Original Article

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Comparative Evaluation of Supraclavicular and Infraclavicular Approaches to Brachial Plexus Block for Upper Limb Surgeries Using Ultrasonography

Rohini Rajendran[1], Sushma D Ladi[2]

Author's Affiliation:

[1]Junior Resident, [2]Professor, Department of Anesthesiology, Bharati Vidyapeeth Medical College, (Deemed to be University) Pune, Maharashtra 411043, India.

Abstract

Background and Aim: Brachial plexus blocks when administered adroitly offer numerous benefits over general anaesthesia for upper limb surgeries. It is especially beneficial in patients with substantial comorbid conditions such as diseases involving the respiratory and cardiovascular system, life-threatening obesity, and those with an anticipated difficult airway. Out of its many approaches, we aim to compare and assess the Supraclavicular and Infraclavicular techniques utilising ultrasonography.

Methods: Sixty consenting ASA I–II patients, aged 18–65 years, scheduled for elective upper limb surgery were randomly divided into two groups of 30 each: Supraclavicular (S) and Infraclavicular block Groups (I). Blocks were performed under ultrasound-guidance. The quality of the block intra-operatively, patient satisfaction post-operatively, duration of the sensory & motor block, and complications were observed.

Results: Demographics, number of attempts, mean pain score felt during the administration of the block, mean duration of motor and sensory blockade and incidence of complications were all comparable between the two groups & statistically not significant. However, at 5 and 10 minutes after the execution of the block, the Infraclavicular group showed a higher level of blockade, indicating that the onset of action of the block was significantly quicker.

Conclusion: Time taken to perform & rapidity of onset were more in the Infraclavicular block with no difference in adequacy of both blocks at 30 minutes.

Keywords: Brachial plexus blocks; Ultrasonography; Supraclavicular; Infraclavicular.

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Corresponding Author: Rohini Rajendran, Junior Resident, Department of Anesthesiology, Bharati Vidyapeeth Medical College, (Deemed to be University), Pune, Maharashtra 411043, India.

Email: rohinirajendran.7@gmail.com

Introduction

Regional anaesthesia, on account of its benefits, which involve not losing consciousness, avoiding the side effects of the multitude of drugs used in general anaesthesia, better haemodynamic stability, better handling of comorbidities and excellent post-operative pain relief has gained immense popularity.[1,2]

The Supraclavicular approach has the anatomical upper hand of providing the block at a position where the brachial plexus components are tightly clustered, aiding a single point injection.[3] The Infraclavicular block combines the postulated advantages of Axillary and Supraclavicular techniques, a tight anatomical distribution of the plexus that allows a single injection of local anaesthetics, and a decreased risk of pneumothorax.[4]

With this study we aim to compare and evaluate both the blocks with respect to time taken, number of attempts, onset and duration of both sensory and motor components and incidence of complications.

Material and Methods

After approval from the Institutional Ethical Committee, this randomized prospective comparative study was conducted in the attached teaching hospital, consisting of 60 patients who were undergoing upper limb surgeries. They were randomly divided into 2 groups of 30 each by chit system, namely Group S who were administered the Supraclavicular block and Group I where Infraclavicular block was given.

Patients of both genders/sexes belonging to American Society of Anesthesiology (ASA) Grade I/II, in the age group between 18 to 65 years undergoing upper limb surgery were included in this study. Meanwhile, patients unwilling or unable to give consent for regional anaesthesia, those with allergy to local anaesthetics, presence of chest deformities/significant pulmonary pathology or neurological disorders, patients with coagulopathies, or infections at the needle insertion site were excluded.

Pre anaesthetic examination was done as per standard protocol and appropriate investigations were advised before the patient was posted for surgery. After arriving in the operation theatre an IV line was secured, ECG leads placed, and a blood pressure cuff and a pulse oximetry probe attached to the non-operative arm. Patients were given a mild anxiolytic in the form of Inj. Midazolam 0.02mg/kg IV. All the blocks were performed with a mixture of Inj. Lignocaine-Adrenaline at 5mg/kg and Inj. Bupivacaine 0.5% at 2mg/kg. The ultrasound imaging was performed using a high-frequency linear probe.

The Infraclavicular approach was administered after placing the patient supine, elbow flexed, and the arm abducted to ninety degrees. This method helped to decrease the distance to the plexus from the skin, elevate the clavicle, 5 and altogether improved visualization of the needle, the pectoralis muscles, and the brachial plexus cords.[6] Ultrasound scanning was initiated medial to the coracoid process and once the axillary artery was identified, the needle was inserted through the pectoralis muscles while being directed toward the artery's posterior part. It was carefully observed that the injectate dispensed downward and upward to encompass the medial and lateral cords, respectively.

For the Supraclavicular block, the transducer was oriented just above the midpoint of the clavicle, in the transverse plane and an in-plane approach taken after identifying the subclavian artery and the nerve plexus adjacent to it.

The pain caused while administering the block was assessed just after the needle was removed. The patient was asked to give a verbal estimate of his/her grade of pain on a scale between 0 and 10 (0 signifying no pain and 10 for severe pain). The time between disinfecting and draping, to the removal of the needle was identified as the performance time of block and taken note of, along with the number of needle pricks needed to successfully administer the block, which signified the number of attempts.

The sensory block was analysed for each nerve considered, using the pin-prick method in each nerve territory in comparison to the contralateral limb. (graded as: 0 = no change from baseline; 1 = diminished pin-prick sensation; 2 = no pin-prick sensation). Similarly, the motor block was assessed by checking for the thumb and second digit pinch, finger abduction, thumb abduction, and forearm flexion (for the median, ulnar, radial, and musculocutaneous nerves, respectively) graded as follows: 0 = no decrease in force; 1 = decreased force in comparison to the contralateral arm; 2 = incapacity to overcome gravity. Both sensory and motor effects of the block were evaluated at 5, 10, 15, 20, 25, and 30 minutes.

After 30 minutes, the total block quality was assessed and decided to be either Satisfactory (complete motor and sensory block with no nerve-sparing), Unsatisfactory (presence of nerve-sparing and/or requirement of supplementation/sedation) and Complete Failure (if the patient complained of pain regardless of maximum possible

supplementation/anesthesiologist induced general anaesthesia). Post-operatively, the patient was followed up to assess the duration of action of block. Incidence of certain anticipated complications or side-effects, such as pneumothorax, blood vessel puncture, diaphragmatic paresis, and Horner syndrome, etc. were taken note of.

Statistical Analysis

The inter-group statistical comparison of distribution of categorical variables was tested using Chi-Square test or Fisher's exact probability test and that of continuous variables was done using independent sample T test. In the entire study, the p-values less than 0.05 are considered to be statistically significant.

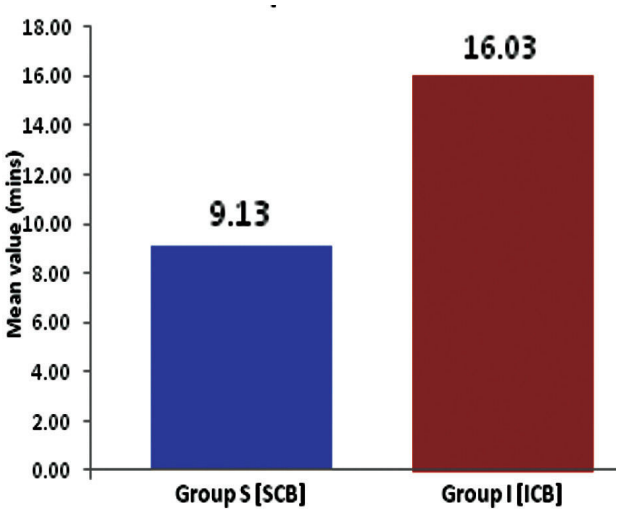
Results

The study included 60 patients who were randomly allocated into two equal groups. The patient demographics (mean age, sex and BMI distribution) were comparable between the two groups as seen in Table 1. (Group S & Group I, n=30).

Table 1: Demographic Characteristics of patients, operative data in studied groups.

Variable	Mean		P value	Statistical Significance
	Group S (n=30)	Group I (n=30)		
Age (years)	42.9	41.53	0.518	NS
Sex				
Males	16	15	0.796	NS
Females	14	15		
BMI	25.7	26.03	0.592	NS

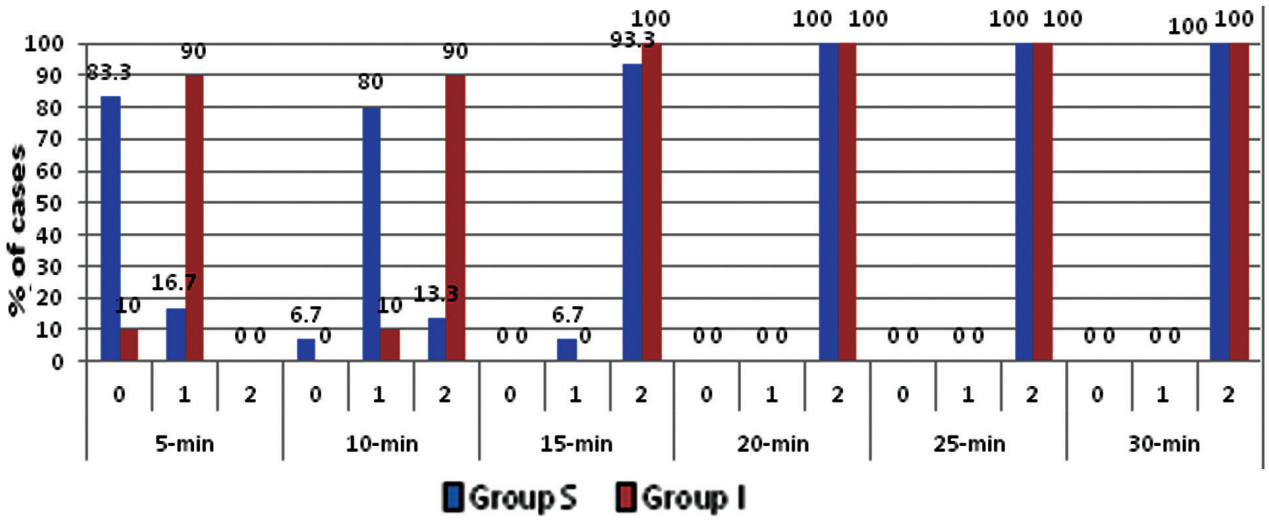
Graph 1: Inter-group comparison of mean performance time of block (SCB – Supraclavicular Block, ICB – Infraclavicular Block).



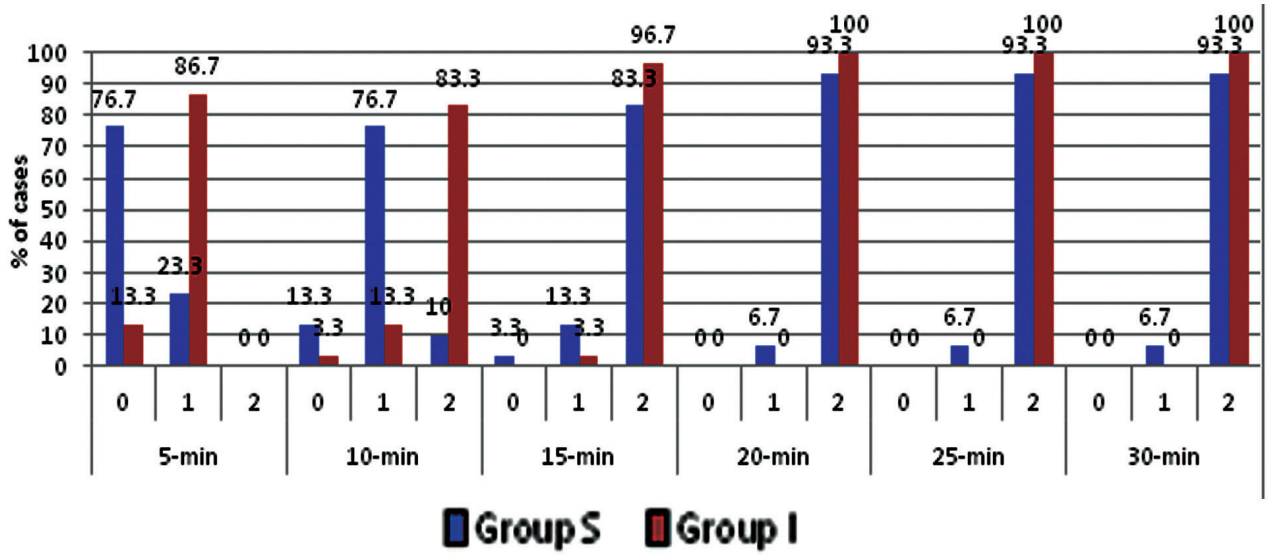
Graph 1 shows the distribution of the mean performance time of the two blocks. The range of minimum-maximum performance time of blocks in Group S and Group I were 6 – 13 minutes (mean time – 9.13 minutes) and 10 – 20 minutes (mean time – 16.03 minutes), respectively, which was statistically significant (P<0.001).

All 30 of the Supraclavicular blocks were done within two attempts, while 2 out of the 30 Infraclavicular blocks required more than two attempts. This, however, was not statistically significant. The pain experienced by the patients while performing the block, were comparable in both the groups with a score of approximately 3/10.

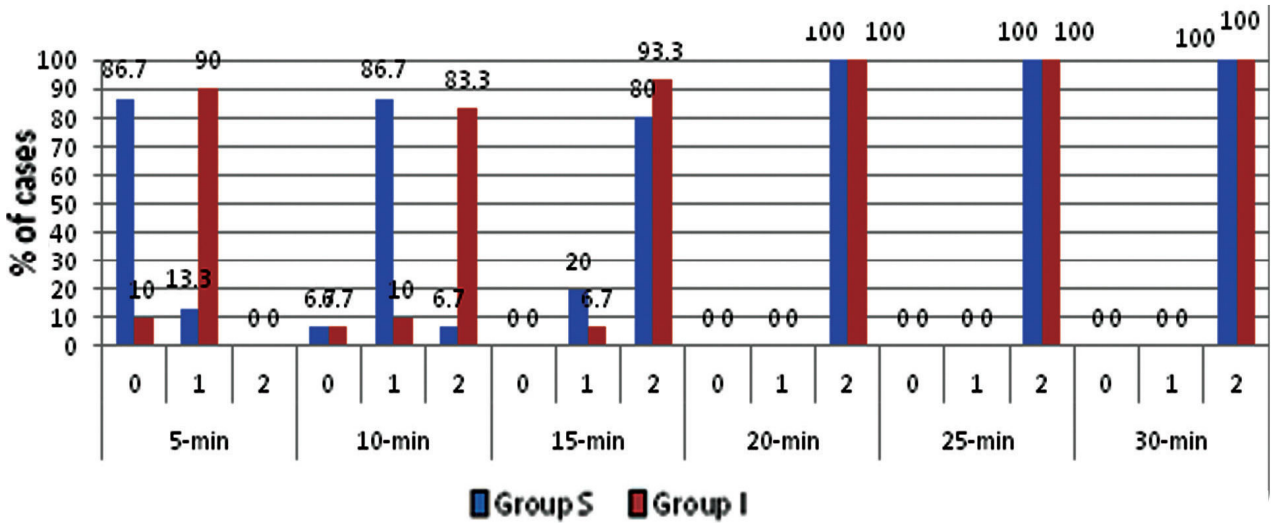
Graph 2: Inter-group comparison of status of median nerve in the onset of sensory blockade.



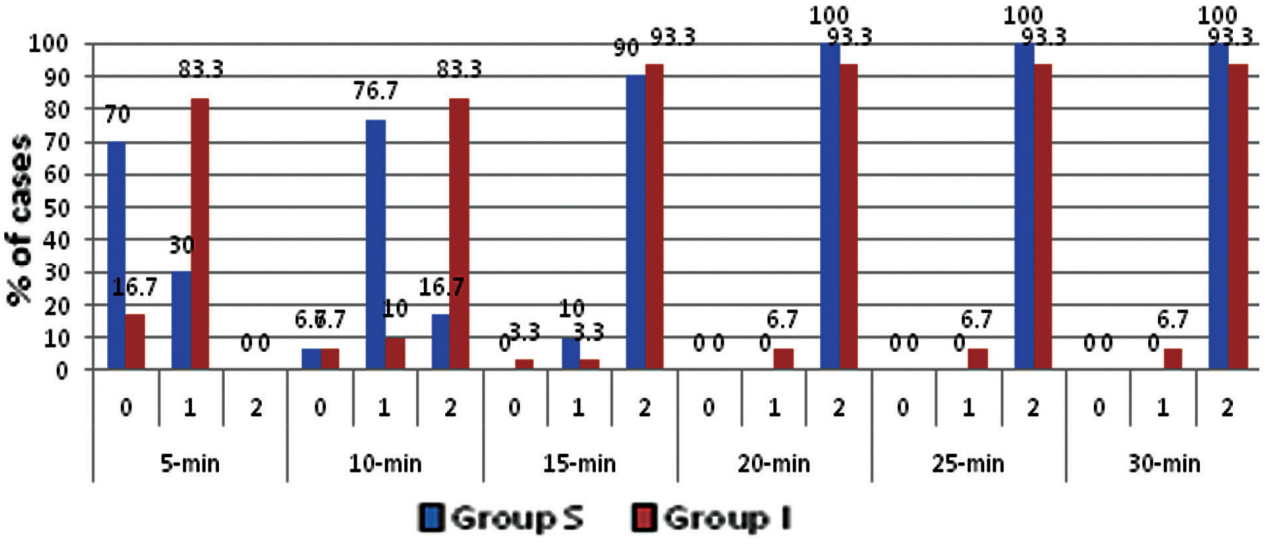
Graph 3: Inter-group comparison of status of ulnar nerve in the onset of sensory blockade.



Graph 4: Inter-group comparison of status of radial nerve in the onset of motor blockade.



Graph 5: Inter-group comparison of status of musculocutaneous nerve in the onset of motor blockade.



Supraclavicular and Infraclavicular groups were compared on the status of the onset of sensory blockade in the median, ulnar, radial, and musculocutaneous nerve regions. In all four groups, the level of sensory blockade was significantly higher in the Infraclavicular group at 5 and 10 minutes after completing the block, which indicated faster onset of action in Group I (P<0.001) as seen in Graphs 2 & 3. Likewise, in Graphs 4 and 5, onset of motor blockade in the same four nerves at 5-minute intervals were compared, and again, was faster in the Infraclavicular group, with the degree of motor blockade at 5 and 10 minutes being superior to that seen in the Supraclavicular group (P<0.001). By 30 minutes, though, there was no difference between the groups in terms of quality of block.

The mean duration of motor blockade in Groups S and I were both approximately 7 hours, while sensory blockade was 7.5 hours (as seen in Table 2), which was comparable and hence, statistically insignificant.

Table 2: Inter-group comparison of mean duration of sensory and motor blockade.

Duration (Hrs)	Group S (n=30)		Group I (n=30)		P-value
	Mean	SD	Mean	SD	
Sensory blockade	7.45	0.55	7.42	0.51	0.808NS
Motor blockade	6.93	0.57	6.92	0.51	0.905NS

Values are mean and SD, P-value by independent sample t test. P-value<0.05 is considered to be statistically significant. NS – Statistically non-significant.

Discussion

With time, regional anaesthesia, particularly nerve blocks, have grown in popularity due to a myriad of reasons. One of the most important of these is the significant decrease in perioperative risk to the patient that accompanies the administration of general anaesthesia. This modality is especially beneficial when it comes to surgeries for patients with a multitude of comorbidities, such as cardiopulmonary, renal, hepatic, or neurologic disturbances, in whom the plethora of anaesthetic drugs used, could prove to be dangerous.

Apart from this, when an operative procedure is conducted under regional anaesthesia, there is a notable decrease in the requirement of postoperative analgesia, lower incidence of postoperative complications, higher levels of patient satisfaction, and reduced duration of hospital stay. The arrival of nerve stimulation and ultrasound technologies only strengthened their position by improving the ease of administration and increasing the safety margin.

There are various approaches to a brachial plexus nerve block, which include, but are not limited to, Interscalene, Supraclavicular, Infraclavicular, and Axillary, each of which come with their own set of pros and cons. We aimed to compare and evaluate the efficacy of ultrasound guided Supraclavicular (Group S) and Infraclavicular (Group I) blocks in this study consisting of 60 patients undergoing upper limb surgeries. The demographic data of our patients pertaining to age, gender, and BMI were comparable between the two groups.

Our observations showed a statistically significant difference (Graph 1) in the performance time of the two blocks with the Infraclavicular block taking longer to complete (P<0.001). The increase in time could be due to the increased depth at which the posterior cord of the brachial plexus is located in the Infraclavicular region, compared to the lateral and medial cords.[7] A study conducted by De Jose Maria B et al.[8] comparing the two blocks in eighty children between the ages 5-15, also showed similar results. The mean time to perform the block in Group I was 13 minutes, which significantly differed (P<0.05) from Group S, which was 9 minutes.

In terms of number of attempts taken to administer the block, there was no statistically significant difference in between both groups. At the same time, pain felt by the patient during block administration was comparable. Similar studies conducted by Arcand G et al.[7] consisting of 80 patients and Satani TR, Shah SS, et al.[4] consisting of 100 patients, also reached a similar conclusion, where the block performance-related pain in both the approaches was minimal and did not differ.

We observed that the onset of sensory action was faster in all four nerve regions with a denser level of blockade noted at 5 and 10 minutes in the Infraclavicular group (Graphs 2 &3). This was statistically significant (P<0.001). However, there was no compelling difference in the level of blockade at the 15, 20, 25- and 30-minute marks. Abhinaya RJ, et al[9] conducted a similar study on 60 patients, analyzing the two approaches, and noted that the start of sensory blockade was attained later in Group S (8.45 minutes, P = 0.006) than Group I (6.43 minutes).

Ultrasound-guided Supraclavicular and Infraclavicular blocks were administered as part

of a study, in 120 patients undergoing upper limb surgeries, by Koscielniak Nielsen, et al.[10] which showed fewer cases in the S group (P=0.017) were prepped for surgery at twenty minutes after the block, leading them to conclude that the Infraclavicular block had a faster onset. The same statistically significant conclusion regarding motor blockade was reached by us as seen in Graphs 4 & 5.

Both groups S and I had two cases each in which the quality of the block was unsatisfactory, and supplementation was required, hence insignificant. Similar conclusion was reached by Harrison TK, et al.[12] who in fifty patients compared the efficiency of Infraclavicular and Supraclavicular blocks using through the catheter, ultrasound-guided bolus anaesthesia. 100% in the Infraclavicular and 88% of the candidates in the Supraclavicular groups (P=0.088), achieved satisfactory sensory blockade within thirty minutes.

Neither of the groups showed any incidence of the anticipated complications, such as diaphragmatic paresis, pneumothorax, blood vessel puncture, or Horner's syndrome. Yuan JM, et al in 2012, in their study, concurred that ultrasound guidance decreases the risks of complications like hemi-diaphragmatic paresis or vascular puncture.11 However, a larger sample size may be required for the purposes of comparing the incidence of complications, which is beyond the scope of our study.

Conclusion

Our study concludes that the Supraclavicular block takes a shorter time to administer, however, the onset of sensory and motor blockade at 5 and 10 minutes after administration was faster in the Infraclavicular group, with no difference in adequacy of both blocks at 30 minutes.

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