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# Evaluation of Axillary Plexus Block A Comparison of Single Injection and Double Injection Method

[1]Shaik Mohammed Ghiyazuddin, [2]K. Anitha, [3]M.J.K. Sowjanya and [4]P.S. Arunalatha

*[1-3]Department of Anesthesiology, Kurnool Medical College, Kurnool. Andhra Pradesh, India*

*[4]Department of anaesthesiology GMC, Ananthapuram, India*

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**Corresponding Author**
P.S. Arunalatha,
Department of anaesthesiology GMC, Ananthapuram

**Author Designation**
[1,3]Assistant Professor
[2,4]Associate Professor

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**ABSTRACT**

For all the happiness, mankind can gain is not in pleasure, but in rest from pain. To compare sensory and motor blockade with single injection method and double injection method of axillary plexus with 20 ml of I Lignocaine for elective surgeries of forearm and hand. The present study was carried out in 60 patients of either sex undergoing axillary brachial plexus block, using local anaesthetic agent with injection 1.5% lignocaine in the Department of Anaesthesiology and critical care at Kurnool Medical College, Kurnool from July 2013 to August 2014. There was faster onset of sensory and motor block in patients of Group D compared to patients of Group S. In group D 96% of Patients had effective sensory neural blockade compared to 86.6% in patients of Group S. Patients in both Group S and Group D needed at least 20 mins to have complete block. In Group S 27(90%) patients had effective blockade of musculocutaneous nerve while in Group D 28 (93.3%) patients had effective blockade of musculocutaneous nerve. In Group S 20 (66.6%) patients had effective blockade of radial nerve, while in Group D all patients had effective blockade of radial nerve. The duration of analgesia was prolonged in patients of Group D. Inspite of complete motor block of 46% and 86% in patients of Group S and Group D respectively, surgical procedures were conducted without any issues on to the patients. The duration of motor block was 4 hours in patients of Group D whereas 2 hours in patients of Group S. Double injection method for axillary plexus block has good success of sensory and motor blockade compared to single injection method. Axillary plexus block is a simple, reliable and safe technique. It can be used for surgeries of forearm and hand. Axillary plexus block provides excellent quality of sensory and motor block. Double injection method of axillary block has faster onset of sensory and motor block than single injection method.

## INTRODUCTION

Effective pain control is essential for optimal care of surgical patients, especially in patients undergoing orthopaedic surgeries as these patients suffer from considerable pain in the postoperative period. Acute postoperative pain is a complex physiological reaction to tissue injury or disease. Its manifestation of automatic, psychological and behavioral responses results in unpleasant, unwanted, sensory and emotional experience. Despite advances in knowledge of pathophysiology of pain, pharmacology of analgesics and development of effective techniques for postoperative pain control, many patients continue to experience considerable discomfort[1,2]. Anaesthesia has evolved into a speciality subject over decades with lot of improvements in the methods employed and drugs used to provide anaesthesia with least complications. With the introduction of newer and safer local anaesthetics and better advantages of regional anaesthesia has taken over as the principle technique for upper limb surgeries.

There are many advantages of brachial plexus for upper limb surgeries over general anaesthesia, namely:

- Effective analgesia with good motor blockade
- Awake patient
- Extended post-operative analgesia
- Early ambulation
- Early resumption of oral feeding
- Minimal number of drugs used, so that polypharmacy is avoided
- No airway manipulation
- Less incidence of post-operative nausea and vomiting
- Ideal operating conditions can be met
- PACU and ward nurses particularly appreciate the use of regional anaesthesia

Brachial plexus block provides anaesthesia and post-operative analgesia for all the upper limb procedure. Supra clavicular brachial plexus block provides anaesthesia for surgeries around elbow, forearm and hand. With this technique, land marks are easy to locate and tourniquet pain is better tolerated, whereas inter scalene brachial plexus block provides better anaesthesia for upper limb surgeries at arm and forearm. The axillary brachial plexus block was first described by Halsted in 1884 at the Roosevelt Hospital in New York City. The axillary brachial plexus block is one of the most commonly used regional anaesthesia techniques. The proximity of the terminal nerves of the brachial plexus to the axillary artery makes identification of the landmarks consistent (axillary artery) equally for both nerve stimulator and surface-based ultrasound-guided-techniques. The axillary block is an excellent choice of anaesthesia technique for elbow, forearm and hand surgery.

## MATERIALS AND METHODS

The present study was carried out in 60 patients of either sex undergoing axillary brachial plexus block, using local anaesthetic agent with injection 1.50/0 lignocaine in the Department of Anaesthesiology and critical care at Kurnool Medical College, Kurnool from July 2013 to August 2014. The study was undertaken after obtaining ethical committee clearance.

All the patients were randomly allocated into two groups:

- Group S (Single injection method)
- Group D (Double injection method
- Each group consists of 30 patients
- GROUP S: 20 ml of Inj. lignocaine 1.5%
- GROUP D: 20ml of Inj. lignocaine 1.5%

**Inclusion Criteria:** Patients undergoing orthopaedic upper limb surgeries (i.e., forearm & hand surgeries) in the age group of 18-60 years of both sexes will be included with ASA grade I and grade ll.

**Exclusion Criteria:**

- ASA Grade-Ill and IV high risk patient.
- Cardiovascular disorders, respiratory disorders, renal disease andliver diseases
- Circulatory instability
- Known hypersensitivity to local anaesthetics
- Pregnant women
- Morbidly obese patient
- Neurological, psychiatric or neurovascular disorders
- Alcohol abuse
- Injury to any of the nerves of the upper limb
- Infection at the site of block

**Sample Size:** Considering the mean and SD of duration of analgesia as per VAS score at the end of 7 hour at allowable error +1, the calculated sample size n is 30.

Using statistical formula $n = 4\ \sigma^2/L^2$

Hence a total number of 30 patients in each group with inclusion and exclusion criteria were selected for the study. During time bound stuff patients were allocated randomly to each group by lottery method.

**Pre-Anaesthetic Assessment:** Patient's demographic data like age, height, weight, history and findings of the examination of airway, cardiovascular and other symptoms were recorded. Routine investigation like Haemoglobin, urine sugar, Blood Urea, Creatinine, Chest X-ray, ECG were done in all the patients. Patients were explained in detail about the anaesthetic procedure and drugs. All the patients were kept nil by mouth for 6-8 hours prior to induction. Written and informed consent were taken.

**Premedication:** All patients were pre-medicated with Alprazolam 0.5 mg, Ranitidine 150 mg orally at night before the surgery and Inj. Glycopyrrolate 4pgm $kg^{-1}$ and Inj Ondansetron 4mg IV,Inj midazolam Img IV given 5 mins before surgery. No analgesic drugs were given in pre-medication.

**Procedure of Axillary Block:** In group S (single-injection method), the median nerve was located by eliciting the maximal flexor response in the fingers of the hand with a current of 0.5 mA, after eliciting the response in Group S (single- shot). 20 mL 1.5 % lidocaine was injected above the axillary artery (15 mL around median and 5 mL around musculocutaneus nerve). In group D (double-injection method), the median nerve was located as above. The radial nerve was then located by eliciting the maximal extensor response in the fingers and wrist with a current of 0.5 mA , after eliciting the response in Group D (double- shot), the same local anaesthetic was injected above (5 mL around median and 5 mL around musculocutaneus nerve) and below the axillary artery (10ml around radial or ulnar nerve). With both methods, the musculocutaneous nerve was first located by eliciting maximal biceps contraction with a current of 0.5 mA and 5 ml of the 1.5% lignocaine was injected.

The sensory block was evaluated for the median nerve on the palm side of the 3rd finger, for the ulnar nerve on the palm Side of the 5th finger, for the radial nerve on the lateral portion of the back of the hand and for the musculocutaneous nerve on the lateral portion of the forearm. Motor block was evaluated in the following stages: O = no weakness: I = paresis: 2 = paralysis. Motor block of the median nerve was evaluated by flexion of the 2nd and 3rd fingers for ulnar nerve by flexion of the 4th and 5th fingers, for radial nerve by abduction of the thumb and for musculocutaneous nerve by the flexion movement of the elbow. Sensory function was assessed by pin prick and scored present or absent. Similarly, motor function was assessed by the inability to move the relevant muscle groups of the limb against gravity was taken as the motor block end-point.

A modified Bromage scale was used to assess the motor function of upper limb

- Score of 4 : Full Power
- Score of 3: Reduced power but able to lift the arm against resistance
- Score of 2: moves relevant muscle group against the gravity but not against the resistance
- Score of 1: perceptible muscle contraction but unable to lift the arm against gravity
- Score of O: no movement in relevant muscle group

Duration of the sensory blockade was assessed by asking the patient to record the time of onset of first pain sensation. Sensory block was assessed by pin prick method.

- Grade O = Sharp pain
- 1 = Dull sensation (Analgesia)
- 2 = No sensation (Anaesthesia)

Duration of sensory blockade: It is the time from the onset of sensory blockade to onset of pain at the surgical site [duration of analgesia] Duration of motor blockade: It is the time from the onset of motor blockade to the

**VAS (Visual Analogue Scale):** (0-10) No Pain, Excruciation pain

It is a 10 cm long slide ruler with “no pain” written at one end and “Maximum Pain” at the other. The patient slides the cursor along the ruler until it reaches the level that represents the intensity of pain. The other side of ruler is graduated over 100 mm and gives the investigator a numerical measure of the pain.

**Statistical analysis:** At the end of study, all the data is compiled and analysed statistically by Diagrammatic representation, Descriptive data presented as mean±SD, Continuous data are analysed by paired/unpaired‘t' tests and Chi-square test to assess the statistical difference between the groups.

## RESULTS

The present study was done in 60 patients of ASA group grade I divided into two groups of 30 patients each in Group S(Single injection)and Group D double Injection respectively. The following observations and results were noted. The patients age in Group S ranged from 18-60 years had a mean of 36.41+10.959 while in Group D patients age ranged from 18-60 yrs with a mean of 34.733+11.264. When comparison was made between two groups t-value was 0.580 and p-value was 0.563. The values were statistically not significant. In Group S the average male were 19 and female were 11. While in Group D the average male were 21 and females were 9. The weight distribution in Group S ranged from 50-60kgs with a mean of 54.8+3.377 while in Group D weight ranged from 50-60 kgs with a mean of 54.933+3.35. When a comparison was made between two groups t-value was 0.153 and p-value was 0.878.The values were statistically not significant.

**Sensory Block:** The onset of sensory block was noted after peripheral nerve stimulation in both the groups. The onset of sensory block between 5-10 mins was noted no patients in Group S had a sensory block whereas 9 patients in Group D had sufficient block. At

15 mins only 12 patients in Group S and all patients in Group D had complete sensory block. After 16-20 minutes 27 patients in Group S and all patients in Group D had complete sensory block.

**Time of Onset of Sensory Block:** The mean value of onset of sensory block in Group S was 17.033+2.385 whereas in Group D was 11.86+2.012. when compared between two groups p-value was statistically significant.

**Sensory Block:** The effectiveness of axillary plexus block was judged by the blockade of individual nerves and medial cutaneous nerve of forearm. In Group S 6 patients had incomplete block of medial cutaneous nerve of forearm while in Group D only 1 patient had incomplete block of medial cutaneous nerve of forearm. In Group S 27 patients had effective blockade of musculocutaneous nerve, while in Group D all patients had effective blockade of musculocutaneous nerve. In Group S 20 patients had effective blockade of radial nerve while in Group D 30 patients had effective blockade of radial nerve. In Group S 4 patients received supplementation of analgesia. Pattern of motor blockade was assessed by the complete motor block and blockade of individual nerves.

In Group S only 14 patients had complete motor block while in Group D 26 patients had complete motor block. Motor Block was significantly better in Group D. In Group S 10 patients had incomplete radial nerve block where as in Group D only 2 patients had incomplete radial nerve block. Radial nerve was difficult to block by single injection method. The mean value of onset of motor block in Group S was 19.33+2.468.Whereas mean value of onset of motor block in Group D was 14.93+2.448When compared between two groups p-value was statistically significant.

**Recession of Sensory Block**: In Group S the mean duration of sensory block was 129.6+28.785. Whereas in Group D the mean duration of sensory block was 213.56+49.635. When compared between the two groups the p-value was statistically significant. Group D patients had longer duration of sensory block. The data is given below in (Table 1 and 2) and The duration of motor block in Group S was 2.43+0.504. While in Group D the duration of motor block was 4+0.870. When compared between two groups the p-value was statistically significant. Group D patients had longer duration of motor block.

The patients in Group S at the end of 3hrs had VAS score of13.33±11.47 and patients in this group had mild pain and required rescue analgesia. Patients in Group D at end of 3hrs had no pain and at end of 3hrs data was analysed and found to be statistically significant. At end of 4 hours patients in Group S had VAS score of 26.16±5.36 and required rescue analgesia. Patients in Group D at end of 4 hours had a VAS score of 10.83±12.6 and patients in this group had mild pain and required rescue analgesia. At end of 4 hours data was analysed and found to be statistically significant. At the end of 5 hours patients in Group S had VAS score of 32 and these patients required rescue analgesia. Patients in Group D had VAS score of 22.66±6.26 at end of 5 hours had mild pain and required rescue analgesia.

The patients data was analysed and found to be statistically significant. At the end of 6 hours patients in Group S had VAS score of 39 and patients in this group had moderate pain and required rescue analgesia. Patients in Group D at end of 6 hours had VAS score of 30 and patients in this group also had moderate pain and required rescue analgesia. The patients data analysed and found to be statistically

**Table 1: Pattern of Sensory Block**

| Sensory Onset (min) | Group S | Group D |
|---|---|---|
| 5.0-10.0 | 0 | 9(30%) |
| 11.0-15.0 | 12(40%) | 21(100%) |
| 16-20 | 15(90%) | 0 |
| 21-25 | 3 | 0 |
| 26-30 | 0 | 0 |

**Table 2: Time of onset of sensory block**

| Onset of Sensory Block(min) | Mean | SD | t-value | p-value |
|---|---|---|---|---|
| Group S | 17.0333 | 2.38506 | 9.06801212 | 0.00001 Sig |
| Group D | 11.8667 | 2.0126 | | |

**Table 3: Efffectiveness of axillary plexus blockade**

| Nerve blockade | Group S | Group D |
|---|---|---|
| Musculocutaneous nerve | 27(90%) | 30(100%) |
| Median nerve | 30(100%) | 30(100%) |
| Medial cutaneous nerve of arm | 25(83.3%) | 29(96.6%) |
| Medial cutaneous nerve of forearm | 24(80%) | 29(96.6%) |
| Ulnar nerve | 26(86.6%) | 30(100%) |
| Radial nerve | 20(66.6%) | 30(100%) |
| Supplemented | 04(13.3%) | 00 |

**Table 4: pattern of motor blockade**

| Complete Motor block | Group S | Group D |
|---|---|---|
| Complete motor block | 14(46%) | 26(86.6%) |
| Incomplete MCN nerve | 3(10%) | 2(6.6%) |
| Incomplete Median nerve | 3(10%) | 2(6.6%) |
| Incomplete Ulnar nerve | 1(3.3%) | 0 |
| Incomplete Radial Nerve | 10(33.3%) | 2(6.6%) |

**Table 5: Onset of motor block**

| Onset of Motor Block(min) | Mean | SD | t-value | p-value |
|---|---|---|---|---|
| Group S | 19.3333 | 2.46819 | 6.93182582 | 0.00001 Sig |
| Group D | 14.9333 | 2.44855 | | |

**Table 6: recession of sensory block**

| Recession of Block(min) | Mean | SD | t-value | p-value |
|---|---|---|---|---|
| Group S | 129.633 | 28.7852 | 8.012181254 | 0.00001 Sig |
| Group D | 213.567 | 49.635 | | |

**Table 7: Duration of Motor Block**

| Duration of the block (hrs) | Mean | SD | t-value | p-value |
|---|---|---|---|---|
| Group S | 2.4333 | 0.50401 | 8.527248173 | 0.00001 Sig |
| Group D | 4 | 0.87099 | | |

**Table 8: Duration of analgesia (VAS values)**

| VAS Scores | Group S Mean | Group S SD | Group D Mean | Group D SD | t-value | p-value |
|---|---|---|---|---|---|---|
| PostOP immediate | 2.83333 | 8.6785 | 1.6667 | 6.3427 | 0.59447 | 0.55451 NS |
| 30 min | 2.83333 | 8.6785 | 1.6667 | 6.3427 | 0.59447 | 0.55451 NS |
| 60 min | 2.83333 | 8.6785 | 1.6667 | 6.3427 | 0.59447 | 0.55451 NS |
| 2hr | 2.83333 | 8.6785 | 1.6667 | 6.3427 | 0.59447 | 0.55451 NS |
| 3hr | 13.3333 | 11.472 | 1.6667 | 6.3427 | 4.87468 | 0.00001 Sig |
| 4hr | 26.1667 | 5.3632 | 10.833 | 12.6 | 6.13286 | 0.00001 Sig |
| 5hr | 32 | 5.8132 | 22.667 | 6.2606 | 5.98370 | 0.00001 Sig |
| 6hr | 39 | 5.3175 | 30 | 4.3549 | 7.17202 | 0.00001 Sig |
| 7hr | 44.6667 | 4.3417 | 35.167 | 4.2514 | 8.56292 | 0.00001 Sig |

significant. At the end of 7 hours patients in both Groups S and D had VAS score of and 35.16±4.25 respectively. Patients in both groups required rescue analgesia. It was analysed that patients in Group S required earlier rescue analgesia than group D patients.

## DISCUSSIONS

Brachial plexus block via axillary approach is a very common method to provide anaesthesia for surgeries of the forearm and hand. Many different methods were performed to increase the success of nerve block with the use of nerve stimulator, ultra-sonography and fluoroscopic guided or computerized tomography. Several methods such as trans-arterial, single, multiple paraesthesia and catheterization in plexus sheath has improved the success of the block. Since many studies and structural anatomy has shown that major arteries, veins and nerves are embedded in plexus sheath and few of the nerves are likely to be missed during the block.

In single injection method 20 ml of 1.5% lignocaine was given after identifying median nerve and small amount was deposited after musculocutaneous nerve was identified by peripheral nerve stimulator. In double injection method 10 ml of 1.5% lignocaine was given after identifying median nerve and musculocutaneous nerve and 10ml was given after identifying radial nerve. Injection of local anaesthetic into the brachial plexus sheath near median nerve laterally to the axillary artery was shown to facilitate the spread of local anaesthetic around the musculocutaneous nerve. Yamamoto *et al*.[3] also confirmed that the proximal spread is inhibited by 900arm abduction , arm position had no impact on the sensory block of any of the brachial plexus nerve in their study as this was also found in the study done Koscielniak-Nielsen *et al.*[4] Thompson and Rorie[5] confirmed in their study in which injection were made in multiple sites and found local anaesthetic tended to stay in isolated pockets.

**Sensory Block:** Lavoie *et al.*[6] suggested that injecting a large quantity of local anaesthetic in a single site makes local anaesthetic to diffuse and to produce a block. In spite of small segments of peripheral nerves, musculocutaneous nerve been missed in 3 (10%) patients of Group S and none in Group D patients. Sufficient time was taken to start the surgery as most of patients in both the groups needed at least 20 minutes to have complete block. In Group S only 4 (13.3%) patients needed supplementation and 86.6% of block was effective. In Group D patients had complete block and needed no supplementation.

Bernucci *et al.*[7] showed that axillary plexus block by single injection method had only 50% block. The reason for ineffective block was probably related to the location of nerve by the peripheral nerve stimulator. The Completeness of the block is related to the type of local anaesthetic and the dose that is involved. In our study 1.5 % plain lignocaine was used as local anaesthetic. So the onset of sensory block was complete in 17 mins in single injection method and 11 mins in double injection method. The speed of onset of sensory block was faster in double injection method due to faster spread of local anaesthetic above and below the axillary artery. Most of the surgeries were conducted on forearm and hand. Toumiquet pain was not assessed during our study but most of patients did not expressed tourniquet pain. Dubravka Bartolek *et al*.[8] pointed out the double injection technique with Peripheral nerve stimulation in axillary brachial plexus block was significantly more effective than single injection technique. In our study the patients in d0uble injection method had faster onset of complete block than patients in single injection method. Results are in correlation with our study. Patients in Group S at 3 ,5 and 7 hours had higher VAS values than inPatients of Group D. Patients in Group S had earlier onset of pain at 3 hours and required rescue analgesia. Patients in Group D had low VAS values and longer duration of analgesia.

**Motor Block:** Different methods of assessment of motor block have been used by various authors making inter study comparisons difficult. However technically similar grades of motor blockade were found in higher number of patients in some studies while others had comparable outcomes. Onset of motor block in patients of Group S was 19 mins and in patients of Group D was 14 mins. Patients in Group D had faster onset of motor block. In a study done by De Tran[9,10] significantly faster onset of sensory and motor block achieved after injecting local anaesthetic near

musculocutanous nerve and radial nerve in axillary block. The duration of motor block in patients of Group S was 2 hours and in patients of Group D was 4 hours, which is in correlation with the results of De Tran Q In patients of Group S lignocaine was deposited above the axillary artery after eliciting musculocutaneous nerve and median nerve. Where as in patients in Group D the local anaesthetic was deposited above and below the axillary artery after eliciting musculocutaneous nerve, median nerve and radial nerve respectively. As the ulnar nerve is posterior to radial nerve, the local anaesthetic diffused to ulnar nerve in patients of Group S, this was the reason for radial nerve block being skipped in 10 patients of Group S. we are more concerned with the spread of analgesia rather than motor block for surgical success. In patients of Group D as radial nerve was identified they had faster onset and more complete block. This is according to study done by Coventry and barker[9]. In spite of having complete motor block of 46% and 86% in patients of Group S and Group D respectively, surgical procedures were conducted without any issues on to the patients. Motor blockade testing showed significant advantage in double injection method both in onset and completeness of block compared to single injection method. During our study recovery of motor block was much faster with single injection method rather than double injection method, probably due to distribution of local anaesthetic within axillary sheath.

All the above studies have commented more on the sensory block and minimal given to motor. In the present study patients with double injection method of axillary plexus block had earlier onset of sensory and motor block with very few missed mixed segments of musculocutaneous and radial nerve. Patients in Group D had longer duration of analgesia and required less rescue analgesia.

## CONCLUSION

It can be concluded that Axillary plexus block is a simple, reliable and safe technique. It can be used for surgeries of forearm and hand. Axillary plexus block provides excellent quality of sensory and motor block. Double injection method of axillary block has faster onset of sensory and motor block than single injection method. Duration of analgesia is prolonged in double injection method. Double injection method to be preferred over single injection method. Side effects are minimal with axillary plexus block.

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