



ORIGINAL RESEARCH PAPER

Anesthesiology

COMPARISON OF ULTRASOUND GUIDED TECHNIQUE WITH CONVENTIONAL LANDMARK TECHNIQUE FOR SUPRACLAVICULAR BRACHIAL PLEXUS NERVE BLOCK IN PATIENTS UNDERGOING UPPER LIMB SURGERIES

KEY WORDS: Supraclavicular brachial plexus block, ultrasound, upper limb surgery, conventional subclavian perivascular technique

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ABSTRACT

Background: supraclavicular block offers dense anaesthesia of the brachial plexus of surgical procedures at or distal to the elbow. Landmark technique has been traditionally used. But blind technique often requires multiple trial and error needle attempts, resulting in long procedure time, procedure related pain, discomfort and lethal complications. Ultrasound is a new technique with short procedure time, less pain, discomfort and complications.

Objectives: The main objectives of the study was to compare both the techniques in terms of time taken for the procedure, onset and duration of sensory and motor blockade, effectiveness of the block.

Methods: We included 60 ASA I or ASA II patients, aged from 17 to 60 years who underwent elective upper limb surgeries under supraclavicular block. Patients were divided into two groups. In one group (Group C n=30) conventional subclavian perivascular technique was used while in other group (Group US n=30), supraclavicular nerve block was performed under ultrasound guidance. Block was performed with 15 ml of 0.5% bupivacaine and 15 ml of 2% lignocaine with adrenaline 1:2,00,000 in both the groups.

Results: when compared with conventional technique, the onset of sensory and motor blockade is found to be earlier, the duration of sensory and motor blockade is found to be prolonged, analgesic requirement is reduced and overall effectiveness was better with ultrasound guided supraclavicular block. Time taken for the block performed by ultrasound was little longer than the conventional subclavian perivascular technique.

Conclusion: Ultrasound guided supraclavicular block has a rapid onset of both sensory and motor blockade, prolonged duration of blockade, reduced analgesic requirements with increased success rate and fewer complications.

INTRODUCTION

Regional nerve blocks prevent the unwanted stress of laryngoscopy and tracheal intubation and the adverse effects of general anaesthetic drugs¹. Supraclavicular nerve block is ideal for procedures of upper arm, from mid humeral level down to hand. Brachial plexus is most compact at the level of trunks formed by C5-T1 nerve roots, so blockade here has greatest likelihood of blocking all of the branches of brachial plexus. But the proximity of the brachial plexus at this location to pleura has resulted in unacceptable high incidences of pneumothorax (0.5% to 6 %) which has been of concern to many practitioners.

USG guidance provides real time visualization of anatomical structures and needle movement and has decreased the complication rates². We performed this study to evaluate safety and usefulness of ultrasound for supraclavicular brachial plexus blocks in comparison to blind landmark based technique.

MATERIALS AND METHODS

60 adult patients of either sex, age 18-60, ASA physical status I and II with fracture lower end of humerus or both bone forearm were included in the study.

Exclusion criteria was Patients refusal, Patients below 17 and above 60 years of age and with total body weight less than or equal to 50kg, Patients with coagulopathy or peripheral neuropathy and allergy to local anaesthetics.

All the patients were premedicated with injection glycopyrrolate 8µg/kg intramuscularly (IM) 45 minutes before starting the procedure. Intravenous fluid was started for all patients and was shifted to operating room. Block was performed with 15 ml of 0.5% bupivacaine and 15 ml of 2% lignocaine with adrenaline 1:2,00,000 in both the groups. Pulse oximetry, non-invasive blood pressure monitor on the opposite upper limb and electrocardiogram (ECG) were connected and baseline parameters were recorded for all patients.

PROCEDURE

GROUP C, CONVENTIONAL

In Group C, block was performed by conventional subclavian perivascular technique by eliciting paraesthesia^{1,3,5,6}. After sterile preparation of the site and draping, a 22 gauge 5 cm Huber point needle was inserted at the lowest point of the interscalene groove. The plexus was identified by eliciting paraesthesia which should be

evident in area below the shoulder. After eliciting paraesthesia, 30 ml of local anaesthetic solution was injected.

GROUP US, ULTRASOUND

In group US, block was performed after real time visualization of the vessels, nerves and bones with "in-plane approach"^{1,4,7}. This procedure was done using Sonoray ultrasonogram machine with 10-6 MHz transducer by the "in-plane approach" using 20G spinal needle. The brachial plexus was visualized by placing the transducer in the sagittal plane in the supraclavicular fossa behind the middle-third of the clavicle. Two distinct appearances of the brachial plexus was seen at the supraclavicular region.

A 20 G spinal needle was connected to a 10 cm extension line, which in turn was connected to a 10 ml disposable syringe containing the local anaesthetic solution. The whole line was primed with the drug. Then the needle was inserted and Once the needle reached the plexus, predetermined volume of 30 ml of local anaesthetic solution was administered inside the brachial plexus sheath after negative aspiration of blood to avoid accidental intravascular needle puncture.

The proper spread of local anaesthetic solution around the considered nerves was continuously evaluated under sonographic vision, and needle tip position was continuously adjusted with minimum movements during injection under sonographic vision. The multiple injection technique was used to deposit the total amount of drug. Ineffective blocks were considered as block failure and converted to general anaesthesia.

OBSERVATION AND RESULTS:

Table 1: Comparison of conventional and ultrasound guided block on the basis of time taken for the procedure

Study Group	Mean ±SD (mins)	Mean Difference	t* value	p value	Significance
Group C	5.66±1.7	3.03	4.17	0.000	Highly Significant
Group US	8.7±2.36				

* Student's unpaired t test Highly significant - p<0.001

As shown in Table 1 and graph 1, the mean time taken to perform a conventional block was 5.66±1.7 minutes and in group US, it was 8.70 ± 2.36 minutes. The statistical analysis by student's unpaired 't' test showed that, conventional technique was significantly faster to perform when compared to ultrasound

guided technique ($p < 0.001$).

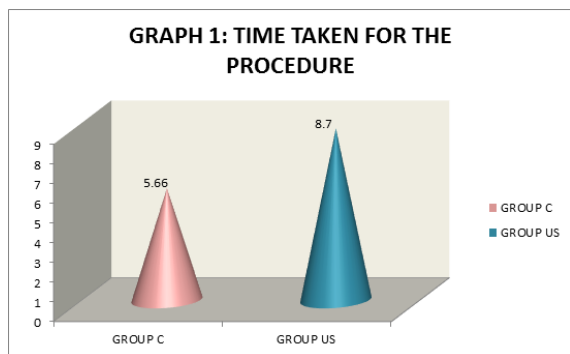


Table 2: Comparison of conventional and ultrasound guided block on the basis of time taken for the onset of sensory blockade

Study Group	Mean±SD (mins)	Mean Difference	t* value	p value	Significance
Group C	10.89±8.11	2.77	3.16	0.003	Highly Significant
Group US	8.11±2.67				

* Student's unpaired t test Highly significant - $p < 0.01$

As shown in Table 2 and graph 2, the mean time for the onset of sensory block in group C was 10.89 ± 8.11 minutes and in group US, it was 8.11 ± 2.67 minutes. The statistical analysis by student's unpaired 't' test showed that the time taken for the onset of sensory block in group US was significantly faster when compared to group C ($p = 0.003$).

Table 3: Comparison of conventional and ultrasound guided block on the basis of time taken for the onset of motor blockade:

Study Group	Mean± SD (mins)	Mean Difference	t* value	p value	Significance
Group C	13.00±3.7	2.58	2.81	0.007	Highly Significant
Group US	10.42±3.16				

* Student's unpaired t test Highly significant - $p < 0.01$

As shown in Table 3 and graph 2, the mean time for onset of motor block in group C was 13 ± 3.7 minutes and in group US, it was 10.42 ± 3.16 minutes. The statistical analysis by student's unpaired 't' test showed that the time for onset of motor block in group US was significantly faster when compared to group C ($p = 0.007$).

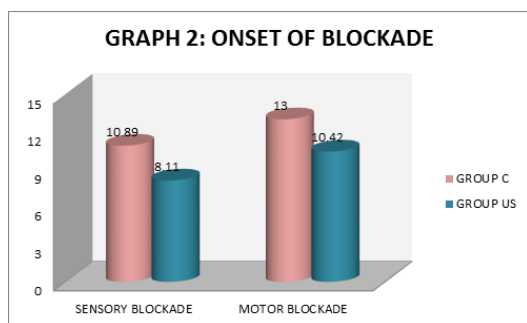


Table 4: Comparison of conventional and ultrasound guided block on the basis of duration of sensory blockade

Study Group	Mean ± SD (hrs)	Mean Difference	t* value	p value	Significance
Group C	5.41±1.1	0.91	3.34	0.001	Highly Significant
Group US	6.32±0.97				

* Student's unpaired t test Highly significant - $p < 0.01$

As shown in Table 4 and graph 3, the mean duration of sensory block in group US was 6.32 ± 0.97 hours and in group C was

5.41 ± 1.1 hours. The statistical analysis by students unpaired 't' test showed that the duration of sensory block in group US was significantly longer when compared to group C with p value of 0.001 ($p < 0.01$).

Table 5: Comparison of conventional and ultrasound guided block on the basis of duration of motor blockade

Study Group	Mean± SD (hrs)	Mean Difference	t* value	p value	Significance
Group C	5.04±1.08	0.77	3.08	0.003	Highly Significant
Group US	5.82±0.83				

* Student's unpaired t test Highly significant - $p < 0.01$

As shown in Table 5 and graph 3, the mean duration of motor block in group US was 5.82 ± 0.83 hours and the group C was 5.04 ± 1.08 hours. The statistical analysis by students unpaired 't' test showed that the group US has longer duration of motor blockade when compared to group C and it is statistically significant ($p < 0.01$).

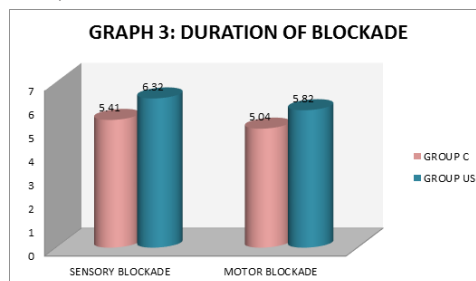


Table 6: Comparison of conventional and ultrasound guided block on the basis of requirement of intraoperative analgesic supplementation

Study group	Analgesic Supplementation		Chi-square value	p value	Significance
	Required	Not Required			
Group C	9	21	7.68	0.006	Highly Significant
Group US	1	29			

Chi Square test Highly Significant - $p < 0.01$

As shown in the table 6 and graph 4, in Group US, 1 out of 30 patients required analgesic supplementation during surgery and in conventional group, it was 9 out of 30 patients. The chi square value is 7.68. The requirement of analgesics was significantly reduced in ultrasound group than in conventional group. ($p = 0.006$)

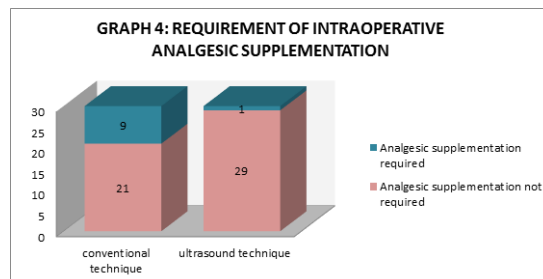


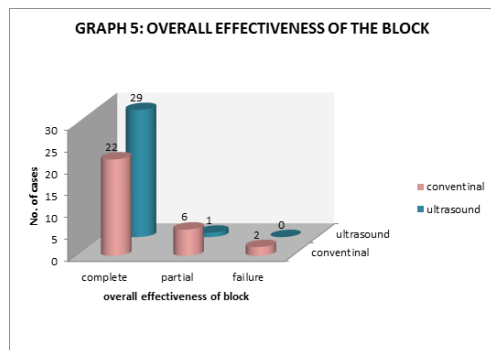
Table 7: Comparison of conventional and ultrasound guided block on the basis of overall effectiveness of the block

Study Group	Totally effective	Partially effective	Conversion to GA	Chi Square	p value	Significance
Group C	22	6	2	6.53	0.038	Significant
Group US	29	1	0			

Chi square test Significant - $p < 0.05$

As shown in the table 7 and graph 5, in group US, 29

patients (96.67%) had totally effective blockade, and in 1 patient the block was partially effective (3.33%) and there was no conversion to General Anaesthesia in US group. Whereas in group C, only 22 patients had totally effective block, in 6 patients the block was partially effective and in 2 patients block was totally failed and required conversion to general anaesthesia. This difference is statistically significant by chi-square test with p value of 0.038 ($\chi^2 = 6.53$, $p < 0.05$)



DISCUSSION:

Brachial plexus block has been proven to be a valuable method of providing anesthesia for surgery of the forearm and hand. The most common technique is the supraclavicular approach of brachial plexus because of its ease of performance and increased extent of blockade. In previous days, various blind techniques were used to find the brachial plexus sheath. The most important among them is by eliciting paraesthesia in the subclavian perivascular approach. Although nerve stimulator technique improves the success rate of supraclavicular brachial plexus block, it is not used routinely. Even after the invention of ultrasound, most of the anaesthesiologists are still practising conventional blind technique for peripheral nerve blocks especially supraclavicular brachial plexus block.

Time taken for the procedure:

The mean time taken for ultrasound guided supraclavicular block in our study was 8.7 ± 2.36 minutes and for conventional technique it was 5.66 ± 1.7 minutes. The p value was 0.000. Hence, conventional technique is significantly faster to perform than ultrasound guided technique ($p < 0.005$).

Gajendra Singh et al⁸ conducted a study between conventional and ultrasound guided supraclavicular block. They concluded that the mean time taken for an ultrasound guided supraclavicular block was 10.1 ± 1.15 minutes and for conventional technique it was 5.43 ± 1.45 minutes. This is more similar to our study. Veeresham et al⁹, in their study compared ultrasound with conventional technique of supraclavicular brachial plexus block, found that the mean time taken for the procedure was 5.37 ± 1.45 minutes in conventional group whereas, it was 9.97 ± 2.44 minutes in ultrasound group ($p < 0.0001$). In a study by Mithun Duncan et al¹⁰ compare the efficacy of ultrasound guided technique with nerve locator guided method, the time taken for them in ultrasound group was 7.27 ± 3.87 minutes which is similar to our study.

Onset of sensory block:

The mean onset time for sensory blockade in ultrasound group (US) was 8.11 ± 2.67 minutes and in conventional group it was 10.89 ± 8.11 minutes with p value of 0.003 ($p < 0.05$). This can be due to the direct visualization of structures in ultrasound group. Moreover, we can administer the drug intrafascially with ultrasound guidance. According to Shweta S. Mehta et al¹¹, the onset of sensory blockade was significantly faster in ultrasound guided technique (6.64 ± 0.89 minutes) than conventional nerve stimulator technique (9.64 ± 1.14 minutes). This is concordant with our study.

Gajendra Singh et al⁸, in their study administered 15 ml of 0.5% bupivacaine and 15 ml of 2% lignocaine. The mean onset of sensory blockade was 10.83 ± 2.94 minutes in ultrasound group

and 11.60 ± 3.48 minutes in conventional paraesthesia group but this slight delay was not statistically significant. Mithun Duncan et al¹⁰, in their study administered 1:1 mixture of 0.5% lignocaine and 2% bupivacaine and they found that the onset of sensory block was 5.47 minutes in ultrasound group and 5.90 minutes in nerve stimulator group. It supported our study.

Onset of motor blockade:

The mean onset of motor block in conventional technique was 13 ± 3.7 minutes and in ultrasound group was 10.42 ± 3.16 minutes. The p value was 0.007. Thus, it was evident that there is significantly faster onset of motor block in ultrasound group when compared to conventional group. In our study, the onset of motor blockade in supraclavicular block was found to be delayed than that of sensory blockade in both the groups.

In a study done by Gajendra singh et al⁸, the onset of motor blockade was within 14.56 ± 4.49 minutes in ultrasound group and 16.8 ± 3.43 minutes in conventional group with a p value of 0.02 (statistically significant). Mithun Duncan et al¹⁰ also used 0.5% Inj. bupivacaine and 2% Inj. lignocaine in 1:1 ratio. They found that ultrasound guided technique has faster onset of motor block than nerve stimulation technique. Shweta S. Mehta et al¹¹ conducted a study to compare the efficacy of ultrasound guided supraclavicular block with peripheral nerve stimulator technique. The mean onset of motor block in their study was 10.1 ± 1.14 minutes for ultrasound group and 12.18 ± 1.48 minutes in nerve stimulator group. Their result was concordant with our study.

Duration of sensory blockade:

The mean duration of sensory blockade in ultrasound group (US) was 6.32 0.97 hours and in group C (conventional), it was 5.41 1.1 hours. This difference between the two groups was statistically significant with p value 0.001 ($p < 0.05$).

Gajendra singh et al⁸, in their study, on comparison between ultrasound guided and paraesthesia eliciting technique found that the duration of sensory blockade was significantly prolonged in ultrasound group (397.93 67.32 minutes.) when compared to conventional group (352.22 87.50 minutes). It is concordant with our study.

Veeresham et al⁹, in their study found that the duration of sensory block was prolonged in ultrasound group (444.16 ± 116 minutes) than conventional group (393.2 ± 95.33 minutes). It is similar to our study. Mithun Duncan et al¹⁰ also found a slight prolongation of sensory blockade in US group (429.5 minutes) when compared to NS group (401.13 minutes) but it was not statistically significant.

Duration of Motor blockade

The mean duration of motor blockade in group US was 5.82 .83 hours and in group C, it was 5.041.08 hours. The difference between the two groups was statistically significant with p value of 0.003 ($p < 0.05$).

Gajendra singh et al⁸, in their study with the same drug combination found that the duration of motor blockade was significantly prolonged in US group (343.45 60.84 minutes) than paraesthesia group (305.19 60.08 minutes). This is concordant with our study.

Overall effectiveness of block:

Out of the 30 cases studied under ultrasound group, 29 blocks were complete and 1 block was inadequate with sparing of ulnar nerve segment, none of the patients had failed block. Thus 97% of patients attained complete block, 3% had partial blockade and 0% failure. Out of the 30 cases studied under subclavian perivascular approach 22 blocks were complete, 6 were partial and 2 totally failed blocks. Thus statistically 73% of patients attained complete block, 20% had partial blockade and 7% failure. This was statistically analysed with chi square test and p value was 0.038 ($p < 0.05$). Thus ultrasound guided technique had significantly higher success rate than conventional subclavian perivascular paraesthesia eliciting method.

According to Gajendra Singh et al⁸ and Marhofer et al¹² ultrasound guided technique had provided more effective blocks than conventional paraesthesia eliciting technique or using nerve stimulator. This is similar to our study. The drawback in our study was that we have not used nerve stimulator in addition to anatomical landmarks for identifying the nerves. However Baranowski and Pither, in their study did not observe any difference in success rate of nerve block by using either nerve stimulator or conventional paraesthesia method. This study was supported by studies done by Nithin Sathyan et al¹³ and Horlocker et al

CONCLUSION:

Ultrasound guided supraclavicular block for upper limb surgeries when compared to conventional subclavian perivascular technique has a rapid onset of both sensory and motor blockade, prolonged duration of blockade, reduced analgesic requirement both intra- and postoperatively, increased success rate with fewer complications.

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