Original Article

Comparative evaluation of ultrasound-guided supraclavicular approach and subclavian perivascular approach to brachial plexus block for upper-limb surgeries: A prospective randomised control study

Ravi Kerur, Purvashree Deshmukh, Meghana Hanagandi, P. Apoorva

Department of Anaesthesia, Jawaharlal Nehru Medical College, KLE Academy of Higher Education and Research, Belagavi, Karnataka, India

Abstract

Background: Subclavian perivascular block aims to anaesthetise three trunks of the brachial plexus at its most compact point. Hence, a low dose of local anaesthesia is sufficient.

Methods: The prospective randomised study consisted of 60 adult patients belonging to American Society of Anaesthesiologists (ASA) classification Grade I and II, scheduled for upper-limb surgeries, who were randomised to Group A (US-guided supraclavicular block) and Group B (US-guided subclavian perivascular block). Blocks were performed with a 20 mL equal mixture of 2% lignocaine + adrenaline and 0.5% bupivacaine. Sensory and motor blockades were assessed using a needle prick method and four-point scale, respectively; blockade was evaluated every 3 min till onset and then every 30 min after surgery. Eventually, inference was made in terms of block performance time, onsets and duration of sensory and motor blocks and first rescue analgesia.

Results: The mean age, body mass index, gender and ASA grades of the patients in both the groups were comparable. The block performance time was significantly shorter in Group B (12.3 ± 1.53) compared to Group A (21.90 ± 2.47; $P < 0.0001$). The complete blockade time for sensory and motor blocks was significantly shorter in Group B compared to Group A ($P < 0.0001$), whereas no significant difference was found with respect to first rescue analgesia ($P = 0.9688$).

Conclusions: US-guided subclavian perivascular block is more rapidly executed than US-guided supraclavicular block with a similar duration of blockade.

Keywords: Brachial plexus block, subclavian-perivascular, supraclavicular, ultrasonography

Address for correspondence: Dr Ravi Kerur, Assistant Professor, Department of Anaesthesia, Jawaharlal Nehru Medical College, KLE Academy of Higher Education and Research, Belagavi 590 010, Karnataka, India.
E-mail: ravikerur@gmail.com

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INTRODUCTION

Brachial plexus block is a regional anaesthetic technique, an alternative or an adjuvant for general anaesthesia for upper-limb surgeries. Supraclavicular, infraclavicular and axillary brachial plexus blocks are commonly used techniques for upper extremity surgery.[1]

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Supraclavicular brachial plexus block is considered to be one of the most effective methods of anaesthetic procedures in upper-limb surgeries. The supraclavicular approach to the brachial plexus provides reliable anaesthesia of the entire arm. Blockade occurs at the distal trunk, proximal division level of the brachial plexus. At this point, the brachial plexus is relatively compact. The supraclavicular approach is easier as it is a more superficial block. In general, some studies reported that ulnar nerve block is incomplete with supraclavicular brachial plexus block.[2]

The subclavian perivascular block is a supraclavicular, retroclavicular approach to the brachial plexus. Unlike the traditional Kulenkampff technique, this is an interscalene brachial plexus block, but aiming to anaesthetise the three trunks of the brachial plexus, as they cross the first rib rather than the nerve roots as they emerge between the scalene muscles can be more useful. This is the point at which the brachial plexus is at its most compact. As a result, it is possible to block the majority of the brachial plexus with one injection and with a lesser volume of local anaesthetic.[3]

At the level of the first rib, the trunks are invested in a sheath (formed from the anterior part of the middle scalene muscle sheath to the posterior part of the anterior scalene sheath), which also includes the subclavian artery.[3] None of the studies evaluated the ultrasonography (US)-guided supraclavicular brachial plexus block and subclavian perivascular block.[3-5] Thus, this study was intended to evaluate the quality of blockade and block performance time in US-guided supraclavicular and subclavian perivascular approach to brachial plexus block for upper-limb surgeries.

MATERIAL AND METHODS

The prospective randomised study, carried out between November 2021 and January 2022, included 60 adult patients belonging to American Society of Anaesthesiologists classification (ASA) Grade I and II, scheduled for upper-limb surgeries, who were randomised to Group A (US-guided supraclavicular block) and Group B (US-guided subclavian perivascular block). Blocks were performed with a 20-mL equal mixture of 2% lignocaine + adrenaline and 0.5% bupivacaine. Sensory and motor blockades were assessed using a needle prick method and four-point scale, respectively; blockade was evaluated every 3 min till onset and then every 30 min after surgery. Eventually, inference was made in terms of block performance time, onsets and duration of sensory and motor blocks and first rescue analgesia. The present study was approved by KAHER's Jawaharlal Nehru Medical College Belagavi Ethics Committee (MDC/DOME/819). A written informed consent form was obtained from all the patients.

Patients with body mass index (BMI) >30 kg/m^2, coexisting lung diseases, allergy to local anaesthetics, chest deformities, previous clavicular fractures, neurological deformities and pregnancy were exempted from the study.

The sample size was calculated according to the previous literature (block performance time: 2.9 ± 0.84 vs. 3.7 ± 0.92). A minimum of 19 subjects were required in each group.[5] Hence, 60 subjects were recruited (30 in each group).

All the patients were kept nil by mouth, and the baseline parameters, such as pulse rate, systolic blood pressure, diastolic blood pressure, end-tidal carbon dioxide ($EtCO_2$) and arterial oxygen saturation (by pulse oximeter) (SpO_2), were recorded in the pre-coded pro forma. Under aseptic precautions, a preliminary scan was performed using a Sonosite US machine; a 8–15 MHz linear probe (B-probe) and a 22-gauge 50-mm insulated stimulation short bevel needle were used to perform the block. Twenty mL of equal mixture of 2% lignocaine with adrenaline + bupivacaine 0.5% was used for the block. The scanning time and the interval from the insertion of needle placement to the removal of the needle were noted for each block. Standard procedures were followed by an experienced anaesthesiologist to perform US-guided supraclavicular brachial plexus block and subclavian perivascular block.

The onset and degree of sensory and motor block were observed every 3 min till complete blockade was achieved. If after 30 min, complete sensory blockade was not achieved and patient perceived pain, then it was considered a failed block. If the single nerve was spared, then a rescue block of the concerned nerve at appropriate level was given. If more than one nerve was spared, then general anaesthesia was administered. Findings were noted by an observer who was blinded about the block performed. The sensory score was assessed using a needle prick method by testing the five individual nerves: median nerve, radial nerve, ulnar nerve, musculocutaneous nerve and medial cutaneous nerve of the forearm. The scoring system for sensory block and four-point scale for quality of motor block previously reported were followed in the current study.[2] Rescue analgesia was given if visual analogue score

of >4 (diclofenac 75 mg) was identified, and this time was considered the first rescue analgesia time.

Statistical analysis

Quantitative variables were presented as mean ± standard deviation and were compared by unpaired *t*-test. All the proportions were compared using Chi-square test or Fisher's exact test. A *P*-value < 0.05 was considered statistically significant. Data were compiled and analysed using the SPSS Statistics 20.0 statistical package (IBM Corp. Version 20.0. Armonk, NY, USA: IBM Corp.).

RESULTS

The mean age of the patients in Group A was 35.5 ± 9.5 and in Group B was 40.4 ± 10.6 years ($P = 0.0011$). Table 1 depicts the patients' baseline demographic characteristics and surgical data. Statistically, no significant difference was found between the study groups with respect to BMI (24.8 ± 2.9 vs. 24.47 ± 3.1; $P = 0.6704$). The block performance time, onset, complete blockade time and duration of sensory and motor block are presented in Table 2. The block performance time was significantly shorter in Group B (12.3 ± 1.5) compared to Group A (21.9 ± 2.5; $P < 0.0001$). No side effects were observed in both the study groups.

Table 1: Baseline characteristics of the study participants

Variable	Group A (No.)	Group B (No.)
Gender		
Male	14	16
Female	16	14
Age group (years)		
20–24	8	1
25–29	6	4
30–34	7	6
35–39	6	4
40–44	0	5
45–49	0	2
50–54	1	4
≥55	2	4
BMI		
<20	0	1
20–23	10	8
23–25	4	8
25–30	14	11
≥30	2	2
Comorbidities		
Bronchial asthma	2	1
DM	9	9
HTN	6	7
Nil	13	13
ASA		
I	13	13
II	17	17
Type of surgery		
Forearm	16	16
Hand	14	14

ASA=American Society of Anaesthesiologists; BMI=Body mass index; DM=Diabetes mellitus; HTN=Hypertension

Table 2: Block-related parameters*

Variables	Group A	Group B	*P*-value
Block performance time (min)	21.9 ± 2.5	12.3 ± 1.5	<0.0001
Onset (min)	4.4 ± 0.8	4.4 ± 1.2	0.8042
Complete blockade time (min)	17.0 ± 2.3	12.9 ± 2.2	<0.0001
Duration (min)	5.6 ± 0.5	5.9 ± 0.6	0.0460
Onset (min)	6.0 ± 0.8	5.7 ± 1.1	0.2671
Complete blockade time (min)	19.6 ± 3.1	16.6 ± 2.2	<0.0001
Duration (min)	5.6 ± 0.5	5.9 ± 0.6	0.0460
First rescue analgesia time (h)	2.6 ± 0.4	2.6 ± 0.5	0.9688

*Data are presented as mean±standard deviation
SD=Standard deviation

DISCUSSION

In the current prospective, randomised, observer-blinded study, we evaluated and compared the US-guided supraclavicular and subclavian perivascular approaches with respect to the quality of blockade and block performance time for upper-limb surgeries. Brachial plexus block, like any other regional anaesthetic technique, offers a specific advantage to the patients, anaesthesiologist and surgeon.[6] In this technique, anaesthesia is localised to a restricted portion of the body on which the surgery will be performed, leaving other vital centres unaffected. Patients who present for surgery with an upper extremity at risk of vascular compromise may improve as soon as pain has been relieved and vasodilatation has been produced by the block.[6,7] Various approaches have been described for brachial plexus blocks, the supraclavicular brachial plexus block being the most popular procedure for upper extremity surgeries due to its quick onset and high success rate.[2] At present, a greater incidence of complications such as inadvertent vascular injections, phrenic nerve palsy, pneumothorax and Horner's syndrome has been reported with the supraclavicular brachial plexus block.[2]

The current study compared US-guided supraclavicular with subclavian perivascular approach to the brachial plexus. In subclavian perivascular block, it is possible to block the majority of the brachial plexus with one injection and a lesser volume of local anaesthetic.[3] The block performance time was significantly shorter in Group B (12.3 ± 1.5) compared to Group A (21.9 ± 2.47; $P < 0.0001$). None of the cases in both the groups had block failure. However, established literature reported a success rate of 90%–95% for US-guided supraclavicular blocks; this difference in findings could be due to a larger sample size in their studies.[8-10]

In the current study, we observed that the onset of sensory and motor blockade was almost similar in both the study groups; no significant difference was found ($P > 0.05$). In another study[11] the sensory block to all seven terminal

nerves following brachial plexus block was evaluated, The authors[11] reported that supraclavicular block had a significantly poorer block of the ulnar and median nerves. The subclavian perivascular block was performed faster and had a similar success rate to supraclavicular block. The complete blockade time for sensory and motor blocks was significantly shorter in the subclavian perivascular block group compared to the supraclavicular block group ($P < 0.0001$). These observations support our hypothesis that subclavian perivascular block is effective and can be performed faster than supraclavicular block in the presence of US. In addition, none of the cases had any complications since experienced anaesthesiologists were employed to perform the blocks. In another study,[12] it was reported that US-guided subclavian perivascular brachial plexus block reduces the incidence of complications such as pneumothorax and vascular puncture with a higher success rate as has been documented in the present study. Horner's syndrome is more common in interscalene brachial plexus block than supraclavicular and infraclavicular brachial plexus blocks.[12] In our study, we did not have an incidence of Horner's syndrome in either group of brachial plexus block. However, the incidence of Horner's syndrome and diaphragmatic paresis does not depend on the experience of the anaesthesiologist performing the block.[5] Whereas, no significant difference was found between both blocks with respect to first rescue analgesia ($P = 0.9688$). In this study, we used an equal mixture of 2% lignocaine with adrenaline + bupivacaine 0.5%; this combination reduces the toxicity potential and allows a quicker onset.

The present study had a major limitation that although all the findings were in support of subclavian perivascular block, we could not find a statistically significant difference in onset and duration of sensory and motor blocks due to small sample size. Future studies with much larger sample size may be required to achieve a statistical difference and generalise the data.

US-guided subclavian perivascular block is more rapidly executed than US-guided supraclavicular block with a similar duration of blockade. Hence, US-guided subclavian perivascular block is a reliable and comprehensive anaesthesia for upper-limb surgeries.

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Conflicts of interest

There are no conflicts of interest.

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