients from Group ISB were excluded because the operation was planned arthroscopically and changed to open procedure. Statistical evaluation was performed with 44 patients from Group ISB and 43 patients from Group SSB.

Table 1. Demographic data of patients, operation, anesthesia and analgesia information

	Groups		p
	Suprascapular block n (%)	Interscalene block n (%)	
Age			
Mean±SD	47.86±10.87	44.27±12.19	0.151
Median (Min-Max)	49 (21-64)	44 (21-64)	
Gender			
Male	27 (62.8)	26 (59.1)	^b 0.724
Female	16 (37.2)	18 (40.9)	
ASA			
ASA 1	25 (58.1)	29 (65.9)	^b 0.455
ASA 2	18 (41.9)	15 (34.1)	
Comorbidity			
Absent	25 (58.1)	29 (65.9)	^b 0.455
Present	18 (41.9)	15 (34.1)	
Height (cm)			
Mean±SD	176.56±7.08	175.45±8.31	0.507
Median (Min-Max)	178 (161-187)	176 (157-188)	
Weight (kg)			
Mean±SD	78.09±10.29	77.57±10.48	0.814
Median (Min-Max)	78 (59-96)	79 (58-96)	
BMI (kg/m ²)			
Mean±SD	24.95±2.43	25.05±1.71	0.823
Median (Min-Max)	25.1 (18.9-29.4)	25.2 (21.9-28.3)	
Analgesia duration (min)			
Mean±SD	891.9±466.0	799.3±178.6	^c 0.899
Median (Min-Max)	805 (160-2225)	837.5 (395-1100)	
Duration of operation			
Median (Min-Max)	805 (160-2225)	837.5 (395-1100)	0.440
Median (Min-Max)	100 (60-135)	95 (60-140)	
Duration of anesthesia			
Mean±SD	115.81±18.09	110.45±14.26	0.128
Median (Min-Max)	115 (80-155)	110 (70-150)	
Number of people using tramadol in the first 24 hours (n=50)			
Negative	17 (39.5)	20 (45.5)	^b 0.577
Positive	26 (60.5)	24 (54.5)	
Type of surgery			
Bankart repair	5 (11.6)	2 (4.5)	^b 0.349
Frozen shoulder	4 (9.3)	7 (15.9)	
Rotator cuff repair	34 (79.1)	35 (79.5)	

Data are expressed as n (%) and Mean±Ss. ^aStudent-t Test; ^bPearson Chi-square test; ^cMann-Whitney U test; p<0.05. ASA: American Society of Anesthesiologists Physical Status Classification System, BMI: Body Mass Index; cm: centimeter; kg: kilogram, m²: square meter.

**Figure 2.** Analgesia duration: The duration till the first intravenous analgesic requirement after the block was performed.

nificant difference was observed in opioid consumption within the first 24 hours between the two groups (p>0.05) (Table 1), (Fig. 2). Postoperative VAS scores at the 0th hour (p<0.01), 1st hour (p<0.05), 4th hour (p<0.01), and 6th hour

Table 2. Visual analog scale scores

	Groups		p
	Suprascapular block	Interscalene block	
VAS 0			
Mean±SD	0.16±0.37	0±0	0.006**
Median (Min-Max)	0 (0-1)	0 (0-0)	
VAS 1 th hour			
Mean±SD	0.72±1.42	0.11±0.39	0.017*
Median (Min-Max)	0 (0-5)	0 (0-2)	
VAS 4 nd hour			
Mean±SD	1.70±1.39	0.73±1.35	0.001**
Median (Min-Max)	2 (0-5)	0 (0-5)	
VAS 6 th hour			
Mean±SD	2.6±1.09	2.02±1.13	0.005**
Median (Min-Max)	2 (1-6)	2 (0-6)	
VAS 12 th hour			
Mean±SD	3.56±1.35	4.02±1.15	0.083
Median (Min-Max)	3 (2-6)	4 (2-6)	
VAS 24 th hour			
Mean±SD	2.6±0.73	3.82±1.13	0.001**
Median (Min-Max)	2 (2-4)	4 (2-6)	

^cMann Whitney U test, *p<0.05, **p<0.01. VAS: Visual analog scale.

($p < 0.01$) were lower in the ISB group compared to the SSNB group. However, VAS scores at the 12th hour showed no significant difference between the groups ($p > 0.05$). Moreover, VAS scores at the 24th hour were higher in the ISB group than in the SSB group ($p < 0.01$) (Table 2).

Patient satisfaction rates were similar between the groups ($p > 0.05$), but a significantly higher proportion of patients in the SSNB group rated their satisfaction as “excellent” (Table 3). The incidence of adverse effects was also evaluated. The ISB group had a significantly higher rate of muscle weakness (54%) and arm numbness (25%) compared to the SSB group ($p < 0.01$). No cases of dyspnea, Horner’s syndrome, or hoarseness were observed in either group (Table 4).

Table 3. Patient satisfaction scores

	Suprascapular block	Interscalene block	<i>p</i>
Patient satisfaction			
Poor	0 (0)	0 (0)	^{dd} 0.080
Fair	1 (2.3)	2 (4.5)	
Good	11 (25.6)	20 (45.5)	
Excellent	31 (72.1)	22 (50.0)	

Data are expressed as n (%) and Mean±SD. ^{dd}Fisher-Freeman-Halton Test, $p < 0.05$.

Table 4. Complication rates by groups

	Suprascapular block n=43 (%)	Interscalene block n=44 (%)	<i>p</i>
Muscle weakness			
Absent	37 (86)	20 (45.5)	^b 0.001**
Present	6 (14)	24 (54.5)**	
Numbness in arm			
Absent	43 (100)	33 (75)	^b 0.001**
Present	0 (0)	11 (25)**	
Dyspnea			
Absent	43 (100)	44 (100)	-
Present	0 (0)	0 (0)	
Horner’s syndrome			
Absent	43 (100)	44 (100)	-
Present	0 (0)	0 (0)	
Deepening of the voice			
Absent	43 (100)	44 (100)	-
Present	0 (0)	0 (0)	

** $p < 0.01$, ^bPearson chi-squared test

Discussion

Our study demonstrated that ISB provided lower pain scores in the early postoperative period (up to 12 hours) compared to SSB. However, opioid consumption over 24 hours was similar between the two groups. SSB provides adequate pain relief and could be used as an alternative peripheral nerve block technique as part of multimodal analgesia for arthroscopic shoulder surgery.

Suprascapular nerve blocks (SSNB) can be performed using several techniques, including landmark-based, ultrasound-guided posterior, and ultrasound-guided anterior approaches.^[14-17] When the analgesic scores of these methods are examined, a study by Auyong et al.^[16] applied anterior suprascapular, interscalene, and supraclavicular blocks to patients and concluded that analgesia provided by an anterior SSNB following arthroscopic shoulder surgery is noninferior to ISB. In another study including 97 patients comparing posterior SSNB with the landmark method and ISB, VAS scores were compared until the 6th day; although the ISB group had lower pain scores in the first 6 hours, similar pain scores were observed afterward.^[15] Kumara et al.^[18], who also compared the analgesic effect of posterior SSNB and ISB, observed that the VAS scores of the ISB group were lower in the first 6 hours and similar at 24 hours. ISB is accepted as the most effective analgesia method in arthroscopic shoulder surgery, but its analgesic efficacy is limited in the early postoperative period (first 12 hours) and is associated with rebound pain and increased opioid requirement between the 8th and 12th hours postoperatively.^[7,19] In our study, although VAS values were lower in the ISB group in the early postoperative period until the 12th hour, both the block effect of ISB decreased and the rebound pain effect.^[20] became prominent in the following hours. Although the difference in VAS scores at the 24th hour was statistically significant, this difference was not clinically relevant, as both groups had scores below 4, indicating adequate pain control. We think that the lower efficacy of SSB in the early postoperative period may be related to the skin incision and the limited sensory skin branches of the suprascapular nerve.^[21]

A study comparing anterior and posterior SSNB techniques found that while the anterior approach yielded pain scores closer to those of ISB, opioid consumption in both anterior and posterior SSNB was similar to that of ISB.^[13] In a meta-analysis of 17 randomized studies, SSNB (both landmark and ultrasound-guided) and ISB were compared and it was emphasized that VAS scores were higher in the SSNB group in the early postoperative period up to 12 hours, but they were comparable at 12 hours, and there was no significant difference in opioid consumption between the groups.^[22]

In accordance with the literature, we did not observe a significant difference in 24-hour opioid consumption.^[16,18,23] On the other hand, Figure 2 shows that in the ISB group, the first opioid requirement occurred at approximately the 12th hour with the decrease in the effect of the block, while in the SSNB group the distribution of the first opioid requirement was wider, and in parallel with the increase in VAS values an earlier opioid requirement may occur. Neuts et al.^[24] also pointed out that opioids may be needed earlier with SSNB compared to ISB, although total opioid consumption was similar.

There are few studies in the literature reporting the duration of analgesia. Abdallah et al.^[23] reported the analgesia duration of anterior SSB and ISB as 673 and 783 minutes, respectively. Another study showed that the analgesia duration of SSNB was 2.5 hours and that of ISB was 7.5 hours when the posterior approach with the anatomical landmark technique was applied.^[18] In our study, the duration of analgesia was found to be 891 and 799 minutes in SSB and ISB, respectively. Although the first analgesic requirement occurred earlier in the SSB group in parallel with the VAS values, the mean analgesia duration was similar in both groups (Fig. 2). We believe that two factors contributed to the longer analgesic duration observed compared to previous studies: first, all blocks were performed under ultrasound guidance; second, patients underwent preoperative block assessment and only those with successful blocks were included in the study.

In the literature, it is indicated that diaphragmatic paralysis due to phrenic nerve palsy occurs in almost every patient with ISB, and pulmonary functions are reduced by 25%.^[8,25] The anterior approach to SSNB is used as an alternative to ISB, offering advantages such as less impact on diaphragm function, blocking the suprascapular nerve more proximally and leading to spread to motor and sensory branches and the axillary nerve.^[16,26,27] Lim et al.^[13] showed that both anterior and posterior SSNB did not impair pulmonary functions as much as ISB. Furthermore, respiratory function assessments in 83 patients undergoing shoulder surgery with anterior and posterior approaches to SSB demonstrated that posterior SSNB preserved respiratory function better than the anterior approach.^[28] In that study, hemidiaphragmatic paralysis was detected in 41% of patients with the anterior approach and persisted in 33% of them after 8 hours; on the other hand, this rate was only 2% with the posterior approach.^[28] Considering that ISB is the gold standard analgesic method in shoulder surgery, it is extremely important to demonstrate that respiratory function is less compromised with the posterior approach, especially when SSB is evaluated as an alternative technique in patient groups where

ISB cannot be applied. Although postoperative pulmonary functions were not evaluated in our study, no clinically significant respiratory complications were observed in either group.

To promote early recovery, enhance rehabilitation, and improve patient satisfaction, it is crucial to provide effective pain relief while minimizing motor block.^[29] ISB causes deep motor and sensory block by blocking C5–C6 nerve roots, whereas PSSB affects more sensory fibers and produces less motor block.^[24] Another undesirable effect of ISB is sensory and motor block in the lower brachial plexus (C7–T1) outside the surgical site.^[29] Lim et al.^[13] showed that PSSB did not affect the motor and sensory innervation of the median, ulnar, musculocutaneous, and radial nerves, unlike ISB and ASSB. We speculate that weakness in the forearm and hand may cause more discomfort for patients and may result in dissatisfaction. As Wiegel.^[27] reported a correlation between grip strength and patient satisfaction with PSSB, we think the remarkably high rate of “excellent” responses for patient satisfaction in the PSSB group is due to the low incidence of neurologic side effects.

Our study is one of the few comparing the effects of ultrasound-guided PSSB and ISB on analgesia. Moreover, it is the only study comparing the analgesic duration of these two techniques under ultrasound guidance. However, our study has several limitations. One limitation is the inclusion of patients undergoing different types of arthroscopic shoulder surgeries.^[30] Although we believe this heterogeneity does not significantly affect acute postoperative analgesic outcomes and other studies have included different surgical procedures in their analyses.^[17,23] it may still introduce variability in the findings. Additionally, a literature search indicates significant variability in local anesthetic doses across studies, ranging between 3, 5, 15, and 20 mL.^[22] Pier et al.^[31] demonstrated in their cadaver study that 10 mL of local anesthetic injected at the suprascapular notch spreads to sensory fibers innervating the coracoclavicular ligament, subacromial bursa, and the glenohumeral joint. To reduce heterogeneity and maintain consistency with previous studies, we preferred the application of 0.5% 10 mL bupivacaine; however, lower concentrations may result in less muscle weakness. Our final limitation was that we did not combine PSSB with axillary nerve block because the axillary nerve contributes approximately 10% of the sensory innervation of the shoulder and we aimed to investigate the sole analgesic effect of PSSB.^[13,32] PSSB is a distal peripheral nerve block that selectively blocks the suprascapular nerve and further plexus branches that provide most of the analgesia of the shoulder.

Conclusion

We conclude that ultrasound-guided PSSB can be an alternative peripheral nerve block technique as part of multimodal analgesia for arthroscopic shoulder surgery, with similar opioid consumption and a lower side-effect profile.

Disclosures

Ethics Committee Approval: This study was approved by the Health Sciences University Sisli Hamidiye Etfal Training and Research Hospital Clinical Research Ethics Committee (Date: 24.11.2020, Decision no: 1708).

Informed Consent: Written informed consent was obtained.

Conflict of Interest: None declared.

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Authorship Contributions:

Concept – SO, ASC, LK; Design – SO, LK, PS; Supervision – SO, ASC, LK; Resource – SO, TY; Materials – SO, PS; Data collection and/or processing – SO, DD, TY, PS; Analysis and/or interpretation – SO, DD, TY, PS; Literature review – SO, DD, TY; Writing – SO, LK, ASC; Critical review – SO, ASC, LK.

Peer-review: Externally peer-reviewed.

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