Hashem *et al.*
Ain-Shams Journal of Anesthesiology (2023) 15:26
https://doi.org/10.1186/s42077-023-00324-8

Ain-Shams Journal of Anesthesiology

ORIGINAL ARTICLE

Open Access

A comparative study between ultrasound-guided interscalene and ultrasound-guided suprascapular nerve blocks in postoperative pain and hand motor power affection in shoulder scope surgeries

Mohamed Medhat Mohamed Hashem[1*], Sherif Farouk Ibrahim[1], Waleed Ahmed Mansour[1], Noha Mohamed Abdelaziz[1] and Niven Gerges Fahmy[1]

Abstract

Background Interscalene approach for brachial plexus block is recognized as the gold standard technique for postoperative pain control after shoulder scope surgeries. However, it is associated with major adverse effects and patient discomfort due to paralysis of the hand muscles. The suprascapular nerve block is considered to be a safe and effective alternative to interscalene nerve block for shoulder surgery without affecting the motor function of the hand muscles and other serious complications of interscalene nerve block, especially in ambulatory surgery.

The aim of this study is to compare interscalene and suprascapular nerve block in terms of postoperative pain, opioid consumption, and hand grip strength in shoulderscopic surgeries.

This prospective, randomized trial was done in Ain Shams University Hospitals. A sample of 50 patients was divided into two groups; 25 patients in each group, namely Group ISB (interscalene approach of brachial plexus block) and Group SSNB (suprascapular nerve block). Visual analogue scale (VAS) was used to assess shoulder pain at rest and upon flexion in the first 24 h. The degree of hand motor power affection, the total amount of opioids used as rescue analgesia, and the incidence of complications were also recorded.

Results The findings revealed no statistically significant difference between groups (*P*-value > 0.05) in pain control all over the 24 h by VAS score at rest and at arm flexion. SSNB received a larger total narcotic dose (60 ± 26.02) mg of pethidine than ISB (52 ± 22.73). However, there was no statistical difference between them throughout the 24 h regarding total narcotic consumption and 1st time for pethidine administration. The ISB group showed a statistically significant reduction in the hand power grip strength postoperatively (83.68 ± 4.75%).

Conclusions The results of the present study favor SSNB as the first choice of pain control after shoulderscopic surgeries for a patient scheduled for early home discharge because of the complete recovery of the hand muscles' motor power.

Trial registration This study was registered on PACTR (www.pactr.org) database; identification number for the registry is PACTR202201840526231.

*Correspondence:
Mohamed Medhat Mohamed Hashem
m.medhathashem@med.asu.edu.eg
Full list of author information is available at the end of the article

Keywords Interscalene block, Suprascapular nerve block, Total narcotics demand, Visual analogue scale, Bulb dynamometer

Background

Today, there is a greater demand for good pain management because pain is seen as a key symptom and has been linked to quality features in the healthcare system (Thota et al. 2019). Effective early postoperative analgesia decreases the incidence of chronic postoperative pain (Gan 2017). Regional anesthesia decreases postoperative opioid requirements with a subsequent decrease in opioid-related adverse effects and complications. Moreover, it has been significantly linked to a lower incidence of chronic postoperative pain. Therefore, regional anesthesia is recommended as the first choice of postoperative pain control in many types of surgeries (Garimella and Cellini 2013).

Advances such as ultrasonography have led to regional anesthesia becoming a rapidly developing field. It avoids serious complications and is associated with a greater success rate by proper visualization of the nerves and adjacent structures (Andreae and Andreae 2013).

As a diagnostic tool and for surgical treatments including acromioplasty, glenohumeral joint stability, acromioclavicular joint arthroplasty, and rotator cuff repairs, shoulder arthroscopy is becoming more common, representing the second most common orthopedic surgery after knee arthroscopy (Beecroft et al. 2008).

Interscalene nerve blockade (ISB) offers patients undergoing shoulder surgeries the best analgesia; it lowers pain scores for at least 8 h and lowers opioid administration for between 8 and 12 h after surgery. (Abdallah et al. 2015). However, ISB could lead to a lot of complications such as its significant potential for both short-term and long-term respiratory problems, in particular phrenic nerve paresis. Moreover, interscalene block (ISB) also produces an intense motor block of the upper limb muscles which may extend to the hand muscles, leading to the discomfort of patients and predisposing them to injuries (Hussain et al. 2017).

The suprascapular nerve block (SSNB) for analgesia following shoulder surgery has recently attracted considerable interest (Raj 2011). The suprascapular nerve innervates 70% of the sensory input to the glenohumeral joint as well as the acromioclavicular joint (Chan and Peng 2011). Consequentially, it has been suggested that the SSNB will deliver adequate analgesia for shoulder surgery, and as a result, it has been considered as an alternative to the ISB (Fernandes et al. 2012). There have been multiple randomized controlled trials comparing ISB with SSNB; however, the results are inconsistent (Shin and Han 2010; Konradsen and Larsen 2009).

Dynamometer is an appropriate tool for assessing hand grip strength; it allows easy and objective measurement of hand grip strength. Consequently, it can be used to assess the motor power of hand muscles after upper limb regional blocks (Maher et al. 2018).

Our aim is to compare the analgesic effect of interscalene block and suprascapular block in shoulderscopic surgery. We hypothesized that their use would decrease the postoperative opioid requirements. Our secondary outcomes include assessment of postoperative VAS scores, hand grip power, and possible postoperative complications.

Methods

This prospective, randomized, two-armed, comparative trial was registered at pactr.org (PACTR202201840526231) on 11/1/2022 and reported according to the CONSORT guidelines. The study was approved by the Research Ethics Committee (REC) at the Faculty of Medicine, Ain Shams University (FMASU M D 04/2021) on 9/1/2021. All procedures were conducted in accordance with the Helsinki Declaration, 2013.

Sample size was determined using the PASS11 tool, setting power at 80%, and alpha error at 5%. After assessing the data from the Kondrastan et al. study (Konradsen and Larsen 2009), a sample size of 50 patients (25 in each group) is predicted to have 80% power to identify statistical significance between the two groups.

A sample of 50 patients ASA grades I or II scheduled for unilateral shoulderscopic surgery with a BMI less than 35 kg/m^2 and aged between 20 and 50 years old were divided into 2 groups, 25 patients in each group:

1) *Group ISB* (interscalene block group): This group consists of 25 patients who received an ultrasound-guided interscalene approach of brachial plexus plane block.
2) *Group SSNB* (suprascapular nerve block): This group consists of 25 patients who received ultrasound-guided suprascapular nerve block.

Patients who had history of allergic reactions to the drugs utilized in the study. Contraindications to regional anesthesia including local infection and coagulopathy were excluded. Previous surgery in the neck,

infraclavicular region, or suprascapular fossa since could affect the spread of the local anesthetic had been also excluded from the study. Also, significant neurological disorders including preexisting neuropathy or psychiatric disorders, addiction to narcotics or psychoactive drugs, and chronic pain syndromes requiring opioid intake at home were excluded.

Once the patient is included in the study, randomization will be done using opaque-sealed envelopes Patients will be randomly divided using the opaque-sealed envelopes method into two groups, 25 patient each: the group receiving interscalene nerve block and the group receiving suprascapular nerve block.

In the anesthesia clinic, preoperative assessment was done which includes full history taking, number of fasting hours, clinical examination, standard laboratory investigations including complete blood count (CBC), kidney function tests (KFT), liver function tests (LFT), and prothrombin time (PT). During the preoperative assessment, patients were taught about the visual analogue scale (VAS). VAS is a continuous line 10 cm long with the left end representing zero pain and the right end at 10 cm representing the worst pain ever.

Bulb dynamometers are designed to measure the amount of pressure a person can apply to the compressible bulb-shaped handle (Fig. 1). It is calibrated in standard PSI (pound per square inch) reading over a scale from 0 to 30 PSI. Patients were asked to squeeze the dynamometer as hard as possible to measure baseline hand grip strength (Maher et al. 2018).

Fig. 1 Baseline.® pneumatic squeeze bulb dynamometer (NC 70,122)

For all patients, regional anesthesia was started 30 min before the induction of general anesthesia. In all groups, general anesthesia was induced with intravenous propofol 1.5 mg/kg (LBW), fentanyl 1 µg/kg (TBW), and atracurium 0.5 mg/kg (IBW) to facilitate endotracheal intubation. Atracurium was given every 20 min, and its effect was monitored using neuromuscular testing keeping the train of four between 0 and 1. General anesthesia was maintained with sevoflurane in an oxygen and air mixture (70% and 30%, respectively) guided by a bispectral index score between 40 and 60. Patients were mechanically ventilated with the maintenance of normocapnia (end-tidal CO_2 35–40 mmHg) and normal SpO_2 (> 95%).

Group ISB patients received ultrasound-guided interscalene block on the same side of the surgery in the supine position. The transducer was placed at the level of cricoid cartilage behind the clavicular head of the sternocleidomastoid muscle; after identifying the carotid artery, the transducer is moved slightly laterally across the neck. The purpose was to recognize the anterior and middle scalene muscles, as well as the brachial plexus segments that lie between them. After that, the needle was inserted in-plane towards the brachial plexus, from lateral-to-medial direction until reaching the interscalene groove between scalenus anterior and scalenus medius. After negative aspiration, 15 ml of 0.25% bupivacaine was injected in-plane under ultrasound guidance with an ultrasound-visible needle.

Group SSNB received suprascapular nerve block which was performed before general anesthesia. Ultrasound probe was placed, one end of the transducer over the scapular spine and the other end directed towards the coracoid process, and the needle is introduced in-plane towards the lateral aspect of the supraspinous fossa, beneath supraspinatus muscle, and deep to the transverse scapular ligament. Under ultrasound guidance, a total dose of 15 ml of 0.25% bupivacaine was injected. The suprascapular nerve and artery were visible either before or after the injection of LA.

Both blocks were done under strict aseptic conditions with an ultrasonic machine equipped with a high-frequency linear probe enclosed by a sterile sheath (the SonoSite M-Turbo, Inc., Bothell, 98,021, WA, USA) with high-frequency linear probe (12 MHz) and 22-G needle peripheral nerve block needle (B. Braun Medical Inc., Bethlehem, PA, USA).

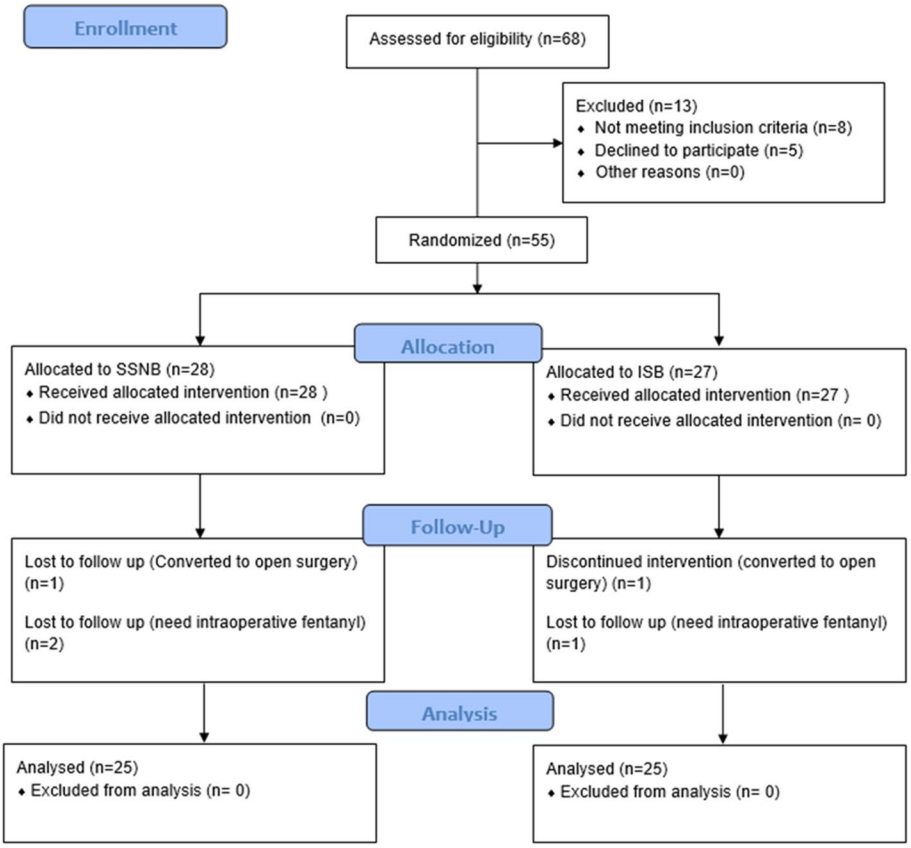

Fig. 2 CONSORT flow diagram of the study

In intraoperative pain defined as development of tachycardia and hypertension of more than 20% from the baseline, 1–2 ug/kg fentanyl was administered intraoperatively, and the patients will be excluded from the study.

At the end of the procedure, sevoflurane was discontinued, and to counteract the effects of atracurium, neostigmine 0.04 mg/kg with atropine 0.02 mg/kg was given. Oxygen saturation, heart rate (beats/min), and mean arterial pressure (mmHg) were measured upon arrival to the postanesthetic care unit (PACU) and as needed. The visual analogue score (VAS) was used at rest and upon flexion for assessment of pain intensity upon arrival to the PACU.

Patients were kept in the PACU for observation after extubation for 1 h. They were not discharged until they achieved an Aldrete score of 9. In the event of a drop in SpO2 measured by pulse oximetry, additional oxygen was supplied to keep it above 92%.

All patients received paracetamol 1 g every 8 h which was started immediately postoperatively in the PACU.

Table 1 Comparison of groups according to demographic and operative data

Demographic data		ISB group ($n=25$)	SSNB group ($n=25$)	T/χ^2	*p*-value
Age (years)		41.1 ± 7.3	40.2 ± 9.4	0.3^{t}	0.74
ASA	**I**	11 (44%)	15 (60%)	$1.3^{\chi 2}$	0.26
	II	14 (56%)	10 (40%)		
Sex	**Male**	16 (64%)	17 (68%)	$0.1^{\chi 2}$	0.77
	Female	9 (36%)	8 (32%)		
BMI		22.7	22.4	0.67	0.5
Duration of surgery (min)		102.4 ± 11.7	106.4 ± 12.6	1.2^{t}	0.25

Data expressed as mean ± SD, proportion, *t* student *t*-test, χ^2 chi-square test, *SSNB* suprascapular nerve block, *ISB* interscalene block

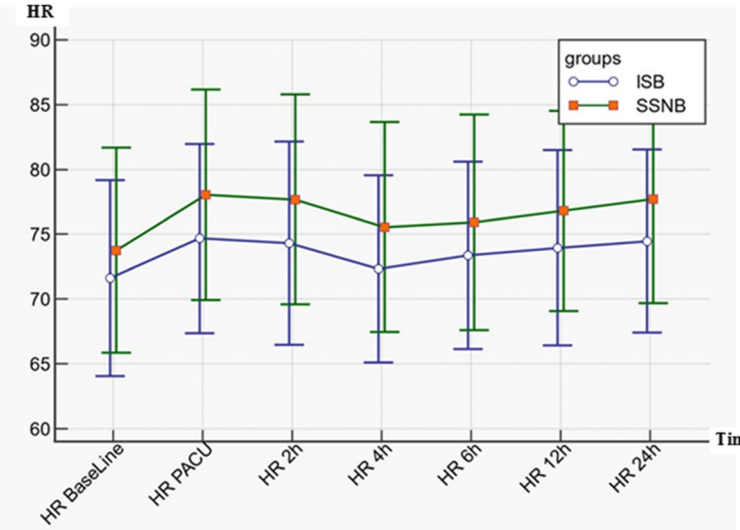

Fig. 3 Heart rate readings in the studied groups

Outcomes of the study

The primary outcome of this study was the evaluation of the pain intensity immediately and 2, 4, 6, 12, and 24 h postoperatively during flexion of the shoulder joint using the visual analogue scale (VAS) score. However, the pain intensity immediately and 2, 4, 6, 12, and 24 h postoperatively at rest was evaluated and calculated as a secondary outcome. When VAS is > 3, 25 mg pethidine was given.

Other secondary outcomes

Hand grip power of the same side of surgery was carried out to detect the hand grip power after surgery in the PACU, 2, 4, 6, 12, and 24 h postoperatively to detect affection of the motor power of hand muscles using bulb dynamometer and the time until regaining full hand grip strength was recorded. Vital signs (HR, SBP, MBP, and DBP) were recorded at 0, 2, 4, 6, 12, and 24 h postoperatively. The first-time analgesia requirement was documented. The total amount of pethidine consumed during

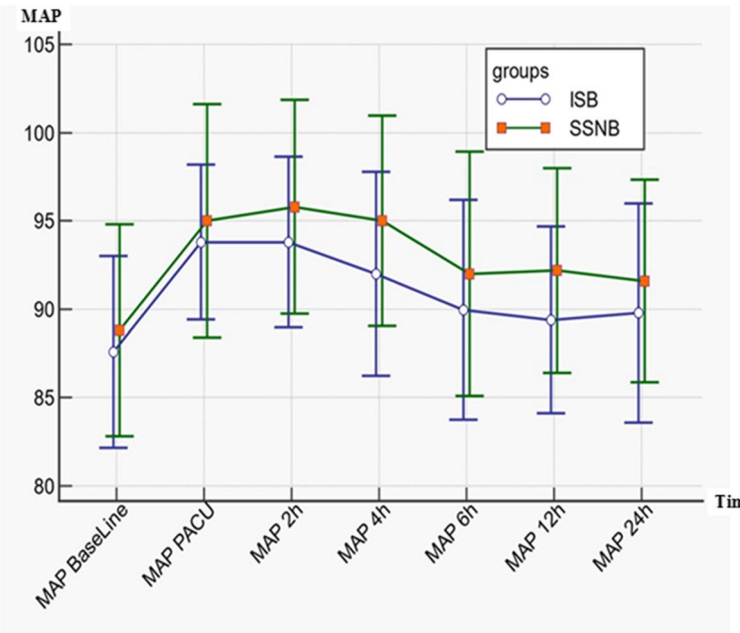

Fig. 4 MAP readings in the studied groups

Table 2 Comparison between the two groups as regards VAS at rest and during flexion

	ISB group ($n=25$)		SSNB group ($n=25$)		*U*	*p*-value
	Median	IQR	Median	IQR		
VAS during rest						
Baseline	3	2–4	3	3–4	1.24	0.22
PACU	3	1–3	3	2–3	1.04	0.3
2 h	3	3–5	3	3–5	0.06	0.95
4 h	4	3–4	3	3–4.24	1.4	0.18
6 h	4	3–5	4	3–5	0.98	0.33
12 h	3	3–4	3	3–4.25	0.2	0.82
24 h	3	2–3	3	3–3	1.5	0.13
VAS during flexion						
Baseline	5	4–6.25	6	5–8	1.8	0.07
PACU	3	3–5	3	3–5	0.26	0.8
2 h	5	4–5	4	3–6.25	0.2	0.8
4 h	5	5–7	5	4–6	1.04	0.29
6 h	6	5–7	6	5–7	0.39	0.7
12 h	5	5–7	6	5–7	0.82	0.41
24 h	6	5–7	6	5–7	0.72	0.47

Data expressed as median (IQR), *U* Mann–Whitney test, *SSNB* suprascapular nerve block, *ISB* interscalene block

the course of a 24-h period was documented. Possible complications of the nerve blocks were recorded including respiratory distress, vascular hematoma, and local anesthetic toxicity.

Statistical analysis

Data analysis was carried out using SPSS version 22.0. Quantitative data was analyzed using mean ± standard deviation (SD), while for qualitative data, information was analyzed using median and interquartile range.

Results

A total of 68 patients were assessed for eligibility between June 2021 and June 2022. Fifty-five patients were enrolled in the study, 28 patients in SSNB group, and 27 patients in ISB group. Five patients were excluded as they refused to participate, and eight patients were not meeting inclusion criteria: three patients because of a history of psychiatric problems, three because of addiction, and two because of pervious neck surgery. Three patients were lost to follow-up in SSNB group: one due to conversion to open surgery and two due to the need of intraoperative fentanyl. Two patients were lost to follow-up in ISB group: one due to conversion to open surgery and the other due to the need of intraoperative fentanyl (Fig. 2).

This study found no statistically significant differences in baseline variables such as age, gender, body mass index ASA classification, and duration of surgery as demonstrated in Table 1. There was no significant difference in postoperative hemodynamic measurements between the two groups (Figs. 3 and 4).

The two groups were comparable as regards pain control all over the 24 h by visual analogue score (VAS) at regular intervals (baseline, at PACU, 2, 4, 6, 12, and 24 h) at rest and at flexion, and there was no statistical difference between them throughout the 24 h (Table 2).

SSNB group received a higher total narcotic dose than the ISB group, and the time necessary to obtain first rescue analgesia in the SSNB group was shorter compared to the ISB group. However, no statistical difference was found between the two groups, as demonstrated in Table 3.

Groups were comparable in hand power, and there was no statistical difference between them at base line, but there was statistically significant difference between them as regard hand power immediately and 2, 4, and 6 h postoperative. However, there was no statistically

Table 3 Comparison of groups in terms of opioid consumption

	ISB group ($n=25$)	SSNB group ($n=25$)	*t*	*p*-value
Pethidine consumption (mg) over 24 h	52 ± 22.73	60 ± 26.02	1.16	0.25
1st-time pethidine need (min)	265 ± 144	262 ± 137	0.07	0.93

Data expressed as mean ± SD, *t* Student *t*-test, *SSNB* suprascapular nerve block, *ISB* interscalene block

significant difference in hand power at 12 and 24 h hand power postoperative as given in Fig. 5.

In 2 patients from 25 patients in interscalene group, saturation decreased to below than 92% on room air; however, saturation increased above 92% with oxygen supply via oxygen mask.

Intraoperative fentanyl was needed in 2 patients in the SSNB group and 1 patient in the ISB group at 1 ug/kg when blood pressure and heart rate increased > 20% of the baseline.

Discussion

There was no significant difference in terms of demographic data (age, gender, and BMI), duration of surgery, and ASA classification in the patients participating in the current study. There was no significant difference in postoperative hemodynamic measurements between the two groups.

In the current study, there is a significant decrease in hand motor power in the interscalene group revealed by a significant decrease in the measured hand grip using the bulb dynamometer device in the upper limb.

Although bupivacaine 0.25% was used to target sensory nerves more than motor nerve fibers, the duration of return to the baseline hand grip power is variable between patients in ISB, and the mean is 13 h after block. SSNB showed no affection for hand grip strength after block, and there is no difference between pre- and post-hand grip power using a dynamometer.

Measurement of the pain score at rest and during shoulder flexion showed no statistical difference between them throughout the 24 h postoperative. Also, the comparison between the two groups regarding postoperative pethidine consumption showed no significant difference between the two groups, the mean pethidine required dose in ISB was 52 mg throughout 24 h, and SSNB was 60 mg throughout 24 h.

Konradsen and colleagues (Konradsen and Larsen 2009) in their study comparing suprascapular nerve block and interscalene brachial plexus block for pain relief after arthroscopic acromioplasty agreed with concurrent study results in marked affection in hand grip strength in interscalene nerve block patients which lead to increased patients discomfort in ISB; also, their study showed better control of pain in suprascapular nerve block group than interscalene group, and they recommend suprascapular nerve block for shoulderscopic procedures; the blocks in this study were done using nerve stimulator without ultrasound guidance which is different from the concurrent study.

Singelyn and colleagues' (Singelyn et al. 2004) findings indicated that ISB provided marginally better pain relief than SSB in shoulderscopic surgeries; moreover, a significant reduction in morphine consumption score was noted only in the interscalene group, which is against the results of the concurrent study.

Desroches and colleagues (Desroches et al. 2016) compared the effectiveness of suprascapular nerve block (SSB) and interscalene block (ISB) as postoperative

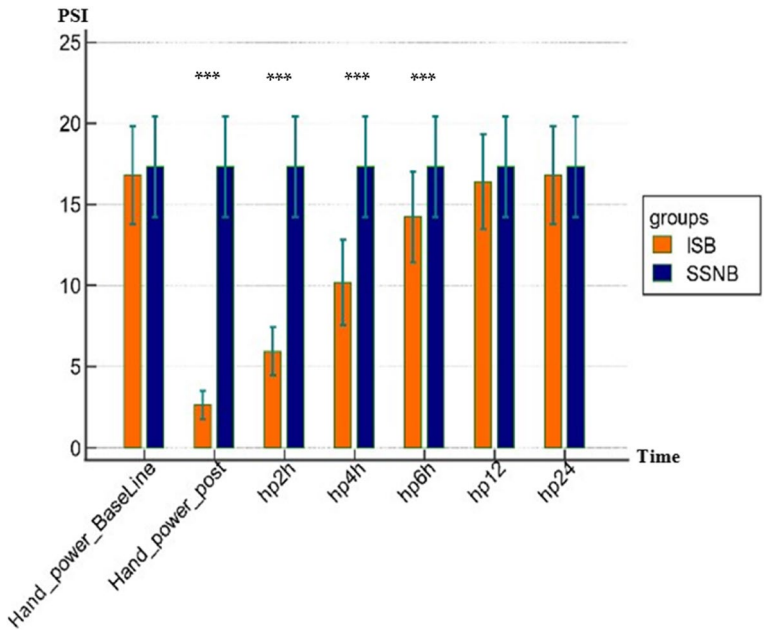

Fig. 5 Hand power pre- and post-block injection comparison graph using a bar chart (hp, hand power after). Asterisks indicate statistical significance between the two groups (*P*-value < 0.05)

analgesia within the first 24 h after arthroscopic supraspinatus and/or infraspinatus tendon surgery. While ISB was more successful at reducing pain in the recovery room following arthroscopic supraspinatus and/or infraspinatus tendon surgery, SSNB was equally as effective at controlling mean pain within the first 24 h.

Nasir H. and colleagues (Hussain et al. 2017) designed a systematic review and meta-analysis of 16 randomized studies comparing interscalene block with suprascapular block for shoulder surgery. The primary outcomes were the 24-h cumulative oral morphine consumption following surgery and the rest pain scores. Block-related and respiratory adverse effects were the secondary outcomes. In all groups, the data indicated equal 24-h morphine consumption and pain scores, except for after 1 h following surgery; interscalene block showed less pain scores. Suprascapular blocks have fewer side effects than interscalene blocks; therefore, it is safer than ISB, especially in high-risk patients with pulmonary diseases, morbidly obese, or obstructive sleep apnea.

Auyong and colleagues (Auyong et al. 2018) compare anterior suprascapular, supraclavicular, and interscalene nerve block approaches for major outpatient arthroscopic shoulder surgery; the study results agreed with the concurrent study that the suprascapular block, but not the supraclavicular block, gives comparable analgesia to the interscalene technique for major arthroscopic shoulder procedures.

Conclusions

The suprascapular nerve block is a powerful tool to provide postoperative shoulder analgesia in shoulder scope surgeries without affecting hand motor power and avoids patients' discomfort with hand muscles paresis with interscalene nerve block. Thus, suprascapular nerve block is a good alternative to interscalene block not only in patients with limited respiratory reserve but also in outpatient shoulderscopic surgeries.

Abbreviations

ASA	American Society of Anesthesiologists
APTT	Activated partial thromboplastin time
BMI	Body mass index
BP	Blood pressure
CBC	Complete blood count
DBP	Diastolic blood pressure
HR	Heart rate
hr	Hour
IBW	Ideal body weight
ISB	Interscalene nerve block
IV	Intravenous
KFT	Kidney function tests
LBW	Lean body weight
LFT	Liver function tests
MAC	Minimum alveolar concentration
MBP	Mean blood pressure
mmHg	Millimeter of mercury
PACU	Post-anesthesia care unit
PSI	Pound per square inch
PT	Prothrombin time
SBP	Systolic blood pressure
SD	Standard deviation
SPO2	Arterial oxygen saturation
SSNB	Suprascapular nerve block
TBW	Total body weight
VAS	Visual analogue scale

Acknowledgements

Not applicable

Authors' contributions

MM designed the study, revised the literature, performed the analysis, followed up with the patients, and wrote the manuscript. SE designed the study, performed the analysis, and wrote and critically revised the manuscript. WM revised the literature, performed the analysis, and critically reviewed the manuscript. NM revised the literature, followed up with the patients, collected the data, performed the analysis, and critically reviewed the manuscript. NG followed up with the patients, collected the data, and performed the analysis. All authors approved the final version of the manuscript.

Funding

None.

Availability of data and materials

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

Declarations

Ethics approval and consent to participate

After approval of the ethical committee in the Faculty of Medicine, at Ain Shams University, this randomized controlled study was conducted over 50 patients from July 2021 to December 2021. The identification code in the Pan African Clinical Trial Registry (www.pactr.org) database is PACTR202201840526231. Written informed consent was obtained from the patient's legal guardian(s) after explaining the procedure and its potential complications.

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Author details

[1]Department of Anesthesiology, Intensive Care, and Pain Management, Faculty of Medicine, Ain Shams University, Cairo 11591, Egypt.

Received: 15 November 2022 Accepted: 17 April 2023
Published online: 09 May 2023

References

Abdallah FW, Halpern SH, Aoyama K, Brull R (2015) Will the real benefits of single-shot interscalene block please stand up? A systematic review and meta-analysis. Anesth Analg. 120(5):1114–29. [cited 2022 Nov 5]. Available from: https://pubmed.ncbi.nlm.nih.gov/25822923/

Andreae MH, Andreae DA (2013) Regional anaesthesia to prevent chronic pain after surgery: a Cochrane systematic review and meta-analysis. Br J Anaesth. 111(5):711–20. [cited 2022 Nov 5]. Available from: https://pubmed.ncbi.nlm.nih.gov/23811426/

Auyong DB, Hanson NA, Joseph RS, Schmidt BE, Slee AE, Yuan SC (2018) Comparison of anterior suprascapular, supraclavicular, and interscalene nerve block approaches for major outpatient arthroscopic shoulder surgery: a randomized, double-blind, noninferiority trial. Anesthesiology.

129(1):47–57. [cited 2022 Nov 8]. Available from: https://pubmed.ncbi.nlm.nih.gov/29634491/
Beecroft CL, Rcs F, Coventry DM (2008) Anaesthesia for shoulder surgery. Contin Educ Anaesth Crit Care Pain 8:193–198
Chan CW, Peng PWH (2011) Suprascapular nerve block: a narrative review. Reg Anesth Pain Med. 36(4):358–73. [cited 2022 Nov 5]. Available from: https://rapm.bmj.com/content/36/4/358-373
Desroches A, Klouche S, Schlur C, Bauer T, Waitzenegger T, Hardy P (2016) Suprascapular nerve block versus interscalene block as analgesia after arthroscopic rotator cuff repair: a randomized controlled noninferiority trial. Arthroscopy. 32(11):2203–9. [cited 2022 Nov 8]. Available from: https://pubmed.ncbi.nlm.nih.gov/27177436/
Fernandes MR, Barbosa MA, Sousa ALL, Ramos GC (2012) Suprascapular nerve block: important procedure in clinical practice. Rev Bras Anestesiol. 62(1):100–4. [cited 2022 Nov 5]. Available from: http://www.scielo.br/j/rba/a/N4Nd9Zr5tZjZghZ3NgJc4Kb/abstract/?lang=en
Gan TJ (2017) Poorly controlled postoperative pain: prevalence, consequences, and prevention. J Pain Res. 10:2287. [cited 2022 Nov 5]. Available from: /pmc/articles/PMC5626380/
Garimella V, Cellini C (2013) Postoperative pain control. Clin Colon Rectal Surg 26(3):191–196
Hussain N, Goldar G, Ragina N, Banfield L, Laffey JG, Abdallah FW (2017) Suprascapular and interscalene nerve block for shoulder surgerya systematic review and meta-analysis. Anesthesiology. 127(6):998–1013. [cited 2022 Nov 5]. Available from: https://pubs.asahq.org/anesthesiology/article/127/6/998/19150/Suprascapular-and-Interscalene-Nerve-Block-for
Konradsen LKP, Larsen V (2009) Suprascapular nerve block or interscalene brachial plexus block for pain relief after arthroscopic acromioplasty. Ambul Surg 15:16–19
Maher C, Yoon S, Donovan S, Mendonca RJ (2018) Reliability of the bulb dynamometer for assessing grip strength. Open J Occup Ther. 6(2):10. [cited 2022 Nov 5]. Available from: https://scholarworks.wmich.edu/ojot/vol6/iss2/10
Raj PP. Suprascapular nerve block. In: Pain management. Elsevier; 2011. pp. 1174–8.
Shin YD, Han JS (2010) The effect of sono-guided brachial plexus block on postoperative pain control for arthroscopic shoulder surgery: comparison with general anesthesia. Anesth Pain Med 5(3):183–186
Singelyn FJ, Lhotel L, Fabre B (2004) Pain relief after arthroscopic shoulder surgery: a comparison of intraarticular analgesia, suprascapular nerve block, and interscalene brachial plexus block. Anesth Analg. 99(2):589–92. [cited 2022 Nov 8]. Available from: https://pubmed.ncbi.nlm.nih.gov/15271745/
Thota R, Ramkiran S, Garg R, Goswami J, Baxi V, Thomas M (2019) Opioid free onco-anesthesia: is it time to convict opioids? A systematic review of literature. J Anaesthesiol Clin Pharmacol. 35(4):441–52. [cited 2022 Nov 5]. Available from: https://pubmed.ncbi.nlm.nih.gov/31920226/

Publisher's Note