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Low dose interscalene with superficial cervical plexus block versus superior trunk, supraclavicular nerve and superficial cervical plexus block for mid and lateral clavicular surgeries in adult patients- A randomized double-blind study.

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KEYWORDS
Interscalene block, superior trunk, clavicle surgery, ultrasound guided nerve block

Abstract

Background and aims: Interscalene brachial plexus with superficial cervical plexus block has been the procedure of choice performed regularly to provide analgesia for clavicular surgeries. However, the phrenic nerve is invariably involved in the block resulting in hemi-diaphragmatic paresis. With the frequent use of ultrasound for nerve blocks, superior trunk, supraclavicular nerve and superficial cervical plexus can be blocked specifically to provide analgesia using low doses of local anaesthetic drug for clavicular surgeries in adult patients. Thus, the complications of usage of large doses of drug can be prevented, but with effective analgesia.

Methods: 80 adult patients of American Society of Anaesthesiology I&II, undergoing clavicular surgeries were randomized into two groups. Group ST received 6ml, 2ml and 5ml of 0.5% bupivacaine for superior trunk plus supraclavicular nerve and superficial cervical plexus block respectively. Group IS received interscalene brachial plexus block and superficial cervical plexus with 8 ml and 5 ml of 0.5% bupivacaine respectively. Hemi-diaphragmatic paresis, loss of pin prick sensation in 10 minutes

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and need for rescue analgesia in the intraoperative period was noted.

Results: Data was analyzed using SPSS 22 version software. Chi-square test was used as test of significance for qualitative data and independent t-test for quantitative data. 2.5% of patients in IS group required general anaesthesia due to inadequate analgesia whereas 7.5% in ST were comfortable with bolus dose of fentanyl. 5/40 had hemi diaphragmatic paresis in IS group, compared to 2/40 in ST group at 60 min. There was no statistically significant difference in diaphragmatic movements or block failure between two groups.

Conclusion: Low dose superior trunk block preserves diaphragm function and provides adequate analgesia for mid and lateral clavicle surgeries in adults in comparison with interscalene block.

INTRODUCTION:

Clavicle surgeries have been increasing in number globally with the increase in trauma, cosmetic relevance and the ease of performing the surgery. Tran Q and colleagues in their anatomical review concluded that nerve supply of clavicle is controversial and may predominantly be innervated by the supraclavicular, subclavian, and long thoracic/suprascapular nerves.(1) KlineJP has observed that the main nerve supply for distal clavicle maybe from superficial cervical plexus (SCP) and C5 nerveroot, through suprascapular nerve and its branches.(2)

Over the years, anaesthetic management of clavicle surgeries has shifted from general anaesthesia to regional anaesthesia and at present with the use of ultrasound, specific nerve trunk and the nerves innervating the clavicle can be blocked. The regional anaesthesia technique commonly employed for clavicle surgeries include superficial cervical plexus block alone or in combination with interscalene brachial plexus block, selective C5 nerve root or supraclavicular nerve block which may or may not be accompanied by general anaesthesia.(3)

The higher incidence of hemi-diaphragmatic paresis with interscalene brachial plexus block precludes its use, especially in patients with poor respiratory reserve. Other potential advantages have been studied with the use of superior trunk block when compared with interscalene block which includes thicker nerve sheath reducing trauma to the nerves and also lesser vascular injuries (4)

During peripheral nerve blocks, low dose of local anaesthetic drugs when deposited under direct vision using ultrasound can significantly reduces the risk of complications.(5) Hence, in our study we have compared the efficacy of low dose bupivacaine in conventional interscalene approach and superior trunk block for mid and lateral clavicle fractures.

METHODOLOGY:

The process of this study was as follows (Figure 1)

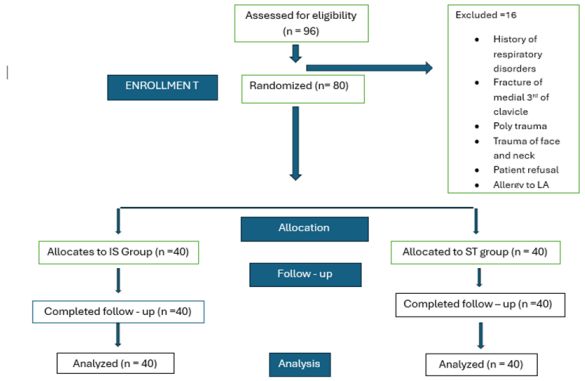

Figure -1

After obtaining Institutional Ethics Committee (IEC) and Clinical Trials Registry of India (CTRI) number CTRI/2022/01/039433, 80 patients of American Society of Anaesthesiologists- Physical Status (ASA-PSA) I and II; age ≥ 18 years posted for clavicle surgery with no contraindication for the intended block will be included in the study. Pre anaesthetic evaluation was done 24 hours prior to the planned procedure, the anaesthetic procedure was explained in detail, along with the complications and informed consent was obtained. Standard pre-anaesthetic advice of fasting was given to the patient. Randomization was done by the sequentially numbered, opaque, sealed envelope (SNOSE) technique by experienced anaesthesiologist performing the block. This experienced anaesthesiologist had performed at least 25 cases each of ultrasound guided interscalene brachial plexus (IS) block with superficial cervical plexus (SCP) block (IS group) and superior trunk (ST) with supraclavicular nerve (SC) plus superficial cervical plexus(SCP) block (ST group).

Based on the randomization, 80 patients were classified as

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- **IS group-** 40 patients received ultrasound guided interscalene and SCP block with 8 ml and 5 ml of 0.5% bupivacaine respectively.
- **ST group-** 40 patients received 6ml, 2ml and 5 ml of 0.5% bupivacaine in the ST, supraclavicular nerve region and SCP respectively under USG**.**

On the day of the procedure, PAE was reviewed and any fresh clinical history or signs, along with relevant investigations was noted. Fasting status and the side of the surgery was confirmed. After shifting to the operation theatre (OT), necessary monitors like electrocardiogram (ECG), oxygen saturation (SpO_2), non-invasive blood pressure (NIBP) was connected and basal parameters were noted. Premedication was done with inj midazolam 0.03mg/kg and fentanyl 1mcg/kg. Oxygen 4lts/ min was supplied through the face mask. Patency of the intravenous (IV) canula was checked and IV fluids were on flow. Ultrasound (US) used was LOGIQ P6 PRO ultrasound system by GE healthcare with linear probe (3.4 Hz- 10.8 Hz) a pre block scan was done to assess the anatomy and location of the nerves and its relation to the vessels with the use of color doppler. Ultrasound of the abdomen to compare the range of bilateral hemi diaphragmatic movement on deep inspiration and expiration was noted by the observer . Diaphragmatic movement was assessed using M-mode ultrasonography with the patient in the sitting position. 5 to 2 MHz curvilinear transducer was placed under the lowest rib at the anterior or midaxillary line, and the liver or spleen was used as an acoustic window.

Under strict aseptic precautions, area of injection was cleaned with antiseptic solution and ultrasound probe was covered with sterile wrap. Patient in supine position and head being flat was turned to the contralateral side of the block. The anaesthesiologist performing the block was positioned comfortably on the same side of the block. After applying sufficient jelly on the US probe, it was placed on the supraclavicular region to identify the subclavian artery and the lateral location of the supraclavicular portion of the brachial plexus. Tracing the nerves upwards at the level of C6 or cricoid cartilage the interscalene part of the brachial plexus was identified between the scalenus anterior and Medius muscle on medial and lateral side respectively. Color Doppler was added to confirm the presence of vessels in the same region. Local infiltration was done with 2-3ml of 2% lignocaine at the injection site. In plane approach of needle placement was used to locate and all drug depositions were done under direction vision of the needle after confirming negative for aspiration of blood. In the IS group, 8 ml of 0.5% bupivacaine was injected all around the plexus. Identifying the superficial cervical plexus block under the belly of lateral end of sternocleidomastoid muscle 5 ml of 0.5% bupivacaine was injected. In the ST group, the superior trunk was blocked as per the method described by Burkett-St. Laurent et al (6)-the nerve roots of C5 & C6 are traced from the interscalene groove downwards where they fused to form the superior trunk, 6 ml of 0.5% bupivacaine was instilledaround the neural sheath and 2 ml of 0.5% bupivacaine was injected into the supraclavicular nerve region and 5 ml of the same drug into the superficial cervical plexus.

The time of completion of injection of the drug was taken as T0. After the completion of the block, the anaesthesiologist who had given the block was no longer involved, but the observer who was blinded to the approach did the evaluation to assess the efficacy of the block. Loss of pin-prick sensation in the surgical site was assessed at 5 and 10 minutes after completion of the block (T1 and T2 respectively). Diaphragmatic movement on both sides was assessed at T2, partial paresis was defined when there was 25% reduction of diaphragm movement and complete paralysis when there was 75-100% reduction when compared to the contralateral diaphragm.(7) SpO_2, heart rate (HR), systolic blood pressure (SBP), diastolic blood pressure (DBP) and mean blood pressure (MBP) were also recorded at T1, T2 and every 15 minutes after completion of the block.

Block failure was defined as the need for rescue analgesia i.e. analgesic doses of fentanyl and conversion to general anaesthesia. . Despite additional fentanyl being administered in the dosage of 1mcg/kg, when the surgeon and patient was uncomfortable, general anaesthesia with supraglottic airway placement was the technique of anaesthesia. Patient was maintained on oxygen, nitrous oxide and isoflurane on spontaneous ventilation. The surgical incision was placed 20 minutes after the block was given.

The observer also checked for complications like superior laryngeal nerve block or hoarseness of voice, Horner's syndrome.

RESULTS:

Data was analyzed using SPSS 22 version software. Chi-

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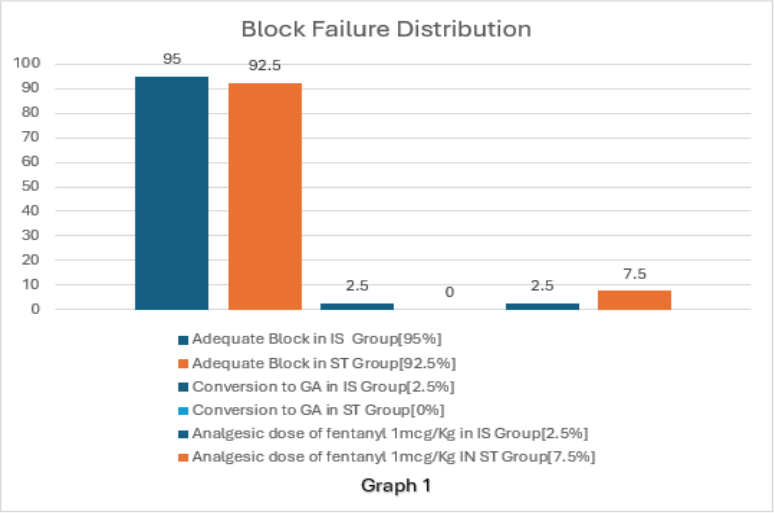
square test was used as test of significance for qualitative data and Independent t-test for quantitative data. The physical characteristics of the 80 patients included in the study is depicted in Table 1. The average onset for sensory block was 6.004 ± 0.75 minutes in Group IS and 5.89 ±0.79 minutes in Group ST which was not clinically significant (p-value 0.284) and the average duration for sensory block for IS Group was 9.01 ± 0.07 hours and 9.05 ± 0.32 hours. The surgical incision was placed 20 minutes after the block was given and by this time 100% of the patients had loss of pin prick sensation at the incision site. In Group IS, majority patients (95%) had no block failure, 2.5% had analgesia with a bolus dose of intravenous fentanyl (1 mcg/kg) and 2.5% patients required conversion to general anaesthesia with supraglottic airway placement. In Group ST, 92.5% had no block failure, 7.5% had analgesia with bolus dose of intravenous fentanyl. None of the patients required conversion to general anaesthesia .There was no significant difference in block failure between two groups as shown in Graph 1.

Pre procedure and 10 minutes following the block, hemi-diaphragmatic movements on both sides on deep inspiration and expiration was assessed. There was no hemi-diaphragmatic paresis at the end of 10 minutes seen in any of the group. At the end of 60 mins 5/40 patients in IS group showed complete hemi-diaphragmatic paresis whereas 2/40 patients in Group ST had partial diaphragm movements on the block side. At the end of 90 mins of giving the block 4/40 patients had complete hemi-diaphragmatic paresis on the block side in Group IS whereas in Group ST only 1/40 patients had partial hemi-diaphragm paresis as shown in Graph 2.

DEMOGRAPHY	**GROUP IS**		**GROUP ST**		
	MEAN	SD	MEAN	SD	**P-VALUE**
AGE	36.65	12.92	40.73	11.91	0.147
WEIGHT	73.33	5.86	73.08	6.94	0.862
HEIGHT	159.78	5.61	158.35	4.92	0.231
BMI	28.81	2.85	29.17	2.69	0.561

TABLE 1: Demographic comparison of both groups



Graph 1

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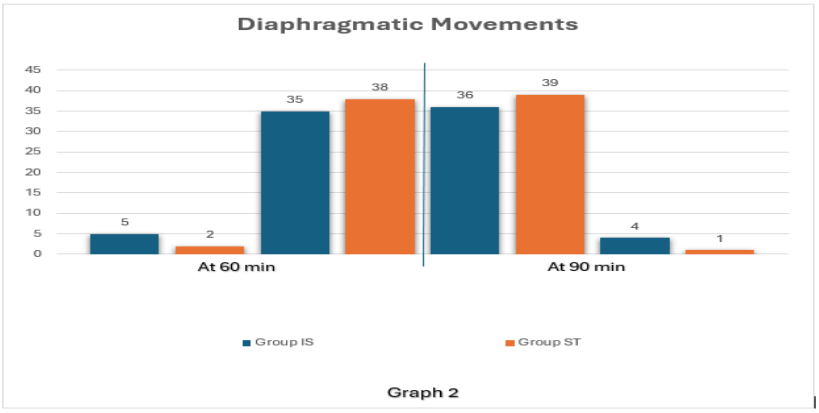

Graph 2

DISCUSSION:

Peripheral nerve block is a safe technique for providing anaesthesia and analgesia. However, the complications have to be anticipated and all precautions must be taken to prevent and treat any such adverse event. Injecting large volume of local anaesthetic drug during interscalene block can lead to epidural spread of the drug, phrenic nerve palsies and potential nerve damage. Volume of local anaesthetic drug as low as 5 ml for interscalene block was used and significant decrease in hemidiaphragmatic paresis was noted.(8)

In our study,13 ml of 0.5% bupivacaine was used in both ST and IS group which were divided appropriately and deposited around the required nerves. Administration of this small dose is possible only with the use of ultrasound to locate and deposit the drugs in the vicinity of these nerves. Also many of the complications of administration of large dose of local anaesthetic drugs like local anaesthesia systemic toxicity can be prevented.

Kim et al in 2019 compared ultrasound guided superior trunk block with interscalene block for ambulatory shoulder surgery using 15 ml of 0.5% bupivacaine and concluded that superior trunk block patients had better satisfaction and unaffected respiratory parameters (9)

Hemi diaphragmatic paresis was noted only in 2 patients in ST group as compared to 5 patients in IS group at 60 minutes after the block. This observation is of clinical significance where patients with compromised respiratory system or poor respiratory reserve will tolerate the block better when isolated superior trunk, supraclavicular and superficial cervical plexus is blocked instead of blocking the brachial plexus at the interscalene level, where phrenic nerve is also blocked. Sparing of phrenic nerve and subsequently better diaphragmatic function also aids in early recovery and efficient respiratory function, early mobilization and shorter hospital stay. At 90 minutes, only 1 patient had hemi diaphragmatic paresis in ST group whereas 2 patients had in IS group. In the study done by Kang et al the incidence of complete or partial hemidiaphragmatic paresis was significantly lower in the superior trunk block group than in the interscalene block group (29 [76.3%] *vs.* 39 [97.5%] patients; $P = 0.006$).(4)

In this prospective study, we observed that even though 100% of the patients had effective loss of pin-prick sensation at the end of 5 minutes and 10 minutes, in the IS group, 2.5% were converted to general anaesthesia for the patient and surgeon comfort

In the ST group, none of the patients required conversion to GA and 7.5% were given fentanyl bolus owing to manipulation or extension of the incision to the medial end of the clavicle. This was mainly noticed in displaced and multiple fractures of the clavicle. Following administration of fentanyl 1 mcg/kg, these patients were comfortable throughout the surgery. However one patient in group IS had persistent discomfort for which general anesthesia with supraglottic airway device was administered. However, at the end of the procedure following removal of the supraglottic device, analgesia was adequate when the patient was questioned about pain in the surgical site. The pain was mainly during manipulation of the multiple fracture fragments on the medial side or extension of the incision to the medial end of the clavicle. Better patient satisfaction was observed in regional anaesthesia when compared to general anaesthesia owing to the fact that patients are aware of the care and concern in terms of pain and post operative nausea and vomiting (10)

It was observed that the superior trunk block, supraclavicular nerve and superficial cervical plexus block can be used as sole anaesthetic technique to provide

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surgical anaesthesia for patients undergoing mid and lateral clavicle surgeries.

CONCLUSION

We conclude that combination of low dose superior trunk, supraclavicular and superficial cervical plexus block is as effective as an equal dose of interscalene with superficial cervical plexus block to provide noninferior surgical anesthesia with preserved diaphragmatic function for adult patients undergoing elective mid and lateral clavicle fracture surgeries .

Disclosure And Acknowledgement

The authors declare no conflict of interest in procuring or publishing this data.

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