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COMPARISON OF ULTRASOUND GUIDED SUPRACLAVICULAR VERSUS COSTOCLAVICULAR BRACHIAL PLEXUS BLOCK FOR UPPER LIMB SURGERIES : A PROSPECTIVE RANDOMISED CLINICAL TRIAL

Anaesthesiology

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ABSTRACT

Introduction: Ultrasound guided supraclavicular block is one of the best technique. Supraclavicular brachial plexus block also known as "spinal of arm" is a popular anaesthetic technique for upper limb surgeries for relief of intraoperative and perioperative pain. Ultrasound guided supraclavicular and costoclavicular techniques have become common brachial plexus blocks for upper limb surgery. Costoclavicular brachial plexus block varies from supraclavicular block. All the three cords of brachial plexus are clustered in the former and the low dose of local anesthetic agent with single injection provides effective analgesia and anesthesia. **Objective:** We aimed to compare onset of sensory and motor blockade, nerve sparing effect and duration of analgesia in both group. **Methods:** This was a comparative, randomized study among patients undergoing upper limb surgeries under regional anesthesia at our hospital. Patients between 18-65 years of age of either sex under ASA I and II criteria with Mallampati grade I and grade II were enrolled. The study population was subdivided randomly into 2 groups each consisting 30 patients. Group S received Brachial plexus block using Supraclavicular space and Group C received Brachial plexus block using Costoclavicular space. **Results:** Duration of block performance time was statistically significant when compared among two different groups. The group C had shorter onset of nerve block when compared with Group S [P value < 0.001]. When comparison was done between duration of sensory nerve block and motor nerve block among groups, we found that the duration was prolonged in group C which was statistically significant. Duration of block performance was shorter in costoclavicular brachial plexus. **Conclusion:** Like conventional ultrasound guided supraclavicular block it has postoperative analgesia along with safety profile for surgeries in forearm and hand. Hence using CCB as an alternative technique to supraclavicular approach can be beneficial in providing surgical aesthesia in routine clinical practice

KEYWORDS

INTRODUCTION

Regional anesthesia for upper limb surgeries have an edge over general anesthesia as it has many benefits like ensuring superior quality of intraoperative and post-operative analgesia, stable hemodynamics and avoidance of airway manipulation [1]. Ultrasound guided supraclavicular block is one of the best technique and supraclavicular approach was first described by kulenkamff in 1911. Supraclavicular brachial plexus block also known as the "spinal of arm" is a popular anaesthetic technique for upper limb surgeries for relief of intraoperative and perioperative pain and it also contributes to reduced hospital stay [2].

Ultrasound [USG] guided supraclavicular and costoclavicular techniques have become common brachial plexus blocks (BPB) for upper limb surgery. It is because of its greater safety methods due to real time USG guidance and its faster onset time [3,4]. Costoclavicular brachial plexus block is a modification of ultrasound guided infraclavicular brachial plexus block. Under USG the costoclavicular space [CCS] can be visualized in a well defined manner where an intermuscular space is lying deep and in the posterior region to the midpoint of clavicle. It is located in between the clavicular head major anteriorly of the pectoralis and upper slips of the serratus anterior muscle and the second rib posteriorly [5]. The brachial plexus which contain 3 cords are seen as a single transverse of CCS because the cords are clustered laterally to the axillary artery because of which they exhibit a triangular arrangement [6]. Costoclavicular block is a retrograde channel to supraclavicular area, which involves the nerve suprascapular and enables reliable analgesia for arthroscopic shoulder surgery [7]. Costoclavicular brachial plexus block varies from supraclavicular block. All the three cords of brachial plexus are clustered in the former and the low dose of local anesthetic agent with single injection provides effective analgesia and anesthesia [5].

Supraclavicular block has been the most common brachial plexus block technique. Some of the disadvantages of supraclavicular block are hoarseness of voice due to ipsilateral laryngeal nerve block, Horner syndrome from stellate ganglion block, hemidiaphragmatic paresis from a phrenic nerve blockade, pnuemothorax and vessel rupture. Brachial plexus around the subclavian artery is blocked with the higher risk of ulnar nerve sparing and vessel rupture in conventional supraclavicular approach. [5]. Costoclavicular variant of brachial plexus block are at low risk of vessel rupture and pleural rupture. This is because the nerve cords are first approached before vessel and pleura when compared with other approaches to infraclavicular brachial plexus block [5]. Hemidiaphragmatic paralysis is the most common complication after brachial plexus block when performed above clavicle. Incidence of Hemidiaphragmatic paralysis is reported upto 70 % in supraclavicular approach compared to costoclavicular brachial plexus block [8]. Very few studies have been conducted to compare the efficacy of costoclavicular approach of brachial plexus block with the conventional supraclavicular brachial plexus block. Hence our study was aimed to compare the onset of sensory and motor blockade, nerve sparing effect and duration of analgesia in both the group.

MATERIALS AND METHODS

Institutional Ethical committee approval was obtained. Study was conducted among 60 adult patients scheduled for elective upper limb surgeries under regional anesthesia as per American Society of Anesthesiologists I [ASA] and ASA II criteria. Simple Random Sampling method was used and consisted of two groups with 30 each. The study was conducted for a period of 18 months i.e. May 2022 to November 2023. This was a comparative, randomized study among patients undergoing upper limb surgeries under regional anesthesia at our hospital.

Study followed a strict inclusion and exclusion criteria. Patients willing to participate and give consent, between 18-65 years of age of either sex under ASA I and II criteria with Mallampati grade I and grade II were enrolled. Patients with deranged coagulation profile, receiving chronic analgesic therapy and anticoagulants, history of opioid dependence, patients with morbid obesity, heart block, hypertensive, diabetes mellitus, hepato-renal disturbances and known allergic disorders were excluded from the study. The study population was subdivided randomly into 2 groups each consisting 30 patients. Group S each consisting of 30 patients will receive Brachial plexus block using Supraclavicular space and Group C each consisting of 30 patients will receive Brachial plexus block using Costoclavicular space.

Pre anesthetic evaluation was done for all the patients a day prior to surgery and included the following assessments like general condition, air way assessment, physical examination. Detailed examination of

cardiovascular, respiratory, per abdomen, CNS and evaluation of neurodegenerative conditions. Biochemical and pathological blood investigations were done as routine evaluation process along with chest X ray and electrocardiogram [ECG]. The procedure of regional anesthesia was explained to the patient and written informed consent was taken. Patients were allowed for overnight fast of 8 hours before the surgery. The procedure of regional anesthesia will be explained to the patient and written informed consent will be taken. Preparation will include an overnight fast of 8 hours before the surgery.

On arrival of the patient to the operating room, intravenous access (20 G) was established on the contralateral hand or forearm and standard ASA monitors (electrocardiogram, noninvasive blood pressure and SpO2) were connected. Intravenous fluids will be started. Block was performed by ultrasound guided block techniques. Outcome measures were observed after the performance of block.

Patients allocated in group C were positioned supine with ipsilateral arm abducted for scan and head of contralateral side for brachial plexus block. Anatomical landmarks was identified and marked on the skin. Midpoint of the clavicle and the tip of the coracoid process, transducer was placed directly in transverse orientation laterally outward and moved caudally until it reached the clavicle in order to visualize axillary artery and vein. Maintaining the same transducer position it was then tilted cephalad to direct towards Costoclavicular space, which is the space between the posterior surface of the clavicle and 2nd rib. The USG image was then stabilized until all 3 cords of brachial plexus are clearly visualized. Care was taken so that the needle won't be inserted to the cephalic vein or the thoracoacromial artery. The skin was then infiltrated with 2% lignocaine using 23G Spinal needle in-plane from lateral to medial direction, cords of the brachial plexus was located and needle tip was placed at the center of the nerve cluster by advancing the needle through the gap between the lateral and posterior cord and towards the medial cord. After confirmation of the needle via direct visualisation and saline dissection a total volume of 12- 15 ml of 0.5% bupivacaine was injected in small allicots and at a single site [9].

In group S, patients, were in supine position with head end elevation of 15 degree, the skin was disinfected and the transducer was positioned in the transverse plane immediately proximal to the clavicle at its midpoint. The transducer was tilted caudally to obtain a cross sectional view of the subclavian artery and the brachial plexus was seen as a collection of hypoechoic oval structures superficial to the artery posteriorly .Proper needle placement was done with saline dissection .When the injection displaces the brachial plexus away from the needle an additional advancement of the needle 1-2 mm closer to the plexus was accomplished for adequate local anaesthetic spread. A total amount of 12- 15ml of 0.5% bupivacaine was then given around the subclavian artery [9].

After local anaesthetic injection through the block needle, measurements of onset of sensory and motor blockade were taken by an independent observer who was blinded to the technique. Sensory blockade was graded according to a 3-point scale using a cold test using spirit swab as follows: 0-no block; 1- analgesia (patient can feel touch, not cold); and 2- anaesthesia (patient cannot feel touch). Sensory blockade of the musculocutaneous, median, radial, and ulnar nerves was assessed on the lateral aspect of the forearm, the volar aspect of the thumb, the lateral aspect of the dorsum of the hand, and the volar aspect of the fifth finger, respectively.

Motor blockade was also graded on a 3-point scale: 0-no block; 1-paresis; and 2- paralysis. Motor blockade of the musculocutaneous, radial, median, and ulnar nerves was evaluated by elbow flexion, thumb abduction, thumb opposition, and thumb adduction, respectively. Overall, the maximal composite score was 16 points and considered patients ready for surgery, when a minimal composite score of 14 points were achieved, provided the sensory block score is equal or superior to 7 out of 8 points. Duration of onset of surgical anaesthesia was noted by sensory assessment at regular intervals in both the groups.

Postoperatively numerical rating Scale score was assessed to elicit duration of post-operative analgesia at predetermined time intervals 0, 1, 2, 4, 6, 12, 24 th hour. Once the NRS score is ≥4, patients were started on Inj. Tramadol 50 mg IV. In case of brachial plexus block failure in either of the approaches, supplemental analgesia with Inj. Fentanyl in graded doses or conversion into general anesthesia was planned. Complications, if any was documented and treated accordingly.

Patients were observed for 24 hours after the surgery in post anesthesia care unit by an anesthesiologist who was blinded for group assignment. The pain score was evaluated using 11-point numerical rating Scale (0=pain, 10=worst pain) and sent to post anesthesia care unit and followed up at 0, 1, 2, 4, 6,8,12 and 24 hours postoperatively. The number of patients requiring rescue analgesia during the first 24 hours after the surgery was recorded.

Patient's satisfaction with the anesthesia technique was assessed at 24 hours after surgery and using 11-point satisfaction score (0=completely unsatisfied, 10=most satisfied).

Statistical Analysis

Data was collected and entered in MS Excel using SPSS version 24.0 for analysis. Study was conducted on 60 patients between two groups for onset of sensory and motor blockade. With standard deviation of 0.8, 90% statistical power and 5% level of significance, a sample size of 60 with 30 patients in each group was adequate. Descriptive statistics was used for assessing demographic variables. Hemodynamic variables were assessed by student t test. Unpaired t test was used for statistical analysis of onset of block, duration of sensory and motor block and postoperative analgesia. Fisher Exact test was used for categorical variables. P-value of <0.05 was considered statistically significant.

RESULTS

Demographic variables like age, height, weight, BMI and ASA grading was compared in both the groups. On observation, the duration of block performance time was statistically significant when compared among the two different groups. The onset of sensory nerve blockade (7.20 ± 0.46 min vs 8.72 ± 0.79 min) and motor nerve blockade (11.8 ± 0.59 min vs 11.64 ± 0.81 min) was compared among the groups and found that the group C had shorter onset of duration nerve block when compared with Group S [P value < 0.001]. When comparison was done between duration of sensory nerve block and motor nerve block among groups, we found that group S had shorter time duration in comparison to group C which was also found to be statistically significant.

Duration of block performance was shorter in costoclavicular brachial plexus block when compared to supraclavicular brachial plexus block. Nevertheless, the duration of analgesia was comparable among the groups. Necessity of rescue analgesics was also similar between the groups and had comparable difference with respect to duration of postoperative analgesia. Several studies have revealed nerve sparing effect mainly at the posterior cord, at ulnar nerve in supraclavicular block. But, in our study our results did not show nerve sparing effect in any of the group. [Table 1 and 2]

DISCUSSION

This is a prospective randomized study. We have compared the block between two groups i.e., costoclavicular and supraclavicular brachial plexus using ultrasound. The CCS has a well-defined intermuscular space which is lying deep in the mid of the clavicle in the posterior region.

The visualization of the posterior, medial, and lateral nerve cords of the brachial plexus can be analyzed by infraclavicular approach in costoclavicular space, which is in triangular arrangement. This is in the retropectoralis minor space in the proximal part. Cords of the brachial plexus in CCS lie in the axillary artery laterally. The cords appeared as hypoechoic clusters and exhibited a consistent anatomic arrangement relative to one another. This axillary artery is comparable to the study conducted by Demondion et al. [10] .

The consistent arrangement of the brachial plexus anatomically explains the success rate of such approach. We, in our study, observed that onset of sensory blockade and motor blockade was slightly prior in group C when compared with group S. In a study by Venkataraman et al. [11] results showed early onset of sensory blockade in Group C than Group S when infraclavicular block was compared with supraclavicular block. The onset of motor blockade was faster in Group C when compared to than Group S.

A study by Li et al. [6] described the anatomy, its technique and the block dynamics of ultrasound guided costoclavicular brachial plexus block. In their study, the costoclavicular brachial plexus block was successful using 20ml of Inj. Ropivacaine of 0.5% on 30 patients. This produced speedy onset of sensory-motor blockade with a median time to readiness for surgery as 10. This early blockade was effective as surgical anesthesia in 97% of the patients.

The CCS block is a single point injection which is given lateral to the axillary artery, while the supraclavicular approach requires multiple point injections in the subclavian artery. The timer required for the block performance was compared and found that it was shorter in costoclavicular brachial plexus block. Our study results were similar to the previous study conducted by Venkataraman et al. [11] where the block performance time was relatively quicker in Group C than Group S. A Similar study conducted by Koscielniak-Nielsen ZJ et al. [12] showed that the mean block performance time was 5.7 min in supraclavicular group and 5.0 min in the infraclavicular group.

Our study results showed that postoperative analgesia as statistically insignificant when compared among both the groups. This was comparable with study conducted by Venkataraman et al. [11]. As per our study observation, costoclavicular brachial plexus block is compared to supraclavicular brachial plexus block and found that the costoclavicular brachial plexus block had early onset of sensory and motor blockade. The duration of the sensory and motor blockade also was longer with group C, in comparison to group S. Hence, with the above observation, we see that the costoclavicular approach can be considered as sole anaesthetic procedure for surgeries like forearm and hand and this can be considered as an alternative to supraclavicular approach.

Other studies done on supraclavicular brachial plexus block have shown that the ulnar nerve requires supplemental analgesia or needs to be converted to general an aesthesia. In our study we did not find any such results in either of the groups Though all the values in our study were in favor of costoclavicular approach, we did not find any statistically significant difference in postoperative analgesia.

Study conducted by Charles et al. [13] summarized that the costoclavicular approach is better due to its mechanical stability for catheter placement when compared with supraclavicular approach. Safe neck movements are achieved when the catheter is able to pierce the pectoralis major and subclavius muscles. This if happens in a larger proportion it remains tunneled. However, we did not practice any catheters in our study.

Limitations

We conducted a study in a small population. To draw a better conclusion, study should be conducted in a larger population and needs randomization.

CONCLUSION

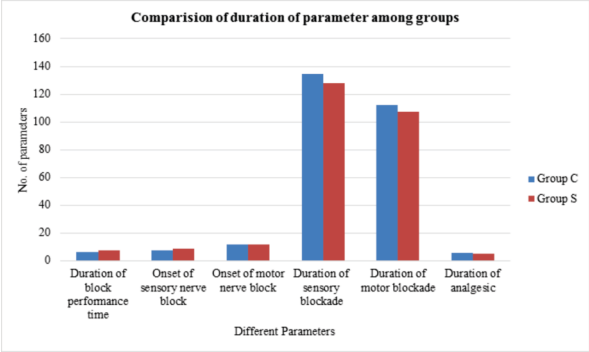
The ultrasound guided costoclavicular brachial plexus block can be executed rapidly. This has rapid onset of blockade in sensory-motor. Like conventional ultrasound guided supraclavicular block it has postoperative analgesia along with safety profile for surgeries in forearm and hand. Hence using CCB as an alternative technique to supraclavicular approach cab be beneficial in providing surgical aesthesia in routine clinical practice.

Table : Demographic Variables Among Two Groups

	GROUP C	GROUP S	P VALUES
AGE IN YEARS	38.00± 12.27	40.87± 14.82	0.41
Weight in kgs	64.00± 10.13	66.00± 7.60	0.39
Height in cms	162.17± 7.81	162.00± 6.78	0.92
Sex M/F	0.46	0.46	1
BMI	24.3± 3.50	25.3± 1.67	0.16

Table 2: Comparison of Parameter Among Two Groups

Parameters	GROUP C	GROUP S	P VALUE
Duration of block performance time	6.4 ± 1.59	7.60± 1.55	0.0044
Onset of sensory nerve block	7.20 ± 0.46	8.72 ± 0.79	0.0001
Onset of motor nerve block	11.8 ± 0.59	11.64 ± 0.81	0.0018
Duration of sensory blockade	134.33 ± 10.20	128 ± 10.95	0.0241
Duration of motor blockade	112.33 ± 9.50	107.33 ± 8.90	0.0397
Duration of analgesic	5.4 ± 0.77	5.00 ± 0.74	0.0237



Graph 1: Comparison of Parameter Among Two Groups

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