Archives of Anesthesiology and Critical Care (In Press); x(x): xx-xx.

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Research Article

Comparison Between Ultrasound-Guided Supraclavicular and Infraclavicular Block Approaches for Upper Limb Surgeries

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ARTICLE INFO

Article history:
Received 28 February 2026
Revised 21 March 2026
Accepted 04 April 2026

Keywords:
Ultrasound;
Supraclavicular;
Infraclavicular;
Anaesthesia

ABSTRACT

Background: A properly administered regional anaesthesia technique provides significant benefits to anaesthesiologists, surgeons and patients alike due to its advantages over general anaesthesia. These includes maintaining consciousness, improved hemodynamic stability and superior postoperative pain relief. The objective of this prospective study was to evaluate and compare the technical simplicity and efficacy of supraclavicular and infraclavicular approaches to brachial plexus.

Methods: This study randomly allocated 100 patients to two groups: Group I received a supraclavicular block, and Group II received an infraclavicular block as a part of a prospective observational design.

Results: The study groups showed no significant association or differences in various parameters, including age, sex, ASA, duration of surgery, block performance time, onset of motor block, duration of motor block, successful block, and patient satisfaction. The study found a significant difference in sensory blockade onset time between the two study groups ($p < 0.001$). and a higher complication rate in the supraclavicular group ($p < 0.05$).

Conclusion: Both supraclavicular and infraclavicular block techniques showed equivalent effectiveness in terms of block execution time, success rate, duration of sensory and motor blockade and patient satisfaction in upper extremity surgeries. Infraclavicular group had a quicker sensory blockade onset, whereas the supraclavicular group had more complications and conversion to general anesthesia was more frequent in infraclavicular group but the difference was not significant.

Introduction

A properly administered regional anesthesia technique provides significant benefits to anesthesiologists, surgeons, and patients alike due to its advantages over general anesthesia. These include maintaining consciousness, greater cardiovascular stability, and enhanced relief of postoperative pain [1]. Brachial plexus block can be performed mainly using three approaches: supraclavicular, infraclavicular, and axillary [2]. The supraclavicular approach is preferred for surgeries involving the upper extremity below the shoulder due to its rapid onset and high success rate. The supraclavicular technique blocks the brachial plexus where trunks and divisions are densely clustered which may contribute to a quicker onset of anesthesia when a single-injection method is utilized [3]. The infraclavicular brachial plexus block is considered an effective technique for operations involving the distal upper extremity, particularly procedures on the elbow, forearm, wrist, and hand [4]. This Technique combines the benefits of both the supraclavicular and axillary techniques while reducing

The authors declare no conflicts of interest.

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DOI:

the risk of pneumothorax [5]. Both supraclavicular and infraclavicular approaches offer similar anesthesia coverage. The ultrasound-guidance enhances block quality and effectiveness, largely due to real time visualization of target structures, precise needle guidance, and observable spread of local anesthetic [6].

Methods

This prospective observational study, approved by the Institutional Ethics Committee and adhering to Declaration of Helsinki guidelines, included 100 patients (ASA I-III,18-60 years) between October 2018 to July 2020, undergoing elective surgeries at a government tertiary care hospital (Figure1). We recruited 100 patients of both sexes, aged 18-60 years, American Society of Anesthesiologist (ASA) I-III, undergoing elective surgeries. Written informed consent was obtained from all participants. Exclusion criteria included patients unwilling to participate, those under 18 or over 60 years of age, individuals with significant coagulopathy or peripheral neuropathy, a history of relevant drug allergies, difficult intubation, asthma, COPD, diabetes, or hypertension.

A routine pre-anesthetic assessment was performed for all 100 patients one day prior to surgery. The participants were allocated into two equal groups comprising 50 patients each through a computer-based randomization technique. Patients in group I underwent supraclavicular block administered with mixture of 15 ml of 0.5 % Bupivacaine and 2% lignocaine with adrenaline (10 ml, 1:200,000). Group 2 received an ultrasound-guided infraclavicular brachial plexus block with the same local anesthetic mixture and dosage as group I. Patients were positioned supine and monitored using standard intraoperative monitors, including Electrocardiogram, Oxygen saturation monitoring, and Automated blood pressure monitoring. A 20 G IV cannula was aseptically inserted in the contralateral upper limb for intravenous access. Premedication included inj. Ondansetron 0.08 mg/kg iv and inj. midazolam 0.02 mg/kg iv. Ultrasound equipment and probe were prepared aseptically for the procedure. After appropriate skin preparation, using a 38 mm high frequency linear ultrasound transducer (10-15 MHz) positioned in the coronal oblique plane over the supraclavicular fossa, clear visualization of the subclavian artery, brachial plexus, and other relevant structures was achieved. This technique enabled for clear visualization of the subclavian artery, brachial plexus, and other relevant structures. Machine settings such as depth (2-3 cm), focus, and gain were adjusted to enhance imaging quality. After visualizing the nerves, the drug was injected around the nerve. The Infraclavicular Block was performed using a high-frequency (8–13 MHz) linear probe, scanning the infraclavicular region between the middle of the clavicle and the coracoid process. Ultrasound guidance allowed precise localization of the brachial plexus cords (lateral, posterior, medial) to the axillary artery, appearing hyperechoic on ultrasound. A parasagittal approach was used to insert the needle, directing it posteriorly to the artery. A horseshoe-shaped pattern of Local anesthetic deposition was created around the artery, from 3 and 11 O' Clock, improving visualization of plexus by creating an echogenic window. Data collected included time taken for procedure, onset and duration of sensory and motor blockade. The sensory block assessment used 3-point scale (cold sensation) to anesthetized & contralateral arm. Grade 1 indicated no alteration in cold perception, Grade 2 represented reduced cold sensation with preserved perception in the blocked limb, and Grade 3 denoted complete loss of cold sensation in the anaesthetized arm. Motor blockade was graded as: 1- Normal power ,2- Reduced power ,3- Complete loss of power. Evaluation of motor block included testing flexion of arm (musculocutaneous nerve), extending the flexed arm & wrist (radial nerve), third finger flexion (median nerve) and little finger flexion (ulnar nerve). Patient assessments were performed by a second anaesthesiologist. Observations were documented every 10 minutes during the first 30 minutes, followed by recordings at 15-minute intervals until surgery was completed. Postoperative monitoring of sensory and motor block characteristics was continued at regular intervals at least for 8 hours. Vital parameters monitored intraoperatively included pulse rate, respiratory rate, and non-invasive blood pressure.

The sensory block onset time was considered as the duration between injection of the local anesthetic solution and attainment of a sensory score of 2. Sensory block duration was measured from the onset of sensory blockade until the postoperative sensory score reached 3. Motor block onset time referred to the interval from administration of the local anesthetic to development of grade 1 motor blockade. The duration of motor blockade was calculated from the onset of motor impairment until full restoration of hand and finger movement. All study data were recorded in a Microsoft Excel worksheet and analyzed using IBM SPSS software version 22. Descriptive analysis of categorical variables was performed using frequencies and percentages, while numerical variables were represented as mean with standard deviation. The Chi-square test was applied for comparison of categorical data, and the independent sample t-test was used to compare mean values between the two groups. A P value < 0.05 was considered statistically significant.

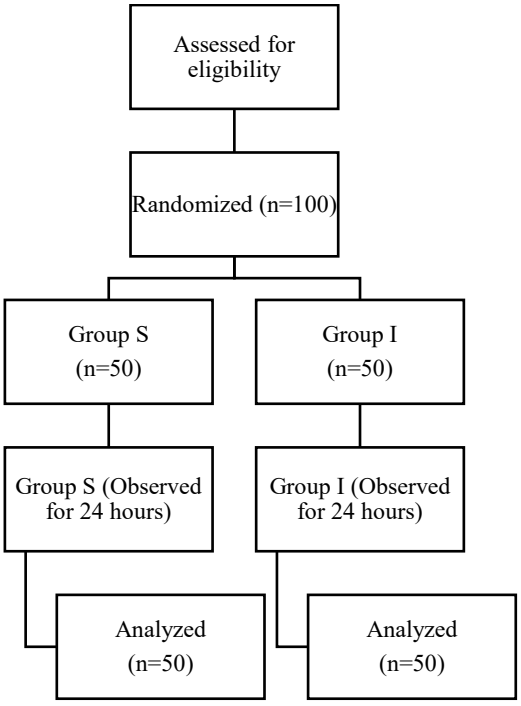

Figure 1- Consort diagram showing the number of patients included and analyzed

Results

The both groups were comparable in terms of demographic characteristics as shown (Table 1).

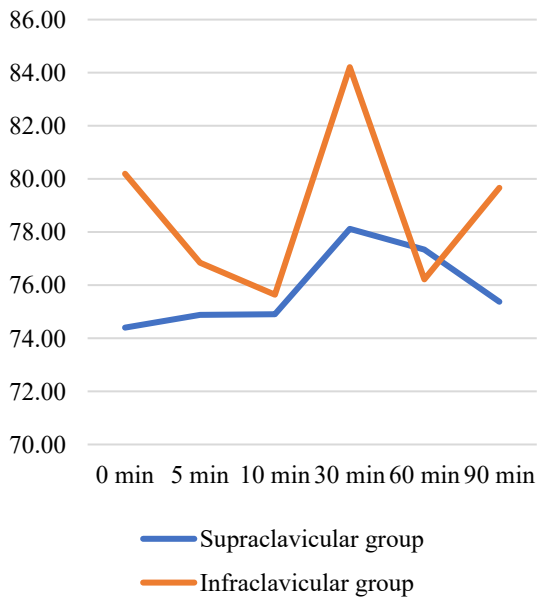

Figure 2- Heart rate variability in each group

The two groups were similar in terms of durations of surgery, block performance times, onsets of sensory and motor block, durations of sensory and motor block, and quality of block (Table 2). However, sensory block onset was faster in the infraclavicular group (6.28 ± 1.32 min) than in the supraclavicular group (8.96 ± 1.35 min) with a statistically significant difference ($p < 0.05$). Hemodynamic parameters showed no significant variability in the two groups (Figure 2,3).

Horner syndrome was seen in 5 (10%) patients of the supraclavicular group and in 1 (2%) patient of the infraclavicular group; dyspnea was seen in 2 (4%) patients of the supraclavicular group one (2%) patient of the supraclavicular group developed pneumothorax, which needed intercostal drain insertion.

Inadvertent vascular puncture was done in 2 (4%) patients of the supraclavicular group and one (2%) patient of the infraclavicular group.

There were no complications such as seizures or hematoma, possibly because of the slow injection technique. A difference in the proportion of complications in patients of both study groups was found to be statistically significant. A difference in proportion of complications was observed between both study groups ($P < 0.05$), with a higher proportion of complication rates noted in the supraclavicular group. However, the supraclavicular group had a significantly higher respiratory rate (Table 3).

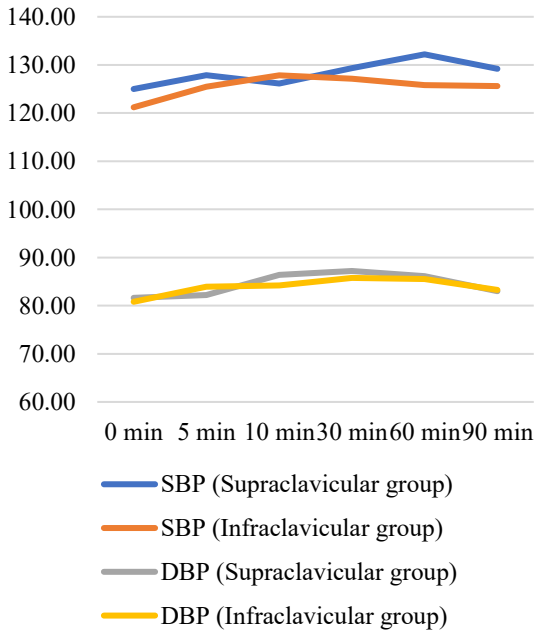

Figure 3- Systolic and diastolic blood pressure variability in both groups

Table 1- Demographic data

Characteristics	GROUP I	GROUP II	P value
Mean Age (Yrs)	34.54 ± 6.85	35.28 ± 6.14	>0.05
Gender: Male	31 (62%)	33 (66%)	>0.05
Female	19 (38%)	17 (34%)	
ASA I	29	27	>0.05
ASA II	21	23	
Weight (kg)	68.16 (± 7.13)	67.2 (± 8.73)	>0.05

Table 2- Characteristics of blocks

Parameters	Group I	Group II	P value
Duration of surgery (min)	95.64 (± 14.09)	97.8 (± 13.81)	>0.05
Block performance time (min)	6.08 (± 1.29)	6.62 (± 1.60)	>0.05
Onset of sensory blockade (min)	8.96 (± 1.35)	6.28 (± 1.32)	<0.001
Onset of motor blockade (min)	8.5 (± 1.86)	7.94 (± 1.78)	>0.05
Duration of sensory block (min)	440.8 (± 49.82)	433 (± 50.51)	>0.05
Duration of motor block	439.2 (± 57.59)	435.2 (± 46.08)	>0.05
Quality of block	Number of patients	Number of patients	
Satisfactory	44	43	
Unsatisfactory	5	6	>0.05
Failure	1	1	
	50	50	

Table 3- Respiratory rate variability in both groups

Mean Respiratory Rate	0 Min	5 Min	10 Min	30 Min	60 Min	90 Min	P value
Supraclavicular	15.86	16.96	17.80	18.70	20.28	17.96	<0.05
Infraclavicular	15.68	16.38	16.58	16.96	16.60	16.36	<0.05

Discussion

Brachial plexus blockade is one of the most challenging techniques in regional anesthesia; however, the incorporation of ultrasound guidance can improve accuracy and increase the likelihood of successful blockade. There are different ways to a brachial plexus block like Interscalene, supraclavicular and infraclavicular. The supraclavicular area was among the earliest sites described for the application of ultrasound-guided nerve blocks [7]. At this level, ultrasound facilitates identification of the brachial plexus divisions [8]. According to the study, Real-time ultrasound-guidance enhances success rate of supraclavicular block, with reported success rate of 95% effectiveness after a single attempt [9]. This technique is recognized for its excellent block characteristics, making it a reliable option for regional anesthesia [10]. The coracoid infraclavicular block at the mid clavicular level is highlighted for its ability to anesthetize all three brachial plexus cords effectively while minimizing complications such as sparing the musculocutaneous nerve. The infraclavicular approach is effective, providing reliable anesthesia with minimal complications and side effects [11]. This approach combines the advantages of the supraclavicular and axillary techniques, offering a favorable anatomical distribution that allows for a single injection to block the plexus without risks of pneumothorax or vascular complications [12]. In Our study, we compared the effectiveness of supraclavicular and infraclavicular brachial plexus blocks in 100 patients undergoing upper limb surgeries.

The Infraclavicular group in our study demonstrated a significantly faster onset of sensory block (6.28 ±1.32) minutes compared to (8.96 ±1.35) minutes in the supraclavicular group, aligning with results from Koscielniak et al [12]. and Abhinaya et al. [13]. nonetheless, both approaches showed comparable outcomes in terms of motor blockade onset or the duration ($p > 0.05$). Similar to our study, Arcand et al [14] found no notable differences in onset of motor blockade time, supporting our results. According to Lanz et al. study [15], motor blockade developed faster than sensory blockade across all four techniques, suggesting that choice of approach should primarily depend on the surgical site. Unlike Abhinaya et al., who reported statistically significant block performance times of (9.57 ± 3.19) minutes supraclavicular and (11.53 ± 2.90) minutes infraclavicular brachial plexus block, our study found no significant difference, with the mean block performance times of 6.08 (±1.29) minutes and 6.62 (±1.60) minutes, respectively. These findings are similar to a study by Arcand et al. who found no significant

difference in block performance time.[14] Both groups reported high satisfaction rates: 94% in the supraclavicular group and 92% in the infraclavicular group in our study. The patient satisfaction outcomes in the present study were comparable to those reported by Abhinaya et al. [13] and Rekhi et al. [16], both of whom noted similarly high satisfaction levels.

Patients in our study maintained hemodynamic stability, with similar heart rate, blood pressure, and oxygen saturation observed in both supraclavicular and infraclavicular groups throughout surgery. These findings align with previous studies such as those by Abhinaya et al [13] and Tarıkçı Kılıç E et al [17]. Unlike to our study, Junghare et al [5] observed a Shigher respiratory rate in the supraclavicular group, potentially attributed to due to hemi-diaphragmatic palsy resulting from the block. In the supraclavicular group, one patient experienced pneumothorax, three patients developed Horner's syndrome, and another patient had diaphragmatic paresis as reported in their study. Our study took place at a single tertiary care institution. Additional multicenter research with a larger study population is recommended to further investigate and compare the effectiveness of supraclavicular and infraclavicular brachial plexus blocks in upper limb surgical procedures. We conducted perineural infusion in our study without the utilizing catheters.

Conclusion

Both supraclavicular and infraclavicular block techniques showed equivalent effectiveness in terms of block execution time, success rate, duration of sensory and motor blockade and patient satisfaction in upper extremity surgeries. Infraclavicular group had a quicker sensory blockade onset, whereas the supraclavicular group had more Complications and conversion to general anesthesia was more frequent in infraclavicular group but the difference was not significant.

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