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Original Research Article

Newly Experiment Comparing Brachial Plexus Blocks in the Extreme Upper Limb: A Prospective Study on Tertiary Hospital in Bangladesh

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Abstract: ***Background:*** Using brachial plexus blocks as regional anaesthetic is standard procedure for upper limb surgery. Although a retro-clavicular brachial plexus block has just been proposed, another technique has not been thoroughly evaluated. This single-blinded, randomized, controlled experiment looked at whether the retroclavicular technique had a higher success rate than the supraclavicular approach. ***Methods:*** This experimental study was conducted in the Department of Anaesthesia, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh From June 2019 to June 2021. The physical state of one hundred and twenty ASA members there was randomization of 1-3 patients having distal surgery on their upper limbs to receive a 30 mL 1:1 mixture of mepivacaine and ropivacaine, which was administered as a single injection without repositioning the needle tip, using ultrasound guidance for the retroclavicular or supraclavicular brachial plexus block. In the 30 minutes following local anaesthetic injection, the primary outcome was block success rate defined as a composite score of 14 points, including sensory and motor components, inclusive. Additionally, secondary outcomes were the number of needles used, the time it took to obtain an opioid, the amount of oxycodone taken, and the patient's postoperative pain level (on a numeric rating range of 0-10). ***Results:*** Success rates were 98.3% [95% confidence interval (CI): 90.8%, 99.9%] and 98.3% [95% CI: 90.9%, 99.9%] in the supraclavicular and retroclavicular groups, respectively (P¼0.99). The mean needling time was reduced in the supra- clavicular group [supraclavicular: 5.0 (95% CI: 4.7, 5.4) min; retroclavicular: 6.0 (95% CI: 5.4, 6.6) min; P¼0.006]. The mean time to first opioid request was similar between groups [supraclavicular: 439 (95% CI: 399, 479) min; retroclavicular: 447 (95% CI: 397, 498) min; P¼0.19] as were oxycodone consumption [supraclavicular: 10.0 (95% CI: 6.5, 13.5 mg; retro- clavicular: 7.9 (95% CI: 4.8, 11.0) mg; P¼0.80] and pain scores at 24 h postoperatively [supraclavicular: 1.2 (95% CI: 2.1, 2.7); retroclavicular: 1.5 (95% CI: 1.6, 2.4); P¼0.09]. ***Conclusions:*** Once that comes to success rates and pain reduction, ultrasound-guided retroclavicular and supraclavicular brachial plexus blocks are the same. In the supraclavicular technique, shorter needle times aren't clinically significant.

Keywords: Brachial plexus; nerve block; postoperative analgesia; regional anaesthesia.

INTRODUCTION

Supraclavicular, infraclavicular, or axillary brachial plexus blocks are commonly used for regional anesthesia during distal upper limb surgery [1]. The supraclavicular block is the preferred approach in a busy outpatient facility, according to the authors, due to its short onset time of about <10 minutes [2]. The retroclavicular block is a novel ultrasound-guided technique to the brachial plexus that was recently studied on a group of 50 patients [3]. The needle is inserted behind the clavicle, until it is behind the axillary artery. this technique involves placing the needle into the supraclavicular fossa in the paramedian sagittal plane cephalo-caudad orientation [3, 4]. The RAPTIR block is the name given to this technology very lately. (Retroclavicular approach to the infraclavicular region) [5]. When compared to the usual

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infraclavicular method, the retro-clavicular block has reported advantages such as shorter treatment times, greater needle vision, less discomfort for patients, and high patient satisfaction, as well as an appropriate catheter insertion location [3]. According to a recent study, the retroclavicular brachial plexus block was more effective in improving sight of the needle than the infraclavicular brachial plexus block at improving pain outcomes [6].

There has never been a comparison between the retroclavicular approach and a more established ultrasound-guided approach, so we conducted this randomized controlled single-blinded trial to see if using a retro-clavicular brachial plexus block would increase the success rate over doing it supraclavicular [7].

METHODS

This experimental study was conducted in the Department of Anaesthesia, National Institute of Traumatology and Orthopaedic Rehabilitation (NITOR), Dhaka, Bangladesh from June 2019 to June 2021. Participants in this study ranged in age from 18 to 85 years and had an ASA physical status ranging from 1 to 3, depending on whether they were having elective forearm or hand surgery. Included in the list of contraindications to peripheral nerve block are existing upper-limb neurological impairment, coagulopathy, infection, and pregnancy. Once they signed an informed consent form, patients were randomly assigned to the retroclavicular or supraclavicular brachial plexus groups on the day of surgery. Patients were randomly assigned using a computer-generated randomization table in groups of 10. The assignments were tucked away in an opaque envelope that was tightly sealed.

Ultrasound-Guided Procedures

Two of the authors, both experienced regional anaesthetists, performed all ultrasound-guided blocks prior to surgery in a separate block procedure room (S.G., E.W.). This technique involved having the patient lie supine with their head 45 degrees to the non-operative side, and their ipsilateral arm extended by their sides. Routine use of ECG, pulse oximetry, and blood pressure (BP) monitors, as well as the provision of oxygen, were performed. It was decided to use i.v. midazolam 1-4 mg for anxiolysis and sedation, and this dosage was provided to the patient. The needle insertion site was cleaned with a 70% isopropyl alcohol solution of 2% chlorhexidine. As long as the environment remained as clean as possible, researchers employed a high-frequency linear array transducer. If you're having surgery on your upper arm, the probe should be put above your supraclavicular fossa and parallel to your collarbone so that you can see the brachial plexus and the subclavian artery, which are located on your first rib. Using an insulated block needle (Temena UPC®, Felsberg-Gensungen, Germany), a 23-gauge 70-mm ultrasound beam was inserted into the skin after a lidocaine 1%, 1-3 ml infiltration, and the needle tip was placed at the junction of the first rib and the subclavian artery, traditionally known as the "corner pocket" location (Fig 1a). 8 Except for individuals who complained of paranesthesia, the local anaesthetic was placed using a single-injection approach without moving the needle tip. An alternative method, known as the retroclavicular approach, uses a probe positioned below and perpendicular to the collarbone on the coracoid process in the paramedian sagittal plane, to get a short-axis view of the brachial-plexus cords and axillary arteries. This was followed by placing the needle roughly 1 cm posterior to the clavicle in the supraclavicular fossa before moving it forward in a straight line with the ultrasound transducer.

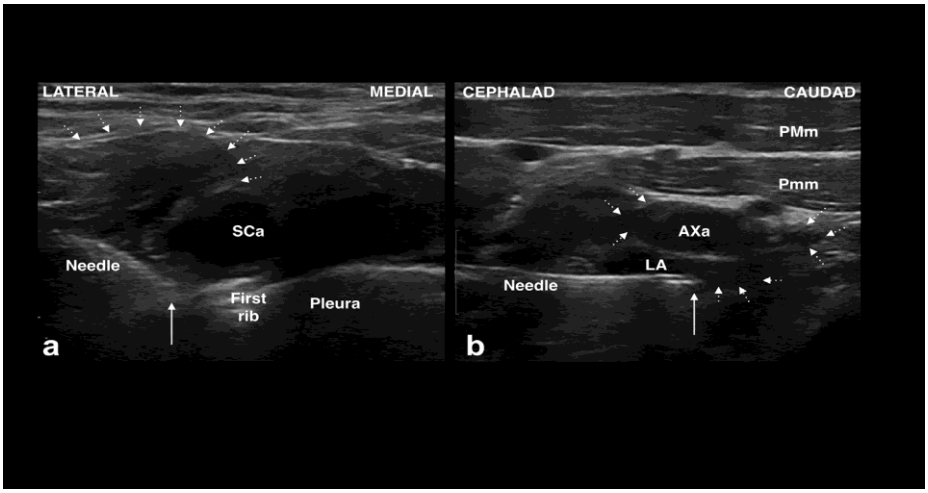


Fig 1: In all cases, local anaesthetic injections were used to block the brachial plexus and no needle repositioning was necessary until paraesthesia was felt. (1) Supraclavicular Brachial Plexus Block: The needle tip was placed in a corner pocket ('corner pocket') to block the brachial plexus upper limit and anaesthetize the various branches of it. To block the brachial plexus's lateral, posterior, and medial cords from a cephalad-to-caudad orientation, the needle point (white arrow) was placed posterior to the axillary artery (dotted arrow). PMm is a contraction of the pectoralis major muscle, whereas PMm is a contraction of the pectoralis minor muscle. SCa is a contraction of the subclavian artery

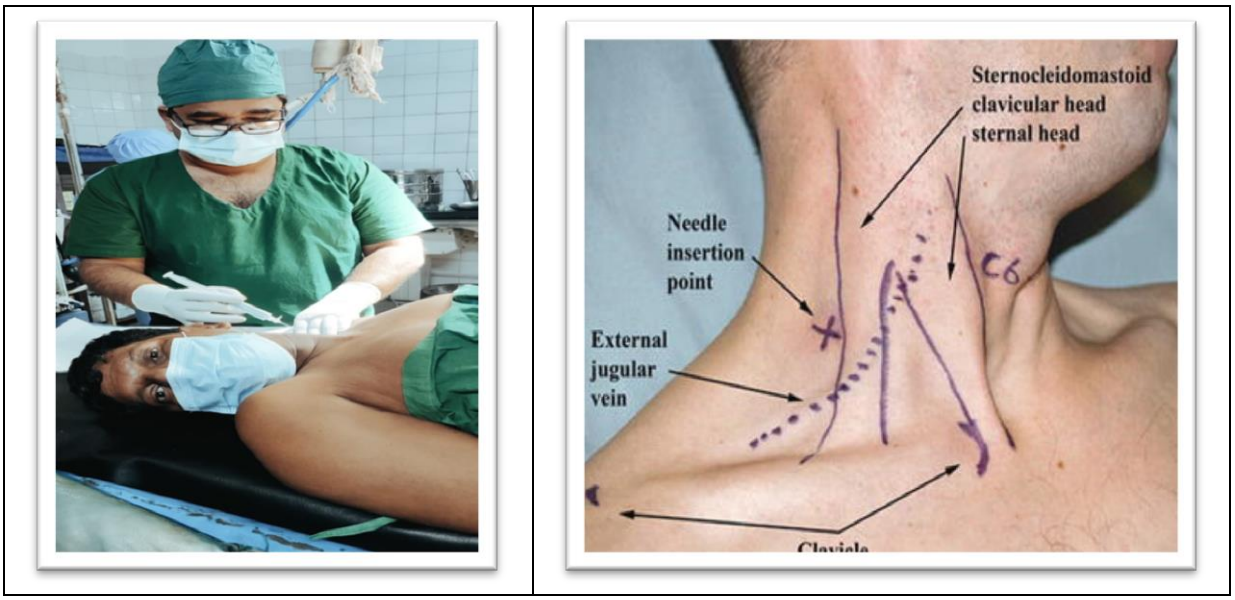
As soon as I got through the 2 cm blind spot produced by the clavicle's acoustic shadow, I could see the needle's tip all the way to the axillary artery's posterior end (Fig. 1b). Unless there was paresthesia, a single injection approach was used, with the local anaesthetic given without moving the needle.

In gradual 5 ml increments, with intermittent aspiration and continual ultrasound imaging, all patients received 30 ml of a 1:1 combination of 1% mepivacaine and 5% ropivacaine. The injection volume was set at 30 ml since this was the most common amount used in most studies included in a recent meta-analysis of ultrasound-guided supraclavicular or infraclavicular brachial plexus blocks. 1 Patients were fully watched once the block was completed until they were transferred to the surgical room.

Block assessment and definition of successful block

One of the investigators tested for sensory and motor blockades every 5 minutes for 30 minutes after a local anesthetic injection, as per a previously reported procedure. 2 As an example, sensory block was examined in the dermatomes of the musculocutaneous (lateral forearm) and radial/median/ulnar nerves (ventral thumb and fifth finger) with a blunt-tip needle pinprick test (0, normal sensation; 1, decreased sensation; 2, no sensation). elbow flexion (musculocutaneous nerve), thumb abduction (radial nerve), thumb opposition (median nerve), and thumb adduction (ulnar nerve) were used to test motor block with the following scale: 0, no loss of force; 1, reduced force in comparison with the contralateral arm; 2 inabilities to overcome gravity. Within 30 minutes after conducting the regional operation, a block was considered effective if it had a composite score of 14. In the event of a block failure, the operation was performed while the patient was under general anesthesia, rather than having the block redone.

Brachial Plexus Block



Intraoperative and postoperative procedures

Patients who requested it got propofol 2-4 mg kg—1 h—1 conscious sedation after regular operating room monitoring and oxygen were applied. A standardized postoperative analgesic regimen was administered to patients after surgery, consisting of oral acetaminophen 1000 mg every 4 hours and oral ibuprofen 400 mg every 8 hours. Patients were then transported to the ward. As is standard procedure, we had Oxycodone 5 mg every 4 hours on hand for anyone who required it. Oral ondansetron 4 mg served as an antiemetic and an antihistaminergic were provided if required.

Outcomes

The central finding was the success rate of the block 30 minutes after the injection of local anaesthetic. Aspect- and pain-related outcomes were used to classify the secondary outcomes. A block-related outcome was the imaging time (defined as the time elapsed between probe placement and needle insertion) as well as the needling time (defined as the time between needle insertion through the skin wheal and the end of the local anaesthetic injection). Procedure time (defined as the sum of the imaging and needling times) was also included (defined as time from injection of local anaesthetic to the time the patient could recover full function of the arm). There were pain-related outcomes such as pain score during the block operation (0e10), pain ratings at 2 and 24 postoperative hours (NRS out of 10), time to first opioid request, and postoperative oxycodone use for 24 hours after the surgery, as well as patient satisfaction (NRS out of 10).

The patients were sent home with a journal after Phase II recovery, and they were asked to record

the time it took to recover from full arm feeling, full arm mobilization, pain scores at rest and during movement, and the time it took until they took their first oxycodone dose. An investigator phoned each patient 24 hours after surgery to ask on the aforementioned outcomes, along with the existence of hematoma, persistent paresthesia or paralysis.

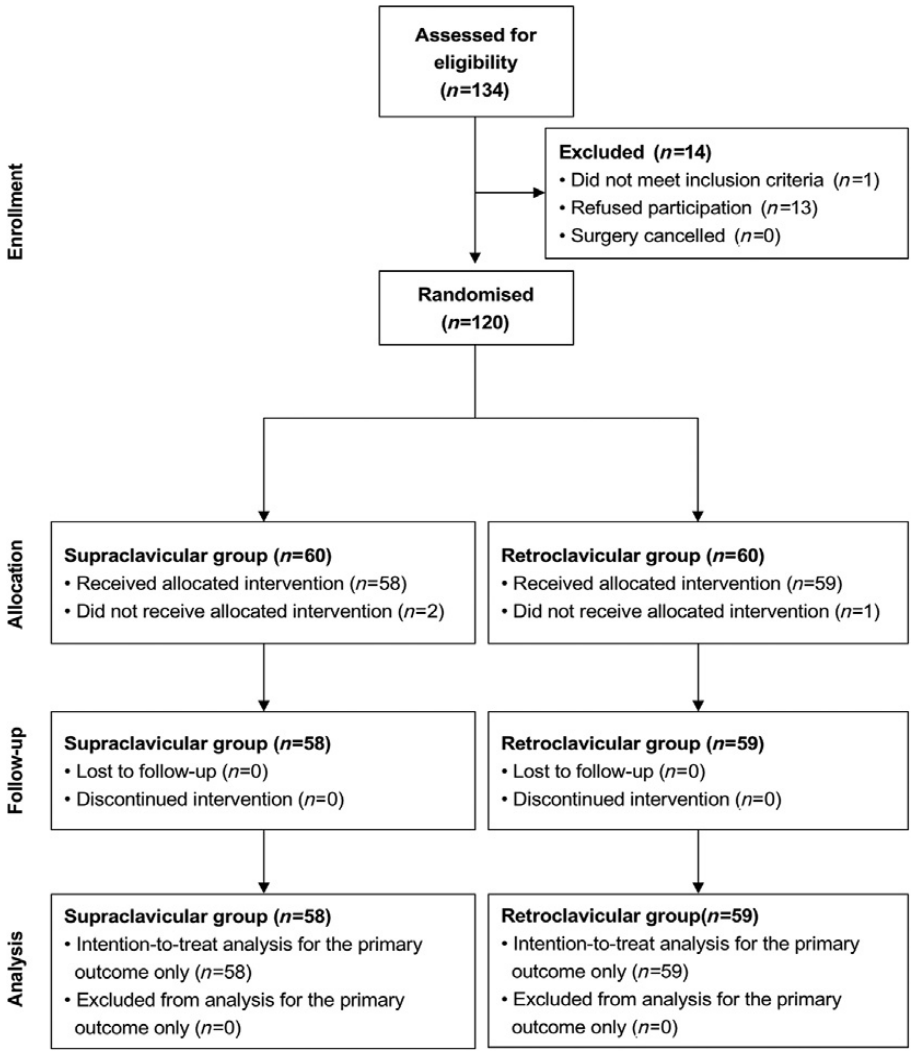


Fig 2: Flow of patients through trial

There was no way for patients, nurses, or statisticians to know which group they were in because the puncture site was identical to a supraclavicular or retroclavicular brachial plexus block.

Sample size calculation

According to our group's recent meta-analysis, a supraclavicular block with a single injection had an 86% success rate. 1 A retroclavicular technique was expected to boost success rates by 15%. We computed those 48 patients per group were needed to detect a statistically significant difference using an alpha error of 0.05 and a power of 70%. Assuming a protocol violation and dropout rate of 20%, our recruitment goal was to include 120 patients.

Statistical Analysis

Expectation analysis was used to evaluate the results. The frequencies of categorical variables are shown, and the mean values with 95% confidence intervals of continuous variables are summarized (95 percent CI). The student t-test and Manne Whitney U-test were used to compare continuous parametric and non-parametric data, respectively. For dichotomous data, Fisher's exact test was used. For categorical data, Pearson test was used. A two-tailed probability cutoff of P0.05 was used to determine significance. The JMP 9 statistical software was used for the analysis (SAS Institute,).

RESULTS

Three individuals withdrew permission, resulting in 118 participants completing the procedure for measuring the main outcome. Figure 2 depicts the trial's patient flow, while Table 1 lists the patients' individual characteristics. There were 98.3% success rates (95 percent confidence interval: 90.8%, 99.9%) and 98.3% success rates (95 percent confidence

interval: 90.9%, 99.9%) in the supraclavicular and retro-clavicular groups, respectively No differences were found between the supraclavicular and retroclavicular groups in the onset times of sensory and motor blockade for any specific nerve. For example, in the supraclavicular group, the mean onset time of sensory blockade for the musculocutaneous nerve was 13.2 minutes (95 percent confidence interval: 11.8, 14.4 minutes; P140.32). Likewise, mean onset times of motor blockade for the same nerve were 13.5 min (95% CI: 12.1, 14.9 min) and 15.3 min (95% CI: 13.9, 16.6 min; P¼0.08) in the supraclavicular and retroclavicular groups, respectively.

Details of the composite score are presented in Figure 3. Among the block-related outcomes, needling time, procedure time, and duration of motor blockade were statistically different (Table 2), while pain-related outcomes were similar between groups (Table 3). Rates of transient par aesthesia in the supraclavicular and retroclavicular groups were, respectively, 12.1% (95% CI: 5.0%, 23.3%) and 18.6% (95% CI: 9.7%, 30.9%; P¼0.30). Two patients from the retroclavicular group had a vascular puncture vs none in the other group, P¼0.16. No patients developed hematoma, persistent paraesthesia, or weakness in the upper limb, with assessment 24 h after the procedure.

Table 1: Presented as a mean (95 percent confidence interval) or as an absolute value, depending on the situation

	Supraclavicular group (*n*¼58)	**Retroclavicular group (*n*¼59)**	***P*-value**
Gender (male/female)	33/25	37/22	0.52
Age (yr)	51 (45, 56)	46 (42, 51)	0.23
Height (cm)	172 (170, 174)	173 (171, 175)	0.54
Weight (kg)	75 (70, 80)	77 (72, 82)	0.62
BMI (kg m^{-2})	25.2 (23.8, 26.6)	25.6 (24.2, 27.0)	0.67
ASA (1/2/3)	23/30/5	27/28/4	0.78
Duration of surgery (min)	57.8 (50.0, 65.7)	53.7 (45.6, 65.7)	0.47
Surgical location (elbow/forearm/wrist/hand)	3/2/22/31	3/3/16/37	0.64

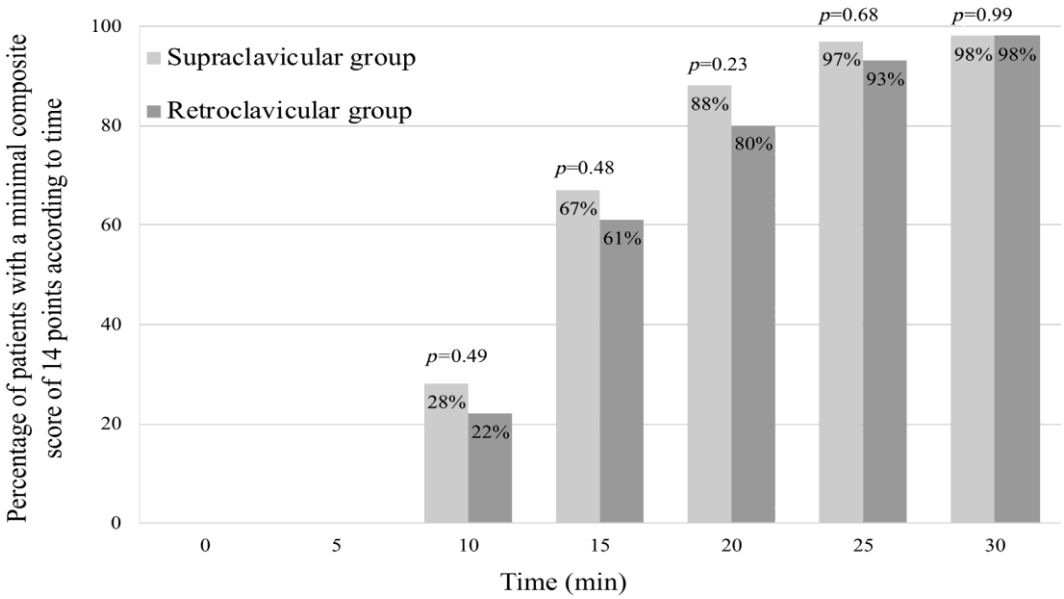


Fig 3: percentage of patients having a composite score of 14 points or less throughout time. Within-group differences were not significant throughout the 30-minute block assessment

Table 2: Block-related outcomes

	Supraclavicular group (*n*¼58)	**Retroclavicular group (*n*¼59)**	***P*-value**
Imaging time (min)	1.8 (1.5, 2.0)	2.3 (1.9, 2.6)	0.07
Needling time (min)	5.0 (4.7, 5.4)	6.0 (5.4, 6.6)	0.006
Procedure time (min)	6.8 (6.4, 7.5)	8.3 (7.6, 9.0)	0.005
Pain score during block procedure (NRS, 0e10)	1.6 (1.3, 1.8)	1.8 (1.5, 2.1)	0.19
Duration of sensory blockade (min)	381 (349, 414)	415 (380, 450)	0.16
Duration of motor blockade (min)	432 (394, 471)	507 (469, 544)	0.006

Table 3: Pain-related outcomes

	Supraclavicular group (*n*¼58)	**Retroclavicular group (*n*¼59)**	***P*-value**
Pain score at rest at 2 postoperative hours (NRS, 0e10)	0.4 (0.1, 0.7)	0.4 (0.2, 0.6)	0.95
Pain score at rest at 24 postoperative hours (NRS, 0e10)	1.2 (2.1, 2.7)	1.5 (1.6, 2.4)	0.09
Time to first opioid request (min)	439 (399, 479)	447 (397, 498)	0.80
Total oxycodone consumption at 24 postoperative hours (mg)	10.0 (6.5, 13.5)	7.9 (4.8, 11.0)	0.37
Patient satisfaction (NRS, 0e10)	9.3 (9.0, 9.5)	9.2 (8.9, 9.4)	0.61

DISCUSSION

This standard randomized controlled experiment, which included 117 patients, found no difference between a supraclavicular approach and a retroclavicular brachial plexus block in terms of success rates. Both treatments had a 98 percent success rate and were also equal in terms of action initiation timings, sensory and motor blockade length, pain ratings and oxycodone intake during the first 24 postoperative hours. In the supraclavicular group, the statistically significant variations in needle and process times are not clinically relevant with mean differences of 1 and 1.5 minutes. Similarly, there is little clinical significance to the length of motor blockage [3].

Charbonneau and colleagues found a reduced success rate (90 percent) despite using more mepivacaine 1 percent in a case series of 50 patients (40 ml). One explanation for this discrepancy is because the physicians doing the blocks had varying levels of experience. There were only two consultants engaged in our experiment, as opposed to first- and second-year residents who were under the direct supervision of the program director. Our findings suggest that the retroclavicular and supraclavicular brachial plexus blocks are interchangeable. However, a post hoc study found that 420 patients with alpha and beta values of <0.05 and 0.2 were needed to demonstrate formal equivalence with a limit of 4%.

Because of these risks and drawbacks, we believe the retroclavicular brachial plexus block should only be used in a small percentage of patients. At least two centimeters are obscured by the acoustic shadow cast by the bony structure behind the clavicle, making it difficult to see the needle's course. This puts neuro-vascular tissues at danger of being punctured [8]. The suprascapular nerve and the suprascapular vein were found to be in the needle's path in a recent cadaveric investigation, and the posterior cord or its components were pierced in 50% of patients by a retroclavicular-sited catheter [9]. However, no individuals in our research had any lingering paraesthesia or motor impairment 24 hours after their surgery. Second, the presence of the clavicle prevents compression of the ruptured arteries in situations of vascular damage. On the first postoperative day, no patients, including the two who had a vascular puncture in the retro-clavicular brachial plexus block, reported having a superficial haematoma. This nerve can depart before the coracoid process in 35% of individuals, which means that the musculocutaneous nerve block could be delayed or even absent [5]. However, our findings demonstrated that no matter what technique was used, the beginning timings of action for each nerve, including the musculocutaneous nerve, were equal. It's for this reason that the practitioner should be conscious of any nerve damage or vascular puncture risks while doing retroclavicular brachial plexus block procedures blindly behind the collarbone, as we'd like to emphasize [9].

There is a possibility that one of the study's limitations is that the retroclavicular brachial plexus block was compared to the supraclavicular brachial plexus block rather than the more usual infraclavicular method. Our comparison was with a supraclavicular operation, which at our institution is the gold standard for needle identification and process time due to the superficial position of anatomical features. Although the arm was abducted for both blocks, we are convinced that the patients were blindfolded throughout, as the needle insertion site was always in the supraclavicular fossa despite the different probe placements. This study also has a disadvantage in that the person who collected the results was not identified. The validity of the results was not affected by this, as all patients, careers, and statisticians were blinded. Finally, it's probable that gathering data from patients 24 hours after surgery via a diary and a 24-hour telephone assessment skewed the results [10, 11].

CONCLUSION

With the same success rates and equal block features, ultrasound-guided retroclavicular and supraclavicular brachial plexus blocks provide equivalent pain relief.

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