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International Journal of Pharmaceutical and Clinical Research 2023; 15(3); 1249-1256

**Original Research Article** 

# A Comparative Study between Anatomical Landmark and Ultrasound Guided Supraclavicular Brachial Plexus Block in Upper Limb Surgery

Madhulika Kumari<sup>1</sup>, K. H. Raghwendra<sup>2</sup>, Kumar Saurabh<sup>3</sup>, Bibha Kumari<sup>4</sup>

<sup>1</sup>MD (Anaesthesiology and CCM) IGIMS, Patna, Bihar
<sup>2</sup>M.B.B.S, MD (Anaesthesiology) MD (Radiodiagnosis) Ex. Prof. and Head, Department of Anaesthesiology And CCM, IGIMS, Patna, Bihar
<sup>3</sup>Senior Resident, Anaesthesiology and CCM, IGIMS, Patna, Bihar
<sup>4</sup>M.B.B.S, MD (Anaesthesiology and CCM), Associate Professor, Anaesthesiology and CCM, IGIMS, Patna, Bihar

Received: 13-01-2023 / Revised: 18-02-2023 / Accepted: 11-03-2023 Corresponding author: Dr. Bibha Kumari Conflict of interest: Nil

# Abstract

**Background:** Brachial plexus blockade is a time-tested technique for upper limb surgeries. Ultrasound for supraclavicular brachial plexus block has improved the success rate with excellent localization as well as improved margin of safety.[8] Hence, this study was planned for comparing the efficacy of supraclavicular brachial plexus block using anatomical landmark with ultrasound guided technique.

**Methods:** The present prospective, randomized, comparative study was conducted among 60 patients undergoing elective upper limb surgery under the Department of Anaesthesiology and Critical Care. The study was approved by the Institutional ethical committee. Blood investigations, Urine routine (Albumin, sugar) and microscopy, ECG and Chest x-ray PA view was done in all patients. All the patients underwent thorough pre anaesthetic evaluation on the day prior to surgery. The 60 patients were randomly divided into two groups of 30 patients each, Group AS and Group US. The time taken for the procedure, the onset of sensory blockade and motor blockade were noted. Data were coded and recorded in MS Excel spreadsheet program. SPSS V 23.0 (IBM Corp.) was used for data analysis. Descriptive statistics were used elaborated in the form of means/ standard deviations and medians/ IQRs for continuous variables, and frequencies and percentages for categorical variables.

**Results:** In our study the block execution time was lower in group AS (5.37+1.45 minutes) and higher in group US (9.97+2.44 minutes) and it was statistically significant (p<0.05). The block effectiveness in group AS was total in 70.0%, partial in 10.0% and failure in 20.0%, whereas block effectiveness in group AS was total in 90.0%, partial in 6.7% and failure in 3.3%. Vessel puncture as complication was seen in 20.0% of patients in group AS and no vessel puncture was seen in group US.

**Conclusion:** From our study it was concluded that time taken to perform block by ultrasound was longer than the anatomical landmark technique. Onset and duration of both sensory and motor blockade were similar in both groups.

Keywords: Anatomy, USG, Supraclavicular Brachial Plexus Block, Upper Limb, Surgery.

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# Introduction

Brachial plexus blockade is a time tested technique for upper limb surgeries. [1] the various approaches of Among block, supraclavicular brachial plexus approach is considered easiest and most effective. The first supraclavicular brachial plexus block was performed bv Kulenkampff in 1912. [2] He pointed out that above the clavicle the plexus lies under the skin as it passes over the first rib and accessible to a percutaneous technique. The midpoint of clavicle and the subclavian artery provided a constant landmark, most frequently at the point where external jugular vein intersects the clavicle. He emphasized that the purpose of the technique was not to hit the rib but to find the trunks by eliciting paraesthesia. He said that the first rib just prevented pleural penetration. The classical approach using paraesthesia technique is a blind technique and may be associated with higher failure rate and injury to the nerves and surrounding structures. [3]

To avoid some of these problems use of peripheral nerve stimulator was started which allowed better localization of the nerve/plexus. [4,5] In 1962, Greenblatt and Denson devised a portable transistorized nerve stimulator which stimulated further use of nerve stimulators in regional anaesthesia. This equipment was still expensive and not readily available. Finally in 1969, Wright reported the Block- Aid monitor for nerve blocks which popularized the technique making it more feasible. However, this technique may not be full proof with persistent risk of injury to surrounding structures, especially vascular structures, nerves and pleura leading to pneumothorax. [6,7]

Ultrasound guided nerve blocks were first described as early as 1978, but it was not until the advent of advanced ultrasound technology in the 1990's that interest in this field grew. Published reports of ultrasound guided regional anaesthesia have largely focused on brachial plexus blockade in the interscalene, supraclavicular, infraclavicular and axillary regions. The application of ultrasound technique for exact localization of nerves/plexus has revolutionized the regional anaesthesia field where in ultrasound probes with suitable frequencies have been successfully tried. [7]

Ultrasound for supraclavicular brachial plexus block has improved the success rate with excellent localization as well as improved margin of safety.[8] Hence, this study was planned for comparing the efficacy of supraclavicular brachial plexus block using anatomical landmark with ultrasound guided technique.

# **Materials and Methods**

# Study setting and participants

The present prospective, randomized, comparative study was conducted among 60 patients (either sex, aged between 18-60 years) undergoing elective upper limb surgery (lasting more than thirty minutes) American society of with Anaesthesiologists grade I and II physical Department status under the of Anaesthesiology and Critical Care, IGIMS, Patna. The elective surgical interventions were internal fixation of bones with plates and screws, excision of bone cysts, and other surgeries involving upper limb. Pregnant patients, patients with significant coagulopathy, peripheral neuropathy, allergy to local anaesthetics and significant pre-existing systemic diseases were excluded from the study. The study was approved by the Institutional ethical committee.

# Pre operative procedure

Blood investigations (Hb%, BT, CT, Urea, Serum creatinine, Blood sugar, Blood grouping and cross matching), Urine routine (Albumin, sugar) and microscopy, ECG and Chest x-ray PA view was done in all patients. All the patients underwent thorough pre anaesthetic evaluation on the day prior to surgery. All systems were examined including airway and the surface anatomy where the block was going to be given, and the procedure to be carried out was explained. They were informed about development of paraesthesia. Patients were reassured to alleviate their anxieties. All the patients were kept nil per oral as per the fasting guidelines. All of them received Tab. Diazepam 10 mg and Tab. Ranitidine 150 mg night before the surgery. Written informed consent taken. Ultrasound machine and probe were prepared for the procedure under all aseptic precautions.

# Procedure

Patient was made to lie supine with head turned opposite to side of intended block and arm adducted and pulled down gently. A small pillow or folded sheet was placed below the shoulder to make the field more prominent. Land marks A point 1cm above the mid-point of clavicle and pulsations of subclavian artery. The 60 patients were randomly divided into two groups of 30 patients each, Group AS (anatomical receive landmark) to conventional supraclavicular brachial plexus block, and Group US (ultrasound guided) to receive ultrasound guided supraclavicular brachial plexus block. In group AS conventional supraclavicular brachial plexus was performed by eliciting paraesthesia and when paraesthesia was obtained we withdrawn the needle about 1 to 2mm, then the drug is injected. In group US, block is performed after real time visualization of the vessels, nerve and bone. In plane approach using 10ml syringe containing local anaesthetic is injected and the drug distribution in noted. This procedure was done by using sonosite ultrasound machine with 13-6MHz transducer by in-plane approach using 22G needle.



Figure 1: USG guided technique for supraclavicular brachial plexus.

# **Data collection**

The time taken for the procedure, the onset of sensory blockade and motor blockade were noted. Following completion of surgery, the patients were monitored to assess the quality and duration of postoperative analgesia. Thus, the patients were asked to classify analgesia as no pain, mild pain, moderate pain or severe pain every hour for the first 6 hours and then again at 8 and 10 hours. At the time of each subsequent assessment, patients were observed and/or questioned about any subjective and/or objective side effects

### Kumari et al.

#### International Journal of Pharmaceutical and Clinical Research

(sedation, nausea, vomiting or respiratory depression, neurological injury).

# **Statistical Analysis**

Data were coded and recorded in MS Excel spreadsheet program. SPSS v 23 (IBM Corp.) was used for data analysis. Descriptive statistics were used elaborated in the form of means/ standard deviations medians/ IQRs for continuous and variables, and frequencies and percentages for categorical variables. Group comparisons for continuously distributed data were made using independent sample 't' test when comparing two groups. If data were found to be non-normally distributed, appropriate non-parametric tests in the form of Wilcoxon Test were used. Chi-square test was used for group comparisons for

categorical data. In these the expected frequency in the contingency tables was found to be <5 for >25% of the cells, Fisher's Exact test was used instead. Statistical significance was kept at p<0.05.

# Results

The mean age of patients in the group AS and group US was 32.03+12.97 years and 35.83+15.02 years respectively. In group AS, there were 56.7% male patient and 43.3% female patients, while in group US, there were 63.3% male patient and 36.7% female patients. The weight of patients in the group AS and group US was 57.20+7.80 kg and 59.87+7.34 kg respectively. The baseline characteristics of two groups were comparable (Table 1).

Variables	Mean+SD/	P value	
	Group AS	Group US	
Age (in years)	32.03+12.97	35.83+15.02	0.283
Gender			
Male	17 (56.7)	19 (63.3)	0.598
Female	13 (43.3)	11 (36.7)	
Weight (in Kg)	57.20+7.80	59.87+7.34	0.178

Table 1: Comparison of baseline characteristics among the group AS and group US.

In our study the block execution time was lower in group AS (5.37+1.45 minutes) and higher in group US (9.97+2.44 minutes). Time of onset of sensory block was higher in group AS (10.11+3.27 minutes) and lower in group US (9.93+2.86 minutes). Time of onset of motor block was higher in group AS (13.80+3.39 minutes) and lower in group US (13.33+2.80 minutes). Duration of sensory block was lower in group AS (417.08+87.80 minutes) and higher in group US (441.03+92.67 minutes) (Table 2).

Table 2: Comparison of characteristics of anaesthesia technique among the group AS
and group US.

Variables	Mean+SD/ Number (%)		P value
	Group AS	Group US	
Block execution time (in minutes)	5.37+1.45	9.97+2.44	< 0.001
Time of onset of sensory block (in	10.11+3.27	9.93+2.86	0.956
minutes)			
Time of onset of motor block (in	13.80+3.39	13.33+2.80	0.598
minutes)			
Duration of sensory block (in minutes)	417.08+87.80	441.03+92.67	0.304
Duration of motor block (in minutes)	417.08+87.80	441.03+92.67	0.304

Non-Parametric Wilcoxon rank-sum test (Mann Whitney U test) was used to compare the two groups in terms of Heart Rate (BPM) and MAP (mmHg) at each of the timepoints. The two

#### International Journal of Pharmaceutical and Clinical Research

groups did not differ in terms of Heart Rate (BPM) and MAP (mmHg) at any of the timepoints (p>0.05) (Figure 2).



Figure 2: Comparison of hemodynamic parameters among the group AS and group US. A: Line diagram depicting the change in Heart Rate (BPM) over time in both the groups. B: Line diagram depicting the change in Mean arterial pressure (MAP) over time in both the groups.

The block effectiveness in group AS was total in 70.0%, partial in 10.0% and failure in 20.0%, whereas block effectiveness in group AS was total in 90.0%, partial in 6.7% and failure in 3.3%. Vessel puncture as complication was seen in 20.0% of patients in group AS and no vessel puncture was seen in group US (Table 3).

Kumari et al.

#### International Journal of Pharmaceutical and Clinical Research

Variables	Mean+SD/ Number (%)		<b>P-value</b>
	Group AS	Group US	
Block effectiveness			
Total	21 (70.0)	27 (90.0)	0.117
Partial	3 (10.0)	2 (6.7)	
Failure	6 (20.0)	1 (3.3)	
Complications	13 (43.3)	11 (36.7)	
Vessel puncture	6 (20.0)	0 (0.0)	0.024
None	24 (80.0)	30 (100.0)	

Table 3: Comparison of block effective and complications among the group AS and<br/>group US.

# Discussion

This study is intended to compare the eliciting conventional method bv with guided paraesthesia ultrasound supraclavicular brachial plexus block in terms of time taken for the procedure, onset and duration of sensory blockade, onset and duration of motor blockade, success rate and the incidence of complications. This study was done in patients undergoing upper limb surgeries with similar demographic profile.

Mean time to perform the block with  $(9.97 \pm 2.44)$ ultrasound min) was significantly longer when compared to conventional group ( $5.37 \pm 1.45$  min). The longer time for the block performance found in group US can be explained by the lesser experience and skills in using the ultrasound. The study done by Morros et al., suggest that the use of ultrasound in regional anaesthesia requires the acquisition of new knowledge and skills not only by anaesthesiologists in training but also by anaesthesiologists experienced in neurostimulation guided peripheral nerve blocks. [9]

The onset of sensory blockade in all the major nerve distributions were similar in the conventional and ultrasound groups in our study. Onset time of sensory block with use of ultrasound in our study was  $(9.93\pm2.86)$  min and  $(10.11\pm2.86)$  min with the anatomical landmark method. In contrast, Marhofer et al., found that onset time was significantly shorter in the US

guided group compared with both NSguided groups A(US guidance with 20 mL 0.5% bupivacaine), Group B(received 20 mL 0.5% bupivacaine using NS guidance) Group C (received 30 mL 0.5% bupivacaine using nerve stimulator) (group A 13±6 minutes; group B 27±12 minutes; and group C 26±13 minutes; P < .01 to groups B and C).[10] Quality of sensory block was significantly better in ultrasound group than nerve stimulator.

The present study showed that out of 30 patients in ultrasound group, twenty-seven blocks (90%) were completely successful; two block (6.7%) were incomplete and needed supplementation; one blocks (3.3%) failed and required general anaesthesia. Out of 30 patients in anatomical landmark group, twenty one blocks (70%) were completely successful; three blocks (10%) incomplete were and needed supplementation; and six (20 %) failed and required general anaesthesia. Study by Williams et al., reported that in Group US, 85% of blocks could be successfully achieved (surgical anaesthesia) without supplementation, compared with 78% in Nerve Stimulator group. General anaesthesia was required in 0% and 8% of US and NS patients, respectively. [11]

In the present study the onset of motor blockade in ultrasound guided group occurred within  $(13.33\pm2.80 \text{ min})$  and  $(13.80\pm3.39 \text{ min})$  in anatomical landmark group. Study by Williams et al., found that the onset of motor blockade paralleled that of sensory blockade.[11] Study by Egon Lanz, et al., found that motor blockade developed faster than sensory blockade.[12] They explained this to arrangement of motor fibres in the mantle and sensory fibres in the core of the trunks and cords.

In the present study the duration of sensory blockade was more in ultrasound group than the anatomical landmark group which was not statistically significant. The duration of motor blockade was also more in USG guided group than anatomical landmark group. But in a study by Kapral et al., it was found that sensory, motor, and extent of blockade was significantly better in the ultrasound group when compared with the nerve stimulation group. [13]

In the present study we found that vessel puncture occurred only in the anatomical landmark group (6%) whereas ultrasound group did not have any of the mentioned complications because ultrasound provides direct visualization of vessels around the plexus and also needle path. We can also take the help of Doppler to visualize the vessels. Study by Kothari et al., showed that 6% cases had vessel puncture.[14] Jia-min et al., studied complications of US and Peripheral nerve stimulator guidance for upper-extremity peripheral nerve blocks (brachial plexus) and found that US decreases risks of complete hemidiaphragmatic paresis or vascular puncture and improves success rate of brachial plexus nerve block compared with techniques that utilize PNS for nerve localization.[15] Neurological complications following peripheral nerve blocks i.e. post block neuralgia show an incidence of 1.7% to 12.5%. [14,17]

# Conclusion

From our study it was concluded that time taken to perform block by ultrasound was longer than the anatomical landmark technique. Onset and duration of both sensory and motor blockade were similar in both groups. Success rate and quality of the block was more with ultrasound group than anatomical landmark group. Incidence of complication like vessel puncture was seen only in anatomical landmark method.

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