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Ultrasound-Guided Retroclavicular Approach to Infraclavicular Block: Reducing Complications and Improving Needle Visibility - A Case Series

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ABSTRACT

Background: Ultrasound-guided Retroclavicular Infraclavicular block (RCB) offers improved needle visualization and may enhance safety compared to traditional approaches.

Methods: This case series included patients undergoing upper limb orthopedic surgeries under ultrasound-guided RCB. Block onset, duration, and adequacy of anesthesia were assessed. Patients were monitored for 24 hours for analgesic requirements, complications, and satisfaction. Rescue analgesia (tramadol 50 mg IV) was given for NRS > 4.

Results: All patients achieved effective surgical anesthesia with high satisfaction scores. Sensory and motor blocks had rapid onset and provided excellent intraoperative conditions. Needle visibility was consistently good, leading to shorter performance times and fewer needle passes. No major complications, such as vascular puncture, local anesthetic toxicity, or pneumothorax, occurred. Minor transient paraesthesia resolved without intervention.

Conclusion: Ultrasound-guided RCB is a safe, effective, and patient-friendly technique for upper limb surgeries, combining high success with excellent visualization and low complication rates

Key words: Ultrasound-guided block, Retroclavicular approach, Infraclavicular brachial plexus block, Upper limb surgery, regional anaesthesia, Needle visibility

INTRODUCTION

Regional anaesthesia is preferred over general anaesthesia for upper limb surgeries as it provides intraoperative and postoperative analgesia, maintains haemodynamic stability, avoids airway-related complications, and reduces opioid requirements along with their side effects. (1) Several brachial plexus block techniques are described for upper limb procedures, including supraclavicular, infraclavicular, and axillary approaches. (2) The interscalene block carries a high incidence of phrenic nerve palsy, while the supraclavicular block is associated with an increased risk of pneumothorax. The infraclavicular block (ICB) is therefore often preferred due to its lower complication rate.

The coracoid approach to ICB is commonly employed, particularly for distal upper limb surgeries. However, this technique has limitations, such as poor needle visibility caused by the steep angle between the needle and the ultrasound probe. To address these issues, the retro clavicular approach to the perivascular technique of the infraclavicular region (RAPTIR/retro clavicular block, RCB) was introduced.

In the retro clavicular approach, the needle is inserted through the supraclavicular fossa, posterior to the clavicle, and advanced in-plane in a paramedian sagittal plane, cephalocaudally, until the tip lies posterior to the axillary artery. (3) This entry point provides near-perpendicular alignment of the needle with the ultrasound beam while targeting the same anatomical endpoint as ICB.

Studies have demonstrated that RCB offers superior needle visibility, with procedure time comparable to ICB, and ensures equivalent block quality and success rates. (4)

We present a case series of ultrasound-guided retroclavicular blocks performed for orthopaedic upper limb surgeries.

CASES

List of cases with their details in whom we planned to give retroclavicular block are given in table 1.

Table 1: Characteristics of 10 patients.

Case	Age (years)/ Sex	Diagnosis	Procedure planned	Comorbidities	Preoperative blood investigations	ECG	X-ray chest	ASA status
1	45/Female	Open fracture mid shaft both bone forearm right side	Open reduction internal fixation (ORIF) and plating	NIL	Normal	Normal	Normal	I
2	70/Female	Closed fracture distal end radius right side	Closed reduction internal fixation (CRIF)by nailing	Hypertension, on anti-hypertensive drugs	Normal	Normal	Normal	II
3	24/ male	Fracture distal end radius left side	CRIF by plating	NIL	Normal	Normal	Normal	I
4	26/ male	Closed fracture midshaft ulna right side	ORIF by ulnar plating	NIL	Normal	Normal	Normal	I
5	16/male	Closed fracture distal end radius with closed fracture ulna styloid left side	ORIF by plating followed by K wire fixation of styloid	NIL	Normal	Normal	Normal	I
6	22/male	Closed fracture intra articular distal end radius with ulnar injury	Tension band wiring	NIL	Normal	Normal	Normal	I
7	15/female	Closed fracture distal end radius right side	ORIF by plating	NIL	Normal	Normal	Normal	I
8	15/ male	Closed fracture both bone fore arm left side	ORIF by plating	NIL	Normal	Normal	Normal	I
9	19 /male	Closed fracture distal end radius left side	CRIF by K wire	NIL	Normal	Normal	Normal	I
10	24/ male	Closed fracture distal end radius right side	ORIF by K wire	NIL	Normal	Normal	Normal	I

PROCEDURE

Written informed consent was obtained from all patients after explaining the procedure. As it is a case series, we did not require ethical clearance from our institution. Procedure was explained to all the patients beforehand. Standard monitoring, including pulse oximetry, electrocardiography, and non-invasive blood pressure, was applied, and an intravenous line was secured. All patients received intravenous midazolam 2 mg and fentanyl 50 µg for sedation and analgesia. Supplemental oxygen was administered via face mask at 5 L/min.

Patients were positioned supine in a semi-sitting posture with the head turned 45° to the contralateral side and the ipsilateral arm adducted alongside the body. The needle insertion site was prepared with betadine. Under strict aseptic precautions, a high-frequency linear ultrasound probe was placed below and perpendicular to the clavicle in a paramedian sagittal plane, medial to the coracoid process, to obtain a short-axis view of the brachial plexus cords and axillary vessels.

The needle was introduced through the supraclavicular fossa, approximately 1 cm posterior to the clavicle, and advanced in-plane, parallel to the ultrasound transducer. Continuous visualization of the needle tip was maintained until it was positioned posterior to the axillary artery. A total of 12 ml of 0.5% isobaric levobupivacaine was then administered.

Following the block, sensory and motor function were assessed at 5-minute intervals for 30 minutes.

Block Assessment

- **Sensory block:** Assessed at 10, 20, and 30 minutes in the territories of the radial (lateral dorsum of hand), median (volar index finger), ulnar (volar fifth finger), musculocutaneous (lateral forearm), and medial cutaneous (medial forearm) nerves. Sensory response to pinprick was graded on a 3-point scale: *0 = normal, 1 = hypoesthesia, 2 = analgesia*. The total (maximum 10) was recorded as the sensory score.
- **Motor block:** Assessed at the same intervals for radial (wrist extension), median (thumb–little finger opposition), ulnar (fifth finger abduction), and musculocutaneous (elbow flexion) nerves. Motor function was graded on a 3-point scale: *0 = normal, 1 = weakness, 2 = paralysis*. The total (maximum 8) was recorded as the motor score.
- All assessments were performed by an independent, blinded observer. A minimum sensory score of 9/10 at 30 minutes was considered adequate for surgery. Patients with scores <9/10 at 30 minutes received supplemental blocks or general anaesthesia.
- In the event of block failure, the procedure was not repeated, and surgery proceeded under general anaesthesia. (5)

Outcomes

- The primary outcomes included onset of block, defined as the time from the last injection to the appearance of diminished response to pinch and motor weakness; duration of sensory block, defined as the interval from local anaesthetic injection to complete recovery of sensation in the upper limb; and duration of motor block, defined as the interval from local anaesthetic injection to complete recovery of motor function in the arm. Time required to perform the block was also recorded, which comprised imaging, marking, preparation, draping, needle insertion, and drug injection. Imaging time was measured as the interval between the placement of the ultrasound probe on the skin and acquisition of an adequate image, while needling time was defined as the interval from creation of the skin wheal to removal of the needle after injection.
- The secondary outcomes included the incidence of paraesthesia and vascular puncture, as well as postoperative pain assessment using the Visual Analogue scale (VAS, 0–10) at 2, 4, 6, 8, 12, and 24

hours after surgery. Patient satisfaction was recorded on an Numeric Rating Scale out of 10. Needle visibility was assessed from video recordings of each procedure, which were reviewed independently by two experienced anaesthesiologists and rated on a 5-point Likert scale (1 = very poor, 5 = very good); each procedure was evaluated twice. The number of needle passes, defined as the number of times the needle required realignment on the skin to reach its final target position beneath the axillary artery, was also noted.

- Complications, both early and late, were documented. These included paraesthesia, vascular puncture, Horner's syndrome, dyspnoea, and signs of local anaesthetic toxicity. All patients were contacted 48 hours after surgery to enquire about delayed complications such as persistent dyspnoea, paraesthesia, weakness, pain at the puncture site, or haematoma.

Table 2: Clinical outcomes of the 10 patients.

Case	Onset of sensory block (minutes)	Onset of motor block (minutes)	Duration of sensory block (hours)	Duration of motor block (hours)	Block performance time (minutes)	Needle visualization	Number of block needle passes	Patient satisfaction score
1	6	10	4	3	10	5	2	9
2	5	10	4	3	8	5	1	10
3	8	15	3.5	2.5	8	5	1	10
4	6	10	3	2.5	10	4	1	9
5	8	12	4	3	10	5	2	10
6	8	10	4	3.5	10	4	1	9
7	6	10	3.5	3	8	5	1	9
8	5	10	4.5	3.5	10	4	2	10
9	5	8	3.5	3	10	5	1	10
10	6	8	4	3	8	5	1	10

Table 3: Postoperative VAS scores in 10 patients.

Case	VAS 2hrs	4 hrs	6hrs	8hrs	12 hrs	24hrs
1	1	2	3	4	3	3
2	1	2	3	4	3	3
3	1	2	2	3	3	2
4	2	3	4	4	3	3
5	1	2	3	3	3	2
6	2	2	3	3	3	2
7	1	2	3	3	3	3
8	1	2	2	3	2	2
9	1	2	2	3	3	2
10	1	2	1	2	2	2

If VAS score exceeded 4, rescue analgesia was provided with intravenous tramadol 50 mg. All patients were followed for 24 hours postoperatively, either through direct hospital visits or telephone contact at home. No immediate block-related complications were observed, and none of the patients' developed signs or symptoms suggestive of local anaesthetic toxicity.

DISCUSSION

In this case series, we found that the retroclavicular approach provided a high success rate with good patient satisfaction.

The mean onset time for sensory and motor block was 6.3 minutes and 10.3 minutes, respectively, while the mean duration of sensory and motor block was 3.5 hours and 3 hours respectively. The mean block performance time was 9.2 minutes.

Our findings are consistent with those of Grape et al., who demonstrated that ultrasound-guided retroclavicular and supraclavicular brachial plexus blocks provide comparable success rates and similar analgesic efficacy.(5) In our series, needle visualization was consistently good, in line with the study by Andrés Felipe Gil Blanco, who reported that retroclavicular block (RCB) achieved >1 point higher visibility scores compared to infraclavicular block (ICB) on a Likert scale.(4) Improved needle visibility in our study also translated into reduced performance time, as similarly observed by Chin et al., who noted that enhanced visibility contributes to a safer technique and faster needling time.(6)

We observed a low incidence of complications, consistent with the findings of Kavrut Ozturk et al., who reported a 5.7% incidence of paraesthesia with RCB, lower than that described in the literature for ICB. (7) The higher arterial puncture rates associated with ICB have been attributed to poor needle visibility inherent to the technique and the time pressure to complete the block, which may compromise safety. Supporting our results, Luftig et al. also concluded that the retroclavicular approach offers superior needle tip and shaft visibility, shorter block performance and anaesthesia-related times, fewer paraesthesia, and fewer needle passes compared with the coracoid approach, further suggesting that RCB may be particularly useful in emergency settings due to its simplicity, safety, and efficacy. (8)

Similarly, Sancheti et al. highlighted that RCB was specifically designed to overcome the limitations of the commonly performed parasagittal infraclavicular approach.(9) Our injection technique involved deposition of local anaesthetic in a proportion of 25% at the 5 o'clock position (medial cord), 50% at the 6 o'clock position (posterior cord), and 25% at the 7 o'clock position (lateral cord), as described by Uppal et al.(10) Superior needle visibility may allow more precise deposition of local anaesthetic around target nerves, thereby optimizing spread and potentially reducing drug volume requirements. Supporting this, Kavakli et al. demonstrated that the MEV50 of bupivacaine 0.5% for ultrasound-guided RCB is only 9.6 mL. (11) Furthermore, Georgiadis et al. reported that RCB is significantly less likely to impair ipsilateral diaphragmatic function compared with supraclavicular block. (12)

Taken together, our findings and the supporting literature suggest that RCB provides reliable block success, better needle visibility, shorter performance time, fewer complications, and greater patient satisfaction compared with traditional approaches. Nevertheless, large-scale randomized controlled trials will be required to definitively establish the superiority of this technique.

CONCLUSION

Ultrasound-guided Retroclavicular block offers a high success rate, rapid onset, low incidence of complications, and excellent analgesia, even with tourniquet application. The technique is well tolerated by patients. Although the cost of an ultrasound device may be a limiting factor, it constitutes a one-time capital investment that can become cost-effective when amortized across multiple procedures, particularly when accounting for the time saved per block.

Main Points:

1. **High Efficacy:** The retroclavicular approach achieved a high success rate with rapid onset and effective anaesthesia.
2. **Superior Needle Visibility:** Excellent needle visualization improved accuracy, reduced performance time, and enhanced safety.
3. **Low Complication Profile:** The incidence of paraesthesia and vascular

puncture was minimal compared to infraclavicular techniques.

4. **Efficient Anaesthetic Use:** Precise drug deposition allowed effective spread of local anaesthetic with potentially lower volume requirements.
5. **Safe, Practical, and Cost-Effective:** The technique is well tolerated, suitable even with tourniquet use, and becomes cost-effective when ultrasound use is optimized across multiple procedures.

Declaration by Authors

Ethical Approval: Not required as it is a case series

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Conflict of Interest: The authors declare no conflict of interest.

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