Original Research Article

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Retroclavicular Versus Classical Approach for Infraclavicular Brachial Plexus Block Under Dual Guidance: A Randomised Clinical Study

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Abstract

Introduction: Infraclavicular brachial plexus can be blocked by various approaches like classical infraclavicular(CIB), retroclavicular (RCB), parasagittal and pericoracoid. In our study we compared novel RCB approach with CIB approach using dual guidance of ultrasound and peripheral nerve locator. *Methodology:* In this prospective, randomised trial, 60 patients were randomly allocated in to two groups CIB (n=30) and RCB (n=30). In the CIB approach, the needle is inserted 2 cm medial and 2 cm inferior to the coracoid process and directed from ventral to dorsal. In RCB approach, the needle insertion point was found by palpating the supraclavicular fossa, just medial to the shoulder at a point sufficiently posterior to the clavicle and the needle was advanced from cephalad to caudal and block was given with 0.5% ropivacaine injection in the both groups. The primary aim of our study was to compare needle visualization and needling time and secondary outcomes studied were clinical success rate of block, onset and duration of sensory block and motor block, and patient satisfaction between CIB and RCB groups. *Results:* Needle visibility score in RCB was 4.8276 and in CIB 3.0714 which was significantly better in retroclavicular group (p=0.0453) and needling time in RCB was 2.8 mins and in CIB 4.67 which was lesser when compared to classical approach group (p=0.030). There were no statistically significant differences between the two groups in terms of sensory or motor block success, surgical success, patient satisfaction and complication rate. *Conclusion:* The flat needle angle, needle visibility, and needling time was better in RCB in comparison with CIB. Hence we conclude that RCB can be considered as a better alternative to CIB approach. Further study in a larger patient population is needed to evaluate if utilizing the retroclavicular approach results in improved efficacy, increased safety, and more rapid acquisition of skill for novice regional anaesthetists.

Keywords: Brachial Plexus; Retroclavicular; Infraclavicular; Ultrasonography; Nerve Stimulator.

Introduction

Infraclavicular brachial plexus block is used to perform forearm and wrist surgeries. ICB was introduced in early 20th century as an alternative to axillary and supraclavicular approaches [1]. Several approaches for ICB have been published in literature till now like classical approach, parasagittal and pericoracoid approaches. However, this was not utilised despite its advantages of less complications and more consistent block until Raj et al. introduced this in 1973 [2]. But Raj's technique could also not gain widespread use probably due to unreliable results [3] and and lack of precision in needle placement [4]. Although the infraclavicular block has a success rate similar to axillary or supraclavicular approaches [5-8] needle visibility can be difficult [5], even with echogenic needles, potentially increasing needling time. Superficially and at a distance from the neurovascular bundle, visibility is good, but image attenuation at critical structures as approached may degrade the view. Among the several infraclavicular approaches, classical infraclavicular block (CIB) approach is generally

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preferred. But the needle visibility remains a challenge in classical approach since it requires a steep angle between ultrasound beam and needle shaft [9].

In novel retroclavicular block (RCB) the needle insertion point is posterior to the clavicle instead of inferior to it. This allows an almost perpendicular alignment of the ultrasound (US) beam and needle shaft. This approach has proven to be effective as the needle visibility is enhanced because the angle of incidence of the US beam which is a major determinant of reflection [9,10].

Due to less published data on the novel RCB approach we undertook this study which delineates retroclavicular approach with dual guidance of ultrasound and peripheral nerve locator.

The primary aim of our study was to compare needle visualization and needling time and secondary outcomes studied were clinical success rate of block, onset and duration of sensory block and motor block, and patient satisfaction between (CIB) and (RCB) groups.

Methods

After obtaining ethics committee approval and written informed consent, 60 patients undergoing surgery of the forearm, wrist or hand were prospectively enrolled and randomisation was done based on computer generated random table method.

Inclusion criteria were age between 18 and 80 years, American Society of Anesthesiologists (ASA) physical status I to II. And exclusion criteria were abnormal anatomy, infection, coagulopathy, pregnant patients, severe pulmonary disease, preexisting neurological symptoms in the operated arm patients weighing less than 50 kgs, allergy to amide type local anesthetics.

After arrival in the induction room, an 18 or 20 gauge intravenous catheter was placed in the upper limb contralateral to the surgical site, and intravenous premedication (0.03 mg/kg of midazolam and 0.6 mcg/kg of fentanyl) was administered to all patients. Supplemental oxygen (by nasal cannulae at 4 L/min) and standard ASA monitors were applied throughout the procedure.

The nerve block was performed by only one expert anaesthesiologist who had performed US guided RCB and CIB approach 50 times or more.

The patients were put in a supine position. In CIB, arm was abducted at 90° and externally rotated and with their elbows bent at 45° towards arm.

The location of the cord and axillary artery was identified using GE machine LOGIQ-E with high frequency linear probe with 7-11 MHZ. The 38 mm linear probe was covered with Tegaderm® (3M, St. Paul, MN, USA) and positioned across parasagittally just medial to the coracoid process and caudal from the clavicle to allow for visualisation of the cords and the axillary artery in the short axis and puncture site is above the midpoint of clavicle and needle was advanced with a 45-60 degree angle from ventral to dorsal (Figure 1). In the RCB approach, the arm positioned was in adducted position and puncture site was medial to the shoulder at a point sufficiently posterior to the clavicle and the needle entry was from cephalad to caudal (Figure 2). The block was performed under aseptic precautions with the in plane technique using a 22 gauge, 50 mm needle (Stimuplex®, B. Braun, Melsungen, Germany) connected to a syringe containing 0.5% ropivacaine. The end point was posterior cord response (finger and wrist extension) response obtained at 0.2-0.3ma. After local anaesthetic injection through the needle, measurements of brachial plexus blockade and vital parameters were carried out every 2 min until 30 min by another anaesthesiologist who was blinded to the study. Sensory blockade of the musculocutaneous, median, radial and ulnar nerves was graded according to a 3 point scale using pin prick test: 0 = sharp pin sensation felt, 1 = analgesia (dull sensation felt), or 2 = anaesthesia (no sensation felt). Sensory blockade of the musculocutaneous, median, radial and ulnar nerves was assessed in the corresponding dermatomal areas. After the completion of the block procedure, sensory onset was considered when there was dull sensation to pin prick (Grade 1) along the distribution of any of the above mentioned nerves. The duration of sensory block was defined as the time interval between the end of LA administration and the complete resolution of anaesthesia on all nerves. Motor blockade assessment was based on the modified Bromage scale for upper extremities on a 3 point scale [11,12]. Grade 0 = normal motor function with full extension of elbow, wrist and fingers, Grade 1 = decrease motor strength with ability to move fingers and/or wrist only and Grade 2= complete motor blockade with inability to move fingers.

Onset of motor blockade was considered when there was Grade 1 motor blockade after completion of block procedure. Peak motor block was considered when there was Grade 2 motor blockade. The duration of motor block was defined as the time interval between the end of LA administration and

the recovery of complete motor function of the hand and forearm. In our study needle visibility was assessed by using 5-point Likert scale (1 = very poor, 2 = poor, 3 = fair, 4 = good, 5 = very good) [12]. Needling time was defined as the time from the beginning of skin anaesthesia until the end of injection of local anaesthesia [12].

Patient satisfaction was assessed by using 7-point Likert satisfaction scale [13].

1. Extremely dissatisfied,
2. Dissatisfied,
3. Somewhat dissatisfied,
4. Undecided,
5. Somewhat satisfied,
6. Satisfied,
7. Extremely satisfied.

Sample size was calculated based on pilot study results. Based on the proportion of failure rates in classical approach group, at 95% confidence interval and 80% of power of study the calculated sample size 28 in each group, but we considered 30 in classical and 30 retroclavicular group to compensate the dropouts. Statistical analysis was done using SPSS software 20.0. Data obtained was tabulated in the excel sheet and analysed. All values are expressed as mean ± standard deviation. Chi-square test for proportions in qualitative data. Student's unpaired t – test for quantitative data.

$P < 0.05$ was considered statistically.

Results

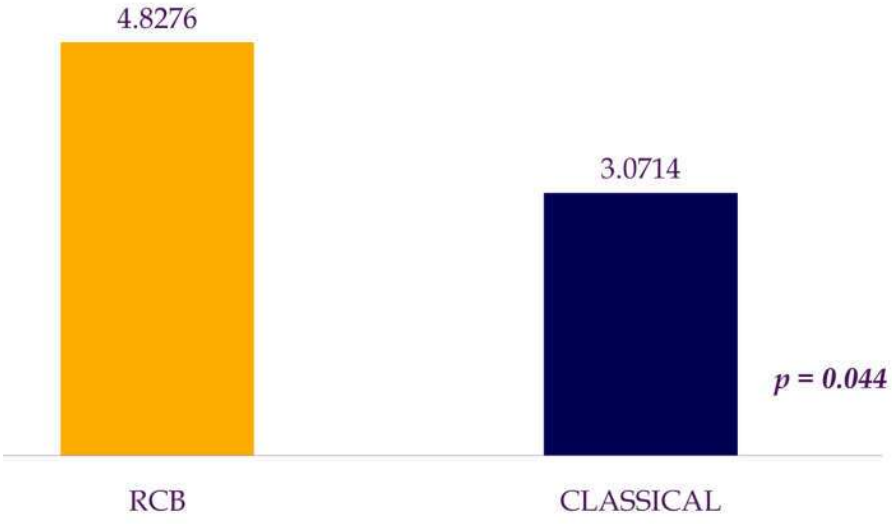
Patient demographics and baseline clinical characteristics were similar across the two groups, including the types of surgical procedures performed.

In CIB group, there were 18 male patients and 12 female patients and in RCB group there were 19 male and 11 female patients. Both groups had predominantly male population. The average age of the patients was 38.00±18.23 years in CIB group and 38.32±15.48 years in RCB group. The average weight of the patients was 69.43±5.57 kg in CIB group and 70.03±7.37 kg in RCB group. There were no significant differences in weight and age between two groups.

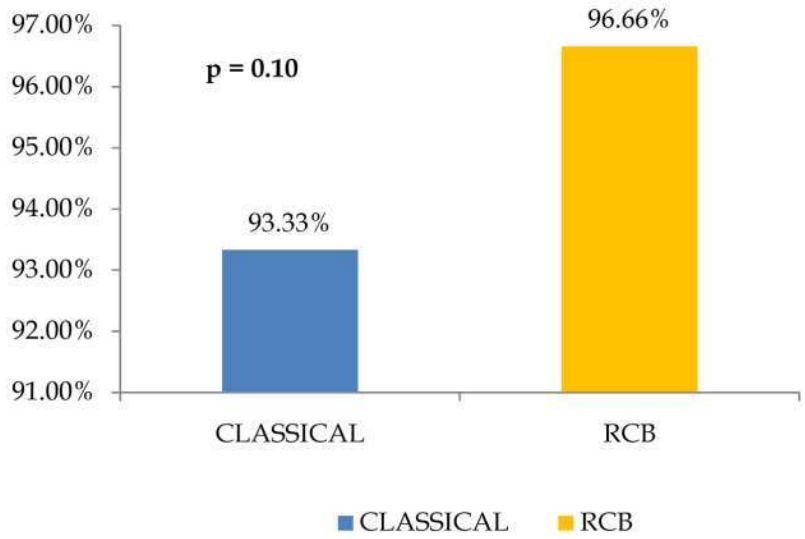
Table 1: Patient Characteristics

	Classical	Retroclavicular	p- Value
Age	38.00±18.229	38.32±15.480	0.138 (NS)
Gender (M /F)	18/12	19/11	0.74 (NS)
Weight	69.43±5.567	70.03±7.365	0.061(NS)

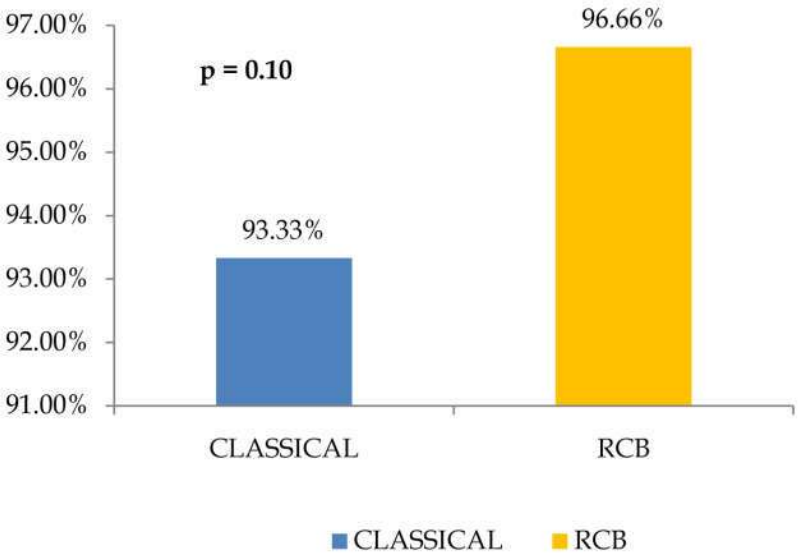
Needle visibility score in RCB was 4.8276 and in CIB 3.0714, thus needle visibility was better in RCB compared to CIB which was statistically significant (0.044). (Graph 1) and also needling time in RCB was 2.8 mins and in CIB 4.67mins, thus needling time was earlier in RCB compared to CIB which was statistically significant (0.030) (Graph 2) No other adverse events were noted in either groups.



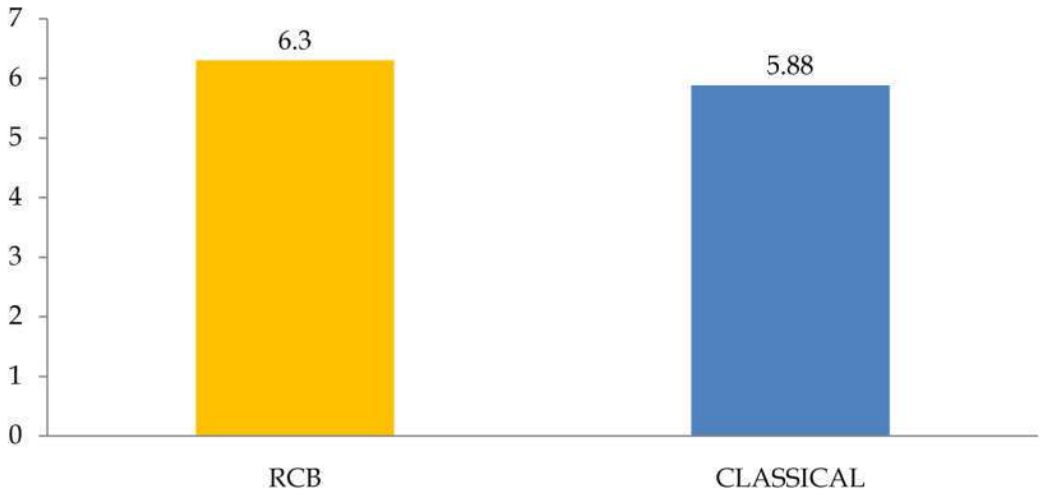
Graph 1: Graph showing needle visibility score



Graph 2: Graph showing needling time



Graph 3: Percentage of success rate



Graph 4: Mean patient satisfaction score

No significant difference was observed in parameters like success rate, (Graph 3) patient satisfaction score (Graph 4) in both CIB and RCB groups which statistically insignificant (p>0.05) in our study The mean time for onset of sensory block in CIB group was 8.14±1.079 min and in RCB group was 8.07±0.651 min. The mean time for onset of motor block in CIB group was 14.93±1.844 min and in RCB group was 14.62±2.077 min. (Graph 5). The mean duration of sensory block in CIB group was 976.79±74.352 min and in RCB group was 981.38±76.239 min. The mean duration of motor block in CIB group was 872.14±81.154 min and in RCB group was 894.31±82.880 min. (Graph 6).

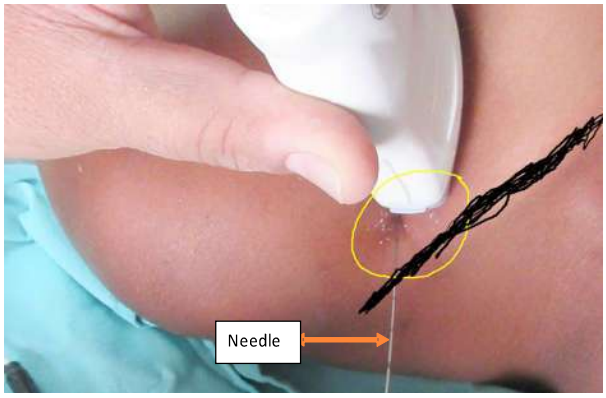


Fig. 1: Showing parasagital placement of the needle medial to the coracoid process and inferior to the clavicle and angle of needle advancement at 45 to 60 degree

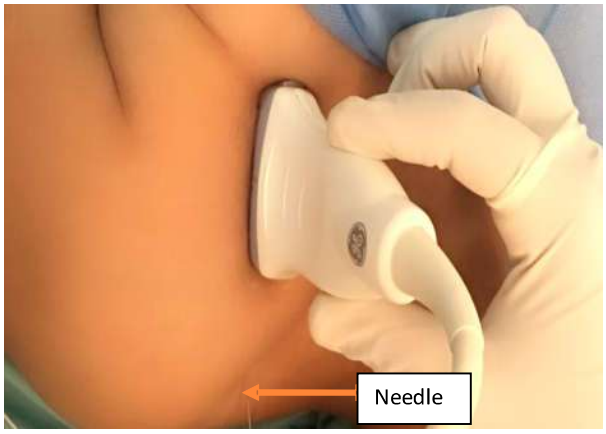


Fig. 2: Showing parasagital placement of the needle medial to the Shoulder and posterior to the clavicle and angle of needle advancement is perpendicular to clavicle

Discussion

Infraclavicular brachial plexus block can be achieved by various approaches. In present study we compared classical infraclavicular approach with retroclavicular approach due to paucity of published data on retroclavicular approach.

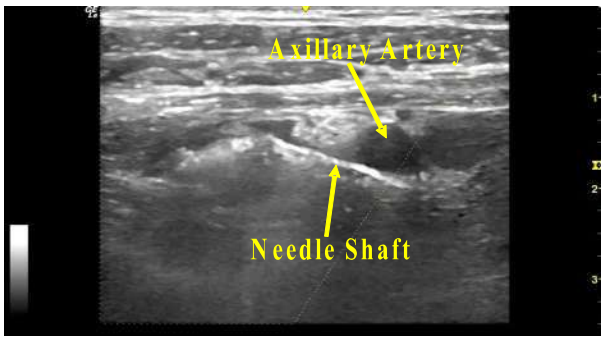


Fig. 3: A transverse sonogram showing the axillary artery and needle shaft in CIB and angle of needle shaft is noted to be at 45 to 60 degree

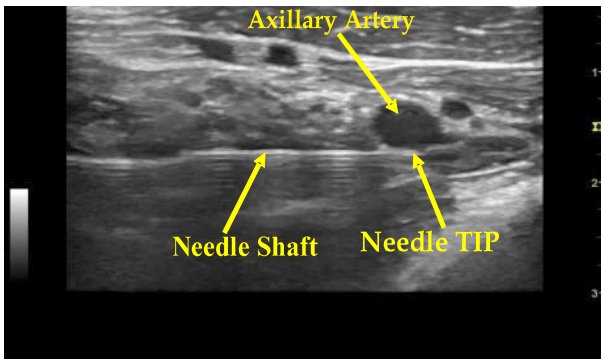


Fig. 4: A transverse sonogram showing the axillary artery and needle shaft in RCB and angle of needle shaft is noted to be perpendicular

A study by Jasmin Charbonneau et al. suggested the notable advantage of the retroclavicular approach lies in the perpendicular alignment of the US beam and the needle, as reflected by the high visibility scores obtained for the shaft and tip (Figure 3,4). Good visibility thus, theoretically, provides a safer technique and a quicker needling time.

The primary objectives, needle visibility scores and needling time was better in RCB group then CIB group which was comparable to the study by Nilgun at al. In our study no statistically significant differences were found in patient characteristics between two groups. Similarly there were no statistically significant differences were found in onset and duration of sensory and motor blocks in both groups.

We also noted there were no statistically significant difference between two groups in patient satisfaction and success rate of which P value obtained is P=0.08 and P=0.10 respectively. We did

not encounter any events of vascular puncture in our study. It might be because of extreme caution and attention given to every detail in order to avoid intravascular injection or damaging the nerve. We always made sure that the needle tip was clearly visible through out the procedure. The incidence of convulsions and paraesthesia was nil in both the groups. Vital parameters, such as pulse rate, systolic blood pressure, diastolic blood pressure and saturation values, were similar in both the groups. No patients in either group required any interventions, rescue analgesics.

Limitations of our study are, smaller sample size, blinding could not be done, study results may not be extrapolated to obese patients. Further study in a larger patient population is needed to evaluate if utilizing the retroclavicular results in improved efficacy, increased safety and more rapid acquisition of skill for novice regional anaesthetists.

Conclusion

The flat needle angle, distance from critical neck and thoracic structures, comprehensive upper extremity anaesthesia and minimal manipulation of the injured upper extremity are clear benefits of the retroclavicular approach. Our initial experience suggests that the retroclavicular is technically feasible and safe alternative to classical approach.

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