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The effect on the incidence of rebound pain of the application of anterior suprascapular nerve block added to interscalene brachial plexus block for shoulder surgery: A randomized controlled study

Tayfun Et[1], Muhammet Korkusuz[1], Rafet Yarimoglu[1], Umman Menendi[2]

[1]Karamanoğlu Mehmetbey University, Faculty of Medicine, Department of Anesthesiology and Intensive Care Medicine, Karaman, Türkiye
[2]Karamanoğlu Mehmetbey University, Faculty of Medicine, Department of Orthopedics and Traumatology, Karaman,Türkiye

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Abstract

This study aimed to compare the incidence of rebound pain applied with anterior suprascapular nerve block (ASSB) added to interscalene brachial plexus block (ISB) as postoperative analgesia in shoulder surgery. This prospective, observer-blinded, randomized study involved 60 patients who were to undergo shoulder surgery. The patients were divided into two groups: group ISB (n=30) received ISB block, while group ISB+ASSB (n=30) received ASSB in addition to ISB. The primary outcome was to determine the occurrence of rebound pain. Secondary outcomes were numerical rating scale (NRS) values of postoperative pain at 6, 8, 12, 16, 18, 24, and 48 hours, 48-hour opioid consumption, sleep scale for the postoperative night and subsequent 6 nights, and the quality of recovery (QoR) scale evaluated on postoperative days 1 and 7. No statistically significant difference was found between the ISB group (56.7%) and the ISB+ASSB group (40%) in the incidence of rebound pain following the resolution of peripheral nerve block (PNB) (p=0.196). The ISB+ASSB group had a significantly longer time to PNB wear off (14.77±2.07) compared to the ISB group (12.87±1.94) (p=0.001). The postoperative day 1 QoR-15 values were significantly better in the ISB+ASSB group (122.60±10.79) than in the ISB group (116.33±11.48) (p=0.031). Sleep evaluation on the postoperative night showed a significant difference between the groups; ISB+ASSB (3[2-3])–ISB (2[1-3]). The addition of ASSB to ISB did not have a sufficient effect with respect to the incidence of postoperative rebound pain following shoulder surgery. However, there was seen to be a positive effect on prolonging the PNB and on the QoR day 1 values.

Keywords: Pain management, postoperative pain, rebound pain, shoulder surgery

Introduction

In terms of intraoperative and postoperative analgesia for shoulder surgery, interscalene brachial plexus block (ISB) provides strong and effective pain control [1]. However, ultrasound-guided ISB may cause adverse effects [2]. The most frequently seen side effects associated with ISB application are phrenic nerve block, horner syndrome, hoarseness, and more commonly arm and/or hand motor block [3]. In addition, rebound pain is seen, which is described as severe and disturbing pain with sudden onset, associated with the resolution of ISB [4]. There is still uncertainty about the mechanism causing rebound pain and the incidence at which it is seen after peripheral nerve block (PNB) resolution [4]. This condition emerging after ISB resolution is disturbing for patients postoperatively and affects opioid consumption, recovery, and sleep quality [5,6].

To reduce the unwanted side effects of the interscalene brachial plexus block, suprascapular nerve blocks (SSNB) and axillary nerve blocks (ANB) are being used as alternatives to provide anesthesia and postoperative analgesia in shoulder surgery [7]. Effective anesthesia and analgesia can be achieved by blocking the C5 and C6 nerve roots that innervate the shoulder joint [8,9]. These two peripheral nerves provide most of the sensory

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Corresponding Author: Tayfun Et, Karamanoğlu Mehmetbey University, Faculty of Medicine, Department of Anesthesiology and Intensive Care Medicine, Karaman, Türkiye
Email: drtayfunet@gmail.com

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innervation for the shoulder [7-9]. The suprascapular and axillary nerves include the C5 and C6 roots that are responsible for shoulder innervation. Using SSNB+ANB for shoulder surgery is a safe and effective analgesic technique [10]. It has also been reported that ISB during shoulder surgery is a clinically good alternative in patients with conditions such as advanced morbid obesity, obstructive sleep apnea, or chronic obstructive pulmonary disease [10]. There is increasing use of anterior suprascapular nerve block (ASSB) in arthroscopic shoulder operations, but there has been no proven superiority over ISB, although there are sufficient data about the incidence of rebound pain after ASSB [11].

Rebound pain after PNB resolution can eliminate the analgesic effect provided and can cause re-admission to the hospital in day-case operations. Some adjuvant agents such as dexamethasone and dexmedotomidine are used to prevent rebound pain from developing [5,6,12,13]. The intravenous and perineural use of dexamethasone in particular has been informed to significantly lower the incidence of rebound pain [5,6,12]. There are also studies showing that rebound pain incidence is lowered with continuous catheter application of PNB [14].

The aim of this study was to compare the incidence of postoperative rebound pain between ISB and ASSB in shoulder surgery. The secondary aims were to evaluate the numerical pain scale values, opioid consumption, and the effect on sleep and recovery quality of the different methods applied.

Material and Methods

Approval was granted by the Ethics Committee of Karamanoğlu Mehmetbey University Medical Faculty for a single-center, observer-blinded, randomized, controlled study (decision no: 07-2021/13, dated 11.10.2021).

The study included 60 patients, aged 18-80 years, of the American Society of Anesthesiologists (ASA) physical status I-III, who were to undergo unilateral shoulder surgery between December 2021 and May 2022. All patients provided written informed consent based on the principles of the 2013 Helsinki Declaration.

The study exclusion criteria were defined as an insufficient indication for interscalene block (clotting disorder, local infection in the block region, diaphragm paralysis, allergy to local anesthetics), the presence of any neuropathic disorder, severe cardiopulmonary disease, the use of systemic steroids, morbid obesity (body mass index>35 kg/m^2), chronic opioid use, stomach ulcer, uncontrolled diabetes, pregnancy, or psychological disorder. All the patients included had no problems communicating in the Turkish language. Preoperatively, the patients were informed about the numerical rating scale (NRS), quality of recovery (QoR-15), and sleep quality evaluations. The ISB and SSNB blocks were performed under ultrasound guidance by a certified anesthesia specialist with at least 10 years of experience.

Randomization and blinding

The patients were randomly assigned to the groups in a ratio of 1:1 using the randomization method of previously numbered sealed envelopes. Then patients were assigned to the ISB group (n=30) or the ISB+ASSB group (n=30) (Figure 1). Throughout the study, the statisticians and results evaluators were blinded to the groups.

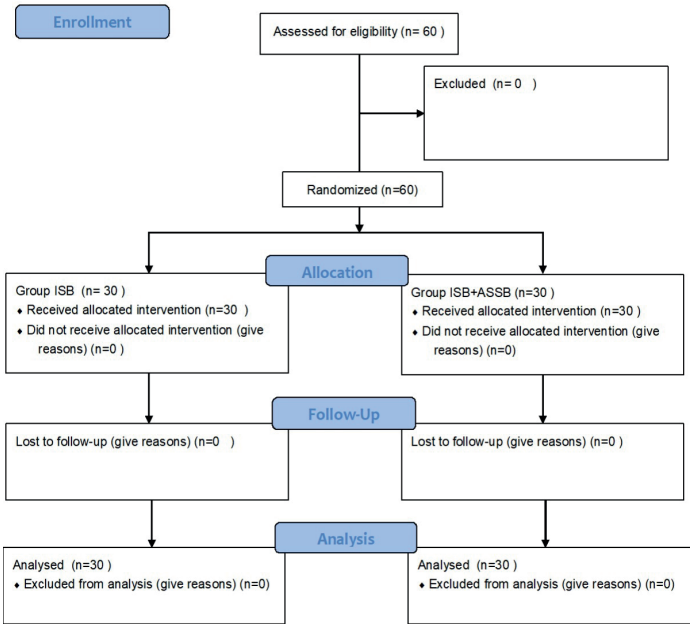

Figure 1. CONSORT flow diagram. CONSORT, consolidated standards of reporting trials; ISB, interscalene brachial plexus block; ASSB, anterior suprascapular nerve block

Preoperative

Thirty minutes before the operation, all the patients were administered 1000mg paracetamol intravenously (iv) as pre-emptive analgesia. The iv access was made after ECG, blood pressure, and oxygen monitorisation. Dormicum of 2mg and fentanyl of 50mcq were administered iv for sedation.

ISB block application

After positioning the patient appropriately, clean the lateral surface of the neck and supraclavicular region on the same side with an antiseptic solution. A high-frequency linear ultrasound probe (13-6 Mhz, Samsung RS85) was placed in the interscalene region to identify the brachial plexus short axis with ultrasound guidance. After obtaining the correct positioning of the tip of a 22-gauge insulated regional needle (Stimuplex®; Braun) with a posterior approach, and negative aspiration, 15ml 0.5% bupivacaiine was injected.

ASSB block application

The ASSB under ultrasound guidance was used as described in the literature [15,16]. The suprascapular nerve arises from the superior trunk of the brachial plexus. It travels in a dorsocaudal

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direction until it reaches the suprascapular fossa and the omohyoid muscle. The suprascapular nerve was identified on the superficial part of the prevertebral fascia and the lower depths of the belly of the omohyoid muscle. The ASSB was performed using the in-plane approach with a Stimplex needle and 5ml 0.5% bupivacaine was injected.

Intraoperative

The surgeon performed all the rotator cuff and acromioplasty repairs as open surgery with the patient in the beach chair position.

Multimodal analgesia

On the ward, all the patients were administered 1000 mg acetaminophen every 6 hours and 50mg dexketoprofen iv every 12 hours. For patients with NRS>4, it was planned to administer oral oxycodone 5mg as rescue analgesia. The postoperative 6-day sleep follow-up and quality of recovery evaluations were made through telephone calls to the patient.

Outcome evaluation

The incidence of rebound pain was defined as the primary outcome. In accordance with the literature, rebound pain was evaluated as severe pain (NRS≥7) measured before and after PNB wear-off [4,5,17]. In the evaluation of secondary outcomes, 24-hour analgesia consumption was recorded as oral morphine equivalent doses. As the patients used a shoulder sling, only static NRS scores were recorded at 6, 8, 12, 16, 18, 24, and 48 hours. The postoperative 1 and 7-day QoR-15 values and time to block resolution were recorded. In the sleep evaluation from the postoperative night to 6 nights postoperatively, a likert-type classification was used.

Statistical analysis

In the power analysis performed, it was calculated that a minimum of 54 cases were required to provide 0.80 power and an alpha 5% error margin for the two groups. To ensure an equal number of participants in each group and to collect an additional 5% of data to account for potential issues, it was decided to include a total of 60 cases.

Data collected in the study were statistically analyzed using SPSS 26 software. The normal distribution of data was evaluated using the Shapiro-Wilk test. Descriptive statistics were reported as mean±standard deviation (SD) values or median and interquartile range (IQR) values for continuous variables according to the normality of distribution. Categorical variables were stated as number (n) and percentage (%). In the comparisons of two independent groups of continuous data, the Student's t-test was used when the distribution was normal and the Mann-Whitney U-test when the distribution was not normal. Relationships between categorical variables were investigated using the Chi-square test or Fisher's Exact test depending on the sample number in the cross-table cells. A value of $p<0.05$ was accepted as statistically significant.

Results

In the preoperative evaluations of the patients, no statistically significant difference was determined between the groups in respect of demographic data, preoperative NRS values, anesthesia time, and operating time (Table 1).

Table 1. Comparison of patient characteristics and intraoperative data between research groups

Variable		Group ISB (n=30)	Group ISB+ASSB (n=30)	P values
Sex	**Female**	20 (66.7%)	16 (53.3%)	0.292[a]
	Male	10 (33.3%)	14 (46.7%)	
Age (years)		54.40 (7.70)	57.60 (6.89)	0.673[b]
ASA		1.90 (0.60)	2.00 (0.58)	0.591[b]
BMI (kg/m²)		30.46 (4.13)	30.63 (3.63)	0.869[b]
Duration of anesthesia, min		105.80 (11.92)	101.90 (10.76)	0.189[b]
Surgical time, min		70.56 (13.01)	72.46 (10.32)	0.534[b]
Preoperative NRS		4.93 (1.59)	4.63 (1.44)	0.449[b]

aChi-Square test with n (%), bStudent's t-test with mean (SD). ASA: American Society of Anesthesiologists, NRS: numeric rating scale, BMI: body mass index, SD: standard deviation, ISB: interscalene brachial plexus block, ASSB: anterior suprascapular nerve block

No significant difference was determined between the ISB group and the ISB+ASSB group in respect of the incidence of rebound pain (p=0.196). The time to PNB resolution was statistically significantly longer in the ISB+ASSB group (14.77±2.07 hours) than in the ISB group (12.87±1.94 hours) (p=0.001). The NRS values after PNB resolution were statistically significantly better in the ISB+ASSB group (5.56±2.04) than in the ISB group (6.70±1.80) (p=0.027). The postoperative 1-day QoR results were statistically significantly better in the ISB+ASSB group (122.60±10.79) than in the ISB group (116.33±11.48, p=0.031). The postoperative 7-day QoR results were similar in both groups (p=0.096) (Table 2).

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Table 2. Comparison of postoperative data and rebound pain scores among research groups

Variable		ISB (n=30)	ISB+ASSB (n=30)	P values
PNB resolution time, hours		12.87 (1.94)	14.77 (2.07)	0.001[b]*
NRS before PNB dissolution		2.56 (0.67)	2.30 (0.70)	0.140
NRS after PNB dissolution		6.70 (1.80)	5.56 (2.04)	0.027*
Incidence of rebound pain	**No**	13 (43.3%)	18 (60%)	0.196[a]
	Yes	17 (56.7%)	12 (40%)	
Time of need for additional analgesia, hours		13.66 (2.78)	14.13 (4.36)	0.623[b]
Qor-15 day 1		116.33 (11.48)	122.60 (10.79)	0.031*
Qor-15 day 7		141.93 (2.72)	143.23 (3.20)	0.096
Nausea vomiting	**No**	17 (56.7%)	22 (73.3%)	0.326[a]
	Mild	7 (23.3%)	4 (13.3%)	
	Moderate	2 (6.7%)	3 (10%)	
	Severe	4 (13.3%)	1 (3.3%)	

[a]Chi-Square test with n (%), [b]Student's t test with mean (SD), *Statistically significant p< 0.05. PNB: peripheral nerve block, NRS: numeric rating scale, BMI: body mass index, SD: standard deviation, ISB: interscalene brachial plexus block, ASSB: anterior suprascapular nerve block, QoR: quality of recovery

Opioid consumption at postoperative 0-12, 12-24, 24-48, and 0-48 hours was seen to be statistically similar in both groups (Table 3). In the postoperative 48-hour evaluation, the NRS values were determined to be statistically significantly higher at 12 and 16 hours in the ISB group (3.50±2.44, 5.46±1.92) compared to the ISB+ASSB group (0.96±1.49, 3.50±2.28) (p=0.000, p=0.001, respectively) (Table 4).

Table 3. Comparison of the amount of postoperative analgesia needed between study groups at 0-12, 12-24, 24-48, and 0-48 hour time intervals. Oral Morphine equivalent daily dose

The need for analgesia	ISB	ISB+ASSB	P values
0- 12 hour	0 (0)	0 (0-0)	0.423
12-24 hour	7.5 (7.5-15)	7.5 (7.5-15)	0.517
24-48 hour	7.5 (7.5-7.5)	7.5 (0-7.5)	0.264
0-48 hour	15 (15-22.5)	15 (7.5-15)	0.096

Mann-Whitney U test with median (interquartile range: Q1, Q3). ISB: interscalene brachial plexus block, ASSB: anterior suprascapular nerve block

Table 4. Comparison of NRS scores measured static in study groups

Variable	ISB (n=30)	ISB+ASSB (n=30)	P values
NRS static			
6 hr	0.00±0.00	0.06±0.36	0.321
8 hr	0.86±1.22	0.26±1.46	0.090
12 hr	3.50±2.44	0.96±1.49	0.000*
16 hr	5.46±1.92	3.50±2.28	0.001*
18 hr	3.13±0.77	3.46±1.50	0.285
24 hr	2.36 ±0.80	2.43±0.85	0.758
48 hr	2.26±0.82	1.83±0.69	0.032

Values are presented as mean±SD. *P value <0.05; statistically significant. NRS: numeric rating scale, ISB: interscalene brachial plexus block, ASSB: anterior suprascapular nerve block

In the sleep evaluation on the postoperative night, the ISB group scores (2[1-3]) were statistically significantly worse than those of the ISB+ASSB group (3[2-3]) (p=0.019). The results of the sleep evaluation between postoperative days 1 and 6 were similar in both groups (Table 5).

Table 5. Comparison of preoperative and postoperative 7-day sleep disturbance scores between research groups

Sleep	ISB	ISB+ASSB	P values
Night of postoperative	2 (1-3)	3 (2-3)	0.019*
Day 1	3 (3-3)	3 (3-4)	0.212
Day 2	4 (3-4)	3.5 (3-4)	0.204
Day 3	4 (3-5)	4 (4-5)	0.137
Day 4	5 (4-5)	5 (5-5)	0.449
Day 5	5 (5-5)	5 (5-5)	0.073
Day 6	5 (5-5)	5 (5-5)	0.690

Mann-Whitney U test with median (interquartile range: Q1-Q3). * P value <0.05; statistically significant. ISB: interscalene brachial plexus block, ASSB: anterior suprascapular nerve block

Discussion

The results of this randomized, observer-blinded study showed that the addition of ASSB to ISB in shoulder surgery did not decrease the incidence of rebound pain. However, the time to PNB resolution was prolonged and the NRS scores, especially at postoperative 12 and 16 hours were significantly lower. Patients experienced better sleep on the postoperative night and the 1-day QoR results were better. It was also seen that that the addition of ASSB to ISB had no effect in respect of 48-hour opioid consumption and postoperative 7-day recovery.

Although there are uncertainties related to the definition of rebound pain, the method used by Barry et al. [17] and most preferred recently was used as the criteria in this study. Thus,

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rebound pain was defined as a transition within 24 hours to severe pain (NRS≥7) from well-controlled pain (NRS≤3) while the block was working [17]. There is still a limited number of studies in the literature related to the pathomechanism of rebound pain. Sensitization emerging in both peripheral and central neuronal areas is thought to probably lead to an increasing and continuous signal reaction from peripheral nociceptors [18]. This increasing pain sensitivity can lead to hyperalgesia and allodynia. It has been hypothesized that sensitivity originating from this process causes the increase in pain that is felt when the PNB is terminated [18]. There are also opinions advocating that when the advancement of the physiological inflammatory reaction is not prevented and there is no systemically effective drug treatment, the resulting hyperalgesia area becomes increasingly nociceptively active after the PNB has worn off [19]. As there is a lack of research related to rebound pain and its pathomechanism, one of the potential targets is to prevent this phenomenon through appropriate means before the need for treatment. For this purpose, the continuous catheter technique can be completed with the use of different blocking techniques or adjuvants to prolong the duration of the sensory blockade [5,6,19,20]. In a study comparing axillary nerve block combined with suprascapular block in arthroscopic rotator cuff operations, Lee et al. [20] reported a significant reduction in the incidence of rebound pain. In the current study, it was seen that ASSB added to ISB effectively prolonged the PNB duration and better pain scores were obtained after resolution. However, this improvement was not positively reflected in the incidence of rebound pain, and the patients were observed to experience rebound pain in the same way. The major factor in this was thought to be that dexamethasone was not used preoperatively. A previous study conducted in our clinic found that dexamethasone effectively reduced rebound pain [6]. However as the aim of the current study was to demonstrate the effect of different block techniques on the incidence of rebound pain, preoperative dexamethasone was not used in this study.

It has been previously reported that after the occurrence of rebound pain, the postoperative NRS values of patients and opioid consumption increase significantly [5,17,18]. This affects the sleep quality of the patient [5,6]. The recovery and sleep quality of patients are disrupted due to the development of rebound pain in particular. In a recent study, it was emphasized that the sleep quality of patients is affected as a result of rebound pain developing and the time of block resolution generally occurring at night [5]. This causes emotional and stress disorders in patients and ultimately affects the quality of recovery. The results of the current study showed that patients experienced better sleep on the postoperative night as a result of the prolonged sensory block. Consequently, after a comfortable sleep on the postoperative night, better QoR values of the patients were obtained on postoperative day 1. Prolonging the block duration with ASSB added to ISB provided the particular benefit of patients having a comfortable sleep on the postoperative night. However, there was no significant benefit in the 7-day QoR values. It was also determined that as there was no significant effect of the combination of ASSB and ISB on rebound pain incidence, it did not significantly reduce postoperative opioid consumption.

There were some limitations to this study. First dynamic pain could not be evaluated as the patients were using a shoulder sling. Secondly, rebound pain incidence was used for the sample size calculation and this was the sample calculated for postoperative QoR, NRS, and opioid consumption. Finally, postoperative dermatome evaluation could not be fully performed due to the presence of the shoulder sling.

Conclusion

In conclusion, the results of this study indicated that the addition of ASSB to ISB for preoperative and postoperative analgesia in shoulder surgery prolonged the block duration and provided lower NRS scores, while also allowing patients to sleep more comfortably on the postoperative night. However, this combination remained insufficient in respect of lowering the incidence of rebound pain developing after PNB resolution.

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

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
The study was approved by the Ethics Committee of Karamanoğlu Mehmetbey University Medical Faculty Faculty (decision no:07-2021/13, dated: 11.10.2021).

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