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Original Research Article

Randomized Control Trial to Compare the Efficacy of Infraclavicular Block versus Axillary Block Using Ultrasound and Peripheral Nerve Stimulator in Upper Limb Surgeries

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Abstract:

Background and Aim: The combined use of Peripheral nerve stimulator (PNS) and Ultrasound (USG) has added advantage of real time visualization and reduced number of needle passes to reach the target nerve group which in turn shortens the time required to perform the block and thus increasing the success rate. The aim was to compare the efficacy of infraclavicular block and axillary block using ultrasound and peripheral nerve stimulator in upper limb surgeries in a tertiary care centre.

Material and Methods: 60, ASA grade I-II patients, age 18 to 50 years, weighing between undergoing upper limb surgery under regional anaesthesia were equally allocated in two groups. GROUP I- USG and PNS guided Vertical Infraclavicular block (n=30) GROUP A- USG and PNS guided Axillary block (n=30). Hemodynamic parameters, onset of sensory and motor blockade, total duration of blockade and VAS score were compared.

Results: Onset of sensory block, in group I was 794.9 ± 54.91 seconds and in group A was 802.4 ± 57.87 seconds. Onset of motor blockade, in group I was 943.1 ± 54 seconds and in group A was 949.4 ± 56.46 seconds. Total duration of block, in group I was 721.6 ± 56.27 minutes and in group A was 701.5 ± 77.98 minutes. Hemodynamic stability in terms of heart rate, systolic, diastolic and mean arterial blood pressure was observed and noted that all the patients in both the groups were haemodynamically stable.

Conclusion: Peripheral nerve blocks (PNB) have an increasingly important role in ambulatory anaesthesia and have many characteristics of the ideal outpatient surgical anaesthesia with prolonged postoperative analgesia, early ambulation and facilitated discharge with less hospital stay.

Keywords: Axillary block, Hemodynamic Parameters, Peripheral nerve stimulator, Ultrasound.

Introduction

Surgical procedures involving hand and forearm can be performed either with general anaesthesia or regional anaesthesia techniques.

Peripheral nerve blocks are gaining widespread popularity for perioperative pain management because of their distinct advantages over general and central neuraxial anaesthesia. 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 anaesthesia. [1,2] The benefits of performing a surgery under regional anaesthesia far outweigh the risks of general anaesthesia. Peripheral nerve blocks also provide postoperative pain relief which contributes to improved patient satisfaction, stable hemodynamic, early ambulation, decreased length of hospital stay and hospital cost. [3,4]

Brachial plexus block has stood the test of time for upper limb surgeries. Peripheral nerve block of upper limb includes the various techniques of brachial plexus block. Axillary block is a distal brachial plexus block targeting the cords at the level of the axilla where they are positioned surrounding the axillary artery. Infraclavicular block is a proximal brachial plexus block which

targets the plexus at the level of the cords before the musculocutaneous nerve exits the brachial plexus sheath. [5]

Initially nerve block was performed with paraesthesia technique followed by nerve stimulator technique. Since the introduction of ultrasound into clinical practice, it has become a valuable adjuvant for peripheral nerve blocks. Initially used in conjunction with nerve stimulation, ultrasound guidance has increasingly been used as the sole to localize and anaesthetize the brachial plexus. Ultrasound guidance also provides excellent localization and hence increases the safety margin. [6,7]

The combined use of Peripheral nerve stimulator (PNS) and Ultrasound (USG) has added advantage of real time visualization and reduced number of needle passes to reach the target nerve group which in turn shortens the time required to perform the block and thus increasing the success rate. [8] The volume of drug required for nerve blockade has also decreased due to combined use of the Peripheral nerve stimulator (PNS) and Ultrasound guidance (USG). Hence the aim was to compare the efficacy of infraclavicular block and axillary block using ultrasound and peripheral nerve stimulator in upper limb surgeries in a tertiary care centre.

Materials & Methods

The present study is the randomized control trial, done in the Department of Anaesthesiology, GMERS Medical College, Sola, Ahmedabad. The study was done for the period of two years. All patients undergoing upper limb surgery as per inclusion criteria were included in the study.

Inclusion Criteria:

Patients with age group of 18-50 years, ASA grade 1 or 2, Patients coming for forearm and hand surgeries, weights ranging from 50 to 80 kg, height ranging from 145 cm to 185 cm were included in the study

Exclusion Criteria:

Patient with ASA grade III and IV, Patient refusal, shoulder and above elbow surgeries, allergy to amide group local anaesthetics, with pregnancy and lactation, patients on anticoagulants or bleeding disorders, local site infection, Neurological and Psychiatric disorders, Significant alcohol, drug or medication abuse, Patients who fail to achieve desired sensory and motor blockade were excluded from the study.

ASA grade I-II patients, age 18 to 50 years undergoing upper limb surgery under regional anaesthesia were equally allocated in two groups after taking Institutional Ethical committee approval as per hospital rules & regulations. After taking written informed consent from every patient in their own language, injection of local anaesthetic using ultrasound and peripheral nerve stimulator was administered as follows:

- Group I (n=30) received 30 ml of drug (20 ml of 0.5% ropivacaine (5 mg/ml) + 10 ml of 2% lignocaine (20 mg/ml)).
- Group A (n=30) received 30 ml of drug (20 ml of 0.5% ropivacaine (5mg/ml) + 10 ml of 2% lignocaine (20mg/ml)).

The average duration of surgery was between 45-60 minutes. Preanesthetic check-up of all the Patients was done for through history, examination and investigations. On the day of operation, all the patients were re-assessed in pre-operative anaesthesia room for NBM status, consent and baseline vital data were recorded. Patients were premedicated with injection ondansetron 0.15 mg/Kg. Under all aseptic and antiseptic precautions regional anaesthesia technique was performed as described under-

Parameters Evaluated

1. Sensory block Characteristics:

The level of sensory block was evaluated by loss of pinprick test.

Scoring system for sensory blockade:

0. Painful sensation on the site of surgery.

1. Sensation is present but no pain.

2. No sensation at the site of surgery.

2. Motor blocks Characteristics:

- 0% - Flexion and extension in both the hand and arm against resistance.
- 33% - Flexion and extension in both the hand and arm against gravity but not against resistance.
- 66% - Flexion and extension movements in the hand but not in the arm.
- 100% - No movement in the entire upper limb.

3. Hemodynamic parameters:

HR, SBP, DBP, MAP, and SpO2 recorded at 5, 10, 15, 20, 30, 60 minutes and 2, 4, 6, 8, 10, 12, 14 hours. When the MAP and/or the HR decreased to less than 25% from baseline, patients were treated respectively with injection mephenteramine 6 mg and/or atropine 0.02 mg/kg intravenously, dose titrated according to response.

Statistical Analysis

Descriptive analysis of numerical data (mean ±SD) and categorical data (frequency and percentage) was performed. Statistical tests like student's unpaired t-test were used for continuous variables

as per normality distribution of data using SPSS Statistics software and a p-value of <0.05 was considered statistically significant.

Results

Sixty, ASA grade I-II patients, age 18 to 50 years undergoing upper limb surgery under regional anaesthesia were equally allocated in two groups Group I(n=30) received 30 ml of drug (20 ml of 0.5% ropivacaine + 10 ml of 2% lignocaine) and Group A(n=30) received 30 ml of drug (20 ml of 0.5% ropivacaine + 10 ml of 2% lignocaine). The sensory, motor, duration of blockade and hemodynamic characteristics were compared between the two groups. Statistical tests like student's unpaired t-test were used for continuous variables as per normality distribution of data and a p-value of <0.05 was considered statistically significant. The following were the observations: Both the groups, Group I and Group A are matched for gender, with the difference being statistically insignificant. There were 30 males, 15 in each group and same number of female patients in each group. (Figure 1)

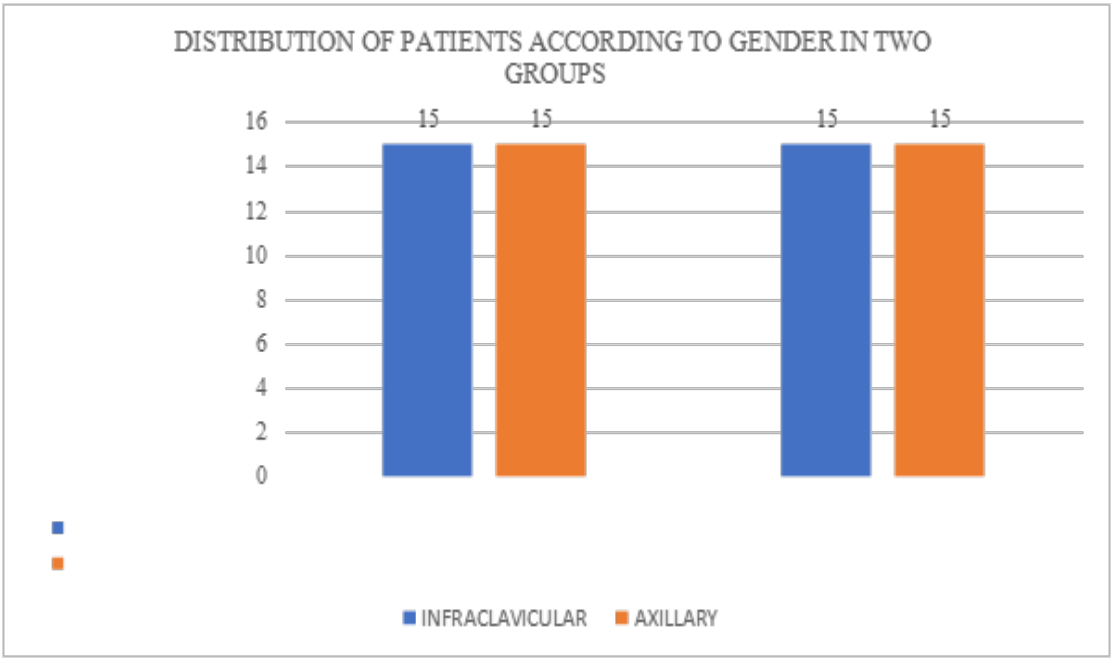

Figure 1: Distribution of Patients According to Gender in Two Groups

Patients were in the age group of 18 to 50 years in both the groups. Both groups were comparable in terms of age, weight, height and BMI. The difference was found to be statistically insignificant (p >0.05) in terms of demographic data. (Table 1)

Table 1: Distribution of Patients According To Age, Height, Weight, BMI in Both Groups

	Age	Height	Weight	BMI
Infra Clavicular	**33.43 ± 8.38**	**162.06 ± 9.17**	**66.06 ± 7.63**	**25.13 ± 1.83**
Axillary	**34.16 ±7.04**	**161.96 ± 10.53**	**63.83 ± 7.22**	**24.6 ± 1.93**
P Value	**0.7162**	**0.9688**	**0.2497**	**0.2796**

P value is > 0.05. Values are expressed as Mean ± Standard Deviation.

On comparison of heart rate (/min) and mean arterial pressure in between the two groups, the p value was found to be more than 0.05. The difference was found to statistically insignificant (p >0.05) in terms of comparison of heart rate (per min) and mean arterial pressure.

On comparison of systolic and diastolic blood pressure (mm hg) in between the two groups, P-value is more than 0.05. The difference was found to be statistically insignificant (p >0.05) in terms of comparison of diastolic and systolic Blood Pressure (mmhg).On comparison of mean time for onset of motor and sensory block in between the two groups (in seconds), P-value is found to be more than 0.05.

The difference was found to be statistically insignificant (p >0.05) in terms of comparison of time taken for onset of sensory and motor blockade (in seconds). (Table 2 and 3)

Table 2: Comparison of Mean Time for Onset of Motor Block in Two Groups (In Seconds)

	Infra Clavicular	Axillary	P Value
Mean ± Standard Deviation	943.1 ± 54	949.4 ± 56.46	0.6604

Table 3: Comparison of Mean Time for Onset of Sensory Block in Two Groups (In Seconds)

	Infra Clavicular	Axillary	P Value
Mean ± Standard Deviation	794.9 ± 54.91	802.4 ± 57.87	0.6086

On comparison of total duration of blockade and VAS score in between the two groups, P-value is found to be more than 0.05. The difference was found to be statistically insignificant (p >0.05) in terms of comparison of total duration of blockade and VAS score. (Table 4)

Table 4: Comparison of VAS Score in Two Groups

		Infra Clavicular	Axillary	P Value
Mean ± Standard Deviation				
	5 Minutes	5.83 ± 1.04	5.87 ± 1.23	0.8923
	10 Minutes	3.1 ± 0.7	3.43 ± 0.80	0.0944
	15 Minutes	1.23 ± 0.67	1.5 ± 0.89	0.1895
	20 Minutes	0.1 ± 0.3	0.13 ± 0.34	0.7184
	30 Minutes	0 ± 0	0 ± 0	0
	2 Hours	0 ± 0	0 ± 0	0
	4 Hours	0 ± 0	0 ± 0	0
	6 Hours	0 ± 0	0 ± 0	0
	8 Hours	0.033 ± 0.18	0.07 ± 0.25	0.5132
	10 Hours	0.17 ± 0.45	0.3 ± 0.64	0.3665
	12 Hours	2.83 ± 1.16	3.37 ± 1.08	0.0671
	14 Hours	6.7 ± 1.22	6.933 ± 1.34	0.4897

Discussion

A well-conducted regional anaesthetic technique has its advantages over general anaesthesia such as remaining conscious, minimal airway manipulation, avoiding polypharmacy, better haemodynamic stability and excellent post-operative analgesia. Brachial plexus block is close to the ideal anaesthetic technique for upper limb surgeries. Axillary block is a distal brachial plexus block targeting the cords at the level of the axilla where they are positioned surrounding the axillary artery. Infraclavicular block is an approach to the brachial plexus block that has gained popularity owing to lesser complications and a better dermatomal blockade. It is a proximal brachial plexus block which targets the plexus at the level of the cords before the musculocutaneous nerve exits the brachial plexus sheath. [9,10]

The axillary approach to block the brachial plexus has been widely used to provide anaesthesia for surgery of the forearm and hand because its benefits include simplicity, reliable efficacy and safety. However, its application may be difficult in patients with limited movement of the shoulder or arm, as in those with painful injuries. Also, with the standard single injection axillary block, reliable musculocutaneous nerve (MCN) and radial nerve anaesthesia is limited by anatomical conditions. Infraclavicular block is an approach to brachial plexus blocks which requires less painful arm positioning for patients with fractures and has reliability of the technique on the identification of easily palpable landmarks even in obese patients. [11,12]

In our study we compare brachial plexus block performed by the axillary & the infraclavicular routes using a peripheral nerve stimulator and ultrasound guidance in terms of onset of sensory block and motor block, total duration of blockade, hemodynamic parameters and complications such as torniquet pain. The result of the present study is the finding that the infraclavicular approach to the brachial plexus using ultrasound and peripheral nerve stimulator resulted fewer incomplete blocks with lesser torniquet pain incidence than the axillary approach. The hemodynamic, onset of sensory and motor blockade and the duration of post-operative analgesia was similar in both the groups with p-value of more than 0.05, which was statically insignificant.

In Ae Song et al found in their study there were no differences between the two groups with regard to height, weight, gender, age, physical status. In our study the demographic data i.e age, gender, weight, height and BMI were comparable. No significant statistical difference was found in both groups regarding the demographic data. In our study both groups had equal number of male (15) and female (15). [12] The mean age for Infraclavicular group was 33.43 ± 8.38 years and that for Axillary group

was 34.16 ±7.04 years. The mean height for Infraclavicular group was 162.06 ± 9.17 and that for Axillary group was 161.96 ± 10.53. the mean weight for Infraclavicular group was 66.06 ± 7.63 and that for Axillary group was 63.83 ± 7.22. The mean BMI for Infraclavicular group was 25.13± 1.83 and that for Axillary group was 24.6 ± 1.93.

In our study the hemodynamic parameters observed were heart rate, systolic blood pressure, diastolic pressure and mean arterial pressure. No statistically significant changes were observed in hemodynamic parameters in both the group. Lahori VU et al (56) found in their study that the mean duration of onset of sensory block was almost similar in both the approaches i.e around 13.98 ± 7.68 minutes in Infraclavicular group and 13.68 ± 7.28 minutes in Axillary group.

No statistically significant difference was found on comparing the onset times of individual nerves in both the groups. Brenner et al (48) found in their study that the Onset times for the two blocks were similar; median [interquartile range] for both groups was 10 [10 to 20] min. In our study the time for onset of sensory and motor blockade had no significant statistical difference. The time for onset of sensory block in Infraclavicular group was 12.23 ± 0.95 minutes and that for Axillary group was 13.93 ± 0.93 minutes. Th time for onset of motor block in Infraclavicular block was 14.17 ± 1.10 minutes and that for Axillary group was 15.83 ± 1.04 minutes. It was observed that Infraclavicular Block was associated with lower sensory scores (denser block) in the distributions of both the axillary nerve and musculocutaneous.

This may be a consequence of the anatomical fact that the level at which Infraclavicular block is administered is closer to the point in which these nerves arise. In our study the difference between two groups in terms of VAS score was not significant statistically. Lahori VU et al (56) found in their study that the mean duration of block in Infraclavicular group was 332 ± 44 minutes and 338 ± 43 minutes in Axillary group.

The difference again being statistically insignificant. The difference was statistically insignificant. In our study the total duration of blockade had no significant statistical difference. The total duration of block, in Infraclavicular group was 721.6 ± 57.23 minutes and in Axillary group was 701.5 ± 79.31 minutes.

Tourniquet pain is a poorly localised, dull, tight, aching sensation at the site of tourniquet application. The pathophysiology of tourniquet pain is incompletely understood: it is commonly attributed to ischaemia and mechanical compression of the structures situated deep to the tourniquet. Sensitisation, metabolic changes and spinal receptive field expansion of nociceptors also play a role. Within mixed somatic nerves, C-fibres may have an important role in tourniquet pain mediation as, compared with A delta fibres, they are less sensitive to the effects of local anaesthetics. (50-54) The degree or quality of the nerve blockade may also be relevant: it has been shown that tourniquet pain can occur even if the patient has adequate sensory block for pinprick, and it can be prevented by measures resulting in a denser block. Mechanical factors such as tourniquet width, shape, inflation pressures and duration of application can also influence tourniquet pain. Circumferential non-homogenous pressure distribution under the tourniquet can also contribute to tourniquet pain. Younger age and oxygen administration prior to tourniquet application appear to facilitate tourniquet tolerance.

The duration of tourniquet tolerance time varies widely depending on the type of the anaesthesia. In the absence of analgesia or sedation, patients or volunteers can tolerate it for 20 to 30 minutes. This interval can be increased with sedation, semi-circular subcutaneous anaesthesia of the medial aspect of the arm or eutectic mixture of local anaesthetic cream application to the tourniquet site. The incidence of torniquet pain in infraclavicular block group is less as compared to axillary block group

A recent Cochrane review of ICB reported collective evidence from articles in which tourniquet pain had been a secondary outcome measure. The incidence of tourniquet pain was lower when ICB was performed compared with other types of brachial plexus blocks (risk reduction 0.66, 95% CI 0.47 to 0.92). In our study the incidence of torniquet pain in infraclavicular block group is less as compared to axillary block group.

Conclusion

Peripheral nerve blocks (PNB) have an increasingly important role in ambulatory anaesthesia and have many characteristics of the ideal outpatient surgical anaesthesia with prolonged postoperative analgesia, early ambulation and facilitated discharge with less hospital stay.

Ritically evaluating the potential benefits and supporting evidence is essential to appropriate technique selection. When Peripheral Nerve Blocks are used for upper extremity procedures, there is consistent opioid sparing and fewer treatment-related side effects when compared with general anaesthesia.

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