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

KEYWORDS: Axillary Plexus block,Lignocaine,single injection method ,Double injection method,sensoryblockade,motorblockade,analgesia,.

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ABSTRACT *A prospective randomized double blind study was undertaken to compare sensory and motor blockade with single injection method and double injection method of axillary plexus with 20 ml of 1.5% Lignocaine for elective surgeries of forearm & hand.*

METHODS

Sixty patients of ASA class I of age 18-60yrs posted for elective surgeries of forearm and hand were randomly divided into two groups. Group S (single injection method) and Group D (double injection method). Each group consisting of 30 patients to receive 20 ml of 1.5% Lignocaine in single injection method and 20ml of 1.5% Lignocaine in double injection method. . Statistical analysis:the data was analysed using two tailed tests for differences between means of two samples(Z test) and in needed situation using x2 test.significant level for rejecting null hypothesis was taken p<0.05

RESULTS

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. . In Group S only 4 (13.3%) patients needed supplementation and 86.6% of block was effective. In Group D all patients had complete blockade and needed no supplementation. 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 where as 2 hours in patients of Group S.

INTRODUCTION

"For all the happiness, mankind can gain is not in pleasure, but in rest from pain" - John Dryden (1631-1701).

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.

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.

Brachial plexus block provides anaesthesia and post operative analgesia for all the upper limb procedure. Supraclavicular 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, where asinterscalene brachial plexus block provides better anaesthesia for upper limb surgeries at arm & 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.

METHODS

Sixty ASA Grade I and Grade II Patients posted for elective surgery orthopaedic upper limb surgeries (i.e., forearm & hand surgeries) in the age group of 18-60 years of both sexes were selected for the study. 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. All patients were pre medicated with Alprozolam 0.5 mg, Ranitidine 150 mg orally at night before the surgery and Inj. Glycopyrrolate 4µgm/kg and InjOndansetron 4mg IV,Inj midazolam 1mg IV given 5 minutes before surgery. No analgesic drugs were given in pre medication. On the day of surgery, base line blood pressure and heart rate of all the patients were recorded. The patients were randomly divided in to two groups of thirty patients each.

Each group consists of 30 patients.

GROUP S: 20 ml of Inj. lignocaine 1.5%

Volume : 5 | Issue : 7 | July 2015 | ISSN - 2249-555X

GROUP D: 20ml of Inj. lignocaine 1.5%

With the patient lying supine, with their head placed on a pillow, the arm was abducted to 90° and the axillary artery palpated. The skin was cleaned and then anaesthetized with 1–2 ml of 1% plain lidocaine 10 mg / ml. Neural blockade was facilitated by using a 22G insulated short-bevelled needle and peripheral nerve stimulator (Stimuplex; B. Braun Medical). All patients were received a total of 20 ml of 1.5% lidocaine (15 mg/ml.).

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 medianand 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 anaestheticwas injected above (5 mL around median and 5mL 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 quality of the nerve blockade was evaluated prior to surgical incision and the assessment was performed at 5-minute intervals up to 30 minutes after the completion of the last injection. Simultaneously sensory and motor functions in the contralateral limb were used for comparison purposes.

By using a short-bevelled 27G needle, all six upper limb areas-median, musculocutaneous, ulnar, radial and medial cutaneous nerve of arm and forearm—were tested for complete sensory loss. The above mentioned areas were chosen because these areas are considered as at most relevant to the surgical procedure used.

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: 0 = no weakness; 1 = 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.

All the patients were observed hourly for analgesia until patient demanded analgesia and duration of analgesia was noted. Pulse rate, blood pressure, Visual analogue scale were observed every hourly for 7 hrs post operatively.

Patients received rescue analgesia injection Diclofenac sodium 75 mg iv infusion, when patient complained of pain.

VAS (VISUAL ANALOGUE SCALE):

0 1 2 3 4 5 6 7 8 9 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:

The data was analysed using two tailed tests for differeces between means of two samples (Z test) and in needed situations using x^2 test.Significant level for rejecting null hypothesis was taken as $p<0.005$.

RESULTS

The present study was done in 60 patients of ASA grade I divided into two groups of 30 patients each into Group S (Single injection) and Group D (Double injection) respectively. The following observations and results were noted.

AGE

The patients age in Group S ranged from 18-60 yrs had a mean of 36.4110.959 .while in Group D patients age ranged from 18-60yrs with a mean of 34.73311.264 .When comparison was made between two groups t-value was 0.580 and p-value was 0.563.The values were statistically not significant.The data is shown below in table-1.

Table – 1 AGE

Age(Years)	Mean	SD	t Value	P value
GROUP S	36.4	10.95948652	0.58084316	0.56359644 NS
GROUP D	34.73333333	11.26463288		

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 minutes was noted no patients in Group S had a sensory block whereas 9 patients in Group D had sufficient block. At 15 minutes 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. The data is given below in table-2

Table - 2 PATTERN OF SENSORY BLOCK

SENSORY ONSET (min)	GROUP S	GROUP D
5-10	00	09(30%)
11-15	12(40%)	21(100%)
16-20	15(90%)	00
21-25	03	00
26-30	00	00

Time of onset of sensory block

The mean value of onset of sensory block in Group S was 17.0332.385 whereas in Group D mean value was 11.862.012.When compared between two groups p-value was statistically significant. The data is shown in table-3

Volume : 5 | Issue : 7 | July 2015 | ISSN - 2249-555X

SENSORY BLOCK

Table - 3TIME OF ONSET OF SENSORY BLOCK

Onset of Sensory block (min)	Mean	SD	t Value	P value
GROUP S	17.03333333	2.38505886	9.06801212	0.00001 Sig
GROUP D	11.86666667	2.01260393		

Effectiveness of Axillary plexus blockade

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 musculocutaneousnerve,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. The data is given below in table-4.

Table - 4EFFECTIVENESS 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
Radial nerve	20(66.6%)	30
Supplemented	04(13.3%)	00

Pattern of motor blockade

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 data is given below in table-5.

Table- 5 PATTERN OF MOTOR BLOCKADE

Motor blockade	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(3.33%)	0
Incomplete Radial nerve	10(33.3%)	2(6.6%)

TIME OF ONSET OF MOTOR BLOCK

The mean value of onset of motor block in Group S was 19.332.468.Where as mean value of onset of motor block in Group D was 14.932.448.When compared between two groups p-value was statistically significant. The data is given below in table-6.

Table - 6ONSET OF MOTOR BLOCK

Onset of Motor block(min)	Mean	SD	t Value	P value
GROUP S	19.33333333	2.468188409	6.93182582	0.00001 Sig
GROUP D	14.93333333	2.448551061		

TIME FOR COMPLETE MOTOR BLOCK

The mean value of time for complete motor block in Group S was 21.832.533 while in Group D the mean value was 17.762.473. When compared between the groups p-value was statistically significant. The data is given below in table-7.

Table -7 TIME FOR COMPLETE MOTOR BLOCK

Time for complete motor blockade(min)	Mean	SD	t Value	P value
GROUP S	21.83333333	2.5336812	6.2910926	0.00001Sig
GROUP D	17.7666666	2.4730732		

DURATION OF MOTOR BLOCK

The duration of motor block in Group S was 2.430.504 While in Group D the duration of motor block was 40.870. When compared between two groups the p-value was statistically significant. Group D patients had longer duration of motor block. The data given below in table-8.

Table – 8 DURATION OF MOTOR BLOCK

Duration of the block(hours)	Mean	SD	t Value	P value
GROUP S	2.4333	0.504007	8.527248173	0.000001 Sig
GROUP D	4	0.870988		

DURATION OF ANALGESIA (VAS SCORE)

At the end of 7 hours patients in both Groups S and D had VAS score of 44.664.34 & 35.164.25 respectively. Patients in both groups required rescue analgesia. It was analysed that patients in Group S required earlier rescue analgesia than group D patients.

Table - 9 DURATION OF ANALGESIA (VAS VALUES)

VAS Scores	GROUP S		GROUP D		t Value	P value
	Mean	SD	Mean	SD		
Post OP 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
2 hr	2.83333	8.6785	1.6667	6.3427	0.59447	0.55451 NS
3 hr	13.3333	11.472	1.6667	6.3427	4.87468	0.00001 Sig
4 hr	26.1667	5.3632	10.833	12.6	6.13286	0.00001 Sig
5 hr	32	5.8132	22.667	6.2606	5.98370	0.00001 Sig
6 hr	39	5.3175	30	4.3549	7.17202	0.00001 Sig
7 hr	44.6667	4.3417	35.167	4.2514	8.56292	0.00001 Sig

Volume : 5 | Issue : 7 | July 2015 | ISSN - 2249-555X

DISCUSSION

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[1,2,3,4].

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 musculocutaneousnerve[5,6,7].

Yamamoto K et al(7)also confirmed that the proximal spread is inhibited by 90˚arm 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 ZJ et al(8).

Thompson and Rorie(9) confirmed in their study in which injection were made in multiple sites and found local anesthetic tended to stay in isolated pockets.

SENSORY BLOCK

Lavoie et al(5).suggested that injecting a large quantity of local anaesthetic in a single site makes local anaesthetic to diffuse and to produce a block.

Inspite 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 F et al.(10) 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 minutes in single injection method and 11 minutes in double injection method. The speed of onset of sensory block was faster in double injection method due to to faster spread of local anaesthetic above and below the axillary artery.

Fu-Chao Lui FC et al.(11) in their study had block of 70% when all six nerves were blocked using peripheral nerve stimulator and ultrasound. Though there is a little difference in effectiveness of sensory block. They reported a 90% sensory block to the effect. In our study the block was 96% effective in Group D and 86.65% effective in Group S.

DubravkaBartolek et al.(12) 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 double injection method had faster onset of complete block than patients in single injection method. Results are in correlation with our study.

DURATION OF ANALGESIA

Patients in Group S at 3 ,5 and 7 hours had higher VAS values than in patients 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

Onset of motor block in patients of Group S was 19 minutes and in patients of Group D was 14 minutes. Patients in Group D had faster onset of motor block. In a study done by De Tran[13,14] 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 QH review(13,14).

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).Inspite 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.

No adverse effects were observed during our study. The theoretical concern for neuropraxia or peripheral neuropathy was not evaluated. There were no signs of local anaesthetic toxicity as the dose of lignocaine was within the prescribed range. They have been no anxiety to the patients as the procedure was thoroughly explained and patients had been sedated at the time of peripheral nerve stimulation.

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

From the present study of a comparison of single injection method and double injection method of axillary plexus block it can be concluded that

1. Axillary plexus block is a simple, reliable and safe technique. It can be used for surgeries of forearm and hand.
2. Axillary plexus block provides excellent quality of sensory and motor block.
3. Double injection method of axillary block has faster onset of sensory and motor block than single injection method.

Volume : 5 | Issue : 7 | July 2015 | ISSN - 2249-555X

4. Duration of analgesia is prolonged in double injection method.
5. Double injection method to be preferred over single injection method.
6. Side effects are minimal with axillary plexus block.

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