Section: Anaesthesia

Original Research Article

ULTRASOUND-GUIDED SUBCLAVIAN PERIVASCULAR VS. COSTOCLAVICULAR BRACHIAL PLEXUS BLOCK: A COMPARATIVE CLINICAL STUDY

Ayushi Sharma[1], Richa Gupta[2], Atanu Mukherjee[3]

[1]Junior Resident, Muzaffarnagar Medical College and Hospital, Muzaffarnagar, Uttar Pradesh, India
[2]Assistant Professor, Meerut, Uttar Pradesh, India
[3]Associate Professor, MMC & Hospital, Muzaffarnagar, Uttar Pradesh, India

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Corresponding Author:
Dr. Richa Gupta,
Email: richagupta9dec@gmail.com

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Abstract

Background: Regional anaesthesia is vital in upper limb surgeries, with brachial plexus blocks offering effective analgesia and fewer side effects than general anaesthesia. Among them, subclavian perivascular (SPB) and costoclavicular blocks (CCB) are widely used. While SPB ensures faster onset, CCB provides longer block duration and fewer complications. Previous studies have shown mixed outcomes. This study compares SPB and CCB in adult patients, evaluating block characteristics, hemodynamic stability, and postoperative analgesia to guide clinical decision-making. The aim & objective are to compare block characteristics, hemodynamic stability, and postoperative analgesic needs between ultrasound-guided subclavian perivascular and costoclavicular brachial plexus blocks in upper limb surgeries. **Materials and Methods:** This 18-month hospital-based study included 60 ASA I–II adults undergoing elective upper limb surgery, randomized to receive either subclavian perivascular or costoclavicular brachial plexus block. Blocks were ultrasound-guided using 25 mL of 0.5% bupivacaine. Block characteristics, hemodynamics, and analgesic needs were assessed. Data were analysed using SPSS v20. **Result:** Sixty patients were randomized into two equal groups (SPB and CCB), with no significant differences in baseline demographics ($p > 0.05$). The SPB group showed a significantly faster onset of sensory and motor blocks, while the CCB group had a longer duration of both blocks ($p < 0.0001$). Hemodynamic parameters remained stable across both groups, as shown in Table 3 and Figure 5.1. The duration of surgery was comparable. Fewer patients in the CCB group required rescue analgesia, though not statistically significant ($p = 0.47$). Hemi diaphragmatic paralysis occurred in three SPB patients but none in the CCB group ($p = 0.15$). **Conclusion:** Both subclavian perivascular and costoclavicular blocks were effective and hemodynamically stable for upper limb surgeries. SPB offered a quicker onset, while CCB provided longer-lasting anaesthesia with fewer complications like hemi diaphragmatic paralysis. Selection between the two should depend on the clinical context and whether faster onset or extended postoperative analgesia is prioritized.

INTRODUCTION

Regional anaesthesia plays a key role in upper limb surgeries, and among the most effective options is the brachial plexus block. It not only avoids the side effects of general anaesthesia but also provides superior pain relief—especially useful in patients with comorbidities like cardiovascular or respiratory issues.[1]

Thanks to ultrasound guidance, these blocks have become safer and more precise. Two techniques often used for surgeries involving the elbow, forearm, or hand are the subclavian perivascular block (SPB) and the costoclavicular brachial plexus block (CCB).

CCB targets a space under the clavicle where all three cords of the brachial plexus lie close together. This makes it easier to block the nerves with a single injection, using a smaller dose of anaesthetic, and with fewer risks like vascular puncture or lung injury.[2-4] It's also been shown to last longer and cause fewer complications like diaphragmatic paralysis.[5-7]

On the other hand, SPB works at the level where the brachial plexus crosses the first rib. It's effective and quick, but it comes with a slightly higher chance of

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side effects like Horner's syndrome or pleural injury due to its anatomical location.[8]

While both blocks are widely used in clinical practice, only a few studies have directly compared their performance. Zhang et al, [9] and Ramesh et al,[3] found that CCB offers a longer duration of sensory and motor block, whereas Kerur et al,[10] observed that SPB has a quicker performance time. Li et al,[11] also highlighted the potential of CCB in high-risk patients due to its anatomical advantage and reduced complication rates. Despite this growing evidence, further head-to-head comparisons are needed to guide anaesthesiologists in choosing the most appropriate technique.

This study aims to fill that gap by comparing SPB and CCB in adult patients undergoing upper limb surgeries, focusing on block characteristics, hemodynamic stability, and postoperative analgesia.

Aim & Objectives

1. Compare the onset time and duration of sensory and motor blockade between ultrasound-guided subclavian perivascular and costoclavicular brachial plexus blocks.
2. Assess hemodynamic stability and postoperative analgesic requirements associated with both techniques in adult patients undergoing upper limb surgeries.

MATERIALS AND METHODS

This hospital-based interventional study was carried out over a period of 18 months in the Department of Anaesthesiology and Critical Care at Muzaffarnagar Medical College. Sixty adult patients, aged between 18 and 50 years, scheduled for elective surgeries involving the elbow, forearm, or hand were enrolled after obtaining ethical clearance and informed consent. All participants were classified as ASA physical status I or II and were randomly allocated into two equal groups: Group I received the ultrasound-guided subclavian perivascular block (SPB), and Group II received the costoclavicular brachial plexus block (CCB).

Patients with coagulopathies, allergy to local anaesthetics, significant cardiovascular or respiratory disease, or pre-existing neurological disorders of the upper limb were excluded from the study. Prior to the procedure, all patients underwent thorough pre-anaesthetic evaluation. Standard fasting guidelines were followed, and baseline vitals—including heart rate, blood pressure, respiratory rate, and oxygen saturation—were recorded upon arrival in the operating room.

Both blocks were administered under strict aseptic conditions using ultrasound guidance with a high-frequency linear probe. After appropriate positioning of the patient, the targeted anatomy was identified on ultrasound. A 23-gauge spinal needle or a 5 cm echogenic needle was used to perform the block. A total of 25 mL of 0.5% bupivacaine was injected in both groups after confirming negative aspiration. The time taken to perform the block, onset of sensory and motor blockade, and duration of block were recorded. Throughout the procedure and postoperative period, patients were monitored for any complications such as vascular puncture, local anaesthetic toxicity, or signs of hemi diaphragmatic paralysis.

Pain levels were assessed postoperatively, and the time to first rescue analgesic was documented as an indicator of block efficacy. Hemodynamic parameters were recorded at regular intervals during the surgery. All collected data were compiled and analysed using SPSS version 20. For comparing numerical variables between the groups, the independent samples Student's t-test was used, while categorical data were assessed using the Chi-square test. A p-value of less than 0.05 was considered statistically significant.

RESULTS

A total of 60 patients were included in the study, with 30 in each group (SPB and CCB). As shown in [Table 1], both groups were comparable in terms of demographic characteristics such as age, gender, height, weight, and ASA physical status. There were no statistically significant differences in any of these baseline parameters ($p > 0.05$).

The characteristics of the blocks are summarized in [Table 2]. The onset of sensory and motor blocks was significantly faster in the SPB group compared to the CCB group (14.67 ± 0.81 vs. 18.20 ± 1.09 minutes for sensory onset, and 19.17 ± 1.02 vs. 24.27 ± 0.98 minutes for motor onset; $p < 0.0001$). However, the duration of both sensory and motor blocks was significantly longer in the CCB group ($p < 0.0001$). The motor block grade was uniformly 2 in both groups.

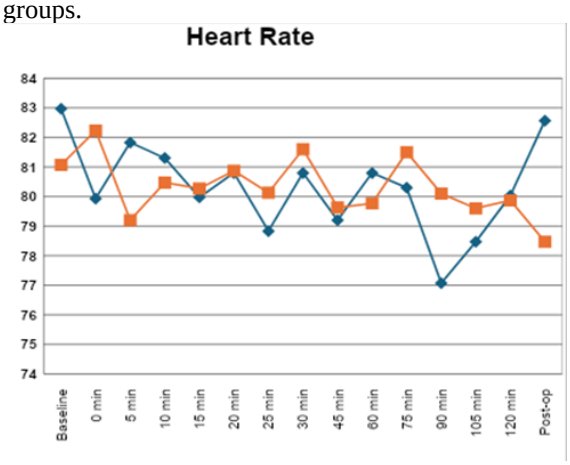

Figure 1: Comparison of mean Heart Rate at different time intervals between two groups

Hemodynamic parameters remained stable throughout the procedure in both groups, with no statistically significant differences observed at any time point. [Table 3] provides selected time intervals for heart rate, systolic blood pressure, and oxygen saturation. These findings are also visually represented in Figure 5.1, which illustrates the heart

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rate trends across time, further confirming the hemodynamic stability of both techniques.

Postoperative outcomes are outlined in [Table 4]. The mean duration of surgery was similar between the two groups. Although slightly fewer patients in the CCB group required rescue analgesia postoperatively, the difference was not statistically significant (6 vs. 3 patients; p = 0.47). Three cases of hemi diaphragmatic paralysis were noted in the SPB group, while none occurred in the CCB group, though the difference was not statistically significant (p = 0.15).

Table 1: Baseline Demographics and ASA Physical Status of Study Groups (N = 60).

S.No	Parameter	Group I (SPB) Mean ± SD / n (%)	Group II (CCB) Mean ± SD / n (%)	p-value
1	Age (years)	34.4 ± 10.64	38.87 ± 9.27	0.09
2	Gender (M/F)	19 / 11	16 / 14	0.98
3	Height (cm)	158.93 ± 5.34	158.90 ± 5.43	0.22
4	Weight (kg)	62.63 ± 8.67	65.33 ± 8.36	0.60
5	ASA I / II	21 / 9	21 / 9	1.00

Table 2: Block Characteristics in Both Groups

S.No	Parameter	Group I (SPB) Mean ± SD	Group II (CCB) Mean ± SD	p-value
1	Onset of Sensory Block (min)	14.67 ± 0.81	18.20 ± 1.09	<0.0001
2	Onset of Motor Block (min)	19.17 ± 1.02	24.27 ± 0.98	<0.0001
	Duration of Sensory Block (hr)	6.86 ± 0.12	7.84 ± 0.20	<0.0001
3	Duration of Motor Block (hr)	7.81 ± 0.13	8.84 ± 0.10	<0.0001
4	Grade of Motor Block	2 ± 0	2 ± 0	NS

NS = Not significant.

Table 3: Postoperative Outcomes and Complications

S.No	Time Point	Heart Rate (bpm) SPB / CCB	Systolic BP (mmHg) SPB / CCB	SpO_2 (%) SPB / CCB	p-value Range
1	Baseline	82.97 / 81.07	130.77 / 131.20	97.8 / 97.73	NS
2	15 minutes	79.97 / 79.37	128.4 / 129.1	97.6 / 97.5	NS
3	30 minutes	80.8 / 80.27	129.1 / 128.8	97.5 / 97.4	NS
4	60 minutes	80.8 / 81.13	130.6 / 130.2	97.8 / 97.6	NS
5	90 minutes	77.07 / 78.93	129.2 / 130.3	97.9 / 97.7	NS

NS = Not significant.

Table 4: Comparison of Complications Between Groups

S.No	Parameter	Group I (SPB)	Group II (CCB)	p-value
1	Duration of Surgery (min)	75.3 ± 10.2	76.5 ± 9.8	0.72
2	Rescue Analgesia Required (n)	6	3	0.47
3	Hemi diaphragmatic Paralysis (n)	3	0	0.15

DISCUSSION

This study set out to compare two ultrasound-guided approaches for brachial plexus block—subclavian perivascular block (SPB) and costoclavicular brachial plexus block (CCB)—in adult patients undergoing upper limb surgeries. Both techniques were found to be safe and effective, but with key differences in onset and duration of anesthesia.

The faster onset of both sensory and motor blocks in the SPB group observed in our study is consistent with previous findings. The subclavian perivascular approach targets the brachial plexus where the nerve trunks are most tightly packed as they pass over the first rib, allowing local anesthetic to spread quickly and uniformly.[8,12] This anatomical advantage is likely why several studies, such as those by Ramesh et al,[3] and Kerur et al,[10] have reported similar trends in quicker onset with SPB.

However, CCB demonstrated a significantly longer duration of both sensory and motor blocks, which is in line with studies like those by Zhang et al,[9] and Li et al.[11] In the costoclavicular approach, the cords of the brachial plexus lie close together lateral to the axillary artery, forming a stable and consistent triangular pattern.[2,3] This allows for efficient drug deposition and prolonged nerve blockade, even with smaller anesthetic volumes.[4]

Hemodynamic stability was well-maintained in both groups throughout the procedure, with no significant intergroup differences. This supports existing literature suggesting that both SPB and CCB, when performed under ultrasound guidance, are safe from a cardiovascular standpoint.[6-10] Our use of Figure 5.1 to track heart rate changes further illustrates this trend.

An interesting observation in our study was the lower incidence of hemi diaphragmatic paralysis in the CCB group. Though not statistically significant, this aligns with growing evidence suggesting that CCB is associated with reduced risk of phrenic nerve involvement due to its more distal and anatomically separated injection site.[6,7,13] Luo et al,[13] for instance, reported a markedly lower incidence of diaphragmatic dysfunction in patients receiving CCB compared to interscalene or supraclavicular blocks.

Finally, while postoperative analgesic requirements were slightly lower in the CCB group, the difference

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was not significant. This suggests that both techniques offer effective postoperative pain control—an essential consideration in ambulatory surgical care. These findings echo those of Zhang et al,[9] and Sadakah et al,[14] who reported comparable postoperative analgesia with both approaches.

CONCLUSION

Both subclavian perivascular and costoclavicular brachial plexus blocks proved to be effective, safe, and hemodynamically stable techniques for upper limb surgeries. While the subclavian approach offered a faster onset of sensory and motor blockade, the costoclavicular block provided a longer duration of anaesthesia and was associated with fewer complications such as hemi diaphragmatic paralysis. The choice between the two should be guided by individual patient needs, the clinical scenario, and the desired balance between rapid onset and prolonged postoperative analgesia.

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