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Original Research Article

ULTRASOUND GUIDED SUPRACLAVICULAR VS RETROCLAVICULAR BRACHIAL PLEXUS BLOCK IN UPPER LIMB SURGERY: A RANDOMISED COMPARATIVE STUDY

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ABSTRACT

Background: The supraclavicular approach to brachial plexus block offers rapid onset and dense blockade due to compact neural anatomy but may be associated with complications such as phrenic nerve involvement. The retroclavicular approach, a modification of the infraclavicular technique, has been introduced to enhance needle visualization and procedural ergonomics while maintaining comparable efficacy. This study was conducted to compare the clinical performance of ultrasound-guided supraclavicular and retroclavicular brachial plexus blocks.

Materials and Methods: This prospective, randomized comparative study included 90 patients aged 18–60 years, belonging to ASA physical status I and II, undergoing elective upper-limb surgeries. Patients were randomly allocated into two groups of 45 each: Group SC (supraclavicular approach) and Group RC (retroclavicular approach). All blocks were performed under ultrasound guidance using standardized technique and local anesthetic dosage. The primary outcome was block success rate. Secondary outcomes included onset time of sensory and motor blockade, procedural time, number of needle passes, duration of postoperative analgesia, time to first rescue analgesic, and incidence of complications. Statistical analysis was performed using appropriate tests with $p < 0.05$ considered significant.

Results: Both groups demonstrated comparable block success rates and adequate surgical anesthesia. Onset times of sensory and motor block were similar between the two techniques. The retroclavicular approach provided improved needle visualization and required fewer needle adjustments. Duration of postoperative analgesia and time to first rescue analgesic were comparable. Complication rates were low and did not differ significantly between groups.

Conclusion: Ultrasound-guided supraclavicular and retroclavicular brachial plexus blocks are equally effective and safe for upper-limb surgeries. While the supraclavicular approach offers rapid onset and dense blockade, the retroclavicular technique provides improved procedural ergonomics and needle visualization.

Keywords: supraclavicular approach, retroclavicular approach

INTRODUCTION

Brachial plexus block can be performed using various approaches such as interscalene, supraclavicular, infraclavicular, and axillary techniques. Each method targets the plexus at a different anatomical level and is selected depending on the location of surgery and individual patient

factors. The supraclavicular approach is commonly preferred for operations involving the arm distal to the shoulder because the neural components of the plexus are closely grouped at this level. This compact anatomical arrangement allows uniform distribution of local anesthetic with relatively smaller volumes, resulting in rapid onset and dense neural blockade.[1] Availability of ultrasonography has facilitated the procedure in recent times.

Despite these advantages, the supraclavicular approach has certain limitations. Anatomical variations, limited needle visibility in some patients with deep or obscured supraclavicular fossae, and the close proximity of important structures such as the pleura, phrenic nerve, and stellate ganglion can increase technical difficulty and the possibility of complications.[2,3] These potential limitations have led clinicians to explore alternative techniques that provide similar anesthetic effectiveness while potentially reducing associated risks. The infraclavicular approach represents one such alternative technique. This approach targets the cords of the brachial plexus located below the clavicle and provides reliable anesthesia for procedures involving the elbow, forearm, and hand. Because it is performed at a more distal level of the plexus, the likelihood of phrenic nerve involvement may be reduced.[3] A modification of this technique, known as the retroclavicular approach, was described by Hebbard and Royse.[4] In this method, the needle is inserted from a point superior and posterior to the clavicle and directed caudally toward the cords of the brachial plexus. This needle trajectory allows improved alignment with the ultrasound beam, which enhances visualization of both the needle shaft and its tip.

This randomized comparative study was designed to evaluate and compare ultrasound-guided supraclavicular and retroclavicular brachial plexus blocks in patients undergoing upper-limb surgery, focusing on block efficacy, onset characteristics, procedural efficiency, and complication profile.

MATERIALS AND METHODS

A prospective comparative study was conducted involving 90 patients of age between 18-60 years scheduled for elective upper limb surgery under ultrasound guided Supraclavicular vs Retroclavicular brachial plexus block. Sample size was calculated based on previous studies. All patients were randomized into two equal groups: Group RC – Retroclavicular approach, Group SC – Supraclavicular approach. After through preanesthetic evaluation patients were monitored for baseline vital parameters. All patients received 20 mL of 0.5% ropivacaine. Patients were placed supine with the head elevated 45 degrees and the ipsilateral arm adducted at the side. Blocks were performed by an experienced anaesthesiologist. The skin was prepared with 5% povidone-iodine. A 6–12 MHz linear probe of the GE Logiq C5 Premium ultrasound machine was used.

For supraclavicular approach the probe was positioned over the supraclavicular fossa, parallel to the clavicle, to visualize the divisions of the brachial plexus and the subclavian artery over the first rib. After local infiltration, a 50-mm 20G insulated Stimuplex A (B Braun) needle was inserted in-plane from lateral to medial. Once the needle tip pierced the brachial plexus sheath and negative aspiration was confirmed, the local anesthetic was injected as a single bolus.

For retroclavicular approach the probe was placed below and perpendicular to the clavicle in a paramedian sagittal orientation, medial to the coracoid process, to visualize the cords of the brachial plexus and axillary vessels. The needle was introduced through the supraclavicular fossa, posterior to the clavicle, and advanced in-plane parallel to the probe. After confirming needle penetration into the plexus sheath and obtaining negative aspiration, the local anesthetic was deposited using a single-injection technique.

All patients were monitored for sensory and motor blockade and haemodynamics at regular intervals. Also, data collected for Needling time (Skin puncture to completion of local anesthetic injection), Imaging time (Probe placement to needle insertion) and Performance time (Imaging time + needling time). Postoperatively, patients were assessed every 2 hours until NRS $\geq$ 4. At that point, rescue analgesia (Injection Diclofenac 75 mg) was administered, and the time was documented as rescue analgesia time. Statistical analysis was performed using Software: SPSS version 23.0 (IBM). Continuous variables were compared using independent t-test. Categorical variables were compared using Chi-square. Significance Level: $p < 0.05$ considered statistically significant.

RESULTS

In this study demographic profile of patients of both the groups were comparable. Also, haemodynamic parameters of all the patients were stable throughout the surgery. Block characteristics showed statistically significant differences as shown in table 1. It indicates that the retroclavicular approach provides significantly prolonged sensory and motor blockade. Procedural parameters demonstrated that imaging time and performance time were longer in the RC compared to the SC group (Table 2). Both differences were statistically significant ($p < 0.001$), indicating that the supraclavicular approach was quicker to perform. The number of needle pricks required was similar between groups as shown in table 3. The p-value of 0.548 indicates no statistically significant difference between groups regarding needle attempts.

Table 1: Block Characteristics

Parameter	RC Mean ± SD	SC Mean ± SD	p-value
Sensory Onset (min)	13.96 ± 0.79	13.11 ± 0.69	<0.001*
Motor Onset (min)	14.47 ± 1.23	13.17 ± 0.60	<0.001*
Sensory Duration (min)	437.91 ± 9.47	379.58 ± 17.95	<0.001*
Motor Duration (min)	514.09 ± 20.98	425.58 ± 17.08	<0.001*

Table 2: Procedural Parameters

Parameter	RC Mean ± SD	SC Mean ± SD	p-value
Imaging Time (min)	2.25 ± 0.22	1.77 ± 0.15	<0.001
Performance Time (min)	8.07 ± 0.39	6.73 ± 0.26	<0.001

Table 3: Number of Needle Pricks

Needle pricks	RC (n=45)	SC % (n=45)	p-value
2	8 (17.8%)	12 (26.7%)	0.548
3	22 (48.9%)	19 (42.2%)	
4	14 (31.1%)	13 (28.9%)	
≥5	1 (2.2%)	1 (2.2%)	
Total	45 (100%)	45 (100%)	

Complication rates were very low and identical in both groups. The only complication observed was vascular puncture, occurring in 2.2% of patients in each group (Figure 1). No pleural puncture or persistent paraesthesia was reported, and Fisher's Exact Test showed no significant association. Figure 2 shows that the postoperative pain scores were identical at 2 and 4 hours in both groups, with no pain reported. At 6 hours, the mean NRS score was 1.84 ± 0.90 in the RC group and 1.91 ± 0.93 in the SC group, with no statistically significant difference (p = 0.730). At 8 hours, both groups had identical mean scores of 4.80, with no significant difference (p = 1.000). Thus, postoperative pain scores were comparable between the two techniques. The time to rescue analgesia was significantly longer in the RC group (437.91 ± 9.47 minutes) compared to the SC group (379.09 ± 17.10 minutes), with a highly significant p-value (< 0.001). This indicates that patients in the RC group experienced prolonged postoperative analgesia and required rescue medication later than those in the SC group.

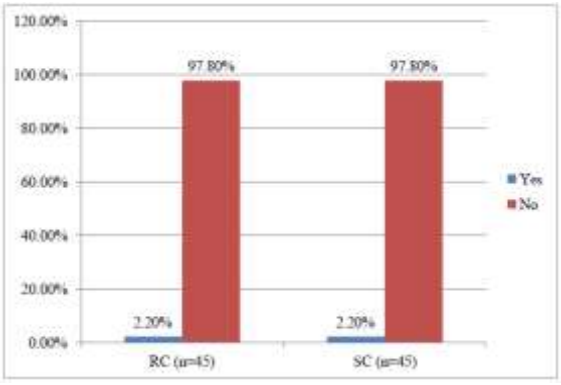

Figure 1: Bar graph showing type of complication

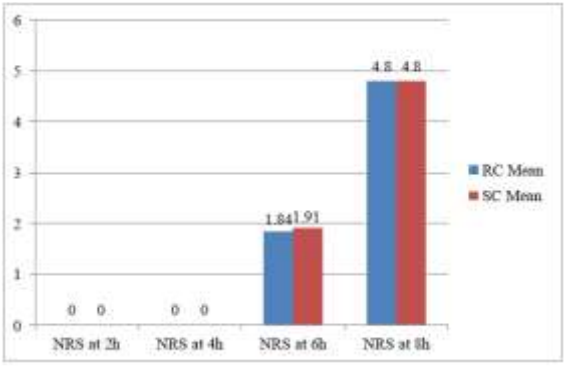

Figure 2: Bar graph postoperative pain scores

DISCUSSION

I in our study, we conducted a prospective comparative evaluation of the Retroclavicular (RC) approach and the Supraclavicular (SC) approach to brachial plexus block in patients undergoing upper limb surgeries. Our findings showed that both techniques were comparable in terms of patient characteristics, surgical profile, and overall safety.

In our study, sensory onset time was slightly longer in the Retroclavicular group. In comparison, Grape S et al, found no statistically significant difference in sensory onset (13.2 vs 14.1 minutes; p = 0.32) or motor onset (13.5 vs 15.3 minutes; p = 0.08) between supraclavicular and retroclavicular groups.[2] Interestingly, Agrawal DA et al, comparing retroclavicular and coracoid approaches, found significantly shorter sensory onset (5.40 ± 1.77 vs 8.06 ± 1.31 minutes; p = 0.001) and motor onset (9.40 ± 1.77 vs 12.06 ± 1.31 minutes; p = 0.001) with the retroclavicular technique.[5] This variation across studies suggests that onset differences may be influenced by anatomical level, technique variation, and local anesthetic protocol.

A key finding in our study was the significantly prolonged duration of both sensory and motor block in the Retroclavicular group. Georgiadis PL et al, reported no significant difference in distal arm composite block scores (F = 1.559; p = 0.22),

indicating comparable overall completeness of distal blockade, although suprascapular (p = 0.031) and axillary nerve blockade (p = 0.045) were more pronounced in the supraclavicular group.[3] Overall, while onset times appear comparable or only minimally different across studies, there is a consistent trend toward longer motor block duration with the retroclavicular approach, as demonstrated both in our study and in the findings of Grape S et al.[2]

In our study, imaging time was significantly longer in the Retroclavicular (RC) and overall performance time was also longer in RC group. Our findings are comparable to those reported by Grape S et al, who observed shorter needling time in the supraclavicular group (5.0 vs 6.0 minutes; p = 0.006) and shorter total procedure time (6.8 vs 8.3 minutes; p = 0.005), although imaging time difference (1.8 vs 2.3 minutes) did not reach statistical significance (p = 0.07).[2] This aligns closely with our observation that the supraclavicular approach may be relatively quicker in routine clinical practice. In contrast, Georgiadis PL et al, reported no statistically significant differences in imaging time (14 ± 13 vs 22 ± 18 seconds), needling time (262 ± 100 vs 276 ± 119 seconds), or total block time (276 ± 106 vs 298 ± 128 seconds) between supraclavicular and retroclavicular approaches.[3] Similarly, Blanco AFG et al, found no significant differences in imaging time (35 ± 42 vs 41 ± 52 seconds; p = 0.725) or needling time (4.2 ± 1.7 vs 4.5 ± 2.2 minutes; p = 0.702) between retroclavicular and infraclavicular techniques.[6] Attia JZ et al, reported significantly shorter needle and overall procedure time in the retroclavicular group compared to costoclavicular and classic techniques, while imaging time remained comparable.[7] These variations across studies suggest that procedural efficiency may depend not only on the anatomical level (supraclavicular vs retroclavicular) but also on the specific comparator technique and operator familiarity.

In our study, the overall incidence of complications was very low and identical in both groups. Complications occurred in 2.2% of patients in the Retroclavicular (RC) group and 2.2% in the Supraclavicular (SC) group, with vascular puncture being the only observed complication in each group. Our results are in agreement with previously published studies. Grape S et al,[2] reported transient paresthesia in 12.1% of supraclavicular patients and 18.6% of retroclavicular patients (p = 0.30), and vascular puncture in two retroclavicular patients versus none in the supraclavicular group (p = 0.16), with no cases of hematoma, persistent neurological symptoms, or motor weakness at 24-hour follow-up. In contrast, Georgiadis PL et al, observed higher rates of certain transient complications, including paraesthesia in 45% of supraclavicular patients versus 20% of retroclavicular patients, and Horner's syndrome in 20% of supraclavicular patients versus none in the retroclavicular group.[3] A more pronounced difference was reported by Hazarika R et al, where Horner's syndrome occurred in 62.5% of supraclavicular patients compared to 5% in the infraclavicular group, while vascular puncture occurred in 5% of patients in both groups.[8]

In our study, postoperative pain scores were comparable between the two groups at measured time intervals. Grape S et al, reported comparable postoperative pain outcomes between supraclavicular and retroclavicular groups.[2] Pain scores at rest at 2 hours were identical (0.4 in both groups; p = 0.95), and at 24 hours were 1.2 versus 1.5 (p = 0.09), indicating no significant difference. Furthermore, time to first opioid request was similar (439 vs 447 minutes; p = 0.80), and total oxycodone consumption at 24 hours did not differ significantly (10.0 mg vs 7.9 mg; p = 0.37). Unlike our findings, they did not observe a significant difference in duration of postoperative analgesia between techniques.

In a retrospective analysis, Kukreja P et al, found no significant differences in postoperative opioid consumption, highest and average PACU pain scores, or incidence of postoperative nausea and vomiting between supraclavicular and infraclavicular groups, supporting the concept that both approaches provide effective postoperative pain control.[9]

CONCLUSION

Ultrasound-guided supraclavicular and retroclavicular brachial plexus blocks are equally effective and safe for upper-limb surgeries. While the supraclavicular approach offers rapid onset and dense blockade, the retroclavicular technique provides improved procedural ergonomics and needle visualization. Technique selection should be individualized based on patient characteristics and operator expertise.

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