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ORIGINAL RESEARCH REGIONAL ANESTHESIA

Comparison between supra-scapular nerve block combined with axillary nerve block and interscalene brachial plexus block for postoperative analgesia following shoulder arthroscopy

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Abstract

Background & objective: Inter-scalene brachial plexus block (ISB) is the gold standard for postoperative pain management in shoulder surgery. Although, this method has its side-effects and possibly complications. Supra-scapular nerve block and axillary nerve block have also been used in upper limb procedures. We compared ISB with the blockade of supra-scapular and axillary nerves (called shoulder block) for postoperative analgesia after shoulder arthroscopic surgical operation under ultrasound guidance (USG) and nerve stimulators.

Methodology: It was a prospective, randomized, comparative study.

Results: The VAS pain scores at different times postoperatively were not significantly different between the ISB and ShB groups (P = t 0.071, 0.28, 0.378, 0.358, 0.451 at 2, 4, 8, 16, and 24 h respectively. VAS 0 was significantly difference (P = 0.029) but still the VAS score was less than 3, so no pain killers were given.

Conclusion: Ultrasound guided supra-scapular and axillary nerve blocks ae equally effective as inter-scalene brachial plexus block for postoperative analgesia in shoulder arthroscopic surgery with less side-effects.

Abbreviations: ANB: Axillary Nerve Block; ISB: Interscalene Block; MAC: Minimum OR: Operating Room; REC: Research Ethics Committee; ShB: Shoulder Block; SSB: Supra-scapular Nerve Block; VAS: Visual Analogue Scale

Key words: Interscalene Block; Supra-scapular Block; Axillary Nerve Block; Ultrasound Guidance; Postoperative Analgesia

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1. Introduction

Shoulder joint arthroscopy (SJA) is used to treat several injuries and disorders as ambulatory cases.[1] Although it a minimally invasive procedure, it may be accompanied by severe intra- and postoperative pain. Therefore, it needs satisfactory analgesia and muscles relaxation. For shoulder arthroscopy, local anesthesia is considered better than general anesthesia (GA) due to prolonged

postoperative analgesia and fast recovery to discharge.[2] However, GA with a regional nerves block decreases intra-operative anesthetic requirement leading to fast recovery and decrease of postoperative pain.[3]

Interscalene brachial plexus block (ISB) has been the most consistent and the commonly used local block for shoulder surgery; but it has several complications, the commonest being the phrenic nerves palsy. Other lesser frequent yet critical complications are Horner's syndrome, recurrent laryngeal nerve block that can cause voice hoarseness, brachial plexus neuropathy, vascular puncture, and accidental injections of local anesthetic into the sub-arachnoid space, extradural space, or vertebral arteries.[4] ISB may also produce intense motor blockades of whole of the upper limb.[5]

The supra-scapular nerves supply most parts of the shoulder joint capsule. It also innervates the supraspinatus and infraspinatus muscles of the spinner cuff and some branches to the teres minor, acromion, glenoid, and posterior superficial part of the scapula.[5]

The usage of US plus the nerve stimulator in blocks provide better visualization and localization of the nerves, leading to effective blockade with lesser complications.[6]

We carried out this study to evaluate if block of the supra-scapular and axillary nerve (ShB) with US guidance and the nerve stimulator can be as effective as ISB for postoperative pain relief after the SJA.

2. Methodology

A prospective, randomized, comparative study was done over a period of one year in our department. We included 50 patients, 18 to 60 y old, both genders and physical condition: ASA I and II undergoing SJA.

Patients excluded were; on refusal to participate in the study, pregnant or lactating ladies, infection at the site of injections, psychiatric disease, CNS Diseases (epilepsy, stroke …etc.) or neurological disease affecting patient's upper limb, history or evidence of coagulopathy, allergies to drug used (Bupivacaine 0.5%), difficult visualization of the anatomy and recorded failure of block 30 min after injection of LA.

A previous study (Zanfaly and Amina, 2015) showed that among ISB, the complications were significantly more compared to the shoulder block. Horner's syndrome was detected with ISB in 36% of cases compared to none among ShB group. Using PASS program, setting alpha error at 5% and power at 80%, we needed a total of 50 patients, with 25 patients per group; Group A: GA + ISB group: and Group B: GA + shoulder block.

The study was explained to the patients after taking their informed consent. This work was a randomized prospective controlled clinical study. All cases were fasted for 8 h pre-operatively. In the preinduction room, IV cannula G18 was introduced in the forearm opposite the surgical site and monitors were attached. The procedure was performed in the operating rooms (OR) under full aseptic conditions under conscious sedation using 1-2 mg midazolam and 25−50 µg fentanyl or more if needed. Supplemental oxygen was used either through nasal prongs or face mask.

SonoSite M-Turbo C® US device with HFL – 38 X Linear probes (Japan) with high frequency (6 -13 MHz) were used in imaging of patient. Nerve stimulator (B-Braun-Stimuplex® HNS 11–12218, Stockert GmbH, Botzinger StraBe 72, D-79111 Freiburg, Germany) was used with 22 G, 50 mm and 100 mm nerves block needles (B. Braun Medical Inc., Bethlehem, Pennsylvania, USA). Markyrene 0.5% (Bupivacaine HCl) equivalent to 5 mg/ml (SigmaTec Pharmaceutical Industries) was used for the blocks.

The patients were explained pre-operatively to use visual analogue scale (VAS) for pains.

Group A received ISB under US guidance and with nerve stimulator before GA using 10−30 ml of 0.25 % bupivacaine. Group B received combined supra-scapular and axillary nerve blocks (ANB) using 20 ml of bupivacaine 0.25%.

Sensory block was assessed by pinprick using a 20 G needle over the skin at the deltoid muscle. Motor block was assessed by evaluating the deltoid muscle function: the shoulder was abducted 70° and the elbow was flexed 30°. The anterior part of the deltoid was assessed by active resistance against posterior and downward movement of the arm. The middle part of the deltoid was assessed by active resistance against adduction of the shoulder while it was in 90° abduction and the elbow was at 90° flexion. Active resistance against flexion of the arm with shoulder at 30° extension and the elbow at 90° flexion was used to assess the posterior part.

The assessments of the blocks were done every 5 min. If the block was not effective after 30 min from local anesthetic injection, it was be considered unsuccessful.

Postoperative pain was measured via VAS every hour on first postoperative day. Paracetamol 1 gm was given IV. If the patient complained of pain in between scheduled doses of paracetamol, inj. pethidine 50 mg was used as rescue analgesia on demand (VAS > 3) provided that the total dosage did not exceed 50 mg per 8 h.

VAS was employed to measure the postoperative pain at rest and on passive movements in the recovery room and at 2, 4, 8, 16, and 24 h postoperatively. The time to first analgesic demand was documented. The total dosage of pethidine utilized over a day was documented. The next day after the surgery the patients were assessed with a

Table 1: Comparison of demographic data in the groups

Variables		Group A (n = 25)	Group B (n = 25)	Test value	P-value
Age (years)	Median (Range)	34.0 (24 – 57)	41.0 (22 – 54)	-1.04≠	0.298
Sex	Male [n (%)]	23 (92.0%)	22 (88.0%)	0.222*	0.637
	Female [n (%)]	2 (8.0%)	3 (12.0%)		
Weight (kg)	Mean ± SD	76.40 ± 10.45	78.40 ± 11.78	-0.635*	0.529

*P < 0.05: Significant; * Chi-square test; * Independent t-test ≠ Mann-Whitney test*

Table 2: Comparison of type of surgery, duration of surgery and time to execute the block

Parameter	Group A (n = 25)	Group B (n = 25)	Test value	P-value
Type of surgical operation - Diagnostic	7 (28.0%)	6 (24.0%)	0.120*	0.942
- Subacromial decompression	11 (44.0%)	12 (48.0%)		
- Shoulder dislocation & anchor application	7 (28.0%)	7 (28.0%)		
Duration of surgical operation (h)	1.80 ± 0.63	1.86 ± 0.64	−0.335*	0.739
Time to perform the block (min)	14.00 ± 4.33	17.24 ± 5.17	−2.401*	0.02*0

*P < 0.05: Significance; * Chi-square testing; * Independent t-testing; Data given as Mean ± SD or n (%)*

questionnaire on a 10-point scale to measure their satisfaction concerning the operation (from 0 = unsatisfied to 10 = fully satisfied). Any complications were documented.

Statistical Analysis

The results were reviewed, coded and analyzed via the winnows SPSS-15.0.1 (SPSS Inc., Chicago, IL. 2001). Data was introduced as mean and standard deviation for quantitative Prometric data. Appropriate analyzing was performed in accordance with the found data type. Significance was considered at $P < 0.05$.

3. Results

Comparison of demographic data in Group A and Group B was illustrated in Table 1. There were no significant differences between the two groups regarding age, sex and weight.

Duration of surgical operation at Group A was 1.80 ± 0.63 h while in Group B was 1.86 ± 0.64 h. Time to execute the block at Group A was 14.00 ± 4.33 min while in Group B was 17.24 ± 5.17 min.

No significant difference was found between two groups regarding type of surgical operation and duration of surgical operation. But the time to perform the block was significantly prolonged in the Group B (P = 0.020) (Table 2).

MAC (isoflurane) used in Group A and B was 1.14 ± 0.14 % vs. 1.23 ± 0.16 % respectively. Total dose of fentanyl at Group A was 99.00 ± 8.78 µg while in Group B was 108.00 ± 15.68 µg; total propofol use in Group A was 125.20 ± 20.64 mg while in Group B was 139.20 ± 18.47 mg (Table 3).

No significant difference was found among the study groups regarding MAC (isoflurane) (p = 0.055). But

Table 3: Comparison of MAC (isoflurane), total dose of fentanyl and propofol

Variable	Group A (n = 25)	Group B (n = 25)	Test value	P-value
MAC (Isoflurane) (%)	1.14 ± 0.14	1.23 ± 0.16	-1.969*	0.055
Total dose of fentanyl (µg)	99.00 ± 8.78	108.00 ± 15.68	-2.504*	0.016
Propofol used (mg)	125.20 ± 20.64	139.20 ± 18.47	-2.528*	0.015

*P < 0.05: Significance; * Independent t-test; Data given as Mean ± SD*

Table 4: Comparison of VAS in Group A and B

Time	Group A (n = 25)	Group B (n = 25)	Test value	P-value
0 h	0 (0 – 1)	0 (0 – 2)	-2.188≠	0.029*
2 h	0 (0 – 2)	0 (0 – 2)	-1.804≠	0.071
4 h	0 (0 – 2)	0 (0 – 4)	-1.080≠	0.280
8 h	0 (0 – 4)	0 (0 – 4)	-0.881≠	0.378
16 h	0 (0 – 4)	1 (0 – 6)	-0.919≠	0.358
24 h	0 (0 – 8)	1 (0 – 6)	-0.754≠	0.451

**P < 0.05: Significance; ≠: Mann-Whitney testing; Data given as Median (Range)*

Table 5: Comparison of analgesic demand, time to 1st analgesic and total dose of pethidine in 24 h

Variable	Group A (n = 25)	Group B (n = 25)	Test value	P-value
Analgesic demand	7 (28.0%)	11 (44.0%)	1.389*	0.239
Time of 1st analgesic (h)	13.71 ± 6.05 (8 – 24)	13.45 ± 7.65 (4 – 24)	0.076•	0.941
Total dose of pethidine in 24 h (mg)	114.29 ± 37.80 (50 – 150)	118.18 ± 51.35 (50 – 200)	-0.172•	0.865

*P < 0.05: Significance; *: Chi-square testing; •: Independent t-testing; Data given as n (%) or Mean ± SD (Range)*

Table 6: Comparison of patient satisfaction (1-10), PONV and complications in the groups

Parameter	Group A (n = 25)	Group B (n = 25)	Test value	P-value
Patient satisfaction (1-10)	9.20 ± 0.87 (8 – 10)	9.64 ± 0.70 (8 – 10)	-1.976•	0.054
Complications				
PONV	6 (24.0)	1 (4.0)	4.153*	0.042*
Horner syndrome	3 (12.0)	0 (0.0)	8.140*	0.017*
Delayed recovery of muscle power	4 (16.0)	0 (0.0)		

*Data give n as n (%) or Mean ± SD. *P < 0.05: Significance. Chi-square testing; •: Independent t-testing*

there was a significant difference regarding the total dose of fentanyl and dose of propofol (P = 0.016 and 0.015 respectively).

The postoperative VAS scores showed no significant differences between the two groups at all times, except at VAS 0, where a significant difference (P = 0.029) was found but the VAS score was less than 3, so no pain killers were given. This may be due to the very dense block offered by interscalene brachial plexus block unlike the selective shoulder block.

There was no significant difference in total patients needing analgesics postoperatively in the two groups, e.g., 7 (28.0%) vs. 11 (44.0%) in Group A and B respectively (P = 0.239) as shown in Table 5. The time to first analgesic and total dose of pethidine consumed in 24 h was equivalent in Group A and B (P = 0.941 and P = 0.865) respectively. So, the ISB and ShB exhibited equivalent efficacy for postoperative analgesia after SJA.

There was statistically no difference in patient satisfaction assessed 24 h postoperative (P = 0.054) (Table 5). PONV was reported in one case in ShB group and in 6 patients in ISB group, the difference being significant with p = 0.042 (Table 5).

This might be explained to be due to the associated hypotension in ISB group, and it was resolved with isotonic solution infusion and antiemetics; the complaint resolved after normalization of blood pressure.

The frequency of complications, e.g., Horner's syndrome and delayed recovery of muscle power was significantly more in the Group A (P = 0.017), while no such complication was observed in Group B.

4. Discussion

SJA has been successfully used for treating a number of shoulder joint injuries and disorders on an ambulatory base. It is considered as a minimally invasive procedure, yet, it may be accompanied with severe intra- and postoperative pains.[7]

Adequate peroperative analgesia will ensure postoperative pain free patient and promote faster recovery and rehabilitation of these cpatients.[8] Usually, it is accomplished with GA with local nerve block, leading to fast recovery and decreased chance of postoperative pain.[9]

Supra-scapular nerves block (SSNB) and ANB (SSNB+ANB) could present a secure substitute to ISB. Several studies have assessed the effectiveness of SSNB to find out the intra- and postoperative pain relief in cases undergoing SJA under GA.[10]

We aimed to compare the ISB with the supra-scapular and ANB (ShB) for postoperative analgesia in SJA. In our study, in 50 patients, mean age was 37.32 ± 10.13 y, most of them were males (90%), and the most performed surgical operation was subacromial decompression (46%). Similar statistics were observed in some previous trials.[7,10]

A significant difference was found in regard to the mean time to perform the block, 14.00 ± 4.33 in Group A vs. 17.24 ± 5.17 in Group B. This parameter is highly operator dependent and relies on technical feasibility and the patient's condition.

Numerous methods to relieve postoperative pain have gained popularity, but all involve the dilemma of efficacy versus adverse effects. The two most popular methods are ISB and SSNB. Many studies have confirmed the efficacy of these two methods compared to control, intravenous patient-controlled analgesia (IV-PCA), and regional anesthetic infiltration. Previous studies have reported that adding an axillary nerve block to SSNB improves shoulder analgesia; we did not apply the axillary nerve block.[11]

Arthroscopic shoulder operations have high frequency of severe intra- and postoperative pain, that interferes with the early recovery and re-habilitation.[12] In our study, a nonsignificant relationship was found with MAC of isoflurane being used (P = 0.055). But a significant association was found with the mean total dose of opioids (P = 0.865).

In disagreement with our results, a researcher compared ISB (30 patients) and SSNB+ANB (30 patients) in AJS regarding postoperative analgesia, incidence of complications, and patient satisfaction.[13] After 6 h, 6 cases in the ISB group needed rescue analgesia (5 mg morphine intra-muscularly), whereas in the SSNB+ ANB group, 8 patients received the same dosage of rescue analgesia. A difference between the required doses of analgesia was not significant (P = 0.582).

In another study, the authors compared GA only or mixed with shoulder block (ShB) vs. inter- scalene block for postoperative pain relief after SJA. Regarding the period to first analgesic request, it was significantly extended in the GA+ISB group and GA+ShB group in comparison to the GA-only group (P < 0.001). The total mean morphine consumption over a day postoperatively was significantly elevated in the GA-only group in comparison to the GA+ISB group and GA+ShB group (P < 0.001).[7] Another researcher found that shoulder block lead to pain relief analogous to ISB with lower postoperative morphine consumptions.[14]

However, in a metanalysis done by Hussain et al. to compare between SSN and ISB for shoulder surgical operation, it was concluded that both ISB and SSN had no effect on the first day morphine consumption.[8]

In our study, VAS scores among the studied patients showed non-significant difference between the ISB and ShB groups at all times, except at VAS 0, where a significant difference was found (P = 0.029) but still the VAS score was less than 3, So, no pain killers were needed.

In the study of Abdallah et al., the duration of analgesia by the ISB was restricted to 8 and 12 h postoperatively, but there was rebound pain and increased frequency of unwanted events.[10] The proximity of the site of ISB to other neck structures has led to a higher risk profile. For instance, the occurrence of temporary neurologic complications afterward ISB was recorded to be as high as 16, about 3-fold the risk of all other marginal nerve blocks combined. However, a meta-analysis, comparing the SSNB with ISB showed decreased postoperative pain but not opioid consumption throughout stay at recovery room (P < 0.0001).[8] On the other hand, SSNB decreased the frequency of block-related and breathing complications.

Our results are in agreement to an earlier report, and the VAS scores was significantly lesser in the GA+ISB and GA+ShB groups in comparison to the GA only group (P < 0.001).[7]

In another report, the analgesic effect of ISB in comparison with SSNB+ANB was studied in cases

undergoing patient-controlled analgesia (PCA) after SJA.[15] The VAS scores of the PCA in the ISB group was significantly low in comparison to the PCA in the SSNB+ANB group in the recovery room. At the 16 h postoperative evaluation, significant changes were found among the two groups; but, there were large variations with time in the ISB group, and the VAS score of the PCA with SSNB+ANB group was non-significantly higher in comparison to the PCA with ISB group. In the current study, there were no significant variations in the outcomes of the two groups over time.

In a study done by Singelyn et al., assessment of the analgesic effect of ISB, SSNB, and intraarticular local anesthetic after arthroscopic acromioplasty showed that in the PACU and at the 4 h following-up, significantly less pain on movements was noticed in the ISB group in comparison with the SSNB group, with no difference in the total paracetamol consumption. However, significantly more patients in the SSNB group received morphine analgesia in comparison with the ISB group (19/30 patients vs. 8/30 patients); this is mostly because of the lack of ANB.[16]

However, in the study of Choi et al., the continuous SSNB group revealed significantly higher VAS score at 0 to 1 h and 1 to 2 h after the surgical operation in comparison to the single-shot ISNB group (4.9 ± 2.2 vs. 2.3 ± 2.2; P = 0.0001 and 4.8 ± 2.1 vs. 2.4 ± 2.3; P = 0.0001, respectively). The SSNB group revealed significantly low VAS score at 6 to 12 h after the surgical operation in comparison to the ISNB group (4.1 ± 1.8 vs. 5.0 ± 2.5; P = 0.031). The continuous SSNB group needed significantly high dosages of total equianalgesic fentanyl in the PACU in comparison to the S-ISN- group (53.66 ± 44.95 vs. 5.93 ± 18.25; P = 0.0001).[17]

In our study, non-significant difference in patient satisfaction was assessed 24-h postoperatively, with P = 0.054**.** PONV was reported in one case in ShB group and in 6 patients in ISB group; the difference was statistically significant (P = 0.04)2**.** This might be explained with the associated hypotension in ISB, because the complaint was associated with postoperative hypotension and tachycardia, and resolved with normalization of blood pressure**.**

Use of USG and nerve stimulator as a guide for the nerve blocks simplifies the straight visualization and localization of the target nerves, and it permits precise deposition of the drug solutions around the roots of the plexus and/or the peripheral nerves, consequently enhancing the success of the blocks and decreasing the blockade complications.[18] In the study of Waleed et al. complications like Horner's condition, voice hoarseness, upper arm general weakness, and dyspnea have been reported in the ISB group. No significant difference regarding satisfaction was observed between both of the groups.[13]

Consistent with our results, Brown et al. compared ISB with GA for shoulder arthroscopy;[19] 5 patients developed Horner's syndrome and 6 complained of hoarseness (recurrent laryngeal nerve block), which was transient and resolved without any treatment. Simeoforidou et al. reported that 33.3 of patients complained of Horner's syndrome signs in their study.[21] In all these patients, the signs were noticed after ISB after about 30 min, and all patients were symptom-free before leaving the PACU. This high percent may be because of the performance of the block without US guidance.[20]

Zanfaly et al. concluded that the occurrence of complications was significantly higher in the GA+ISB group in comparison to the other two groups (P < 0.001).[7] ShB was as operative as ISB for postoperative pains relief but with less complications. Thus, ShB is a good substitute for cases at high risk than ISB.

5.Conclusion

From the results of our study, we can conclude that both inter-scalene brachial plexus block and shoulder block (supra-scapular nerve plus axillary nerve block) under ultrasound guidance and with the use of nerve stimulator, provide analogous postoperative analgesia and patient satisfaction, but the elevated complications rate in the former make the shoulder block superior for using in arthroscopic shoulder joint operations.

6. Ethics approval / Trial registration

This study was approved by the research ethics committee at the Faculty of Medicine, Ain Shams University (No. FMASU M D 95/2018) and registered retrospectively with Pan African Clinical Trial Registry, identifier: PACTR20211271572407.

7. Data availability

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

8. Competing interests

The authors declare that there were no conflicts of interest.

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10. Author contribution

ME: Conduct of the study work.

SF: Manuscript editing

RM: Literature search

MM: Statistical analysis and review

All authors have read the manuscript and approve it for publishing.

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