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Comparison of Clavipectoral Fascial Plane Block and Interscalene Block for Postoperative Analgesia Following Elective Clavicle Surgery: A Prospective Comparative Study

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ABSTRACT

Background: Effective postoperative analgesia following clavicle surgery is essential for early mobilization and improved patient recovery. Ultrasound-guided clavipectoral fascial plane block (CPB) has emerged as a diaphragm-sparing alternative to the conventional interscalene block (ISB).
Objective: To compare the analgesic efficacy and safety of ultrasound-guided clavipectoral fascial plane block with ultrasound-guided interscalene block in patients undergoing elective clavicle surgery.
Materials and Methods: This prospective, randomized, single-blinded comparative study included 50 ASA physical status I–II patients aged 18–60 years undergoing elective open reduction and internal fixation of clavicle fractures. Patients were randomly allocated into the CPB group (n=25) or the ISB group (n=25). The primary outcome was postoperative pain assessed using the Visual Analogue Scale (VAS) at 2, 6, 12, and 24 hours. Secondary outcomes included time to first rescue analgesia, 24-hour tramadol consumption, diaphragmatic function, block-related complications, and patient satisfaction.
Results: Baseline characteristics were comparable between the groups. Postoperative VAS scores, time to first rescue analgesia, tramadol consumption, rescue analgesic doses, and patient satisfaction were similar ($p>0.05$). However, diaphragmatic function was significantly better preserved in the CPB group, with normal diaphragmatic movement observed in 96.0% versus 64.0% in the ISB group ($p=0.006$). Horner's syndrome, hoarseness of voice, and vascular puncture occurred only in the ISB group.
Conclusion: Ultrasound-guided clavipectoral fascial plane block provided postoperative analgesia comparable to interscalene block while offering superior preservation of diaphragmatic function and fewer block-related complications. CPB appears to be an effective diaphragm-sparing alternative for postoperative analgesia in elective clavicle surgery.

Keywords: *Clavipectoral fascial plane block; Interscalene block; Clavicle fracture; Regional anesthesia; Postoperative analgesia; Diaphragmatic function.*

INTRODUCTION

Clavicle fractures account for approximately 2.6–5% of all fractures and 35–45% of shoulder girdle injuries, with the middle third being the most commonly affected site[1]. Although many fractures can be managed conservatively, displaced, comminuted, or unstable fractures often require open reduction and internal fixation (ORIF) to restore anatomical alignment, facilitate fracture union, promote early mobilization, and improve functional outcomes.[2]Despite advances in surgical techniques, postoperative pain following clavicle surgery remains a significant challenge. Moderate-to-severe pain during the first 24–48 hours may impair shoulder movement, delay rehabilitation, increase opioid consumption, prolong hospital stay, and reduce patient satisfaction. Consequently, effective multimodal analgesia has become a key component

of enhanced recovery after surgery (ERAS) protocols, with regional anesthesia playing an important role in reducing postoperative pain while minimizing opioid-related adverse effects.[3]Regional anesthesia for clavicle surgery is complicated by the complex sensory innervation of the clavicle. While the overlying skin is supplied mainly by the supraclavicular nerves (C3–C4), the periosteum and deeper structures receive contributions from the subclavian, suprascapular, lateral pectoral, and long thoracic nerves, along with branches of the upper trunk of the brachial plexus (C5–C6). This overlapping innervation makes complete analgesia difficult with a single regional technique.[4]The ultrasound-guided interscalene brachial plexus block (ISB) has long been considered the standard regional anesthetic technique for clavicle and shoulder surgery because it provides reliable analgesia through blockade of the upper roots and trunks of the brachial plexus.[3] However, ISB is frequently associated with phrenic nerve blockade, resulting in ipsilateral hemidiaphragmatic paralysis, which may compromise pulmonary function, particularly in patients with underlying respiratory disease.[5,6] Other recognized complications include Horner's syndrome, recurrent laryngeal nerve block, upper-limb motor weakness, vascular puncture, local anesthetic systemic toxicity, and, rarely, pneumothorax.[3]

To address these limitations, the ultrasound-guided clavipectoral fascial plane block (CPB) has recently emerged as a promising alternative. This technique involves deposition of local anesthetic between the clavipectoral fascia and the clavicle, allowing blockade of terminal sensory branches supplying the clavicle while largely avoiding the brachial plexus and phrenic nerve.[7,8] Early evidence from case reports, case series, and prospective studies suggests that CPB provides effective postoperative analgesia with reduced opioid requirements, preservation of diaphragmatic function, minimal upper-limb motor blockade, and earlier mobilization following clavicle surgery.[7,9] Nevertheless, direct prospective comparisons between CPB and ISB remain limited, and additional evidence is needed to establish whether CPB offers analgesia comparable to ISB with a better safety profile.[6,10]

Therefore, the present prospective comparative study was undertaken to compare the postoperative analgesic efficacy and safety of ultrasound-guided clavipectoral fascial plane block and interscalene block in patients undergoing elective clavicle surgery by evaluating postoperative pain scores, duration of analgesia, rescue analgesic requirements, block-related complications, respiratory safety, and patient satisfaction.

MATERIALS AND METHODS

A prospective, randomized, single-blinded comparative study was conducted to compare the analgesic efficacy and safety of the clavipectoral fascial plane block (CPB) and ultrasound-guided interscalene block (ISB) in patients undergoing elective clavicle surgery. The study was carried out after obtaining approval from the Institutional Ethics Committee, and written informed consent was obtained from all participants before enrolment.A total of 50 adult patients scheduled for elective open reduction and internal fixation (ORIF) of clavicle fractures were included in the study. Eligible patients were between 18 and 60 years of age and belonged to American Society of Anesthesiologists (ASA) physical status I or II.
The study included 50 patients, who were randomly allocated into two equal groups of 25 patients each.

- **Group CPB (n = 25):** Patients received an ultrasound-guided clavipectoral fascial plane block.
- **Group ISB (n = 25):** Patients received an ultrasound-guided interscalene brachial plexus block.

Inclusion Criteria

Patients fulfilling all of the following criteria were included in the study:

- Age between 18 and 60 years.
- ASA physical status I or II.
- Scheduled for elective open reduction and internal fixation of clavicle fractures.
- Willingness to provide written informed consent.

Exclusion Criteria

Patients meeting any of the following criteria were excluded:

- Coagulopathy or ongoing anticoagulant therapy.
- Infection at the proposed block site.
- Known hypersensitivity to local anesthetic agents.
- Pre-existing neuromuscular disorders.
- Severe pulmonary disease.
- Refusal to participate in the study.

Randomization and Blinding

Patients were randomly assigned to one of the two study groups using a computer-generated randomization sequence. Group allocation was concealed using sealed opaque envelopes, which were opened immediately before administration of the regional block. The patients were blinded to the group allocation, while the anesthesiologist performing the block was aware of the assigned intervention.

Anaesthetic Technique
All patients underwent standard pre-anesthetic evaluation before surgery. On arrival in the operating room, routine monitoring, including electrocardiography (ECG), non-invasive blood pressure (NIBP), pulse oximetry (SpO_2), and heart rate, was instituted. Intravenous access was secured, and standard institutional anesthetic protocols were followed.

Clavipectoral Fascial Plane Block (CPB Group)
Patients in the CPB group received an ultrasound-guided clavipectoral fascial plane block. Under aseptic precautions, a high-frequency linear ultrasound transducer was placed over the clavicle to identify the clavipectoral fascia and periosteum. A 22-gauge block needle was advanced in-plane, and 20–25 mL of 0.25% bupivacaine was injected into the plane between the clavipectoral fascia and the periosteum at both the medial and lateral aspects of the fracture site to achieve adequate spread.

Interscalene Block (ISB Group)
Patients in the ISB group received an ultrasound-guided interscalene brachial plexus block. A high-frequency linear ultrasound probe was placed over the interscalene groove to identify the C5 and C6 nerve roots. Using an in-plane technique, a 22-gauge block needle was advanced adjacent to the brachial plexus, and 20 mL of 0.25% bupivacaine was administered after negative aspiration under real-time ultrasound visualization.

Outcome Measures
Primary Outcome
The primary outcome measure was postoperative pain intensity, which was assessed using the Visual Analogue Scale (VAS) at 2, 6, 12, and 24 hours after surgery.

Secondary Outcomes
The secondary outcome measures included:

- Time to first rescue analgesia (hours).
- Total tramadol consumption during the first 24 postoperative hours.
- Diaphragmatic function assessed by ultrasonography.
- Block-related and postoperative complications, including diaphragmatic paresis, hoarseness of voice, Horner's syndrome, vascular puncture, pneumothorax, local anesthetic toxicity, nausea, and vomiting.
- Patient satisfaction with postoperative analgesia, assessed using a standardized satisfaction score at 24 hours.

Rescue Analgesia
Rescue analgesia was administered whenever the VAS score reached 4 or greater. Intravenous tramadol was used as the rescue analgesic according to institutional protocol, and the time to first rescue analgesia along with the total tramadol consumption during the first 24 hours was recorded.

Statistical Analysis
The collected data were entered into Microsoft Excel and analyzed using SPSS .21statistical software. Continuous variables were expressed as mean ± standard deviation (SD), while categorical variables were presented as frequencies and percentages. Continuous variables were compared between the two groups using the Student's independent t-test, whereas categorical variables were analyzed using the Chi-square test or Fisher's exact test, wherever appropriate. A p-value <0.05 was considered statistically significant.

RESULTS
A total of 50 patients undergoing elective open reduction and internal fixation of clavicle fractures were enrolled in the study and were equally randomized into the Clavipectoral Fascial Plane Block (CPB) group (n = 25) and the Interscalene Block (ISB) group (n = 25). All patients completed the study and were included in the final analysis.

The baseline demographic and clinical characteristics were comparable between the two groups. There were no statistically significant differences with respect to age, sex distribution, body mass index (BMI), ASA physical status, side of fracture, or duration of surgery (all $p > 0.05$), indicating successful randomization (Table 1).

Postoperative pain intensity, assessed using the Visual Analogue Scale (VAS), was low in both groups throughout the first 24 hours after surgery. Although the ISB group demonstrated marginally lower VAS scores at all postoperative time points, the differences between the groups at 2, 6, 12, and 24 hours were not statistically significant (all $p > 0.05$) (Table 2, Figure 1).The analgesic efficacy of both regional techniques was comparable. The mean time to first rescue analgesia was 8.96 ± 1.74 hours in the CPB group and 9.41 ± 1.69 hours in the ISB group ($p = 0.366$). Similarly, total tramadol consumption during the first 24 postoperative hours and the number of rescue analgesic doses did not differ significantly between the groups ($p > 0.05$) (Table 3, Figure 2).Assessment of diaphragmatic function demonstrated a significantly greater preservation of diaphragmatic movement in the CPB group. Normal diaphragmatic excursion was observed in 96.0% of

patients receiving CPB compared with 64.0% in the ISB group. Reduced diaphragmatic excursion and hemidiaphragmatic paresis were observed more frequently following ISB, and the overall difference between the groups was statistically significant ($p = 0.006$) (Table 4).Block-related complications were infrequent in both groups. Horner's syndrome, hoarseness of voice, and vascular puncture occurred only in the ISB group, whereas no cases of local anesthetic systemic toxicity or pneumothorax were observed in either group. The incidence of postoperative nausea and vomiting was similar between the groups. None of the observed complications showed a statistically significant intergroup difference (all $p > 0.05$) (Table 5).Patient satisfaction with postoperative analgesia was high in both study groups. Most patients rated their analgesic experience as excellent or good, with no statistically significant difference in overall satisfaction between the CPB and ISB groups ($p = 0.962$) (Table 6, Figure 6).

Table 1. Baseline Demographic and Clinical Characteristics of the Study Participants

Variable	CPB Group (n=25)	ISB Group (n=25)	p-value	Statistical test
Age (years), Mean ± SD	38.64 ± 11.25	39.28 ± 10.84	0.842	Independent t-test
Male, n (%)	18 (72.0)	17 (68.0)	0.758	Chi-square test
Female, n (%)	7 (28.0)	8 (32.0)		
BMI (kg/m²), Mean ± SD	24.31 ± 2.91	24.74 ± 3.16	0.621	Independent t-test
ASA I, n (%)	17 (68.0)	16 (64.0)	0.765	Chi-square test
ASA II, n (%)	8 (32.0)	9 (36.0)		
Right-sided fracture, n (%)	14 (56.0)	15 (60.0)	0.774	Chi-square test
Left-sided fracture, n (%)	11 (44.0)	10 (40.0)		
Duration of surgery (minutes), Mean ± SD	82.4 ± 12.6	80.9 ± 11.8	0.667	Independent t-test

Table 2. Comparison of Postoperative Pain Scores (VAS)

Time	CPB Group Mean ± SD	ISB Group Mean ± SD	p-value	Statistical test
2 hours	1.32 ± 0.56	1.18 ± 0.48	0.351	Independent t-test
6 hours	2.26 ± 0.81	2.08 ± 0.74	0.412	Independent t-test
12 hours	3.41 ± 0.92	3.18 ± 0.86	0.369	Independent t-test
24 hours	2.84 ± 0.75	2.69 ± 0.71	0.468	Independent t-test

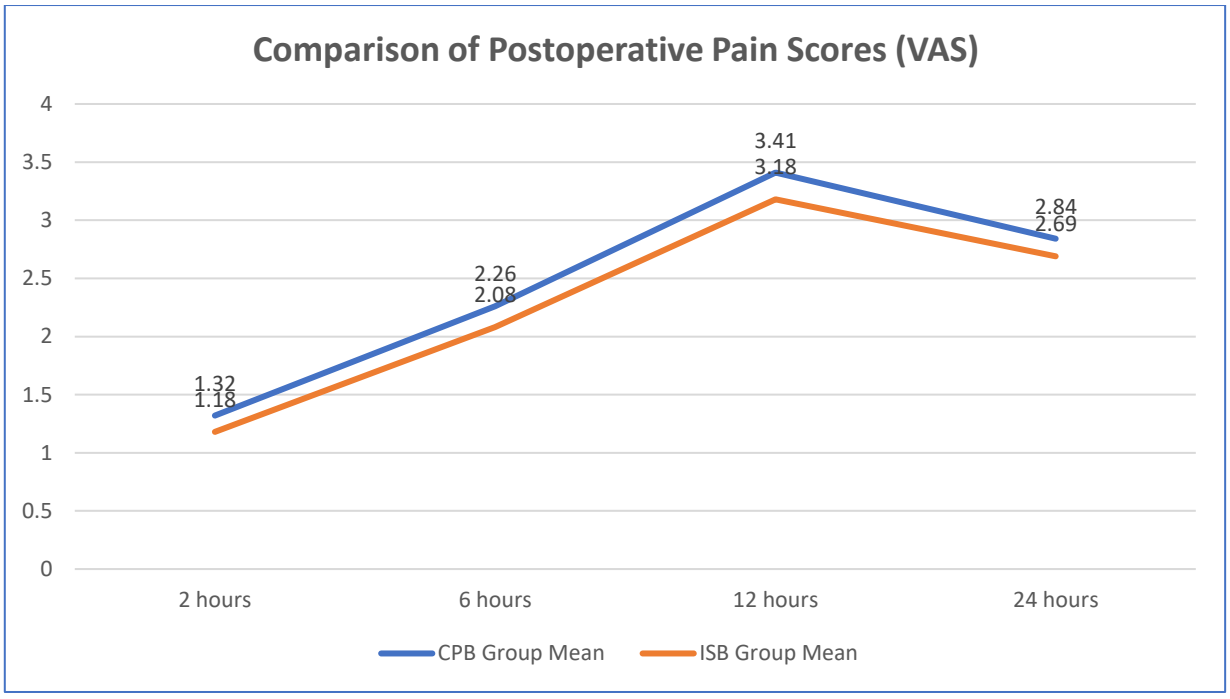

Figure 1 Comparison of Postoperative Pain Scores (VAS)

Table 3. Comparison of Analgesic Outcomes

Variable	CPB Group Mean ± SD	ISB Group Mean ± SD	p-value	Statistical test

Time to first rescue analgesia (hours)	8.96 ± 1.74	9.41 ± 1.69	0.366	Independent t-test
Total tramadol consumption (mg/24 h)	91.6 ± 28.4	84.8 ± 24.9	0.372	Independent t-test
Rescue analgesic doses	1.32 ± 0.48	1.20 ± 0.41	0.341	Independent t-test

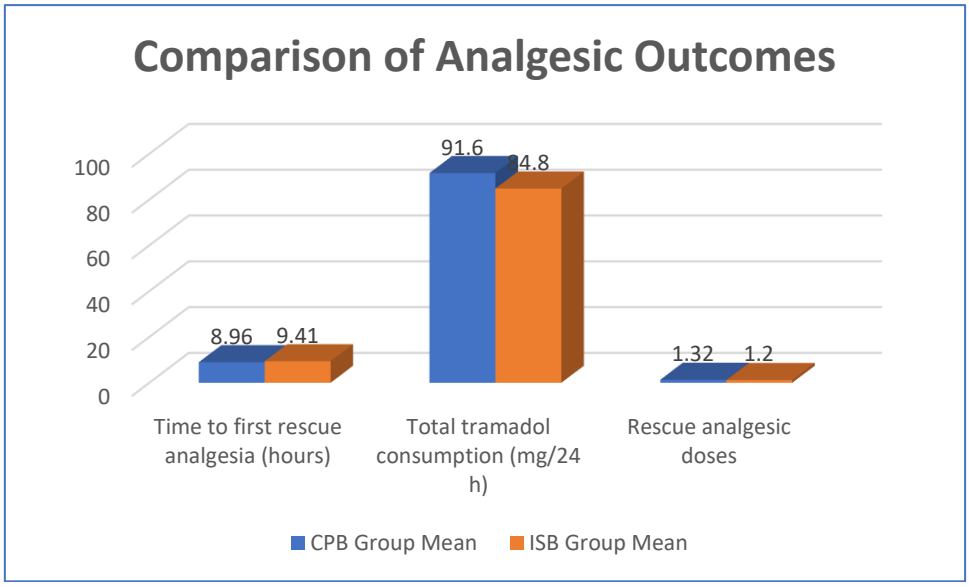

Figure 2 Comparison of Analgesic Outcomes

Table 4. Comparison of Diaphragmatic Function

Diaphragmatic function	CPB (n=25)	ISB (n=25)	p-value	Statistical test
Normal movement	24 (96.0%)	16 (64.0%)	0.006	Fisher's Exact test
Reduced excursion	1 (4.0%)	6 (24.0%)		
Hemidiaphragmatic paresis	0 (0%)	3 (12.0%)		

Table 5. Comparison of Block-related Complications

Complication	CPB (n=25)	ISB (n=25)	p-value	Statistical test
Horner's syndrome	0 (0%)	3 (12.0%)	0.074	Fisher's Exact test
Hoarseness of voice	0 (0%)	2 (8.0%)	0.149	Fisher's Exact test
Vascular puncture	0 (0%)	1 (4.0%)	0.500	Fisher's Exact test
Local anesthetic toxicity	0 (0%)	0 (0%)	—	—
Pneumothorax	0 (0%)	0 (0%)	—	—
Nausea/Vomiting	2 (8.0%)	3 (12.0%)	0.637	Fisher's Exact test

Table 6. Patient Satisfaction Score

Satisfaction	CPB (n=25)	ISB (n=25)	p-value	Statistical test
Excellent	15 (60.0%)	16 (64.0%)	0.962	Chi-square test
Good	8 (32.0%)	7 (28.0%)		
Fair	2 (8.0%)	2 (8.0%)		
Poor	0 (0%)	0 (0%)		

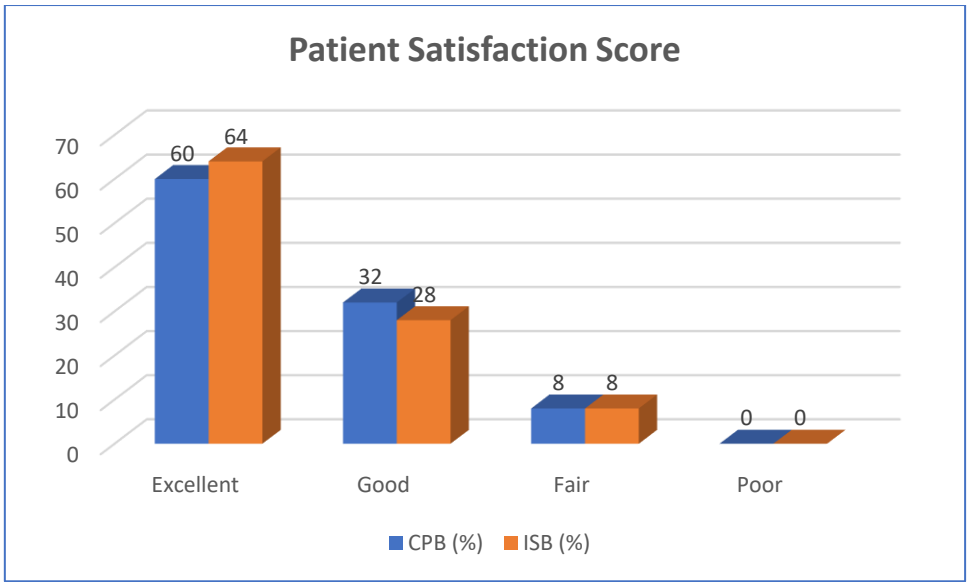

Figure 6 Patient Satisfaction Score

DISCUSSION

The present study demonstrated that ultrasound-guided clavipectoral fascial plane block (CPB) provided postoperative analgesia comparable to interscalene block (ISB). Mean VAS scores remained low throughout the first 24 hours, with no statistically significant differences at 2 hours (1.32 ± 0.56 vs. 1.18 ± 0.48), 6 hours (2.26 ± 0.81 vs. 2.08 ± 0.74), 12 hours (3.41 ± 0.92 vs. 3.18 ± 0.86), or 24 hours (2.84 ± 0.75 vs. 2.69 ± 0.71) (all $p>0.05$). Similarly, Guangmin Xu et al.[11] randomized 50 patients (25 per group) undergoing clavicle fixation and reported comparable VAS scores at 6 and 12 hours between CPB and ISB, although the CPB group demonstrated significantly lower pain scores at 24 hours together with a longer duration of analgesia. Likewise, Zhu et al.[12] evaluated 40 patients undergoing midshaft clavicle surgery and found that CPB combined with intermediate cervical plexus block produced postoperative analgesia equivalent to ISB with intermediate cervical plexus block while significantly reducing respiratory complications. Their study concluded that CPB can effectively replace ISB for clavicle surgery without compromising analgesic quality. More recently, Gupta S et al.[13] compared supraclavicular nerve block with clavipectoral fascial plane block against the SCUT block in a randomized controlled trial involving 50 patients. Both techniques provided satisfactory postoperative analgesia and high patient satisfaction, supporting the role of fascial plane blocks as effective regional anesthetic techniques for clavicle surgery.

In the present study, the mean time to first rescue analgesia was comparable between CPB and ISB (8.96 ± 1.74 vs. 9.41 ± 1.69 hours, $p=0.366$). Total tramadol consumption over the first 24 hours (91.6 ± 28.4 vs. 84.8 ± 24.9 mg) and rescue analgesic doses (1.32 ± 0.48 vs. 1.20 ± 0.41) were also similar. Comparable findings were reported by Guangmin Xu et al.[11], who observed that CPB produced a significantly prolonged duration of analgesia while maintaining opioid consumption comparable to ISB, indicating that CPB provides sustained postoperative pain relief without increasing analgesic requirements. In a prospective case series of 50 patients, Labandeyra et al.[14] reported successful use of CPB as the primary anesthetic technique for midshaft clavicle fractures. Only 18% of patients required postoperative rescue analgesia, no patient required conversion to general anesthesia, and none developed upper-limb motor blockade or hemidiaphragmatic paralysis, further supporting the analgesic efficacy of CPB. One of the most important findings of the present study was the significantly better preservation of diaphragmatic function following CPB. Normal diaphragmatic excursion was observed in 96.0% of CPB patients compared with only 64.0% in the ISB group ($p=0.006$), while hemidiaphragmatic paresis occurred in 12.0% of ISB patients but in none of the CPB patients. Similar observations were reported by Guangmin Xu et al.[11], who demonstrated a significantly higher incidence of diaphragmatic paralysis following ISB than CPB despite comparable postoperative analgesia.

Similarly, Zhu et al.[12] showed that CPB combined with intermediate cervical plexus block markedly reduced hemidiaphragmatic paralysis compared with ISB while maintaining equivalent surgical anesthesia. The authors concluded that CPB is particularly advantageous in patients with limited pulmonary reserve because it avoids phrenic nerve blockade. Block-related complications were uncommon in both groups; however, Horner's syndrome (12%), hoarseness of voice (8%), and vascular puncture (4%) occurred only in the ISB group. No cases of pneumothorax or local anesthetic systemic toxicity were observed. These findings agree with Guangmin Xu et al.[11], who also reported fewer block-related complications with CPB owing to the absence of direct brachial plexus or phrenic nerve blockade. Furthermore, Labandeyra et al.[14] observed no hemidiaphragmatic paralysis, upper-limb motor weakness, vascular injury, or neurological complications following CPB in their prospective case series, supporting the excellent safety profile of the technique. Patient satisfaction was similarly high in both groups in the present study, with excellent satisfaction reported by 60.0% of CPB patients and 64.0% of ISB patients ($p=0.962$). Guangmin Xu et al. also demonstrated similarly high

patient satisfaction despite better preservation of diaphragmatic function and upper-limb motor power in the CPB group. Likewise, Gupta S et al.[13] reported excellent patient satisfaction with CPB-based regional anesthesia for clavicle surgery, confirming that diaphragm-sparing fascial plane blocks can provide an equally satisfactory perioperative experience while minimizing adverse effects associated with interscalene block.

CONCLUSION

Ultrasound-guided clavipectoral fascial plane block provided postoperative analgesia comparable to interscalene block following elective clavicle surgery, with similar pain scores, rescue analgesic requirements, and patient satisfaction. Importantly, CPB demonstrated significantly better preservation of diaphragmatic function and a lower incidence of block-related complications. These findings suggest that CPB is an effective and safer diaphragm-sparing alternative to ISB, particularly in patients at risk of respiratory compromise. Larger multicenter studies are warranted to further validate these results and establish its role in routine clinical practice

Limitations

The present study was conducted at a single tertiary care center with a relatively small sample size, which may limit the generalizability of the findings. The postoperative follow-up was restricted to the first 24 hours, preventing assessment of long-term analgesic outcomes and functional recovery. In addition, complete double blinding was not feasible because the anesthesiologist administering the regional block was aware of the group allocation, which may have introduced procedural bias.

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