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Randomized Controlled Trial

Comparison of Erector Spinae Plane Block at the Level of the Second Thoracic Vertebra With Suprascapular Nerve Block for Postoperative Analgesia in Arthroscopic Shoulder Surgery

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Background: Appropriate postoperative pain management in shoulder surgeries is the mainstay of rehabilitation therapy and subsequent improved functional outcomes. However, adequate pain control either with opioids or interscalene brachial plexus block is often challenged by their side effects. In this context, this study compared the suprascapular nerve block (SSNB) to the newly emerging erector spinae plane block at the second thoracic vertebral level (high thoracic-ESPB) as an alternative pain therapy.

Objectives: This study aimed to compare the efficacy of high thoracic-ESPB with SSNB as analgesic options for arthroscopic shoulder surgery.

Study Design: Prospective randomized, double-blinded, controlled, clinical trial.

Setting: This clinical trial was performed at Zagazig University.

Methods: This prospective, randomized controlled clinical trial was registered at ClinicalTrials.gov (NCT04669639, December 15, 2020). Patient enrollment was initiated after the registration date (December 20, 2020), and the study was conducted from December 2020 to November 2021. Ninety-six adult patients who prepared for arthroscopic surgeries were assigned to the high thoracic-ESPB group, SSNB group, and control group; all with 32 patients each.

Results: A significant difference was found between the control group and block groups concerning the Numeric Rating Scale (NRS-11) at recovery, 2, 4, 6, 8, and 12 hours postoperatively at rest and with shoulder movement. However, the NRS-11 was significantly higher in the SSNB group than in the high thoracic-ESPB group only with movement both at recovery and 2 hours postoperatively. Otherwise, no significant difference between the 2 block groups was found throughout different time points of the study. The doses of fentanyl given intraoperatively were significantly higher in the control group than in the high thoracic-ESPB and SSNB groups (mean ± standard deviation [SD], 326.6 ± 45.8, 224.7 ± 17.1, and 232.8 ± 17.8; *P* value < 0.001, respectively). A significant difference also was observed concerning postoperative morphine use, where the mean ± SD was 18.8 ± 2.9 in the control group vs 5.7 ± 1.02 and 6 ± 0.81 (*P* value < 0.001) in the high thoracic-ESPB and SSNB groups, respectively.

Limitations: A continuous local anesthetic (LA) infusion catheter can be used either in the high thoracic-ESPB or SSNB to provide extended periods of analgesia. However, our investigation was confined to a single LA injection.

Conclusions: SSNB is not inferior to high thoracic-ESPB in the context of phrenic nerve sparing pain control for arthroscopic surgeries. Moreover, SSNB is a more established technique with more predicted sensory distributions and a lower risk of LA toxicity.

Key words: Arthroscopic shoulder surgery, erector spinae plane block, suprascapular nerve block

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Arthroscopic techniques have enabled surgeons to perform shoulder procedures as day-case surgeries. Unfortunately, 54% of these patients experience severe postoperative pain and ineffective rehabilitation, which may warrant readmission (1,2). The sensory innervation in the shoulder comes from both cervical (C3-C4) and brachial (C5-C6) plexuses (3). When the interfascial thoracic erector spinae plane block is performed at the level of the T2 transverse process (high thoracic-ESPB), a local anesthetic (LA) disperses over the cervical region and provides analgesia for shoulder pain. Forero et al (4) were the first to investigate the effect of high thoracic ESPB on the management of chronic shoulder pain; whereas, Selvi et al (5) reported the first successful postoperative pain relief for shoulder surgeries in a small case series study. Interscalene brachial plexus block (ISB) was recognized as the gold standard for shoulder surgeries. However, a high incidence of ISB-associated side effects obliged scientists to search for alternatives. A recently published comparative study (6) revealed that phrenic nerve sparing ESPB can be an effective alternative to ISB. However, in a systematic meta-analysis review, Saadawi et al (7) emphasized the need for future trials to illuminate the ESPB gap in knowledge concerning the optimal technique and required LA concentration and volume. Moreover, pain experts still believe that peripheral nerve block is more effective than interfascial plane block (8).

Recent attention has shifted to the use of the suprascapular nerve block (SSNB) as a phrenic nerve-sparing approach for arthroscopic surgical analgesia. The SSN provides 70% of the sensory input to the shoulder joint through its C5-C6 and variable C4 contribution (9). On this anatomical basis, the SSNB was proposed to produce sufficient analgesia for arthroscopic surgery and was consequently suggested as an ISB alternative (10). In an interesting systematic meta-analysis review, Hussain et al (9) compared SSNB and ISB for shoulder surgery. They reported that SSNB may be considered an effective and safe ISB alternative for shoulder surgery.

Interest of the newly emerging high thoracic-ESPB for shoulder surgeries, beside its relative infancy and limited literature, guided the authors to evaluate its analgesic efficacy to the standard SSNB for arthroscopic surgeries as a phrenic nerve sparing technique. In this study, the supposed hypothesis was that the SSNB is not inferior to high thoracic-ESPB. To the best knowledge of the authors, this is the first study to compare these 2 analgesic block techniques for arthroscopic shoulder surgeries.

Methods

This prospective, randomized, controlled clinical trial was ethically approved by the Institutional Review Board (IRB) of Zagazig University Hospitals, Zagazig University, Zagazig, Egypt, in November 2020 (Approval no IRB#6506). The study was also registered in ClinicalTrials.gov (NCT04669639, December 15, 2020). Patient enrollment was initiated after the registration date (December 20, 2020), and the study was conducted from December 2020 to November 2021. Patients, who were scheduled for elective arthroscopic surgeries, were recruited. They all provided written informed consent after an illustration of the steps of the procedures.

A total of 96 patients aged 21-60 years with American Society of Anesthesiologists (ASA) Physical Status Classifications I-II from both genders were considered for this study (Table 1). Only patients with body mass < 35 kg/m^2 were enrolled in the study. Patients who had severe cardiopulmonary diseases, local tissue infections, coagulopathy, allergy to local anesthesia, and previous thoracic or cervical spine surgery, or had chronic opioid therapy (> 6 months) were excluded. In addition, uncooperative patients were also excluded from the study (Fig. 1).

Randomization and Blinding

The patients were randomly assigned in a 1:1:1 ratio to be allocated either in the high thoracic-ESPB, SSNB, or control group (received general anesthesia only) by a person who wasn't included in the study, with 32 patients each. Randomization assignments were kept in sealed envelopes, and they were opened by the investigator immediately before the nerve block procedure. Both blocks were performed by the same investigator before the induction of general anesthesia using LOGIQ P7 (GE Healthcare Ultrasound, Korea). Block procedures were performed in the recovery room before the patients enter the operating room to ensure the blinding of the monitoring anesthesiologists to the block groups. Moreover, in all patients, the entry sites of the needles were masked by placing 2 adhesive tapes on both block areas. Adhesive tapes were removed just before surgical sterilization by the operating surgeons who were not participating in the study.

After a detailed illustration of the block procedures to the patients and providing assurance, an 18-G intravenous cannula was inserted, and intravenous fluid infusion of Ringer's lactate was started. Standard ASA monitors were applied. Patients then received midazolam (1-3 mg) before the block procedure. Pre-

Table 1. *Demographic and clinical characteristics of the studied groups.*

Variables	High thoracic-ESPB (n = 32)	SSNB (n = 32)	Control (n = 32)	*P* value
Age (y), mean ± SD	45.9 ± 6.7	47.5 ± 7.9	48.8 ± 6.3	[a]0.527
Hb (g/dL), mean ± SD	11.8 ± 1.1	11.4 ± 1.2	12.1 ± 1.2	[a]0.09
Gender: no (%) Women Men	 7 (21.9%) 25 (78.1%)	 10 (31.2%) 22 (68.8%)	 8 (25%) 24 (75%)	[c]0.685
ASA no (%) I II	 20 (62.5%) 12 (37.5%)	 14 (43.8%) 18 (56.2%)	 19 (59.4%) 13 (40.6%)	[c]0.271
BMI, mean ± SD	27.6 ± 2.2	26.9 ± 1.4	27.3 ± 1.6	[a]0.292
Anesthesia Duration (min), mean ± SD	98.7 ± 19.4	102.6 ± 13.6	104.2 ± 17.5	[a]0.415
Time for Block (min), median (range)	9 (6-11)	7 (6-10)		#0.002**

a: one-way ANOVA test. c: chi-square test. #: Mann-Whitney test. *significant ($P < 0.05$). **highly significant ($P < 0.001$).
Abbreviations: High thoracic-ESPB, erector spinae plane block at the second thoracic vertebral level; SSNB, suprascapular nerve block; y, years; SD, standard deviation; no, number; ASA, American Society of Anesthesiologists; BMI, body mass index; min, minutes.

operatively, the Numeric Rating Scale (NRS-11) was illustrated to all patients.

High Thoracic-ESPB

The patient was placed in the lateral decubitus. Subsequently, an ultrasound (US)-guided aseptic technique, with a high-frequency linear probe enveloped in a sterile sheath containing a thin film of US gel, was used to locate the transverse process of T2. After LA skin infiltration, a 22-G block was inserted in a cephalocaudal direction until the space between the fascia of the erector spinae and the transverse process of T2 was identified. After negative aspiration, hydro dissection using 2 mL of saline was performed. Eventually, 30 mL of the LA bupivacaine 0.25% and epinephrine 5 µg/ mL was injected (Fig. 2a).

SSNB

The block was performed with the patient sitting and arms flexed at the elbow and resting on the anterior thigh. Under complete aseptic technique, a high-frequency linear probe, enveloped in a sterile sheath containing a thin film of US gel, was placed in a sagittal orientation at the superior medial border of the scapula to view the pleura, then scanning continued in a lateral direction to get the scapula beyond the lung fields. Then after, the transducer was directed to become parallel to the spine of the scapula and was moved cephalic to the supraspinatus fossa. Moving the probe laterally up to the scapular notch where the nerve was identified by its round hyperechogenic shape. Color Doppler was applied to identify the suprascapular artery that runs near the SSN when possible. After LA skin infiltration, the 22-G needle was advanced along the longitudinal axis of the US beam using an in-plane technique. When the needle reached the SNN vicinity, 10 mL of bupivacaine 0.25% with epinephrine 5 µg/ mL was injected after a negative aspiration test (Fig. 2b).

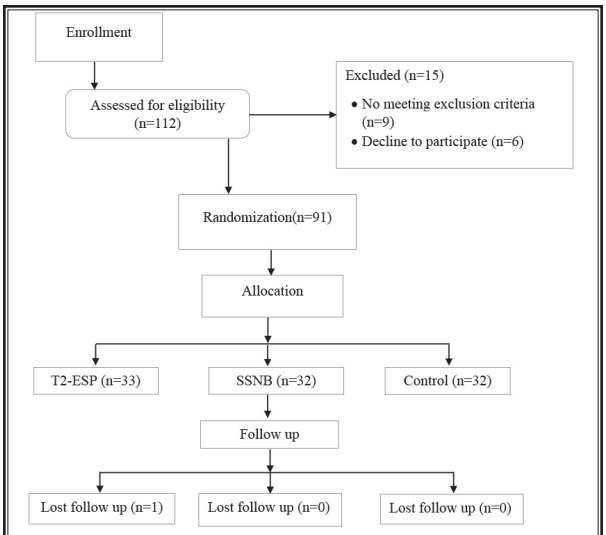

Fig. 1. *Consort flow diagram of the study.*

Block Assessment

After 30 minutes from the block, the sensory block was tested in both groups using the cold test in the appropriate dermatome where a loss of cold sensation was considered a complete sensory block. A blinded

observer (unaware of the block assignment and absent during the block technique) evaluated the blocks.

Induction, Maintenance, and Recovery From Anesthesia

Preoxygenation of the patients with 100% oxygen for 3 minutes was ensured before anesthesia induction. A combination of 2 mg/kg propofol and 1.5 µg/kg fentanyl was used for anesthesia induction. Muscle relaxation was also achieved with the administration of 0.6 mg/kg rocuronium. After gentle mask ventilation, patients were intubated with an appropriately sized endotracheal tube (8.0 for men and 7.0 for women). Rocuronium increments (10 mg) were given regularly every 30 minutes. Anesthesia was maintained with isoflurane at one minimum alveolar concentration. Fentanyl (0.5-1 µg/kg dose) was used to keep the heart rate and the mean blood pressure within 20% of the baseline value. Vital signs (continuous electrocardiography with heart rate, noninvasive blood pressure, oxygen saturation, and end-tidal carbon dioxide) were monitored throughout the anesthesia. A decrease in the mean arterial pressure (MAP) < 25% than the baseline value was treated with fluid therapy and/or intravenous administration of ephedrine 5-10 mg, followed by titration of anesthetic agents based on the clinical situation and clinical judgment. Before the end of the surgery, 2-3 mg morphine was given intravenously. After reversal of muscle relaxation, the patients were transferred to the recovery room.

The pain control target was considered at NRS-11 < 4, where NRS-11 of 0 means no pain and 10 means the worst pain imaginable. Patients started acetaminophen (1 g PO) before surgery. Acetaminophen infusion continued postoperatively at a dose of 1 g/6 hours. Later, 75 mg diclofenac sodium was also given intravenously twice a day, in combination with 40 mg pantoprazole once. Rescue analgesia of 2-3 mg morphine was given intravenously if the postoperative Visual Analog Scale score was > 3 or the patient requested additional analgesia.

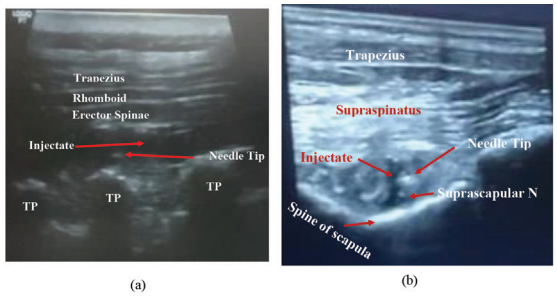

Fig. 2. *US image: (a) High thoracic-ESPB showing the 3-layered muscles and injectate above the T2 transverse process; (b) SSNB showing the layers of the muscles covering the scapula and the injectate in the vicinity of SSN.*
US, ultrasound; high thoracic-ESPB, erector spinae plane block at the second thoracic vertebral level; SSNB, suprascapular nerve block; SSN, suprascapular nerve.

Outcome and Complication Assessment

Postoperative pain at rest and on shoulder abduction was assessed using NRS-11. Pain was assessed in the postanesthesia care unit at 2, 4, 6, 8, 12, and 24 hours postoperatively both at rest and with movement. A blinded observer recorded all patient data. The investigators contacted by telephone patients who were discharged from the hospital to know their self-rating NRS-11 score, rescue analgesic need, and complications. Nausea and vomiting were assessed clinically; ondansetron 4 mg was given intravenously for nausea. Sedation was assessed using the Ramsay sedation score, and sedation scores of 2-3 were accepted.

Sample Size

As the total morphine dose needed in the high thoracic-ESPB group is 6 ± 5 and that in the control group is 13 ± 14, the sample size calculated by the OpenEpi program should be 78 cases (26 cases in each group) with a confidence level of 95% and power of 80%. The sample size was then powered to 90%; thus, 96 cases were required (32 patients in each group).

Statistical Analysis

All data were collected, tabulated, and analyzed using SPSS Version 24 (IBM Corporation, Armonk, NY). Continuous quantitative variables were expressed as the mean ± standard deviation (SD) and median (range), and categorical qualitative variables were expressed as absolute frequencies (number) and relative frequencies (percentage). Continuous data were checked for normality by using the Kolmogorov-Smirnov test. One-way analysis of variance (ANOVA) test was used to compare more than 2 groups of normally distributed data. For the comparison between more than 2 groups of nonnormally distributed data, the Kruskal-Wallis test was used. Moreover, the Mann-Whitney test was applied to compare 2 groups of nonnormally distributed data. Repeated-measures ANOVA test was also used to

compare normally distributed data among the same group; whereas, the Friedman test was used to compare nonnormally distributed data among the same group. Categorical data were compared using the chi-square test (χ^2 test). All tests were 2 sided: *P* value < 0.05 was considered significant, *P* value < 0.001 was highly significant, and *P* value ≥ 0.05 was not significant (Tables 2 and 3).

Results

No significant difference was found among the groups regarding demographic data or anesthesia duration. The time taken for high thoracic-ESPB (median [range], 9 [6-11] minutes) was significantly higher than that for SSNB (median [range], 7 [6-10] minutes) as demonstrated in Table 1.

Moreover, no significant difference was found among the studied groups regarding the MAP and heart rate. However, a significant difference in MAP and heart rate was found between different timings in each group separately, as shown in Fig. 3.

As shown in Tables 2 and 3, a significant difference was found between the control group and block groups regarding NRS-11 at recovery, 2, 4, 6, 8, and 12 hours postoperatively both at rest and with movement. However, no significant difference was observed among the 3 groups at 24 hours postoperatively both at rest and with movement. Moreover, the NRS-11 at rest was higher in the SSNB group than in the high thoracic-ESPB group, but the difference was not significant. The NRS-11 at movement was significantly higher at recovery and 2 hours postoperatively in the SSNB group than in the high thoracic-ESPB group.

A nonsignificant difference was also observed between the 2 block groups regarding intraoperative fentanyl consumption. While the SSNB group consumed higher morphine doses than the high thoracic-ESPB group, it was not significantly different. The doses of fentanyl and morphine consumed were significantly higher in the control group than in the block groups. Moreover, the time to the first rescue analgesic requirements were significantly lower in the control group (mean ± SD; 23.1 ± 5.2) than in the high thoracic-ESPB (mean ± SD; 281.3 ± 31.3) and SSNB group (mean ± SD; 296.9 ± 36.7) (Table 4).

Table 2. *NRS-11 at rest through 24 hours of the studied groups.*

Variables	High thoracic-ESPB (n = 32)	SSNB (n = 32)	Control (n = 32)	*P* value	Test
NRS-11 at Recovery, median (range)	1 (0-3)	1.5 (0-3)	5 (3-9)	[c]< 0.001	> 0.05[1] < 0.05[2**] < 0.05[3]
NRS-11 2h, median (range)	1 (0-2)	1 (0-4)	5 (2-9)	[c]< 0.001	> 0.05[1] < 0.05[2**] < 0.05[3**]
NRS-11 4 h, median (range)	2 (0-3)	2 (0-3)	4 (2-6)	[c]< 0.001	> 0.05[1] < 0.05[2**] < 0.05[3**]
NRS-11 6 h, median (range)	1 (0-3)	1 (0-4)	4 (2-9)	[c]< 0.001	> 0.05[1] < 0.05[2**] < 0.05[3**]
NRS-11 8 h, median (range)	2.5 (0-3)	1 (0–3)	3 (2-7)	[c]< 0.001	> 0.05[1] < 0.05[2**] < 0.05[3**]
NRS-11 12 h, median (range)	2 (2-3)	2 (2-3)	5.5 (3-9)	[c]< 0.001	> 0.05[1] < 0.05[2**] < 0.05[3**]
NRS-11 24 h, median (range)	4 (3-6)	4 (2-7)	4 (2-7)	[c]0.243	> 0.05[1] > 0.05[2] > 0.05[3]
P value[$]	< 0.001**	< 0.001**	< 0.001**		

[c]Kruskal-Wallis test; [$]Friedman test; *significant ($P < 0.05$); **highly significant difference; #Mann-Whitney test.
[1]: High thoracic-ESPB group vs SSNB group; [2]: High thoracic-ESPB group vs control group; [3]: SSNB group vs control group.
Abbreviations: High thoracic-ESPB, erector spinae plane block at the second thoracic vertebral level; SSNB, suprascapular nerve block; NRS-11, numeric rating scale; h, hours.

Table 3. *NRS-11 at movement of the studied groups.*

Variables	High thoracic-ESPB (n = 32)	SSNB (n = 32)	Control (n = 32)	*P* value	Test
NRS-11 at Recovery, median (range)	2.5 (1-3)	3 (1-6)	7 (4-10)	[c]< 0.001	< 0.05[1**] < 0.05[2**] < 0.05[3**]
NRS-11 2 h, median (range)	3 (2-4)	3 (1-7)	7.5 (3-10)	[c]< 0.001	< 0.05[1**] < 0.05[2**] < 0.05[3**]
NRS-11 4 h, median (range)	2 (0-3)	2 (0-3)	5 (3-9)	[c]< 0.001	> 0.05[1] < 0.05[2**] < 0.05[3**]
NRS-11 6 h, median (range)	2 (0-3)	2 (0-4)	6 (3-10)	[c]< 0.001	> 0.05[1] < 0.05[2**] < 0.05[3**]
NRS-11 8 h, median (range)	2 (0-3)	2 (0-3)	5 (3-9)	[c]< 0.001	> 0.05[1] < 0.05[2**] < 0.05[3**]
NRS-11 12 h, median (range)	3 (2-4)	3 (2-4)	5 (3-10)	[c]< 0.001	> 0.05[1] < 0.05[2**] < 0.05[3**]
NRS-11 24 h, median (range)	6 (4-8)	5.5 (3-9)	6 (2-10)	[c]0.402	> 0.05[1] > 0.05[2**] > 0.05[3**]
P value[$]	< 0.001**	< 0.001**	0.005**		

[c]Kruskal-Wallis test; [$]Friedman test; *significant ($P < 0.05$); **highly significant difference; #Mann-Whitney test.
[1]: High thoracic-ESPB group vs SSNB group; [2]: High thoracic-ESPB group vs control group; [3]: SSNB group vs control group.
Abbreviations: High thoracic-ESPB, erector spinae plane block at the second thoracic vertebral level; SSNB, suprascapular nerve block; NRS-11, numeric rating scale; h, hours.

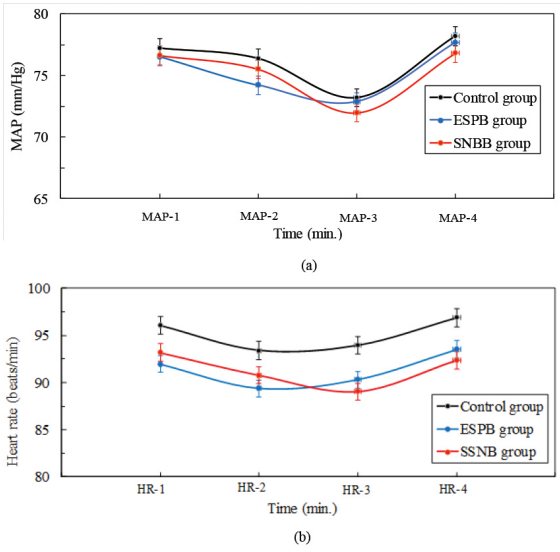

Fig. 3. *Line graph of: (a) the mean arterial pressure among the studied groups; (b) the heart rate among the studied groups.*

Table 5 shows the distribution of arthroscopic surgical procedures among the 3 groups, where no significant differences were detected. However, significant differences were found among the studied groups regarding the percentage of nausea, vomiting, and sedation, which was higher in the control group than in the high thoracic-ESPB and SSNB groups. The occurrence of other findings, such as constipation and itching, was not significant. Moreover, among the studied groups, no patients had any signs of respiratory distress. The sensory level distribution after block in the SSNB group extended from the fourth cervical dermatomes to the sixth ones in only 11 (34.4%) patients; whereas, in the remaining 21 (65.6%) patients, the sensory block was confined to the fifth and sixth dermatomes. On the contrary, the sensory block in the ESPB group was identified from the fourth cervical dermatomes to the third thoracic ones in 53.1% of the patients; whereas, in 34.4%, it ranged from C5 to T4. In the remaining 12.5% of the patients, the sensory block was from C4 to T4. No harm was documented from either block techniques throughout the study periods.

Table 4. *Intra- and post-operative opioid requirements among the studied groups.*

Variables	High thoracic-ESPB (n = 32)	SSNB (n = 32)	Control (n = 32)	[a]*P* value	LSD
Morphine Dose, mean ± SD	5.7 ± 1.02	6 ± 0.81	18.8 ± 2.9	< 0.001**	^ > 0.05[1*] < 0.05[2**] < 0.05[3**]
Fentanyl Dose, mean ± SD	224.7 ± 17.1	232.8 ± 17.8	326.6 ± 45.8	< 0.001**	^ > 0.05[1] < 0.05[2**] < 0.05[3**]
Time to First Rescue Analgesic (min), mean ± SD	281.3 ± 31.3	296.9 ± 36.7	23.1 ± 5.2	< 0.001**	^ > 0.05[1] < 0.05[2**] < 0.05[3**]

[a]one-way ANOVA test; *significant ($P < 0.05$); **highly significant difference. ^: t test.
[1]: High thoracic-ESPB group vs SSNB groups; [2]: High thoracic-ESPB group vs control group; [3]: SSNB group vs control group.
Abbreviations: High thoracic-ESPB, erector spinae plane block at the second thoracic vertebral level; SSNB, suprascapular nerve block; LSD, least significant difference; SD, standard deviation; min, minutes.

Discussion

Arthroscopic procedures are minimally invasive approaches. However, many patients complain of considerable shoulder pain during the postoperative period. Sun et al (6) reported that high thoracic ESPB is comparable to ISB analgesic efficacy for shoulder procedures, but ESPB may be preferred because of its phrenic nerve-sparing effect. Although high thoracic-ESPB may permit LA spread up to C3 as confirmed by radiological scan, a theoretical possibility of diaphragmatic involvement still exists (4). In this study, no cases of breathing difficulties were reported during the current study or in other previous investigations. Moreover, the results revealed that the sensory dermatomal block in the high thoracic-ESPB group was distributed from the C4-C5 level to T3-T4 with sparing of the C3 branch. Meanwhile, Ciftci et al (11) reported that sensory loss distribution with high thoracic-ESPB occurred from C3-C5 to T2-T3. These variable sensory findings of both studies were confirmed by Schwartzmann et al (12), who reported a highly variable level of sensory block extent under

Table 5. *Clinical findings and postoperative opioid associated complications within the studied groups.*

Variables	High thoracic-ESPB (n = 32)	SSNB (n = 32)	Control (n = 32)	*P* value
Types of Arthroscopic Surgical Procedures, nb (%)				
Diagnostic Procedure Rotator Cuff Repairs Acromioplasty Subacromial Bursectomy	6 (18.8%) 4 (12.5%) 13 (40.6%) 9 (28.1%)	6 (18.8%) 5 (15.6%) 11 (34.4%) 10 (31.3%)	7 (21.9%) 4 (12.5%) 12 (37.5%) 9 (28.1%)	0.989[c]
Blocked Sensory Level, nb (%)				
From C4, C5, C6 From C5 to C6 From C4 to T3 From C4 to T4 From C5 to T4	- - 17 (53.1%) 4 (12.5%) 11 (34.4%)	- -	-	
Side Effects Reported in the Studied Groups, nb (%)				
Nausea and Vomiting No Yes	 29 (90.6%) 3 (9.3%)	 28 (87.5%) 4 (12.5%)	 20 (66.7%) 12 (37.5%)	 0.01[c]
Itching No Yes	 32 (100%) 0 (0%)	 31 (96.8%) 1 (3.1%)	 30 (93.3%) 2 (6.2%)	 0.356[c]
Constipation No Yes	 25 (78.1%) 7 (21.8%)	 23 (71.8%) 9 (28.1%)	 25 (78.1%) 7 (21.8%)	 0.796[c]
Sedation No Yes	 18 (56.2%) 14 (43.7%)	 16 (50%) 16 (50%)	 8 (25%) 24 (75%)	 0.03*[c]
Respiratory Distress No Yes	 30 (100%) 0 (0)	 30 (100%) 0 (0)	 30 (100%) 0 (0)	 1.00[c]

[c]chi-square test; *significant ($P < 0.05$); **highly significant difference
Abbreviations: High thoracic-ESPB, erector spinae plane block at the second thoracic vertebral level; SSNB, suprascapular nerve block.

magnetic resonance imaging. Moreover, Selvi et al (5) reported that the anesthetizing effect of the ESPB may not include supraclavicular nerve (C3, C4) distributions in some patients. This may be explained by the anatomical differences among patients that lead to the variable sensory effects of the block.

The results of this study demonstrated a nonsignificant difference between the 2 block groups concerning NRS-11 scores, except within 2 hours postoperatively with arm abduction, where pain scores were significantly higher in the SSNB group. Unfortunately, some patients in both block groups exhibited high pain scores upon arm mobilization early within the first 2 hours after surgery. This early postoperative pain may be precipitated by the intraoperative fluid irrigation of the shoulder joint with subsequent joint edema and nerve compression. It may be also caused by the supraclavicular nerve (C3, C4)-sparing effect of ESPB. The supraclavicular nerve controls the sensory up to the cape of the shoulder and acromioclavicular and sternoclavicular joints. Whereas, the SSNB technique spares many sensory branches, which also includes the supraclavicular nerve. However, the high pain scores were pronounced mainly in patients with rotator cuff surgical repair. This observation agreed with the findings of (3,13) who reported that rotator cuff repair is one of the most painful procedures among arthroscopic surgeries.

ESPB has only been employed in clinical practice recently, and several concerns have not been resolved yet. First, the optimal LA volume, concentration, and type have not been adequately outlined. The interfascial plane block is known to be volume dependent. Thus, the investigators of this study preferred to use LA volume of 30 mL instead of 20 mL to ensure the adequate spread of the injectate. This preference to a high volume was also based on the recommendations of previous studies conducted by Ciftci et al (11).

The SSN has both motor and sensory fibers that come from the ventral rami of the fifth and sixth cervical nerve roots (13). The results of this study showed that blocked C4 dermatomes are seen in only 34.4% of the patients in the SSNB group (Table 5). These results agreed with the findings of Barber (14) and Ajmani (15), who documented that there may be a possible involvement of the fourth cervical nerve root into the SSN. The SSNB group showed a significant decrease in both pain scores and incidence of nausea in comparison to the control group throughout varied time points of the current study. These findings agreed with the results of systematic meta-analysis review conducted by Chang et al (16) who confirmed the effective role of SSNB as a part of multimodal analgesia for relief of postoperative pain in shoulder surgery with decreased incidence of nausea in block groups. Barber (14) also reported a decrease in postoperative pain after arthroscopic shoulder surgery with SSNB. Singelyn et al (17) compared ISB with SSNB during arthroscopic shoulder surgery and proved that both blocks are comparable concerning morphine consumption. However, the ISB group exhibited better pain control upon arm mobilization and patient satisfaction. The pneumothorax was the most fearful side effect associated with SSNB in pain management practice. The reported incidence of pneumothorax by Moore (18) was as low as 1%. However, the technique of SSNB under the US guidance described by Harmon et al (19) lessened this fear. US-guided injection technique also enables the approximation of the needle tip to the nerve. Thus, a small volume and 10 mL of LA will adequately anesthetize the nerve while avoiding LA spread to the brachial plexus. This low LA volume used in SSNB provides safer clinical practice than ESPB. LA systemic toxicity after ESPB is caused by LA spread to the surrounding highly vascular tissue planes (20). Lee et al (21) reported LA toxicity during ESPB for the management of herpes zoster. Many concerns still exist regarding ESPB, such as the unpredicted level of LA spread, volume, and concentration. Moreover, ESPB-associated pneumothorax was reported by Ueshima (22). Selvi et al (23) also reported an unintended motor block linked to ESPB. Moreover, a possible sympatholytic effect may be associated with ESPB, which is attributed to the LA spread to the paravertebral space (24,25).

Conclusions

This study suggests the absence of a significant analgesic difference between SSNB and high thoracic-ESPB, except that high thoracic-ESPB provides better pain control upon movement during recovery room stay and 2 hours after surgery. However, SSNB has more expected sensory block coverage in contrast to the variable sensory block in ESPB. Moreover, the risk of LA toxicity with the interfacial plane block, especially with the use of a high LA volume, necessitates more anesthetist caution during the procedure. Indeed, a smaller LA volume used for SSNB is greatly advantageous. Our findings suggest that SSNB is not inferior to high thoracic-ESPB; moreover, both blocks can provide safe and effective postoperative analgesia for arthroscopic shoulder surgery. A continuous LA infusion catheter can be used either in ESPB or SSNB to provide extended periods of analgesia. However, our investigation was confined to a single LA injection. This limitation reduced the dura-

tion of analgesic effect in the studied patients to 12 hours postoperatively. Extra nursing care that required ensuring catheter safety may not be easily obtained at our facility units. To avoid any catheter-associated complications, the investigators preferred the preoperative one-shot block technique.

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