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AN OBSERVATIONAL COMPARATIVE STUDY ON PERIPHERAL NERVE STIMULATOR GUIDED BRACHIAL PLEXUS BLOCK FOR FOREARM SURGERIES: INFRACLAVICULAR VERSUS AXILLARY APPROACH

Anaesthesiology

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ABSTRACT

Background and Aim: To compare infraclavicular versus axillary approach for brachial plexus block in terms of characteristics of sensory and motor blockade and block performance time. **Method:** Patients posted for forearm orthopaedic surgeries under ASA grade II, III were included in this study. In (group I) infraclavicular group, block was given by single needle through modified infraclavicular approach. In (group A) Axillary group, block was given by double needle stimulation technique , one at musculocutaneous nerve selectively and another at any one of the 3 major nerves of forearm (Radial, Median or Ulnar) stimulated through PNS. Total 37ml local anaesthetics was given. Musculocutaneous nerve, Radial, Median, Ulnar, Intercostobrachial and Medial cutaneous nerve of arm and forearm were evaluated for study. **Results:** Total 60 patients, 30 in each group were included. Time to perform block was statistically less in group I (5.86min ±2.08) then in group A(10.76min±2.92) [p <0.0001]. Incidence of blockade of Musculocutaneous, Ulnar, Radial, Median and Medial cutaneous nerve of arm and forearm in both groups were comparable. Incidence of blockade of Intercostobrachial nerve was statistically less in group I (7%) than in group I (67%) (p<0.001). Success rate in group A was 93% and in group I was 100%(p>0.05) statistically not significant. Total duration of sensory blockade was statistically and clinically more in group I than group A. [sensory blockade in group I (576.65 min±38.06), in group A (493.03min ±45.73) (p < 0.0001)]. Total duration of motor blockade was statistically and clinically more in group I than group A and (motor blockade in group I (532.5min±39.62), in group A (444min±46.11), (p < 0.0001). There were no complications noted in any of the groups. **Conclusion:** We infer that infraclavicular brachial plexus with easily palpable landmark, comfortable positioning during block procedure in painful arm injuries, takes shorter block performance time, ability to block larger spectrum of nerves and longer duration of sensory and motor blockade thus seems to be better alternative to axillary approach.

KEYWORDS

INTRODUCTION

The axillary approach has been widely used to provide anaesthesia for surgery of forearm and hand and it was commonly considered to be a "gold standard" technique for surgery of forearm and hand. Its benefit includes simplicity, reliability, efficacy and safety and can also be performed without using a neurostimulator when using the transarterial technique. But often multiple stimulation of terminal branches is required to improve block effectiveness and its application may be difficult in patients with limited movement due to painful arm injuries[(2).]

The infraclavicular block technique was described in 1917 by Bazy and has been modified by Raj et al. in 1973 and Sims in 1977 (2). In 1995, Kilka and colleagues introduced the vertical infraclavicular block[(3).] This block can be performed with paraesthesia (landmark guided techniques), by neurostimulation (by stimulating nerve with help of nerve locator) or under guidance of ultrasonography.

So in this study, we aimed to compare the technique and characteristics between newer infraclavicular with old one axillary approach of brachial plexus block for undergoing forearm and hand orthopaedic surgeries with the help of peripheral nerve stimulator by assessing block performance time, onset and total duration of sensory and motor blockade and identifying block related side effects, any complications and haemodynamic changes.

MATERIAL AND METHODOLOGY

After clearance from institutional ethical committee patients posted for planned forearm and hand orthopedic surgeries and had given written informed consent, belonging to ASA grade II, III of either sex, between the age group of 18-65 years were included in study. Patients having contraindication for regional block like, infection at local site, coagulopathy, with pre-existing neurological disorders like, peripheral neuropathy, h/o previous nerve injury, BMI > 35 kg/m² were excluded from study. All Patients were premedicated with inj. Dexmedetomidine 1 mcg/kg intravenously over 10 minutes. All blocks were given using 37 ml of local anaesthetics (20 ml of 0.5 % Bupivacaine + 15 ml of 2 % Lignocaine with adrenaline + 2 ml of Dexamethasone 4mg/ml).[(4)]

For Infraclavicular approach patients were placed in supine position with head turned away from the side to be blocked and arm to be operated was adducted and forearm was rested on abdomen. The coracoid process was palpated and a 22 G insulated needle was inserted at 2cm medial and 2cm caudal to the most prominent part of the coracoid process. Using PNS the nerve was identified by observing an adequate motor response (Flexion or extension at interphalangeal joints) and then total volume of drug was injected with repeated negative aspiration.

For the Axillary approach a double injection technique in which the Musculocutaneous Nerve was selectively stimulated in addition to any one of the remaining three major nerves (Median, Ulnar and Radial). Patients were placed in supine position with arm abducted at 90° and elbow flexed at 90°with head turned away from operating site. Axillary Artery was palpated at the highest point in axillary groove. After that a 22 G insulated needle was connected to PNS and nerve identification was done by observing an adequate motor response. First, the Musculocutaneous Nerve was stimulated within the substance of coracobrachialis muscle by observing arm flexion and 12 ml of drug volume was injected to block it. then any one of the 3 major nerves (Ulnar, Median or Radial) was stimulated within the Axillary sheath as confirmed by the appropriate motor response (flexion or extension of interphalangeal joints) and the remaining volume (25 ml) of drug was injected with repeated negative aspiration.

Sensory blockade of individual nerve was assessed by cutaneous innervation. Musculocutaneous nerve (lateral aspect of forearm), Ulnar nerve (skin over medial surface of hand), Radial nerve (posterior aspect of forearm), Median nerve (anterolateral surface of hand, Medial cutaneous nerve of arm and forearm (medial aspect of arm) and forearm and intercostobrachial nerve (medial aspect of arm).

Motor blockade of individual nerve was assessed by arm flexion (musculocutaneous), flexion of fingers (median), flexion of little and forth finger (ulnar), extension of fingers (radial).

Those patients who had complete sensory block in their entire distribution of forearm except intercostobrachial nerve and didn't required general anaesthesia considered as complete block. Those patients with nil or incomplete sensory block in some of these nerves

and supplemented with minimal sedation in form of Inj. Ketofol defined as incomplete block. Complete and incomplete both block considered as successful block. Those patients who had absence of sensory block in all major nerves or presence of sensory block in only one of these nerves and required general anaesthesia defined as failed block.

Post operatively appearance of finger movement and sensation at finger tips was considered as end point of motor and sensory block respectively. We have looked for side effects and complications like pneumothorax, vascular injury, tinnitus, dizziness, circumoral numbness, seizures, local anesthetics agent toxicity.

Statistical Analysis

The standard analysis was done with the help of Open EPI software, and student t test was applied and p value < 0.05 was considered significant. All the data were entered in Microsoft Excel program work sheet.

Quantitative data were expressed as mean ± standard deviation. Qualitative data were expressed as percentage. Mean and SD were calculated for demographic data, vital parameters was noted. Statistical analysis was done using student's t-test in Open EPI software. P<0.05 was considered as statistically significant. P>0.05 was considered as statistically insignificant. P<0.001 was considered as highly significant.

Observation And Results

Primary aim of study was to assess the time to perform block and sensory and motor blockade characteristics. Secondary aim was to asses hemodynamic changes and block related side effects and complications.

Total 60 Patients of age in range of 18 to 65 years scheduled to undergo forearm & hand surgeries were included in this study.

Table 1: Demographic Data

	Group A (n=30)	Group I (n=30)	P value
Mean Age ± (year) SD	34.63±11.62	40.36±11.85	>0.05
Male Female	25 (84%) 5 (16%)	21 (70%) 9 (30%)	>0.05

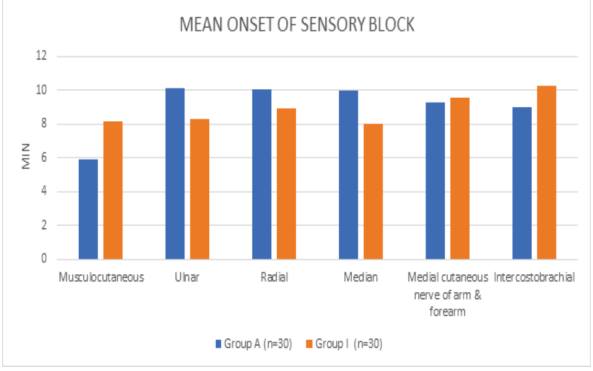
Mean time to perform block in group A was 10.76 (min)± 2.92 and in group I was 5.86 (min) ± 2.08, (p<0.0001).

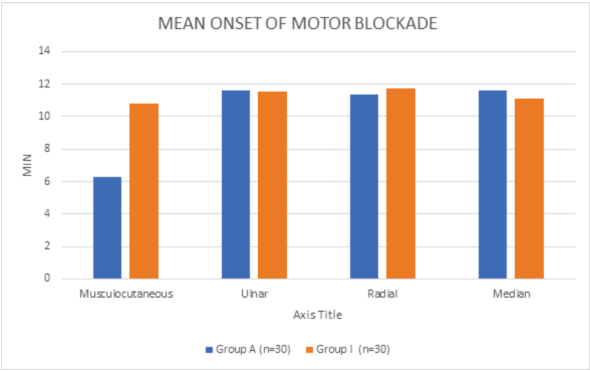
Table 2: Incidence Of Blockade Of Nerves

Incidence of blockade of nerves	Group A (n=30)	Group I (n=30)	P value
Musculocutaneous	29 (97%)	28 (93%)	>0.05
Ulnar	29 (97%)	29 (97%)	>0.05
Radial	27 (90%)	30 (100%)	>0.05
Median	28 (93%)	29 (97%)	>0.05
Medial cutaneous nerve of arm and forearm	27 (90%)	23 (77%)	>0.05
Intercostobrachial	2 (7%)	20 (67%)	<0.00001

Table 3: Success Rate Of Block

	Group A (n=30)	Group I (n=30)
Successful block a) Complete block b) Patchy block	28 (93%) 26(87%) 2 (7%)	30 (100%) 28(93%) 2(7%)
Complete failure	2 (7%)	0





Mean total duration of sensory blockade in group A was 493.03 (min)± 45.73 and in group I was 544 (min)± 38.06, statistically highly significant. (p<0.0001). Mean total duration of motor blockade in group A was 476.65 (min)± 46.11 and in group I was 532.5 (min)± 39.62, highly significant. (p<0.0001)

The baseline mean pulse rate was 86.73 ± 7.70 min in group A while 90.66±10.56 min in group I. There was no statistically difference in mean pulse rate after giving block and at 15 minutes of interval up to 60 minutes except at 30 minutes where the difference was significant.

The baseline mean systolic blood pressure was 119±9.94mm of Hg in group A and 119.33±6.91mmHg in group I. There was no statistically significant difference in mean systolic blood pressure from the baseline value throughout the observation period of 60 minutes (p>0.05).

The baseline mean oxygen saturation was 98.43±0.50 % in group A and 98.06±0.73% in group I. There was no statistically significant difference in mean oxygen saturation from the baseline value throughout the observation period of 60 minutes (p>0.05).

There were no any side effects nor complications like pneumothorax, vascular injury, tinnitus, dizziness, circumoral numbness, seizures, local anesthetics agent toxicity noted in both groups.

DISCUSSION

Block performance time was calculated from the time PNS needle was inserted till the drug was given. In my study more time was required to perform block in group A. As, in this group we used double needle technique to selectively block Musculocutaneous nerve in body of coracobrachialis muscle and any one of major nerve of forearm (Radial/ Median/ Ulnar) because Musculocutaneous nerve leaves the neurovascular compartment at the level of coracoid process, so there is high chances of sparing in axillary approach and musculocutaneous nerve provide sensory innervation of lateral part of forearm. My observation which was similar to study done by Arnaud Deleuze et al 2003, Z. J. Koscielniak-nielsen et al 2005[9], In Ae Song et al 2011[10]. In above all study they use multiple stimulation technique in axillary approach which increases block performance time.

A study done by Z. J. Koscielniak-nielsen et al 2000, [8] observed that block performance time was similar in both groups, but block latent time was significantly shorter after axillary block and therefor patients in this group were sooner ready for surgery than patients in group I. (Block latency time was defined as the time from end of the initial block procedure until the analgesia was complete). Similar block performance time in both groups was explained by more comprehensive experience of anaesthetist with axillary blocks and deeper position of the cords in infraclavicular block.

Vikram Lahori et al 2011, [2] conducted a study titled "A randomised comparative study or efficacy of axillary and infraclavicular approaches for brachial plexus block for upper limb surgery using PNS". They assessed Musculocutaneous, Radial, Median, Ulnar, Medial cutaneous nerve of arm and forearm and Intercostobrachial nerve for onset duration of sensory and motor blockade and incidence of blockade.

Incidence of blockade of Musculocutaneous, Ulnar, Radial, Median and Medial cutaneous nerve of arm and forearm in both groups were comparable. Had statistically insignificant difference. My findings were similar to study done by Arnaud Deleuze et al 2003, [1] observed

that blockade of Musculocutaneous (100% v 98%), Median (100% v 98%), Radial (96% v 98%), Ulnar (92% v 90%), medial cutaneous nerve of forearm (100% v 42%) in group A and group I respectively. In this comparative study they used single stimulation in group I and triple stimulation to selectively block Radial, Median/Ulnar and Musculocutaneous nerve in group A so more incidence of blockade of Musculocutaneous, ulnar and median nerve. But in both groups difference was statistically insignificant.

Incidence of blockade of Intercostobrachial nerve in group A was 2 (7%) and in group I was 20 (67%) ($p<0.001$). statistically highly significant difference. Intercostobrachial nerve is a lateral cutaneous branch of second intercostal nerve and innervate medial part of arm, which was linked to tourniquet pain and was not directly linked to surgical site and we did not observe tourniquet pain so none of those patient with sparing of this nerve did not required any supplementation. This finding was similar to study done by Vikram Lahori et al 2011, [2] observed that blockade of Musculocutaneous nerve (97% v 90%), Median (80% in both groups), Radial (80% v 87%), Ulnar (77% v 90%), medial cutaneous nerve of forearm (83% v 73%) in group A and group I respectively. The difference between two groups were statistically insignificant except in case of Intercostobrachial nerve blockade (10% in group A & 77% in group I) in which difference was statistically significant.

Linda Le-Wendling 2021-22, [11] conducted a study on role of an Intercostobrachial nerve block in alleviating tourniquet pain. They explained that placement of an infraclavicular block spills into area where Intercostobrachial nerve traverses and results in an unanticipated spread in this distribution.

Success rate in group A (n=30) was 28(93%) and in group I (n=30) was 30(100%). ($p>0.05$) statistically not significant. In group A, 26 (87%) patients and in group I, 28 (93%) patients had complete block and didn't require any supplementation. In group A, 2 (7%) patients had patchy block and received IV supplementation. First patient had sparing of Median nerve and second patient had sparing of Radial nerve. In group I, 2 (7%) patients had patchy block and received IV supplementation. one patient had sparing of median nerve and medial cutaneous nerve of arm and forearm. And second patient had sparing of Ulnar nerve and medial cutaneous nerve of arm and forearm. In group A, 2(7%) patients' majority of nerve had absence of anaesthesia and general anaesthesia was given and considered as failed block.

Success rate in both groups in my study was similar to study done by S. Kapral et al 1999, [5] observed that successful block was 85% in group A while 100% in group I. In group A three patients had insufficient block and patients showed an absence of anaesthesia of ulnar, radial, median and musculocutaneous nerve and general ansesthesia was given. In group I two patients had missing of median cord anaesthesia and peripheral nerve block were performed.

The mean onset of sensory and motor blockade of all nerves in both groups were comparable except of Musculocutaneous having statistically significant early onset of sensory and motor blockade in group A. Because in group A we first selectively blocked Musculocutaneous nerve then any one of the major nerve of forearm. My observations were similar to study which was done by Arnaud Deleuze et al 2003, [1] observed that there was no difference in onset of sensory and motor blockade in both groups except for a shorter time to achieve block of the Musculocutaneous nerve in group A.

Total duration of sensory blockade was calculated from onset of sensory blockade to appearance of sensation over finger tips. Total duration of motor blockade was assessed from onset of motor blockade to appearance of finger movements. There is statistically and clinically more duration of sensory and motor blockade in group I than group A. Vikram Lahori et al 2011,[2] observed that the mean duration of block in group I was 332 min ± 44 and in group A was 338 min ± 43. The difference was statistically insignificant. Vikram Lahori et al used 40 ml volume of local anaesthetic (20 ml Inj. Bupivacaine 0.5% + 10 ml Inj. Lignocaine + inj. Normal Saline). In group A they used 10 ml for Musculocutaneous and 30 ml for remaining one of three major nerve of forearm. In our study we used total 37 ml volume of local anaesthetic (20 ml Inj. Bupivacaine 0.5% + 15 ml Inj. Lignocaine with adrenaline + 2 ml Inj. Dexamethasone). In group A we used 12 ml for musculocutaneous and 25 ml for remaining nerves to be block.

There was no statistically difference in mean pulse rate after giving block and at 15 minutes of interval up to 60 minutes except at 30 minutes where the difference was significant. There was no statistically significant difference in mean systolic blood pressure and mean oxygen saturation from the baseline value throughout the observation period of 60 minutes ($p>0.05$). my observations are supported by study done by S. Kapral et al 1999, [5] conducted a study and compared Lateral Infraclavicular plexus block with Axillary block for hand and forearm surgeries. They observed that heart rate, systolic and diastolic pressure, oxygen saturation and respiratory rate remained stable in all study patients.

CONCLUSION

We infer that infraclavicular brachial plexus with easily palpable landmark, comfortable positioning during block procedure in painful arm injuries, shorter block performance time, ability to block larger spectrum of nerves and longer duration of sensory and motor blockade seems to be better alternative to axillary approach.

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