

# A Comparative Evaluation of Techniques in Interscalene Brachial Plexus Block: Conventional blind, Nerve Stimulator Guided and Ultrasound Guided.

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## ABSTRACT

**Background:** This study was conducted to compare the three technique Conventional blind, Nerve stimulator guided and Ultrasound guided for Interscalene brachial plexus block in surgeries of upper limb. **Methods:** Total 60 patients were included in our study which were randomly allotted by closed envelope technique into either of the three groups namely Conventional blind (group CB), US-guided (group US) or NS-guided (group NS). The drug bupivacaine 0.5% (2 mg/kg) was used and diluted with normal saline to make a total volume of 30 ml. **Results:** Comparison between the Conventional blind (CB), Nerve Stimulator (NS) and Ultrasound guided (US) technique of interscalene brachial plexus block revealed that the block execution time, time of onset of sensory and motor block was significantly less in ultrasound group as compare to other groups. The mean duration of analgesia too, was significantly higher in both NS and US group (3 hr & 23 min, 3 hrs 30 min respectively), while it was 2 hr 47 min in CB group. The incidence of patchy effect (3 cases) and blockade failure requiring general anesthesia (4 cases) were significantly higher in CB group compared to NS group (2 cases each) and US group (1 case each). **Conclusion:** The success rate and effective quality of the block were more satisfactory with ultrasound technique than the nerve stimulator or conventional blind technique.

**Keywords:** Interscalene block, Ultrasound, Nerve stimulator, Shoulder surgery.

## INTRODUCTION

Anesthesiologists routinely use peripheral nerve blocks as an alternative or an adjunct to general anesthesia in addition to postoperative analgesia for a wide variety of procedures.<sup>[1]</sup> The goal of a peripheral nerve block is to apply a local anesthetic directly onto a peripheral nerve or nerve plexus to completely anesthetize the surgical site.

Brachial plexus blockade has long been used for upper extremity surgery and there are several standard techniques. Interscalene brachial plexus block is recommended in the perioperative management of patients presenting for shoulder surgery<sup>[2]</sup>. Benefits of this technique include excellent intraoperative anesthesia and muscle relaxation, better recovery room pain scale scores, and lower incidences of nausea and vomiting. Moreover, it may be more cost effective compared to general anesthesia.<sup>[3]</sup>

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The Interscalene brachial plexus block can be performed by conventional blind; nerve stimulator (NS)-guided or ultrasound (US)-guided technique. In conventional blind technique anesthesiologists used the paresthesia technique in which the needle is inserted at a point determined by standard anatomic

landmarks and then advanced until the patient feels paresthesia in the relevant sensory distribution. In nerve stimulator guided technique current sends through the stimplex needle to elicit contraction of relevant muscle groups when in close proximity to the nerve of interest. These techniques are effective and are still in use, although they have many drawbacks. Over the past decade, ultrasound has gained popularity for peripheral nerve blockade because it allows the anesthesiologist to directly visualize the nerves, the needle tip itself, and the spread of the local anesthetic in the desired location. In addition, the ultrasound image reliably depicts other structures such as blood vessels and lungs that the anesthesiologist wants to avoid. Because of this, ultrasound guidance has increasingly become the standard technique for regional anesthesia. In this prospective randomized study, we compared conventional blind, NS-guided technique and US-guided interscalene brachial plexus block and evaluated time of onset of sensory and motor block, block execution time, duration of analgesia, failure rate, and complications if any.

## MATERIALS AND METHODS

After approval by the ethical committee and written informed consent obtained from all patients, 60 patients who satisfied the inclusion and exclusion criteria, undergoing surgeries of proximal humerus, clavicle and shoulder were selected for the study.

### Inclusion criteria

ASA (American society of anaesthesiologists) 1, and 2 patients.  
Age group between 18 and 75 years.

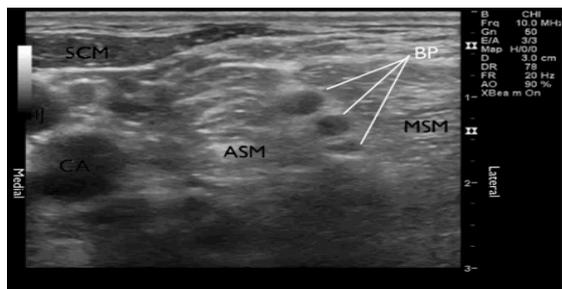
**Exclusion criteria**

Patient who refuses to participate in the study, infection at the proposed site of block, coagulopathies, and allergy to local anesthetics, pulmonary, cardiac pathology and preexisting neurological deficit in the upper limb were excluded from the study.

Routine preoperative assessments of all the patients were done and anaesthetic procedure was explained. All the patients were fasted adequately and were pre-medicated with tab. Alprazolam 0.25 mg and tab. ranitidine 150 mg on the night before surgery. In the operation theatre, patients were monitored with pulse oximetry, non invasive blood pressure and ECG. After establishing an intravenous access, the patients received inj. midazolam 2 mg intravenously. No other sedation was given till evaluation of the block was completed. The patients were randomly allotted by closed envelope technique into either of the three groups namely Conventional blind(group CB), US-guided (group US) or NS-guided (group NS)..The drug bupivacaine 0.5% (2 mg/kg) was used and diluted with normal saline to make a total volume of 30 ml. The patient was positioned supine with the head turned away from the side to be blocked. The proposed site of block was aseptically prepared and draped.

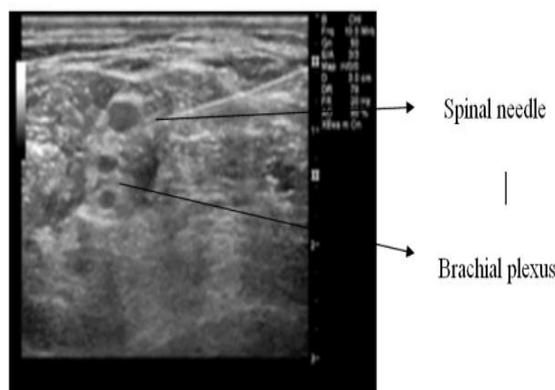
**Group US:**

A Sonosite Micromax-HFL linear 38 probe (6-13 MHz) was used for conducting the block in every case. The probe was inserted into a sterile plastic sheath so as to maintain sterility. The ultrasound probe was positioned over the sternocleidomastoid at the level of the cricoid cartilage in axial plane. After identifying the jugular vein and carotid artery in the short axis, the operator slides the probe laterally/posteriorly until the brachial plexus nerve roots were visualized. At this level, the nerve roots of the brachial plexus appeared as 2 to 4 round hypoechoic circles lying between the anterior and middle scalene muscle.



**Figure 1:** Interscalene brachial plexus anatomy. ASM indicates anterior scalene muscle; BP, brachial plexus, nerve roots of C4, C5, and C6; CA, carotid artery; MSM, middle scalene muscle; and SCM, sternocleidomastoid muscle.

Once an optimal view of the nerve roots was established and color Doppler imaging confirms the absence of blood vessels in the trajectory of the needle, the operator prepares for the block. . The skin was anesthetized with 1 to 2 ml of lidocaine 1%. While holding the ultrasound transducer with the non-dominant hand, the operator then inserts a 22-gauge × 50-mm nerve block needle “in plane” with the probe, allowing visualization of the entire needle. The operator advanced the needle slowly, taking care to avoid any vascular structures and keeping the needle tip in view at all times. Once the needle tip was adjacent to the brachial plexus, an assistant aspirate (checking for intravascular needle placement) and then injects 1 ml of a local anesthetic. The optimal needle location visualized as the spread of the local anesthetic as a hypoechoic area around the nerve roots. Once the ideal local anesthetic spread was visualized, the assistant injects a local anesthetic, in total 30 ml of the local anesthetic mixture was injected in 5- to 10-ml aliquots, with continuous monitoring for early symptoms or signs of intravenous injection. The needle was then removed.



**Figure 2:** Needle placement “in plane.” The needle tip is within the brachial plexus sheath, sitting between the nerve roots of C4 and C5.

**Group NS:**

After positioning the patient on operating table with the head turned to opposite side, interscalene groove was identified by rolling the finger posterior to sternocleidomastoid muscle between the belly of the anterior and middle scalene muscle at the level of cricoid cartilage. Skin over the insertion site was infiltrated with local anesthetic. The stimulating needle (2-inch, 22-gauge Stimuplex insulated needle) was connected to a nerve stimulator at an initial current intensity of 1 mA and advanced until it elicited motor responses in the distribution of the axillary, musculocutaneous or radial nerve. The current was gradually decreased to a range of 0.3 to 0.4 mA, with a persistent acceptable motor response. In total, 30 ml of the local anesthetic mixture was

injected in 5-ml aliquots, with frequent aspirations to assess intravascular needle migration.

**Group CB:**

After identification of interscalene groove, at the determined needle site, skin wheal was raised using local anesthetic and needle was inserted 3-4 cm deep, perpendicular to skin in all plains in slightly caudad, medial and posterior direction aimed at localizing ventral rami of C5-C7 nerve roots. On eliciting paresthesia (explained to the patient as sensory perception, tingling or current like) on shoulder, arm, elbow was accepted as evidence of correct needle placement, 10-12 cc of local anesthetic mixture was injected and needle redirected through same prick to locate paresthesia in any other nerves of brachial plexus, followed by delivery of remaining volume. If patient experienced severe pain during injection, the needle was withdrawn slightly, and the injection was continued. The sensory and motor blocks were then assessed by an independent observer by pin prick method who was not aware of the technique used, for every 2 min till the onset of block and every 5 min thereafter for 30 min. Any failure in establishing the block was converted to general anesthesia.

**Definitions**

**Block execution time**

1. In the group US, it is calculated from the time of initial scanning to the removal of the needle.
2. In the group NS and group CB, it is the time from the time of insertion of the needle to its removal.

**Time of onset of sensory block**

It was assessed by pin prick every 2 min till the onset of sensory block. The time from the removal of block needle to the time when the patient first says he/she has reduced sensation when compared to the opposite limb.

**Time of onset of motor block**

**Table 1:** Comparison of demographic data between different groups

Demographic Data	CB Group	NS Group	US Group	Significance
Age (years)	35.4 ± 12.4	31.5 ± 9.8	33.3 ± 12.7	NS
Weight (kg)	56.6 ± 7.9	52.4 ± 13.5	51.6 ± 9.4	NS
Gender (M:F)	12:8	13:7	14:6	NS
ASA Grading (I:II:III)	14:5:1	15:4:1	15:3:2	NS

Comparison of blockade characteristics between the Conventional blind (CB), Nerve Stimulator (NS) and Ultrasound guided (US) groups revealed that the procedural time, onset of sensory and motor blockade was significantly less in US group, while they were comparable in NS and CB groups. The average duration of surgery was comparable in all the three groups. The mean duration of analgesia too, was significantly higher in both NS and US group (3 hr & 23 min & 3 hrs 30 min respectively),

The onset of motor blockade was assessed every 2 min till the onset of motor block. It is the time of removal of the block needle to the time when the patient had weakness of any of the joints – Shoulder, elbow upon trying to perform active movement.

**Quality of sensory block**

The quality of sensory block was assessed every 5 min after the onset was established. It was assessed using pin prick. At the end of 30 minutes, the quality of sensory block was assessed by the number of dermatomes having a full block. The sensory block in each dermatome was graded as follows:

- Blocked: Complete absence of sensation
- Patchy: Reduced sensation when compared to the opposite limb
- No block: Normal sensation

**Duration of analgesia**

Postoperatively, patients were supplemented with analgesics when they complained of pain or had a VAS score of more than 4, and the duration of analgesia was recorded

**Statistical Analysis:** The data were analyzed using the SPSS (version 19) software. The demographic characteristics, duration of analgesia and blockade failures were compared using one way ANOVA test. Variables like time of onset of motor, sensory blockade and total duration of analgesia between all the three groups were compared using chi-square tests and Fishers exact test whichever appropriate. Post hoc intergroup comparisons were made using Bonferonni’s correction. A *P*-value of < 0.05 was considered significant.

**RESULTS**

There were no significant differences between both the groups with respect to demographic parameters such as age, height, weight, and gender.

while it was about (2 hr 47 min) in CB group. The incidence of patchy effect (3 cases) and blockade failure requiring general anesthesia (4 cases) were significantly higher in CB group compared to NS group (2 cases each) and US group (1 case each). No incidence of serious side effects or life threatening complications like pneumothorax, arrhythmias, hemodynamic instability or local anaesthetic toxicity were observed in any of the groups. However the vessel puncture was seen in few cases.

DISCUSSION

**Table 2:** Comparison of blockade characteristics between different groups

Block Characteristics	CB group	NS group	US group	Significance
Block execution time(min)	9.4±1.4	9.19±1.4	5.26±1.05	p value is ≤ .001 for US group
Time of onset of sensory block(min)	14.5±1.45	14.45±1.35	11.34±1.46	p value is ≤ .001 for US group
Time of onset of motor block(min)	16.19±1.8	17.91±1	11.71±1.49	p value is ≤ .001 for US group
Duration of analgesia(min)	167±13.21	194±8.2	210±14.51	p value is ≤ .001 for US group

**Table 3:** Showing Quality and Complication of block technique.

Block Characteristics	CB group	NS group	US group
Patchy effect	3	2	1
Failure	4	2	1
Complication(vessel puncture)	5	1	Nil

This prospective randomized study was aimed at determining how useful US guidance is when compared with NS guidance and blind technique for performing interscalene brachial plexus block. The success of a peripheral nerve block is based on the ability to correctly identify nerves involved in the surgery, and place an adequate dose of local anaesthetic around them, to achieve a complete impregnation of all nerves involved in the surgery. The established methods of nerve location were based on either elicitation of paraesthesia or identification of the proper motor response on NS. In past few years, there has been a shift in established methods of nerve location from elicitation of paraesthesia to identification of the proper motor response on NS. Each of these two techniques has been reported to have a low sensitivity for detection of needle to nerve contact<sup>[4]</sup>. A successful brachial plexus block depends not only on the technique used, but also on the experience of the anesthetist, patient's body habitus, amount and type of drug injected, the level of motivation of the patient, and the definition of a successful block. US guidance introduced into clinical practice to identify peripheral nerves offers the potential advantage of optimizing the spread of the local anaesthetic solution around the nerves under sonographic vision<sup>[5-9]</sup>. US imaging technique not only enables to secure an accurate needle position but one can also monitor the distribution of the local anaesthetic in real time, with the potential advantage of improving the quality of nerve block, shortening the latency of the block, and reducing the minimum volume required to obtain a successful nerve block<sup>[10-13]</sup>. The use of USG improves the onset and completeness of sensory and motor blocks<sup>[8-11]</sup>.

Although typically effective, the landmark-based technique is problematic in that it is a “blind” procedure. Because of anatomic variation and occasional difficulty palpating the interscalene groove, the landmark technique is subject to failure or the need for multiple needle passes. There are many vulnerable anatomic structures in close proximity to

the brachial plexus, including the carotid artery, jugular vein, vertebral artery, phrenic and laryngeal nerves, dura mater, and dome of the pleura. Thus, there are more chances of serious complications, including nerve injury, intravascular injection with subsequent local anesthetic toxicity, total spinal anesthesia, and pneumothorax during blind needle insertion. In recent years, real time ultrasonographic guidance has been introduced for peripheral nerve blocks which is rapidly evolving and becoming increasingly more useful in the field of regional anaesthesia. Furthermore the problems with blind procedure also mitigated with ultrasound guided technique because the anesthesiologist can directly visualize the anatomy as well as the needle. It has also resulted in improved success rate and decreased procedural time.

Liu *et al.*<sup>[14]</sup> who studied the use of ultrasound guidance in the ambulatory shoulder surgery and concluded that the use of ultrasound to guide interscalene or supraclavicular blocks was very effective and minimized the incidence of complications.

This study compared different parameters between conventional blind, nerve stimulator guided and USG guided interscalene block.

The average block execution time was found statistically significant shorter in US group (5.26 ± 1.05 min) than the NS group (9.19 ± 1.4 min) and CB group(9.4 ± 1.4 min).

The onset time of sensory and motor blockade was significantly less using ultrasound guided technique (11.34 ± 1.46 min and 11.71 ± 1.49 min respectively) while the same were significantly higher using conventional blind (14.5 ± 1.45 min and 16.19 ± 1.8 min respectively) and nerve stimulator guided techniques (14.45 ± 1.35 min and 17.91 ± 1 min respectively). We found that sensory-motor and extent of blockade was significantly better in the ultrasound group when compared with the nerve stimulation group. El-Dawlatly *et al.*<sup>[15]</sup> they found out that the ultrasound guidance facilitated the exact injection of the local anesthetic in place leading to a better quality of analgesia compared to standard general anesthesia. Consistent with the current study, are results demonstrated by Thomas *et al.*<sup>[16]</sup> who compared ultrasound guided IBPB to nerve stimulation in residency training programs and concluded that it was associated with shorter procedure time and lower incidence of postoperative neurological complications. McNaught *et al.*<sup>[17]</sup>

discussed the difference between the ultrasound-guided and nerve stimulation IBPB and summarized that the ultrasound decreased the number of needle passes indicating easier technique. Danelli *et al.*<sup>[18]</sup> compared ultrasound to neuro-stimulation IBPB and concluded that the ultrasound facilitated a shorter procedure time with less incidence of complications and fewer needle puncture. So, the results in our study are comparable with other researchers.

We observed a higher duration of analgesia in both NS and US guided groups compared to CB group. This could be explained by more precise delivery of drug closer to the brachial plexus. Similar findings have been observed by Abrahams *et al*<sup>[7]</sup>. where they observed a combined mean increase in block duration of 25% as compared with NS group. A higher incidence of patchy effect requiring intravenous anesthetic supplementation was observed using conventional blinded technique (3 cases) compared to nerve stimulator (2 cases) or ultrasound guided techniques (1 case). Not only the conventional blinded technique which relies on eliciting paresthesia, even the peripheral nerve stimulator technique can result in inadequate blockade owing to anatomical variation and thus sparing of peripheral nerves. Again, these spared nerves have been shown to be more effectively blocked using multiple point paresthesia technique, either by conventional blinded or nerve stimulator guided technique that points towards the merits of nerve bundle visualization using ultrasonography. Owing to the real-time visualization of injected drug spreading around the nerve sheaths, the failure rate of interscalene blocks requiring conversion to general anesthesia was least in ultrasound group (1 case ) compared to CB (2 cases) and NS groups (4 cases).

Duncan *et al*<sup>[19]</sup> observed in their study that US and NS group guidance for performing supraclavicular brachial plexus blocks ensures a high success rate and a decreased incidence of complications that are associated with the blind technique.

Chan *et al*<sup>[11]</sup> also concluded in their study that real-time ultrasound imaging during supraclavicular brachial plexus blocks can facilitate nerve localization and needle placement and examine the pattern of local anesthetic spread.

## CONCLUSION

From present study, it was concluded that the success rate and effective quality of the block were more satisfactory with ultrasound technique than the nerve stimulator or conventional blind technique. Moreover, the incidence of complications like vessel puncture was seen only in conventional blind group.

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