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**Original Research Article**

# A comparative study between conventional and ultrasound-guided supraclavicular brachial plexus block in upper limb surgeries

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## ABSTRACT

**Background:** The well-researched method of brachial plexus blocking is used in upper limb procedures. The blind paresthesia methodology used in the conventional approach has a greater failure rate and may cause damage to the tissues that surround and nerves. Peripheral nerve stimulators and ultrasound methods were used to better localise the nerve/plexus in order to prevent certain of these issues.
**Methods:** A total of 50 patients were included in this prospective randomized trial and randomly assigned to two groups: US (Group US) and LM (Group LM) after receiving clearance from the institutional ethics committee and consent from the patients. Each of the two groups got 0.5% bupivacaine. The injection of local anaesthetic (bupivacaine, 2 mg/kg) did not exceed the hazardous dosage since the amount was determined based on body weight.
**Result:** The demographic information for both groups was similar. When compared to ultrasound, the mean time required for the method to provide a block via inducing paraesthesia was much shorter. There was no statistically significant difference in the meantime of motor block start, sensory blockade, or the length of both types of blockades. The ultrasonic group had a higher block success rate than the traditional group, although this difference didn't prove clinically important.
**Conclusions:** The most secure and effective approach to perform a supraclavicular brachial plexus block is using ultrasound guidance. Because ultrasonography allows for the transmission of local anaesthetic and instantaneous imaging of underlying structures, the incidence of problems is lower.

**Keywords:** Paresthesia, supraclavicular block, Ultrasound, Ultrasound-Guided Supraclavicular Brachial Plexus Block

## INTRODUCTION

A proven, safe, and efficient anaesthetic method for upper limb procedures in the distal arm, forearm, and hand is brachial plexus block.[1] It provides brachial plexus dense anaesthesia, resulting in total muscular relaxation, stable intraoperative hemodynamics, sympathetic block, and sustained post-operative analgesia-all of which contribute to the best possible surgical circumstances.[2] The supraclavicular method is the most effective brachial plexus block technique for numbness over the whole upper arm away from the elbow. Because of its capacity to give complete anaesthesia in this area, it is sometimes designated as the "Spinal of the arm". Kulenkampff initially detailed the method in 1912.[3] The affordability, effectiveness, safety, dependability, and postoperative advantages of regional anaesthesia methods have made them more popular recently than general anaesthesia4. Nevertheless, the conventional landmark method for supraclavicular brachial plexus block is a blind method that frequently necessitates several needles tries, lengthening the procedure's duration, causing discomfort

to the patient, and raising the possibility of failure and consequences including nerve and vascular damage.[5]

Peripheral nerve stimulators were developed as a solution to these problems, enabling improved brachial plexus and nerve localization. Nonetheless, there is still a chance that this method will harm nearby structures. Regional anaesthesia has undergone a revolutionary change thanks to the development of ultrasound technology and a deeper comprehension of anatomical sonography.[6] Accurate needle insertion, visualisation of nerve/plexus structures, and continuous surveillance of local anaesthetic distribution are made possible by ultrasound-guided procedures. Increased safety, a decreased risk of complications, and a greater success rate are provided by ultrasound-guided supraclavicular brachial plexus block. In light of these developments, the purpose of this research is to evaluate the effectiveness and success rate of the supraclavicular brachial plexus block utilizing both the landmark and ultrasound guided techniques.[7]

## METHODS

After receiving institutional approval and authorization from the ethics committee, a prospective, randomised study was carried out throughout January 2023 and January 2024, Department of Anaesthiology and Critical Care, DMCH, Laheriasarai. According to inclusion and exclusion criteria, the research comprised fifty patients who had appointments for upper limb procedures. Every patient got premedication and had a standard pre-anaesthetic examination. On the other side of the operated limb, a 20G IV cannula was used for establishing intravenous access. Two groups of 25 patients each were randomly assigned to the patients: Group LM (Landmark): Landmark technique of supraclavicular brachial plexus block. Group US (Ultrasound): Ultrasound-guided supraclavicular block.

Aseptic procedures were followed during the supraclavicular brachial plexus block, and a 25 ml 0.5% ropivacaine local anaesthetic was used. To lessen the patient's suffering, a 2% lignocaine skin infiltration was applied where the block needle penetration occurred. The patient was put in a supine posture, with the arm being gently pulled down and the head rotated to the opposing side of the targeted block. A noticeable field was made beneath the shoulder using a cushion or folded sheet.

### *Landmark technique*

A subcutaneous wheal was produced with 2% lignocaine using a 25G needle, somewhat lateral to the subclavian artery, which was palpated in the supraclavicular fossa. Next, an 18G needle was put downward, inside, and backward into the skin wheal. The medication was administered after the needle was removed by one to two millimetres, eliciting paraesthesia. Without paraesthesia, a walk-over approach was used to inject the medication close to the first rib.

### *Ultrasound technique*

After positioning the patient appropriately, the skin was cleaned and the ultrasonography transducer was positioned above the clavicle to acquire a cross-sectional image of the subclavian artery. The brachial plexus was superficial to the artery and lateral to it, appearing as a cluster of hypoechoic oval structures (grape-like). Following local infiltration towards the brachial plexus, an 18G block needle was placed in-plane in a lateral to medial orientation. There is frequently a perceptible "pop" audible when the needle enters the brachial plexus sheath after passing through the paravertebral fascia. A meticulous aspiration was performed to rule out blood, and then tiny aliquots of the necessary amount of local anaesthetic were administered. After then, the needle was redirected, and the plexus was fully injected with the remaining medication. The extent of both the motor and sensory blockage, as well as the time it took for the process to complete, were recorded. Hemodynamics was routinely checked during the procedure. The patients were observed after surgery to determine how long the motor and sensory inhibition would last. Patients were asked to move their fingers to gauge their motor recovery, and pinprick feeling was used to gauge their sensory recovery.

Some parameters were recorded: Procedure time: The amount of time it takes to complete the steps from part preparation to local anaesthetic delivery. The period of time between the test drug injection and the loss of pinprick feeling is known as the "onset of sensory blockade." Motor blockage onset: The period of time from the drug's administration till the affected limb's motor weakness manifests. Length of sensory block: The amount of time that passes between the start of sensory blockade and the patient's initial feeling in the impediment. Length of motor blockade: The amount of time that passes between the patient's first movement in the immobilized limb and the start of motor blockade. Failure of block: even following 30 minutes of medication delivery, insufficient or uneven analgesia. General anaesthesia was used in these situations. Sensory blockage grading: I: No change; II: Some change, but blocked arm feels pinprick; III: No pinprick in blocked arm. The motor blockage is graded as follows: I: Normal power; II: Reduced power; and III: Total loss of power.

In order to examine the duration, success rate, and complications of conventional and ultrasound guided supraclavicular brachial plexus block, as well as the amount of time required for the procedure, a prospective, randomized, comparative study was carried out on sixty patients, aged 18 to 60, who had been posted for upper limb surgeries. The patient demographics in neither group differed in a clinically or statistically meaningful way. Microsoft excel was employed to tabulate the data, and SSPS V22 software was then used to analyse it. Numbers (%) are used to represent categorical measures while mean±SD is used for continuous measurements. Utilizing

the independent sample t-test and the chi square test, significance was determined at a 5% level of confidence.

## RESULTS

There were no significant differences between both groups with respect to demographic data.

**Table 1: Age distribution in study group.**

| Age Ggroup | Mean | SD | t value | P value |
|---|---|---|---|---|
| **Group LM** | 35.61 | 11.61 | -1.539 | 0.102 |
| **Group US** | 38.55 | 14.58 | | |

**Table 2: Sex distribution in study group.**

| Sex | Group LM | Group US | Total | P value |
|---|---|---|---|---|
| **Male** | 13<br>52% | 16<br>64% | 29<br>58% | 0.411 |
| **Female** | 12<br>48% | 9<br>36% | 21<br>42% | |
| **Total** | 25<br>100% | 25<br>100% | 50<br>100% | |

There were no significant differences between both groups with respect to sex demographic data.

**Table 3: Time taken for procedure.**

| | Mean | | SD | t value | P value |
|---|---|---|---|---|---|
| **Time taken for procedure (in sec)** | Group LM | 312.43 | 68.12 | -10.102 | <0.05 |
| | Group US | 589.12 | 117.55 | | |

The time taken for the procedure in Group US is relatively more than Group LM.

**Table 4: Onset of sensory and motor blockade.**

| | | Mean | SD | t value | P value |
|---|---|---|---|---|---|
| **Onset of sensory** | Group LM | 12.19 | 1.31 | 8.29 | <0.0001 |
| | Group US | 8.27 | 2.01 | | |
| **Onset of motor** | Group LM | 17.55 | 1.71 | 8.02 | <0.0001 |
| | Group US | 13.49 | 1.88 | | |

Onset duration of motor blockade and sensory blockade was not statistically significant in both groups.

**Table 5: Duration of motor and sensory blockade.**

| | Mean | | SD | t value | P value |
|---|---|---|---|---|---|
| **Duration of motor blockade** | Group LM | 427.23 | 75.54 | 3.579 | 0.006 |
| | Group US | 517.57 | 92.75 | | |
| **Duration of sensory blockade** | Group LM | 509.44 | 92.15 | 2.702 | 0.007 |
| | Group US | 581.89 | 99.39 | | |

**Table 6: Effectiveness of the block.**

| | Group LM | Group US | Total | P value |
|---|---|---|---|---|
| **Incomplete** | 3 | 0 | 3 | 0.011 |
| **Complete** | 22 | 25 | 47 | |
| **Total** | 25 | 25 | 50 | |

Effectiveness of the blocks in both the groups was not statistically significant.

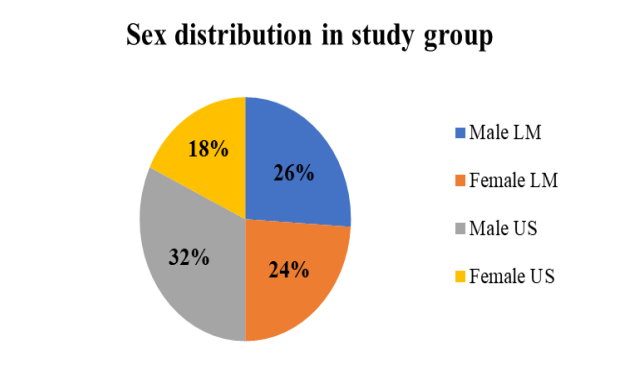


**Fig 1: Sex distribution in study group.**

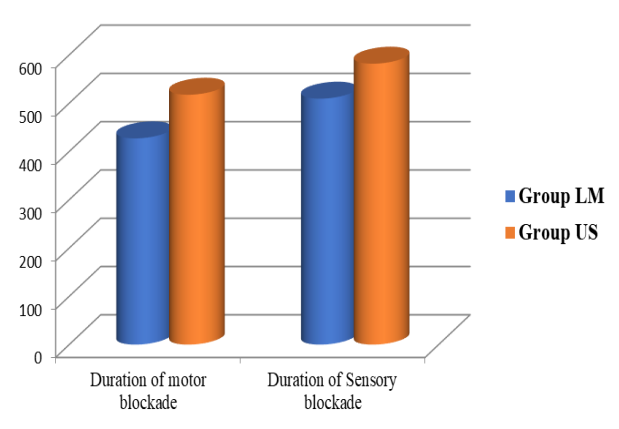


**Figure 2: Mean duration of motor and sensory blockade.**

## DISCUSSION

### *Age group*

In group LM, the average age was 35.61±11.61 years, whereas in group US, it was 38.55±14.58 years. The age variances among the two groups were negligible.

### *Time taken for procedure*

The average time required to do the identical surgery utilising an ultrasound (group US) was 589.12 seconds (9.81 minutes), whereas the traditional landmark approach (group LM) took 312.43 seconds (5.20 minutes). Both statistically and clinically, this was substantial. The ultrasonic guided block took 9.81 minutes on average, which was a lot longer than the landmark technique's 5.20 minutes. Consultants carried out both blocking strategies. The landmark approach took comparatively less time for the block since the specialists were experienced with it, while the ultrasound was a more recent expertise. It needs more time. This may be attributed to a lack of ultrasound experience and expertise. Due to its lengthier learning curve, the use of ultrasonography in regional anaesthesia necessitates the development of new skills and knowledge.

High-end ultrasonographic equipment and extensive training are necessary for the use of ultrasound guidance in routine clinical practice. After completing 15 to 20 processes, all unskilled users' performance times' increase as a result of the US guided blocks' learning curve. In a study by Williams et al., the number of brachial plexus blocks required to get a decent level of technique skill was calculated8. They projected that a success rate of 87% would require at least 62 blocks to be executed. Most residents are often not permitted to finish their learning curve in this number of blocks during residency. The group US's extended block performance length can be attributed to their intermediate ultrasonography proficiency.[9]

### *Onset of sensory and motor blockade*

In group LM, the average time it took for sensory blocking to start was 12.19±1.31 minutes. It took 8.27±2.01 minutes for the US group. With the use of ultrasound technology, sensory onset occurred more quickly, and the outcomes are statistically and clinically significant. In the LM group, motor block started at 17.55±1.71 minutes, while in the US group, it started at 13.49±1.88 minutes. In the landmark group, motor onset was significantly delayed, and the findings are statistically significant. In comparison to the LM group, the USG group experienced the start of sensory blockade and motor blockade substantially sooner. In landmark, the beginning of sensory perception was 12.19±1.31 minutes, while with ultrasonic technology, it was 8.27±2.01 minutes. In a comparable manner motor obstruction began in landmark at 17.55±1.71 minutes and in ultrasound at 13.49±1.88 minutes.

The onset of sensory and motor blockade was considerably shorter in the Dureja J et al. study using the US guided technique (9 min ± 33s and 14 min ± 3s, respectively), but it was substantially greater when using the conventional (11 min±31s and 17 min±1s) and nerve stimulator (20 min±1s and 22 min±06 s) techniques. Comparably, research by Raghove P et al discovered that the USG group had sensory and motor block onset earlier than the traditional group.[10] Due of the blind methodology and perivascular drug injection with the hope that it would disseminate throughout the nerves, delayed beginning of action is taken into consideration when using the landmark technique. The effect of the block is sped up by using ultrasonography to implant the medicine in close proximity to the nerve plexus under direct observation.[11] The motor phase started at the same time as sensory blocking, and this was consistent with research by Williams et al, Honnannavar et al and Veeresham et al.[12]

### *Duration of motor and sensory blockade*

The average length of motor blockage in group LM was 427.23±75.54 minutes, but in group US, it was 517.57±92.75 minutes. Relative to group US, the duration of motor obstruction in group LM was much shorter. There is statistical significance in the results. The average length of sensory blocking in group LM was 509.44±92.15 minutes, whereas in group US it was 581.89±99.39 minutes. Compared to the landmark group, the ultrasound group experienced longer blockage duration. Both clinically and statistically, it is substantial.

In comparison to the conventional group, the Dureja et al. research found that the analgesia duration was longer in the groups using nerve stimulators and ultrasound than in the traditional group.[13,14] Comparably, Raghove P et al discovered that USG guided block produced analgesia that lasted longer. The length of sensation was longer with ultrasound than with landmark in investigations by Veeresham et al and Honnannavar et al but this difference was not considered statistically significant.[15]

### *Effectiveness of the block*

All of the blocks were carried out while sedated. 88% of patients in the LM group and 100% of patients in the US group had a successful block. In the LM group, 12% of the blocks experienced a total failure. No block in the US group failed. Clinical significance was involved here. In the LM group, the block was effective in 88% of the patients, whereas in the US group, it was 100%. In the LM group, 12% of the blocks had total failure. IV midazolam was used to sedate all of the patients during the procedures. The blocks that failed were put under general anaesthesia. When analgesia had been achieved in every location supplied by the four principal nerves,

we regarded the block as complete. When sensory block was absent in a minimum of one neural distribution, or when a different anaesthetic approach was required to enable surgery, we deemed the block incomplete. Following one effort at a USG guided block, Vincent WS Chan et colleagues discovered that the block was effective in 95% of instances.[16] According to Dureja et al., the Conventional group experienced a greater incidence of patchy effects that required intravenous anaesthetic replenishment than the Nerve Stimulator or Ultrasound Guided procedures.[17,18] The direct ultrasound visualization of the plexus and the real-time medication injection surrounding the plexus account for the high success rate of USG.[19] It should be remembered, nevertheless, that the effectiveness of both procedures depends on the patient's cooperation as well as the expertise and ability of the anesthesiologist doing the block.[20]

The study is limited to a specific area of Bihar, for further results we need more geographical area. The population is only 50, the results may defer in larger populations.

## CONCLUSION

According to our research, there are a number of benefits that the ultrasound-guided method of supraclavicular brachial plexus block has over the landmark method. Ultrasound guiding offered quicker onset and longer duration of sensory and motor blockage, albeit requiring more time to complete the procedure. With ultrasound guidance, problems such vascular puncture were avoided and the success rate increased. For supraclavicular brachial plexus blocks, ultrasound-guided methods should thus be taken into consideration as the best course of action, given that the anesthesiologist has the required qualifications.

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