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Comparative Effects of Supraclavicular Perivascular and Infraclavicular Brachial Plexus Block for Upper Limb Surgeries

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Abstract

Background: Supraclavicular and infraclavicular both approaches have identical distributions of anesthesia. Proximal blocks generally have rapid onset than blocks which are distal. *Objective*: To compare the clinical effect of supraclavicular perivascular technique and infraclavicular brachial plexus block for upper limb surgery. *Methods:* A prospective randomized clinical trial was performed among hundred patients receiving upper limb surgery under infraclavicular or supraclavicular brachial plexus block. The infraclavicular brachial plexus block was achieved by using the vertical technique with 30 ml of 0.5% ropivacaine. The supraclavicular block was performed using the plumb bob technique with 30 ml of 0.5% ropivacaine. The pain related to block administration was evaluated. The sensory and motor block extent as well as the complications were assessed. *Results:* No significant differences were observed in the block administration related pain, evolution of sensory and motor block quality, or the success of the block. There was significant differences in the patient's satisfaction. *Conclusions:* Both infraclavicular and supraclavicular block had effects which were similar. When considering the complications, the infraclavicular approach may be preferred to the supraclavicular approach.

Keywords: Supraclavicular perivascular block; Upper limb surgery; Infraclavicular brachial plexus block; Pneumothorax; Nerve Injury.

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Introduction

Four approaches are there to a brachial plexus block namely interscalene, supraclavicular, infraclavicular and axillary. Associated to the axillary approach, at the level of the clavicle, a brachial plexus block can anesthetize all 4 distal upper extremity nerve areas without need of separate musculocutaneous nerve block. The supraclavicular approach has a supplementary advantage of a blockade at a level where the brachial plexus elements are firmly grouped, which eases an injection at single point and is supposed to result in onset rapidly.[1] In all patients, the infraclavicular approach should be feasible. It is also the theoretical way of both the supraclavicular and axillary approaches which are anatomical distribution of plexus structures allowing single injection of local anesthetics and a reduced risk of pneumothorax. Both supraclavicular and infraclavicular approaches have similar distributions of anesthesia.[2] Proximal blocks have rapid onset than distal blocks (infraclavicular and axillary), but there are lacuna in literature. So,

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this Interventional study was programmed for comparing both approaches to the brachial plexus using nerve stimulation in patients under going upper limb surgery.

Materials and Methods

Type of study - Prospective study;

Study design - Interventional study;

Study population - Patients enrolled for Upper limb surgery;

Study place - Department of Anesthesia of Tertiary care Institution;

Study duration - 6 months (February 2019 to July 2019);

Sampling technique - Consecutive sampling Technique;

Sample size - 100 consecutive patients.

Inclusion criteria

- > = 18 years;
- Scheduled to undergo surgery of the elbow, forearm, or hand underbrachial plexus anesthesia.

Exclusion criteria

- Coexisting lung, heart, liver, or kidney disease;
- Pregnancy;
- Inability to understand the information provided;
- Allergy to local anesthetics;
- Chest deformities; previous clavicle fractures;
- Neurologicaldisorders.

Methodology

The patients were randomly distributed to receive either infraclavicular plexus block (Group I, $n = 50$) or supraclavicular block (Group S, $n = 50$). All blocks were performed by the same anesthesiologist. Standard monitoring (noninvasive blood pressure, pulse oximetry and ECG) was commenced upon arrival to the preoperative holding area.

A 22-gauge 50-mm insulated stimulation short bevel needle (Stimuplex® A, B/Braun Medical, Germany) connected to a nerve stimulator (Stimuplex® -DIG, B/Braun, Germany) was used for all blocks. The nerve stimulator settings initially were 1.5 mA with a duration of impulse of 0.1 ms. The position of needle was decent when the response of motor in the hand or wrist was obtained and remained visible with a maximum current of 0.5 mA. 30 ml 0.5% ropivacaine was used as local anesthesia and it was injected slowly for about 60 seconds with periodic aspiration. The infraclavicular approach was done in position of supine with the side of upper arm, but with the elbow flexed and the hand resting on the lower-chest or abdomen. After landmarks identification, the site of puncture was marked halfway between the notch of jugular and the most ventral part of the acromion. The needle was injected vertical to the horizontal plane.

The supraclavicular Perivascular block was performed according to the original procedure reported by Brown et al.[3] In the supine position, the patient was placed with their head turned toward the opposite side. The point at which the lateral border of the sternocleidomastoid muscle joins the superior aspect of the clavicle was marked, and a needle was inserted at this point in a direction that is directly. The needle was pierced until a motor response was elicited. During the initial insertion, if a motor response in the hand or wrist was not obtained, or in small steps, the needle was redirected cephalad, if the first rib was not contacted, until a motor response in the hand or wrist was obtained or until it was angled approximately 30°.

Immediately after removing the needle, assessment of block performance pain was done by asking the patient to verbally quantify the pain level using a score between 0 and 10; 0 = meaning no pain and 10 = meaning excruciating pain. As a point of reference, a simultaneous comparison of the sensory and motor function in the contralateral limb was used. After the injection, a block assessment was assessed at 10 min intervals until 50 min. The sensory block for each nerve (radial, median, ulnar, musculo-cutanoeus, and media cutaneous of forearm) was ranked as follows: 0 = no difference from an unblocked extremity; 1 = less cold than unblocked extremity; and 2 = no sensation of cold.

The evaluation of motor block was performed using the forearm flexion and scored as follows: 0 = no loss of force; 1 = reduced force compared with the contralateral arm; and 2 = incapacity to overcome gravity.

The quality of the block was evaluated in the intraoperative time: (a) Satisfactory block—Surgery without patient discomfort or the need for supplementation; (b) Unsatisfactory block—A sensory region involved in the surgery was not completely anesthetized and the block was supplemented by the continuous infusion of propofol at 50 μg/kg/min and sufentanil 0.1–0.3

µg/kg IV; and (c) Complete failure— If the patient still experienced pain despite supplementation, general anesthesia was induced by the attending anesthesiologist using his/her preferred technique.

The duration of the sensory block was noted as time between the end of the local anesthetic injection and the total recovery of sensation. The side effects and complications namely intravascular injection, blood vessel puncture, overdose and dyspnoea, were noted. The satisfaction of patient with the anesthetic procedure was assessed after postanesthesia care ward arrival using a 2-point scale (0 = unsatisfied, 1 = satisfied).

Ethical Consideration - The study was approved by Institutional Ethics Committee.

Consent Type - Written Informed consent.

Statistical Analysis

Recorded observation were analyzed using SPSS. The values were expressed as the mean ± SD. Group sizes (50 patients per group) were determined using the proportion sample size estimates. Unpaired *t*-test and Chi-quare test was performed for analysis. A *p* - value of < 0.05 is considered statistically significant.

Results

Table 1: Demographic and Clinical details of the study participants

Features	Group I (*n* = 50)	Group S (*n* = 50)
Age (years)	46 ± 18*	47 ± 18
Male / Female	27/23	26/24
Height (cm)	164 ± 8	163 ± 7
Weight	60 ± 8	62 ± 10
Type of Surgery		
Wrist	1	2
Elbow	45	42
Forearm	4	6
Duration of Surgery (min)	70 ± 32*	64 ± 30

*$p < 0.05$ is statistically significant.

Shown as per Table 1 demographic and surgical features of the patients were studied. Mean age of Group I was 46 years and it was found to be statistically significant when compared with mean age of Group S. The study was male preponderance in both groups. Height and weight in both groups were nearly similar and were not significant ($p > 0.05$). Most of the upper limb surgeries included elbow. Duration of Surgery was higher using Infraclavicular plexus block and it was found to be significant ($p < 0.05$).

Table 2: Duration of Sensory and Motor Block

Duration	Group I (*n* = 50)	Group S (*n* = 50)
Sensory (min)	821 ± 170	760 ± 200
Motor (min)	820 ± 2015	772 ± 230

Shown as per Table 2 determines the duration of sensory and motor block between the groups. Duration of both sensory and motor in Group I was higher than Group S but was not to be statistically significant ($p > 0.05$).

Table 3: Quality of Block

Quality	Group I (*n* = 50)	Group S (*n* = 50)
Satisfied	48	42
Unsatisfied	2	5
Complete failure	0	3

Shown as per Table 3 satisfactory block was achieved in 96% of patients who undergone Infraclavicular plexus block which was statistically significant, while 84% are satisfied with supraclavicular perivascular block. An unsatisfactory block was reported more in supraclavicular block. While a complete failure was seen in 3 patients of Group S which was significant. ($p < 0.05$).

Table 4: Patient's Satisfaction

Level	Group I (*n* = 50)	Group S (*n* = 50)
Satisfied	48	47
Unsatisfied	2	3

According to Table 4 Ninety six percent of patients were satisfied with infraclavicular block and 94% were satisfied with supraclavicular block. More patients are unsatisfied with Group S block. There were no statistically significant differences in the level of patient's satisfaction between the groups. One patient in Group S had a pneumothorax after the block, and one patient in the Group I was unhappy with the prolonged sensory and motor block with ropivacaine.

Table 5: Side Effects and Complication due to Blocks

Side effects & Complication	Group I (*n* = 50)	Group S (*n* = 50)
Dyspnoea	2	28
Pneumothorax	0	2
Vascular Puncture	3	5
Horner Syndrome	7	7

Shown in Table 5 presents side effects and complications. No systemic reactions to the local anesthetic were reported. Horner's syndrome was observed in 7 patients in Group S (14%) and I (14%), respectively. Vascular puncture happened while performing the blocks occurred in both groups, 10% ($n = 5$) in Group S and 6% ($n = 3$) in Group

I. 28 patients from Group S versed with dyspnea that was resolved after applying 6 L of oxygen by a mask. A pneumothorax was observed in 2 patients in Group S (4%), but none in Group I. A thoracostomy tube was not traced.

Discussion

In this study, no important clinical differences were shown using neurostimulation, the supraclavicular and infraclavicular approach except for the patient satisfaction, high incidence of Horner's syndrome and the pneumothorax in 2 patients with the supraclavicular approach. A brachial plexus block could be done using several approaches. Selection of the selected approach is decided by the innervations of the site of surgery, risk of regional anesthesia complications, as well as the exposure of the anesthesiologist. Other factors which may be considered such as the reliability, rapidity and ease, patient comfort during block performance.

Compared with the axillary block, the supraclavicular approach to the brachial plexus offers a marked advantage in upper limb surgery, particularly a rapid onset of a dense block with a single injection using minimal local anesthesia.[4] However, many anesthetists do not perform this procedure for fear of causing a pneumothorax. To avoid pneumothorax, the plumb - bob technique was used as supraclavicular approach. Enough surgical analgesia in the vertical infraclavicular approach was reported by Kilka et al.[5] in 95% of patients at 30 min using 40 ml of prilocaine 1.5% and 10 ml of bupivacaine 0.5%. Neuburger et al.[6], without specifying the time of assessments, reported enough surgical anesthesia in 87% and 88% of patients. In the supraclavicular block, Franco et al.[1] reported a 97.2% success rate using the subclavian perivascular technique in 1,001 patients. Possible reasons for the lower succes rate observed in both groups include the lower volume of local anesthesia used, operator's inexperience, different local anesthetics used or the definition of success. There are no reports comparing the supraclavicular with infraclavicular method using neurostimulation. In several studies, the supraclavicular approach with the infraclavicular approach with ultrasound were compared. No significant difference in either the block performance or onset times or block efficacy was reported in Arcand et al.[7] and they compared ultrasound-guided supraclavicular with infraclavicular blocks. In contrast, Koscielniak et al.[8] reported that an ultrasound - guided infraclavicular block had a faster onset, better surgical efficacy and fewer adverse events than a supraclavicular block. Recently, Fredrickson et al.[9] compared an ultrasound - guided supraclavicular block using multiple injection with ultrasound-guided triple injection infraclavicular block. The incidence of vessel puncture was similar in both groups. None of them resulted in serious complications, such as seizures or hematoma. This might be due to the slow injection technique with repeated aspiration and the use of a traumatic needles. According to Rettig et al[10], Horner's syndrome is a clinically significant sign (100%) that predicts changes in hemidiaphragmatic movement. However, in their patients, changes in hemidiaphragmatic movement were also observed without Horner's syndrome. In this study, Horner's syndrome was observed in 7 patients in both groups respectively. When the complication rates between the supraclavicular and infraclavicular approaches are compared, an impairment in diaphragmatic movements can be rated as 100% for interscalene[11], 50% to 77% for supraclavicular[12,13], 24% to 26% for proximal infraclavicular[10], and 0% for more distal infraclavicular blocks[14,15]. This has also been reported after interscalene[16], coracoid and vertical infraclavicular blocks. The noted incidence of pneumothorax after a supraclavicular block is 0.5% to 6.1%. To reduce the risk of pneumothorax, the plumb-bob and subclavian perivascular approaches were designed. The pneumothorax risk in tall, thin patients might be reduced by initially directing the needle 45° cephalad during the supine plumb-bob technique, than directly toward the floor. This magnetic resonance imaging finding has not been confirmed clinically. The pneumothorax incidence is likely to be decreased by the operator's experience, using needles which are shorter, and taking extra care with tall, thin patients who are more likely to have high apical pleural reflections or in patients with emphysema.

Conclusion

The results of the present study, concludes that both the supra-clavicular and infra-clavicular method to the similar clinical efficacy, but the supraclavicular block caused more dyspnoea, pneumothorax and has less patient satisfaction. For hand, forearm, and/or elbow surgery, these results suggest that the infraclavicular approach might be preferable.

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Conflict of Interest: None declared.

References

1. Franco CD, Vieira ZE. 1,001 subclavian perivascular brachial plexus blocks: Success with a nerve stimulator. Reg Anesth Pain Med 2000;25:41–46.
2. Neal JM, Gerancher JC, Hebl JR, et al. Upper extremity regional anesthesia: essentials of our current understanding. Reg Anesth Pain Med. 2009;34(2):134–70.
3. Brown DL, Cahill DR, Bridenbaugh LD. Supraclavicular nerve block: Anatomic analysis of a method to prevent pneumothorax. Anesth Analg 1993 Mar;76(3):530–34.
4. Brown AR. Anesthesia for procedures of the hand and elbow. Best Pract Res Clin Anesthesiol 2002 Jun;16(2):227–46.
5. Kilka HG, Geiger P, Mehrkens HH. Infraclavicular vertical brachial plexus blockade. A new method for anesthesia of the upper extremity. An anatomical and clinical study. Anesthesist 1995;44(5):339–44.
6. Neuburger M, Kaiser H, Rembold-Schuster I, et al. Vertical infraclavicular brachial-plexus blockade. A clinical study of reliability of a new method for plexus anesthesia of the upper extremity. Anesthesist 1998;47(7):595–99.
7. Arcand G, Williams SR, Chouinard P, et al. Ultrasound-guided infraclavicular *versus* supraclavicular block. Anesth Analg 2005;101(3):886–90.
8. Koscielniak-Nielsen ZJ, Frederiksen BS, Rasmussen H, et al. A comparison of ultrasound-guided supraclavicular and infraclavicular blocks for upper extremity surgery. Acta Anesthesiol Scand 2009 May;53(5):620–26.
9. Fredrickson MJ, Patel A, Young S, Chinchanwala S. Speed of onset of 'corner pocket supraclavicular' and infraclavicular ultrasound guided brachial plexus block: a randomised observer-blinded comparison. Anaesthesia. 2009;64(7):738–44.
10. Rettig HC, Gielen MJ, Boersma E, et al. Vertical infraclavicular block of the brachial plexus: Effects on hemidiaphragmatic movement and ventilatory function. Reg Anesth Pain Med 2005 Nov-Dec;30(6):529–35.
11. Urmey WF, Talts KH, Sharrock NE. One hundred percent incidence of hemidiaphragmatic paresis associated with interscalene brachial plexus anesthesia as diagnosed by ultrasonography. Anesth Analg 1991 Apr;72(4):498–503.
12. Neal JM, Moore JM, Kopacz DJ, et al. Quantitative analysis of respiratory, motor, and sensory function after supraclavicular block. Anesth Analg. 1998;86(6):1239–44.
13. Mak PH, Irwin MG, Ooi CG, et al. Incidence of diaphragmatic paralysis following supraclavicular brachial plexus block and its effect on pulmonary function. Anesthesia 2001;56(4):352–56.
14. Rodriguez J, Barcena M, Rodriguez V, et al. Infraclavicular brachial plexus block effects on respiratory function and extent of the block. Reg Anesth Pain Med 1998 Nov-Dec;23(6):564–68.
15. Dullenkopf A, Blumenthal S, Theodorou P, et al. Diaphragmatic excursion and respiratory function after the modified Raj technique of the infraclavicular plexus block. Reg Anesth Pain Med 2004;29(2):110–14.
16. Borgeat A, Ekatodramis G, Kalberer F, et al. Acute and nonacute complications associated with interscalene block and shoulder surgery: A prospective study. Anesthesiology 2001 Oct;95(4):875–80.