ISSN:0975-3583,0976-2833 VOL14, ISSUE06 ,2023

Comparative study of ultrasound guided infra-clavicular brachial plexus block versus ultrasound guided axillary block for upper extremity surgeries

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Received Date: 25/04/2023 Acceptance Date: 23/06/2023

Abstract

Background: Surgical anaesthesia of the arm, can be achieved by injection of local anaesthetic around the brachial plexus. The ultrasound (US)-guided technique gives the best quality of regional block, irrespective of the approach. Present study was aimed to compare ultrasound guided infra-clavicular brachial plexus block versus ultrasound guided axillary block for upper extremity surgeries. **Material and Methods:** Present study was comparative study, conducted in patients of age 18-65 years, either gender, Body mass index (BMI) between 18-25, belonging to ASA grade I and II, posted for elective and emergency upper extremity surgeries. 40 patients were randomized into two groups as Group I (ultrasound guided axillary block) and Group II (ultrasound guided infra-clavicular block). **Results:** The mean age was for Group 1 was 33.45±7.95 years and Group 2 was 32.15±7.29 years. Distribution of age, gender, and ASA status in both the groups was comparable (P>0.05). Block procedure duration in Group 1 (16.7 ± 1.69 min) was more than Group 2 (13.6 ± 2.26 min). There is statistically significant difference in block procedure duration (P<0.0001). Onset time of anaesthesia was 10 minutes in majority patients of group 1 (70 %) and Group 2 (55 %). The two groups had comparable onset time of anaesthesia and difference was not statistically significant. (P value - 0.471). **Conclusion:** Ultrasound guided infra-clavicular block can be performed in any arm position and it has a shorter procedure duration, it has the potential to be the technique of choice for upper extremity surgeries.

Keywords: Ultrasound guided, infra-clavicular block, brachial plexus block, axillary block, upper extremity surgeries.

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Introduction

Surgical anaesthesia of the arm, can be achieved by injection of local anaesthetic around the brachial plexus. This regional anaesthesia technique avoids the need for a general anaesthetic and its accompanying risks (airway injuries, postoperative nausea and vomiting, postoperative drowsiness, etc.). Control of postoperative pain is also excellent as the sensory block typically persists for several hours following injection.[1]

ISSN:0975-3583,0976-2833 VOL14, ISSUE06 ,2023

There are several techniques of brachial plexus blockade that can be used to provide anaesthesia for surgery of the lower arm. The brachial plexus may be approached with a needle at various sites along its course.[2] These approaches include inter-scalene block (where the needle passes between the scalene muscles after piercing the skin in the front of the neck); supraclavicular block (where the skin is pierced lower and more laterally in the root of the neck above the clavicle); infra-clavicular block (where the skin is pierced in the area below the clavicle); axillary block (where the skin is pierced in the axilla) and mid-humeral block (where the skin is pierced in the upper arm).[2]

The ultrasound (US)-guided technique gives the best quality of regional block, irrespective of the approach, most probably due to the visualization of the target structures, as well as the visualization of the needle and the spread of the local anaesthetic after the injection.[3-4]

Present study was aimed to compare ultrasound guided infra-clavicular brachial plexus block versus ultrasound guided axillary block for upper extremity surgeries.

Material And Methods

Present study was comparative study, conducted in department of anaesthesiology, at A. J. Institute of Medical Sciences and Research Centre Hospital, Mangaluru, India. Study duration was of 2 years (December 2017 to October 2019). Study approval was obtained from institutional ethical committee.

Inclusion criteria

- Patients of age 18-65 years, either gender, Body mass index (BMI) between 18-25, belonging to ASA grade I and II, posted for elective and emergency upper extremity surgeries, willing to participate in present study.

Exclusion criteria

- Patients who were administered with supplementary general anaesthesia or with analgesia intraoperatively.
- Patients with constraints in the local area of anaesthesia such as infection in the area of the block, systemic coagulopathy, etc.
- Patients with known hypersensitivity or contra-indications to local anaesthetics.
- Patient refusal.

Study was explained to patients in local language and written consent was taken for participation and study. Each patient underwent detailed pre-anaesthetic examination prior to surgery. Necessary investigations were done and the patients were classified into ASA grading as appropriate. All elective patients received tablet ranitidine, 150 mg, preoperatively, night time. Elective patients were fasting for 8 hours prior to surgery for solids and two hours for clear fluids. Elective patients underwent scheduled surgery next day. The routine monitoring protocols were followed as per our institution department protocol.

Intravenous cannulas (16G or 18G), monitoring with 5 lead electrocardiogram (ECG), pulse oximetry, non-invasive blood pressure monitoring (NIBP), were considered in all patients. Hemodynamic changes, vital parameter data etc. were documented along with intravenous infusion of crystalloids, colloids etc.

40 patients were randomized into two groups (Group I and Group II) of 20 patients each. Randomization was done using a randomization program on the internet (randomizer.org).

Group I: were administered with ultrasound guided axillary block. Patients were laid in the supine position with the arm to be blocked externally rotated up to 90 degrees to expose the armpit. Povidone iodine 1% (Ioprep) was applied to the skin of the armpit and the site was draped. All block procedures were done using aseptic technique. A high frequency linear probe (6-13 MHz, Sonosite S=Nerve SonoSite, Inc., Bothell, Washington) was positioned in the axillary crease perpendicular to the axillary artery for observation of the axillary artery

ISSN:0975-3583,0976-2833 VOL14, ISSUE06 ,2023

and surrounding structures. After local anaesthesia, the block needle (23 G B- bevel, 2.5 inch, 30˚, VYGON, stimulplex) was inserted at a shallow angle because terminal branches of the brachial plexus in the axilla are superficial. The musculocutaneous nerve was blocked separately as it branches in the coracobrachialis muscle. The radial nerve was located deep to the ulnar nerve in the proximal axilla. The needle was inserted deep to contact the radial nerve
(R) before local anaesthetic injection. Local anaesthetic was injected at each nerve's location. Total of 25 ml of mixture of local anaesthetic (MOLA) solution was injected. 20 ml of 0.375% of inj. Levobupivacaine was mixed with 5ml of 2% Lignocaine without adrenaline (LOX 2%, NEON Laboratories Limited, Mumbai).
Group II: were administered with ultrasound guided infra-clavicular block. The patients were laid in supine position with their arms beside their body with only the head turned toward the opposite direction of the block area. Ioprep was applied to the skin on the infra-clavicular area and the area was draped. All procedures were performed using aseptic technique. A high frequency linear probe (6-13 MHz, Sonosite S=Nerve SonoSite, Inc., Bothell, Washington) was placed just medial to the coracoid process with its cranial end just below the clavicle. The skin was anesthetized and the block needle (similar to the one used in the first group), was inserted 1 cm into the skin. The needle tip was sonographically located and followed throughout the procedure. Being careful to avoid any sensitive structures, the needle was slowly advanced towards the deep border of the artery. Once the needle was in the vicinity of the artery, a volume of 25 ml of local anaesthetic was injected. The Anaesthetic solution was similarly prepared as explained for the first group. Appropriate needle placement was confirmed by spread of anaesthetic around the artery, dissecting the cords away from the artery.
Block procedural details were clearly documented. Opioid use and additional analgesics administration were also documented. Once the surgical procedure was concluded, the stable patients were shifted to postoperative anaesthesia care unit and monitored.
The duration of each procedure was measured from the time the Ioprep was applied to the skin to the end of the infiltration of the anaesthetic, including the removal of the block needle. The nerve block of the patient was evaluated immediately after the block procedure and at 10 and 30 minutes afterwards. The sensory nerves were assessed by alcohol swab testing the radial nerve (posterior part of wrist and of the three first fingers), median nerve (anterior part of wrist and of the three first fingers), and ulnar nerve (medial part of wrist and of the hand): axillary (over deltoid) responses were compared with the opposite corresponding areas.
In the case when there was no onset of nerve block 30 minutes after the procedure, it was considered as a block failure. In addition, cases where general anaesthesia was administered due to pain during surgery were also recorded as a block failure. The occurrence of complications such as hemorrhage, hematoma, pneumothorax, and intravascular injection or any other complication were also recorded.
Age, block procedure duration and onset time was compared. Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi- square test or Fisher exact test as applicable. P value less than 0.05 was considered as statistically significant.

Results

In present study, 40 patients were randomized into two groups (Group I and Group II) of 20 patients each. The mean age was for Group 1 was 33.45±7.95 years and Group 2 was

ISSN:0975-3583,0976-2833 VOL14, ISSUE06 ,2023

32.15±7.29 years. Distribution of age, gender, and ASA status in both the groups was comparable (P>0.05).

Table 1: General characteristics

	Group 1 (n=20)	Group 2 (n=20)	P value
Mean age (in years)	33.45 ± 7.95	32.15 ± 7.29	0.593
Gender			
Male	17 (85 %)	17 (85 %)	>0.9999
Female	3 (15 %)	3 (15 %)	
ASA			
I	15 (75 %)	14 (70 %)	>0.9999
II	5 (25 %)	6 (30 %)	

In present study, block procedure duration in Group 1 (16.7 ± 1.69 min) was more than Group 2 (13.6 ± 2.26 min). There is statistically significant difference in block procedure duration (P<0.0001).

Table 2: Comparison of Block procedure duration between the groups.

	Group 1 (n=20)	Group 2 (n=20)	P value
Block Procedure duration (min)	16.7 ± 1.69	13.6 ± 2.26	<0.0001

In present study, onset time of anaesthesia was 10 minutes in majority patients of group 1 (70 %) and Group 2 (55 %). The two groups had comparable onset time of anaesthesia and difference was not statistically significant. (P value - 0.471).

Table 3: Comparison of Onset time between the groups.

Time (minutes)	Group 1	Group 2	P value
10	14 (70 %)	11 (55 %)	0.51
30	6 (30 %)	9 (45 %)	

Discussion

When comparing the different techniques of brachial plexus block, the success rate was considered as the most important indicator. However, with the introduction of ultrasound-guided technique, the success rate has reached 95- 100%.[3-4] The block procedure duration can be reduced by simplifying the procedure. Ultrasound-guided axillary block requires three needle insertions, whereas ultrasound-guided infra-clavicular block requires only one needle insertion.[5,6] The other advantage of infra-clavicular block is that it can be performed in any arm position, this is particularly helpful in patients with trauma and limited arm mobility. There also appears to be lesser incidence of accidental vascular puncture in infra-clavicular block compared to axillary block.[7]

Ultrasound-guided technique gives the best quality of regional block, irrespective of the approach, most probably due to the visualization of the target structures, as well as the visualization of the needle and the spread of the local anaesthetic after the injection.[8] Ultra-sound guided techniques performed by experienced anaesthetists have a very high success rate.[9] Therefore, other factors like block procedure duration, onset time, duration of analgesia, etc. was considered as evaluating factors for comparison of blocks.

In our study, the onset time of the nerve block was defined as the time taken, for hypoesthesia to occur in the dermatome of the median, ulnar and radial nerves with muscle power grading also lower than 3. Here, we observed that there was no difference between the two groups with respect to the onset time. Of course, there were no disruptions in the anaesthesia or operations in this study, in both the groups, but there were difficulties in comparing the onset

ISSN:0975-3583,0976-2833 VOL14, ISSUE06 ,2023

time in between the groups. This was probably because the small volume of local anaesthetic used for performing the blockade in both the groups delayed the progression of the nerve block.

In study by Song et al.,[10] similar results to our study with respect to performance time. But, the onset time was longer in infra-clavicular group than in axillary group which was in contrast to our study. This was probably because they used a local anaesthetic mixture of Lignocaine with Adrenaline and Sodium bicarbonate, whereas in our study, we used a local anaesthetic mixture of Levobupivacaine 0.375% and Lignocaine without Adrenaline. Also, they evaluated the nerve block on 5, 10, 15, 20 and 30 minutes after blockade in contrast to our evaluation timings of 10 and 30 minutes following the block. Hence, the difference with respect to onset time, if any, probably would not have been appreciated.

Tran et al.,[11] noted that, the block procedure duration was shorter for the infra-clavicular approach compared to the axillary approach, but there were no differences in the onset times. These findings were similar to our study.

Lopez et al.,[12] showed that the time of onset of anaesthesia was faster in the infra-clavicular block under ultrasound guidance than the axillary block. Again, this finding was contrary to our study. The difference was probably because they calculated the time of onset from the beginning of the infiltration of the 4 nerve components of the axillary block, not after the completion of the technique, which was done in our study. Other observation in their study was absence of difference in the completion time and quality of the related surgical anaesthesia. This finding was very similar to our study, however. Apart from these findings, they found that infra-clavicular block provided longer analgesia when compared to axillary block, which we could explain by volume of local anaesthetics.

Stav et al.,[13] observed that time of onset of anaesthesia and block procedure duration were similar between ultrasound guided axillary block and ultrasound guided infra-clavicular block. Their finding on block onset time was similar to our study.

In this study, the block procedure duration was defined as the time taken, from the time of Ioprep application onto the skin to the removal of the block needle. The difference in the procedure duration was because the infra-clavicular approach required only one injection of local anaesthetic while the axillary approach requires three injections around the axillary artery and one injection for the musculocutaneous nerve, which is a total of four injections. The reduction in the procedure duration is more convenient and comfortable for the patient who needs to be under a drape for the procedure. Moreover, a reduction in the performance time also provides time for the anaesthetist to focus on the patient and other matters. The ultrasound-guided infraclavicular block can be performed without mobilization of the arm, this is helpful in trauma patients.[7]

Our study has several limitations such as blinding technique was not followed, also, the varied nature of surgeries itself, can influence the onset and effective duration of sensory blockade, as some procedures tend to be more painful than the others. Furthermore, testing of blockade was performed only twice in our study, at 10 minutes and 30 minutes after blockade, because of the difficulty in repeated assessment of the block, which itself might have over-estimated the onset time. Larger sample size would have clearly differentiated the primary outcomes with higher power. Follow-up till the blockade recovery was not done for all patients, as it was not feasible.

Conclusion

Ultrasound guided infra-clavicular brachial plexus block can reduce the block procedure duration when compared to ultrasound guided axillary brachial plexus block. However, there is no difference in the onset time. Since, ultrasound guided infra-clavicular block can be

ISSN:0975-3583,0976-2833 VOL14, ISSUE06 ,2023

performed in any arm position and it has a shorter procedure duration, it has the potential to be the technique of choice for upper extremity surgeries. Further studies are required to evaluate this possibility.

Conflict of Interest: None to declare

Source of funding: Nil

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