Randomized Trial

Ultrasound-guided Retroclavicular Approach Versus Costoclavicular Approach of Infraclavicular Brachial Plexus Block for Upper Limb Surgeries

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Background: Regional anesthesia for an upper limb provides many advantages over general anesthesia, especially in orthopedic surgery.

Objectives: This trial aimed to compare a retroclavicular approach to the infraclavicular brachial plexus with a costoclavicular approach in term of needle time, image time, and procedure time, and comparing both with the classic technique for upper limb surgeries guided by ultrasound.

Study design: Prospective, randomized, single-blinded controlled trial.

Setting: Minia University, Faculty of Medicine, Anesthesia and Intensive Care Department.

Methods: Sixty patients of both sees with an American Society of Anesthesiologists Classification of I and II, a BMI (kg/m^2) of 20-35, aged from 18-60 years who were scheduled for a forearm or hand surgery under infraclavicular brachial plexus block were divided into 3 parallel equal groups. Group I (RC) received a retroclavicular approach. Group II (CC)received a costoclavicular approach. Group III (CT) received the classic technique. Procedure time, the sum of the imaging and needling times, was our primary outcome. Secondary outcomes were the motor and sensory block success rate 30 minutes postinjection of local anesthesia, duration of motor and sensory block, Visual Analog Score, first analgesic need, total analgesia requirements during the first postoperative 24 hours, and any complications.

Results: The procedure and needle times were significantly decreased in the retroclavicular group due to better needle visibility. There was no significant difference regarding sensory and motor block data. The VAS score in the first postoperative 24 hours showed no statistical significance. Regarding analgesic data and patient satisfaction, there was no statistical significance among the 3 studied groups. There were no complications in any of the used approaches.

Limitation: Our trial did not include patients with a BMI > 35.

Conclusions: The retroclavicular approach is superior because of its decreased procedure time and needle time than both the costoclavicular approach and classic approach.

Key words: Retroclavicular, costoclavicular, infraclavicular brachial plexus block, upper limb surgery

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Regional anesthesia for upper limb surgery provides many advantages over general anesthesia, especially in orthopedic surgery. The most important of them is the control of postoperative pain, which results in decreased postoperative opioid requirements and the patient's recovery time (1).

The infraclavicular brachial plexus block (IBPB) was first described by Bazy in 1914 and modified in 1973 by Raj (2). Since then, different approaches to infraclavicular IBPB have been described, using multiple surface landmarks, needle insertions points, and directions (3).

The most popular approach by this landmark tech-

nique is the coracoid approach, as the insertion point is 2 cm medial and inferior to the process. Ultrasound facilitates visualization of the cords around the axillary artery and injection of the local anesthetic around it, but it is difficult to visualize the entire needle length due to the deep position of the cords (4.5–7.5 cm) in this region (4).

The retroclavicular approach was first described by Hebbard and Royse in 2007 (5). The needle insertion point is posterior to the clavicle and directed in a cephalocaudad direction. This allows perfect visualization of the needle as the ultrasound beam becomes perpendicular to the needle shaft. This approach might reduce the chance of trauma to the lateral cord and acromial artery since the needle position is posterior to these structures (6).

The costoclavicular (CC) approach became an alternative to the infraclavicular approach for surgery below the elbow. It is an effective and easily performed technique, since the brachial plexus structures in this space are more superficial, and lateral to the vascular structures. This technique consists of an ultrasound-guided single in plane needle placement. It is considered to be an easy and safe technique since it is possible to see the entire needle pathway with a single skin puncture (7).

In our trial we compared the retroclavicular approach with the costoclavicular approach for an IBPB in terms of needle visibility, and compared both with the classic technique for upper limb surgeries. Our primary outcome was procedure time, which is the sum of the imaging and needling times. Imaging time is defined as the time from probe placement to needle insertion). Needle time is defined as the time from needle insertion through the skin wheal until the end of local anesthetic injection). Secondary outcomes were the motor and sensory block success rate 30 minutes postinjection of local anesthesia, duration of motor and sensory block, Visual Analog Score (VAS), first analgesic request, and total analgesia consumption during the first postoperative 24 hours, and any complications.

Methods

After obtaining Ethical Committee approval number 53:2021 from our faculty and written informed consent from the patients, and a registration number at clinicaltrials.gov (NCT05240729), this prospective, randomized controlled trial was conducted with 69 adult patients of both genders, 18- 60 years of age, who had an American Society of Anesthesiologists Classification of either I or II, a body mass index (BMI) from 20 to 35 kg/m^2, who were scheduled for a forearm or hand surgery from May 2021 through June 2022 receiving an IBPB.

Exclusion Criteria

Patients with an anatomical abnormality in the clavicular region, preexisting neuropathy or coagulopathy, allergic to local anesthetic, or who had a local infection were excluded from our trial. Pregnancy and those who refused to participate were also excluded.

Sample Size Calculation

Before the trial, the number of patients required in each group was determined after a power calculation according to data obtained from a previous trial (8). In that trial, the percentage of patients who had complete sensory block at 20 minutes with a lateral sagittal approach was 0%; with a CC approach it was 30%. A sample size of 20 patients in each group was determined to provide 80% power for Fisher's exact test at the level of 0.05 significance using G* Power 3.1 9.2 software (Heinrich Heine University). For our trial, a third group receiving the classic approach was added with the same number. We increased the sample size to 69 to accommodate any dropouts.

Preoperative Assessment:

A careful history was taken for any medical problems or drug taking, especially anticoagulants. A complete physical examination was done including the central nervous system, chest, heart, and site of injection examination. Routine investigations were done, especially a complete blood count and coagulation profile. All patients were trained on how to use the VAS. The patients were asked to fast for 8 hours for solid foods and 2 hours for clear fluids before their operation.

Randomization and Blinding

Randomization was done by the aid of a computer-generated randomization table. Opaque sealed envelopes were used, which were only accessed by a research assistant. Only the investigator who collected the data in the postoperative period was blinded to the technique used since it was impossible that the patient and the anesthesiologist who performed the block be blinded.

According to the techniques used, 69 patients were randomly allocated into 3 parallel, equal groups (23 patients in each group). In Group I (retroclavicular [RC] group), patients received the retroclavicular ap-

proach for IPBP. In Group II (costoclavicular [CC] group), patients received the costoclavicular approach for IPBP. Group III (CT [classic technique] group), patients received the classic technique for IPBP.

Block Performance

All blocks were initiated in a separate block room under complete aseptic conditions. Routine monitors such as electrocardiogram, pulse oximetry, and noninvasive arterial blood pressure monitors were applied. A peripheral intravenous line was secured. Subcutaneous infiltration by 3-5 mL lidocaine 2% prior to initiation of the block was performed with further supplements as necessary. All patients received a total of 35-40 mL of 0.5% bupivacaine delivered in aliquots. Complications such as vascular puncture and paresthesia during needle placement were documented.

In Group I (RC): The patient was placed supine, head facing the contralateral side. A high-frequency 13-6 MHz linear array transducer probe (Sonosite M-Turbo) was placed medial to the coracoid process below and perpendicular to the clavicle to obtain a short-axis view of the cords of the brachial plexus and the axillary vessels. A 90 mm Turkish needle was inserted in the supraclavicular fossa, approximately one cm posteriorly to the clavicle, and advanced in plane parallel to the probe. After passing the initial blind zone of about 2 cm caused by the clavicle's acoustic shadow, the needle tip was continuously seen, until it appeared posterior to the axillary artery. A single injection of the local anesthetic was performed without needle repositioning unless paresthesia was elicited.

In Group II (CC): The patient was positioned supine, with the surgical arm abducted (Fig. 1). A soft padding (jelly pad) was placed in the interscapular area, and the head was turned slightly to the opposite side. An ultrasound-guided approach as described by Karmakar, et al (9) was used. The ultrasound transducer was placed parallel and below the middle part of the clavicle where the 3 cords of the plexus appeared lateral to the axillary artery and vein. The block needle was inserted in-plane from a lateral to medial direction and the entire local anesthetic was injected in this location.

In Group III (CT): The patient was supine with the head turned to the contralateral side (Fig. 2). The arm was abducted to 90° and the elbow flexed. The probe was placed parasagittally medial to the coracoid process and caudal to the clavicle. The needle was inserted using an in-plane technique cephalad to the ultrasound probe and advanced caudaly, toward the posterior aspect of the axillary artery. Thirty-five mL of the local anesthetic were incrementally injected.

The extent of sensory and motor block was evaluated at 30 minutes postinjection. Patients received a standardized postoperative analgesic regimen consisting of ketorolac 30 mg injection every 8 hours. If the VAS was > 3, the patient received 0.5 µg/kg fentanyl.

Parameters Assessement

Preoperative Period

1) Haemodynamics: blood pressure, heart rate.
2) Block assessment and definition of successful block:

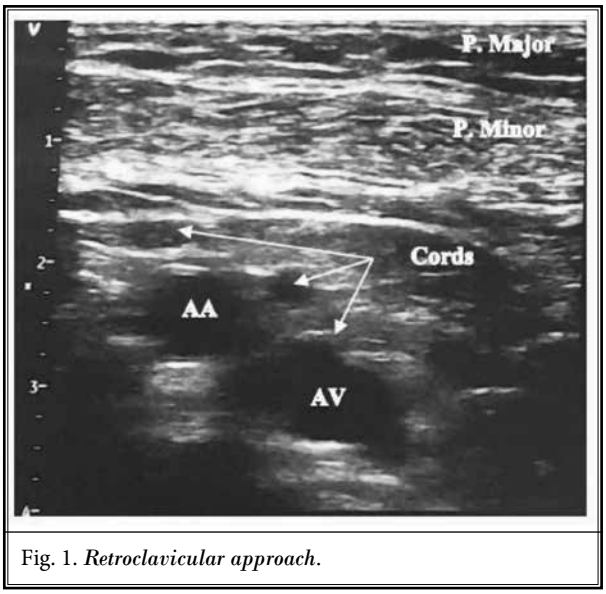

Fig. 1. *Retroclavicular approach.*

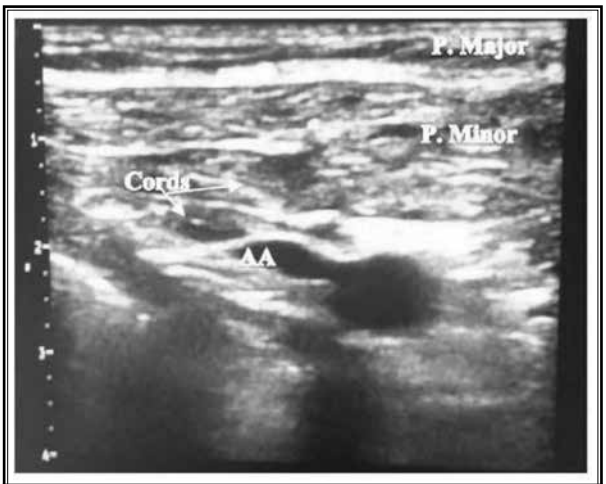

Fig. 2. *Costoclavicular approach.*

Assessment of sensory and motor blocks was done 5 minutes postinjection, then every 5 minutes, up to 30 minutes postinjection. Sensory block was tested using a needle pinprick test (0, normal sensation; 1, decreased sensation; 2, no sensation) in the dermatomes supplied: a) musculocutaneous nerve (lateral aspect of the forearm); b) median nerve (ventral aspect of the thumb); c) radial nerve (lateral aspect of the dorsum of the hand). d) ulnar nerve (ventral aspect of the little finger). Motor block was tested as following: (0, no loss of force; 1 reduced force compared with the other arm; 2 inability to overcome gravity). a) elbow flexion (musculocutaneous nerve); b) thumb abduction (radial nerve); c) thumb adduction (ulnar nerve); d) thumb opposition (median nerve). A score of 14 within 30 minutes of the block represented a successful block. In cases of a block failure, the patient was excluded from our trial and received general anesthesia.

3) Imaging time (the time between probe application and insertion of the needle).
4) Needle time (the time between insertion of the needle and complete injection of local anesthetic).
5) Procedure time (the summation of the imaging and needling times).

Postoperative Assessment

1) Hemodynamics: blood pressure, and heart rate were recorded at one, 2, 4, 8, 12 ,16, 20, and 24 hours postoperative.
2) Duration of the sensory and motor block.
3) VAS at one, 2, 4, 8, 12, 16, 20 and 24 hours postoperative.
4) Time to first analgesic need.
5) Total analgesia need during the first postoperative 24 hours.
6) Incidence of any complications such as hematoma formation or paresthesia.

Statistical Analysis

Data was analyzed using SPSS Statistics version 25 (IBM Corporation). Parametric quantitative data are presented as median ± standard deviation, nonparametric quantitative data are presented as median and interquartile range. A P value < 0.05 was considered significant.

A one way analysis of variance (ANOVA) test was used for statistical analysis of parametric quantitative data among the 3 groups, followed by a post hoc least significant difference analysis between each 2 groups.

The χ^2 test was used for qualitative data among the 3 studied groups.

Paired t test was used for analysis of parametric qualitative data within each group while Wilcoxon signed –rank test was used for analysis of nonparametric quantitative data.

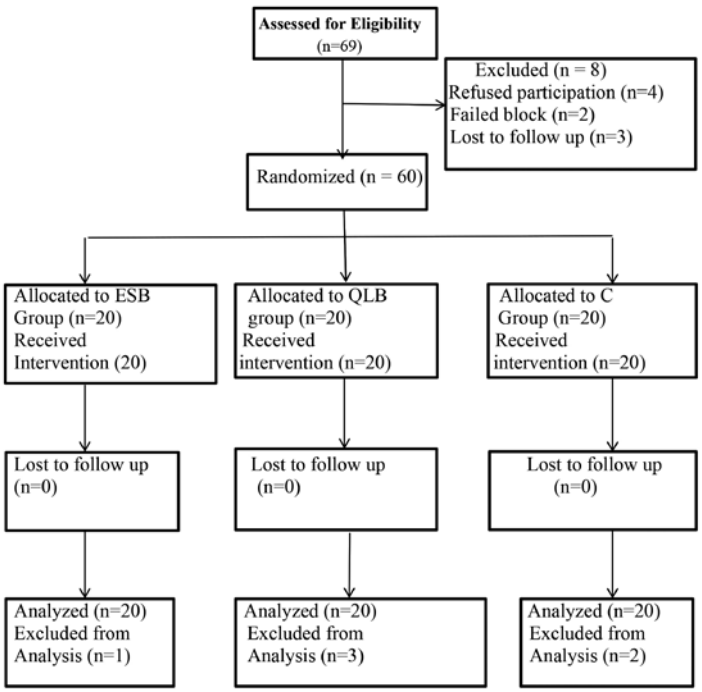

Fig. 3. *CONSORT diagram of the trial.*

Results

Sixty patients were included in the final analysis in this trial after excluding dropouts, as shown in the CONSORT diagram (Fig. 3). The patients were randomly divided into 3 parallel equal groups according to the techniques used (20 patients in each group). Group I (RC group) received the retroclavicular approach for IPBP. Group II (CC group) received the costoclavicular approach for IPBP. Group III (CT group) received the classic technique for IPBP.

Demographic Data

The 3 studied groups were comparable regarding age, gender, BMI, duration of surgery, and ASA physical status as shown in Table 1.

Timing Data

Regarding needle time, a statistical significance was recorded in the 3 groups. There was a statistical difference when the RC group was compared with both the CC group and the CT group; the CC group and CT group were comparable. The 3 groups were comparable regarding imaging time, so the procedure time was significantly lower in the RC group (16-30 minutes) than both the CC group (15-30 minutes) and CT group (18-30 minutes) while the other 2 groups were comparable as shown in Fig 4.

Sensory and Motor Block Data

There was no significant difference when comparing the three groups regarding the onset and duration of sensory and motor block as shown in Table 2.

Postoperative Changes

Hemodynamics:

Regarding heart rate, there was no statistical significant among the 3 groups, while a significant difference was recorded within the same group compared with the base line reading in each group, except in the RC group, at 12 hours, 18 hours, and 24 hours, and in the CC group at 24 hours with no clinical significance, as shown in Table 3. When comparing mean arterial pressure readings, there was no significant difference among the 3 studied groups at all trial intervals, but there was a statistically significant difference recorded in mean arterial pressure in the CT group at one hour, 2 hours, and 4 hours, and in the RC group and CT group at all-time intervals, except 18 hours and 24 hours, but with no clinical significance as shown in Table 4.

Visual Analog Scale

There was a statistically significant difference recorded in VAS among the 3 studied groups at 12 hours, 18 hours, and 24 hours, but clinically they were not significant as shown in Fig. 5.

Analgesic Data

No statistical difference was recorded regarding the first analgesic need and total analgesia requirement among the 3 groups at all time intervals as shown in Table 5 and Figs. 6 and 7.

Patient Satisfaction

There was no statistically significant difference in patient satisfaction among the 3 studied groups at all time postoperative intervals as shown in Table 6.

Table 1. *Demographic data in the studied groups (data presented as mean ± SD).*

		Group RC	Group CC	Group CT	*P* Value		
		n = 20	n = 20	n = 20			
Age	Range Mean ± SD	(18-60) 31.6 ± 10.9	(18-54) 32.7 ± 10.1	(18-56) 36.1 ± 11.7	0.410		
					C vs CC 0.751	RC vs CT 0.201	CC vs CT 0.335
Gender	Male Female	12 (60%) 8 (40%)	10 (50%) 10 (50%)	12 (60%) 8 (40%)	0.762		
					C vs CC 0.525	RC vs CT 1	CC vs CT 0.525
BMI	Range Mean ± SD	(18-30) 22.4 ± 3.5	(18-30) 23.5 ± 4.3	(18-30) 23.8 ± 3.8	0.468		
					C vs CC 0.371	RC vs CT 0.240	CC vs CT 0.775
ASA	ASA I ASA II	20 (100%) 0 (0%)	19 (95%) 1 (5%)	19 (95%) 1 (5%)	0.596		
					C vs CC 0.311	RC vs CT 0.311	CC vs CT 1
Duration of Surgery (m)	Range Mean ± SD	(20-120) 56.5 ± 23.8	(30-120) 54.8 ± 29.3	(30-90) 37 ± 19.2	0.955		
					C vs CC 0.822	RC vs CT 0.949	CC vs CT 0.772

- One Way ANOVA test for parametric quantitative data between the three groups followed by post hoc LSD analysis between each 2 groups
- Chi square test for qualitative data between groups
- Significant level at *P* value < 0.05

Complications:

No patients in any group developed any complications, such as hematoma formation or paresthesia.

Discussion

This prospective, randomized single-blinded controlled trial is the first trial aimed to compare the RC approach for IPBP with the CC approach in terms of needle visibility and compare both approaches with the CT for upper limb surgeries. We report that procedure and needle times were significantly lower in the RC group with better needle visibility than the other groups while the CC group and CT group showed comparable values.

These results are in line with Blanco, et al (1) whose trial included 109 patients randomly divided into 2 groups who received either an RC or CT brachial plexus block for upper limb surgeries with a local anesthetic bolus (20 mL of 0.5% ropivacaine and 1.5 %mepivacaine) and reported that the mean performance time was lower in the RC approach with better needle visibility.

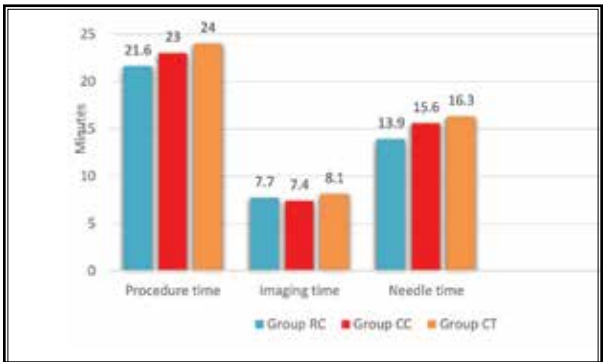

Fig. 4. *Procedure, imaging and needle times among the 3 groups.*

Similarly, Ozturk & Kavakli (3), in their trial, analyzed 100 patients who were candidates for upper limb surgeries who received an IBPB with 25 mL of 0.5 % bupivacaine. Fifty of the patients received a coracoid approach and 50 patients an RC approach. They reported that performance time was significantly shorter in the RC group with better needle visibility than the coracoid group.

These results also agree with Sinha, et al (4) who compared RC and CT approaches of brachial plexus block in 120 Indian patients who were candidates for forearm surgeries. Each group had 60 patients who received 20 mL of 0.5 % levobupivacaine.

Comparing CC and CT groups, Leurcharusmee, et al (10) agreed with our results in their trial of 90 patients scheduled for upper limb surgeries from the elbow distally. Each group had 45 patients who received a mixture of 35 mL 1% lidocaine plus bupivacaine with epinephrine 5 µg/mL. They reported there was no significant difference in performance time.

In the same line, Cesur et, al's (11), trial included 80 patients who underwent upper limb surgeries. They were allocated into 2 groups of 40 patients who underwent IPBP via either the CC or CT approach. They received a mixture of 25 mL of 1% lidocaine and 0.25% of bupivacaine. They found that the ultrasound imaging time and block performance time was faster in the

Table 2. *Sensory and motor block in the studied groups (data presented as mean ± SD).*

		Group RC	Group CC	Group CT	*P* value		
		n = 20	n = 20	n = 20			
Onset of Sensory Block (m)	Range Mean ± SD	(5-15) 7.8 ± 3	(5-15) 7.5 ± 3	(5-10) 7.2 ± 2.6	0.860		
					RC vs CC 0.785	RC vs CT 0.585	CC vs CT 0.785
Duration of Sensory Block (H)	Range Mean ± SD	(8-12) 9.1 ± 1.5	(8-10) 8.4 ± 0.8	(8-10) 8.7 ± 1	0.162		
					RC vs CC 0.058	RC vs CT 0.274	CC vs CT 0.411
Onset of Motor Block (m)	Range Mean ± SD	(5-15) 11 ± 2.6	(10-15) 12.7 ± 2.6	(5-15) 11.7 ± 2.9	0.131		
					RC vs CC 0.051	RC vs CT 0.385	CC vs CT 0.247
Duration of Motor Block (H)	Range Mean ± SD	(8-10) 8.7 ± 1	(8-10) 8.6 ± 0.9	(8-10) 8.7 ± 1	0.931		
					RC vs CC 0.745	RC vs CT 1	CC vs CT 0.745

- One Way ANOVA test for parametric quantitative data between the three groups followed by post hoc LSD analysis between each two groups
- Significant level at *P* value < 0.05

Table 3. *Heart rate data in the studied groups (data presented as mean ± SD).*

		Group RC	Group CC	Group CT	*P* Value		
		n = 20	n = 20	n = 20			
HR 1 h	Range Mean ± SD	# (65-90) 75.6 ± 7.9	# (65-90) 76 ± 6.5	# (65-88) 75.2 ± 7.3	0.926		
					RC vs CC 0.828	RC vs CT 0.862	CC vs CT 0.696
HR 2h	Range Mean ± SD	# (60-90) 76.7 ± 8.3	# (65-90) 78.1 ± 6.6	# (69-88) 78.3 ± 6.3	0.757		
					RC vs CC 0.552	RC vs CT 0.495	CC vs CT 0.930
HR 4 h	Range Mean ± SD	# (70-98) 79.8 ± 8.8	# (68-98) 80.8 ± 7.9	# (69-91) 80.2 ± 6.3	0.911		
					RC vs CC 0.669	RC vs CT 0.855	CC vs CT 0.807
HR 6 h	Range Mean ± SD	# (70-90) 80.5 ± 7.1	# (70-95) 82.8 ± 6.7	# (75-94) 82.8 ± 5.6	0.440		
					RC vs CC 0.268	RC vs CT 0.268	CC vs CT 1
HR 12 h	Range Mean ± SD	(75-95) 83.4 ± 6.3	# (70-97) 84.9 ± 6.8	# (76-94) 85.1 ± 5.2	0.624		
					RC vs CC 0.443	RC vs CT 0.371	CC vs CT 0.898
HR 18 h	Range Mean ± SD	(75-100) 85.8 ± 6.3	# (68-100) 86.4 ± 7.6	# (74-100) 87.5 ± 5.6	0.710		
					RC vs CC 0.774	RC vs CT 0.416	CC vs CT 0.598
HR 24 h	Range Mean ± SD	(77-105) 87.9 ± 6.8	(68-105) 88.3 ± 8.8	# (74-98) 88.8 ± 5.7	0.932		
					RC vs CC 0.879	RC vs CT 0.711	CC vs CT 0.827

• One Way ANOVA test for parametric quantitative data between the three groups followed by post hoc LSD analysis between each two groups
• Paired Samples T test for parametric qualitative data between two times within each group
• #: Significant level at *P* value < 0.05 (each time vs baseline) within each group
• Significant level at *P* value < 0.05

CC group among the patients with a BMI ≥ 30 with no statistical significance between the 2 groups .

On the contrary, Hassan, et al (6) studied 36 patients scheduled for lower arm, elbow, forearm, wrist, or hand operations. Both groups received 25-32 mL of bupivacaine 0.5 % with adrenaline 1:2000000. The RC block group included 17 patients and the CT group included 19 patients. They reported that the performance time was lower in the CT group than the RC group, but insignificant. This disagreement may be attributed to the authors using an infraclavicular approach at a more proximal location in the costoclavicular space, where the 3 cords are grouped together cephalad to the axillary artery which facilitates blocking them by one needle injection.

Beh, et al (12) conducted a trial on 46 patients who underwent forearm, wrist and hand surgeries randomly allocated into 2 groups, CT, 23 patients in each. Both groups received 20 mL of 0.5% bupivacaine. The 2 approaches showed similar imaging, needling, and performance times.

Dost, et al (13) studied 100 patients divided into 2 equal groups aged 18-65 years who were scheduled for elective forearm and hand surgery. They received 20 mL of bupivacaine 0.5%. The performance time was significantly shorter in the CC group compared to the lateral sagittal infraclavicular approach, which differs from our results as the procedure time in CC was less than CT but insignificant statistically.

Regarding sensory and motor block data, our results reveal that there was no significant difference when comparing the 3 studied groups. This coincides with Blanco et al (1) whose trial included 109 patients randomly divided into 2 groups who received either an RC or CT brachial plexus block for upper limb surgeries with a local anesthetic bolus (20 mL of 0.5 % ropivacaine and 1.5 % mepivacaine) concluded that the difference was insignificant regarding sensory and motor block time between the groups .

Similarly, Dost, et al (13) reported that motor block onset and motor-sensory block times were similar in both CC and lateral sagittal infraclavicular approaches.

Table 4. *Mean arterial pressure data in the studied groups (data presented as mean ± SD).*

		Group RC	Group CC	Group CT	*P* Value		
		n = 20	n = 20	n = 20			
MAP post 1h	Range Mean ± SD	# (73-97) 85.3 ± 7.5	# (73-97) 84.7 ± 8.2	# (73-97) 81.3 ± 6	0.186		
					RC vs CC 0.773	RC vs CT 0.888	CC vs CT 0.153
MAP post 2h	Range Mean ± SD	# (77-113) 87 ± 7.7	# (77-113) 87.2 ± 8.1	# (77-93) 83.5 ± 4.5	0.181		
					RC vs CC 0.940	RC vs CT 0.118	CC vs CT 0.102
MAP post 4h	Range Mean ± SD	# (77-107) 87.8 ± 6.5	# (77-107) 88.8 ± 7.7	(77-103) 87.5 ± 5.5	0.835		
					RC vs CC 0.635	RC vs CT 0.937	CC vs CT 0.580
MAP post 6h	Range Mean ± SD	# (83-107) 90.5 ± 6.4	# (87-107) 91.5 ± 5.6	(73-103) 91 ± 7.1	0.797		
					RC vs CC 0.754	RC vs CT 0.721	CC vs CT 0.503
MAP post 12h	Range Mean ± SD	# (83-107) 91.5 ± 6.7	# (83-107) 92.5 ± 6.7	# (73-103) 91 ± 7.1	0.778		
					RC vs CC 0.643	RC vs CT 0.817	CC vs CT 0.488
MAP post 18h	Range Mean ± SD	(83-110) 93 ± 6.7	(87-110) 95.8 ± 6.6	(73-103) 93 ± 7	0.316		
					RC vs CC 0.189	RC vs CT 1	CC vs CT 0.189
MAP post 24h	Range Mean ± SD	(83-110) 95 ± 6.3	(87-110) 96.7 ± 6.8	(73-103) 94.2 ± 7.2	0.497		
					RC vs CC 0.439	RC vs CT 0.698	CC vs CT 0.247

- One Way ANOVA test for parametric quantitative data between the three groups followed by post hoc LSD analysis between each two groups
- Paired Samples T test for parametric qualitative data between two times within each group
- #: Significant level at *P* value < 0.05 (each time vs baseline) within each group
- Significant level at *P* value < 0.0

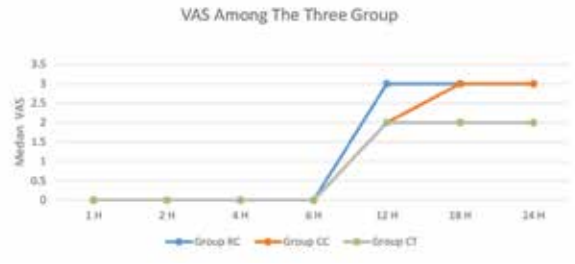

Fig. 5. *VAS among the 3 groups.*

Also, Sinha, et al (4), in their trial which compared RC and CT approaches of IBPB, reported that the rate of block success was the same in both groups .

On the other hand, Cesur, et al (11) found that the sensorimotor onset time was faster in the CC group compared to the lateral sagittal group with a significant difference, which contradicts our results. This difference may be due to their use of 25 mL of 1% lidocaine with 0.25% bupivacaine

When we evaluated postoperative pain in our trial we found there was no statistical significance in VAS scores among the studied groups in the first 24 hours, but it cannot be compared to other studies since pain scores were not reported by most researchers. Albrecht, et al (14) discovered that pain scores were infrequently reported when they systematically reviewed 25 randomized controlled studies of BPB. Only one trial showed no difference at 12 and 24 hours postoperatively between axillary and infraclavicular blocks. Another trial found that the infraclavicular approach decreased pain at 24 hours postoperatively compared with the supraclavicular one, but without a significant difference at 2 hours postoperatively.

No trials reported postoperative opioid requirements. Also Wong, et al (15) reported that regional anesthesia with an infraclavicular block may be preferred over general anesthesia since it is associated with better postoperative pain relief after fixation a distal radial fracture;, the trial compared 52 patients in 2 groups with 26 patients in each group.

Regarding analgesic data and patient satisfaction, our results show that there was not a statistically significant difference among the 3 studied groups.; This agrees with Ozturk & Kavakli (3) who reported similar findings when comparing RC and CT approaches.

Table 5. *Analgesic data in the studied groups (data presented as mean ± SD).*

		Group RC	Group CC	Group CT	*P* Value		
		n = 20	n = 20	n = 20			
First Analgesic Requirement (hours)	Range Mean ± SD	(8-12) 9.3 ± 1.6	(8-10) 8.7 ± 1	(8-12) 9.1 ± 1.2	0.338		
					RC vs CC	RC vs CT	CC vs CT
					0.150	0.628	0.334
Total Analgesic Requirement (µg)	Range Mean ± SD	(30-90) 70.5 ± 24.4	(60-90) 79.5 ± 14.7	(30-90) 73.5 ± 18.1	0.338		
					RC vs CC	RC vs CT	CC vs CT
					0.150	0.628	0.334
					0.105	0.224	0.440

- One Way ANOVA test for parametric quantitative data between the three groups followed by post hoc LSD analysis between each two groups
- χ^2 test for qualitative data between groups
- Significant level at *P* value < 0.05

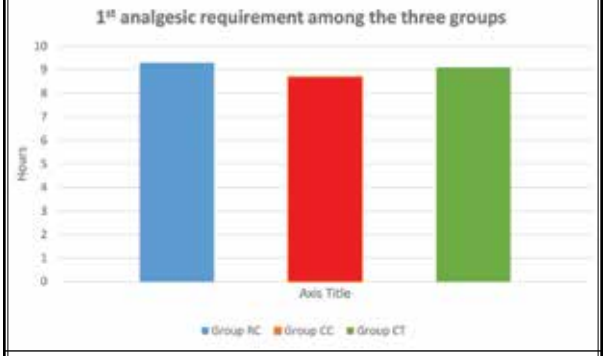

Fig. 6. *First analgesic requirement among the three groups.*

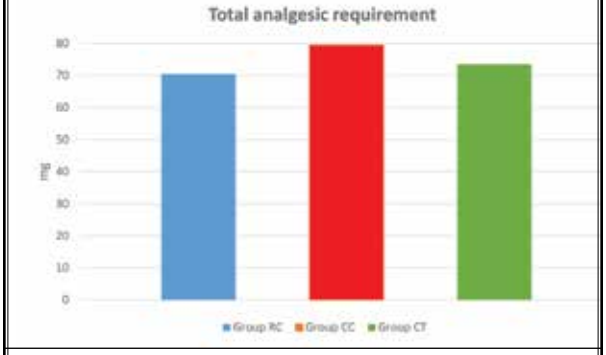

Fig. 7. *Total analgesic requirement among the three groups.*

Table 6. *Patient satisfaction data in the studied groups (data presented as number and percentage).*

		Group RC	Group CC	Group CT	*P* Value		
		n = 20	n = 20	n = 20			
Patient satisfaction	Very Good Excellent	8 (40%) 12 (60%)	7 (35%) 13(65%)	10 (50%) 10(50%)	0.619		
					RC vs CC	RC vs CT	CC vs CT
					0.744	0.525	0.337

- χ^2 test for qualitative data between groups

Dost, et al (13) reported similar patient satisfaction with no significant difference between CC and lateral sagittal infraclavicular approaches. Sinha, et al (4) reported better patient satisfaction with the RC approach than the CT approach.

The present results report no complications in any of the used approaches; this agrees with Cesur, et al (11) who reported no complications or neurological damage in both CC and CT techniques during the 24 hour postoperative period. In the same manner, Hassan, et al (6) reported no complications when comparing RC and CT approaches. Also Li et al (16) used the CC approach in 30 patients who underwent upper limb surgeries. They reported no complications either related to the technique or the local anesthetic injection. On the contrary, Blanco, et al (1) documented complications of 3 cases of paresthesia and one arterial puncture in the RC group and one case of paresthesia and 4 arterial punctures in CT group; there was also one Horner syndrome episode in each group. Late complications in the form of pain at the injection site occurred in 2 and 4 cases in the RC and CT groups respectively.

Limitation

Our trial didn't include patients with a BMI > 35.

Conclusion

The RC approach is superior for decreasing procedure and needle times than the CC and CT approaches and provides the same sensory and motor block onset and time, postoperative analgesic requirement, and patient satisfaction.

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