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# A COMPARATIVE EVALUATION OF THREE TECHNIQUES OF SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK

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ABSTRACT

**Title of the manuscript:** A Comparative Evaluation of Three Techniques of Supraclavicular Brachial Plexus Block
**Background:** Brachial plexus block (BPB) is an excellent alternative to GA for upper limb surgery. US guided peripheral nerve blocks are rapidly gaining popularity by offering safety and accuracy.
**Methods:** The study included 105 patients who were randomly allocated into three groups of 35 patients each: GROUP CP (Conventional paresthesia technique), GROUP NS (Nerve stimulator guided) and GROUP US (Ultrasound guided). Results were statistically analyzed using one way anova test, chi-square test and Fisher exact test.
**Results:** Overall success rate was higher in GROUP US as compared to other two groups. BET was more in GROUP US. GROUP US had shorter onset time for sensory & motor blockade with prolonged duration of blockade. Conversion to GA either due to inadequate or failure of block was highest in GROUP CP. Patients overall satisfaction in GROUP US was significantly high compared to other two groups.
**Conclusion:** US guided supraclavicular BPB is a better nerve block technique as compared to other two techniques in terms of offering a safe block and optimal needle positioning.

## INTRODUCTION

Brachial plexus block(BPB) is an excellent regional anaesthesia technique employed as a safe alternative to GA for upper limb surgeries.[1] The technique involves injection of local anaesthetics in close proximity to the brachial plexus, blocking the sensation and ability to move the upper extremity temporarily.[2]

BPB has evolved into a safer alternative to GA for upper limb surgeries. The supraclavicular block is often called as the "spinal anaesthesia of the upper extremity" because of its ubiquitous application for upper limb surgeries.[3,4]

The advantages of a supraclavicular technique over other approaches of brachial plexus block are its rapid, predictable and complete anaesthesia for upper extremity and particularly, hand surgery.

Aim is to compare the efficacy of blockade between three techniques of supraclavicular brachial plexus block for upper limb surgeries

Objectives are to compare block execution time (BET), time of onset of sensory blockade (SBO), time of onset of motor blockade (MBO), success rate, incidence of complications and patient's satisfaction.

**METHODS:** A prospective randomized single blinded study conducted at K. S. Hegde Hospital, Mangalore from January 2016 – September 2017. Study population included patients belonging to ASA PS I and II, of either sex, aged between 18 to 60 years posted for elective upper limb surgery below mid humerus level.

Patients were randomly allocated by closed envelope technique into either of the three groups namely, GROUP CP/NS/US with sample size of 35 patients in each group.

After obtaining institutional ethical committee clearance, those satisfying the study criteria were enrolled for the study and written informed consent was taken. The procedure and the visual analogue scale (VAS) was explained to the patient. All patients were kept NPO as per standard guidelines. Premedication was given. After shifting the patient to operation theatre, monitors were connected and baseline vitals noted. An IV access was secured. Patients were randomly allocated by closed envelope technique into any of the three groups namely, GROUP CP/NS/US. The respective equipments were kept ready and the drugs were loaded under all aseptic precautions. Mixture of 0.5% bupivacaine and 2% lignocaine with adrenaline(0.3ml/kg each) was used in all patients.

**Conventional paresthesia technique:** The subclavian artery pulsation was palpated 1cm above the midpoint of the clavicle. A 5cm 22G short bevel needle inserted through the skin wheal and advanced slowly backwards, slightly inward and downward, gradually towards first rib. Patient was instructed to say "yes" when he/she feels a sensation of "tingle" or "electric shock" down the arm. Drug was deposited where the paresthesia was elicited. In case of failure to elicit paresthesia after two attempts, drug was injected over the first rib.[7,8]

**Nerve stimulator guided technique:** The subclavian artery was palpated and immediately lateral to it, an intradermal wheal was raised with 2ml of 2% lignocaine using 24G needle. A 20G insulated hypodermic needle attached to the negative electrode of the NS, was then inserted through the skin wheal in a backward, inward and downward direction. NS was set to deliver a current of 3mA in the internal mode. Started with current strength of 3mA and observed for a twitch of the fingers. End motor response was taken as a clear motor twitch of the fingers. If a satisfactory twitch was observed in all fingers even at 0.6 mA current, this confirms the proximity of the needle tip to the nerve and the drug was injected with repeated aspiration for blood and air.

**Ultrasound guided technique:** The subclavian artery, first rib, pleura and the brachial plexus was visualized. The brachial plexus and its spatial relationship to the surrounding structures were noted. The plexus lies superolateral to the subclavian artery.

The block was performed with in-plane approach. Needle was inserted from lateral to medial direction and the needle movement was observed in real time. Once the needle reaches the plexus, after negative aspiration, drug was injected and the spread of the drug was observed in real time.[7,8]

The sensory and motor blocks was assessed every 5min till the onset of block and every 10minutes thereafter for 30min or till the block is complete. Intraoperatively HR, SPO2 and NIBP were recorded every 15min interval till the end of surgery. All patients were observed intraoperatively as well as postoperatively for the complications, such as vessel puncture, nerve injury, intravascular injection, dyspnea, and pneumothorax. Patients were asked to classify post operative analgesia(VAS) as no pain, mild pain(0-3), moderate pain(4-7) or severe pain(8-10) every hour for the first 6hours and then again at 8 and 10h. All patients were followed up

in PACU until complete recovery of sensory and motor function of the limb. Post-block chest radiograph was obtained, if patient complained of respiratory distress.

Postoperatively, pain was assessed using VAS score every 30 min. Patients were supplemented with analgesics when they complained of pain or when a VAS score of more than 4 was recorded, and the duration of analgesia was noted.

Block execution time: In the GROUP CP and NS, it is the time from the insertion of needle to its removal at the end of injecting anaesthetic solution. In the GROUP US, it is calculated from the time of initial scanning to the removal of needle at the end of injecting anaesthetic solution.

Time of onset of sensory block is the time from the removal of the needle to the time when the patient first says he/she has reduced sensation when compared to the opposite limb. It was assessed by cold application every 5min till the onset of sensory block.

Time of onset of motor block is the time from the removal of the needle to the time when the patient develops weakness of any of the two joints (elbow or wrist) upon trying to perform active movements. It was assessed every 5min till the onset of motor block.

Quality of sensory block was assessed using cold application every 10minutes for 30minutes, after the onset is established. The sensory block was evaluated by 3 point scale as: Grade0= no difference from the contralateral arm, Grade1= less cold than the contralateral arm, Grade2= no sensation of cold.

Quality of motor block was assessed every 10 minutes for 30min after the onset is established. it was evaluated using 3 point scale(Grade0= normal power, Grade1= decreased power compared to contralateral arm and Grade2= complete motor block). Block was considered successful when the patient had a complete block of all the sensory dermatomes and no power to move elbow and wrist joint or as failure of the block if there is inadequate or patchy analgesia even after 30min of drug administration.

Depending on the effectiveness of the block, the patient was administered with sedative or analgesic in the form of Inj. Midazolam IV(1mg) and Inj. Fentanyl IV(1mcg/kg). In case of complete failure it was converted into GA. Procedure related pain was evaluated immediately after removal of the needle by asking patient to verbally quantify the level of pain using a VAS score between 0 and 10, 0 meaning no pain and 10 meaning unbearable pain. The patient's overall satisfaction with the anaesthetic technique was assessed after shifting the patient to post-anaesthetic care unit (PACU) using a 2-point scale(0= unsatisfied, 1= satisfied).

Results were statistically analyzed using one way anova test, chi-square test and Fisher exact test. Data was presented in terms of mean, median and range. P value of <0.05 was considered significant.

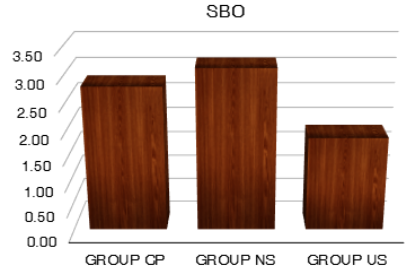
| | GROUPS | N | Mean | Std. Deviation | P VALUE |
|---|---|---|---|---|---|
| BET (in min) | GROUP CP | 35 | 6.86 | 4.48 | 0.054 |
| | GROUP NS | 35 | 8.6 | 3.457 | |
| | GROUP US | 35 | 8.97 | 3.519 | |
| | Total | 105 | 8.14 | 3.921 | |
| SBO(min) | GROUP CP | 35 | 2.8 | 1.937 | 0.012 |
| | GROUP NS | 35 | 3.14 | 2.046 | |
| | GROUP US | 35 | 1.83 | 1.618 | |
| | Total | 105 | 2.59 | 1.94 | |
| MBO(min) | GROUP CP | 35 | 2.8 | 1.659 | 0.003 |
| | GROUP NS | 35 | 3.17 | 1.963 | |
| | GROUP US | 35 | 1.8 | 1.368 | |
| | Total | 105 | 2.59 | 1.763 | |
| VAS | GROUP CP | 35 | 5 | 1.814 | 0.003 |
| | GROUP NS | 35 | 5 | 1.784 | |
| | GROUP US | 35 | 4 | 1.291 | |
| | Total | 105 | 5 | 1.726 | |
| DOA(min) | GROUP CP | 35 | 161.71 | 102.856 | <0.001 |
| | GROUP NS | 35 | 201.14 | 79.808 | |
| | GROUP US | 35 | 242.29 | 43.595 | |
| | Total | 105 | 201.71 | 85.175 | |

Table- 1one way anova of comparison of continuous variables (BET-block execution time, SBO- onset of sensory blockade, MBO- onset of motor blockade, DOA- duration of analgesia)

All three groups were comparable with respect to age, gender, weight, ASA physical status.

Comparison of BET between the three groups shows that GROUP US group has the highest value of 8.97 and GROUP CP has the least value of 6.86. This difference is statistically insignificant with a test value of 3.013 and p value of 0.054.

Comparison of SBO between the three groups shows that GROUP NS group has the highest value of 3.14 and GROUP US has the least value of 1.83. This difference is statistically significant with a test value of 67.261 and p value of 0.012.(Graph 1)




**Graph 1: Comparison of SBO between the three groups**

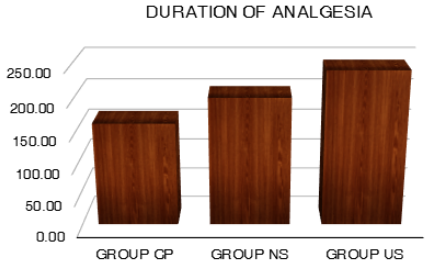
Comparison of MBO between the three groups shows that GROUP NS group has the highest value of 3.17 and GROUP US has the least value of 1.8. This difference is statistically significant with a test value of 6.233 and p value of 0.003.

Quality of sensory blockade was better in ultrasound guided group than conventional paresthesia or nerve stimulator guided techniques and the difference was statistically significant with p value of 0.019.

Quality of motor blockade was highest in US group (97.1%) and least in CP group (68.6%) and the difference was statistically significant with P value of 0.004.

Comparison of VAS between the three groups shows that GROUP NS group has the highest value of 5.63 and GROUP US has the least value of 4.26. This difference is statistically significant with a test value of 6.122 and p value of 0.003.

Comparison of duration of analgesia between the three groups shows that GROUP US group has the highest value of 242.29 and GROUP CP has the least value of 161.71. This difference is statistically Significant with a test value of 59.914 and p value of <0.001.(Graph 2)




**Graph 2: Comparison of duration of analgesia between the three groups**

Analgesic supplementation was highest in GROUP CP(48.6%) and least in GROUP US and the difference is statistically significant with P value of 0.001.

Analgesic supplementation was highest in GROUP CP(48.6%) and least in GROUP US and the difference is statistically significant with P value of 0.001.

Conversion to GA was highest in GROUP CP(20%) and nil in GROUP US and the difference was statistically significant with P Value of 0.003.

Patient's overall satisfaction was highest in GROUP US(100%) and least in GROUP CP(68.6%) with statistically significant P Value of 0.001.

## DISCUSSION

The first successful supraclavicular brachial plexus block was performed by William Halsted. In 1911, Professor KullenKampff, a German doctor, after experimenting on himself, made an attempt at 'blind' infiltration of brachial plexus by supraclavicular route.[11] All three groups were comparable with respect to age, gender, weight, ASA physical status. No patients were excluded from the study.

BET between the three groups was statistically insignificant among three groups.

There was a statistically significant difference in onset in sensory blockade between the three groups. Comparable results were found in a study conducted by Jagdish Dureja et al,[8].

Comparison of MBO between the three groups shows that GROUP NS group has the highest value with statistically significant difference among 3 groups. Similar results were found in a study "Supraclavicular Brachial Plexus Block: Ultrasound Guided Technique Vs Nerve Stimulator Guided Technique" conducted by Anju Jamwal.

Quality of sensory block and motor block was highest in GROUP US and least in GROUP CP and the difference is statistically significant. Better VAS scores found in GROUP US. None of the earlier studies have compared the difference in VAS score immediately following the block.

DOA is highest in GROUP US and least in GROUP CP with statistically significant difference.

More patients required conversion to GA in GROUP CP and also analgesic requirement was more in GROUP CP compared to other two groups. One patient from GROUP NS developed transient hoarseness of voice with nil complications in rest of the patients. Patients overall satisfaction was maximum in GROUP US and least in GROUP CP.

## CONCLUSION:

Supraclavicular brachial plexus block using ultrasound guided technique is an improved nerve block technique due to direct visualization of nerves with more success, decreased complication rate, faster onset, and less time consuming when compared to either nerve stimulator or conventional paresthesia technique. Only possible limitation is necessity to have a good knowledge of sonoanatomy and skill to operate ultrasound machine.

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