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A study on efficacy of brachial plexus block through axillary approach with regards to onset time and duration of blockade by using lignocaine chloride: A case control clinical study

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Abstract

Brachial plexus block via the axillary approach is good alternative in patients with limited arm mobility. The purpose of our study was to observe the block characteristics for the axillary approach for brachial plexus block in patients undergoing forearm and hand surgeries. After obtaining institutional approval and written informed consent, 50 patients of American Society of Anaesthesiologists grade I or II scheduled for forearm and hand surgeries were included in the study. Brachial plexus block was performed via the axillary approach. Sensory block in the distribution of individual nerves supplying the arm, motor block and duration of sensory block were recorded. Successful block was achieved in 90% of the patients in axillary approach. The axillary approach because of its easily identifiable landmarks, a comfortable patient position during the block procedure and the ability to block a larger spectrum of nerves should thus be considered as an effective alternative to the other approach.

Keywords: Axillary approach, sensory block, brachial plexus

Introduction

The axillary approach to block the brachial plexus has been widely used to provide anaesthesia for surgery of the forearm and hand. Its benefits include simplicity, reliability efficacy and safety ^[1]. However, this approach may be difficult in patients with limited movement of the shoulder or arm, as in those with painful injuries ^[2]. Also, with the standard single injection axillary block, reliable musculocutaneous nerve (MCN) and radial nerve anaesthesia is limited by anatomical conditions and success rates vary widely ^[3]. In 1995, Kilka and colleagues introduced the vertical infraclavicular block ^[4]. Favourable characteristics of this approach are less painful arm positioning for patients with fractures, reliability of the technique, easy identification of palpable landmarks (Even in obese patients) and the single injection make this block efficient. This technique is also advantageous for catheter based techniques compared to axillary approach ^[5, 6].

Materials and Method

Study design: Observational study

Place of the study

The present clinical study of "Brachial plexus block through axillary approach" was carried out at Dr VRK Women's Hospital attached to Dr VRK women's Medical College, Aziz nagar, Hyderabad.

Study period

The study was conducted from Feb 2019 to July 2019.

Study population

The study was conducted on 50 patients of age between 15 to 65 years of either sex (Using 1.5% lignocaine hydrochloride with epinephrine).

Inclusion criteria

- Patients of either sex aged between 15 to 65 years scheduled to undergo forearm and

hand surgical procedures.

- Patients of ASA physical status I and II.

Exclusion criteria

- Un co-operative patients
- Patients refusal
- Patients who are not able to abduct the arm.
- Patients with infection and cellulitis at the site of block.
- Patient’s with any upper extremity neurological diseases.
- Patient’s with history of allergy to local anaesthetics and hypersensitivity to drugs.
- Positive history or documented evidence of bleeding tendencies or patient’s on anticoagulants.
- Patients in whom adrenaline is contraindicated.

Investigations

The following investigations were done

- Blood: Haemoglobin %, Total Count, Differential Count, ESR, Bleeding Time, Clotting Time, blood Urea, Serum creatinine and Random blood sugar.
- Urine : Albumin, Sugar and Microscopy
- ECG and Chest X-ray P.A. view.
- HIV and HBsAg

Preliminaries included

1. Written informed consent.
2. Intravenous access - starting of an intravenous line with 20G /18 G intravenous cannula on the contralateral upper limb under aseptic techniques.
3. Premedication: Injection diazepam 0.2mg/kg body weight intravenously administered over 3 minutes, 10 minutes before performing the block (Maximum 10mg).

Local anaesthetic used

1.5% lignocaine hydrochloride with epinephrine.

Dose: 7mg/kg body weight of lignocaine with epinephrine

Equipments

A) For the procedure

A portable tray covered with sterile towels containing -

- 1) Sterile Syringes – 20 ml (2 no’s), 5ml (2 no’s)
- 2) Sterile Hypodermic needles of 2.5cms length 22g - 2.
- 3) Bowls containing iodine and spirit.
- 4) Sponge holding forceps.
- 5) Towels and towel clips.
- 6) Drugs: 2% lignocaine hydrochloride with adrenaline (1:200,000) and distilled water.

B) For emergency resuscitation

The anaesthesia machine, emergency oxygen source (*E’ type cylinder), pipeline O₂ supply, working laryngoscopes, appropriate size endotracheal tubes and connectors.

- Working suction apparatus with suction catheter
- Airways (Oropharyngeal)
- Intravenous fluids.

Drugs: Thiopentone, diazepam, Succinylcholine, hydrocortisone, atropine, adrenaline, ketamine, aminophylline, mephenteramine, calcium gluconate and sodium bicarbonate.

Monitors: ECG, Pulse oximetry, Non-invasive blood pressure monitor on the contra lateral upper limb, visceral monitoring of respiratory rate.

Results

Demographic data

Table 1: Sex distribution

Sex	No. of cases	Percentage
Male	38	76.0
Female	12	24.0
Total	50	100

In the present study, of total study population 76% (n=38) patients were male and 24% (n=12) were female.

Table 2: Shows the distribution of patients

Sex	Elective	Emergency	Total
Male	32	6	38
Female	10	2	12
Total	42 (84)	8 (16)	50 (100)

Table 3: Age distribution

Age in years	Male	Female	Total
16-25	10	2	12
26-35	16	4	20
36-45	6	4	10
46-55	1	1	2
56-65	5	1	6
Total	38	12	50

Table 4: ASA grades among study population

	ASA Grade I	ASA Grade II	Total
Emergency	7	1	8
Elective	35	7	42
Total			50

All the Patients selected for study belonged to ASA Grade I & II. ASA Grade-I patients constituted the largest group (n=42) 84%.

Table 5: Onset time of the blockade

	Minimum onset time (min.)	Maximum onset time (min.)	Average onset time from all the Patients (min.) ±SD
Sensory block	12	26	18.8 ± 3.3
Motor block	5	20	12.9 ± 3.6

Onset of sensory block was evident by absence of pain to pin prick over the areas of distribution of major nerves of forearm. Fastest onset time being 12 minutes and slowest onset time being 26 minutes. Average onset time was 18.8

(±3.3 SD) minutes. Similarly the minimum onset time of motor block was 5 minutes. Maximum onset time of motor block was 20 minutes. Average onset time from all the patients being 12.9 (±3.6 SD) minutes.

Table 6: Duration of blockade

	Least duration (min.)	Maximum duration (min.)	Average from all cases (min.) ± SD
Sensory blockade	90	240	221.3 ± 29.8
Motor blockade	120	210	188.9 ± 27.6

Duration of sensory blockade on an average was 221.3 (± 29.8 SD) minutes, shortest being 90 minutes; longest being 240 minutes. Similarly duration of motor blockade on an average was 188.9 (± 27.6 SD) minutes, minimum duration being 120 minutes and maximum duration being 210 minutes.

Discussion

Brachial plexus block as a regional technique has been in practice since 1884. It has not lost popularity even today, though it is in practice from such long time. With the advent of perivascular concept, brachial plexus anaesthesia may be likened to peridural anaesthesia, with the axillary technique of brachial plexus block being analogous to caudal block, the subclavian perivascular technique being analogous to a lumbar epidural block and interscalene technique being analogous to a thoracic epidural block.

In other words, just as in peridural technique, once the space surrounding the nerves has been entered only single injection is necessary and the extent of anaesthesia that results will depend upon the volume of local anaesthetic utilised and the level at which it is injected.

An advantage of brachial plexus anaesthesia over peridural technique results from the fact that the perivascular space is surrounded throughout its course by soft tissue, whereas the peridural compartment is encased in bone. The perivascular compartment can be deformed by extrinsic pressure to facilitate the flow and distribution of local anaesthetic injected where as this is impossible in peridural techniques. A properly applied digital pressure, the needle direction, position of arm and even to a lesser degree the size of patient, all can have significant effect on the level of anaesthesia resulting from a given volume of local anaesthetic. The anatomical concept of continuous perineural and perivascular space surrounding the brachial plexus from roots to terminal nerves was challenged briefly by Mathews who on the basis of roentgenographic studies using radio opaque dye in cadavers, proved the fact that the supra and infraclavicular portion of the space were separated by coracoclavicular fascia. This thesis has been refuted by Alon P. Winnie [7] both by roentgenographic studies using radio opaque dye in living subjects and by repeated clinical demonstration that high brachial and even cervical plexus anaesthesia may be produced by injecting large volume of anaesthetic solution into the axillary sheath. The present study of axillary brachial plexus block was undertaken at Department of Anaesthesiology, Dr. V.R.K women's Medical College.

The present study was on 50 Patients belonging to both sexes, of them 38 were males and 12 were females. Among the 50 cases 8 were emergencies and the rest 42 were elective cases.

Age distribution

The age group ranged from 16 years to 65 years. The maximum number of blocks were performed in the age group of 26 to 35 years (20 patients) and minimum between 46 to 55 year age group. In the present study very young patients were not selected because of lack of co-operation.

Accardo and Adriani have done this block in age group ranging from 1 year to 60 years [8].

The present study correlated with the previous study, A.P. Winnie (1983) has used all routes of block in infants and children using 25 or 36 gauge needle [7].

The present study included 8(16%) emergency cases of which 6 were males and 2 females and 42 (84%) elective cases of which 32 were males and 10 were females.

In the present study the local anaesthetic agent used was 1.5% of Lignocaine Hydrochloride with epinephrine the volume being 30 ml (Max.). This is similar with that of previous studies; Atkinson Lee in the text book advocated 1.5 to 2% lignocaine 20 to 25 ml with adrenaline for axillary brachial plexus block [9]. Moore D.C. (1970) advocates that lignocaine or mepivacaine be the local anaesthetic agents of choice for the axillary approach; in adults he used 10-50 ml of 1%-1.5% lignocaine solution with or without epinephrine. The maximum dose Moore D.C. advocated is 500 mgs of lignocaine for adults [10].

Wylie and Churchill Davidson (1984) [11] advise 15-20 ml each of 1% lignocaine for axillary brachial plexus block on two sides of axillary artery to avoid failure or partial block on using too small volumes of solution, especially if spread to more proximal parts of plexus is desired, whereas Wedel & Brown in "Anaesthesia" (Ronald D. Miller) [2] advise 10-15ml of local anaesthetic solution on each side of artery with two separate injections [12].

Plevak D.J. *et al.* (1983) used 1% and 1.5% of lignocaine for axillary brachial plexus blocks using 40 to 60 ml of solution with or without epinephrine [13].

Until recently, for choosing a local anaesthetic agent capable of providing appropriate anaesthesia, the limiting factor has been duration of action. Today, local anaesthetic agents, with duration of actions which range from about 20 minutes to 12-24 hours depending on the concentration and volume of the agents and presence or absence of vasoconstrictor, are available. The duration of anaesthesia can be tailored to the individual surgical procedure.

Gale E. Thompson & David L. Brown, advice fan-wise injection of 10ml each of local anaesthetic on each side of artery [14].

In the present study 1.5% lignocaine hydrochloride solution with epinephrine was used for the following reasons.

1. Onset of action & the penetrating capacity is good because of higher concentration of lignocaine (1.5%) used. Also there is less chance of missed segments.
2. The duration of analgesia was prolonged, toxic effects were minimised because of presence of epinephrine.
3. Easy availability of the drug in the market.

Site and nature of the operation

In the present study the site of injection is selected as per Reding's (1921) technique of axillary brachial plexus block, from 'plexus anaesthesia' by Alon P. Winnie [7]. It is at the inferior border of the Pectoralis major muscle and just below the coracobrachialis muscle, where axillary artery is well palpated.

It is at this site where the needles can be fixed easily and the dancing of needle is well appreciated.

- Those cases with injuries below the elbow or manipulation for fractures below the elbow were selected.
- According to Moore D.C (1970) ^[10] the indication for the axillary approach of the block are;
- Surgical: operations or manipulations of the forearm and hand.
- Therapeutic: Severe pain of upper extremity such as that caused by acute bursitis or herpes zoster.

Table: Onset of motor blockade

Sl. No.		Onset of motor blockade (in min.)	
		Minimum	Maximum
1	Egon Lanz <i>et al.</i>	5	-
2	Present study	5	20

In the study group of 50 cases of axillary brachial plexus block after administration of local anaesthetic, fastest onset of motor block was 5 minutes and longest onset was 20 minutes.

Egon lanz *et al.* reported onset time for motor blockade as 5 minutes which is comparable to the present study ^[15]. Longest onset time in present study was 20 minutes.

Table: Onset of sensory blockade

Sl. No.		Onset of Sensory blockade (in min.)	
		Minimum	Maximum
1	Mackay LA, Bowden DF,	-	32.5
2	Moore DC <i>et al.</i> ,	7	15
3	Present study	12	26

The onset time for analgesia in our study was between 12 to 26 minutes. The minimum onset time was 12 minutes in the present study.

The maximum onset time in this study was 26 minutes. Whereas median time of onset was 32.5 min. These results correlated with the results of previous studies of Mackay LA, *et al.*, and Moore DC, *et al.*, of 15 minutes ^[16, 10].

Dejong on the basis of theoretical model concluded that motor nerves are blocked last and recover first, the duration of motor blockade is shorter than that of sensory block and sensory block persists long after motor function has recovered. The critical concentration required to block motor fibres being greater than that of pain fibres. Motor function returns before pain perception, both spreading in a proximal to distal direction ^[17].

Egon Lanz *et al* (1983) ^[15] have noticed the development of motor blockade before sensory blockade. This may be due to the arrangement of motor fibres in the mantle and sensory fibres in the core of the trunks and cords. Thus local anaesthetic diffuses first through the motor fibres and blocks them prior to or simultaneously with blockade of sensory fibres.

Alon P. Winnie (1983) ^[7] has shown in humans that, provided the concentration of local anaesthetic injected is greater than the critical concentration of that agent needed to block motor nerves, the onset of motor blockade precedes or at least occurs simultaneously with the onset of sensory blockade, first on the mantle bundles and then in the core bundles.

In the present study it is observed that motor blockade developed before sensory blockade. The minimum onset

time for motor blockade was 5 minutes, where as for sensory blockade it is 12 minutes. This compares with the observation made by Egon Lanz & Alon P. Winnie ^[15, 7].

The more rapid development of motor blockade makes it possible to predict the success of block within few minutes after injection of local anaesthetic.

Duration of blockade

Table: Duration of sensory blockade

	Duration of sensory blockade (In minutes)
Mackay CA, Bowden DF	240
Moore DC, <i>et al.</i>	120-180
Present study	90-240

In the present study duration of sensory blockade varied from 90 minutes to 240 minutes. The present findings are similar to that of Moore DC, *et al.*, who noted that duration of analgesia lasted for 120-180 minutes ^[10]. According to Mackay CA and Bowden DF, duration of analgesia lasted for 240 minutes ^[16].

Alon P. Winnie (1983) ^[7] says the duration of analgesia can be prolonged by adding vasoconstrictors. For prolonged anaesthesia of 10-12 hours bupivacaine 0.5% or etidocaine 0.5 to 1% are both effective. With 1% lignocaine the analgesia lasts for 1 to 1.5 hours. The results in this study are comparable to those of Moore DC ^[10].

Conclusion

From the observations made in this study of 50 patients, involving procedures under the axillary brachial plexus block, it is evident that this technique of brachial plexus block can be performed with least armamentarium. It is an alternative form of providing anaesthesia for forearm and hand surgeries in accident and emergency situations in different age groups. The perivascular double injection technique is easy to perform, very reliable, safe with least complications, well tolerated by patients, an efficient, economical method and have the advantage of postoperative analgesia. The preoperative preparation and the need for postoperative care is minimal.

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Conflict of interest

No conflict of interest

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