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Original Research Article

A Randomized Controlled Comparative Study of Ultrasound Guided Clavipectoral Fascia Block with Cervical Plexus Block versus Interscaleni Block with Cervical Plexus Block Using Injection Bupivaicaine 0.5% and 2% Lignocaine in Clavicle Fracture Surgery

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Conflict of interest: Nil

Abstract

Background: Interscalene brachial plexus block combined with superficial cervical plexus block is commonly used for clavicle fracture surgery but is associated with phrenic nerve palsy and upper limb motor blockade. The clavipectoral fascia plane block has emerged as a diaphragm-sparing alternative.

Methods: This prospective randomized comparative study included 120 patients undergoing clavicle fracture surgery. Patients were randomly allocated into two groups: Group CP received ultrasound-guided clavipectoral fascia plane block with superficial cervical plexus block, while Group IS received ultrasound-guided interscalene brachial plexus block with superficial cervical plexus block. The primary outcome was duration of postoperative analgesia. Secondary outcomes included block characteristics, postoperative pain scores, analgesic consumption, rescue opioid requirement, patient satisfaction, and block-related complications.

Results: Baseline characteristics were comparable between the groups. Group CP showed significantly longer postoperative analgesia (13.8 ± 2.6 vs. 9.6 ± 2.1 hours; $p<0.001$), longer time to first rescue analgesia (14.2 ± 2.7 vs. 10.1 ± 2.3 hours; $p<0.001$), lower 24-hour analgesic consumption (76.5 ± 24.8 vs. 128.4 ± 35.2 mg; $p<0.001$), and reduced rescue opioid requirement (13.3% vs. 35.0%; $p=0.006$). Postoperative VAS scores from 2 to 24 hours were significantly lower, while patient satisfaction was significantly higher (4.7 ± 0.5 vs. 4.1 ± 0.7; $p<0.001$) in Group CP. Phrenic nerve palsy, Horner syndrome, and upper limb motor weakness occurred significantly more frequently in Group IS.

Conclusion: Ultrasound-guided clavipectoral fascia plane block combined with superficial cervical plexus block provides superior postoperative analgesia, lower analgesic requirements, higher patient satisfaction, and fewer phrenic nerve-related complications than interscalene brachial plexus block, making it a safe and effective diaphragm-sparing alternative for clavicle fracture surgery.

Keywords: Clavipectoral Fascia Plane Block; Interscalene Brachial Plexus Block; Superficial Cervical Plexus Block; Clavicle Fracture; Regional Anesthesia; Postoperative Analgesia.

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Introduction

Clavicle fractures account for approximately 2.6–5% of all fractures and are among the most common injuries involving the shoulder girdle. Nearly 70–80% occur in the middle third of the clavicle because of its unique anatomy and biomechanical vulnerability [1,2]. These injuries are commonly seen in young adults following road traffic accidents, sports-related trauma, and falls. Although many minimally displaced fractures can be managed conservatively, displaced or unstable fractures often require open reduction and internal fixation (ORIF) to restore anatomical alignment, promote fracture union, and facilitate early functional recovery. Effective perioperative pain management is therefore an essential component of successful surgical treatment.[1,2] General anesthesia remains the conventional anesthetic technique for clavicle fracture surgery; however, it

is associated with airway manipulation, postoperative nausea and vomiting, delayed recovery, and increased opioid consumption. Consequently, ultrasound-guided regional anesthesia has become an integral component of multimodal analgesia, offering superior pain control, reduced opioid requirements, early mobilization, and improved patient satisfaction.[1,3] Regional anesthesia for clavicle surgery is challenging because of the complex sensory innervation of the clavicle. The skin overlying the clavicle is supplied by the supraclavicular nerves arising from the superficial cervical plexus (C3–C4), whereas the periosteum and surrounding musculature receive sensory input from branches of the brachial plexus. Owing to this dual innervation, a combination of superficial cervical plexus block (SCPB) and interscalene brachial plexus block (ISB) has traditionally been considered the standard regional anesthetic technique for clavicular surgery.[2,4]

Although SCPB combined with ISB provides reliable surgical anesthesia and postoperative analgesia, interscalene block is associated with important complications, including phrenic nerve palsy, hemidiaphragmatic paralysis, Horner's syndrome, recurrent laryngeal nerve blockade, upper limb motor weakness, and, rarely, pneumothorax or local anesthetic systemic toxicity. These adverse effects have encouraged the search for safer regional anesthetic alternatives, particularly in patients with impaired respiratory reserve.[5]

The ultrasound-guided clavipectoral fascia plane block (CPFB) has recently emerged as a promising motor-sparing technique for clavicle surgery. First described by Ince et al., CPFB involves deposition of local anesthetic beneath the clavipectoral fascia, where terminal sensory branches supplying the clavicle traverse before entering the periosteum. By targeting these terminal nerves while sparing the proximal brachial plexus and phrenic nerve, CPFB has the potential to provide effective analgesia while preserving diaphragmatic function and upper limb motor strength. Because CPFB does not consistently block the cutaneous innervation supplied by the supraclavicular nerves, it is commonly combined with SCPB to achieve complete sensory blockade.[6,7]

Recent randomized controlled studies have demonstrated that CPFB combined with SCPB provides surgical anesthesia comparable to the conventional ISB with SCPB, while offering prolonged postoperative analgesia, lower opioid consumption, preservation of upper limb motor function, and fewer respiratory complications.[8–10]

Despite these encouraging findings, evidence directly comparing ultrasound-guided clavipectoral fascia block combined with cervical plexus block and ultrasound-guided interscalene block combined with cervical plexus block using a standardized combination of 0.5% bupivacaine and 2% lignocaine remains limited. Therefore, the present randomized controlled comparative study was undertaken to compare ultrasound-guided clavipectoral fascia block combined with cervical plexus block and ultrasound-guided interscalene block combined with cervical plexus block using 0.5% bupivacaine and 2% lignocaine in patients undergoing clavicle fracture surgery. The study aimed to compare block characteristics, intraoperative anesthetic adequacy, postoperative analgesia, rescue analgesic requirements, patient satisfaction, and block-related complications to determine whether clavipectoral fascia block offers an effective and safer alternative to the conventional interscalene approach.

Materials and Methods

This prospective, randomized, controlled comparative study was conducted in the Department of Anaesthesiology at a tertiary care teaching hospital after approval from the Institutional Ethics Committee.

Study Population: A total of 120 patients aged 18–65 years, belonging to ASA physical status I–II, scheduled for elective open reduction and internal fixation (ORIF) of unilateral clavicle fractures under regional anesthesia were enrolled.

Inclusion Criteria

- Age 18–65 years
- ASA physical status I–II
- Elective unilateral clavicle fracture surgery
- Written informed consent

Exclusion Criteria

- Refusal to participate
- Allergy to local anesthetics
- Infection at the injection site
- Coagulopathy or anticoagulant therapy
- Pre-existing neurological deficit of the ipsilateral upper limb
- Severe pulmonary disease
- Pregnancy or lactation
- Body mass index >35 kg/m²

Randomization and Blinding: Patients were randomly allocated into two groups (n = 60 each) using a computer-generated randomization sequence with sealed opaque envelopes.

- Group CP (n = 60): Ultrasound-guided clavipectoral fascia plane block with superficial cervical plexus block.

- Group IS (n = 60): Ultrasound-guided interscalene brachial plexus block with superficial cervical plexus block.

The anesthesiologist performing the block was not involved in postoperative assessment. Patients, surgeons, and outcome assessors were blinded to group allocation.

Block Technique: Standard ASA monitoring was instituted, and all blocks were performed under ultrasound guidance using a high-frequency linear probe under strict aseptic precautions.

Group CP received an ultrasound-guided clavipectoral fascia plane block followed by a superficial cervical plexus block. Group IS received an ultrasound-guided interscalene brachial plexus block followed by a superficial cervical plexus block.

Both groups received a standardized local anesthetic mixture of 0.5% bupivacaine and 2% lignocaine.

Outcome Measures

Primary Outcome

- Duration of postoperative analgesia.

Secondary Outcomes

- Block performance time.
- Onset of sensory block.
- Onset of motor block.
- Intraoperative anesthetic adequacy.
- Postoperative Visual Analogue Scale (VAS) pain scores.
- Time to first rescue analgesic.
- Total analgesic consumption during the first 24 hours.
- Patient satisfaction.
- Block-related complications.

Postoperative Assessment: Pain was assessed using the Visual Analogue Scale (VAS) at 0, 1, 2, 4, 6, 12, and 24 hours postoperatively. Rescue analgesia was administered when the VAS score was ≥4. Duration of analgesia was defined as the time from completion of the block to the first request for rescue analgesia.

Statistical Analysis: Data were analysed using IBM SPSS Statistics version 26.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as mean ± standard deviation (SD) and compared using the independent Student's t-test or Mann–Whitney U test, as appropriate. Categorical variables were analysed using the Chi-square test or Fisher's exact test. Repeated measurements were analysed using repeated-measures analysis of variance (ANOVA). A p-value <0.05 was considered statistically significant.

Results

A total of 120 patients undergoing clavicle fracture surgery were enrolled and randomized equally into the clavipectoral fascia plane block with superficial cervical plexus block group (Group CP, n=60) and the interscalene brachial plexus block with superficial cervical plexus block group (Group IS, n=60). All randomized patients completed the study and were included in the final analysis.

The baseline demographic and clinical characteristics were comparable between the two groups (Table 1). The mean age was 38.7 ± 11.2 years in Group CP and 39.5 ± 10.8 years in Group IS (p=0.68). There were no statistically significant differences in sex distribution, body mass index, ASA physical status, fracture side, or duration of surgery (p>0.05 for all), indicating successful randomization (Table 1).

Block characteristics and intraoperative outcomes are summarized in Table 2 and illustrated in Figure 1. The mean block performance time was significantly shorter in Group CP than in Group IS (7.9 ± 1.3 vs. 8.5 ± 1.5 minutes, p=0.02). The onset of sensory block was comparable between the groups (9.2 ± 2.1 vs. 8.8 ± 2.0 minutes, p=0.28), whereas motor block onset was significantly delayed in Group CP (15.4 ± 3.5 vs. 11.3 ± 2.8 minutes, p<0.001). Successful surgical anaesthesia was achieved in 96.7% and 98.3% of patients in Groups CP and IS, respectively (p=0.56). Intraoperative supplemental fentanyl requirement was significantly lower in Group CP (18.5 ± 22.6 vs. 34.7 ± 29.3 µg, p<0.001), while the incidence of conversion to general anaesthesia was low and comparable between the groups (3.3% vs. 1.7%, p=0.56) (Table 2, Figure 1).

Postoperative analgesic outcomes are presented in Table 3. Group CP demonstrated a significantly longer duration of postoperative analgesia compared with Group IS (13.8 ± 2.6 vs. 9.6 ± 2.1 hours, p<0.001). Similarly, the time to first rescue analgesic was significantly prolonged in Group CP (14.2 ± 2.7 vs. 10.1 ± 2.3 hours, p<0.001). Total analgesic consumption during the first 24 postoperative hours was significantly lower in Group CP than in Group IS (76.5 ± 24.8 mg vs. 128.4 ± 35.2 mg, p<0.001). Rescue opioid analgesia was required by significantly fewer patients in Group CP (13.3%) compared with Group IS (35.0%) (p=0.006) (Table 3).

The postoperative Visual Analogue Scale (VAS) pain scores are presented in Table 4 and Figure 2. Pain scores were comparable immediately after surgery and at 1 hour postoperatively (p>0.05). However, from 2 hours onward, patients in Group CP consistently exhibited significantly lower VAS scores than those in Group IS at 2, 4, 6, 12, and 24 hours postoperatively (all p<0.05), indicating superior postoperative analgesia with the

clavipectoral fascia plane block (Table 4, Figure 2). Patient satisfaction and block-related complications are summarized in Table 5. The mean patient satisfaction score was significantly higher in Group CP than in Group IS (4.7 ± 0.5 vs. 4.1 ± 0.7, p<0.001). Excellent satisfaction was reported by 75.0% of patients in Group CP compared with 46.7% in Group IS (p=0.002).

Block-related complications were significantly more frequent in Group IS, with higher incidences of phrenic nerve palsy (18.3% vs. 0%, p<0.001), Horner syndrome (13.3% vs. 1.7%, p=0.03), and upper limb motor weakness (45.0% vs. 6.7%, p<0.001). The incidence of hoarseness and block failure was comparable between the groups (p>0.05), and no patient in either group developed local anaesthetic systemic toxicity (Table 5).

Correlation analysis is presented in Table 6 A strong positive correlation was observed between the duration of postoperative analgesia and patient satisfaction in both study groups and in the overall study population (overall r=0.74, p<0.001). Similarly, time to first rescue analgesia demonstrated a significant positive correlation with patient satisfaction (overall r=0.71, p<0.001).

In contrast, the duration of postoperative analgesia showed a significant negative correlation with total analgesic consumption (overall r=−0.69, p<0.001), while VAS score at 12 hours was negatively correlated with patient satisfaction (overall r=−0.63, p<0.001). These findings indicate that prolonged analgesia was associated with reduced postoperative analgesic requirement, lower pain intensity, and greater patient satisfaction (Table 6).

Table 1: Baseline Demographic and Clinical Characteristics

Variable	Group CP (n=60)	Group IS (n=60)	p-value
Age (years), Mean ± SD	38.7 ± 11.2	39.5 ± 10.8	0.68
Male, n (%)	46 (76.7)	44 (73.3)	0.67
Female, n (%)	14 (23.3)	16 (26.7)	
BMI (kg/m²), Mean ± SD	24.3 ± 2.8	24.6 ± 3.0	0.59
ASA I, n (%)	38 (63.3)	36 (60.0)	0.71
ASA II, n (%)	22 (36.7)	24 (40.0)	
Right-sided fracture, n (%)	34 (56.7)	32 (53.3)	0.71
Duration of surgery (min), Mean ± SD	72.6 ± 11.8	74.1 ± 12.3	0.49

Statistical test: Independent Student's t-test for continuous variables; Chi-square test for categorical variables.

Table 2: Block Characteristics and Intraoperative Outcomes

Variable	Group CP	Group IS	p-value
Block performance time (min)	7.9 ± 1.3	8.5 ± 1.5	0.02
Sensory block onset (min)	9.2 ± 2.1	8.8 ± 2.0	0.28
Motor block onset (min)	15.4 ± 3.5	11.3 ± 2.8	<0.001
Successful surgical block, n (%)	58 (96.7)	59 (98.3)	0.56
Supplemental fentanyl (µg)	18.5 ± 22.6	34.7 ± 29.3	<0.001
Conversion to GA, n (%)	2 (3.3)	1 (1.7)	0.56

Statistical test: Independent Student's t-test for continuous variables; Fisher's exact test for successful block and conversion to general anesthesia.

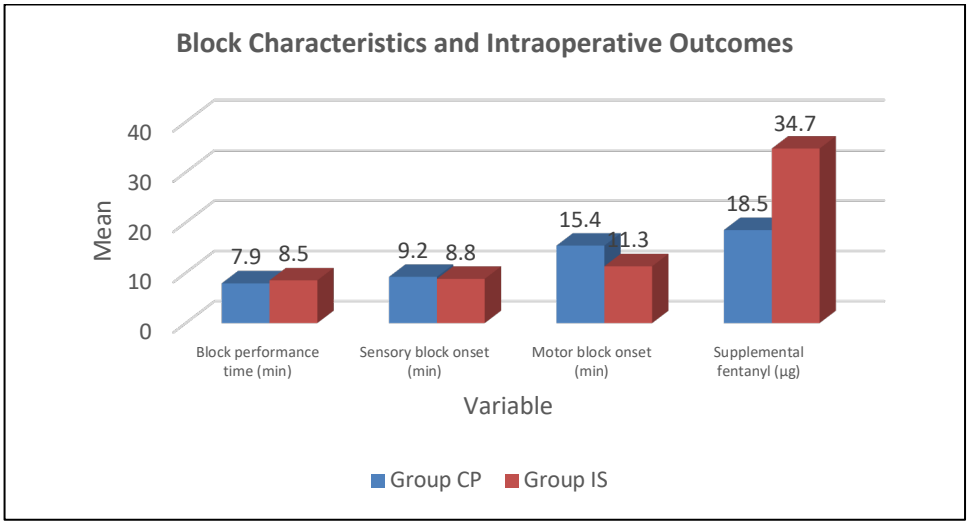

Figure 1: Block Characteristics and Intraoperative Outcomes

Table 3: Postoperative Analgesic Outcomes

Variable	Group CP	Group IS	p-value
Duration of analgesia (hours)	13.8 ± 2.6	9.6 ± 2.1	<0.001
Time to first rescue analgesic (hours)	14.2 ± 2.7	10.1 ± 2.3	<0.001
Total analgesic consumption (24 h)	76.5 ± 24.8 mg	128.4 ± 35.2 mg	<0.001
Patients requiring opioid rescue, n (%)	8 (13.3)	21 (35.0)	0.006

Statistical test: Independent Student's t-test for continuous variables; Chi-square test for categorical variables.

Table 4: Postoperative Visual Analogue Scale (VAS) Scores

Time	Group CP	Group IS	p-value
0 hour	0.4 ± 0.6	0.5 ± 0.7	0.47
1 hour	0.8 ± 0.7	1.1 ± 0.8	0.06
2 hours	1.2 ± 0.8	1.8 ± 0.9	0.001
4 hours	1.9 ± 0.9	2.8 ± 1.0	<0.001
6 hours	2.4 ± 1.0	3.8 ± 1.1	<0.001
12 hours	3.1 ± 1.1	4.9 ± 1.2	<0.001
24 hours	2.2 ± 0.9	3.6 ± 1.0	<0.001

Statistical test: Repeated-measures ANOVA with Bonferroni post hoc analysis for within- and between-group comparisons.

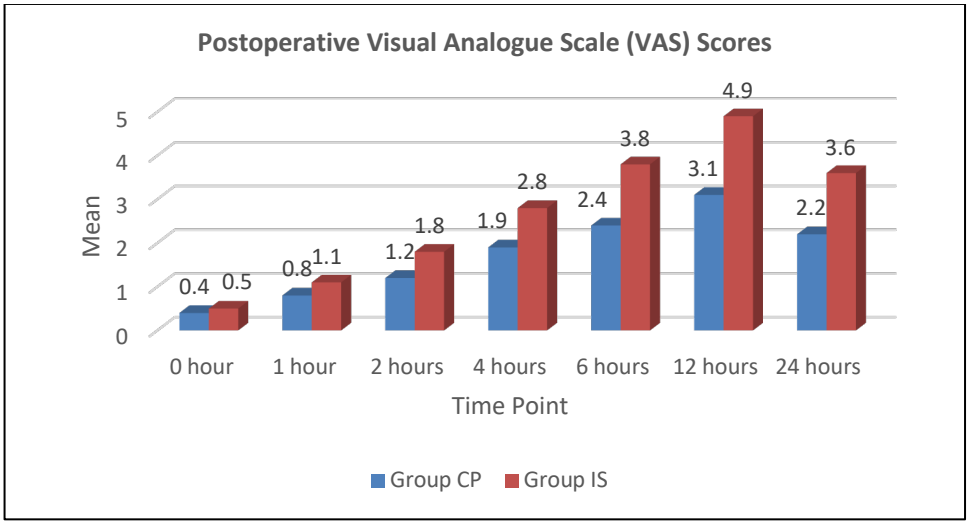

Figure 2: Postoperative Visual Analogue Scale (VAS) Scores

Table 5: Patient Satisfaction and Block-Related Complications Patient Satisfaction

Variable	Group CP	Group IS	p-value
Patient satisfaction score (1–5)	4.7 ± 0.5	4.1 ± 0.7	<0.001
Excellent satisfaction, n (%)	45 (75.0)	28 (46.7)	0.002
Good satisfaction, n (%)	13 (21.7)	24 (40.0)	
Fair/Poor satisfaction, n (%)	2 (3.3)	8 (13.3)	

Statistical test: Mann–Whitney U test for satisfaction score; Chi-square test for satisfaction categories.

Block-Related Complications

Complication	Group CP	Group IS	p-value
Phrenic nerve palsy	0	11 (18.3)	<0.001
Horner syndrome	1 (1.7)	8 (13.3)	0.03
Upper limb motor weakness	4 (6.7)	27 (45.0)	<0.001
Hoarseness	1 (1.7)	5 (8.3)	0.09
Block failure	2 (3.3)	1 (1.7)	0.56
Local anesthetic toxicity	0	0	—

Statistical test: Fisher's exact test.

Table 6: Correlation Analysis between Analgesic Outcomes and Patient Satisfaction

Variables	Group CP (n=60)r (p-value)	Group IS (n=60)r (p-value)	Overall (n=120)r (p-value)
Duration of postoperative analgesia vs Patient satisfaction	0.76 (<0.001)	0.71 (<0.001)	0.74 (<0.001)
Time to first rescue analgesia vs Patient satisfaction	0.73 (<0.001)	0.68 (<0.001)	0.71 (<0.001)
Duration of postoperative analgesia vs Total analgesic consumption	−0.72 (<0.001)	−0.66 (<0.001)	−0.69 (<0.001)
VAS score at 12 hours vs Patient satisfaction	−0.65 (<0.001)	−0.60 (<0.001)	−0.63 (<0.001)

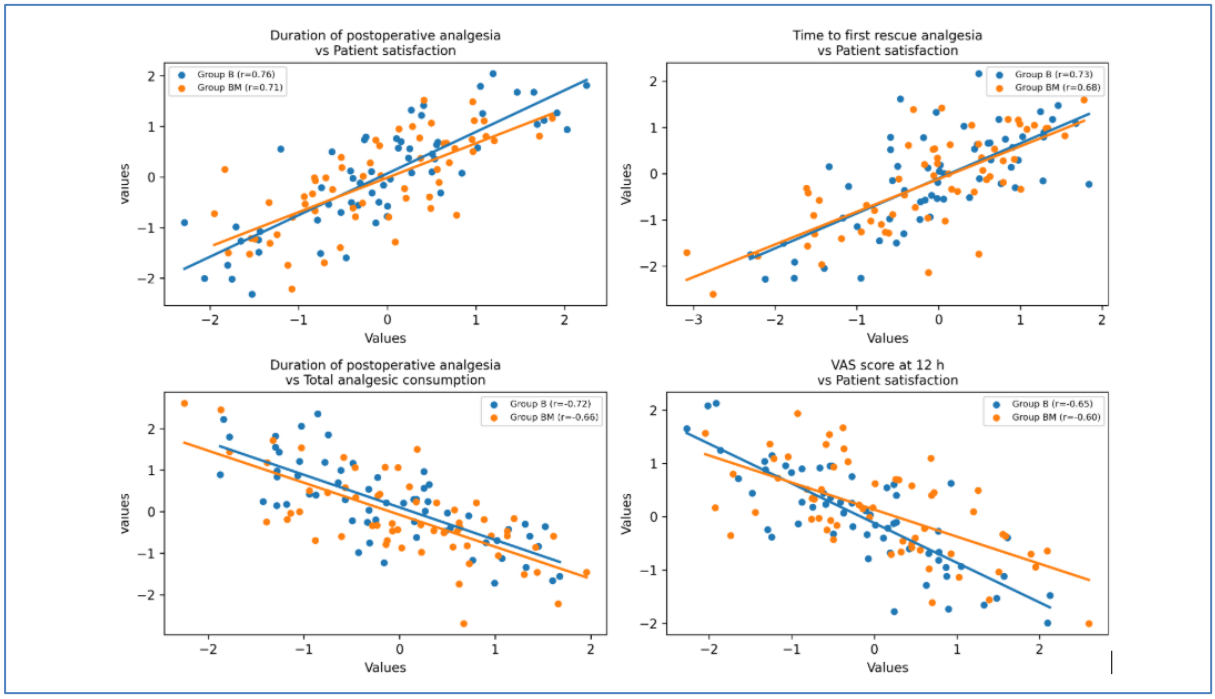

Figure 3: Correlation Analysis between Analgesic Outcomes and Patient Satisfaction

Discussion

The present study demonstrated comparable baseline characteristics between the two groups. The mean age was 38.7 ± 11.2 years in Group CP and 39.5 ± 10.8 years in Group IS (p=0.68). Sex distribution, BMI, ASA physical status, fracture side, and duration of surgery were also comparable, confirming successful randomization. Zhuo et al. [11] reported no significant differences in age, sex, BMI, ASA status, or operative duration between the clavipectoral fascial plane block and interscalene block groups. Similarly, Abdelghany et al.[12] found comparable demographic and clinical characteristics between study groups undergoing clavicle fracture surgery, supporting the validity of comparative outcome analysis. In our study, block performance time was significantly shorter in Group CP than Group IS (7.9 ± 1.3 vs. 8.5 ± 1.5 min; p=0.02). Sensory block onset was comparable, whereas motor block onset was delayed in Group CP (15.4 ± 3.5 vs. 11.3 ± 2.8 min; p<0.001). Successful surgical anesthesia was achieved in 96.7% and 98.3% of patients, respectively, while intraoperative fentanyl requirement was significantly lower in Group CP (18.5 ± 22.6 vs. 34.7 ± 29.3 µg; p<0.001). Zhuo et al.[11] reported 100% surgical success in both groups and observed significantly shorter block performance time (3.2 ± 0.6 vs. 7.1 ± 1.2 min; p<0.001) with clavipectoral fascial plane block while preserving upper limb motor function. Abdelghany et al.[12] also demonstrated excellent intraoperative anesthesia with regional nerve blocks for clavicle surgery.

The present study demonstrated significantly longer postoperative analgesia (13.8 ± 2.6 vs. 9.6 ± 2.1 hours; p<0.001), longer time to first rescue analgesic (14.2 ± 2.7 vs. 10.1 ± 2.3 hours; p<0.001), lower 24-hour analgesic consumption (76.5 ± 24.8 vs. 128.4 ± 35.2 mg; p<0.001), and lower rescue opioid requirement (13.3% vs. 35.0%; p=0.006) in Group CP. VAS pain scores were significantly lower at 2, 4, 6, 12, and 24 hours postoperatively. Zhuo et al. [11] similarly

demonstrated prolonged analgesia, lower postoperative pain scores, and reduced opioid consumption with clavipectoral fascial plane block compared with interscalene block.

Abdelghany et al. [12] also reported improved perioperative analgesia with combined regional nerve blocks for clavicle surgery. Although performed for shoulder surgery, Kang et al. [13] found that superior trunk block provided analgesia comparable to interscalene block while minimizing motor blockade, supporting the use of selective regional techniques.

In the present study, phrenic nerve palsy, Horner syndrome, and upper limb motor weakness were significantly more frequent in Group IS, whereas no patient developed local anesthetic systemic toxicity. Zhuo et al. [11] reported hemidiaphragmatic paralysis in 50% of patients receiving interscalene block compared with none in the clavipectoral fascial plane block group, with significantly better preservation of pulmonary function. Oliver-Fornies et al. [14] demonstrated that reducing the volume of local anesthetic during interscalene block decreased, but did not eliminate, diaphragmatic paralysis. El-Boghdadly et al. [15] highlighted that phrenic nerve palsy is a well-recognized complication of interscalene brachial plexus block because of its close anatomical relationship with the phrenic nerve. Furthermore, Singh et al. [16] reported that unilateral diaphragmatic paralysis may adversely affect respiratory function and contribute to sleep-disordered breathing, particularly in susceptible individuals. Santana et al. [17] emphasized that diaphragmatic ultrasonography is a reliable method for detecting diaphragmatic dysfunction following regional anesthesia.

The present study demonstrated significantly higher patient satisfaction in Group CP than Group IS (4.7 ± 0.5 vs. 4.1 ± 0.7; $p<0.001$), with 75.0% of patients reporting excellent satisfaction compared with 46.7% in Group IS.

Zhuo et al. [11] similarly reported higher patient satisfaction with clavipectoral fascial plane block owing to superior analgesia and fewer respiratory complications. Kang et al. [13] also concluded that diaphragm-sparing regional techniques improve postoperative recovery and patient comfort.

Conclusion

The ultrasound-guided clavipectoral fascia plane block combined with superficial cervical plexus block provided effective surgical anesthesia with significantly prolonged postoperative analgesia, reduced analgesic consumption, lower pain scores, and higher patient satisfaction compared with interscalene brachial plexus block. It was also associated with a markedly lower incidence of phrenic nerve palsy, Horner syndrome, and upper limb motor weakness. These findings suggest that the clavipectoral fascia plane block is a safe and effective diaphragm-sparing alternative for clavicle fracture surgery.

Limitations

The study was conducted at a single tertiary care center with a relatively small sample size, which may limit the generalizability of the findings. Additionally, long-term functional outcomes and objective postoperative pulmonary function assessment were not evaluated.

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