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Original Research Article

ULTRASOUND GUIDED COSTOCLAVICULAR AND SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK IN PATIENTS POSTED FOR OPEN REDUCTION AND INTERNAL FIXATION OF FRACTURE BOTH BONES FORE ARM: A PROSPECTIVE RANDOMISED STUDY

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ABSTRACT

Background: Conventionally, brachial plexus blocks have been a key component of regional anaesthesia for surgeries involving the upper extremities. Ultrasonography guidance has become the standard of care for nerve blocks. Ultrasound guided supraclavicular and ultrasound guided costoclavicular approaches are now widely used, valued for their ease, quick onset, and low risk of complications. The aim is to compare the efficacy of ultrasound guided costoclavicular and supraclavicular brachial plexus block in patients posted for open reduction and internal fixation of fracture both bones fore arm. The primary objective is to compare the onset of sensory and motor block. Secondary objective is to compare the duration of analgesia between the two groups. To compare nerve sparing between two groups. To compare the adverse effects in both groups

Materials and Methods: In this prospective, randomized study, 100 patients of ASA physical status I&II posted for elective open reduction and internal fixation of fracture both bones forearm were included After obtaining institutional ethical committee approval, patients were divided into two groups. Group A(n=50): Patients received ultrasound guided costoclavicular brachial plexus block with 20 ml of 0.5% Ropivacaine. Group B (n=50): Patients received ultrasound guided supraclavicular brachial plexus block with 20 ml of 0.5% Ropivacaine.

Results: The onset of sensory block was 9.06 ± 0.71 minutes and 11.57 ± 1.57 minutes in group A and group B, with (p= 0.0001) which was highly significant. The motor block onset was 13.140 ± 1.261 and 13.890±1.6329 minutes in group A & group B, with p=0.012 which was highly significant. The duration of sensory blockade was 155.68 ± 3.87 and 156.78 ± 5.32 minutes in group A & group B (p= 0.241) which was insignificant statistically.The duration of motor blockade was found to be 134.22 ± 3.58 minutes and 133.52 ± 4.46 minutes in group A & group B, with a statistically insignificant difference(p= 0.389). The duration of analgesia was 13.338±0.4105 hours in group A and 13.092±0.9655 hours in group B, with a (p= 0.102), indicating statistically insignificant difference between the groups.

Conclusion: This study concluded that the ultrasound guided costoclavicular brachial plexus block was as effective as ultrasound guided supraclavicular approach for providing surgical anaesthesia in patients posted for open reduction and internal fixation for fracture both bones forearm.

Keywords: Coatoclavicular, Supraclavicular, Brachial Plexus Block, Ultrasound, VAS Score.

INTRODUCTION

Conventionally, brachial plexus blocks have been a key component of regional anaesthesia for surgeries involving the upper extremities. Over the past few decades, advent of ultrasound has revolutionised regional anaesthesia and acute pain management. The development of ultrasound technology has further improved the precision and safety of these nerve blocks9. Various approaches to brachial plexus can significantly impact the block dynamics.The supraclavicular and costoclavicular approaches are now widely used, valued for their ease, quick onset, and low risk of complications.[1-5]

The costoclavicular space (CCS) is an intermuscular region located between the posterior midpoint of the clavicle and the anterior chest wall. It is bordered anteriorly by the subclavius muscle and the clavicular head of the pectoralis major, while the upper slips of the serratus anterior and the second rib define its posterior boundary. Within this space, the cords of the brachial plexus and the axillary vessels pass through, with the cords positioned parallel and lateral to the axillary artery. Among the three cords, the lateral cord is the most superficial and is located anterior to both the medial and posterior cords. The medial cord is situated directly behind the lateral cord and medial to the posterior cord, while the posterior cord is the most lateral, lying immediately adjacent to the medial cord but positioned posterolaterally to the lateral cord. The arrangement of the cords in relation to the axillary artery and to one another within the CCS is generally consistent. The CCBPB provides anaesthesia for upper extremity below the mid arm.It also blocks the suprascapular nerve.[6-10]

At the supraclavicular level, the brachial plexus is organized into three trunks: the superior trunk (C5-C6), the middle trunk (C7), and the inferior trunk (C8-T1). The trunks run between the anterior and middle scalene muscles, positioned along the lateral border of the first rib. The lower trunk of the brachial plexus lies between the subclavian artery and the first rib. Medially, the pleura is located next to the rib, while the phrenic nerve runs along the lateral edge of the anterior scalene muscle. Furthermore, the suprascapular or transverse cervical artery may cross paths with the plexus in the supraclavicular region.The SCBPB provides anaesthesia for the entire upper limb, often extending to the shoulder, as all trunks and divisions can be anaesthetized from this site.[11-15]

In our study, we compared the efficacy and outcomes of ultrasound-guided costoclavicular brachial plexus block in comparison to ultrasound-guided supraclavicular brachial plexus block in patients undergoing surgery for both-bone forearm fractures.

Aims & objectives: To compare the efficacy of ultrasound guided costoclavicular and supraclavicular brachial plexus block in patients posted for elective open reduction and internal fixation of fracture both bones forearm.

To compare the onset & duration of sensory and motor block & duration of analgesia between the two groups and compare nerve sparing and adverse effects between two groups.

MATERIALS AND METHODS

After obtaining ethical committee approval and written informed consent, we enrolled 100 patients scheduled for elective surgery for fixation of both bones forearm in our study.Simple randomized sampling was done by computer-generated random numbers.An anaesthesiologist who was not involved in the study will perform the block. Patient was not blinded in this study. The observer who assessed the block characteristics and adverse effects were unaware of group allocation.

We included patients with American society of anaesthesiologists (ASA) physical status I and II aged 18 to 60 years of either sex undergoing elective surgery for fixation of fracture both bones fore arm. We excluded patients with known hypersensitivity to the study drugs, medication for chronic pain, neurological deficits, on anti-coagulant therapy, contraindications to peripheral nerve block, prior surgeries on the supraclavicular and infraclavicular fossa, psychiatric and neurological disorder, pregnant patients.

Baseline investigations were done in all patients. The 10 cm visual analogue scale (VAS) (0 - no pain and 10 - worst pain imaginable) was explained during the preanaesthetic visit.

Following the patient transfer to the operation theatre, ASA standard monitors were secured. Following base line vital parameters monitoring, all patients received oxygen supplementation through a nasal cannula at rate of 2L/min. Patients were premedicated with Midazolam 0.02 mg/kg IV.Ultrasound guided Costoclavicular brachial plexus block was performed in Group A patients and Ultrasound guided Supraclavicular brachial plexus block was performed in Group B patients.

Patients were randomized to Group A received ultrasound guided Costoclavicular brachial plexus block.Group B received ultrasound guided Supraclavicular brachial plexus block.

Technique: The patient was positioned supine, (often with a slight incline of 30o) with chin turned to the opposite side of the body and the neck extended. A small pillow or sand bag was placed under the ipsilateral shoulder. The arm is adducted and positioned straight alongside the trunk. USG high frequency linear probe transducer with a frequency of 6-13 MHz was covered with sterile sleeve.

In group A, under aseptic precautions, the limb to be blocked was abducted at 90 degree angle while tilting their head to the opposite side. The transducer was placed transversely directly over the mid-point

of clavicle with its orientation marker directed laterally and the transducer was moved caudally until the inferior border of clavicle and axillary artery were visualized. The transducer was then positioned parallel to the clavicle in the medial infra clavicular fossa. The lateral, medial and posterior cords of brachial plexus were identified lateral to the axillary artery. The cords are visualized as hyperechoic oval structures arranged in a triangular shape. From lateral to medial, we introduced an 80 mm 21 gauge nerve block needle in the space between the three cords. Proper needle placement was confirmed by visualizing the tip of needle and injection of 0.3-0.5 ml saline. Our goal was to position the needle tip precisely at the centre of the nerve cluster by advancing the needle through the space between the lateral and posterior cord and advancing it toward the medial cord. A total volume of 20 mL of 0.5% ropivacaine was injected in small aliquots and at a single site over 2 to 3 minutes.

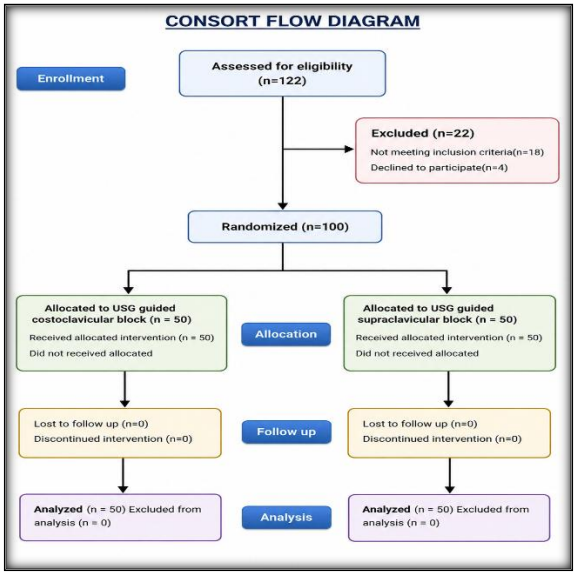
In group B patients, under aseptic precautions the high frequency linear transducer was placed transversely in supraclavicular fossa just proximal to the mid-point of clavicle. To observe the subclavian artery cross-sectionally, the transducer was angled caudally. A group of hypoechoic oval structures situated posterolaterally and superficially to the artery were visualised as the brachial plexus. Proper needle placement was confirmed by visualizing the needle tip and injection of 0.3-0.5 ml saline. Two separate injections were administered at various sites within the bundle, typically starting deep in the "corner pocket" near the artery and moving more superficially between upper and middle trunks.A total volume of 20 ml of 0.5% Ropivacaine is administered.

Assessments of sensory and motor blockade were conducted every two minutes following completion of injection for thirty minutes, then every thirty minutes following completion of surgery for the first twelve hours, and then hourly until the block had fully worn off. Post- operative pain was assessed using VAS (0 – no pain to 10-worst pain) for every hour till the block lasted. Pinprick test with a 3‑point scale was used for sensory loss assessment.0-no block,1-Analgesia, 2-loss of touch. Motor blockade was evaluated by the ability to flex the elbow and hand as: 0-Full flexion/extension movement in hand and arm against resistance 1-Movement against gravity but not against resistance 2-Flicker of movement in hand but not in arm 3-No movement (complete motor block)

A complete block was defined as one associated with Grade 2 sensory anaesthesia and Grade 3 motor block and only these patients were included for further study. Haemodynamic parameters,including heart rate,blood pressure, and peripheral oxygen saturation were assessed at regular time intervals.The time for first rescue analgesic requirement and any associated complications were documented.

After the patient was shifted to the post anaesthesia care unit, pain assessment was performed every hour using the visual analogue scale. When the VAS score exceeded 3, IV Paracetamol 1 gm was administered as rescue analgesic.Heart rate,mean arterial pressure,and SpO2 were measured at specific time intervals following the surgery at 15 minutes, 1 hour,2 hours, 4 hours, 6 hours, 12 hours and 24 hours.

The study was analyzed using the statistical package for the social sciences (SPSS) software version 29.The data in the current study consisted of either quantitative or qualitative data.The quantitative data was represented as mean+/- standard deviation(SD) and evaluated using student's unpaired t-test. Additional data was presented through a variety of tables and charts using Microsoft Office Excel. A p-value less than or equal to 0.05 was deemed to be statistically significant.



RESULTS

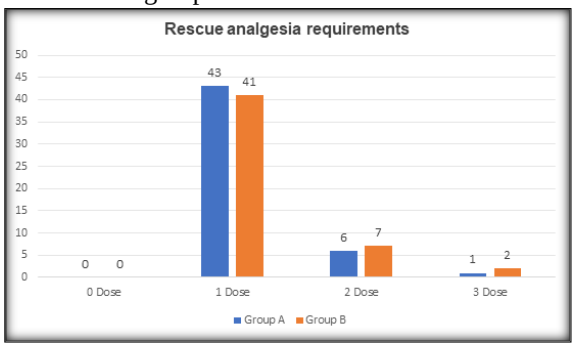
Table 1: Demographic Data

Variable	Group A (n=50)	Group B (n=50)	p-value
Age(years)	42.52±12.36	42.72±11.73	0.934
Weight(kgs)	66.08±4.856	64.96±6.443	0.329
HEIGHT(cm)	166.76±4.364	165.50±5.308	0.198
BMI(kg/m2)	23.794±1.954	23.793±2.847	0.99
Duration of surgery(mins)	80.32±8.48	78.5±8.03	0.273
BLOCKPERFORMANCE TIME (mins)	10.44±1.28	10.1±1.35	0.202

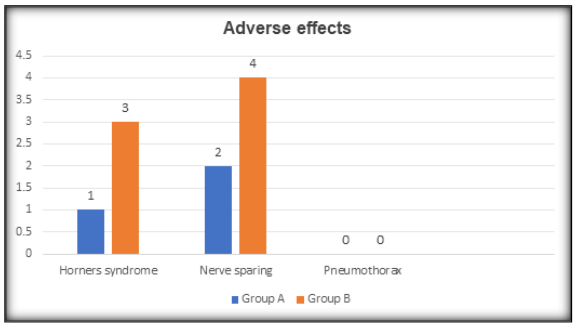
Table 2: Comparison of Onset & Duration of Sensory & Motor Block and Duration of Analgesia between two groups

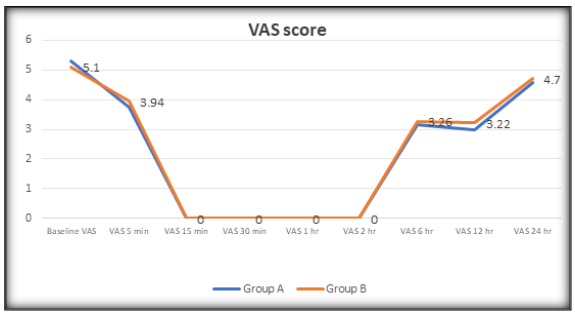
Variable	Group A (n=50)	Group B (n=50)	p-value
Onset of sensory block(mins)	9.06±0.71	11.57±1.57	0.0001
Onset of motor block(mins)	13.140±1.2618	13.890±1.6329	0.012
Duration of sensory block(mins)	155.68±3.87	156.78±5.32	0.241
Duration of motor block(mins)	134.22±3.58	133.52±4.46	0.389
Duration of analgesia(hrs)	13.338±0.4105	13.092±0.9655	0.102

Comparison of rescue analgesia requirements between two groups



Comparison of adverse effects between two groups





DISCUSSION

Among the different techniques for brachial plexus blocks, the supraclavicular approach is the most commonly used. Known as the "spinal anaesthesia of the upper limb", it provides effective perioperative anaesthesia and analgesia, muscle relaxation, and stable haemodynamics during surgery.[9] This approach is particularly preferred for its reliability and intensity in blocking sensation, making it well-suited for most upper limb surgeries below the shoulder. With ultrasound guidance, the precision of supraclavicular blocks has greatly improved, substantially minimizing risks of complications such as pneumothorax , nerve damage and local anaesthetic systemic toxicity.[5,9] In the CCS, cords of the brachial plexus lie lateral to the axillary artery and appear as hypoechoic clusters and exhibited a consistent anatomic arrangement relative to one another and to the axillary artery which are comparable with the study conducted by Demondion et al., This consistent anatomic arrangement of the brachial plexus may explain the high success rate of this approach.The costoclavicular brachial plexus block is a single point injection lateral to axillary artery, whereas supraclavicular approach usually requires multiple point injections around the subclavian artery.

Our study was conducted with primary objective of comparing the block dynamics between ultrasound guided costoclavicular and ultrasound guided supraclavicular brachial plexus block.Demographic data such as age,gender,height,weight,BMI were comparable in both the groups and was not statistically significant.

In our study, the mean duration of block performance was 10.44 ± 1.28 minutes in group A and 10.1 ± 1.35 minutes in group B, with a p-value of 0.202, indicating no statistically significant difference between the two groups. This suggests that the time required to perform the block was comparable between the both techniques studied.

When compared with other studies, we noticed varying results. Shubha M Ramesh et al,[5] reported that the mean duration was 9.68 ± 1.11 minutes in costoclavicular group and 10.56 ± 1.12 minutes in supraclavicular group, with a p-value of 0.035, showing a statistically significant difference.

In our study, the onset of sensory block was significantly faster in group A (9.06 ± 0.71 minutes) compared to group B (11.57 ± 1.57 minutes), with a p-value of 0.0001, indicating a highly significant difference. This suggests that the sensory block was established more quickly in group A, making it potentially more advantageous for procedures requiring rapid onset of anaesthesia.The duration of sensory blockade was 155.68 ± 3.87 minutes in group A and 156.78 ± 5.32 minutes in group B, with a p-value of 0.241 not statistically significant.

In our study, motor block onset occurred at a mean of 13.140 ± 1.2618 minutes in group A and13.890±1.6329 minutes in group B, with a p-value of 0.012, indicating statistically significant difference between the groups. This suggests that the onset of motor blockade in group A was faster compared to group Bthe duration of motor blockade was found to be 134.22 ± 3.58 minutes in group A and 133.52 ± 4.46 minutes in group B, with a p-value of 0.389 not statistically significant.

In our study, the duration of analgesia was 13.338±0.4105 hours in group A and 13.092±0.9655 hours in group B, with a p-value of 0.102, indicating statistically insignificant difference between the groups. This suggests that the duration of analgesia was comparable between the groups.
In our study, the distribution of rescue analgesia requirements and adverse effects were not comparable in both the groups.

CONCLUSION

In our study, ultrasound guided costoclavicular and ultrasound guided supraclavicular approaches to the brachial plexus have demonstrated comparable efficacy in providing excellent blockade quality.But the onset of sensory and motor blockade was faster in ultrasound guided costoclavicular brachial plexus block compared to ultrasound guided supraclavicular brachial plexus block. Therefore, we conclude that the ultrasound guided costoclavicular brachial plexus block can serve as a viable alternative technique to the ultrasound guided supraclavicular approach for providing surgical anaesthesia in patients posted for open reduction and internal fixation for fracture both bones forearm.

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