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Original Articlle

Subscapularis and Sub-omohyoid Plane Block versus Interscalene Block for Analgesia in Arthroscopic Shoulder Surgery: A Randomized Controlled Study

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ABSTRACT

Background: Poor control of pain affects the quality of life and recovery after surgery,which requires management of postoperative pain for better comfort and outcome, with better and faster recovery.This investigation is designed to assess the effectiveness of subscapularis (SC) and sub-omohyoid (SO) plane blocks for analgesia in post-operative arthroscopic shoulder surgery (ASS) and compare them with interscalene block (ISB). **Methods:** This Prospective randomized, controlled,double-blind study was performed on sixty cases of both sexes for arthroscopic shoulder surgery. The cases were allocated to Group S: patients who received SC and SO plane blocks and general anesthesia (n=30). Group C: (control group) cases received ISB in addition to general anesthesia (n=30).The primary outcome included the VAS score, and the secondary outcome included the onset of complete motor and sensory block, first time to rescue analgesia, total amount of analgesia, and patient satisfaction. **Results:** Statistically, the mean values of the time for the first request for supplemental systemic analgesia of the S group were substantially longer than the mean values of the time of the C group. The total consumption of supplemental analgesia in mg was significantly lower in the S than in the C group.The mean values of onset times of complete sensory and motor blocks were statistically remarkably shorter in group S than in group C. patient's satisfaction score in the S group was statistically significantly higher than the C group (8.2 ± 1.0 versus 7.6 ±1.1 in the S and C groups, respectively). **Conclusion:** Our findings demonstrated that subscapularis and sub-omohyoid blocks are more effective and safer analgesic technique than ISB for analgesia as it has a shorter time of onset of complete sensory and motor blocks with less total consumption of supplemental analgesia and less incidence of postoperative complications in unilateral elective arthroscopic shoulder surgery.

Keywords: Subscapularis, Sub-omohyoid Plane Block, Interscalene Block, Shoulder Surgery, Analgesia

INTRODUCTION

Poor control of pain affects the quality of life and recovery after surgery, which requires management of postoperative pain for better comfort and outcome, with better and faster recovery [1]. Multimodal/balanced analgesia decreases post-operative pain. To regulate pain, it makes use of a mix of non-

opioids and opioids that operate on both central and peripheral receptors [2].

A preemptive, multimodal analgesic strategy that uses peripheral nerve blocks can safely and effectively manage postoperative pain with limited adverse effects. Peripheral nerve blocks decrease anesthesia complications with better postoperative pain management (e.g., nausea, vomiting, and drowsiness) [3].

The majority of the nerve supply of the shoulder is axillary and supra-scapular nerves, with limited contributions from subscapular and lateral pectoral nerves. So, interscalene block (ISB) has the potential for shoulder analgesia. However, it has a few side effects, including paralysis of the phrenic nerve and involvement of the recurrent laryngeal nerve, which can cause discomfort in the patient. Knowing that regional anesthesia will decrease the dose of opioids through general anesthesia, postoperative pain, and hospital stay period [2].

For arthroscopic shoulder analgesia, subscapularis (SC) plane and sub-omohyoid (SO) combined injections could be used instead of peripheral nerve blocks, with little to no effect on phrenic nerve function. More thoughtfully planned randomized trials are needed to assess this approach compared to alternative analgesic strategies [4].

This investigation aimed to appraise the effectiveness of SC and SO plane blocks for analgesia in post-operative arthroscopic shoulder surgery (ASS) and compare them with ISB.

PATIENTS AND METHODS

Study population and design:

This Prospective randomized, controlled, double-blind study was performed at Zagazig University Hospitals, Department of Anesthesia, Intensive Care and Pain Management Department for six months (March 2022 to October 2022). Sixty patients of both sexes were scheduled for ASS included in our study (figure 1). Verbal and written informed consent was obtained from all participants after the procedure and medical research were explained. This study was carried out after the approval of the Institutional Review Board (IRB#7039) and Pan African Medical Journal (PAMJ) 69042023050639.

Cases with the following criteria were included: age: 21-50 years, both sexes, physical status: ASA I&II, unilateral elective arthroscopic shoulder surgery, body mass index (20-30 kg/m²), and duration of surgery: 60-90 min.

Cases with the following characteristics were excluded: Patients with hypersensitivity to used local anesthetics (LA), patients with respiratory disorders such as pneumonia and COPD, patients with infected skin at the injection site, and cases with failure of blocks will be excluded from the study, and uncooperative patients, cases with any psychiatric, neurological, or muscular disorder, peripheral neuropathy, severe hepatic and renal failure, coagulopathy, and reaction to LA and injection site infection.

The cases were split into two groups. An independent statistician utilized a computer-generated random number table to create sealed opaque envelopes carrying a group allocation. Two groups of envelopes representing the two research groups were presented to a nurse who had no idea what was inside. The envelopes were randomly delivered to the participants by the nurse, who alternated between the groups. Group S: patients received SC and SO plane blocks in addition to general anesthesia (n=30). Group C: (control group) patients received ISB in addition to general anesthesia (n=30).

On the night before surgery, these patients were visited for evaluation, explained the technique of the desired block and Visual Analogue Scale (VAS) for patients, an informed written consent, and instructions about the fasting period (at least 6 hours before surgery).

ECG leads were applied to the chest, and a pulse oximetry probe was applied to the big toe of one of the lower limbs for monitoring throughout the procedure; line parameters were measured and recorded by the Monitor (Mindray umec 10).

All patients were given premedications with intravenous (IV) injection of 0.02 mg/kg midazolam and O2 supplementation (4-6

L/minute) via nasal cannula. All emergency drugs such as ephedrine, atropine, antiarrhythmic, epinephrine, IV fluids, and 20% lipid emulsion were available near the patients before starting any block. The site of the block was infiltrated subcutaneously (Sc) with 1-2 ml of lidocaine 2%.

The block was performed using lidocaine (2%) and bupivacaine (0.5%) mixture (40 ml) in equal volumes.

The same physician performed all blocks. The physician is an expert in doing brachial plexus block using different techniques and approaches, such as ultrasound imaging and nerve stimulation. Another anesthetist was blind about the block received by the patient and was collecting the patient data.

All blocks were performed using a short bevel 2-inch 22-G insulated needle (Stimuplex B Braun NEL, Singen, Germany).

Nerve location was done using a 38 mm, 7-12 MHz linear probe and a mindray digital ultrasonic diagnostic imaging system (DP-1100 Plus China). A sterile transparent sheath covered the probe surface, andapplied a sterile gelbefore scanning.

Technique of the SC and SO plane blocks:

SC plane block:

The skin was sterilized, and the case was set at a semi-recumbent/supine position with an adducted and externally rotated arm. A linear high-frequency (HF) (6-13 MHz) ultrasound (US) probe was positioned over the shoulder in the coronal plane to identify the lesser and greater trochanters of the humerus. When the arm is externally rotated, the SC muscle connection to the lesser trochanter of the humerus is readily visible. The needle is inserted in-plane medial-to-laterally to deposit 15 ml of (bupivacaine 0.5% 7.5ml, lidocaine 2% 7.5ml) over the SC muscle, which blocks both the axillary and subscapular nerves by dispersing the injectate along the ventral side of the SC muscle [5].

SO plane block:

The skin was sterilized, and the brachial plexus, subclavian artery, and inferior belly of the omohyoid muscle are all located across the supraclavicular fossa using the same linear HF (6-13 MHz) US probe. Using an in-plane lateral-to-medial needle approach, 5 ml of (bupivacaine 0.5% 2.5ml, lidocaine 2% 2.5ml) is deposited above the clavicle, under the inferior belly of the omohyoid to cover the suprascapular nerve. This fascial plane connects the omohyoid's inferior belly to the neck strap muscles and runs parallel to the suprascapular nerve until it reaches the suprascapular notch [5].

Technique of ISB:

Patients are supine, with their heads turned away from the blocked side and their necks slightly stretched. The ultrasonic probe was put in a sterile sheath after sterilizing the skin on the neck. The depth will be 2-4 cm using a linear probe with an HF range of 7-13 MHz. The probe was initially positioned at the cricoid cartilage level over the sternomastoid muscle and proceeded to move laterally to determine the jugular vein, carotid artery, and then posteriorly and laterally until imagining the brachial plexus as a hypoechoic nerve arrangement between the middle and anterior scalene muscle; an assistant began to inject the LA 20ml of (bupivacaine 0.5% 10ml, lidocaine 2% 10ml) with aspiration every 5 ml to avoid intravascular injection and the LA spread will be observed [2].

The sensory block was evaluated every 5 minutes after the end of the injection of LA by pinpricking the forearm lateral side and thumb with 22-G needles.

The patient's motor block was evaluated by abducting his arm at the shoulder and flexing his forearm at the elbow against resistance [6].

The onset of complete sensory block is the time from the start of LA injection to the time of complete loss of cold sensation in minutes. The onset of complete motor block is the time from the start of LA injection to the time of complete loss of the motor response to the targeted nerve stimulation or voluntary movement by the patient to resist the operator's hand.

Progress of sensory block: after 20 minutes of LA injection, the degree of sensory loss was graded as follows (normal sensation = 0, reduced sensation = 1, and no sensation = 2) [7]. Progress of motor block: after 20 minutes

of LA injection, the degree of loss of muscle tone is graded as follows (normal muscle tone= 0, paresis/reduced muscle tone as compared with contralateral arm =1, and paralysis/complete loss of muscle tone= 2) [7].

The block technique features include:

Technique performance (time/minutes): time between the start of needle insertion and the end of LA injection. VAS block-related pain: VAS consists of a 10 cm straight line with verbal anchors at both ends that define the boundaries of the measured pain dimension zero = no pain and 10 = "worst pain imaginable." The block was considered a failure if the block was not successful 30 min after injection of the LA, and patients with block failure were excluded from the study.

All patients included in the study receive general anesthesia as follows:

Preoxygenation of the patient for 5 minutes, then induction IV slowly with fentanyl 1-2 mic/kg, propofol 2-3 mg/kg, atracurium 0.5mg/kg to facilitate intubation of the patient with suitable size cuffed endotracheal tube, connected to a ventilator.

Isoflurane 1.2 MAC (mean alveolar concentration) in oxygen was used for sustaining anesthesia; ventilation control was used to preserve an end-tidal concentration of CO2 between 32 and 35 mm Hg; and IV atracurium (0.1 mg/kg) was used every 30 minutes to preserve muscle relaxation.

During general anesthesia, mean arterial blood pressure (MAP), heart rate (HR), and oxygen saturation were recorded every 5 min in the first 15 minutes and then every 10 minutes during the operation. Paracetamol intravenous infusion (15 mg/kg with a dose not exceeding 1 gm) was given as analgesia for all cases. Sensory block was assessed by the non-increasing MAP or heart rate >20%.if mean AP or heart rate increase >20% intra operatively fentanyl 1mic/kg was given.

After the procedure, neostigmine methyl sulfate (0.05 mg/kg) and atropine (0.02 mg/kg) were given IV to treat neuromuscular block, and the participant was extubated.

MAP, Heart rate, and oxygen saturation were recorded at baseline, skin incision, intraoperative "every 5 minutes," and at the time of skin closure.

Time (hours) to first request for analgesic therapy (FAT) postoperatively and its total consumption (mg) in 24 hours: the time of start of pain sensation and requesting dose of analgesia postoperatively in hours, every patient was given intravenous Nallbuphin 0.15mg/kg if VAS≥4.Postoperative visual analog scale (VAS): was evaluated using VAS at 0 (half hour postoperative at PACU), 2, 4, 6, 12, 18, and 24 hours postoperatively.Patient satisfaction score: patient satisfaction with the anesthetic techniques was evaluated using a 1-10 scale, with 1 representing the least satisfaction and 10representing excellent satisfaction.Post-operative complications, including Horner syndrome, Difficulty breathing, Horzzines, Numbness, Weakness, paresthesia in the arm, nausea, vomiting, and LA toxicity, were recorded.

The primary outcome included the VAS score, and the secondary outcome included the onset of complete motor and sensory block, first time to rescue analgesia, total amount of analgesia, and patient satisfaction.

Sample size: Sample size was calculated according to a previous study [5] regarding the visual analog scale (VAS) as a primary outcome. The main ± standard deviation of the visual analog scale was 6.35± 4.9 in ISC vs. 3.92± 2.1 in combined suprascapular and axillary nerve blocks. The sample size was calculated using the Open-Epi program to be 54 patients with a test power of 80% and CI 95%.The number of patients will be increased to 60 (30 in each group) for any possible dropout.

STATISTICAL ANALYSIS

Data were analyzed using SPSS version 16 statistical programs. Descriptive statistics were used, such as percentages, arithmetic mean, standard deviation, and range. Statistical significance tests, such as the Chi-square test and student test (t), were used to compare the studied groups. P value < 0.05 was considered significant.

RESULTS

Our results showed no remarkable variance between groups respecting their demographic characteristics, as well as the duration of surgery and ASA classification (Table 1).

No substantial variance was detected in the technique characteristics and incidence of side effects during block performance between the two studied groups. There was notable variation between the two studied groups respecting the onset times of complete sensory and motor block (P<0.01) (Table 2).

Regarding the values of onset times of complete sensory block and values of onset times of complete motor block, there were remarkable variances between groups. The variance between S and C groups was not remarkable regarding intraoperative MAP and intraoperative heart rate parameters (Fig. 2, Supplementary Fig. 1).

Statistically, no marked variance between S and C groups was found regarding intraoperative respiratory parameters (Supplementary Fig. 2).

Statistically, the mean values of the time for the first request for supplemental systemic analgesia of the S group were substantially longer than the mean values of the time of the C group. The total consumption of supplemental analgesia in mg was significantly lower in S than C group (Table 3).

No marked variation in the immediate postoperative VAS score in the S and C groups, respectively. VAS was matched until the 7th hour as it started to rise, especially in the S group, which was substantially elevated than the C group until 24 hours postoperatively (Table 4).

There was no remarkable variance between groups regarding postoperative complications. The mean values of the patient's satisfaction scores were 8.2±1.0 and 7.6±1.1 in the S and C groups, respectively, where the patient's satisfaction score in the S group was statistically significantly higher than the C group (Table 5).

Table (1): The demographic characteristics, duration of surgery and ASA classification of the studied groups:

	S group (n = 30)		C group (n = 30)		T	P
Age (years)						
• Mean± SD	43.1±14.5		41.3±15.4		0.46	0.65
Weight(kg)						
• Mean± SD	68.7±8		70.4±9.3		0.77	0.44
Height (cm)						
• Mean± SD	169.4±6.9		167.3±7.5		1.11	0.27
Duration of surgery (minutes)						
• Mean ± SD	79±26.9		71.3±20.4		1.24	0.22
ASA classification						
• Mean± SD	1.8 ±0.8		2.1 ±0.8		1.48	0.14
Sex	**No**	**%**	**No**	**%**	**X^2test**	
• Male	18	60	15	50	0.61	0.44
• Female	12	40	15	50		

Table (2): Techniquecharacteristics and the onset times of complete sensory and motor block (minutes)in the studied groups:

	Subs capularis Plane Block	Sub omohyoid Plane Block	Interscalene Plane Block	t	P
Technique performance time(minute)					
• Mean± SD	6.7±2.4	5.7±2.4	6.1±2	2.30	0.44
• Range	3-11	2-10	4-11		
Number of attempts of skin punctures					
• Mean± SD	3.7±0.9	3.2±0.9	3.5±0.9	3.59	0.34
• Range	2-5	2-4.5	1-5		
Number of needle passes					
• Mean± SD	3.6±1.1	3.7±1.1	3.5±0.7	0.82	0.42
• Range	3-7	2-7	3-6		
VAS block- related pain during block					
• Mean± SD	2.6±1.3	2.5±1.3	2.3±0.9	2.16	0.54
• Range	1-4	1-3	0-4		
Vascular puncture					
• No	30(100%)	29(96.6%)	28(93.2%)	2.30	0.321
• Yes	0(0%)	1(3.4%)	2(6.8%)		
Subcutaneous haematoma					
• No	30(100%)	30(100%)	29(96.6%)	4.9	0.234
• Yes	0(0%)	0(0%)	1(3.4%)		
Painful paresthesia					
• No	30(100%)	30(100%)	29(96.6%)	2.15	0.481
• Yes	0(0%)	0(0%)	1(3.4%)		
Sensory(minutes)	**Mean± SD**	5.6 ± 1.2	7.6 ± 1.7	5.19	<0.001
	Range	4-8	5-10		
Motor (minutes)	**Mean± SD**	7.7 ±1.5	10.3±2.5	4.68	<0.01
	Range	6-10	7-14		

Table (3): Time (hours) to first request for analgesic therapy (FAT) and the total consumption of postoperative supplemental systemic analgesics in mg in the studied groups:

The first request for supplemental systemic analgesia(hours)	**S group (n=30)**	**C group (n=30)**	**t**	**P**
Mean± SD	9.7±1.5	8.6±1.6	3.51	0.04*
Range	4-10	6-10		
Total consumption of supplemental systemic analgesics (mg)	**S group (n=30)**	**C group (n=30)**	**t**	**P**
Mean± SD	18±1.2	22±2.7	4.51	0.01*
Range	4-10	6-10		

Table (4): Visual Analogue Scale (VAS) distribution at different times post operatively between studied groups:

	S group (n = 30)	C group (n = 30)	P
VAS1st_half_hr	0.00±0.0	0.00±0.0	.
VAS2nd_hr	0.00±0.0	0.00±0.0	.
VAS4th_hr	0.00±0.0	0.00±0.0	.
VAS6th_hr	0.1±0.03	0.00±0.0	0.379
VAS12th_hr	4.08±0.28	0.1±0.04	0.00**
VAS18th_hr	3.86±0.49	2.2±0.5	0.001**
VAS24th_hr	4.0±0.0	3.16±0.38	0.00**

Table(5): Post-operativecomplications and satisfaction betweenstudied groups**:**

	S group (n=30)		C group (n=30)		χ^2(P-value#)
Complications	N	%	N	%	
Horner syndrome	0	0%	3	10.0%	3.158(^{FE}p=0.237)
Difficult breathing	0	0%	2	6.7%	2.069(^{FE}p=0.492)
Horzziness	0	0%	4	13.3%	4.286(^{FE}p=0.112)
Numbness	0	0%	1	3.3%	1.017(^{FE}p=1.000)
Weakness in thearm	0	0%	3	10.0%	3.158(^{FE}p=0.237)
Paresthesia in the arm	1	3.3%	4	13.2%	1.964(^{FE}p=0.353)
Nausea	1	3.3%	2	6.6%	0.351(^{FE}p=1.000)
vomiting	1	3.3%	2	6.6%	0.351(^{FE}p=1.000)
Local anesthetic toxicity	0	0%	0	0%	0
Satisfaction Mean± SD (range)	8.2 ±1.0 (4-10)		7.6 ±1.1 (6-10)		2.211 (0.031)

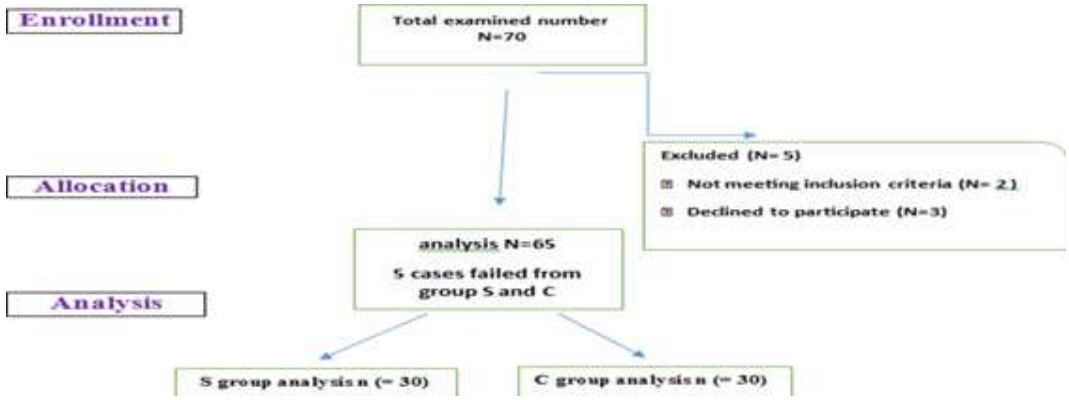


Fig.(1): Flow Chart for the recruited cases.

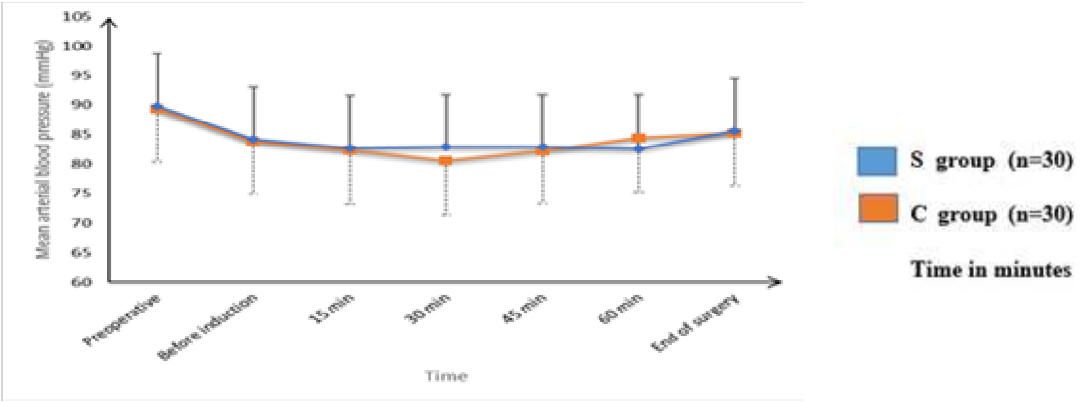
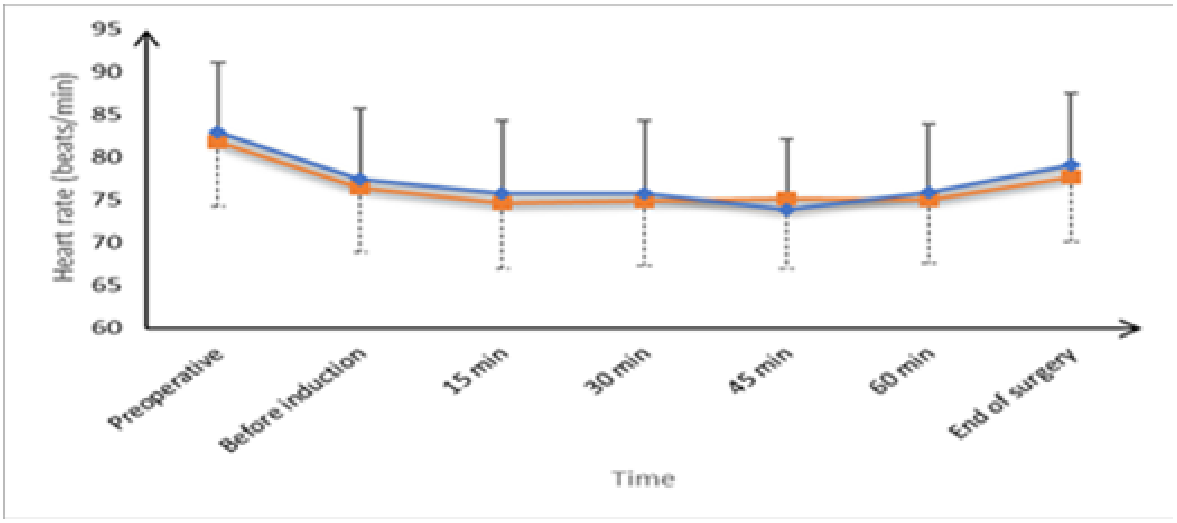
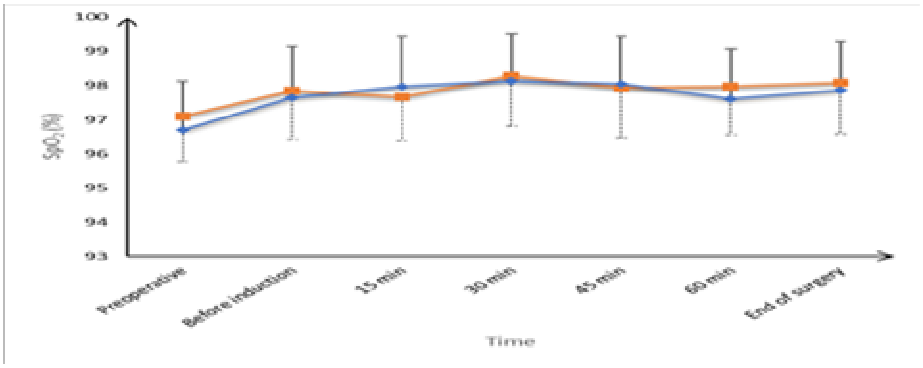


Fig. (2): Intraoperative mean arterial blood pressure (MAP/mmHg) at predeterm ined times in the studied group.



Supplementary Fig. (1): Intraoperative heart rate "HR" (beat/minute) at predetermined times in the studied groups.



SupplementaryFig. (2): Intraoperative SpO2% level at various times of measurements in the studied group.

DISCUSSION

In the current study, the mean values of complete sensory and motor block onset times were substantially shorter in the subscapularis and sub-omohyoid groups than in the ISB groups, respectively.

Aliste et al. [8] compared ISB and small-volume supraclavicular blocks for ASS and found that the onset time of the complete motor block in the ISB group was close to the result obtained in the current study. In disagreement with the current result, Mahrous and Ismail [9] found no significant difference between ISB and sub-omohyoid plane block groups respecting the complete sensory block onset time. This variance can be due to different methodologies between their study and the current study as we compared the combined SC plane and SO versus ISB, not only SO block.

In this study, the mean values of the time for the first request of supplemental systemic analgesia in the scapularis and SO groups were substantially longer than the mean values of the time of inter scalene group, respectively. In disagreement with this result, Mahrous and Ismail [9] found no remarkable variance respecting the time to the first rescue analgesic request between ISB and SO plane block. Another study by Abdallah et al. [4] found little proof that the suprascapular group took relatively less time in the rehabilitation unit following anesthesia requesting an analgesic than the ISB did. This difference may be because of different comparison groups.

In the current study, the total consumption of supplemental analgesia (intravenous nalbuphine) in milligrams was substantially lower in the SC and SO groups than in the ISB group, respectively. In disagreement with this result, Taha et al. [10] conducted a randomized controlled blind study on 72 cases have a scheduled ASS. Before induction of general anesthesia, patients received low-volume ISB using ropivacaine 0.5% (5 ml) or infraclavicular - SO block using ropivacaine 0.5% (25 ml). They found that there was no marked variance in morphine consumption in the ISB group and infraclavicular - SO block group. This difference may be because they used only SO block without adding SC plane block, and they used different types and doses of LA.

This study showed no remarkable variance in the immediate postoperative VAS scores in subscapularis, subomohyoid, and ISB groups, respectively. VAS remained similar until the seventh hour, when it began to climb, particularly in the SC and SO groups, where it was appreciably higher than in the other groups. It was much higher by the twentieth and twenty-fourth hours than in the ISB group.

In agreement with this result, Mahrous and Ismail [9] showed that the pain scores proved to be similar between the ISB and SO groups at PACU, 2 hours. However, Compared to the SO group, the pain score was considerably lower in the ISB group at postoperative, 4, 8, 12, 18, and 24 hours.

However, Abdallah et al. [4] found no substantial variance between SO anterior suprascapular block and ISB, respecting the analgesic outcomes appraised. Similarly, Sun et al. [11] performed a study to assess relevant randomized controlled trials involving axillary Nerve Block (ANB) and suprascapular nerve block (SSNB), and ISB during ASS. They found that VAS was not different in SSNB+ANB from ISB for providing postoperative pain control in 1st 8 hours after the operation.

In this study, postoperative complications (Horner syndrome, difficulty breathing, paresthesia in the arm, nausea, and vomiting) were substantially higher in the ISB group than in the SC and SO groups.

In agreement with the complications in the current study, Mahrous and Ismail [9] showed that When it came to adverse effects involving the brachial plexus, the difference between the SO group's 7.5% and the ISB anesthesia group's 37.5% phrenic nerve palsy was statistically significant. While 7.5% of individuals in the ISB group had Horner syndrome, none in the SO group did. Similarly, Sun et al. [11] observed that SSNB and axillary nerve block were correlated with a reduced incidence of numbness/tingling, Horner syndrome, weakness, and subjective dyspnea than the ISB group.

In the current study, the patient's satisfaction score in the SC, SO group was statisticallysignificantly higher than the ISB group, which can be attributed to delayed first request rescue analgesia and lower incidence of complications in the SC, SO group than the ISB group. In disagreement with this result, Mahrous and Ismail [9] found that most patients in both ISB and SO block groups were satisfied (95 and 92.5%, respectively) and this variance was not substantially varied. This variance may be because of different comparison groups as we compare combined SC plane and SO versus ISB and different sample sizes.

However, Abdallah et al. [4] found no substantial variance in participant satisfaction with pain relief at 24 h in ISB and in SO anterior suprascapular block, whichmay be attributed to different types and doses of LA (15 ml of ropivacaine 0.5% and epinephrine).

There are several limitations of the present trial. First, the sample size is relatively small to confirm the clinical or statistically significant differences between study outcomes, as the results of the present trial could be changed according to the change of anesthetic volume or concentration. Second, the evaluation of the patient's outcomes was only for the first 24 hours, i.e., during the acute postoperative period, which is a short duration, so we did not investigate long-term drawbacks. Finally, we did our study at a single center. To more validated results, it needs to be done more extensively among multicenter larger scale and different demographics of patients.

CONCLUSION

Our findings demonstrated that combined SC and SO blocks are a more effective and safer analgesic technique than ISB for analgesia as it has a longer time of first request of rescue analgesics with less total consumption of supplemental analgesia and postoperative complications in unilateral elective arthroscopic shoulder surgery. The patient satisfaction score in the SC and SO blocks group was statically significantly higher than the ISB group due to delayed first-request rescue analgesia and less incidence of complications.

CONFLICTS OF INTEREST

No potential conflict of interest was reported by the authors.

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