

A PROSPECTIVE RANDOMIZED STUDY TO COMPARE SUPRACLAVICULAR Vs INFRACLAVICULAR BLOCKS FOR FOREARM SURGERIES UNDER NERVE STIMULATOR GUIDANCE

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Abstract

Background: Forearm surgeries are usually performed under regional anaesthesia. Infraclavicular block compared to supraclavicular block offers advantages of avoiding complications like pneumothorax. This study is to compare the time of readiness for surgery, quality of blockade, duration of sensory and motor blockade and duration of analgesia with supraclavicular versus infraclavicular blocks for forearm surgeries using Levobupivacaine and lignocaine with adrenaline under nerve stimulator guidance. **Materials and Methods:** Sixty patients aged 20 to 35 years of ASA I or II were included in the study. The patients were randomized to receive either Infraclavicular plexus block (Group I, n=30) or Supraclavicular plexus block (Group S, n=30). Blocks were given under nerve stimulator guidance. The parameters monitored were time of onset of sensory blockade, time of onset of motor blockade, quality of blockade, duration of analgesia, complications and hemodynamic variables. These parameters were tabulated and analysed statistically. **Result:** The time taken to do infraclavicular block was greater than time taken to perform supraclavicular block. There was a statistically significant difference in relation to time of onset of sensory block between Group S and Group I with Group I having earlier onset. Also there was no statistically significant difference in relation to duration of analgesia between Group S and Group I. No patients in both groups reported any complications. **Conclusion:** We found that Infraclavicular block using coracoid approach is a better alternative to supraclavicular block for forearm surgeries under nerve stimulator guidance as sensory blockade is achieved earlier and duration of sensory and motor blockade is also satisfactory without any change in haemodynamic parameters and without any complications.

INTRODUCTION

“Peripheral nerve blocks can be customized and used for anaesthesia, post operative analgesia and diagnosis and treatment of chronic pain disorders”! Nerves or plexus supplying a particular region is blocked using local anaesthetic and is made insensitive to pain and reflex responses to surgical stimuli. It is superior to general anesthesia in many aspects like sparing CNS, keeping the patient alert, awake and cooperative and avoiding polypharmacy. It can be used both for elective as well as emergency surgeries.

“Brachial plexus block was first done by William Steward Halsted in the year 1889. The use of

electrical stimulation to locate peripheral nerves was introduced in the year 1962.

Different approaches have been designed in order to block Brachial plexus at various levels like

1. Interscalene approach
2. Classical supraclavicular approach by Kulenkampff
3. Subclavian perivascular approach by Winnie and Collins
4. Infraclavicular approach by Raj
5. Axillary approach by Accardo and Adriano.

However complications like Pneumothorax, inadvertent arterial puncture, subarachnoid puncture, phrenic nerve paralysis have been reported in the foresaid approaches

“In supraclavicular block, blockade occurs at the distal trunk – proximal division level. At this location the brachial plexus is compact and even small volume of local anaesthetic injection produces rapid onset of reliable blockade of the brachial plexus.

“In infraclavicular block, the blockade occurs at the level of cords and offers advantages of avoiding complications like pneumothorax and this approach also offers blockade of musculo-cutaneous and axillary nerves. The various techniques used to locate the peripheral nerves include paresthesia techniques, peripheral nerve stimulation and ultrasound guidance. Electrical nerve stimulation is used not only to locate nerves but also to rule out intraneural location of the needle. This technique also provides high success rate. In this study we compare the effectiveness, time of readiness for surgery, quality of blockade, duration of sensory and motor blockade and duration of analgesia with supra-clavicular vs infra-clavicular blocks for forearm surgeries using levo-bupivacaine and lignocaine with adrenaline under nerve stimulator guidance.

Aim of the Study

The aim and objective of this study is to compare the time of readiness for surgery, quality of blockade, duration of sensory and motor blockade and duration of analgesia with supra-clavicular vs infra-clavicular blocks for forearm surgeries using levo-bupivacaine and lignocaine with adrenaline under nerve stimulator guidance.

MATERIALS AND METHODS

This is a prospective randomized study. Study was carried out in orthopedic surgeries at Kanyakumari government medical college hospital, after gaining approval of the Medical Ethics Committee and written informed consent from the subjects. Sixty patients were studied. ASA physical status 1 & 2 patients between 18 to 35 years of both sexes undergoing surgery of the elbow, forearm, or hand under regional anesthesia were included in the study. Those with Coexisting Lung Disease, Heart, Liver or Kidney disease, Pregnancy, Allergy to local anaesthetics, Chest deformities, Previous Clavicle Fractures, Neurological disorders, Coagulopathies were excluded from the study.

This study is to compare supraclavicular and infraclavicular blocks under nerve stimulator guidance To find the required sample size for this Study, a Pilot Study was conducted with 10 cases in each of these two Groups. In the Pilot Study, the following results were obtained for onset of sensory block.

Supraclavicular group = 13.46 ± 2.33 minutes

Infra-clavicular group = 8.03 ± 4.63 minutes

S.D.for total cases = 4.53 minutes

Using these figures, the sample size for this study was calculated with the following formula.

$$\text{The sample size } n = \frac{2 \times \{Z_{(1-\alpha/2)} + Z_{(1-\beta)}\}^2}{\Delta^2}$$

where $Z_{(1-\alpha/2)}$ is the alpha error whose value for significance level of 1% (confidence level of 99%), is 2.5758 and $Z_{(1-\beta)}$ is the beta error or power of the study whose value for power of 95% is 1.6449 and

$$\begin{aligned} \Delta &= \frac{\text{Difference in means}}{\text{S.D}} \\ &= \frac{13.06-8.03}{4.53} \\ &= 1.11 \end{aligned}$$

Alpha error at 1% significance level = 2.5758

Beta error (power) at 95 % = 1.6449

Sample size n = $\frac{2(2.5758+1.6449)^2}{1.11^2}$

= $\frac{2(4.221^2)}{1.23}$

= 28.97 rounded off to 30

The required sample size is 60 (2x30) cases for a significance level of 1% (confidence level of 99%) and power of 95%.

Statistical tools:

The information collected regarding all the selected cases were recorded in a Master Chart (excel sheet). Data analysis was done with the help of computer using SPSS statistical package- Version 17.

Using this software, measures of central tendency, measures of dispersion, ‘t’ value, chi square and ‘p’ values were calculated. Un paired ‘t’ test was used to test the significance of difference between quantitative variables and Yate’s and Fisher’s chi square tests for qualitative variables. A ‘p’ value less than 0.05 denotes significant relationship.

RESULTS

The patients were randomized to receive either a Infraclavicular plexus block (group I, n = 30) or Supraclavicular plexus block (group S, n = 30). MONITORING: Intra operatively Non-invasive blood pressure, pulse oximetry and ECG were monitored.

Procedure: A 22-gauge 50-mm insulated stimulation short bevel needle (stimuplex connected to a nerve stimulator was used for both blocks. The initial stimulation current was set at 1.5mA with impulse duration of 0.1 ms. The needle position was considered to be adequate when the motor response in the hand or wrist is obtained and remained visible with a maximum current of 0.5 mA. The local anesthetic, 20 ml 0.5% levobupivacaine and 10 ml of 2% lignocaine with adrenaline was injected slowly (60 s) with intermittent aspiration every 4-5ml. The supraclavicular block was performed with the patient in supine position and head turned to opposite side. The needle insertion site is 2.5cm lateral to insertion of sternocleidomastoid 1cm cephalad to clavicle. The CORACOID infraclavicular approach was performed on supine position with the upper arm along the side, but with the elbow flexed and the hand resting on the lower chest or abdomen. After identifying the landmarks, the puncture site was 2cm below and 2 cm medial to coracoid process.

The Parameters monitored:**Primary Outcome:**

1. Time of onset of sensory blockade
2. Time of onset of motor blockade
3. Quality of blockade

Secondary outcome:

1. Duration of Analgesia
2. Complications
3. Hemodynamic variables

Time of Onset of sensory and motor blockade was noted. The sensory block evaluation for each nerve (radial, median, ulnar, musculocutaneous, and medial cutaneous of forearm) was assessed by testing for loss of cold sensation with a cotton soaked in spirit and was graded 0, 1, 2. The motor block was evaluated using the forearm flexion (musculocutaneous), thumb abduction (radial), thumb and second digit pinch (median), finger abduction (ulnar) nerves respectively and was graded 0,1,2.

Grades	Sensory	Motor
0	No loss	Able to resist
1	Less Cold	With Less force
2	Complete loss	Not able to move against gravity

The quality of the block was evaluated in the intra operative time:

- a) satisfactory block- surgery without patient discomfort or the need for supplementation; or sensory and motor blockade of grade 2
- b) unsatisfactory block - a sensory region involved in the surgery is not completely anesthetized and the block has to be supplemented by the continuous infusion of propofol at 50 µg/kg/min and fentanyl 50microgram sensory or/and motor blockade of grade 1 or/and 2
- c) complete failure - if the patient still experience pain despite supplementation, general anesthesia has to be induced by the attending anesthesiologist.

The side effects and complications, such as blood vessel puncture, intravascular injection, overdose, dyspnea, Horner's syndrome, and pneumothorax, were noted.

The duration of the sensory and motor block were also assessed post operatively and the duration of analgesia was also recorded.

Definitions:**Time of performance of blockade:**

Duration of procedure commencing from needle puncture to withdrawal.

Duration of the sensory block:

The time between the end of the local anesthetic injection and the total recovery of sensation.

Duration of the motor block:

The time between the end of the local anesthetic injection and the total recovery of motor functions.

Duration of analgesia:

Time between the end of the local anesthetic injection and feeling of pain of score 4 or more or the need for rescue analgesic.

Rescue analgesic:

Injection tramadol 100mg or Injection Diclofenac 50mg will be given as rescue analgesic

Observations

In this Comparative study among the 60 patients, 30 patients (S GROUP) received Supraclavicular block and 30 patients (I GROUP) received Infraclavicular block. Hemodynamic variables like BP, pulse and heart rate, SPO2, Respiratory rate were monitored intra operatively and various parameters like onset of blockade, quality of block, complications and duration of sensory and motor block and duration of analgesia were monitored postoperatively. These parameters were tabulated and analysed statistically using SSPS 17 software.

The demographic parameters like age, weight, height of all sixty patients were documented and analysed statistically. All the demographic variables were comparable in both groups and were statistically insignificant.

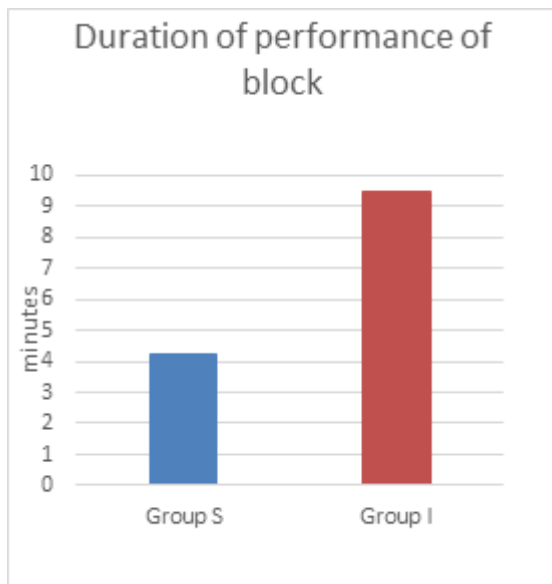
Distribution of Age

Among the patients undergoing brachial plexus block for upper limb surgeries there was no statistically significant difference in relation to age distribution between group S (mean=41.3, SD=14.5) and group I (mean=40.5, SD=14.1) with a p value of >0.05 as per unpaired t test.

There was no statistically significant difference in relation to height distribution between group S (mean=164.7, SD=6.8) and group I (mean=164.1, SD=7.8) with a p value of >0.05 as per unpaired t test. There was no statistically significant difference in relation to weight distribution between group S (mean=61.8, SD=10.1) and group I (mean=59.0, SD=12.1) with a p value of >0.05 as per unpaired t test.

There was no statistically significant difference in relation to BMI distribution between group S (mean=22.8, SD=3.4) and group I (mean=21.8, SD=4.0) with a p value of >0.05 as per unpaired t test.

Duration of Performance of Block



The duration of performance of blockade is defined as duration of procedure commencing from needle puncture to withdrawal.

The time taken to do Infraclavicular block was greater than time taken to perform Supraclavicular block. So there was a statistically significant difference in relation to duration of performance of block between group S (mean=4.21, SD=1.72) and group I (mean=9.44, SD=3.18) with a p value of <0.05 as per unpaired t test.

Type of Nerve Stimulated

In group S

Median nerve was stimulated in 56.7% patients.
Ulnar nerve was stimulated in 6.6 % patients.
Radial nerve was stimulated in 36.6% patients.

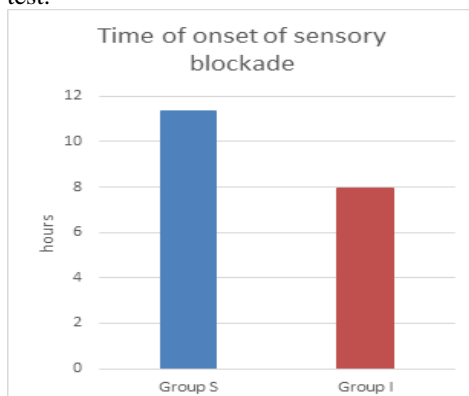
In group I

Median nerve was stimulated in 50.0% patients.
Ulnar nerve was stimulated in 13.3% patients
Radial nerve was stimulated in 36.7% patients

Time of Onset of Sensory Blockade

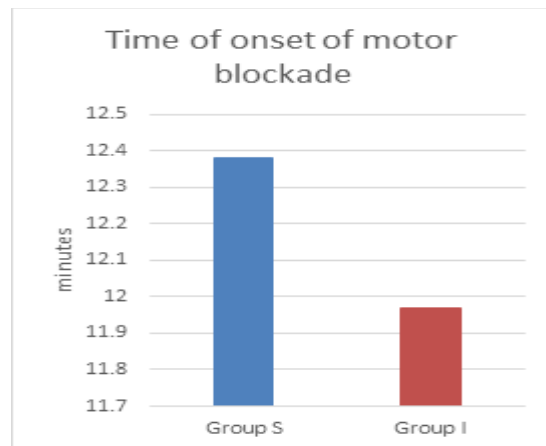
The time of onset of sensory blockade was assessed by checking cold sensation with spirit-soaked cotton and graded accordingly.

There was a statistically significant difference in relation to time of onset of block between group S (mean=11.37, SD=5.81) and group I (mean=7.93, SD=6.48) with a p value of <0.05 as per unpaired t test.



Time of Onset of Motor Blockade

The time of onset of motor blockade is assessed by forearm flexion, thumb abduction, thumb & second digit pinch and finger abduction and graded 0,1,2



The motor blockade time was almost equal in both groups. There was no statistically significant difference in relation to time of onset of motor blockade between group S (mean=12.38, SD=5.95) and group I (mean=11.97, SD=11.08) with a p value of 0.86 [>0.05 as per unpaired t test].

Quality of Blockade

There was no statistically significant difference in relation to quality of block between group S and group I with 93% satisfactory block in group S compared to 83.3% in group I with a p value of <0.05 as per unpaired t test.

Systolic Blood Pressure

There was no statistically significant difference in relation to systolic blood pressure between group S and group I

Diastolic Blood Pressure

There was no statistically significant difference in relation to diastolic blood pressure between group S and group I

Pulse Rate

There was no statistically significant difference in relation to pulse rate between group S and group I

Spo2 and Respiratory Rate

SPO2 and respiratory rate were monitored every 5 minutes for half an hour thereafter every 10 minutes and the results were tabulated

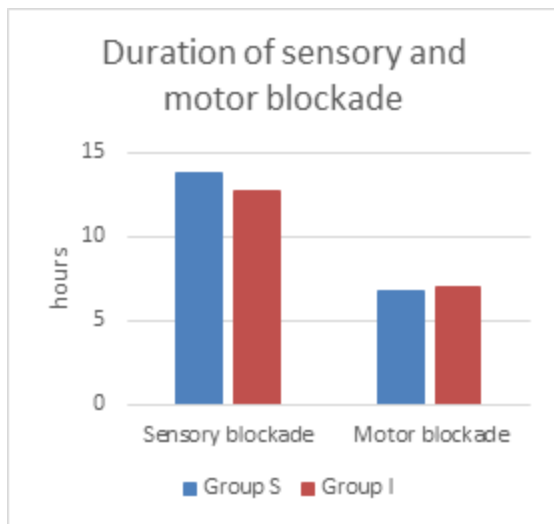
There was no statistically significant difference in relation to respiratory rate between group S and group I.

There was no statistically significant difference in relation to peripheral capillary oxygen saturation between group S and group I.

Visual Analog Score

There was a statistically significant difference in relation to VAS scores between group S and group I after 13hours post operatively with patients of group S had higher scores compared to group I with a p value of <0.05 as per unpaired t test.

Duration of Sensory and Motor Blockade



There was no statistically significant difference in relation to duration of analgesia between group S and group I with a p value of <0.05 as per unpaired t test.

Complications

No patients in both groups reported any complications like

- Blood vessel puncture,
- Intravascular injection,
- Dyspnea
- Horner's syndrome,
- Pneumothorax

Table

Group	Motor Blockade Time (minutes)	
	Mean	SD
Group S	12.38	5.95
Group I	11.97	11.08
'p'	0.86 Not Significant	

DISCUSSION

“Brachial plexus blockade avoids general anaesthesia which has its set of complications like delayed recovery, poly pharmacy, loss of consciousness of the patient etc., To increase the success rate and to avoid complications, various techniques have been developed. In this study the supraclavicular and infraclavicular blocks were performed under nerve stimulator guidance.^[1] Paresthesia techniques are associated with nerve injuries and high failure rates. To avoid failure and nerve injuries, nerve locator is used.^[2]

In supraclavicular block, blockade occurs at the distal trunk – proximal division level”.^[3,4] At this location the brachial plexus is compact and even small volume of local anaesthetic injection produces rapid onset of reliable blockade of the brachial plexus.

In infraclavicular block, the blockade occurs at the level of cords and offers advantages of avoiding complications like pneumothorax and this approach also offers blockade of musculo-cutaneous and axillary nerves. There is nil chance of pneumothorax in this technique. It offers early and complete blockade and avoids complications of supraclavicular blockade.

In this study supraclavicular block was performed using Winnie and Collins perivascular approach and infraclavicular block was performed using coracoid technique under nerve stimulator guidance.

Levobupivacaine when compared to bupivacaine has greater vasoconstrictive action and longer sensory block and less motor block. The real advantage is that it is less cardiotoxic. Hence in this study levobupivacaine, lignocaine with adrenaline mixture was used as adjuvants to local anaesthetics in brachial plexus block to quicken the onset, increase the

duration and the quality of block and also to reduce the post operative requirement of analgesics.^[3]

All demographic variables between two intervention groups were comparable. According to chun woo yang et al in 2010,^[4] there is no significant difference in sensory and motor block evolution, quality of blockade and no difference in duration of sensory and motor blocks.

But in our study, the time of onset of sensory blockade was earlier in group I [7.93± 6.48] compared to group S [11.37±5.81] and it is statistically significant [p value of 0.037]. So, the time to readiness for surgery was achieved earlier in group I compared to group S.

The duration of block performance was longer in group I [9.44± 3.18] compared to group S [4.21± 1.72] and it was statistically significant [p value of 0.043]. So the block performance time was longer in infraclavicular group compared to supraclavicular group.^[5]

The quality of blockade was satisfactory in 93.3% patients and 83.3% in group S and group I respectively it was not statistically significant. The unsatisfactory block was higher in infraclavicular blockade [13.3%] compared to supraclavicular block [6.7%]

The time of onset of motor blockade was similar in both the groups. The duration of sensory and motor blockade were comparable between the intervention groups.

Chun woo yang et al^[4] had reported complications like Horners syndrome and pneumothorax in their study whereas in this study nil complications were noted. This could be possibly explained by the vertical infraclavicular approach and plumb bob technique they had used.

In this study, the time taken to do Infraclavicular block (mean=9.44, SD=3.18) was greater than time taken to perform Supraclavicular block (mean=4.21, SD=1.72). It was statistically significant with a p value of <0.05 as per unpaired t test.^[6]

In another study conducted by Alan macfarlane et al^[5] vertical infraclavicular block scored high success rate but they have reported serious complications like phrenic nerve palsy and pneumothorax. But here in our study supraclavicular block [93.3%] has high success rate compared to infracavicular block [83.3%] but it is not statistically significant.^[7]

In the study conducted by Yavuz gurkan et al^[6] the reported mean duration of analgesia was 13±8 hours and a mean duration of motor block of 6±2 hours using 20 ml of 0.5% levobupivacaine and 10 ml of 2% lignocaine in infraclavicular blocks. In this study the duration of sensory blockade is 13.76±2.8 hours in group S and 12.67±5.8 hours in group I. The duration of motor blockade is 6.72±1.28 hours in group S and 6.94±3.02 hours in group I. The duration of sensory and motor blockade are comparable in both groups and is not statistically significant. This is comparable to the above said study.

In the research study conducted by Thirivikrama padur tantry^[7] to prevent exclusion of ulnar nerve, finger flexion, wrist flexion, wrist adduction may be used for lower trunk blockade because sparing of ulnar nerve often leads to failure of blockade. In this study motor response in fingers were taken as endpoint of neuro stimulation to avoid failure of blockade

So in our study comparing both Infraclavicular and Supraclavicular block, we found that Infraclavicular block using coracoid approach for forearm surgeries under Nerve Stimulator guidance is better than supraclavicular blockade because sensory blockade is achieved earlier which shows that patient is ready earlier for surgery with good quality of blockade and comparable duration of sensory and motor blockade

without any complications.^[8] However the time taken for performing the infraclavicular block is longer than supraclavicular block which is statistically significant. We had no complications and patients were hemodynamically stable throughout the perioperative period.

CONCLUSION

Infraclavicular block using coracoid approach is a better alternative to supraclavicular block for forearm surgeries under nerve stimulator guidance as sensory blockade is achieved earlier and duration of sensory and motor blockade is also satisfactory without any change in hemodynamic parameters and without any complications.

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