

# To Compare the Supraclavicular and Infraclavicular Approaches of Brachial Plexus Block for Upper Limb Surgery Using 0.05mg of Dexmedetomidine and 30ml of 0.5% Ropivacaine

Dr Balwinder Kaur<sup>1</sup>, Dr Tejinderpal Kaur Grewal<sup>\*1</sup>, Dr Shelly Aggarwal<sup>3</sup>

<sup>1</sup>Professor, <sup>3</sup>Junior Resident

Department of Anaesthesia, Govt. Medical College and Rajindra Hospital, Patiala



\*Author of correspondence - [balwinder.rekhi@yahoo.com](mailto:balwinder.rekhi@yahoo.com)

## Abstract

**Purpose:** This prospective study is to compare the supraclavicular and infraclavicular approaches of brachial plexus block for upper limb surgery using 0.05mg of dexmedetomidine and 30ml of 0.5% ropivacaine. **Method:** This prospective, randomized controlled trial was conducted at Govt. Medical College, Rajindra Hospital, Patiala on sixty patients in two groups (group S and group I) of 30 each of 18 to 65 yrs of age of either sex of ASA grade I or II scheduled for upper limb surgery. In both supraclavicular and infraclavicular approach the drug injected was 30ml of 0.5% ropivacaine and 0.05mg of dexmedetomidine. **Result:** We found that in patients with comparable demographic parameters there was no statistically significant difference in hemodynamic parameters, onset and duration of sensory and motor block, duration of analgesia and patient satisfaction score between the groups. There was no statistically significant difference in the quality of block in either group. No episode of pneumothorax, Horner's syndrome or local anaesthesia toxicity occurred in any of the group. Accidental vascular puncture occurred in four out of thirty patients in supraclavicular group and none in infraclavicular group. **Conclusion:** This study concluded that infraclavicular approach is more safe than supraclavicular approach in upper limb surgeries (elbow proximally to hand distally).

**Keywords:** Supraclavicular brachial plexus block, Infraclavicular brachial plexus block, upper limb surgery, ropivacaine

## Introduction

In the light of advancement in the field of anaesthesia, focus has always been on development of newer drugs and techniques that cause minimal interference in normal patient physiology, while at the same time providing optimal operative conditions. A well-conducted regional anaesthetic technique has very much to offer to anaesthesiologist, surgeon, as well as patients owing to its advantages over general anaesthesia such as remaining conscious, avoiding polypharmacy, better haemodynamic stability and excellent post-operative analgesia.<sup>[1]</sup> Supraclavicular block is functionally similar to infraclavicular block.<sup>[2]</sup> The aim of this study is to compare the two approaches of brachial plexus block with respect to the onset of sensory and motor blockade, duration and quality of sensory and motor block, complications, the patient's satisfaction with the block performed.

## Methods

After gaining approval of the Medical Ethics Committee of the institute and written informed consent from the patients, this prospective, randomized controlled trial was conducted at Govt. Medical College, Rajindra Hospital, Patiala. The study was

conducted on sixty patients of 18 to 65 yrs of age of either sex of ASA grade I or II scheduled for upper limb surgery. In this study, patients were randomly divided into two groups (group S and group I) of thirty patients each, receiving 30 ml of 0.5% ropivacaine and 0.05mg of dexmedetomidine in supraclavicular and infraclavicular approach used to block the brachial plexus.

## Exclusion Criteria

- Patient refusal
- Patient with uncontrolled comorbidities
- Pregnant women
- Allergy to local anesthetic
- Coagulation disorder
- Neurological disorder or deficit or associated nerve lesion
- Skin lesion at the site of blockade or associated lesions in other areas of body requiring general anaesthesia

A thorough pre anaesthetic check up was done after taking written informed consent from the patient. Patient was premedicated with tablet lorazepam at 6am per orally on the day of surgery.

**Technique of supraclavicular brachial plexus block:**

**Classical supraclavicular approach to brachial plexus block<sup>[3]</sup>**



**Target is midpoint of clavicle marked for needle insertion by vertical approach. SCM= Sternocleidomastoid muscle. JF= Jugular foramen**

Point of needle insertion is 1 inch (2.5 cm) lateral to the palpation of subclavian artery (red) in parasagittal plane parallel to the clavicle. Dotted line is boundaries of sternocleidomastoid muscle.

The brachial plexus block was carried out after thorough explanation of the procedure and emphasizing the need for patient cooperation. The patient was placed in a supine position with the head rotated away from the site to be blocked and the shoulder pulled down. Once the sternocleidomastoid was identified, a mark was placed on the clavicle where clavicular head of sternocleidomastoid was inserted. This point established the parasagittal plane, medial to which the needle was not crossed to avoid the placement of needle towards the pleural dome. After identifying the lateral insertion of the sternocleidomastoid muscle on the clavicle, subclavian artery pulsations were confirmed by palpation. A point was marked 1cm lateral and posterior to the artery. Skin and subcutaneous tissue was infiltrated with 2ml of 2% lignocaine. A 50mm insulated stimulation needle attached to nerve locator (Nerve Mapper-Locator, NM 20V, Inmed Equipments Pvt. Ltd., Vadodara, India) was inserted through the wheal with current settings at 2mA. The current settings were decreased till 0.5mA and muscle twitching of the fingers and thumb at this current settings were obtained. After needle stabilization, negative aspiration of the blood was confirmed before injecting the local anaesthetic drug combination.

The patient was put in the supine position with the head facing away from the side to be blocked. The patient's arm was kept abducted and flexed at the elbow to keep the relationship of the landmarks to the brachial plexus constant. A point was marked 2cm below the mid point of inferior clavicular border. At this point, skin and subcutaneous tissue was infiltrated with 2ml of 2% lignocaine. Local anaesthetic was also given deeper into the pectoralis muscle to decrease discomfort during needle insertion through the muscle layers. A 50mm insulated needle attached with nerve locator at current settings of 2mA was inserted and advanced laterally. Muscle twitching of the fingers were obtained at current settings 0.5mA. After needle stabilization, negative aspiration of the blood was confirmed before injecting the local anaesthetic drug combination.

Descriptive statistics was done for all data and were reported in terms of mean values and percentages. Suitable statistical tests of comparison were done. Continuous variables were analysed with the unpaired t test and Mann Whitney U test. Categorical variables were analysed with the Chi-Square test. Statistical significance was taken as  $P < 0.05$ . The data was analysed using IBM SPSS statistics (version 21.0).

**Technique of infraclavicular brachial plexus block:**

**Vertical infraclavicular approach to brachial plexus block**

**Distribution of patients according to demographic profile**

	GROUP S	GROUP I	Chi Square	P value	P value
AGE	43.43 ± 12.28 (Mean ± S.D)	40.10 ± 16.19 (Mean ± S.D)	6.834	0.233	NS
GENDER	(M)70.0% (F)30.0%	(M)76.66% (F)23.34%	0.341	0.559	NS
ASA Grade	60% (1) 40%(2)	56.67%(1) 43.33%(2)	0.069	0.793	NS

**Results**

In our study, the two groups were comparable in terms of age, gender, ASA grading, diagnosis, surgery planned for the treatment and duration of surgery.

**Distribution of patients according to variation in time of onset of sensory block**

Groups	Mean(minutes)	S.D	P value	Significance
Group S	14.0000	4.98273	0.841	NS
Group I	13.8333	3.86927		

As shown in table, the mean time for the onset of sensory block was 14 minutes in supraclavicular group and 13.8 minutes in infraclavicular group with p value of 0.841. There was no significant difference in statistical terms.

**Distribution of patients according to time of onset of motor block**

Groups	Mean(minutes)	S.D	P value	Significance
Group S	24.8333	2.06920	0.362	NS
Group I	24.3333	2.17086		

As shown in table, the mean time for the onset of motor block was 24.833 minutes in supraclavicular group and 24.333 minutes in infraclavicular group with p value of 0.362. This shows no significant difference in statistical terms.

**Distribution of patients according to duration of block**

	Groups	Mean(in minutes)	S.D	P value	Significance
Duration of sensory block	Group S	606.33	23.55966	0.071	NS
	Group I	618.33	26.79209		
Duration of motor block	Group S	583.67	23.99473	0.103	NS
	Group I	594.67	27.38403		

As shown in the table, the mean duration of sensory block was  $606.33 \pm 23.559$  minutes and  $618.33 \pm 26.792$  minutes in supraclavicular group and infraclavicular group respectively with a p-value of 0.071. This finding was statistically insignificant (p value > 0.05)

**Distribution of patients according to quality of block**

Groups	Complete	Partial	Chi Square	P value	Significance
Group S	28	2	2.069	0.150	NS
Group I	30	0			

As shown in the table, in group S, 2 patients out of 30 had partial effect of the block and none in group I. However, there was no statistically significant difference in the quality of the block in both the groups as the p value was 0.150 i.e. > 0.05.

**Distribution of patients according to duration of analgesia**

Time (in hours)	Groups	Mean	S.D	P value	Significance
1 <sup>st</sup> Hour	Group S	.5000	1.90734	-	-
	Group I	.0000	.00000		
2 <sup>nd</sup> Hour	Group S	.1333	.50742	-	-
	Group I	.0000	.00000		
3 <sup>rd</sup> Hour	Group S	.1333	.50742	-	-
	Group I	.0000	.00000		
4 <sup>th</sup> Hour	Group S	.4333	1.69550	-	-
	Group I	.0000	.00000		
5 <sup>th</sup> Hour	Group S	.5000	1.90734	-	-
	Group I	.0000	.00000		
6 <sup>th</sup> Hour	Group S	.5000	1.90734	-	-
	Group I	.0000	.00000		
7 <sup>th</sup> Hour	Group S	.5000	1.90734	-	-
	Group I	.0000	.00000		
8 <sup>th</sup> Hour	Group S	.5000	1.90734	-	-
	Group I	.0000	.00000		
9 <sup>th</sup> Hour	Group S	.5000	1.90734	-	-
	Group I	.0000	.00000		
10 <sup>th</sup> Hour	Group S	2.7333	1.63861	0.334	NS
	Group I	2.2667	.44978		
11 <sup>th</sup> Hour	Group S	6.0000	1.11417	0.671	NS
	Group I	5.8000	.80516		
12 <sup>th</sup> Hour	Group S	-	-	-	-
	Group I	-	-		

As shown in the table, patients in supraclavicular group had mean VAS score of 6.00 by the 11th hour of the drug injected in comparison to infraclavicular group where the mean VAS score was 5.8. However this difference was statistically insignificant with p value of 0.671 (p > 0.05). All patients required rescue analgesia only after 11th hour postoperatively.

**Distribution of patients according to complications**

Complication	Groups	Yes	NO	Chi Square	P value	Significance
BRADYCARDIA	Group S	0	30	-	-	-
	Group I	0	30			
HYPOTENSION	Group S	0	30	-	-	-

	Group I	0	30			
HYPOXEMIA	Group S	0	30	-	-	-
	Group I	0	30			
PNEUMOTHORAX	Group S	0	30	-	-	-
	Group I	0	30			
VASCULAR PUNCTURE	Group S	4	26	4.286	0.036	S
	Group I	0	30			
PAIN	Group S	2	28	0.351	0.554	NS
	Group I	1	29			
LAT	Group S	0	30	-	-	-
	Group I	0	30			

As shown in the table, 4 patients had accidental puncture of vessel during nerve location in supraclavicular group. But no such finding was observed in infraclavicular group. There was statistically significant difference in both the groups with p value of 0.03 (p value < 0.05).

#### Distribution of patients according to patient satisfaction

	Groups	Mean	S.D	% of patients satisfied	P value	Significance
PSS	Group S	3.9333	.25371	93.33	0.584	NS
	Group I	3.9333	.36515	96.67		

As shown in the table, in supraclavicular group 93.3% of patients were satisfied whereas in infraclavicular group 96.67% patients were satisfied with the block performed. There was no statistical significant difference with p value of 0.584 (p value > 0.05) in terms of patients satisfaction when two groups were compared.

## Discussion

Supraclavicular and infraclavicular are the two approaches suited for upper limb surgeries (elbow proximally to hand distally).<sup>[4]</sup> Supraclavicular block is functionally similar to infraclavicular block,<sup>[5]</sup> therefore the two techniques are often used interchangeably, depending on whether the anatomy is more conducive to one or the other.

The present prospective, randomized and comparative study was conducted on sixty patients of ASA grade I or II scheduled for elective upper limb surgery. In our study we randomly allocated patients into two equal groups of 30 each, supraclavicular group (Group S) and infraclavicular group (Group-I). In each group patients were given 0.05mg of dexmedetomidine and 30ml of 0.05% ropivacaine. We compared the two techniques of brachial plexus block in terms of onset and duration of sensory and motor block, quality of the block, patient satisfaction score and complications associated with the technique.

#### Demographic profile

In our study, the two groups were comparable in terms of their age, gender, ASA grading, diagnosis, surgery planned for the treatment and duration of surgery.

#### Onset of block

We assessed the onset of sensory block by pinprick on 3 point scale<sup>[6]</sup> [0- sharp pain on pin prick, 1- dull pain on pin prick (Analgesia), 2- No pain perception of pin prick (anaesthesia)] using the blunt end of a 27-gauge needle and onset of motor block by modified Bromage scale<sup>[7]</sup> [0-no block (normal function with full flexion and extension of elbow, wrist and fingers), 1-paresis (decreased motor strength with ability to move fingers only), 2-paralysis (complete motor block with inability to move fingers) (flexion at the elbow -musculocutaneous nerve, thumb abduction-radial nerve, thumb adduction- ulnar nerve, wrist flexion- median nerve)] by asking the patient to perform the respective movements at 2,4,6,8,10,15,20,25 and 30 minutes in the areas of distribution of the respective nerves. In our study, we found that the mean onset

time of sensory block is  $14 \pm 4.982$  minutes in supraclavicular group and  $13.83 \pm 3.869$  minutes in infraclavicular group with p value is 0.841 and the mean onset time of motor block is  $24.833 \pm 2.069$  minutes in supraclavicular group and  $24.33 \pm 2.170$  minutes in infraclavicular group with p value is 0.362. The findings in our study are statistically insignificant in both the groups. Our results are in concordance with findings in the study conducted by Niranjana et al.<sup>[8]</sup> and Hazarika et al.<sup>[9]</sup>

#### Duration of block

The duration of sensory block defined as the time interval between the end of local anaesthetic administration and the complete resolution of anaesthesia on all nerves (score 0 on 3-point scale). The duration of motor block is defined as the time interval between the end of administration of local anaesthetic and recovery of complete motor function of hand and forearm (score 0 on Modified Bromage Score). It was assessed and documented every hourly.

We observed that the sensory block lasted for the mean duration of  $606.33 \pm 23.559$  minutes in supraclavicular group in comparison to infraclavicular group where mean duration of sensory blockade was  $618.33 \pm 26.792$  minutes with a p-value of 0.071. The motor block lasted for the mean duration of  $583.67 \pm 23.994$  minutes in supraclavicular group in comparison to  $594.67 \pm 27.38$  minutes in infraclavicular group with a p-value of 0.103. This difference in the mean is comparable in both the groups and statistically insignificant as p value > 0.05. Addition of dexmedetomidine as an adjuvant in local anaesthetic mixture prolongs duration of block. Similar results of prolonged duration were observed in group B (where dexmedetomidine was used as an adjuvant in LA injected) of study conducted by Chinappa.<sup>[10]</sup> The duration of analgesia in Group A (0.5% ropivacaine 30ml and 1 ml NS) ( $411.0 \pm 91.2$  min) was shorter than that in Group B (0.5% ropivacaine 30ml and 1 mcg/kg dexmedetomidine) ( $805.7 \pm 205.9$  min; P < 0.001).

#### Quality of block

The quality of block was assessed in terms of complete block or partial block. The quality of block was defined as complete when the score for sensory and motor block on their respective scales



(pin point scale and Modified Bromage Scale respectively) is 2. The block was defined as partial when the score for sensory and motor block on their respective scales (pin point scale and Modified Bromage Scale respectively) is 1 in radial, ulnar, medial and musculocutaneous nerve areas. The block was considered successful when no general anaesthesia was required at anytime during the surgery.

In our study, we found that 2 out of 30 patients had partial effect in supraclavicular block due to sparing of ulnar nerve and none in infraclavicular group with p value 0.150. There is statistically insignificant difference between the groups. We supplemented with fentanyl 1mcg/kg to relieve the discomfort of the patient. This finding is similar to study conducted by Yang C W [11] where it was assumed to be due to obstacle to diffusion that the closely located pulsatile artery might exert on lower trunk. Thus, depositing the local anesthetic close to the lower trunk will increase the likelihood of blocking it directly. However, this is speculative finding and will require more study. [11]

**Duration of analgesia** The duration of analgesia was taken from the time of onset of the block to the first complaint of pain (VAS>3). Intra-operative and post operative pain was assessed using Visual Analogue Scale [12] [No pain, 5-moderate pain, 10-maximum pain]. Post operative follow up was carried out in the recovery and post operative ward and the analgesic requirement was documented hourly for 12 hours.

In our study the duration of analgesia lasted for 10 hours in either group except two patients in supraclavicular group where partial effect of the block, i.e sparing of ulnar nerve was observed. Due to incomplete effect, we gave supplement analgesia intraoperatively (fentanyl 1mcg/kg). Rest of the patients in supraclavicular group had mean VAS score of 6.00 in comparison to infraclavicular group where the mean VAS score is 5.80 by the 11th hour of the drug injected. There was statistically insignificant difference in VAS score (p value = 0.671) in both the groups. Therefore, both groups were comparable to each other in duration of analgesia. Our findings of duration of analgesia were similar with findings by Chinappa [10] (805.7 ± 205.9 min). Rescue analgesia in the form of non steroidal anti-inflammatory drugs (IM Diclofenac 1-1.5mg/kg) was given when required postoperatively.

### Complications

There was no episode of bradycardia, hypotension, hypoxemia, Horner's syndrome, pain and local anaesthesia toxicity side effects in either of the groups. However the incidence of accidental vascular puncture was seen in 4 patients of supraclavicular group where we had to change the site of needle insertion again. No such episode occurred in infraclavicular group. In our study we found statistically significant difference between the two groups with p value of 0.03. Our finding is similar to the one observed by Niranjana in his study where the number of vessel punctures in Group S was 2 (6.7%) and none in Group I (0%) with 'p' value of 0.150 which was statistically insignificant. However in our study accidental vascular puncture didn't result in any systemic vascular toxicity. This could be due to the use of repeated aspiration and injection technique and use of atraumatic needles. [13] The vascular puncture incidence was reported from 2% to 2.5% [14] in other studies.

### Patient Satisfaction

We scored it on patients satisfaction scale [1-Not satisfied, will not come to same hospital for same procedure, 2-Satisfied but would have preferred another technique, 3-Satisfied but would have preferred more analgesia, 4-Well satisfied]. The mean of patient satisfaction score was 3.933 in supraclavicular as well as in infraclavicular group with p value of 0.584 with no statistical significant difference. Our findings were similar to study by CW Yang as there were no significant differences in the level of patient's satisfaction between the groups. 98% of patients in either group were satisfied.

**Management of unsuccessful block:** Unsuccessful block is defined as no effect of block or only onset of sensory and motor block in the surgical area and hence surgery could not be performed. In the circumstance of failed block after 30 mins, the block was supplemented with general anaesthesia and these patients were excluded from the study

### Limitations

1. To eliminate the interoperator variability, a single anesthesiologist performed all the blocks.
2. There was more experience with the infraclavicular approach than with supraclavicular approach at that time, which might produce more complications in the supraclavicular approach.
3. The time of readiness for surgery and block performance time were not assessed. These are important factors when two different approaches to the brachial plexus are compared.

### Conclusion

We conclude that infraclavicular approach is more safe than supraclavicular approach in upper limb surgeries (elbow proximally to hand distally).

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