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A comparative study between ultrasonography guided classical interscalene block plus superficial cervical plexus block versus low approach interscalene block plus superficial cervical plexus block in lateral one-third of clavicle and proximal humerus surgery

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ABSTRACT

Background: Classical interscalene approach of brachial plexus block with superficial cervical plexus block has become the anesthetic technique of choice in the upper arm, shoulder, and clavicle surgery but there is high risk of complications and sparing of C8-T1 nerve roots. Here, we used low approach of interscalene block (ISB) with superficial cervical plexus block for lateral one-third of clavicle and proximal humerus surgeries. Previously, none of the study compare ultrasonography (USG) guided low ISB (LISB) to the conventional approach for lateral one-third of clavicle and proximal humerus surgeries. **Aims and Objectives:** The aim of the study was to compare onset, duration, density of sensory-motor block, and severity of complication between ISB and LISB with superficial cervical plexus block. **Materials and Methods:** Patients with fracture of lateral end of clavicle and proximal humerus of 18–60 years of 324, American Society of Anesthesiologists I and II patients, were randomly assigned into two groups ISBS and LISB with superficial cervical plexus block (LISBS) to find out the difference in density of sensory-motor blockade associated with any complications between two groups. **Results:** The degree of the ulnar block after 5 and 15 min was found to be 2.8 ± 2.6 and 1.1 ± 1.8 in LISBS, respectively, for ISBS 3.0 ± 1.5 and 1.8 ± 2.0, respectively, based on a ten-point scale. After 15 min, motor block occurred in the median nerve in 151 patients out of 162 (92.8%), and in all of the other three nerves in all 162 patients. Horner syndrome and hoarseness were less frequent in LISB with superficial cervical plexus block patients than in ISB with superficial cervical plexus block patients (P = 0.0009 and 0.003, respectively) which was statistically significant. **Conclusion:** The present study confirmed the achievement of an appropriate sensory and motor block in the lateral one-third of clavicle with proximal humerus surgery, including the ulnar nerve with no complications than ISB.

Key words: Interscalene block; Low interscalene block; Interscalene block with superficial cervical plexus block; Low interscalene block with superficial cervical plexus block; Gauze; Ultrasonography

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INTRODUCTION

Peripheral nerve blocks are excellent anesthesia technique, gained popularity for providing good quality of anesthesia and perioperative analgesia.[1] Brachial plexus block used for upper extremity surgery.

The brachial plexus runs from the C5-T1 ventral rami, forms the superior, middle, and inferior trunks, divides under the clavicle, leads to the lateral, posterior, and medial cords, and finally forms the peripheral nerves running to the arms. The brachial plexus block is popular for anesthetic and pain control purposes in the upper limbs.

There are a few approaches to the block, including the interscalene approach, supraclavicular approach, infraclavicular approach, and the axillary approach.

The classic interscalene approach has been performed at the C6 level located in the cricoid cartilage and is useful in controlling pain after shoulder surgeries, upper 1/3rd of arm and with superficial cervical plexus block for lateral one-third of clavicle surgery. Superficial cervical plexus block performed by midpoint of a line extending from mastoid process to C6 or posterior border of sternocleidomastoid muscle and then cephalic, caudad direction subcutaneous infiltration. With the conventional approach to interscalene block (ISB), a needle is inserted at the C6 level to deposit local anesthetic in the interscalene groove.[2] However, a single-injection ISB at this level often spares the lower trunk of the brachial plexus (C8-T1; ulnar nerve) in up to 50% of blocks,[3] and associated with complications like Horner syndrome, Hoarseness of voice, and hemidiaphramatic palsy.[4]

With the low ISB (LISB) approach, local anesthetic is deposited more caudad in the brachial plexus than with the ISB approach higher success rate of blockade with lesser complications. However, there have been no studies that have reported this method comparing ISB with superficial cervical plexus used with ultrasound. Hence, this prospective, double blind, parallel group, and randomized study was designed to compare the onset, degree of motor and sensory blockade, and severity of complications.

Aims and objectives

1. Compare onset, duration, density of sensory-motor block
2. Severity of complication between ISB and LISB with superficial cervical plexus block

MATERIALS AND METHODS

Duration hand time period

The duration of the study was 1 year and 6 months, from February 1. 2019 to August 1, 2020.

The present study was conducted on 324 patients (162 in each group) who were classified as physical status 1 or 2 by the American Society of Anesthesiologists (ASA) and who were scheduled to receive a lateral one-third clavicle or proximal humerus surgery at our hospital, after taking Institutional Ethical Committee approval and written informed consent from each patient. We excluded patients with coagulation disorders, those who were under the age of 18 or over the age of 60, those who weighed <50 kg or more than 100 kg, patients with any kind of neurological deficit, or patients with surgical site infections.

We explained to the patients the objective of the study as well as potential risks and complications of the procedure. The study proceeded following consent from the patients. The patients were not premedicated before receiving anesthesia. After they arrived in the operating room, patients were connected to a non-invasive blood pressure manometer, pulse oximeter, and electrocardiogram to monitor their vital signs every 3 min. The patients were in the supine position with their heads facing away from the side of the block. The region was prepped with betadine and the linear probe of the ultrasound (SonoSite M-Turbo, SonoSite, Inc., Bothell, WA, USA) was placed on the interscalene groove, for ISB ultrasonography probe was placed at the level of c6 cartilage in the interscalene groove, for LISB which is located at about two-thirds of the distance caudally from C6 when the distance between C6 and the clavicle is divided into three sections, as suggested by Kim et al.[4] Sterilized plastic wrap and gels, and 22G, 50 mm needles (UniPlex NanoLine facet tip UP 3/50, Pajunk Medical Produkte GmbH, Geisingen, Germany) were used. After identifying the Brachial plexus and confirming the absence of blood vessels in the trajectory of the needle by color Doppler imaging, the operator advances the insulated needle 22G, 20 cm needle (stimuplex) slowly by in plane approach taking care to avoid any vascular structures and keeping the needle in view at all times. Then, an assistant aspirate and injects 1 ml of local anesthetic. The optimal needle location visualized as the spreads of the local anesthetics as a hypoechoics area around the nerve roots. Once the ideal local anesthetic spread is visualized, the assistant inject lignocaine with adrenaline 2% @5 mg/kg, and bupivacaine 0.5% @2 mg/kg with continuous monitoring for early sign and symptoms of intravascular injection. At 5 and 15 min after the injection of the local anesthetic, we confirmed the sensory block using alcohol wipes on the musculocutaneous

nerve, median nerve, radial nerve, and ulnar nerve with a scale ranging from 0 (no sensation) to 10 (normal sensation). We also checked for muscular contractions by assessing flexion of the elbow (musculocutaneous nerve), extension of the elbow and wrist (radial nerve), pronation of the arm and flexion of the wrist (median nerve), and flexion and opposition of the fourth and fifth fingers toward the thumb (ulnar nerve), and considered signs of paralysis (loss of contraction) to indicate a successful motor block. For superficial cervical plexus block after cleansing the skin with an antiseptic solution, a skin wheal is raised at the site of needle insertion using a 25 G needle. Using a "fan" technique with superior-inferior needle redirections, the local anesthetics injected alongside the posterior border of the sternocleidomastoid muscle 2–3cm below and then above the needle insertion site. The goal is to achieve blockade of all four major branches of superficial cervical plexus. Total 10-15ml of LA (3-5ml per each redirection/injection) was given. After block, we also checked for any complications such as Horner syndrome, hoarseness of voice, and hemidiaphragmatic palsy. One anesthesiologist performed the LISB, ISB, and superficial cervical plexus block procedure and one orthopedician performed the surgery. We confirmed cases of hemi diaphragmatic paralysis after the surgery by performing a chest X-ray and consulting a radiologist regarding the results.

RESULTS

Among the 324 subjects of this study, 162 were male and 162 were female. The patients' demographic and clinical data including age, body weight, height, gender, surgery length and block performance time are illustrated in Tables 1 and 2. All patients were posted for lateral end of clavicle fracture or proximal humerus open reduction internal fixation. At 5 and 15 min after the block procedure, the degree of sensory block in the ulnar nerve was found to be 2.8±2.6 and 1.1± 1.8, respectively, for low approach ISB and for classical approach ISB 3.0±1.5 and 1.8±2.0 on a scale of ten. Muscular block occurred in the median nerve after 15 min in 154 of the 162 patients (92.8%), and in all of the other three nerves in all 162 patients (Tables 3 and 4) for low approach ISB and 140 of the 162 patients in the median nerve after 15 min and in all of the other three nerves in all 162 patients. Only 10 patients of Low Interscalene block recieved additional analgesics whereas 20 patients of Interscalene block patient recieved additional analgesics. there was low complications occur in case of Low Interscalene block rather than classical Interscalene block. Only 6 patients develop Horner syndrome, 5 patients develop Hoarseness of voice, 2 patients develop hemidiaphragmatic palsy and 2 patients develop dyspnea in case of LISBS whereas in case of ISBS 40 patients develop Horner, 35 develops Hoarseness of voice, 28 develops Hemidiaphragmatic palsy and 30 patients develops Dyspnea. which was statistical significant (P>0.005).

Table 2 showing no statistical significance between LISBS and ISBS in operation time and Block performance time.

Table 1: Patient dermographic data

Demographic data	LISBS	ISBS
Age (year)	47.8±14.6	45.5±15.2
Height (cm)	160.0±8.6	156.5±7.8
Weight (kg)	59.7±10.6	55.9±12.2
Sex (M/F)	81/81	81/81

Values are mean±standard deviation or number of patients. Table 1 showing there is no statistical significance. LISBS: Low interscalene block with superficial cervical plexus block, ISBS: Low interscalene block

Table 2 :Operation Time and Block performance time (sec)

Types of block	Operation time (min)	Block performance time (s)
LISBS	59.6±33.0	341.7±59.2
ISBS	61±30.2	365.1±60

DISCUSSION

This study confirmed that an appropriate sensory and motor block was achieved in the upper extremities, with clavicular region 15 min after LISB with superficial cervical plexus block and that there were no complications associated with the block than classical ISB with superficial cervical plexus block. Two methods of LISB have been introduced, namely, the anatomical landmark approach and the ultrasound-guided approach.[3,4] There are three approaches to the anatomical landmark method: first, it can be performed in between the cricoid cartilage and the clavicle. Second, it can be performed 2 cm above the clavicle, and third, it can be performed on the interscalene groove, which is located at about two-thirds of the distance caudally from C6 after dividing the distance between C6 and the clavicle into three sections. Although different studies define and name the procedures slightly differently (low approach, lower interscalene approach, or superior trunk approach), these procedures are identical in terms of using an approach through the lower regions of the C6 level compared to the existing ISB.[1,2,3,9] For superficial cervical plexus block performed by midpoint of a line extending from mastoid process to C6 or posterior border of sternocleidomastoid muscle and then cephalic, caudad direction subcutaneous infiltration. Hence, in the present study, we use 20 mL of local anesthetics to ensure a quick onset and complete block of the upper arm and lateral end of clavicle LISB is known to involve a short effect distance (from the C5 nerve root to the C8 nerve root)

Table 3: Characteristics of the sensory block using a low approach interscalene brachial plexus block and classical interscalene brachial plexus block

Sensory Block	LISBS		ISBS		Level of significance	Level of significance
Sensory block (0–10)	5 min after injection	15 min after injection	5 min after injection	15 min after injection	After 5 min	After 15 min
Musculocutaneous nerve	0.7±1.3	0.2±0.6	1.3±1.0	1.3±1.0	<0.001	<0.001
Median nerve	1.6±2.3	0.9±1.9	1.9±1.2	1.7±1.3	0.142	<0.001
Radial nerve	0.5±1.1	0.1±0.3	2.0±1.3	2.0±1.1	<0.001	<0.001
Ulnar nerve	2.8±2.6	1.1±1.8	3.0±1.5	1.8±2.0	<0.001	<0.001

Values are mean±standard deviation. Sensory block (0–10); 0: Loss of sensation, 10: Normal sensation. LISBS: Low interscalene block with superficial cervical plexus block, ISBS: Low interscalene block

Table 4: Characteristics of the motor block of the upper arm with lateral end of clavicle using a low approach interscalene brachial plexus block and classical interscalene block

Motor block	LISBS		ISBS	
Motor block (%)	5 min after injection	15 min after injection	5 min after injection	15 min after injection
Musculocutaneous nerve	154 (95%)	162 (100%)	150 (92.6%)	160 (98.7%)
Median nerve	123 (73.4%)	159 (98%)	125 (77%)	153 (94.5%)
Ulnar nerve	149 (91.9%)	162 (100%)	140 (86.4%)	150 (92.6%)
Radial nerve	145 (89.5%)	162 (100%)	146 (90.1%) 0	154 (95%)

Values are number of patients (percentage). LISBS: Low interscalene block with superficial cervical plexus block, ISBS: Low interscalene block

Table 5: Analgesic requirement and complications after a low approach interscalene block and classical interscalene brachial plexus block combined with superficial cervical plexus block

Requirement of analgesics and complications	LISBS	ISBS
Patients requiring analgesics during operation	10	20
Patients with complications Horner syndrome	6	40
Hoarseness of voice	5	35
Hemidiaphrgmatic palsy	2	28
Dyspnea	2	30

LISBS: Low interscalene block with superficial cervical plexus block, ISBS: Low interscalene block

and to diffuse local anesthetics through the deep cervical fascia. In addition, LISB has been reported to bring about appropriate sensory and motor blocks required for the upper limb surgeries even with a single injection.[7,10] Against this backdrop, the present study was planned and conducted. Moreover, according to Plante et al.,[6] who compared two groups of patients who were injected with local anesthetics either in the upper region of the C5 nerve root or the lower region of the C6 nerve root during an ultrasound-guided interscalene brachial plexus block for analgesia in arthroscopic shoulder surgeries, the group of patients who received local anesthetics in the lower region of the C6 nerve root had appropriate sensory blocks in all of the nerves; they reported that the sensory and motor blocks were especially noticeable in the ulnar nerve and that there was a rapid onset in the ulnar nerve. The results of this study showed that almost equal motor and sensory block in both ISB and LISB. In addition, superficial cervical plexus block provided for lateral end of clavicle surgery. Meanwhile, ISB is known to induce a temporary paralysis in the ipsilateral hemidiaphragm due to phrenic nerve palsy. The phrenic nerve is located within 2 mm of the brachial plexus of the cricoid cartilage and divides 3 mm per 1 cm as it descends caudally. Thus, it can be predicted that the incidence of phrenic nerve palsy-induced hemidiaphragmatic paralysis can be reduced if ISB is performed more caudal to the C6 level or on the superior trunk.[8,10,11,12] In the present study, there were no signs of dyspnea or hemidiaphragmatic paralysis. In addition, LISB is known to reduce the damage to the dorsal scapular and long thoracic nerves, both of which split from the C5 nerve root[2,4] though it was effective for proximal humerus surgery and clavicle surgery. Although we did not assess whether any such damages occurred in the present study, none of the patients experienced any such problems. As mentioned above, there were no complications in the present study. We presume that we were able to reduce the risk of complications, such as vascular injection or nerve injury, using an ultrasound nerve stimulator in addition to the inherent merits of the LISB method. In the present study, the motor block in the median nerve was shown to be about 71.4% at 5 min after the procedure was performed. The block increased to 92.8% at 15 min. Other studies have also reported similarly slow blocks in the median nerve within 15 min,[6] which is thought to be due to the fact that the median nerve innervates all of C5, C6, C7, and T1. Thus far, studies on LISB are only in the form of case reports or brief reports; hence, in conclusion, the present study confirmed that the lateral end of clavicle

surgery and proximal humerus surgery was appropriately blocked with LISB and superficial cervical plexus block without any complications induced by the block than ISB.

Limitations of the study

The present study has some limitations. First, we could not observe the diffusion of local anesthetics through injecting contrast medium. Second, we did not compare the procedure of interest with other approaches. Thus far, studies on LISB are only in the form of case reports or brief reports; hence, in the future, LISB should be compared with other approaches, and cases of LISB using different doses of local anesthetics should be compared as well.

CONCLUSION

The present study confirmed the achievement of an appropriate sensory and motor block in the lateral one-third of clavicle with proximal humerus surgery, including the ulnar nerve with no complications than ISB.

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RB- Concept and design of the study; **SN-** Interpreted the results, reviewed the literature, and manuscript preparation; and **PM-** Concept, coordination, statistical analysis and interpretation, preparation of manuscript, and revision of the manuscript.

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