RESEARCH

COMPARISON OF TWO DIFFERENT VOLUMES OF FIXED CONCENTRATION OF ROPIVACAINE IN USG GUIDED INTERSCALENE BLOCK FOR ARTHROSCOPIC SHOULDER SURGERIES

Sangeeta Khanna[1], Jyoti Joshi[2], Saurabh Sud[1], Krishna Prasad G V[3]

[1]Anaesthesiologist, MH Kirkee, Pune, Maharashtra, India
[2]158 BH, Bagdogra, West Bengal, India
[3]Anaesthesiologist, 158 BH, Bagdogra, West Bengal, India

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Corresponding Author:
Dr. Krishna Prasad G V,
Email. drkaypee99@yahoo.com
ORCID: 0000-0003-1850-3514

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Abstract

Background: To determine the effectiveness of two different volumes of 0.75% ropivacaine as an analgesic in USG-guided interscalene blocks for arthroscopic shoulder surgeries. **Materials and Methods:** This study was a Prospective Randomised Clinical Trial study on 80 patients with two arms. One arm of study is the group of patients injected with 15 ml of 0.75% ropivacaine and other arm is the group of patients injected with 10 ml of 0.75% ropivacaine in the interscalene block given in Arthroscopic Shoulder Surgeries. For up to 30 minutes, sensory and motor blockades were evaluated every 5 minutes. We observed intra-operative hemodynamic parameters, intra-operative analgesic consumption, duration of effective analgesia, visual analogue scale (VAS) ratings at different time intervals, length of motor block, and incidence of side effect in the results. **Result:** Duration of sensory (599.9±110.4 min Vs. 530.2±83.5 min; p=0.002) and motor block (630.1±106.5 min Vs. 554.88±84.4 min; p= 0.001) was significant higher in group A compared to Group B. Hemodynamic parameters were also comparable during surgery and after surgery except Intra op Pulse rate (p<0.001) and post op respiratory rate (p=0.023). At 6 hours and beyond, Group B's postoperative VAS scores were significantly higher than those of Group A. In comparison to group B (98 ±34.9), group A (71±24.9 mg) utilised significantly less analgesia within 24 hours following surgery (P< 0.001). **Conclusion:** 15 ml of 0.75% ropivacaine had prolonged analgesic duration of the ISBPB. When used in conjunction with IVPCA for analgesia following arthroscopic shoulder surgery, it was also successful in lowering the postoperative opioid dosage within 24 hours.

INTRODUCTION

Following orthopaedic surgery, pain may be very severe.[1] Both anesthesiologists and orthopaedic surgeons find it challenging, particularly when it comes to treating pain following shoulder surgeries. The interscalene block (ISB), which can be used alone or in conjunction with general anaesthesia, was initially proposed in 1970.[2] With improvements in surgical tools and methods, ISBs—which can ease intraoperative and postoperative discomfort and relax muscles—are becoming more and more common in shoulder operations.[3] The local anaesthetic (LA) is applied to the C5-C6 nerve roots, blocking the brachial plexus nerve roots and trunks.[4] Depending on the amount of LA utilised, the C7 and C8 nerve roots may be inhibited. With the block, ulnar sparing (C8 and T1 nerve roots) frequently happens.[5] When compared to general anaesthesia, ISB has a number of benefits, including as the prevention of postoperative nausea and vomiting, minimal risk of postoperative delirium, less perioperative opioid use, and lower medical costs.[6]

Interscalene block performed using ultrasound guidance requires fewer needle passes, has a quick onset, better LA distribution, and blocks sensory nerves and major vessels with less chance of harm.[7] Either a single LA injection or a catheter insertion approach could be used. The local anaesthetic ropivacaine is an amino amide and is structurally related to bupivacaine.[8] In treatments requiring high dosages of local anaesthetic, ropivacaine is a reasonable choice to bupivacaine due to its reduced cardiovascular and central nervous system toxicity.[9] Ropivacaine acts preferentially on the pain-transmitting A and C nerves and not the motor-related A nerve fibres.

Ultrasound guidance with or without a nerve stimulator has decreased the amount of local

anaesthetics (LA) required to establish a successful block, which may lessen the occurrence of ISB complications. Prior research indicated that ISBPB with 27 mg of 0.75 or 25 mg of 0.5 or 0.25% low-dose ropivacaine was effective for achieving sensory and motor block during arthroscopic shoulder surgery. Although ISB has used low dosage ropivacaine with concentrations ranging from 0.25 to 0.75%, the ideal ratio of concentration to volume of such low dose has not been researched.[10,11,12] A fixed high dose of LA has been utilised in earlier research to block the sciatic nerve,[13,14] the infraclavicular nerve,[15] the axillary nerve,[16] and the humeral canal,[17] in various volumes and concentrations. There is significant disagreement over the minimum necessary dose of LA needed to deliver sufficient postoperative analgesia. More research is required to determine the optimal concentration-volume ratio for low dosage ISB.[18]

Therefore, the purpose of the current study was to determine the analgesic effectiveness of two different volumes of 0.75% ropivacaine in USG-guided Inter-scalene blocks for arthroscopic shoulder procedures in terms of the onset of sensory and motor block, the time required to administer the block, intraoperative hemodynamics, the length of postoperative relief, and complications.

MATERIALS AND METHODS

This study was a Prospective Randomised Clinical Trial study with two arms. One arm of study is the group of patients injected with 15 ml of 0.75% ropivacaine and other arm is the group of patients injected with 10 ml of 0.75% ropivacaine in the interscalene block given in Arthroscopic Shoulder Surgeries. Institutional ethical approval was obtained from ethical committee. Written informed consent from all patients was taken. The 80 patients were randomly selected to receive an interscalene block with either 5 mL (Group A) or 10 mL (Group B) of 0.75% ropivacaine the day before surgery using a computer-generated sequence.

- 15 ml of 0.75% ropivacaine for Group A
- 10 ml of 0.75% ropivacaine for Group B.

Inclusion Criteria

- Aged 18 – 60 years
- ASA I to III patients
- Patients undergoing arthroscopic shoulder surgeries in this tertiary care hospital.

Exclusion Criteria

- Patient refusal.
- Patient with history of COPD and diaphragmatic palsy.
- Infection at the location of the block
- History of local anaesthetic allergy
- Coagulopathy or Previous neurological deficit
- BMI more than 35
- Mental impairment that prevents use of the study's scale for measuring pain comprehension;

Methodology

Patients were admitted to a preoperative procedure room for 60-90 minutes before operation. Three members of the research team, all fellowship-trained regional anesthesiologists with ultrasound experience, digitally recorded a typical ultrasound assessment of the brachial plexus at the interscalene level Patients were positioned supine with the neck turned to the nonoperative side and the head slanted 45 degrees to ensure homogeneity in imaging The brachial plexus was examined with ultrasonography using an X-Porte (Sono Site, Bothell, WA, USA) fitted with a linear HFL38, 6- to 13-MHz ultrasound transducer after aseptic skin preparation with chlorhexidine and sterile draping. Scan was conducted by firstly viewing the brachial plexus from the supraclavicular level, then moving the transducer proximally to the interscalene region to visualise the brachial plexus between the anterior and middle scalene muscles, then moving the transducer further proximally to visualise the cervical nerve roots accessing neural foramina, and finally moving the transducer distally as the cervical nerve roots exited between the anterior and middle scalene muscles. For uniform image quality and capture, all ultrasound parameters were set to the same value, with the exception of depth, which was adjusted individually for each patient to account for their unique anatomy.

To more accurately simulate the performance of an ISB block in real time, a 30-second prospective video clip was made after the original ultrasound examination was over.

Data Analysis

For up to 30 minutes, motor and sensory blockades were evaluated every 5 minutes. Using a three-point verbal rating scale of 0 (normal sensation) 1 (dull sensation, analgesia), and 2 (no sensation) a pinprick was used to test for sensory blockage in the C5-6 dermatome. The duration between the conclusion of the block process and the time the pinprick test produced a score of 2 was used to determine the onset time for a sensory block. Block failure was defined as failing to achieve a score of 2 within 30 minutes of the interscalene block. Loss of shoulder abduction (deltoid sign) served as a marker for motor blockade, which was then objectively graded on a 3-point rating scale as 0, normal movement, 1, decreased movement, and 2, no movement.

All the patients received Inj Midazolam 1mg IV, Inj Fentanyl at 2mcg/kg IV, and Dexmedetomidine infusion at the rate of 0.5mcg/kg/min intravenously. Postoperatively patient received Inj Paracetamol 1 gm IV 8 hourly

Statistical analysis

The statistical programme for the social sciences, version 23, was used to conduct all data analyses.

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Descriptive statistics were used to summarise the recorded variables (mean with standard deviation for continuous variables and frequencies with proportions for categorical data). For categorical data, the chi square test or Fisher's exact test was employed, and for continuous data, the Student's t test. A P value of 0.05 was used to determine statistical significance.

RESULTS

Demographic profile in terms of weight, Gender, ASA classification, Surgery type and time taken for giving block was comparable between two groups. [Table 1] Onset sensory block [8.1±4.4 Vs 8.5±5.6] and motor block [9.4±4.1 Vs. 10.1±5.4] was also comparable in both group A & B (p>0.05). Duration of sensory (599.9±110.4 min Vs. 530.2±83.5 min; p=0.002) and motor block (630.1±106.5 min Vs. 554.88±84.4 min; p= 0.001) was significant higher in group A compared to Group B. Hemodynamic parameters were also comparable during surgery and after surgery except Intra op Pulse rate (p<0.001) and post op respiratory rate (p=0.023) [Table 3]. [Table 4] compares VAS scores between the two groups. At awakening, 30 minutes, one hour, and three hours following the conclusion of operation, VAS scores were comparable amongst the groups. However, the VAS score at 6 hours and after showed a significant change. The amount of analgesic used within 24 h after surgery was significantly reduced for group A (71±24.9 mg) compared with group B (98±34.9) (P<0.001). [Table 5] Hemi-diaphragmatic palsy was reported maximum in both Group A (94.9%) and Group B (97.5%) but there is no significant difference was observed (p=0.894).

Table 1: Patient demographic Data

	Group A (n= 40)	Group B (n= 40)	P value
Age (years)	32.1±6.4	33.7±6.02	0.615
Weight (kg)	70.0±12.5	67.2±8.8	0.247
Gender (Male/female)	39/1	36/4	0.359
ASA grade (I/II)	37/3	37/3	1.000
Surgery (arthroscopic reconstruction/ diagnostic arthroscopy & repair)	1/39	0/40	1.000
Time taken for giving block (min)	6.43±1.6	6.35±1.8	0.841

Continuous variables are presented as the means ± SDs; categorical variables are presented as counts

Table 2: Block characteristics

	Group A (n= 39)	Group B (n= 40)	P value
Onset sensory block	8.1±4.4	8.5±5.6	0.729
Onset motor block (min)	9.4±4.1	10.1±5.4	0.541
Sensory Recovery/ duration (min)	599.9±110.4	530.2±83.5	0.002
Motor Recovery/ duration (min)	630.1±106.5	554.88±84.4	0.001

Table 3: Intra and post op hemodynamic comparison between groups

	Group A (n= 39)	Group B (n= 40)	P value
Intra op			
Pulse rate (Beat/min)	65.2±14.6	47.4±17.3	<0.001
SBP (mmHg)	114.7±20.9	117.1±9.4	0.514
DBP (mmHg)	72.0±13.8	71.8±8.2	0.933
Respiratory Rate (breaths per minute)	17.5±1.9	18.2±2.0	0.124
SPO2 (%)	99.95±0.2	100±0.0	0.151
Post op			
Pulse rate (Beat/min)	67.9±12.7	66.7±6.0	0.615
SBP (mmHg)	113.8±20.1	118.6±12.9	0.205
DBP (mmHg)	71.9±12.7	74.4±9.6	0.328
Respiratory Rate (breaths per minute)	18.2±1.6	18.95±1.4	0.023
SPO2 (%)	99.0±0.5	98.9±0.3	0.256

Table 4: Showing VAS score between groups

VAS Score	Group A (n= 39)	Group B (n= 40)	P value
	Mean±SD	Mean±SD	
At awakening	0.00±0.0	0.00±0.0	-
30 minute	0.00±0.0	0.00±0.0	-
1 hr	0.82±0.5	1.00±0.4	0.149
3 hr	1.1±0.7	1.2±0.9	0.583
6 hr	1.15±0.4	2.4±0.6	<.001
12 hr	1.87±0.7	2.8±0.5	<.001
24 hr	2.3±0.6	3.6±0.6	<.001

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Table 5: Showing the total consumption of analgesic in between groups

	Group A (n= 39)	Group B (n= 40)	P value
	Mean±SD	Mean±SD	
Total analgesic dose(mg) in 24 hours	71±24.9	98±34.9	<0.001

Table 6: Showing complication between groups

Complication	Group A (n= 39)	Group B (n= 40)	P value
Hemi-diaphragmatic palsy	37 (94.9%)	39 (97.5%)	0.894
scapula alata	0 (0%)	0 (0%)	1.00
Shoulder pain	0 (0%)	0 (0%)	1.00

DISCUSSION

The shoulder arthroscopic operations have increased in popularity since they are less intrusive and result in a quicker recovery. Acromioplasty, repair of rotator cuff lesions, and treatment of recidivating luxation are three of the most common arthroscopic procedures performed on the shoulder. Controlling the pain is one of the biggest challenges with these surgeries because the postoperative discomfort is really intense and difficult to manage.[19,20]

The use of intravenous opioids with or without NSAIDs, articular local anaesthetic, suprascapular nerve block, and cervical and brachial plexus blocks are among the most used procedures for this purpose.[18,19,20,21] Brachial plexus block is one of these methods that has the best analgesic effects.

The interscalene block is the most widely utilised brachial plexus block technique.[18,21] Despite the fact that numerous studies have examined various LA dosages in ISB utilising USG for efficient intraoperative analgesia,[18,21] there is a lack of evidence addressing the ideal dose of LA necessary for sufficient postoperative analgesia and post-operative pain management, particularly in India. Although several anaesthetic amounts have already been used, the optimal volume is not known.

This study was a Prospective Randomised Clinical Trial study with two arms. One arm of study is the group of patients injected with 15 ml of 0.75% ropivacaine and other arm is the group of patients injected with 10 ml of 0.75% ropivacaine in the interscalene block given in Arthroscopic Shoulder Surgeries.

The higher concentration group, or Group A, in the current investigation showed a somewhat faster onset of total sensory and motor blockade. In their study, Zhai et al.[18] examined the block onset with a fixed dose of ropivacaine (50 mg) at concentrations of 0.75, 0.5, and 0.25%. They found that that, in line with the current study, block onset time was sped up with higher LA concentration.

One of the most effective and often used localised procedures for arthroscopic shoulder surgery is the interscalene block. Clinicians like to select a regimen that has a rapid onset, high success rate, consistent analgesic impact, and acceptable diaphragm function preservation. Ropivacaine 0.75% appears to be more advantageous in order to simplify procedure and reduce OR turnover time. LA's volume and concentration both had major roles in the development of block. Theoretically, a higher LA concentration can reduce the onset time by improving the LA molecules,[22] ability to penetrate brain tissue, and a higher volume can do the same by encouraging LA diffusion around neural structures.[23] Uncertainty persists on how the volume/concentration ratio in a fixed dose influences the regional anaesthetic block. Previous investigations on the onset time of the same dose of LA diluted in various volumes for nerve blocks have shown variable findings,[18,23,24,25] some of which can be related to volume/concentration ratio and the following factors.

The duration of the sensory (p=0.002) and motor (p=0.001) blocks was significantly longer in the group receiving 15 ml of the same concentration of ropivacaine than in the group receiving 10 ml. Although the VAS scores of the two groups were comparable in the immediate postoperative period, there was a significant difference at 6 hours and beyond. With more LA, there was a considerable increase in the 24-hour fentanyl usage.

These results suggest that, despite the fact that 15 ml of 0.75% ropivacaine may be more effective for intraoperative and immediate postoperative pain reduction, 10 mL of LA works better for delayed postoperative pain relief.

According to earlier research, 50 mg of low dose ropivacaine diluted into 0.75% of 6.7 ml, 0.5% of 10 ml[11], and 0.25% of 20 ml,[12] was found to be helpful for at least two hours following shoulder surgery in several investigations. In addition, Zhai et al.[18] noted that the shoulder analgesia was effective for at least 8 hours following the interscalane nerve block with 50 mg of ropivacaine. Additionally, they recommended that improved pain management, such as a reasonably high dose of LA, multimodal analgesia, or a continuous interscalene block, should be chosen for procedures with major rotator cuff tears, comparable to the findings of the current study.

ISB frequently results in HD palsy, a complication of the condition. In a study of 50 patients who underwent ISB with 30 mL of LA, Zaragoza-Lemus et al.[26] discovered that 100% of patients had ultrasonographic evidence of ipsilateral HD palsy. With 10 mL of 0.5% bupivacaine and 20 mL of 0.25% bupivacaine, Zhai et al.[18] showed equal incidence of HD palsy. In addition, HD palsy was discovered in all patients treated with varying

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amounts of ropivacaine at various 0.5% concentrations by Sahu GK et al.[27]

With 10 mL of 0.75% bupivacaine, Renes SH et al[28]. compared PNS and USG guided ISB and discovered a reduced incidence of HD palsy when USG was used. The occurrence of HD paresis may be decreased with the administration of low-volume ISB during USG without sacrificing postoperative analgesic effectiveness. The administration of 5 mL of LA as opposed to 20 ml in ultrasound guided ISB was reported to have a lower incidence of HD palsy and respiratory problems by Stundner et al,[29] and Riazi et al.[30] Sinha et al,[31] observed that lowering the LA volume from 20 mL to 5 mL did not have the same beneficial effects on diaphragmatic paresis or pulmonary function as the current study. Regardless of the volume used, HD palsy is a frequent side effect of ISB. Under USG direction, using an ultra-low volume of LA (about 5 mL) may lower the risk of HD palsy. Such a small volume, nevertheless, could not be sufficient for postoperative analgesia.

Some study limitations

1. A single-centric study
2. Because patients with respiratory conditions or obese patients were excluded from the study, it is unclear how diaphragmatic muscle paralysis develops in these patients following ISBPB. Brachial plexus block operators were not blinded due to the differing capacities of the two groups of local anaesthetics.
3. The study's double-blind grouping procedures involved blinding both the patients and the follow-up assessors. However, aside from pain rating, other markers such as lung function testing, ultrasound monitoring of diaphragmatic movement, and other indicators were quite objective, which may impact the efficacy of blinding.

CONCLUSION

In conclusion, 10 ml of 0.75% ropivacaine increased the analgesic duration of the ISBPB compared to 15 ml of 0.75% ropivacaine. When used in conjunction with IVPCA for analgesia following arthroscopic shoulder surgery, it was also successful in lowering the postoperative opioid demand within 24 hours. Higher pain scores were obtained with 10 mL than with 15 mL of ISB following surgery. The incidence of hemi-diaphragmatic weakness did not decline after the LA volume was decreased from 15 mL to 10 mL.

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