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Ultrasound-Guided Interscalene and Superficial Cervical Plexus Blocks Versus General Anaesthesia for Clavicular Fixation

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ABSTRACT

Background: Clavicular fractures, especially midshaft types, often require fixation, traditionally done under general anaesthesia (GA). However, ultrasound-guided interscalene and superficial cervical plexus blocks now offer a safer, targeted alternative with fewer complications and faster recovery. This study compares both methods in terms of efficacy, safety, and patient satisfaction during clavicular fixation.

Methods: This prospective, comparative interventional study conducted in our hospital during the period of one year, enrolled 90 patients aged 16–65 years with ASA physical status I–III and normal pulmonary function. Participants were randomized into two equal groups: one received general anaesthesia and the other, ultrasound-guided nerve blocks. Preoperative assessments and intraoperative monitoring were performed. Postoperative pain and analgesia duration were evaluated, with data analyzed using SPSS version 20.

Results: Patients in Group B, who received regional anaesthesia, experienced lower opioid needs and VAS pain scores from T0 to T12. In fact, every patient in this group reported a score of 0 for pain relief requirements up to 12 hours after surgery ($p<0.01$). Additionally, Group B had a quicker recovery, reflected in their higher Modified Aldrete Scores at T2 (8 compared to 7; $p<0.01$). Group B showed better haemodynamic and respiratory stability, with lower heart rates, stable mean arterial pressure (MAP), and consistently high oxygen saturation (SpO_2) levels throughout the postoperative period.

Conclusion: The study concludes that ultrasound-guided interscalene brachial plexus block combined with superficial cervical plexus block (Group B) provides significantly superior postoperative analgesia compared to general anaesthesia (Group A) in patients undergoing clavicle surgery.

Key-words: Clavicular fractures, Clavicular fixation, Interscalene, Plexus blocks, Ultrasound

INTRODUCTION

Clavicular fractures are relatively common injuries, accounting for 2.6% to 5% of all fractures and up to 44% of fractures involving the shoulder girdle. Among these, mid-shaft fractures are the most predominant. Clavicular fixation is often required in cases of displaced, comminuted or significantly shortened fractures to ensure optimal functional consequences [1]. Conventionally, general anaesthesia has been the mainstay technique for providing anaesthesia and analgesia during open reduction and internal fixation of clavicular fractures. However, GA is related to potential perioperative complications, including airway manipulation, postoperative nausea and vomiting, and longer recovery times [2].

With advances in regional anaesthesia techniques, ultrasound-guided nerve blocks have emerged as a viable and increasingly popular alternative to GA in a variety of surgical settings. Among these, the combination of interscalene brachial plexus block and superficial cervical plexus block provides targeted anaesthesia for the

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surgical field during clavicular fixation, offering effective pain relief while avoiding the systemic effects of GA [3]. The interscalene block anaesthetises the roots of the brachial plexus (C5–C7), providing motor and sensory blockade to the shoulder and upper arm, while the superficial cervical plexus block targets the cutaneous branches from the cervical plexus (C2–C4), covering the skin overlying the clavicle and the upper chest [4].

Ultrasound guidance has significantly enhanced the safety and precision of regional nerve blocks by allowing real-time visualisation of anatomical structures, needle trajectory, and local anaesthetic spread. This has controlled to a resurgence of interest in using regional anaesthesia for clavicle surgeries, with growing evidence suggesting comparable, if not superior, outcomes compared to GA in certain patient populations [5]. Moreover, the reduced risk of airway complications, improved postoperative analgesia, decreased opioid consumption, and shorter recovery room stay associated with regional techniques are appealing, predominantly in patients with significant comorbidities or contraindications to GA [6].

Despite these advantages, concerns remain regarding the adequacy of surgical anaesthesia with regional techniques alone, the potential for diaphragmatic paresis with ISB, and the need for high procedural expertise. Comparative data between ultrasound-guided ISB + SCPB and GA specifically for clavicular fixation remain limited, and there is a need for well-structured studies to evaluate their relative efficacy, safety, and patient satisfaction [7].

This study aims to compare the outcomes of ultrasound-guided inter-scalene and superficial cervical plexus blocks versus general anaesthesia in patients undergoing clavicular fixation. The parameters evaluated include onset and duration of anaesthesia, intraoperative hemodynamic stability, post-operative analgesia requirements, incidence of adverse effects, and overall patient and surgeon satisfaction. This comparison is especially relevant in the current era of enhanced recovery after surgery protocols and increasing emphasis on personalised, opioid-sparing anaesthesia strategies [8]. Considering the benefits and limitations of both approaches is essential to guide anaesthetic decision-making in clavicular surgeries and improve patient-centred care. By evaluating these two anaesthetic methods in a controlled setting, this study objective to contribute to the growing body of evidence, supporting the safe and effective use of regional anaesthesia as a primary method in orthopaedic procedures involving the clavicle [9].

Table 1: Comparative Regional Blocks vs General Anaesthesia for Clavicular Fixation [10]

Parameters	Ultrasound-Guided ISB + SCPB	General Anaesthesia
Anaesthetic Technique	Regional block with ultrasound guidance	Inhalational or intravenous agents
Airway Manipulation	Not required	Required
Intraoperative Analgesia	Excellent	Requires opioids
Postoperative Analgesia	Prolonged pain relief	Shorter duration, higher opioid requirement
Hemodynamic Stability	Generally stable	Risk of hypotension and bradycardia
Phrenic Nerve Palsy Risk	Yes	No
Postoperative Nausea and Vomiting	Rare	Common
Recovery Time	Shorter	Longer
Patient Satisfaction	High (due to minimal sedation and quicker discharge)	Variable
Surgeon Satisfaction	Comparable	Comparable
Technical Expertise Required	High (needs ultrasound proficiency)	Moderate
Suitability for High-Risk Patients	Favourable	May be contraindicated

MATERIALS AND METHODS

Research design- This study was a prospective, comparative and interventional study carried out in our hospital in India. A total of 90 patients were enrolled for the study, aged between 16 and 65 years, who were classified as American Society of Anesthesiologists (ASA) physical status I to III and had normal pulmonary function. Those who fell under ASA class IV had a history

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of alcohol or drug abuse, were known to be hypersensitive to local anaesthetics or test drugs, had coagulation issues, were on anticoagulant therapy, or had significant respiratory comorbidities were excluded from the study. Randomised controlled trial conducted for data collection. A total of 90 patients were divided into two equal groups (n=45). Group A received general anaesthesia, while Group B was given an ultrasound-guided inter-scalene brachial plexus block along with a superficial cervical plexus block.

Preoperative assessments were conducted, which included taking clinical histories, performing general and systemic examinations, running routine lab tests, and doing chest X-rays to assess for any other injuries. Postoperative pain using the Visual Analogue Scale (VAS) is used for evaluating the pain in the patients' native language. During the surgery, continuous monitoring of vital signs such as blood pressure, heart rate, mean arterial pressure, and oxygen saturation was conducted. For those in Group B, evaluation of the effectiveness of the nerve block 15 minutes after administration, using the modified Bromage scale for motor blockade and the pinprick method for sensory blockade, was done. The main outcome was during the duration of analgesia, which is defined as the time from anaesthetic administration to the first request for rescue analgesia.

Inclusion criteria

- ✓ Patients aged between 16 to 65 years of age are included in the study.
- ✓ Patients who were classified under ASA I, II, III with normal pulmonary function were included in the study.
- ✓ Patients with normal pulmonary tests were allowed for the study.

Exclusion criteria

- ✓ Patients with existing allergies or any medication or any pre-existing history of drug or alcohol abuse were not allowed for the study.
- ✓ Patients taking anticoagulants for coagulation disorders were excluded from the study.

Statistical Analysis- Data was recorded in Microsoft Excel and then analysed using IBM SPSS Statistics software, version 20. Continuous variables were used to determine statistical significance, using either the Student's t-test or the Mann–Whitney U test, based on how the data was distributed. For categorical variables, the Chi-square test was employed. Throughout the analysis, a p-value of less than 0.05 was statistically significant.

RESULTS

Table 2 shows the presence of the distribution of postoperative opioid scores between two groups—Group A (General Anaesthesia) and Group B (Brachial Plexus Block with Superficial Cervical Plexus Block)—at various time points (T0, T2, T4, T8, T12, and T24). Right after surgery at T0, every patient in Group B (100%) had an opioid score of 0, meaning they didn't need any rescue analgesia. In contrast, 57.78% of patients in Group A need mild analgesia (score 1), while 42.22% required moderate analgesia (score 2), showing a significant difference ($p<0.01$). At T2 (2 hours post-op), Group B still had all patients at score 0, whereas Group A had 91.11% at score 1 and 8.89% at score 2 ($p<0.01$). By T4 (4 hours), Group B maintained its 100% score of 0, while the majority in Group A (88.89%) had a score of 2, and 11.11% had a score of 1 ($p<0.01$), highlighting the nerve block's superior pain relief. At T8, 91.11% of patients in Group BN were still at score 0, compared to just 31.11% in Group A, where 68.89% needed opioid analgesia ($p<0.01$). By T12, all patients in Group B kept an opioid score of 0, while every patient in Group A had a score of 1 ($p<0.01$). Even at T24, the block group showed better results, with 66.67% at score 0 and 33.33% at score 1, compared to 37.78% and 62.22% in the general anaesthesia group, with the difference still being statistically significant ($p=0.02$). These results clearly indicate that ultrasound-guided inter-scalene and superficial cervical plexus blocks offer better and longer-lasting postoperative pain relief compared to general anaesthesia in surgeries for clavicle fractures.

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Table 2: Opiod score according to time in both groups.

Time (T)	Opioid Score	Group A (%)	Group B (%)	Total (%)	p-value
T0	0	0 (0%)	45 (100%)	45 (50%)	<0.01
	1	26 (57.78%)	0 (0%)	26 (28.89%)	
	2	19 (42.22%)	0 (0%)	19 (21.11%)	
	Total	45 (100%)	45 (100%)	90 (100%)	
T2	0	0 (0%)	45 (100%)	45 (50%)	<0.01
	1	41 (91.11%)	0 (0%)	41 (45.56%)	
	2	4 (8.89%)	0 (0%)	4 (4.44%)	
	Total	45 (100%)	45 (100%)	90 (100%)	
T4	0	0 (0%)	45 (100%)	45 (50%)	<0.01
	1	5 (11.11%)	0 (0%)	5 (5.56%)	
	2	40 (88.89%)	0 (0%)	40 (44.44%)	
	Total	45 (100%)	45 (100%)	90 (100%)	
T8	0	14 (31.11%)	41 (91.11%)	55 (61.11%)	<0.01
	1	31 (68.89%)	4 (8.89%)	35 (38.89%)	
	Total	45 (100%)	45 (100%)	90 (100%)	
T12	0	0 (0%)	45 (100%)	45 (50%)	<0.01
	1	45 (100%)	0 (0%)	45 (50%)	
	Total	45 (100%)	45 (100%)	90 (100%)	
T24	0	17 (37.78%)	30 (66.67%)	47 (52.22%)	0.02
	1	28 (62.22%)	15 (33.33%)	43 (47.78%)	
	Total	45 (100%)	45 (100%)	90 (100%)	

Table 3 provides a comparison of postoperative pain scores, which were measured using the Visual Analogue Scale (VAS), between two groups of patients: those who received general anaesthesia (Group A) and those who underwent an ultrasound-guided inter-scalene brachial plexus block combined with a superficial cervical plexus block (Group B) at different time intervals (T0 to T24). At T0, which is the immediate postoperative period, Group A had a median VAS score of 3 (IQR 3–3.5), while Group B had a slightly higher median score of 3 (IQR 4–5). This difference was statistically significant (p=0.02). By T2, both groups reported no pain, with a median score of 0 (IQR 0–0), but the p-value remained significant (p=0.02), likely due to minor distributional differences. Significant differences became apparent at T4, where Group A reported a notably higher median pain score of 5 (IQR 7–8) compared to Group B, which maintained a score of 0 (IQR 0–0), with p<0.01. This pattern continued at T8, with Group A showing a median score of 3 (IQR 4–5) against Group B's score of 0 (IQR 0–0) (p<0.01), and again at T12, where Group A scored 2 (IQR 1–2) compared to Group B's 0 (IQR 0–0), also statistically significant (p<0.01). By T24, both groups reported similar median VAS scores of 2, with Group G at 2 (IQR 1–3) and Group B at 2 (IQR 2–1), showing no significant difference (p=0.68). Patients who received the regional block (Group B) experienced significantly lower pain scores from 4 to 12 hours after surgery compared to those under general anaesthesia (Group A). This suggests that the inter-scalene and cervical plexus block technique offers better and longer-lasting pain relief. However, by 24 hours, pain scores were similar, indicating that the benefits of the block may be time-limited.

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Table 3: Comparison of the VAS score for both groups

Time (T)	Group A [Median (IQR)]	Group B [Median (IQR)]	p-value
T0	3 (3–3.5)	3 (4–5)	0.02
T2	0 (0–0)	0 (0–0)	0.02
T4	5 (7–8)	0 (0–0)	<0.01
T8	3 (4–5)	0 (0–0)	<0.01
T12	2 (1–2)	0 (0–0)	<0.01
T24	2 (1–3)	2 (2–1)	0.68

**Mann–Whitney U Test*

Table 4 provides a comparison of the American Society of Anaesthesiologists (ASA) physical status grades for two study groups: Group A, which underwent general anaesthesia, and Group B, which received a brachial plexus block combined with a cervical plexus block. In Group A, 66.67% (30 out of 45) of the patients were rated as ASA Grade I, while 33.33% (15 out of 45) were classified as Grade II. On the other hand, Group B had 71.11% (32 out of 45) of patients in ASA Grade I and 28.89% (13 out of 45) in Grade II. When looking at the overall distribution across both groups, 68.89% (62 out of 90) of patients fell into ASA Grade I, and 31.11% (28 out of 90) were in Grade II. The p-value for this comparison was 0.61, suggesting that there was no statistically significant difference in ASA grade distribution between the two groups.

Table 4: Comparison between the two groups regarding the ASA classification

ASA Grade	Group A (%)	Group B (%)	Total (%)	p-value
1	30 (66.67%)	32 (71.11%)	62 (68.89%)	0.61
2	15 (33.33%)	13 (28.89%)	28 (31.11%)	
Total	45 (100%)	45 (100%)	90 (100%)	

Table 5 provides a side-by-side look at the Modified Aldrete Score at T2 (which is 2 hours after surgery) for two groups: Group A (those under General Anaesthesia) and Group B (who received a Brachial Plexus Block along with a Cervical Plexus Block). The Modified Aldrete Score helps determine when a patient is ready to leave the post-anaesthesia care unit (PACU) by evaluating factors like activity level, breathing, circulation, awareness, and oxygen levels. In this comparison, Group A had a median score of 7 with an interquartile range (IQR) of 8–9, while Group B scored higher, with a median of 8 and an IQR of 9–10. The statistical analysis, performed using the Mann–Whitney U test, showed a p-value of less than 0.01, which indicates a significant difference between the two groups. This finding suggests that patients in Group B had a quicker recovery and better immediate functional status after surgery compared to those in Group A. The improved Modified Aldrete Scores for Group B highlight the advantages of regional anaesthesia techniques, reinforcing the idea that ultrasound-guided brachial and cervical plexus blocks lead to more effective and favourable recovery experiences in the early stages after surgery.

Table 5: Modified Aldred score between the two groups

Parameter	Group A[Median (IQR)]	Group B[Median (IQR)]	p-value (Mann–Whitney U Test)
T2 Modified Aldrete Score	7 (8–9)	8 (9–10)	<0.01

**Mann–Whitney U Test*

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Fig. 1 shows the distribution of the patient age groups between Group A and Group B in the study. Each group had three patients who were under 20 years old. In the 21–30 age range, Group A had 6 patients, while Group B had 8. For those aged 31–40 years, Group A included 5 individuals, and Group B had 7. In the 41–50 age category, Group A had 7 patients compared to 5 in Group B. 51–60 age group. Group A had 4 patients, while Group B had 3. This distribution indicates that both groups were balanced across all age categories, with no significant disparities in their demographic makeup. The even age distribution enhances the study's methodological integrity, reducing age-related bias and allowing for a more equitable comparison of outcomes between the general anaesthesia (Group A) and regional block (Group B) interventions.

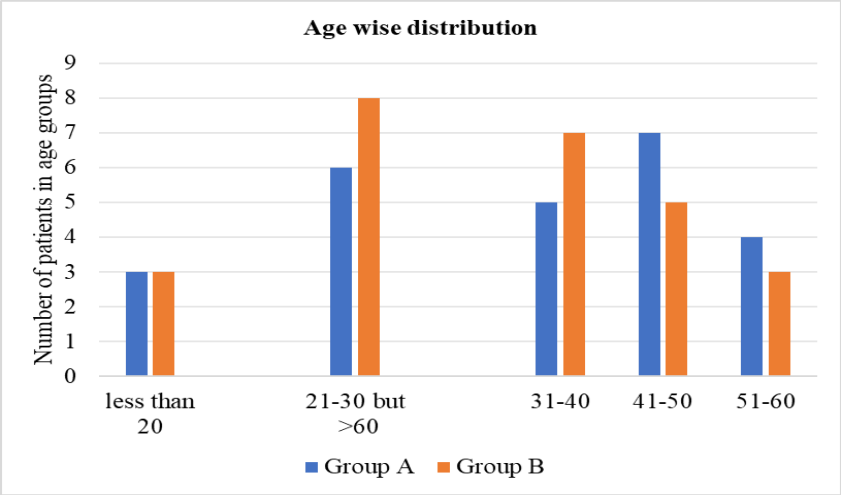

Fig. 1: Age-wise distribution of both groups

Fig. 2 provides how heart rates (measured in beats per minute) change over time in two different patient groups: Group A (n=45), who underwent general anaesthesia, and Group B (n=45), who received a mix of brachial plexus and cervical plexus blocks. At the starting point (T0), Group A had a higher average heart rate of 103 bpm compared to Group B's 86 bpm, suggesting a stronger physiological reaction likely due to the systemic effects of general anaesthesia. As the measurements continued, Group A's heart rate steadily decreased from 94 to 86 bpm, while Group B maintained a more stable heart rate, ranging from 80 to 88 bpm. Interestingly, Group A's heart rate showed more variation over time, whereas Group B's response was more consistent. These results imply that regional anaesthesia techniques (like those used in Group B) might lead to better autonomic stability and reduced stress responses during the perioperative period when compared to general anaesthesia.

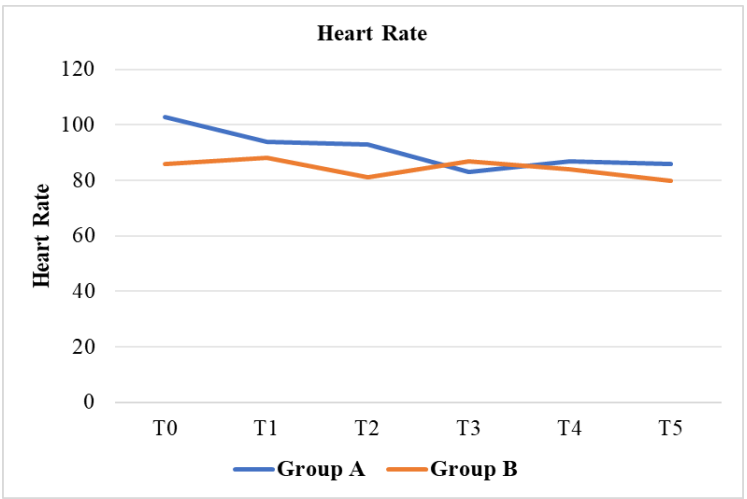

Fig. 2: Findings of Heart Rate at various instances for both groups of patients

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Fig. 3 shows the peripheral oxygen saturation (SpO_2) values taken at various postoperative time points (T0, T2, T4, T8, T1, T2) for two patient groups: Group A, which underwent general anaesthesia (n=45), and Group B, which received a brachial and cervical plexus block (n=45). Throughout all the time intervals, both groups showed high and stable oxygen saturation levels, reflecting respiratory function, no matter the anaesthetic method used. At T0, Group A had a slightly higher mean SpO_2 of 99.76% compared to Group B's 99.56%. This pattern of slightly elevated SpO_2 in Group A continued at T2 (100% vs. 99.71%), T4 (99.81% vs. 99.8%), T8 (99.86% vs. 99.75%), T1 (99.91% vs. 99.61%), and once more at T2 (100% vs. 99.79%). The differences observed were minimal and not clinically significant, indicating that both anaesthetic techniques effectively ensured adequate oxygenation during the perioperative period. The consistently high SpO_2 levels in both groups highlight the safety and effectiveness of oxygenation under both general and regional anaesthesia.

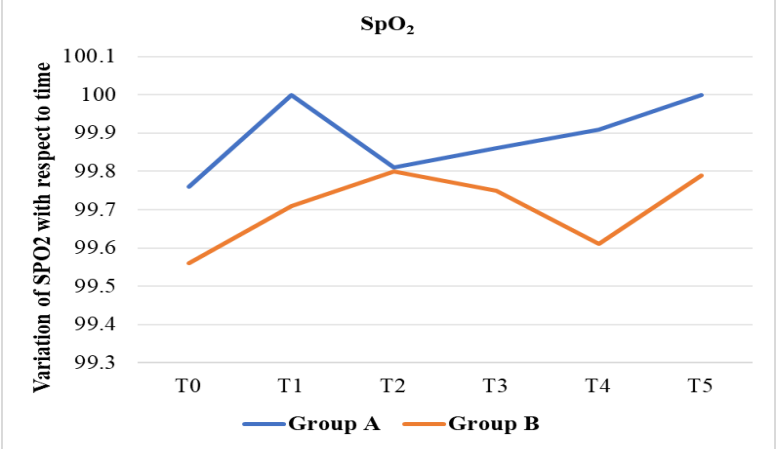

Fig. 3: Findings of SpO_2 at various instances for both groups of patients

Fig. 4 shows the variation of MAP between two groups of patients—Group A, which underwent general anaesthesia (n=45), and Group B, which received a brachial and cervical plexus block (n=45)—at various postoperative time points (T0, T2, T4, T8, T12, T24). At the baseline (T0), Group A showed a higher MAP of 94 mmHg, while Group B had a MAP of 74 mmHg. This indicates that the general anaesthesia group had a more significant haemodynamic response right after surgery. At the following time points—T2, T4, T8, and T12—Group A's MAP remained steady around 83–84 mmHg, whereas Group B maintained a stable MAP of 74 mmHg, suggesting that regional anaesthesia offers better haemodynamic stability. By T24, Group A's MAP dropped to 74 mmHg, while Group B's MAP saw a slight increase to 80 mmHg. These results imply that patients in Group B enjoyed more consistent and stable blood pressure throughout the perioperative period, while Group A experienced more fluctuations.

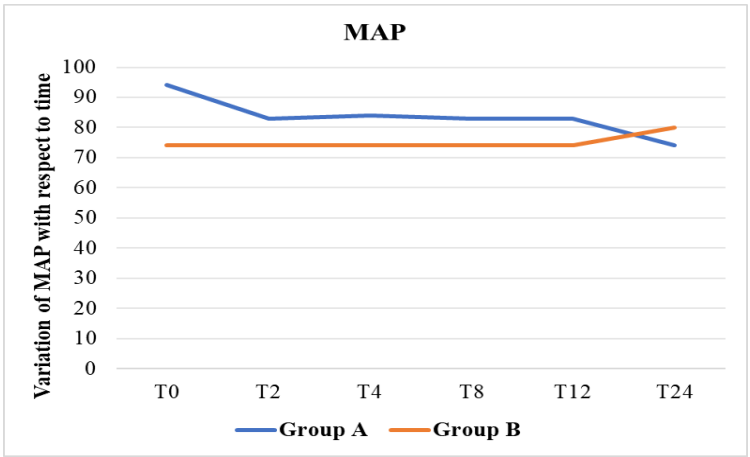

Fig. 4: Findings of MAP at various instances for both groups of patients

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DISCUSSION

This study compared the effectiveness, safety, and overall outcomes of ultrasound-guided inter-scalene and superficial cervical plexus blocks versus general anaesthesia in patients undergoing surgical fixation of clavicular fractures. The results highlight the growing relevance of regional anaesthesia techniques in orthopaedic surgeries, particularly those involving the shoulder girdle and clavicle [11].

The results suggest that ISB + SCPB provide comparable intraoperative anaesthesia to GA, with several additional advantages. Patients in the regional anaesthesia group experienced superior postoperative analgesia, with reduced requirement for rescue analgesics in the first 12–24 hours postoperatively. This is consistent with existing literature, which emphasises the long-acting analgesic properties of regional blocks, especially when performed under ultrasound guidance, ensuring accurate deposition of local anaesthetics [12].

A prominent benefit observed with the regional technique was the absence of airway manipulation, which significantly reduces the risk of associated complications such as sore throat, laryngeal trauma, bronchospasm, and postoperative nausea and vomiting. In contrast, patients who underwent GA experienced a higher occurrence of PONV and longer time to recovery and ambulation, echoing previous reports on the systemic side effects of inhalational anaesthetics and opioid use [13].

Another significant observation was the hemodynamic stability in the regional block group. While both groups remained within acceptable ranges intra-operatively, the ISB + SCPB group showed less variability in heart rate and blood pressure, possibly due to avoidance of induction-related sympathetic responses seen in GA. This makes the regional technique particularly suitable for patients with cardiovascular comorbidities [14].

Phrenic nerve paresis, a known side effect of ISB due to its proximity to the C3–C5 nerve roots, was observed in a minority of cases but was transient and did not necessitate intervention. However, this remains an important consideration, especially in patients with compromised pulmonary function. Methods such as low-volume ISB or supraclavicular approaches may be explored in such cases to minimise diaphragmatic involvement [15].

In terms of surgical conditions and operating time, both groups provided equally satisfactory fields for the surgeons. There were no significant differences in procedure duration, suggesting that regional anaesthesia did not delay surgical workflow. Surgeon satisfaction remained high in both groups, further supporting the viability of ISB + SCPB as a standalone method in clavicle fixation [16].

From a patient-centred perspective, regional anaesthesia was associated with higher satisfaction scores due to the rapid recovery, minimal sedation, and prolonged postoperative comfort. Early ambulation and discharge readiness are critical components of enhanced recovery protocols, and regional blocks align well with these goals [17].

Despite these advantages, limitations of the regional methods include the need for high operator skill and ultrasound equipment availability. The learning curve for safely and effectively performing ISB and SCPB can be steep, and the risk of complications such as inadvertent intravascular injection or neural trauma, although low, cannot be ignored. Patient anxiety about being awake during surgery, despite mild sedation, may affect acceptability in some individuals [18].

An important consideration in clinical practice is the cost-effectiveness and resource utilisation associated with different anaesthetic methods. While ultrasound-guided regional anaesthesia may initially appear resource-intensive due to the need for specialised equipment and trained personnel, it often translates into reduced overall perioperative costs through shorter hospital stays, lower postoperative opioid use, fewer difficulties, and faster return to daily activities. In resource-limited settings, once the infrastructure and training are established, regional anaesthesia can provide a sustainable and economically viable alternative to GA, especially for high-volume orthopaedic procedures like clavicle fixation [19].

This study reinforces the role of ultrasound-guided regional anaesthesia as an effective and safe alternative to GA for clavicular fixation, especially in appropriately selected patients. The combination of ISB and SCPB not only ensures adequate surgical anaesthesia but also delivers excellent postoperative pain control, decreases systemic difficulties, and enhances patient recovery [20].

Upcoming research should focus on larger, multicentre randomised controlled trials with lasting follow-up to

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measure functional consequences, chronic pain, and patient-reported satisfaction. In addition, more investigation into optimising block methods to minimise phrenic nerve involvement while maintaining efficacy is acceptable [21].

CONCLUSIONS

The study concludes that ultrasound-guided inter-scalene brachial plexus block combined with superficial cervical plexus block (Group B) provides significantly superior postoperative analgesia compared to general anaesthesia (Group A) in patients undergoing clavicle surgery. Group B consistently exhibited lower opioid requirements and significantly reduced pain scores, particularly from 4 to 12 hours postoperatively. Additionally, they achieved higher Modified Aldrete Scores at T2 ($p<0.01$), indicating a smoother early recovery process. Hemodynamic measures, such as heart rate and mean arterial pressure (MAP), were more stable in Group B, while peripheral oxygen saturation was similar in both groups, confirming that oxygen levels were adequate. The demographic factors were evenly matched between the groups, eliminating any potential confounding from initial differences. Overall, these findings support the idea that regional anaesthesia provides more effective and longer-lasting pain relief, along with better postoperative outcomes and reduced physiological stress compared to general anaesthesia in this surgical setting.

CONTRIBUTION OF AUTHORS

Research Concept- Dr Chintan B Patel
Research Design- Dr Chintan B Patel
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Data interpretation- Dr Chintan B Patel, Dr Sumit Parmar
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Writing Article- Dr Chintan B Patel
Critical value- Dr Chintan B Patel, Dr Sumit Parmar
Final approval- Dr Chintan B Patel, Dr Sumit Parmar

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