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# A randomized comparative study on brachial plexus block using nerve stimulator: infraclavicular - coracoid approach vs supraclavicular approach

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## Abstract

**Introduction**: Pain relief with peripheral nerve block (PNB) is devoid of side effects such as somnolence, nausea, vomiting, hemodynamic instability and voiding difficulties inherent to general and central neuraxial anesthesia.

**Aim**: To compare the clinical efficacy of infraclavicular and supraclavicular approach of brachial plexus block by using peripheral nerve stimulator.

**Materials & Methods**: Sixty patients of ASA grade I and II undergoing upper limb surgeries were randomly assigned into two groups, Group I and Group S

group I: received infraclavicular block by coracoid approach,

group S: received Supraclavicular block.

Surgeries below the level of elbow were selected for this study.

Parameters observed were – block performance time, sensory and motor blockade, and its quality, duration of post op analgesia, and block related complications.

**Results:** Time to perform block, onset of both motor and sensory blockade, duration of post op analgesia were not different in group I and Group S. Success rate of blocking four nerves to the elbow (musculocutaneous, ulnar, radial, median,) was comparable between the groups. The incidence of complications in the form of vascular puncture was not significant in both group I and Group S.

**Conclusion:** From our study it is inferred that nerve locator guided Infraclavicular block of brachial plexus by coracoid approach is at least as rapidly executed as nerve locator guided Supraclavicular approach and produces a similar degree of surgical anaesthesia with similar complication rates.

## Introduction

Many approaches can be used for brachial plexus block; axillary, supraclavicular and infraclavicular approaches. They were commonly performed by blind techniques or neurostimulation or using ultrasound guidance. supraclavicular block is fast and the blockade is deep as the nerves are very tightly packed but pneumothorax can occur due to the proximity of the pleura. Pneumothorax can be avoided by ultrasonic visualization of the pleura and by proper technique. Infra clavicular brachial plexus block was first described by Bazy in the early 20th century and was even included in LABAT's text book: regional anesthesia in 1922.(1) In 1998 WILSON et al(2) described infraclavicular coracoid technique –In the past few years infraclavicular block has become a method of increased interest. This block targets the musculocutaneous and axillary nerves at the level of the cords before these nerves leave the brachial plexus "sheath". This block carries no risk of accidental intrathecal, epidural, intravertebral injection, stellate ganglion block or paralysis of hemi diaphragm. Peripheral nerve stimulator technology utilizes objective end points for nerve localization and does not depend on patient's subjective feeling for effective nerve localization when used along with ultrasound it increases block success rate.

In our study we compared the clinical efficacy of infraclavicular and supraclavicular approach of brachial plexus block by using peripheral nerve stimulator alone.

## Aim of the Study

To compare the ease of technique & efficacy of block between supraclavicular and infraclavicular approaches for brachial plexus block using nerve locator.

## Materials and Methods

This is a prospective randomized study conducted at Government Stanley Hospital, attached to Stanley Medical College, Chennai. Sixty patients of ASA grade I or II of either sex undergoing surgery on the elbow, forearm or hand (mostly orthopedic plastic surgeries) were randomly allocated into two equal groups.

Randomization techniques: computer generated random numbers

Blinding not done as the two different procedures are used and all the cases were done by the investigator.

group I- Surgery was done under Infraclavicular-coracoid approach

group S- Surgery was done under Supraclavicular – subclavian perivascular approach

## Procedure

After ethical committee approval informed consent was obtained from the patients. Intravenous access was

obtained. Anaesthesia machine checked resuscitative equipment's and drugs were kept ready.

**Inclusion criteria:**

- Age 18 - 60 yrs
- Both sex
- PS I & II undergoing surgery for both elective/emergency
- Hand, wrist, Fore arm and elbow

**Exclusion criteria**

- Infection at the puncture site
- Coagulopathy
- Allergy to amide local anaesthetics
- Pregnancy
- Severe pulmonary pathology
- Mental incapacity or language barrier
- BMI more than 35
- Anatomical variations
- Standard monitoring was applied, an IV line was secured and sedation (midazolam 1-2mg iv) and analgesia (fentanyl 50-100mic iv) were given.(The dose titrated depending on the patient's age, weight and degree of anxiety.

**Technique**

**Infraclavicular Block:** The block was performed with the patient lying in supine position with his head turned in the direction opposite the limb to be anesthetized. The arm abducted to $110^0$. We identified by palpation the coracoid process and marked, with the help of a ruler, the point of entry of the needle – 2cm caudad and 2cm medial to the coracoid process, as previously described by Wilson et al.[10] Using a sterile technique, a 100mm 22 gauge insulated short bevel stimulating needle was inserted perpendicular to the skin and connected to a nerve stimulator that was programmed with the following variables: current 2.0mA and frequency 2HZ.In the absence of an upper extremity motor response, the needle was redirected either cephalad or caudal but never medially to avoid the pleura. In the presence of an upper extremity motor response, the intensity of the current was then progressively reduced to 0.5mA and 0.5 ml/ kg of LA mixture containing 0.25% bupivacaine and 1% Lignocaine with 5µg/ml of adrenaline is injected (not exceeding 30 ml) after a negative aspiration for blood.[42]

**Goal**: Is to achieve a hand twitch (preferably "medianus") using a current of 0.2-0.3mA.

**Supraclavicular Block:** Patient was placed in supine position with head turned $30^0$ to the opposite side to be injected. The arms were placed at the patient's side with hands pointing towards the knee. A rolled towel was placed lenghthwise between the shoulders along the spine to give the best exposure of the area. The interscalene groove and subclavian pulsations were marked. The pulsation of the subclavian artery against the palpating finger was used as a guide and the stimulating needle was inserted just above the palpating finger (i.e. the inferior most point of interscalene groove) and advanced in a direction which is directly caudal running parallel to sagittal axis. The needle was advanced behind the palpating finger until EMR of elbow or hand is obtained. If contraction was observed with a stimulated voltage reduced to 0.5 mA, 0.5 ml/ kg of LA mixture containing 0.25% bupivacaine and 1% Lignocaine with 5µg/ml of adrenaline is injected (not exceeding 30 ml) after a negative aspiration for blood.

**Goal**: Is to achieve a hand twitch (preferably flexion of finger and thumb) using a current of 0.2-0.3mA.

**Parameters Observed**

1. **Time to perform block-** from the time of skin disinfection to the end of injection. If adequate response was not obtained within 20 minutes the procedure was taken as a failure with performance time of 20 minutes.
2. **Successful block**- defined as a blockade in the four nerves to the elbow (musculocutaneous, median, ulnar and radial). If a nerve territory was spared a rescue block was administered. If the patient still experiences pain or discomfort general anaesthesia was administered.
3. **Onset of sensory block -** Onset of sensory block was taken as abolition of temperature sensation using ice over the distribution of musculocutanoeus, radial, ulnar and median nerves compared to the contralateral side was assessed every minute after the performance of the block. Surgery was allowed after all the four nerves were completely blocked.
4. **Onset of motor blockade -** Onset of motor blockade was assessed every 2 minute after the block using four point scale

Normal power, weakness but able to move arm, not able to move arm but the fingers & complete motor Blockade.

Attaining a score of 2 was considered as the onset of motor Block

5. **Duration of motor Blockade -** When (3) in the four point scale changes to (2) the motor blockade is said to be reversed. The duration of motor block is noted from the time from scale (3) to scale (2).
6. **Post op analgesia -** The time interval between the onset of sensory block to the first requirement of post op analgesia was recorded in every patient.

The patient was observed every 30 minutes after the surgery is over till the motor block reverses and thereafter hourly for 6 hrs; second hourly for next 6 hrs and then at 24 hours.

7. **Vital parameters:** Pulse rate, Blood pressure, oxygen saturation & ECG
8. **Complications:** Pneumothorax, Accidental vessel puncture, Haematoma & Paraesthesia in the post-operative period.

## Observation and Results

**Statistical Tools:** The information collected regarding all the selected cases were recorded in a Master Chart. Data analysis was done with the help of computer using SPSS software. Data was expressed as mean +/- of Standard deviation. Quantitative Analysis was compared with Student's 't' test and the Fisher's exact test for 2 x 2 contingency tables were used. A 'p' value < 0.05 was considered significant.

There was no statistically significant difference among the two groups with respect to the age, sex and weight.

**Time to Perform Block:** Time to perform block in Group S 4.61± 0.959, and in Group-I 3.9±1.028. The 'p' value was not significant.

**Time of onset of Motor Block**: Time of onset of motor block in Group_S 5.33min ±1.093 and in Group-I, 5.53min ±1-907 min. P value insignificant.

**Time for onset of sensory block:** Time for onset of sensory block in Group-S o8.2 min± 0.846, and in group_I, 8.03min± 2.189. P value insignificant.

**Motor block time:** Total duration of motor blockade in Group-S, 130.66min±11.79, and in Group-I, 130.83min± 21.21 .P value insignificant.

**Post-Operative Analgesia time:** Total duration of post-operative analgesia in Group-S, 11.42 ±1.42hrs, and in Group-I 10.93 ±2.31 hrs. P value insignificant.

**Successful Block:** Successful block, that is involvement of four terminal nerves: In Group-S, 3 out of four nerves were blocked in 1 patient (3-3 %) and all four nerves were blocked in 29 patients (96.7 %). In group I 3 out of four nerves were blocked in 3 patients (10 %) and all four nerves were blocked in 27 patients (90 %). Applying Chi square tests, it was found to be statistically insignificant. The 'p' value of 0.554 was statistically insignificant.

**Complications:** The number of vessel punctures in Group S was 2 (6.7%). There were no vessel punctures in Group I(0%). Applying Chi square tests, the 'p' value was 0.150 which is statistically insignificant. No other complication was recorded in both the group S and group I. P value insignificant.

## Discussion

**Time to perform block:** Time to perform block in Group-S 4.61min± 0.959, and in Group-I 3.9min± 1.028, with a p value of 0.04393, which is not significant. Results were comparable with the study done by *Genevieve Arcand, Stephen Williams,* ***et al they showed that*** Performance times were significantly shorter in the last 20 patients than in the first 20 patients of Group I (5.65 min versus 2.35 min; *P* _ 0.001), whereas in Group S a similar trend towards shorter performance times was not quite significant (5.65 min versus3.65 min; *P* _ 0.06). Group I performance times also became shorter than those in Group S (*P* _ 0.03). Block quality also improved in Group I as the study progressed. Sandhu and Chan[32] have surmised that approximately 20 blocks are needed to achieve a high degree of proficiency with USG techniques.

**Successful block:** In Group-S, 3 out of four nerves were blocked in 1 patient (3-3%) and all four nerves were blocked in 29 patients (96.7 %). In group I 3 out of four nerves were blocked in 3 patients (10%) and all four nerves were blocked in 27 patients (90 %). No patient in either group underwent general anaesthesia. Applying Chi square tests, it was found to be statistically insignificant.('p' vaule 0.554)- similar to study of *Genevieve Arcand, Stephen Williams,* ***et al. in their study they observed*** Radial block quality was significantly worse in Group I compared with Group S for the first 20 patients (0.77 versus 0.99, respectively; *P* _ 0.02) but was not significantly different in any territory for the last 20 patients. Ootaki et al[31] used USG infraclavicular block, in which the anesthetic was placed using 2 injection sites to completely surround the axillary artery, achieved surgical blocks in 95% of patients and complete sensory block of the radial territory in 95% of patients.

The increased incidence of sparing can be explained by the fact that although the cords of the brachial plexus are compactly arranged around the axillary artery, the posterior cord is deeper from the point of needle entry which may explain the sparing of the radial nerve in the infraclavicular group.

The onset of motor and sensory blockade and duration of motor and sensory blockade was comparable and no significant difference among the two groups. These results were similar to the study done by *Genevieve Arcand, Stephen Williams,* ***et al.***

| Age group | Group S | | Group I | |
|---|---|---|---|---|
| | No. | % | No. | % |
| Less than 20 years | 7 | 23.3 | 10 | 33.3 |
| 21-30 years | 6 | 20 | 10 | 33.3 |
| 31-40 years | 6 | 20 | 4 | 13.3 |
| 40 and above years | 11 | 36.7 | 6 | 20 |
| Total | 30 | 100 | 30 | 100 |
| Range<br>Mean<br>S.D. | 18-60 years<br>29.8 years<br>12.41 years | | 18-60 years<br>34.9 years<br>12.48 year | |
| 'p' | 0.117992<br>Not significant | | | |

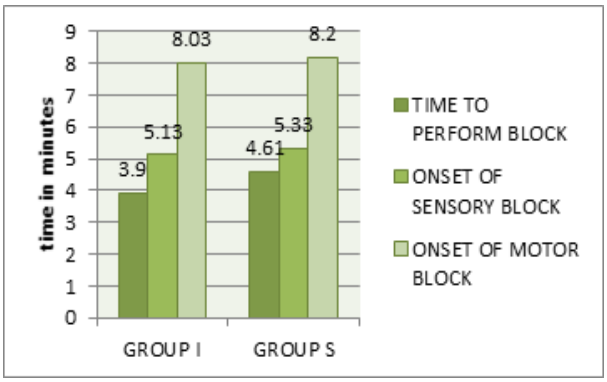
| Sex | Group S | | Group I | |
|---|---|---|---|---|
| | No. | % | No. | % |
| Males | 24 | 80 | 21 | 70 |
| Females | 6 | 20 | 9 | 30 |
| Chi square value | 0.800<br>Not significant | | | |
| 'p' | 0.371<br>not significant | | | |

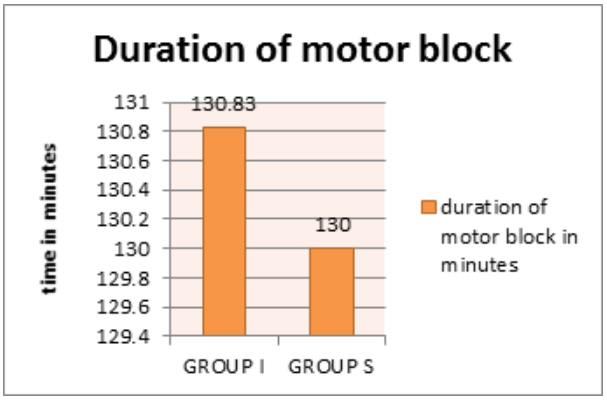
| Weight(in kgs) | Group S | Group I |
|---|---|---|
| Range | 40-70 | 30-70 |
| Mean | 54.96 | 55.46 |
| S.D. | 6.69 | 10.39 |
| 'p' | 0.825001 Not significant | |

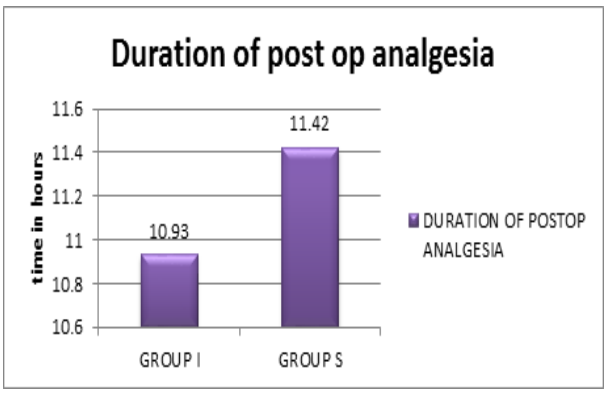
| | Group S | Group I | |
|---|---|---|---|
| Time to perform block (in minutes) | 4.1±0.959 (3-6) | 3.9±1.028 (3-7) | 0.4393 Not Significant |
| Time for onset of motor block (in minutes) | 5.33±1.093 (4-8) | 5.5±1.907 (3-10) | 0.6201 Not Significant |
| Time for onset of sensory block (in minutes) | 8.2±0.846 (7-10) | 8.03±2.189 (5-15) | 0.6987 Not Significant |
| Duration of motor block (in minutes) | 130.66 ±11.79 (100-150) | 130.83± 21.21 (90-180) | 0.970133 Not Significant |
| Duration of Post op analgesia (in hours) | 11.1 ±1.42 (10-15) | 10.93± 2.31 (9-20) | 0.738380 Not Significant |

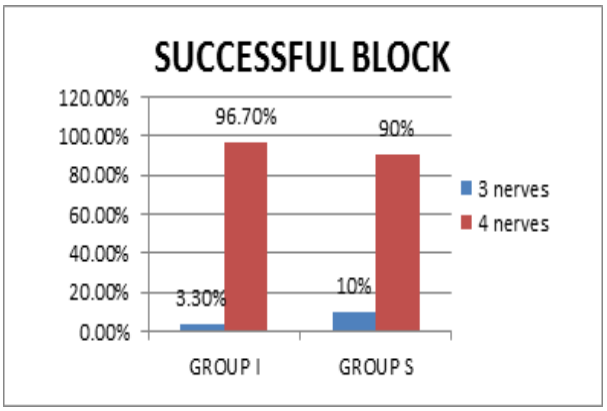
| Complications | Group S | | Group I | |
|---|---|---|---|---|
| | No. | % | No. | % |
| Vessel puncture | 2 | 6.7 | 0 | 0 |
| No complications | 30 | 93.3 | 30 | 100 |
| Chi square value | 2.069 Not significant | | | |
| 'p' value | 0.150 Not significant | | | |

| Number of nerves | Group S | | Group I | |
|---|---|---|---|---|
| | No. | % | No. | % |
| 3 | 1 | 3.3 | 3 | 10 |
| 4 | 29 | 96.7 | 27 | 90 |
| Chi square value | 0.353 Not significant | | | |
| 'p' | 0.554 Not significant | | | |




## Conclusion

From our study it is inferred that nerve locator guided Infraclavicular block of brachial plexus by

coracoid approach is at least as rapidly executed as nerve locator guided Supraclavicular approach and produces a similar degree of surgical anaesthesia with similar complication rates.

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All authors affirm that they have no financial affiliation or involvement with any commercial organization with direct financial interest in the subject or materials discussed in this manuscript, nor have any such arrangements existed in the past 3 years.

## Conflicts of Interest

The authors deny any conflicts of interest related to this study.

## References

1. Labat G: Regional Anesthesia: Its Technic and Clinical Application. Philadelphia, WB Saunders, 1922.
2. Halsted WS: Practical comments on the use and abuse of cocaine: Suggested by its invariably successful employment in more than a thousand minor surgical operations. *N Y Med J* 1885;42:294.
3. Kulenkampff D, Persky M. Brachial plexus anesthesia. Its indications, technique and dangers. Ann Surg 1928;87:883-91.
4. Winnie A: Plexus anesthesia. Perivascular techniques of brachial plexus block. Philadelphia, W.B. Saunders Company, 1993.
5. Winnie A, Collins V: The subclavian perivascular technique of brachial plexus anesthesia. Anesthesiology 25:353-63, 1964.
6. Brown DL, Cahill D, Bridenbaugh D: Supraclavicular nerve block: Anatomic analysis of a method to prevent pneumothorax. AnesthAnalg76:530-34,1993.
7. Raj PP, Montgomery SJ, Nettles D, Jenkins MT: Infraclavicular brachial plexus block: A new approach. *Anesth Analg* 1973;52:897.
8. Raj PP: Infraclavicular approaches to brachial plexus Anesthesia. Techniques in Reg Anesth and Pain Management 1997;1:169-77.
9. Raj PP, Pai U, Rawal N: Techniques of regional anesthesia in adults. In Clinical Practice of Regional Anesthesia Edited by Raj New York, Churchill Livingstone, 1991, pp 276-300.
10. Wilson JL, Brown DL, Wong GY, et al: Infraclavicular brachial plexus block: Parasagittal anatomy important to the coracoid technique. *Anesth Analg* 1998;87:870q.
11. Kilka HG Vertical Infraclavicular Brachial plexus blockade, Anaesthetist 1995;44; 339-44.
12. Cornish PB, Greenfield LJ. Brachial plexus Anatomy Reg Anaesth 1997,22:106-107.
13. William PL, Warwich R, Dyson M. The Brachial plexus. In Gray's Anatomy 37th edition 1989:1131-53.
14. Rorie D. K. The brachial plexus sheath. Anat. Rec; 1974, 187: 451.
15. Patridge B.L., Kartz J, Berirshke K. Functional anatomy of brachial plexus sheath – implications for anaesthesia. Anaesthesiology 1987,6:743- 47.
16. Wilson JL, Brown DL, Wong GY, Ehman RL, Cahill DR: Infraclavicular brachial plexus block: parasagittal anatomy important to the coracoid technique. Anesth Analg 1998;87:870-3.
17. Borgeat et al An Evaluation of infraclavicular approach via a modified ….. Raj technique.93 (2): 436 Anaesth analg.
18. Kapral S et al lateral infraclavicular plexus block vs axillary block for fore arm and hand surgeries. Acta anaesthesiol Scand 1999,43;1047-52.
19. Klaastad O, Lilleas FG, Rotnes JS, Breivik H, Fosse E: Magnetic resonance imaging demonstrates lack of precision in needle placement by the infraclavicular brachial plexus.
20. Pither C E, Raj PP, Ford DJ. The use of peripheral stimulator for regional anaesthetic. Reg Anaes 1985;10:49-58.
21. Hadzic A, Vloka J, Hadzic N et al. nerve stimulators used for peripheral nerve blocks vary in their electrical characteristics. Anaesthesiology 2003;98:969- 74.
22. Peripheral nerve stimulation in practice of brachial plexus anesthesia: a review. Reg Anesth Pain Med 2001;26:478-83.
23. Franco C, Vieira Z: 1,001 subclavian perivascular brachial plexus blocks: success with a nerve stimulator. Reg Anesth Pain Med 25:41-6,2000.
24. Good man & Gilman's – The pharmacological basis of therapeutics. 10th edition.223-38,358-78.
25. Kadzung Basic & Clinical pharmacology 6th edition.165-72.
26. J.N. Cashman, N.J.H. Davie, Lee Synopsis of Anaesthesia 13th edition.365-75.
27. Infraclavicular brachial plexus block for regional anaesthesia of the lower arm KJ Chin, VTW Chee, B Lee. Cochrane Database of Systematic Reviews 2008 Issue 4.
28. Infraclavicular block vs axillary and humeral canal blocks (HCB). Quang Hieu De Tran, MD et al, Canadian Journal of Anesthesia 54:662-674 (2007).
29. Genevieve Arcand, Stephen Williams CHUM hospital Montreal Canada. Anaesth; Analg 2005;101:886 -90 Ultrasound guided Infraclavicular vs Supraclavicular Block.
30. Niemi TT, Salmela L, Aromaa U, Pöyhiä R, Rosenberg PH. Reg Anesth Pain Med. 2005 Jan-Feb;32(1):55-9. Single-injection brachial plexus anesthesia for arteriovenous fistula surgery of the forearm: a comparison of infraclavicular coracoid and axillary approach.
31. Efficacy of vertical infraclavicular plexus block vs. modified axillary plexus block: a prospective, randomized, observer-blinded study Heid FM et al. Clinics of Anesthesiology, Johannes Gutenberg-University Hospital. Mainz Germany. Acta Anaesthesiol Scand 2005 May;49(5);677-82.
32. Brachial plexus block:' Best" approach and "Best" evoked response where are we? (Editorial) Reg Anesth & Pain Med. 2004; 29:520-23. Weller RS, Gerancher JC.