

Comparison of ultrasound-guided and electrical nerve stimulation techniques for interscalene brachial plexus block in patients undergoing clavicle surgeries: A randomized clinical study

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Abstract

Introduction: Interscalene brachial plexus block is one of the commonly performed techniques for upper limb regional anaesthesia which can be performed by paraesthesia, nerve stimulator, or ultrasound guided technique. The present study compares ultrasound and electrical nerve stimulator guided techniques in terms of their efficacy and safety when used for administering interscalene brachial plexus blocks.

Materials and Method: 60 patients belonging to ASA physical status I or II, aged between 18 to 65 years, undergoing elective clavicle surgeries were randomized into two groups of 30 each. They received an interscalene brachial plexus block with 25ml of 0.75% ropivacaine + 1.5ml (75mcg) of fentanyl, with either nerve stimulator (group N) or ultrasound guidance (group U). The time taken to complete the block, onset of sensory and motor block and the number of inadvertent vascular punctures were noted. Post block haemodynamic parameters and adverse events were also noted. The observations were statistically analyzed using the student's t test and chi square test. P value of less than 0.05 was considered statistically significant.

Results: The procedural time in group U (5.93±1.11min) was significantly shorter when compared to that in group N (10.46±2.81min) (p=0.0001). The onset of sensory and motor blocks was similar in both the groups with a P value of 0.91 and 0.89 respectively. Accidental aspiration of blood was seen in 1 patient in Group N (3.33%) but not in Group U. The haemodynamic parameters were in the normal range and there were no adverse events in either group.

Conclusion: Though the block onset times are similar with both ultrasound guidance and nerve stimulator, the use of ultrasound is advocated as it has a better utility (shorter procedural time) and safety profile.

Keywords: Interscalene brachial plexus block; Ultrasound guidance; Nerve stimulator guidance; Ropivacaine.

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Introduction

Interscalene brachial plexus block is one of the commonly performed techniques for upper limb regional anaesthesia. The use of which, as the primary anaesthetic technique, avoids the complications associated with general anaesthesia.^(1,2) Similar to other regional anaesthetic techniques, interscalene blocks can be performed by paraesthesia, nerve stimulator, or ultrasound guided technique. The present study compares ultrasound and electrical nerve stimulator guided techniques in terms of their efficacy and safety when used for administering interscalene brachial plexus blocks.

Many local anaesthetics and adjuvants have been used for peripheral nerve blocks, the most common ones being bupivacaine, lignocaine and ropivacaine. Ropivacaine is a long acting amide local anaesthetic. It is less lipophilic than bupivacaine, which accounts for its decreased central nervous system toxicity and cardiotoxicity. Further, Opioids are known to expedite the onset time, improve the quality of blockade and also prolong the duration of neuronal blockade.⁽³⁾ Hence Fentanyl 75 micrograms has been used as an adjunct to Ropivacaine in the study.

Objectives of Study

To evaluate the differences in efficacy and safety of performing interscalene brachial plexus nerve blocks using a nerve stimulator and ultrasound guidance.

The parameters noted were-

1. Procedural time (time required to complete the block).
2. Onset of sensory and motor block.
3. Number of inadvertent vascular punctures.

Source of Data: 60 patients undergoing elective clavicle surgeries under interscalene brachial plexus block, in Adichunchanagiri Institute of Medical Sciences, Bellur, Mandya, satisfying the inclusion criteria were enrolled for study, during the study period of 1 year, from June 2015 to July 2016.

Inclusion Criteria: Patients-

- Aged between 18 to 65 years, of either sex.
- ASA grade I and II patients.
- Undergoing elective clavicle surgeries.
- Who have given written informed consent for the anaesthetic procedure under the study- ultrasound guided or nerve stimulator guided interscalene brachial plexus block.

Exclusion Criteria: Patients-

- With bleeding disorders/on anticoagulants.

- With known allergy to local anaesthetic drugs.
- Pregnant / lactating
- With morbid obesity or distorted anatomy of neck
- With local infection, respiratory disease (COPD, hemidiaphragmatic palsy), severe systemic disease (cardiac, hepatic, renal diseases, psychiatric disorders)
- With pre-existing neurological disease/ deficit involving the operative limb

Materials and Method

After obtaining the institutional ethical committee approval and written informed consent from the patients, 60 patients posted for elective clavicle surgeries and fulfilling the inclusion criteria were randomly divided into two groups of 30 each, by sealed opaque envelope method- Group U and Group N. Group U received interscalene block with ultrasound guidance and Group N, with nerve stimulator guidance. 25 ml of Ropivacaine 0.75% with 75mcg (1.5ml) of fentanyl was used in both the groups.

Study design: Randomized clinical study.

Sample size calculation: The important outcome studied was the procedural time. Other variable outcomes included time of onset of sensory and motor blocks. The necessary sample size was calculated to detect a 25% change in the procedural time and a standard deviation of 33% of the mean, while giving the trial a power of 80% for $\alpha < 0.05$. Based on this, minimum number of patients required in each group was 25. Considering the dropouts, 30 patients were selected in each group.

A thorough pre-anaesthetic evaluation was done for the study population a day prior to the surgery. Detailed history was recorded, airway examination and cardiorespiratory examination with an emphasis on the Mallampatti grading and rule of 1-2-3 was performed. Relevant clinical investigations were performed. Written informed consent was taken and a nil per oral status for a minimum of 8 hours was advised. Premedications – Tablet Ranitidine 150mg and Tablet Alprazolam 0.5mg were also prescribed.

On arrival of the patient to the operation theatre, intravenous line was secured and iv fluid connected. ECG, pulse oximeter and non-invasive blood pressure monitors were connected and the baseline vital parameters such as heart rate, systolic and diastolic blood pressure, mean arterial pressure and peripheral oxygen saturation were recorded. All the patients were premedicated with inj.Midazolam 0.02mg/kg iv.

The patients were put in the supine position, with the head turned contralateral to the side to be operated and landmarks- Interscalene groove between the scalenus anterior and medius muscles, lateral to the posterior border of the sternocleidomastoid muscle, at the level of the cricoid cartilage were identified.

In Group U, nerve location was performed using a 5cm, 10-12MHz linear probe (LOGIQ E, GE health care) and a 22gauge 50mm short bevelled needle was inserted with an in-plane approach, advanced towards the C5, C6 and C7 nerve trunks and local anaesthetic was injected in increments to surround all the nerve trunks, while intermittently aspirating to rule out intravascular location.

In Group N, landmarks were identified according to the classical approach described by Winnie and a 22gauge, 35mm short bevelled needle was used with a nerve stimulator which was initially set to deliver 1.0mA intensity current (2Hz, 0.2ms) and progressively reduced to 0.5mA on elicitation of the deltoid motor response. Local anaesthetic was then injected in increments with intermittent aspiration to rule out intravascular location.

During the block, the procedural time (time taken to complete the block) defined as the time interval between the first ultrasound scan and needle removal at the end of the block in the ultrasound group and as the time interval between identification of anatomical landmarks and needle removal at the end of the block in the nerve stimulator group was noted. The incidence of inadvertent vascular puncture was also recorded for both the groups.

After administering the block the patients were evaluated every 1 minute for the assessment of onset of sensory and motor blockade. Sensory block was assessed as loss of pinprick sensation using a blunt needle in the C5 to C7 dermatomes. Onset time was defined as the time from the completion of injection of study drug to first loss of pinprick sensation in any of these dermatomes. Onset of motor block was defined as the time required from completion of injection of study drug to loss of motor power at the shoulders. Motor block at the shoulder was assessed by asking the patient to elevate the arm while keeping the elbow straight (superior trunk function) and was graded according to the modified Bromage scale as mentioned below:

Grade	
0	No movement or complete paralysis
1	Perceptible muscle contraction but unable to move purposely
2	Moves against gravity but unable to move against resistance
3	Reduced power but able to move against resistance
4	Full power

Haemodynamic parameters were also monitored throughout the procedure and also in the immediate postoperative period.

Statistical analysis of the data was done using the student's t test and chi square tests and a P value of less than 0.05 was considered statistically significant.

Observation

There were no statistically significant differences in the demographic profile of patients in either group in terms of age, body weights, or male/female (M/F) ratio ($p > 0.05$). Both the groups had patients predominantly belonging to ASA physical status grade I and the difference was statistically not significant.

The block performance time/ procedural time in Group U was 5.93 ± 1.112 minutes, which was significantly shorter than that in Group N, which was 10.466 ± 2.812 minutes (Table 1).

The onset of sensory and motor block was similar in both the groups and the difference was statistically not significant (Table 2 and 3).

Accidental aspiration of blood was seen in 1 patient in Group N (3.33%) but not in Group U.

Table 1: Procedural time in minutes

Procedural time in minutes	Group U		Group N		P value
	Mean	SD	Mean	SD	
	5.93	1.11	10.46	2.81	

Table 2: Sensory block onset time in minutes

Sensory block onset time in minutes	Group U		Group N		P value
	Mean	SD	Mean	SD	
	1.86	0.81	1.9	1.34	

Table 3: Motor block onset time in minutes

Motor block onset time in minutes	Group U		Group N		P value
	Mean	SD	Mean	SD	
	2.86	2.02	3	1.08	

Discussion

The current study was undertaken to evaluate the utility of performing interscalene brachial plexus nerve block under ultrasound guidance over the nerve stimulator guided technique, based on the hypothesis that direct visualization of neural structures under Ultrasound guidance lead to better local anaesthetic disposition around the roots of the plexus, thus improving onset times and success rates.

Ropivacaine was chosen as the study drug as it is a long acting amide local anaesthetic. It is less lipophilic than bupivacaine, which accounts for its decreased central nervous system toxicity and cardiotoxicity.⁽⁴⁾

20 to 30 ml is the conventional volume of local anaesthetic used for interscalene brachial plexus block as is evident from the previous studies, namely, Klein SM et al.⁽⁴⁾ and Eroglu A et al.⁽⁵⁾ who have used 30ml; Casati A et al.,⁽⁶⁾ and Fanelli G et al.,⁽⁷⁾ who have used 20ml. A volume of 25ml was chosen- an average of the 20 and 30ml used conventionally- for the study in order to ensure that the study did not expose patients in the lower weight ranges to an unexpectedly high dose of

local anaesthetic, thus preventing the administration of toxic doses.

Opioids are known to expedite the onset time, improve the quality of blockade and also prolong the duration of neuronal blockade. Hence Fentanyl 75 mcg has been used as an adjunct to Ropivacaine in the study.⁽³⁾

Study parameters:

Both the groups were statistically comparable in terms of age, body weights, male/female (M/F) ratio ($p > 0.05$) and the ASA status.

The procedural time in group U (5.93 ± 1.11 min) was significantly shorter when compared to that in group N (10.46 ± 2.81 min) ($p=0.0001$) (Table 1).

These results are comparable with the study of Danelli G, et al.⁽⁸⁾ who reported the average procedure time of 8 ± 5 minutes in the nerve stimulator guided group and 5 ± 3 minutes in the ultrasound guided group for interscalene brachial plexus block. These results are also comparable with the study of Williams S R et al.⁽⁹⁾ who reported the average procedure time of 9.8 min in nerve stimulator guided group & 5.0 min in USG guided group for supraclavicular brachial plexus block (p -Value < 0.001).

The likely explanation for this shorter procedure time is that, ultrasound can determine the size, depth and exact location of the brachial plexus and its neighbouring structures.

The onset of sensory and motor blocks was similar in both the groups with a P value of 0.91 and 0.89 respectively (Table 2 and 3).

This is similar to the study done by Danelli G et al.⁽⁸⁾ who found that block onset times and success rate were similar whether NS or US was used.

In contrast Marhofer P et al.⁽¹⁰⁾ found that onset time for sensory block was significantly shorter in the US guided group compared with NS guided groups (group A 13 ± 6 minutes received US guided block with 20 ml 0.5% bupivacaine; group B 27 ± 12 minutes received 20 ml 0.5% bupivacaine using NS guidance; and group C 26 ± 13 minutes received 30 ml 0.5% bupivacaine using nerve stimulator; $P < 0.01$ to groups B and C).

Post block haemodynamic parameters like, pulse rate, systolic, diastolic and mean arterial pressures, were normal in both the groups requiring no intervention and the differences between the two groups were statistically insignificant. Accidental aspiration of blood was seen in 1 patient in Group N (3.33%) but not in Group U.

Conclusion

The time of block onset was similar whether Nerve stimulator or Ultrasound guidance was used, although Ultrasound guidance allowed shorter procedural times and fewer vascular punctures.

Hence based on the results of the present study it can be safely concluded that though the block onset

times are similar with both nerve stimulator and ultrasound guidance, the use of ultrasound is advocated as it has a better utility (shorter procedural time) and safety profile.

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