Section: Anaesthesiology

Original Research Article

# STUDY TO DETERMINE THE EFFICACY OF VIBRATION SENSE AS AN INDICATOR OF ONSET OF SURGICAL ANAESTHESIA WITH ULTRASOUND-GUIDED SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK IN UPPER LIMB SURGERIES COMPARED WITH PINPRICK SENSATION

**K.Sivashankari[1], Shalini A[1], M Suresh[1], S. Kiruthiga[2]**

[1]Assistant Professor, Department of Anaesthesiology, Tamilnadu Government Multi Super Specialty Hospital Omandurar Estate, Chennai, Tamilnadu, India
[2]Senior Resident, Department of Anaesthesiology, Government Thiruvallur Medical College, Thiruvallur, Tamilnadu, India

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Corresponding Author:
**Dr. S. Kiruthiga,**
Email: kirushanmathi@gmail.com

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## Abstract

**Background:** Local anaesthesia blocks sensations in the same manner as a central neuraxial blockade. A 128 Hz tuning fork is an excellent non-invasive tool for evaluating vibration sensitivity impairment compared to sensory and motor power tests. The main objective of this prospective cross-sectional study was to determine whether vibration sense is an excellent indicator for adequate nerve blockade. **Materials and Methods:** This prospective study included 45 American Society of Anaesthesiologists physical status I and II patients aged 18 to 55 undergoing upper limb surgery under ultrasound-guided supraclavicular brachial plexus block. Before surgery, every three minutes after administering the block until the onset of complete surgical anaesthetic, baseline values of vibration sense perception using a 128 Hz tuning fork and sensory score by pinprick method were recorded. **Result:** Of the participants, 82.2% were males and 17.8% were females. The mean age and weight were 32.60 ± 9.56 and 62.47 ± 11.6 respectively. The majority of time taken for loss of pinprick was 3 minutes in 67% of participants. However, loss of pinprick was 6 and 9 minutes in 29% and 4% of participants, respectively. The time taken for loss of vibration was 15 minutes in 18 cases (40%). After 30 minutes, all patients lost vibration sense, while all the patients achieved complete sensory blockade after 12 minutes. **Conclusion:** Vibration sense testing with a 128 Hz tuning fork can be utilized to determine the onset of surgical anaesthesia following brachial plexus block.

## INTRODUCTION

A frequent type of anaesthesia used in clinical surgery is brachial plexus block anaesthesia, which can successfully meet the need for excellent surgical anaesthetic outcomes. In the central neuraxial blockade, local anaesthetics block various nerve fibres. The first fibres to become blocked are the autonomic preganglionic B-fibers, followed by those transporting temperature (cold before warm), pinprick, pain, touch and deep pressure, vibration perception, and proprioceptive impulses, which become blocked last. Generally speaking, the blockade recovery happens in the opposite order.[1] The absence of pain during surgery is typically assumed by anesthesiologists to be predicted by the absence of sensitivity to simple stimuli like touch, pinprick, or cold. However, this assumption is incorrect because it does not account for the complete blockade of small-diameter C fibres and A fibres.[2,3]

A 128 Hz tuning fork which has long been the standard method for testing vibration perception satisfies all requirements for a perfect instrument that is simple to use, reasonably priced, and accurate for measuring the impairment of vibration sensation.[4,5] Evaluation of vibration sensation is simpler than sensory and motor function evaluation since patients experience more pain when their limbs are moved or pinched. Numerous studies have assessed the order of blockade of different sensations using only motor strength and sensory perception as criteria. Still, few studies have examined blockade order using vibration sense after brachial plexus block.[6,7] Therefore, the present study aims to determine the efficacy of vibration


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sense as a reliable indicator to measure the onset of surgical anaesthesia following ultrasound-guided supraclavicular brachial plexus block in upper limb surgeries compared to pinprick sensation.

## MATERIALS AND METHODS

This prospective, single-arm, cross-sectional study was conducted for six months at Government Kilpauk medical college and Government Royapettah Hospital, Chennai, Tamil Nadu. All the individuals were selected for the testing according to the inclusion and exclusion criteria. The study was carried out after receiving the approval of the institutional ethical committee.

**Inclusion Criteria**

Individuals with ASA PS class 1 and 2, undergoing upper limb surgeries, and aged 18 to 55 years of both male and female sex were considered for this study. The patients who have given valid informed consent were included.

**Exclusion Criteria**

Patients with peripheral neuropathy, myopathy, bleeding diathesis, coagulation abnormalities, local infection at the injection site, individuals younger than 18 years or older than 55, and patients with allergy or sensitivity to local anaesthetics were excluded. Patients with a history of severe cardiac, respiratory, hepatic, or renal disease, patients who are incomprehensible with the study, pregnant patients, patients who are critically ill, and patients who are not willing to participate were excluded.

**Methodology**

The test was performed in an operation theatre with a 128 Hz tuning fork. Before surgery, the patient was informed about the procedure and allowed to consent. Before the surgery, the patient's perception of vibration was recorded before local anaesthesia was administered. Patients were instructed to notify once they no longer felt the vibration after local anaesthetic instillation. A single anesthesiologist carried out a supraclavicular brachial plexus block under ultrasound guidance after acquiring baseline values. Intravenous midazolam 1 mg and fentanyl 50 mcg were administered to ensure comfort during the procedure while keeping all patients alert and communicative.

After establishing the plexus' placement and negative aspiration of blood, the block was carried out with an injection of lignocaine with adrenaline 2% 15ml and bupivacaine 0.5% 15ml. None of the patients needed block supplemented with general anaesthetic. The sensory block was examined by pinprick method using a 25-gauge sterile needle at the medial and lateral aspect of the forearm on a three-point scale (2 = normal sensation, 1 = blunted sensation, and 0 = absence of sensation). At the styloid process of the radius and ulna, vibration sense was tested twice at each measurement time and graded on a three-point scale (2 = present, 1 = blunted, 0 = absent).

The sensory and vibration block assessment was performed every three minutes from the installation of local anaesthetic until the onset of surgical anaesthesia (S0 and V0). The interval between the local anaesthetic injection and loss of pinprick sensation is known as the sensory block onset (S0). In contrast, the interval between the local anaesthetic injection and the loss of vibration sense is defined as the vibration block (V0). The intraoperative period was uneventful for all patients. IBM SPSS software was used for the analysis, and the alpha level was set at 0.05. The baseline characteristics of the samples were analyzed using descriptive statistical analyses (Mean, Range, & Standard Deviation).

## RESULTS

Among 45 patients, the majority of participants were males, 37 (82.2%), whereas only 8 (17.8%) participants were females. The time taken for loss of pinprick was 3, 6, and 9 minutes in 30 (67%), 13 (29%), and 2 (4%) participants, respectively. The time taken for loss of vibration was 15 minutes in 18 cases (40%). All patients had a loss of vibration sense after 30 minutes. The mean age and weight were 32.60 ± 9.56 and 62.47 ± 11.6, respectively. All the patients achieved complete sensory blockade after 12 minutes. All patients who participated in the study were followed up in the post-operative period and found to have achieved complete neurological recovery without any nerve injury [Table 1].

**Table 1: Demographic data of the study**

| Variables | | Frequency | Percentage |
|---|---|---|---|
| Gender | Male | 37 | 82.2 |
| | Female | 8 | 17.8 |
| Pinprick in minutes | 3 | 30 | 67 |
| | 6 | 13 | 29 |
| | 9 | 2 | 4 |
| Vibration in minutes | 12 | 1 | 2.2 |
| | 15 | 18 | 40 |
| | 18 | 14 | 31.1 |
| | 20 | 1 | 2.2 |
| | 21 | 2 | 4.4 |
| | 24 | 3 | 6.7 |
| | 30 | 6 | 13.3 |
| | Mean ± SD | | Min-Max |
| Age | 32.60 ± 9.56 | | 18-52 |
| Weight | 62.47 ± 11.6 | | 38-88 |


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## DISCUSSION

Numerous studies that only considered sensory perception and motor strength as criteria evaluated how various sensations were blocked after local anaesthetic injection. However, the order of blocking utilising vibration sense after brachial plexus block has only been examined in a few investigations.[6,7] This prompted us to analyse the order of blockade using pinprick sensation after supraclavicular brachial plexus block and vibration sense as a criterion. We have observed that, in the present study, the sensory block occurred earlier. There was a regression of vibration sensation reflecting the order of blockade of nerve fiber, which is sensory, followed by a motor. The last to be blocked were the fibers carrying vibration sense.

Our findings align with a study by Parry et al., who found that the diameter of nerve fibres engaged in a specific modality of sensation determines when regional block anaesthesia begins to take effect.[8] Pain, cold, and touch are the smaller-diameter fibres blocked first; proprioception and vibration are the larger ones blocked last.

Similar findings were made by Adnan et al,[9] in cases when a brachial plexus block was followed by a sensory block rather than a motor block. It was also discovered that there was a constant fall in the scores of all three criteria when the sensory, motor, and vibration blocks were compared at intervals of 5 minutes. These results prove that the blockade order in the brachial plexus block is sensory, followed by motor and vibration sense.

According to a study by Gu et al,[10] the duration of anaesthesia in the study group was slightly longer than in the control group. The study looked at the anaesthetic effect and safety of the ultrasound-guided brachial plexus block in paediatric upper limb surgery. The study group experienced the sensory and motor block earlier than the control group. The study group's one-time puncture success rate was higher than the control group's. This study also showed that ultrasound-guided brachial plexus block anaesthesia substantially impacts paediatric upper limb surgery, which can enhance the anaesthetic effect and decrease the likelihood of problems. As a result, it is clinically advantageous to promote this technique.

Only 2% of patients experienced a total loss of vibration sense because complete sensory blockade was attained after 12 minutes. In contrast, after 20 minutes, 24% of patients experienced a partial loss of vibration perception, and after 30 minutes, they experienced a total loss. Loss of vibration perception and loss of motor function were both well connected.

## CONCLUSION

We conclude that the loss of vibration sensation, as measured by a 128 Hz tuning fork, corresponds well with total sensory and motor block and is a reliable sign that surgical anaesthetic has begun to take effect after the supraclavicular form of the brachial plexus block.

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