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Original Research Article

BALANCING EFFICACY AND SAFETY: A COMPARATIVE ANALYSIS OF INTERSCALENE VS SUPRACLAVICULAR BLOCK IN SHOULDER SURGERY

D. Srividya[1], G. Krishnaja[2], B. Saragini Priya[3], Raveena Miryala[3], N. Gopalreddy[4]

[1]*Assistant Professor, Department of Anaesthesiology, Kamineni Institute of Medical Sciences, Narketpally Nalgonda, Telangana, India.*
[2]*Senior Resident, Department of Anaesthesiology, Kamineni Institute of Medical Sciences, Narketpally Nalgonda, Telangana, India.*
[3]*Post Graduate, Department of Anaesthesiology, Kamineni Institute of Medical Sciences, Narketpally Nalgonda, Telangana, India.*
[4]*Professor, Department of Anaesthesiology, Kamineni Institute of Medical Sciences, Narketpally, Nalgonda, Telangana, India.*

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Corresponding Author:
Dr. D. Srividya,
Assistant Professor, Department of Anaesthesiology, Kamineni Institute of Medical Sciences, Narketpally Nalgonda, Telangana, India.
Email: srividyadevara@gmail.com

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ABSTRACT

Background: Regional anaesthesia techniques such as ultrasound-guided brachial plexus blocks are preferred for shoulder surgeries due to their superior analgesia, reduced opioid requirements, and minimal systemic side effects. Among these, interscalene and supraclavicular approaches are widely used. However, their comparative efficacy and safety remain a subject of ongoing clinical evaluation.

Materials and Methods: This prospective, randomized, comparative study was conducted at the Department of Anaesthesia from August 2024 to June 2025. A total of 100 patients aged 18–65 years, scheduled for elective shoulder surgeries, were randomly assigned into two groups: Group I (Interscalene block, n=50) and Group S (Supraclavicular block, n=50). Blocks were performed under ultrasound guidance using 20 mL of 0.5% ropivacaine. Parameters assessed included block onset time, duration of analgesia, intraoperative opioid consumption, block-related complications, and patient satisfaction scores.

Results: The mean onset time was significantly shorter in Group I (6.4 ± 1.2 min) compared to Group S (8.1 ± 1.5 min, $p<0.001$). Duration of analgesia was longer in Group I (728 ± 94 min vs 662 ± 88 min, $p=0.002$). Group S had a lower incidence of diaphragmatic paresis (4% vs 20%, $p=0.014$). Intraoperative fentanyl requirement was comparable between groups. Patient satisfaction was higher in Group I ($p=0.045$).

Conclusion: Ultrasound-guided interscalene block offers faster onset and longer analgesia for shoulder surgeries, whereas the supraclavicular approach may be safer regarding respiratory complications. Technique selection should consider both clinical goals and individual patient risk profiles.

Keywords: Ultrasound-guided block, Interscalene block, Supraclavicular block, Shoulder surgery, Regional anaesthesia, Diaphragmatic paresis.

INTRODUCTION

Shoulder surgeries, including arthroscopic and open procedures, are often associated with significant postoperative pain that can impair early mobilization, delay recovery, and increase opioid consumption if not adequately managed.[1] Regional anaesthesia has emerged as a cornerstone in perioperative pain control for upper limb surgeries, offering superior analgesia, reduced systemic side effects, and better patient satisfaction when compared to general anaesthesia alone.[2]

Among the regional techniques available, brachial plexus block (BPB) is highly effective for shoulder surgeries. The brachial plexus can be approached at multiple anatomical levels—namely interscalene, supraclavicular, infraclavicular, and axillary—with each approach having specific advantages and limitations based on the target surgical site and the potential for complications.[3] The interscalene approach is considered the gold standard for shoulder surgeries due to its consistent blockade of the upper trunks, which innervate the shoulder region.[4] However, it carries a relatively high risk of phrenic

nerve blockade, leading to diaphragmatic paresis and potential respiratory compromise, particularly in patients with pre-existing pulmonary disease.[5]

On the other hand, the supraclavicular approach, which targets the brachial plexus at the level of the trunks and divisions, offers dense anaesthesia of the upper limb while traditionally being reserved for surgeries below the shoulder. With advancements in ultrasound imaging, there has been increasing interest in utilizing the supraclavicular block for shoulder procedures, as it may avoid some of the complications associated with the interscalene approach.[6]

Ultrasound guidance has significantly improved the safety and efficacy of regional anaesthesia. Real-time visualization enables precise needle placement, reduces local anaesthetic volume requirements, and minimizes the risk of inadvertent vascular or nerve injury.[7] The integration of ultrasound has further fuelled the debate regarding the optimal brachial plexus block approach for shoulder surgeries, as newer evidence suggests that supraclavicular blocks may provide adequate surgical anaesthesia with fewer respiratory complications.[8]

Despite the growing body of literature, there is still no consensus on the superior approach between interscalene and supraclavicular blocks for shoulder surgeries. Prior comparative studies have shown conflicting results with respect to block onset times, duration of analgesia, and complication rates.[9] Additionally, the incidence of hemidiaphragmatic paresis and the effect on postoperative pulmonary function remain important factors in deciding the ideal technique, especially in ambulatory or high-risk patients.[10]

This study was undertaken to provide a direct comparison of ultrasound-guided interscalene and supraclavicular brachial plexus blocks in shoulder surgeries.

MATERIALS AND METHODS

This prospective, randomized, single-blinded, comparative study was conducted in the Department of Anaesthesia from August 2024 to June 2025. The study aimed to compare the efficacy and safety of ultrasound-guided interscalene and supraclavicular brachial plexus blocks in patients undergoing elective shoulder surgeries. Institutional Ethics Committee approval was obtained prior to study initiation, and written informed consent was secured from all participants.

Study Population: A total of 100 adult patients, aged between 18 and 65 years, classified as American Society of Anaesthesiologists (ASA) physical status I or II, and scheduled for elective unilateral shoulder surgeries were enrolled. Patients were excluded if they had a history of coagulopathy, allergy to local anaesthetics, pre-existing neurological deficits in the operative limb, significant pulmonary disease (e.g., COPD, restrictive lung disease), local infection at the injection site, pregnancy, or BMI >35 kg/m².

Randomization and Grouping: Participants were randomly allocated into two equal groups (n=50 each) using a computer-generated random number table:

- Group I (Interscalene Block): Received ultrasound-guided interscalene brachial plexus block.
- Group S (Supraclavicular Block): Received ultrasound-guided supraclavicular brachial plexus block.

The allocation sequence was concealed in sealed opaque envelopes, and the anaesthesiologist assessing outcomes was blinded to group assignment.

Block Procedure

All patients were premedicated with intravenous midazolam 1 mg and fentanyl 1 µg/kg. Standard ASA monitors were applied. Under strict aseptic precautions and using a high-frequency linear ultrasound transducer (6–13 MHz), the respective plexus block was performed on the operative side with the patient in a semi-sitting position. A 22-gauge, 50-mm insulated needle was used for both approaches. A total of 20 mL of 0.5% ropivacaine was injected after negative aspiration for blood or air. Block onset was evaluated every 2 minutes up to 15 minutes post-injection. Sensory blockade was assessed using pinprick method over C5–C6 dermatomes, while motor blockade was assessed using shoulder abduction strength.

Outcome Measures

Primary outcomes included:

- Time to onset of sensory and motor block
- Duration of analgesia (time from block to first analgesic request)

Secondary outcomes included:

- Intraoperative opioid requirement
- Incidence of complications (e.g., Horner's syndrome, diaphragmatic paresis confirmed via ultrasonography)
- Patient satisfaction scores (0–10 scale)

Statistical Analysis: Sample size was calculated assuming a mean difference of 60 minutes in analgesia duration with a standard deviation of 90, power of 80%, and α=0.05. Data were analyzed using SPSS version 26. Continuous variables were expressed as mean ± standard deviation and compared using unpaired t-test. Categorical variables were analyzed using chi-square or Fisher's exact test as appropriate. A p-value <0.05 was considered statistically significant.

RESULTS

The present study demonstrated distinct clinical differences between ultrasound-guided interscalene and supraclavicular brachial plexus blocks in the context of shoulder surgery. Both techniques were effective, but varied significantly in terms of onset, duration, safety profile, and patient satisfaction.

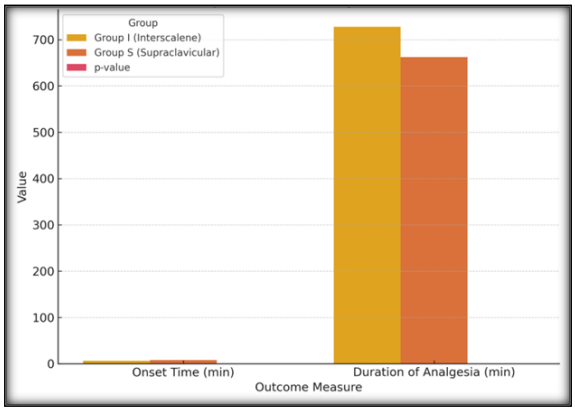

Figure 1: Comparison of primary outcomes

The onset of anaesthesia was significantly faster with the interscalene block (6.4 ± 1.2 minutes) compared to the supraclavicular block (8.1 ± 1.5 minutes; $p < 0.001$). This suggests a more rapid spread of local anaesthetic at the interscalene level, likely due to the compact arrangement of the upper roots and trunks in that region.

Analgesia duration was also significantly longer with the interscalene approach (728 ± 94 minutes) than with the supraclavicular block (662 ± 88 minutes; $p = 0.002$), implying more sustained postoperative pain relief. Despite this, intraoperative opioid requirements were statistically similar (34.2 ± 6.1 µg vs 35.6 ± 5.8 µg; $p = 0.61$), indicating that both blocks were adequate intraoperatively.

In terms of complications, the interscalene group had a notably higher incidence of diaphragmatic paresis (20% vs 4%; $p = 0.014$), aligning with its close anatomical relationship to the phrenic nerve. Although Horner's syndrome was observed in 8% of interscalene cases versus 4% in supraclavicular, this difference was not statistically significant ($p = 0.41$). Patient satisfaction scores favoured the interscalene group, where 80% of patients rated their experience between 7–10 compared to 66% in the supraclavicular group ($p = 0.045$). Fewer patients in Group I reported moderate or low satisfaction.

With regard to block performance characteristics, the interscalene block required fewer needle passes (1.4 ± 0.6 vs 1.8 ± 0.7; $p = 0.011$) and took less time to perform (4.6 ± 1.1 min vs 5.3 ± 1.3 min; $p = 0.008$), indicating procedural ease. Although vascular puncture occurred more often in the supraclavicular group (6% vs 2%), this difference did not reach statistical significance ($p = 0.27$).

Overall, the interscalene block provided superior onset and duration of analgesia, higher patient satisfaction, and procedural efficiency, while the supraclavicular approach demonstrated a safer respiratory profile, making it preferable in select patient populations.

Table 1: Demographic Characteristics

Parameter	Group I (Interscalene)	Group S (Supraclavicular)	p-value
Age (years)	42.5 ± 10.3	43.1 ± 9.8	0.63
Weight (kg)	68.4 ± 11.2	69.2 ± 10.7	0.48
Height (cm)	165.7 ± 6.4	164.3 ± 5.9	0.59
ASA I (%)	60	58	0.81
ASA II (%)	40	42	0.81

Table 2: Primary Outcome Measures

Parameter	Group I (Interscalene)	Group S (Supraclavicular)	p-value
Onset Time (min)	6.4 ± 1.2	8.1 ± 1.5	<0.001
Duration of Analgesia (min)	728 ± 94	662 ± 88	0.002

Table 3: Secondary Outcomes

Parameter	Group I (Interscalene)	Group S (Supraclavicular)	p-value
Intraoperative Fentanyl (µg)	34.2 ± 6.1	35.6 ± 5.8	0.61
Horner's Syndrome (%)	8	4	0.41
Diaphragmatic Paresis (%)	20	4	0.014

Table 4: Patient Satisfaction Scores

Score Range	Group I (Interscalene)	Group S (Supraclavicular)	p-value
0–3	2	3	–
4–6	8	14	–
7–10	40	33	0.045

Table 5: Comparative Analysis of Block Characteristics

Parameter	Group I (Interscalene)	Group S (Supraclavicular)	p-value
Time to Perform Block (min)	4.6 ± 1.1	5.3 ± 1.3	0.008
Number of Needle Passes	1.4 ± 0.6	1.8 ± 0.7	0.011
Vascular Puncture (%)	2	6	0.27

DISCUSSION

Regional anaesthesia has become a critical component in shoulder surgeries, offering superior analgesia, reduced systemic drug use, and enhanced recovery profiles. Among the techniques available, interscalene and supraclavicular brachial plexus blocks are most commonly employed. This study

sought to compare these two ultrasound-guided approaches with respect to block performance, efficacy, complications, and patient satisfaction.

The interscalene block is widely regarded as the gold standard for shoulder surgeries due to its consistent coverage of the C5–C6 nerve roots, which innervate the glenohumeral joint [1]. However, the supraclavicular approach, although traditionally reserved for distal upper limb surgeries, has gained attention for shoulder procedures due to improved visualization and potentially reduced phrenic nerve involvement under ultrasound guidance [2].

In our study, the onset of block was significantly faster in the interscalene group (6.4 ± 1.2 min) compared to the supraclavicular group (8.1 ± 1.5 min), which is in line with findings by Fredrickson MJ et al. [3], who reported shorter onset times with interscalene blocks owing to the anatomical compactness and proximity of nerve roots. Additionally, the duration of analgesia was significantly longer with the interscalene approach (728 ± 94 min vs 662 ± 88 min), which supports similar conclusions drawn by Abdallah FW et al. [4] who demonstrated more durable analgesia with interscalene blockade in shoulder arthroscopy patients.

While both techniques were effective intraoperatively, the complication profile differed. Diaphragmatic paresis occurred in 20% of interscalene blocks versus 4% of supraclavicular blocks ($p = 0.014$), consistent with the observations of Urmey WF et al. [5], who noted nearly universal hemidiaphragmatic paralysis following interscalene injection with volumes >20 mL. This reinforces the clinical recommendation by Tran DQ et al. [6] that supraclavicular block may be safer in patients with compromised respiratory function.

Patient satisfaction was notably higher in the interscalene group, with 80% of patients reporting scores between 7–10, reflecting the importance of effective and long-lasting pain relief. Similar outcomes were reported by Choi S et al. [7], who found that prolonged analgesia strongly correlated with higher satisfaction in patients undergoing shoulder surgery.

From a procedural standpoint, the interscalene block required fewer needle passes and less time to perform, supporting the work of Riazi S et al. [8], who highlighted the technical simplicity and reliable anatomy of the interscalene approach in experienced hands.

CONCLUSION

This comparative study demonstrates that ultrasound-guided interscalene brachial plexus block provides faster onset, longer duration of analgesia, and higher patient satisfaction in shoulder surgeries compared to the supraclavicular approach. Procedural efficiency, characterized by fewer needle passes and shorter block performance time, further favors the interscalene technique. However, the significantly higher incidence of diaphragmatic paresis with the interscalene approach raises important safety considerations, particularly in patients with pre-existing pulmonary compromise. The supraclavicular block, while slightly slower in onset and shorter in duration, presents a lower complication profile and remains a valuable alternative. Clinical decision-making should therefore balance analgesic efficacy with individual patient risk factors. These findings support tailored use of either technique based on surgical context and comorbidities.

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