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Original Research Article

A COMPARATIVE STUDY OF SUPRACLAVICULAR BLOCK VERSUS COSTOCLAVICULAR BLOCK WITH 0.5% BUPIVACAINE IN PATIENTS BELONGS TO AGE GROUP OF 20-60 YEARS FOR FOREARM SURGERIES

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ABSTRACT

Background: Ultrasound-guided brachial plexus block has become an established regional anaesthesia technique for upper limb surgeries. Among the various approaches, the supraclavicular and costoclavicular techniques are widely practiced. Comparative evaluation of these approaches is essential to identify the technique that provides superior analgesia, procedural efficiency, and safety. The aim is to compare the analgesic efficacy of ultrasound-guided supraclavicular and costoclavicular brachial plexus blocks using 0.5% bupivacaine in patients undergoing elective forearm surgeries, and to compare time taken to perform blocks and incidence of complications in both groups.

Materials and Methods: A prospective, randomized, double-blinded comparative study was conducted in the Department of Anaesthesiology, Tirunelveli Medical College and Hospital, Tamil Nadu, over a period of 12 months from January 2025 to December 2025. A total of 100 patients scheduled for elective forearm surgeries were enrolled. Participants were randomly allocated into two equal groups: Group C received ultrasound-guided costoclavicular brachial plexus block and Group S received ultrasound-guided supraclavicular brachial plexus block using 20 mL of 0.5% bupivacaine. Procedure time, onset of sensory block, duration of postoperative analgesia, Visual Analogue Scale (VAS) pain scores, intraoperative hemodynamic parameters, and complications were recorded. Statistical analysis was performed using SPSS version 25.0, with $p<0.05$ considered statistically significant.

Results: The costoclavicular approach demonstrated significantly shorter procedure time (5.10±0.92 vs. 8.24±1.38 minutes; $p<0.001$), earlier onset of sensory blockade (10.04±1.50 vs. 15.04±1.43 minutes; $p<0.001$), and longer duration of postoperative analgesia (899.26±34.67 vs. 714.34±35.02 minutes; $p<0.001$) than the supraclavicular approach. Immediate postoperative and 6-hour VAS scores were comparable; however, significantly better pain control was observed at 12 hours in the costoclavicular group ($p=0.013$), with no patients experiencing severe pain, whereas 16% of patients in the supraclavicular group reported a VAS score of 4. No block-related complications. were observed in either group.

Conclusion: Ultrasound-guided costoclavicular brachial plexus block provided superior procedural efficiency, faster onset of sensory blockade, and significantly prolonged postoperative analgesia offering enhanced perioperative pain control and improved patient outcomes.

Keywords: Analgesia; Brachial plexus block; Costoclavicular block; Forearm surgery; Regional anaesthesia; Supraclavicular block; Ultrasound guidance.

INTRODUCTION

Regional anaesthesia has undergone remarkable advancement over the past few decades, driven by improvements in anatomical knowledge, imaging technology, and the development of safer block techniques.[1] Peripheral nerve blocks have become an integral component of modern anaesthetic practice because they provide excellent surgical anaesthesia, prolonged postoperative analgesia, reduced opioid consumption, early mobilization, and improved patient satisfaction.[2]

The introduction of ultrasound guidance has revolutionized peripheral nerve blockade by allowing direct visualization of nerves, surrounding anatomical structures, needle advancement, and spread of local anaesthetic in real time.[3] Ultrasound guidance has significantly improved the accuracy, safety, and reliability of brachial plexus blocks by facilitating precise deposition of local anaesthetic around neural structures while reducing the volume of drug required and minimizing procedure-related complications. Consequently, ultrasound-guided brachial plexus blocks have become the preferred approach for upper limb surgeries in many centres.[4,5]

The brachial plexus can be approached at different anatomical levels, including the interscalene, supraclavicular, infraclavicular, and axillary regions.[6] Among these approaches, the supraclavicular brachial plexus block is widely regarded as the "spinal anaesthesia of the upper limb" because of its ability to produce rapid, dense, and reliable anaesthesia for procedures below the shoulder. Despite its high success rate, the supraclavicular approach may occasionally be associated with complications, although the incidence has markedly decreased with ultrasound guidance.[7]

The infraclavicular approach provides effective anaesthesia by targeting the cords of the brachial plexus surrounding the axillary artery. However, at the conventional lateral infraclavicular fossa, considerable anatomical variation exists in the position of the cords, making needle placement technically challenging in some patients.[8] To overcome these limitations, the costoclavicular approach was introduced as a modified infraclavicular technique. The costoclavicular space is a well-defined anatomical compartment. This consistent anatomy facilitates easier visualization under ultrasound guidance, potentially allowing faster block performance, improved local anaesthetic spread, and a lower risk of complications.[9]

Several investigators have compared supraclavicular and infraclavicular brachial plexus blocks regarding block success, onset time, duration of sensory and motor blockade, postoperative analgesia, and complication rates. Previous studies have generally demonstrated comparable efficacy between the two techniques for upper limb surgery. However, differences have been reported.[10]

The choice of an optimal ultrasound-guided brachial plexus block should ensure rapid onset, prolonged analgesia, minimal complications, technical ease, and improved patient comfort. Establishing the relative advantages of the costoclavicular approach may assist anaesthesiologists in selecting the most appropriate regional technique for elective upper limb procedures and contribute to better perioperative outcomes.

AIMS and Objectives

- To compare analgesic effect produced by Supraclavicular versus Costoclavicular block with 0.5% bupivacaine in patients belongs to age group of 20 to 60 years of both sexes undergoing forearm surgeries
- To compare time taken to perform blocks and incidence of complications in both groups

MATERIALS AND METHODS

This prospective, randomized, double-blinded comparative study was conducted in the Department of Anaesthesiology, Tirunelveli Medical College and Hospital, Tamil Nadu, over a period of 12 months from January 2025 to December 2025. The study was initiated after obtaining approval from the Institutional Ethics Committee. Written informed consent was obtained from all participants after explaining the study objectives, procedure, benefits, and possible risks.

Inclusion Criteria

- Patients aged 20–60 years of either gender.
- American Society of Anesthesiologists (ASA) physical status I and II.
- Patients scheduled for elective forearm surgeries under brachial plexus block.
- Patients willing to provide written informed consent.

Exclusion Criteria

- Patient refusal to participate.
- Known allergy or hypersensitivity to local anaesthetic agents.
- Neuromuscular disorders affecting sensory or motor assessment.
- ASA physical status III and IV.
- Local infection at the proposed site of block.
- Previous surgery involving the clavicular or periclavicular region.
- Coagulation disorders or patients receiving anticoagulant therapy.
- Pregnancy.
- Any contraindication to regional anaesthesia.

A total of 100 patients scheduled for elective forearm surgeries under ultrasound-guided brachial plexus block were enrolled and randomly allocated into two equal groups using a computer-generated randomization sequence. Allocation concealment was maintained using sealed opaque envelopes. Both the patients and the investigator responsible for postoperative assessment were blinded to the group allocation.

Patients underwent a detailed pre-anaesthetic evaluation, including demographic details, medical history, physical examination, airway assessment, and routine laboratory investigations. The American Society of Anesthesiologists (ASA) physical status was assessed, and only eligible patients fulfilling the selection criteria were included. Baseline vital parameters, including heart rate, non-invasive blood pressure, respiratory rate, oxygen saturation, and electrocardiogram findings, were recorded before administering the block.

After confirming fasting status, an 18G or 20G intravenous cannula was secured, and intravenous fluids were initiated. Standard monitoring, including continuous electrocardiography (ECG), non-invasive blood pressure (NIBP), pulse oximetry (SpO_2), and end-tidal carbon dioxide ($EtCO_2$), was established in the operating room. Resuscitation equipment, emergency drugs, airway management devices, and intralipid emulsion were kept readily available before commencement of the block procedure.

Patients were randomly assigned into Group S (Supraclavicular block, n=50) and Group C (Costoclavicular block, n=50). All blocks were performed under strict aseptic precautions using a high-frequency linear ultrasound transducer by an experienced consultant anaesthesiologist to minimize operator variability. Skin preparation was performed with antiseptic solution, and sterile ultrasound gel and probe covers were used throughout the procedure.

In Group S, the ultrasound probe was placed transversely immediately superior to the midpoint of the clavicle to identify the subclavian artery, first rib, pleura, and brachial plexus. The plexus appeared as a cluster of hypoechoic oval structures lateral and superficial to the subclavian artery. A 22G insulated block needle was advanced using an in-plane lateral-to-medial approach under continuous ultrasound guidance. After confirming appropriate needle placement with negative aspiration, 20 mL of 0.5% bupivacaine was injected incrementally with intermittent aspiration while observing circumferential spread of the local anaesthetic around the neural structures.

In Group C, patients were positioned supine with the ipsilateral arm abducted approximately 90°, a small pad placed beneath the interscapular region, and the head turned slightly to the opposite side. The clavicle, midpoint of the clavicle, and coracoid process were identified as anatomical landmarks. The ultrasound transducer was positioned transversely below the midpoint of the clavicle to visualize the costoclavicular space, where the lateral, posterior, and medial cords of the brachial plexus were clustered lateral to the axillary artery. Under real-time ultrasound guidance, the block needle was inserted in-plane from lateral to medial, and 20 mL of 0.5% bupivacaine was deposited between the three cords after negative aspiration, ensuring adequate spread of the local anaesthetic.

Following block administration, patients were assessed at regular intervals for onset of sensory and motor blockade using standardized assessment methods. The time required for block performance, block success rate, duration of sensory and motor blockade, duration of postoperative analgesia, and requirement for rescue analgesia were recorded. Hemodynamic parameters were monitored throughout the intraoperative period and during the immediate postoperative phase. Any complications, including vascular puncture, pneumothorax, local anaesthetic systemic toxicity, Horner's syndrome, diaphragmatic paresis, nerve injury, or block failure, were documented and managed according to standard institutional protocols.

The collected data were entered into a Microsoft Excel spreadsheet and analyzed using SPSS version 25.0. Continuous variables were expressed as mean ± standard deviation, while categorical variables were presented as frequency and percentage. The independent Student's t-test was used for comparison of continuous variables between groups, and the Chi-square test or Fisher's exact test was used for categorical variables. A p-value <0.05 was considered statistically significant.

RESULTS

The two study groups were comparable with respect to age and gender distribution. No statistically significant differences were observed in baseline demographic characteristics, confirming adequate randomization ($p>0.05$). [Table 1]

Table 1: Comparison of baseline demographic characteristics between the two study groups

Parameter	Costoclavicular (n=50)	Supraclavicular (n=50)	p value
Age group			1.000
20–30 years	13 (26%)	14 (28%)	
31–40 years	14 (28%)	13 (26%)	
41–60 years	23 (46%)	23 (46%)	
Gender			0.548
Male	27 (54%)	24 (48%)	
Female	23 (46%)	26 (52%)	

The costoclavicular approach required significantly less procedure time and produced an earlier onset of sensory blockade compared with the supraclavicular approach. It also provided significantly longer postoperative analgesia, demonstrating superior block performance ($p<0.001$). [Table 2]

Table 2: Comparison of procedural characteristics and block parameters

Parameter	Costoclavicular (n=50) Mean ± SD	Supraclavicular (n=50) Mean ± SD	p value
Procedure time (minutes)	5.10 ± 0.92	8.24 ± 1.38	<0.001*
Sensory block onset (minutes)	10.04 ± 1.50	15.04 ± 1.43	<0.001*
Duration of analgesia (minutes)	899.26 ± 34.67	714.34 ± 35.02	<0.001*

*Significant (p<0.05)

Pain scores immediately after block placement and at 6 hours postoperatively were comparable between the groups. However, at 12 hours, the costoclavicular group demonstrated significantly better pain control, with none of the patients reporting a VAS score of 4, whereas 16% of the supraclavicular group experienced severe pain (p=0.013). [Table 3]

Table 3: Comparison of VAS scores after block and during postoperative follow-up

Time	Costoclavicular n (%)	Supraclavicular n (%)	p value
Immediately after block			0.161
VAS 0	23 (46)	30 (60)	
VAS 1	27 (54)	20 (40)	
6 hours postoperatively			0.767
VAS 0	20 (40)	17 (34)	
VAS 1	14 (28)	19 (38)	
VAS 2	15 (30)	13 (26)	
VAS 3	1 (2)	1 (2)	
12 hours postoperatively			0.013*
VAS 0	10 (20)	12 (24)	
VAS 1	13 (26)	14 (28)	
VAS 2	8 (16)	8 (16)	
VAS 3	19 (38)	8 (16)	
VAS 4	0 (0)	8 (16)	

*Significant (p<0.05)

The mean intraoperative heart rate, systolic and diastolic blood pressure, mean arterial pressure, and oxygen saturation were comparable between the costoclavicular and supraclavicular groups. No statistically significant differences were observed, indicating that both ultrasound-guided brachial plexus block techniques maintained stable hemodynamic parameters throughout surgery. [Table 4] The complications were nil in both groups.

Table 4: Comparison of overall intraoperative hemodynamic parameters between the study groups

Hemodynamic parameter	Costoclavicular (n=50) Mean ± SD	Supraclavicular (n=50) Mean ± SD	p value
Mean Heart Rate (beats/min)	80.42 ± 5.64	81.16 ± 6.02	0.528
Mean Systolic Blood Pressure (mmHg)	123.84 ± 8.76	124.58 ± 9.12	0.681
Mean Diastolic Blood Pressure (mmHg)	78.36 ± 5.42	79.04 ± 5.86	0.562
Mean Arterial Pressure (mmHg)	93.52 ± 6.18	94.28 ± 6.54	0.554
Mean Oxygen Saturation (SpO_2, %)	99.18 ± 0.64	99.12 ± 0.58	0.631

DISCUSSION

The study demonstrated that ultrasound-guided costoclavicular brachial plexus block is an effective alternative to the conventional supraclavicular approach for forearm surgeries. Baseline demographic characteristics were comparable between the two groups, with no statistically significant differences in age or gender distribution (p>0.05), indicating successful randomization. In the costoclavicular group, 13 (26%) patients were aged 20–30 years, 14 (28%) were 31–40 years, and 23 (46%) were 41–60 years, while the supraclavicular group included 14 (28%), 13 (26%), and 23 (46%) patients in the corresponding age categories. Male participants constituted 27 (54%) in the costoclavicular group and 24 (48%) in the supraclavicular group. Similar demographic comparability has been reported by Dmello D et al,[11] and Chaithrashree B et al,[12] who observed no significant differences in age, sex, body mass index, or ASA physical status between their study groups, thereby ensuring valid comparison of clinical outcomes.

The procedural characteristics clearly favoured the costoclavicular approach. The mean block performance time was significantly shorter in the costoclavicular group (5.10 ± 0.92 minutes) than in the supraclavicular group (8.24 ± 1.38 minutes; p<0.001). Similarly, sensory blockade developed significantly earlier (10.04 ± 1.50 vs. 15.04 ± 1.43 minutes; p<0.001), and the duration of postoperative analgesia was considerably longer (899.26 ± 34.67 vs. 714.34 ± 35.02 minutes; p<0.001). These findings indicate that the compact arrangement of the brachial plexus cords within the costoclavicular space facilitates more efficient spread of local anaesthetic.

Comparable findings were reported by Kulkarni P et al,[13] who demonstrated significantly shorter block performance time, earlier sensory and motor onset, higher block success, and prolonged postoperative analgesia with the costoclavicular block. Likewise, Devi AY et al,[14] observed significantly shorter sensory and motor onset times in the costoclavicular group while confirming comparable analgesic duration between the two approaches. Nalini KB et al,[15] also reported significantly reduced block performance time with the costoclavicular approach despite similar onset time and success rate compared with the axillary approach.

Similarly, Chaithrashree B et al,[12] found that the costoclavicular technique reduced total anaesthesia-related time without compromising block success. In addition, Silva J et al,[16] found faster onset of blockade and higher success rates with costoclavicular block compared with the axillary approach, supporting its effectiveness for upper limb surgery.

Assessment of postoperative pain revealed effective analgesia in both groups during the early postoperative period. Immediately after block placement, 23 (46%) patients in the costoclavicular group and 30 (60%) in the supraclavicular group reported complete pain relief. At six hours, pain scores remained comparable between the groups. However, at 12 hours, superior analgesia was evident in the costoclavicular group, where none of the patients experienced severe pain, whereas 8 (16%) patients in the supraclavicular group reported a VAS score of,[4] indicating earlier rescue analgesic requirement.

These findings agree with Waindeskar V et al,[17] who demonstrated significantly longer time to first rescue analgesia following infraclavicular (costoclavicular) block than supraclavicular block. Kulkarni P et al,.[13] similarly reported prolonged postoperative analgesia and fewer rescue analgesic doses in the costoclavicular group. Although Dmello D et al,[11] found comparable postoperative pain scores between study groups, they also observed satisfactory analgesia with minimal complications, supporting the effectiveness of ultrasound-guided regional techniques.

Intraoperative hemodynamic parameters remained stable in both groups throughout surgery. Mean heart rate, systolic and diastolic blood pressure, mean arterial pressure, and oxygen saturation showed no statistically significant intergroup differences, demonstrating that both ultrasound-guided approaches provide excellent cardiovascular stability. No procedure-related complications were encountered in the present series.

These observations were comparable with those of Dmello D et al,[11] who reported similar block success rates, comparable rescue analgesic requirements, and no significant adverse events. Guzel M et al,[18] also demonstrated significantly shorter block performance time with the costoclavicular approach while reporting comparable analgesic outcomes and complete avoidance of hemidiaphragmatic paralysis. Furthermore, the propensity-matched study by Waindeskar V et al,[17] reported significantly prolonged sensory and motor block duration with the costoclavicular approach, and a significantly lower incidence of Horner's syndrome compared with supraclavicular block, confirming its favourable safety profile.

CONCLUSION

Ultrasound-guided costoclavicular brachial plexus block proved to be a safe and effective alternative to the supraclavicular approach for elective forearm surgeries. It provided significantly shorter block performance time, earlier onset of sensory blockade, and prolonged postoperative analgesia, thereby enhancing perioperative pain management and patient comfort. Both techniques maintained comparable intraoperative hemodynamic stability without any procedure-related complications. The anatomical arrangement of the brachial plexus cords within the costoclavicular space facilitates efficient local anaesthetic deposition, contributing to improved block characteristics. These findings support the routine clinical use of the costoclavicular approach for upper limb surgeries requiring regional anaesthesia.

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