ISSN: 1607-8322, e-ISSN: 2220-5799 **Anaesthesia, Pain & Intensive Care**
Vol 29(8); November 2025 DOI: 10.35975/apic.v29i8.3036

ORIGINAL RESEARCH **REGIONAL ANESTHESIA**

Ultrasound-guided interscalene plexus block versus combined ultrasound-guided suprascapular and axillary nerve blocks for proximal humerus fracture surgeries: A randomized controlled study

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ABSTRACT

Background & objective: During the recent past, a renewed interest in regional nerve blocks for intra- as well as postoperative pain management has surged. Interscalene nerve block (ISB) represents an effective regional approach for most of the shoulder surgeries. Nevertheless, it is associated with significant adverse effects. This study aimed to assess the efficacy and safety of the combined suprascapular and axillary nerve block (SSNB/ANB) in comparison to ISB in providing analgesia for surgeries in proximal humerus fractures.

Methods: This clinical trial enrolled 50 patients of both genders with American Society of Anesthesiologists class I-II status scheduled for shoulder surgery under general anesthesia. The patients were assigned to two groups of 25 individuals each. The SSNB/ANB group and the ISB group. The primary outcome was the postoperative visual analog scale (VAS). Secondary outcomes included the amount of analgesic consumption at various time points during the first 24 hours post-surgery, the time of rescue analgesia, and the incidence of adverse effects.

Results: Patients in the SSNB/ANB group exhibited significantly elevated VAS scores in the early postoperative period and comparable scores at 12 and 24 hours postoperatively (P = 0.312 and 0.115, respectively). Additionally, they required a greater quantity of pethidine at various postoperative time points and exhibited a shortened interval before the onset of the need for rescue analgesia when compared to the ISB group. Nevertheless, hemidiaphragmatic paralysis, hypoxia, and hoarseness of voice incidences were significantly higher in the ISB group.

Abbreviations: ANB: axillary nerve block, BMI: body mass index, ISB: Interscalene nerve block, SSNB: suprascapular nerve block, VAS: visual analog scale

Keywords: Anesthesia; Axillary nerve block; General Anesthesia; Interscalene block; Nerve block; Suprascapular nerve block; VAS

Conclusion: In proximal humeral fracture surgery, the combined SSNB/ANB provided analgesia comparable to that of the ISB at 12 and 24 hours postoperatively, with minimal adverse effects.

Citation: Ehab AM, Nady RF, Azzam FMA. Ultrasound-guided interscalene plexus block versus combined ultrasound-guided suprascapular and axillary nerve blocks for proximal humerus fracture surgeries: A randomized controlled study. Anaesth. pain intensive care 2025;29(8):998-1006.

DOI: 10.35975/apic.v29i8.3036

1. INTRODUCTION

Proximal humerus fractures represent the third most common osteoporotic fracture and are primarily observed in women over the age of 60. These fractures result in considerable pain and functional impairment.[1] The postoperative pain associated with a proximal humerus fracture is frequently described as moderate to severe. This postoperative discomfort impedes early mobilization, physical therapy, and patient satisfaction, frequently resulting in delayed discharge due to inadequate pain management and diminished shoulder functionality.[2]

Interscalene nerve block (ISB) is a common regional anesthetic technique employed in the context of shoulder surgery. It is frequently employed for the management of postoperative discomfort.[3] Nevertheless, ISB has been associated with an increased risk of temporary and potentially permanent respiratory complications, including phrenic nerve paresis and unilateral diaphragmatic paralysis.[4] Less common complications include respiratory distress, arm weakness, hoarseness, Horner's syndrome, and brachial plexus neuropathy. Consequently, ISB is contraindicated in individuals with contralateral phrenic nerve palsy, significant underlying respiratory insufficiency due to chronic obstructive pulmonary disease, restrictive lung disease, bronchial asthma, and increased body mass index.[5]

In 2007, the combined suprascapular and axillary nerve block (SSNB/ANB) was introduced as a regional anesthetic for shoulder surgery. The axillary and suprascapular nerves are the primary sources of innervation to the shoulder. Selective blocks may be performed at the posterior humerus for the axillary nerve and at the suprascapular fossa for the suprascapular nerve.[6]

The suprascapular nerve has its origin in the upper trunk of the brachial plexus, which is formed by the fifth and sixth cervical nerves. It supplies 60-70% of the innervation of the shoulder joint, whereas the axillary nerve, which is a branch of the posterior cord of the brachial plexus, supplies 25-30% of the innervation of the shoulder joint. Accordingly, it can be postulated that the combination of SSNB and ANB may enhance the efficacy of the nerve block.[7]

Additionally, the suprascapular and axillary nerves can be accessed via an anterior route. The suprascapular nerve is situated laterally to the brachial plexus beneath the omohyoid muscle, while the axillary nerve is located within the axillary fossa.[8, 9] Analgesia is provided instead of anesthesia by blocking both nerves peripherally around the joint. This approach is applicable in arthroscopic procedures and may offer advantages in open surgery, particularly in cases where ISB is contraindicated or challenging.[10] Recently, the combination of SSNB/ANB has been proposed as a safe alternative to ISB for anesthesia and postoperative analgesia in shoulder surgery. Accordingly, this study aimed to evaluate the efficacy and safety of a combined SSNB and ANB approach as an alternative to ISB in providing analgesia for patients undergoing proximal humerus fracture surgeries.

2. METHODOLOGY

The protocol of the current study was approved by the Research Ethics Committee of the Faculty of Medicine, Ain Shams University, Egypt (ID: FMASU R10/2024, Date: 18/1/2024). All patients singed informed consent before enrollment. All procedures were conducted in compliance with the standards of the Declaration of Helsinki. The trial was registered at the ClinicalTrials.gov (ID: NCT06253442, Date: January 30, 2024).

This randomized, double-blind, parallel-group, clinical trial was conducted at Ain Shams University Hospital, Cairo, Egypt between February 2024 and August 2024. The study enrolled adult patients between the ages of 18 and 65 years of both sexes who were scheduled for proximal humerus fracture surgery and classified as American Society of Anesthesiologists (ASA) physical status I or II. Patients who declined to provide informed consent, those with a history of local anesthetic allergy, bleeding disorder, cardiovascular, renal disease, hepatic, or neuromuscular diseases, chronic opioid use, infection or sepsis at the puncture site, or a body mass index (BMI) greater than 35 kg/m² were excluded from the study.

The primary outcome was the VAS at 0, 6, 12, and 24 hours postoperatively. Secondary outcomes included the amount of analgesic consumed during the surgical procedure, in the PACU, and the first 24 hours following surgery, as well as the time to rescue analgesia and the incidence of adverse effects.

A computer-generated table was used to randomize 50 adult patients into two groups (25 patients each). In the SSNB/ANB group, patients underwent the combined ultrasound-guided suprascapular and axillary nerve blocks. The ISB group underwent an ultrasound-guided interscalene nerve block. The randomization sequence was concealed using sealed, opaque envelopes.[11] The patients and the data collectors were blinded to the intervention groups.

A comprehensive pre-operative assessment was conducted on each patient, encompassing a detailed medical history, physical examination, and an in-depth analysis of the results of routine laboratory tests. The intensity of pain was quantified using the Visual Analog Scale (VAS), wherein a score of 0 signifies the absence of pain and a score of 10 represents the maximum conceivable level of pain.[12] Upon entering the preparation room, a medical professional proceeded to insert an 18-gauge intravenous (IV) cannula. Patients received premedication in the form of an IV administration of 0.02 mg/kg of midazolam, with or without 0.5-1 μ/kg of fentanyl and 10 mg of metoclopramide. In the operating room, patients were monitored using electrocardiography, non-invasive blood pressure, and pulse oximetry. The assessment of diaphragmatic motion was conducted in the holding area with the use of a curvilinear probe (SonoSite, Fuji M-Turbo portable ultrasound system). Patients with abnormal examinations were deemed ineligible for inclusion in the study and were thus excluded.

2.1. The SSNB/ANB Group

The suprascapular nerve block was performed via a posterior route with the patient positioned in an upright, forward-leaning position. The high-frequency linear probe (10-15 MHz) was advanced from medial to lateral across the supraspinatus fossa, situated just above the scapular spine. Once the trapezius and supraspinatus muscles had been identified, the suprascapular nerve was located at the suprascapular notch, situated in proximity to the suprascapular artery. Subsequently, a 15-mL aliquot of 0.5% bupivacaine was administered, confirming the absence of blood by negative aspiration.[13]

The ultrasound transducer for the axillary nerve block was positioned in a sagittal plane over the posterior aspect of the humeral head to locate the deltoid muscle, humeral neck, teres minor muscle, circumflex humeral artery, and triceps muscle. Following the identification of the neurovascular quadrangle and an assessment of the deltoid response to stimulation, a total of 10 mL of 0.25% bupivacaine was administered using the in-plane approach.[14]

Thirty minutes following the administration of the local anesthetic infusion, a masked investigator assessed the extent of the block. Motor block of shoulder external rotation and shoulder abduction at 90 degrees (for the suprascapular nerve) and shoulder abduction (for the axillary nerve) was evaluated using a 4-point Medical Research Council scale. The sensory block was evaluated using a four-point numerical rating scale for cold sensation. A sensory block of this nerve was also evaluated, as the suprascapular nerve does not transmit cutaneous afferent fibers.[15]

2.2. The ISB Group

An ultrasound-guided interscalene nerve block was performed with the assistance of a linear array ultrasound transducer. With the patient positioned supine, the head was rotated to the contralateral side of the block. Ultrasound scanning was conducted in the transverse plane with the long axis of the probe aligned parallel to the clavicle, to visualize the brachial plexus, which is situated between the anterior and middle scalene muscles. Subsequently, a 5 cm 22-gauge insulated needle was positioned in alignment with the probe, oriented laterally to medially. Subsequently, a local anesthetic solution was administered in 15-mL aliquots of bupivacaine 0.5% after negative blood aspiration, to facilitate posterior distribution to or between the C5 and C6 nerve roots.[16]

At the end of the block, motor and sensory assessments were performed. Motor block for ISB was assessed by loss of shoulder abduction. The inability to achieve shoulder abduction within 30 minutes of the block was considered a failure of the block. The median nerve was assessed by loss of thumb opposition, the ulnar nerve by loss of finger adduction, the radial nerve by loss of elbow extension and the suprascapular nerve by loss of arm external rotation. Motor block was graded using the modified Bromage scale, a three-point scale. Grade 0: normal motor function with full flexion and extension of the shoulder and elbow; grade 1: reduced motor strength; grade 2: total motor block with inability to move the shoulder.

Sensory block was assessed using either an ice test or a pinprick test in the relevant dermatome. The assessment employed a 3-point scale, as follows: 0 = normal sensation, 1 = loss of pinprick sensation (analgesia), and 2 = loss of tactile sensation (anesthesia). A successful block was defined as a pinprick test score of ≥1 and a Bromage test score of 2 for the nerves innervating the shoulder.[16]

General anesthesia was administered using a standardized method that included IV propofol at a dose of 2.5 mg/kg, fentanyl at a dose of 1 μ/kg, and atracurium at a dose of 0.5 mg/kg. The airway was maintained by tracheal intubation, and ventilation was provided with 40% oxygen. General anesthesia was maintained with inhaled 0.75-1.2% of isoflurane. Patients with an intraoperative increase in heart rate or arterial pressure greater than 25% of pre-induction values receive IV 25 mg of fentanyl.16

At the end of surgery, atracurium was withdrawn and the neuromuscular blockade was antagonized with IV neostigmine at a dose of 0.04 mg/kg and atropine at a dose of 0.01 mg/kg. Subsequently, the endotracheal tube was removed. Following the surgical procedure, patients were transferred to the post-anesthesia care unit (PACU) for comprehensive recovery and monitoring.

If the visual analogue scale (VAS) score reached 4 or above, an IV dose of pethidine at a concentration of 0.5 mg/kg/dose was administered as rescue analgesia. The objective was to ensure that the total 24-hour dose did not exceed 1 mg/kg every 8 hours. If the patient reported discomfort between scheduled doses of pethidine, intravenous paracetamol was administered at a dose of 15 mg/kg, with a maximum of 1,000 mg per administration.

2.3. Measurement tools

The VAS score was assessed at 0, 6, 12, and 24 hours after surgery. The amount of analgesia used during surgery, in the post-anesthesia care unit and within the first 24 hours after surgery was quantified and documented for each patient. We recorded the number of patients in each group who required additional doses of pethidine during surgery, the total amount of pethidine administered to each patient and the block failure rate. Also, we recorded the time to the first postoperative analgesic request by patients after surgery. A block was considered unsuccessful if the patient required more than two doses of rescue analgesia in the first hour after surgery.

Phrenic nerve block was evaluated by ultrasound by observing the real-time movement of the diaphragm on the side of the block. The US was located at the midpoint of the hemiclavicular and midaxillary lines, aligned with the hemidiaphragm on the ipsilateral side of the block. Ultrasound was performed with a 2-5 MHz curvilinear probe with the subject in the dorsal decubitus position while breathing deeply. Hemi-diaphragmatic paralysis was characterized by elevation of the diaphragm more than 4 cm above the preoperative level.

All block-related complications, such as pneumothorax, hoarseness, nausea, vomiting, and hypoxemia (SpO_2 < 90%), and any additional complications were documented.

Table I: Patients' demographic characteristics

Parameters		SSNB/ANB Group (n = 25)	ISB Group (n = 25)	P-value
Age (years)		39.2 ± 8.6	37.6 ± 8.0	0.521
Gender	Male	14 (56.0)	16 (64.0)	0.564
	Female	11 (44.0)	9 (36.0)	
BMI, kg/m^2		29.3 ± 2.8	29.6 ± 3.2	0.694
ASA	I	13 (52.0)	10 (40.0)	0.395
	II	12 (48.0)	15 (60.0)	
Operative duration (min)		43.5 ± 6.5	42.4 ± 6.4	0.555

Group SSNB/ANB: Suprascapular nerve block and axillary nerve block; Group ISB: Interscalene nerve block group; BMI: body mass index; Data are presented as mean ± SD or n (%); P < 0.05 is significant

2.4. Sample size

The sample size was calculated using STATA 10, following the methodology proposed by Ko et al.[10] With the mean VAS score in interventional group 1.3 ± 1.6, while in the control group 3.3 ± 1.2, an alpha error of 5%, and 80% power, the final calculated sample size per group was 25 participants in each group (total sample size = 50).

2.5. Statistical analysis

The data collected were coded, organized, and statistically analysed using IBM SPSS Statistics software version 28.0 (IBM Corp., Chicago, USA, 2021). Quantitative data were assessed for normality using the Shapiro-Wilk test, then characterized as mean ± SD, and compared using an independent t-test and a one-sample t-test. Qualitative data are presented as numerical values and percentages, then analysed using

Table 2: Pain perception by visual analogue score

Time	SSNB/ANB Group (n = 25)	ISB Group (n = 25)	P-value	Relative effect	
				Mean ± SE	95% CI
Preoperative	6.6 ± 1.5	6.5 ± 1.6	0.927	0.0 ± 0.4	-0.8–0.9
Postoperative, h-0	2.8 ± 1.4	0.9 ± 1.0	< 0.001*	2.0 ± 0.4	1.3–2.7
Postoperative, h-6	3.1 ± 1.1	1.1 ± 1.4	< 0.001*	2.0 ± 0.4	1.3–2.7
Postoperative, h-12	1.2 ± 1.1	1.6 ± 1.4	0.312	-0.4 ± 0.4	-1.1–0.3
Postoperative, h-24	1.2 ± 1.1	1.7 ± 1.2	0.115	-0.5 ± 0.3	-1.2–0.1

*Group SSNB/ANB: Suprascapular nerve block and axillary nerve block; Group ISB: Interscalene nerve block group; SD: standard deviation; n: numbers; BMI: body mass index; Relative effect: Effect in SSNB/ ANB group relative to that in ISB group; SE: Standard error; CI: Confidence interval; *: Significant at P < 0.05.*

Table 3: Intraoperative and postoperative analgesic (pethidine) requirement and dosage

Analgesic (pethidine) requirement	SSNB/ANB Group (n = 25)	ISB Group (n = 25)	P-value	Relative effect	
				Mean ± SE / RR	95% CI
Intraoperative requirement	5 (20.0)	3 (12.0)	0.702	1.67	0.45–6.24
Intraoperative dose (mg)	45.0 ± 11.2	25.0 ± 0.0	0.024*	20.0 ± 6.7	3.7–36.3
PACU requirement	5 (20.0)	1 (4.0)	0.189	5.00	0.63–39.79
PACU dose, (mg)	45.0 ± 11.2	25.0	0.016*	20.0 ± 5.0	6.12–33.9
Ward requirement	7 (28.0)	3 (12.0)	0.157	2.33	0.68–8.01
Ward dose, (mg)	71.4 ± 17.3	33.3 ± 14.4	0.010	38.1 ± 11.4	11.7–64.5
Postoperative requirement	10 (40.0)	4 (16.0)	0.059	2.50	0.90–6.92
Postoperative dose, (mg)	72.5 ± 18.4	31.3 ± 12.5	0.002	41.3 ± 10.1	19.1–63.4
Time of first postop dose, (hours)	2.4 ± 2.3	10.1 ± 8.5	0.017	-7.7 ± 2.8	-13.7–-1.6
Ever requirement	15 (60.0)	7 (28.0)	0.023*	2.14	1.06–4.34
Ever dose, (mg)	63.3 ± 20.8	28.6 ± 9.4	<0.001*	34.8 ± 8.3	17.4–52.1
Acetaminophen dose					
Postoperative requirement	15 (60.0)	12 (48.0)	0.395	1.25	0.74–2.10
Postoperative dose, mg	933.3 ± 258.2	708.3 ± 257.5	0.033*	225.0 ± 99.9	19.3–430.7

Group SSNB/ANB: Suprascapular nerve block and axillary nerve block; Group ISB: Interscalene nerve block group; n: numbers; SD: standard deviation; SE: Standard error; RR: Relative risk; CI: Confidence interval; *: Significant at P < 0.05.

the Chi-square test and Fisher's exact test. The significance criterion was set at a P < 0.050.

3. RESULTS

The participants were randomly divided into two equal groups, comprising 25 individuals each. Group SSNB/ANB underwent a combined suprascapular and axillary nerve block, while Group ISB underwent an interscalene nerve blockade (Figure 1).

No significant differences were observed regarding demographic data, including age, sex, BMI, ASA classification, and operative duration between the two groups (Table 1).

As illustrated in Table 2, the group undergoing ISB exhibited significantly lower VAS scores in the immediate postoperative period and at the six-hour mark compared to the group receiving the combined SSNB/ANB (P = 0.001). The intraoperative, PACU, and postoperative doses of pethidine were higher in Group SSNB/ANB than in Group ISB (P = 0.024, 0.016, and 0.002, respectively). Patients in Group ISB required a longer period to achieve adequate pain relief and required a lower dosage of acetaminophen than those in Group SSNB/ANB (10.1 ± 8.5 vs 2.4 ± 2.3 hours and 708.3 ± 257.5 vs 933.3 ± 258.2 mg, with P = 0.017 and 0.033, respectively) (Table 3).

The SSNB/ANB group exhibited a significantly lower incidence of adverse effects compared to the ISB group, including diaphragmatic excursion reduction, hemidiaphragmatic paralysis, hypoxia (SpO_2 <90%), and hoarseness of voice (Table 4).

4. DISCUSSION

Interscalene nerve block is the most effective regional analgesic for arthroscopic shoulder surgery. The ISB has success rates ranging from 87% to 100%.[17] However, it is associated with potentially serious complications, including inadvertent epidural and spinal anesthesia, vertebral artery injection, paralysis of the vagus, recurrent laryngeal and cervical sympathetic nerves[18] pneumothorax[19], and brachial plexus injury. Phrenic nerve block occurs in all subjects receiving interscalene nerve block.[20] Therefore, an alternative approach of SSB/ANB has been proposed for postoperative analgesia in proximal humerus fracture surgeries to avoid the problems associated with ISB. The aim of this study was

Table 4: Side effects and complications

Conditions	SSNB/ANB Group (n = 25)	ISB Group (n = 25)	P-value	Relative effect	
				Mean ± SE/RR	95% CI
Diaphragmatic excursion reduction, cm	1.0 ± 0.7	3.1 ± 1.7	<0.001*	-2.1 ± 0.4	-2.8–-1.3
Hemidiaphragmatic paralysis	0 (0.0)	15 (60.0)	<0.001*	NA	NA
Hypoxia, SpO_2 <90	0 (0.0)	8 (32.0)	0.004*	NA	NA
Hoarseness of voice	0 (0.0)	6 (24.0)	0.022*	NA	NA
Nausea and vomiting	2 (8.0)	2 (8.0)	0.999	1.00	0.15–6.55
Pneumothorax	0 (0.0)	1 (4.0)	0.999	NA	NA

*Group SSNB/ANB: Suprascapular nerve block and axillary nerve block; Group ISB: Interscalene nerve block group; SD: standard deviation; n: numbers; SE: Standard error; RR: Relative risk; CI: Confidence interval; NA: Not applicable; *: Significant at P<0.05*

to compare the efficacy and safety of the combined SSNB and ANB versus ISB in providing analgesia for proximal humerus fracture Surgeries.

Our main findings were that the VAS score became below 4 in both groups with significantly low in the ISB group in the early postoperative period, while it was comparable between both approaches at 12 and 24 hours. Furthermore, patients who underwent SSNB/ANB required large doses of pethidine at various times, as well as large doses of paracetamol postoperatively, and a shorter time to first analgesic request. However, it has minimal adverse effects compared to the ISB group.

Similarly, Neuts et al.[21] concurred with our findings that the ISB approach was more efficacious in providing postoperative analgesia and reduced the use of opioids compared to the SSNB/ANB approach. Additionally, Dutta et al.[22] reported that both the ISB and SSNB/ANB approaches provide effective anesthesia and analgesia for shoulder surgery. The quality of the block was superior after ISB, yet SSNB/ANB had fewer adverse effects. In patients undergoing arthroscopic shoulder surgery, Dhir et al.[23] observed inferior pain control in the early postoperative period with SSNB/ANB compared to ISB. However, SSNB/ANB provided superior pain control at 24 hours, and the SSNB-ANB group exhibited increased opioid consumption. Moreover, a systematic review and meta-analysis conducted by Zhao et al.[10] revealed that SSNB/ANB did not exhibit superior clinical efficacy in postoperative pain management or patient satisfaction when compared to ISB. However, SSNB + ANB demonstrated enhanced efficacy in reducing the incidence of dyspnea. Concerning the use of opioids, there was an absence of clinical data that could be used to assess the advantages of SSNB/ANB in comparison with ISB.

The suprascapular nerve provides 70% of the sensory and motor coordination for the shoulder girdle and includes the superior, medial, and posterior joint areas, the posterior capsule, the acromioclavicular joint, the subacromial bursa, the coracoclavicular ligament, and variably, the surrounding skin. The axillary nerve provides additional innervation, situated laterally to the radial nerve and entering the quadrangular space, where it divides into two branches. The anterior branch innervates the middle and anterior portions of the deltoid muscle, while the posterior branch innervates the teres minor and the posterior fibers of this muscle, ultimately terminating as the lateral superior cutaneous nerve.[24, 25] In contrast to an interscalene block, which results in anesthesia of the entire shoulder girdle and upper limb, a selective nerve block is limited to the supraspinatus, infraspinatus, and teres minor muscles, sparing the musculature of the arm, forearm, and hand.[21] The subscapularis muscle and the anterior glenohumeral joint capsule, which are innervated by the subscapular nerve, remain uninhibited by the selective approach.[21] This anatomical context may provide an explanation for our findings.

Conversely, Hashem et al.[26] compared ISB with suprascapular nerve block alone and found that the latter was a viable alternative, particularly in patients with restricted breathing capacity and in outpatient arthroscopic shoulder procedures. The discrepancy between our findings and those of other trials may be attributed to the use of disparate local anesthetics and volumes. It is therefore recommended that further investigation be carried out to elucidate the impact of varying anesthetic agents.

In terms of safety, the present study demonstrated that the SSNB/ANB approach exhibited a lower incidence of adverse effects in comparison to the ISB approach.

Similarly, Neuts et al.[21] observed the occurrence of phrenic nerve paralysis, Horner's syndrome, and recurrent laryngeal nerve block in the ISB group. Specifically, three patients required endotracheal intubation and ventilatory support. Furthermore, Dutta et al.[22] documented that three patients in the SSNB/ANB group experienced either inadequate or complete block failure, necessitating general anesthesia for the completion of the procedure.

Interscalene nerve block carries an increased risk of nerve injury due to its focus on cervical nerve roots rather than peripheral nerves.[3] The incidence of ipsilateral phrenic nerve palsy has been documented to range from 25% to 100%,[27, 28] with the potential to result in a 25% decline in lung function. However, this can be compensated for by the intercostals and accessory respiratory muscles, which are less affected by the procedure. Therefore, ISB may be used with caution in patients with compromised lung function.

Conversely, Zhao and colleagues proposed that the concurrent administration of SSNB and ANB may result in diaphragmatic paralysis.[10] Zhao and colleagues ascribed this phenomenon to the anatomical distance between the suprascapular nerve and the phrenic nerve, with the former situated more distally than the latter.[7] Therefore, further research is recommended.

5. LIMITATIONS

The study was limited by its small sample size and single-center design. Future research should involve larger, multicenter trials and explore the effects of varying concentrations and doses of anesthetics. Additionally, noninvasive respiratory monitoring, though informative, remains less accurate compared to the gold standard of spirometry. Nonetheless, the use of the same anesthesia team to perform all blocks helped standardize the procedure, minimizing variability in technique and outcomes. While numerous studies have investigated regional anesthesia for shoulder arthroscopic surgeries, there are relatively few studies focusing on regional anesthesia for proximal humerus fracture surgeries.

6. CONCLUSIONS

In patients undergoing proximal humeral fracture surgery, the combined SSNB/ANB approach provides comparable analgesia to that of the ISB approach at 12 and 24 hours postoperatively, with minimal adverse effects. In light of these findings, it may be posited that a combined SSNB/ANB approach represents a safe alternative.

7. Data availability

All data generated during this study are available with the authors and can be obtained on request.

8. Ethical consideration

The authors declare that this submission is in accordance with the principles laid down by the Responsible Research Publication Position Statements as developed at the 2nd World Conference on Research Integrity in Singapore, 2010. Prior to commencement of the study, ethical approval was obtained from the following ethical review board: Faculty of Medicine, Ain Shams University (ID: FMASU R10/2024, Date: 18/1/2024). Informed consents were obtained from the study participants.
The trial was registered at ClinicalTrials.gov (ID: NCT06253442, Date: January 30, 2024).

9. Acknowledgements

We thank the management of Ain Shams University, and staff of Department of Anesthesia, Intensive Care, & Pain Medicine, Faculty of Medicine, for their assistance and for providing us with the facilities to conduct the research analyses.

10. Funding Declarations

This study did not receive any external or industry funding..

11. Conflicts of interest

The authors have nothing to disclose.

12. Author contributions

AME: Conduction of the study
RFN: Manuscript Editing
AFMA: Literature search

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