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Original Research Article

A Comparative Study Between Ultrasound vs Ultrasound Plus Peripheral Nerve Stimulator Guided Supraclavicular Brachial Plexus Block in Adult Patients for Elective Upper Limb Surgeries

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Abstract:

Introduction: Regional anaesthesia has its own advantages like less interference with normal metabolic process and vital functions of body as compared to general anaesthesia. Brachial plexus blockade allows faster discharge from hospital and fewer side effects when compared with general anaesthesia. Among the various techniques for performing brachial plexus blocks, the supraclavicular approach is one of the most frequently utilized having a high success rate and rapid onset of sensory and motor blockade, making it ideal for procedures involving the shoulder, upper arm, or hand. The present study aims to compare the efficiency of ultrasound-guided versus ultrasound plus peripheral nerve stimulator (US + PNS)-guided approaches for supraclavicular brachial plexus block in adult patients undergoing elective upper limb surgeries.

Methods: The present prospective, comparative study to compare the efficacy and outcomes of ultrasound-guided versus ultrasound plus peripheral nerve stimulator (PNS)-guided supraclavicular brachial plexus blocks in patients undergoing elective upper limb surgeries was conducted from Feb.2023 to July. 2024 in the Department of Anaesthesiology at a tertiary care center. Once eligible patients were identified, they were non- randomly assigned to one of two groups, Group A (Ultrasound-guided) or Group B (Ultrasound + PNS-guided) using purposive sampling technique, ensuring that both groups were comparable in terms of baseline characteristics, such as age, gender, and ASA grade, allowing for a fair comparison of the outcomes. 30 cases allotted in each group so the total study sample was 60.

Results: The average block execution time in the ultrasound-only group (Group A) was 6.55 ± 1.23 minutes, significantly shorter than the 10.30 ± 1.11 minutes observed in the combined ultrasound and nerve stimulator group (Group B). The mean onset of sensory block was 8.43 ± 0.66 minutes in Group A and 8.49 ± 1.26 minutes in Group B, with no significant difference ($p = 0.80$). Motor block onset was not significantly faster in Group A (12.13 ± 0.71 minutes) than in Group B (12.25 ± 0.51 minutes), with a p-value of 0.45. Intraoperative analgesia was not required in 96.7% of patients in Group A and 93.3% in Group B, showing no significant difference ($p = 0.54$). Complication rates were 0% in both groups, with no instances of vascular puncture, pneumothorax, nerve injury, or conversion to general anaesthesia.

Conclusion: The clinical takeaway from this study is clear: ultrasound-guided supraclavicular brachial plexus block is a reliable, efficient, and safe technique that does not require augmentation with peripheral nerve stimulation for routine use. The added time and complexity introduced by nerve stimulator use were not associated with statistically significant improvements in block duration or intraoperative analgesic effectiveness.

Keywords: Brachial Plexus Block, Regional Anaesthesia, Ultrasound-Guided, Peripheral Nerve Stimulator, Intraoperative Analgesia.

Introduction

The brachial plexus is a network of nerves originating from the cervical and upper thoracic spinal cord that supplies motor and sensory innervation to the upper limb. Regional anaesthesia

has its own advantages like less interference with normal metabolic process and vital functions of body as compared to general anaesthesia [1]. Brachial plexus blockade allows faster discharge from hospital and fewer side effects when compared with general anaesthesia. Patient can also enjoy postoperative period free from nausea, vomiting, cerebral depression, and immediate postoperative pain.

Among the various techniques for performing brachial plexus blocks, the supraclavicular approach is one of the most frequently utilized having a high success rate and rapid onset of sensory and motor blockade, making it ideal for procedures involving the shoulder, upper arm, or hand. However, achieving an accurate and reliable block remains a challenge, particularly in patients with difficult anatomical features.[2]

Traditional techniques for performing supraclavicular blocks often rely on anatomic landmarks or electrical nerve stimulation to guide needle placement. This method has long been a mainstay in regional anaesthesia, providing valuable feedback that enhances the accuracy of needle placement.

However, PNS guidance alone does not allow for real-time visualization of the surrounding structures, which can increase the risk of complications such as inadvertent vascular puncture, pneumothorax, or nerve injury. [3]

By using high-frequency sound waves to create real-time images of the needle and surrounding structures, ultrasound enables the anaesthesiologist to directly visualize the brachial plexus, blood vessels, and other anatomical features. This technique offers several advantages, including improved accuracy in needle placement, reduced risk of complications, and the ability to monitor the spread of local anaesthetic.[4] Ultrasound guidance has been associated with increased success rates and a faster onset of block, but its application still requires expertise and proper training. Moreover, in certain challenging clinical scenarios such as in patients with unusual anatomy or anatomical variation ultrasound alone may not be sufficient to guarantee success. In these cases, a combination of ultrasound and peripheral nerve stimulation may offer an additional layer of assurance, improving the overall reliability of the block. [1]

This hybrid approach could provide the optimal balance of precision, efficiency, and safety, particularly in complex cases where one technique alone might not be sufficient. Despite its theoretical advantages, the combined approach has yet to be rigorously studied in direct comparison with ultrasound-guided blocks. [5]

The present study aims to compare the efficiency of ultrasound-guided versus ultrasound plus peripheral nerve stimulator (US + PNS)-guided approaches for supraclavicular brachial plexus block in adult patients undergoing elective upper limb surgeries. By evaluating various factors such as block execution time, the onset and duration of sensory and motor blockade, and the incidence of adverse effects, this research seeks to identify the optimal technique for supraclavicular block that provides the best combination of efficacy and safety.

Material And Methods

The present study is a quasi-experimental, prospective, comparative study to compare the efficacy and outcomes of ultrasound-guided versus ultrasound plus peripheral nerve stimulator (PNS)-guided supraclavicular brachial plexus blocks in patients undergoing elective upper limb surgeries. As the study was non-randomized, care was taken to ensure that inclusion and exclusion criteria were applied rigorously to minimize biases in group allocation. The study was conducted in the Department of Anaesthesiology at a tertiary care center over a period of 18 months from Feb.2023 to July. 2024, divided into data collection and data analysis phases.

Inclusion Criteria: Patients aged 18 to 60 years, ASA grade I & II, patients undergoing elective upper limb orthopedic surgery requiring regional anaesthesia under supraclavicular brachial plexus block, patients with a BMI of <30 kg/m², written informed consent obtained from the patient, patients with no contraindications for the anaesthetic agents used in the study

Exclusion Criteria: ASA grade III or IV patients, patients who refused to provide informed consent, allergies to any of the study drugs (levobupivacaine, buprenorphine), patients taking adrenergic or psychotropic drugs, Pregnant women, local skin infections or patients with coagulopathy, significant cognitive or psychiatric disorders, patients with anatomical variations that make performing the supraclavicular block challenging.

The sample for this study was selected using purposive sampling technique. Once eligible patients were identified, they were non- randomly assigned to one of two groups, Group A (Ultrasound-guided) or Group B (Ultrasound + PNS-guided) using purposive sampling technique, ensuring that both groups were comparable in terms of baseline characteristics, such as age, gender, and ASA grade, allowing for a fair comparison of the outcomes. 30 cases allotted in each group so the total study sample was 60.

The study had two comparative groups: Group A: Received only ultrasound-guided supraclavicular brachial plexus block using 0.5% levobupivacaine,

20 ml with 150 mcg buprenorphine (0.5 ml) and 4.5 ml normal saline, totaling 25 ml. and Group B: Received ultrasound plus peripheral nerve stimulation (PNS)-guided supraclavicular brachial plexus block, using 0.5% levobupivacaine, 20 ml with 150 mcg buprenorphine (0.5 ml) and 4.5 ml normal saline, totaling 25 ml.

A thorough preoperative examination including history taking, physical examination, routine and relevant investigations were done for all the patients. VAS pain score and pin prick sensation for sensory onset was explained to the patients. In operating room, all baselines' vitals were noted.

Under all aseptic precautions and standard monitoring protocols procedures were conducted. In Group A, the anatomical structures were scanned using high frequency linear ultrasound probe and brachial plexus located laterally to the subclavian artery above the first rib. The needle was inserted under real time visualization and first injection of local anaesthetic agent injected after careful aspiration between the first rib and the subclavian artery (corner pocket) to block the lower trunk. Then, the needle withdrawn carefully and redirected towards superficial components and drug injected after careful aspiration to avoid intravascular injection.

In Group B, the anatomical structures were scanned using high frequency linear ultrasound probe and brachial plexus located laterally to the subclavian artery above the first rib. Peripheral nerve stimulator was set to deliver 1mA,1 Hz at 0.1 second pulse. The needle was advanced under real time visualization and advanced to a point between the first rib and subclavian artery. Motor response as flexion of fingers and wrist were noted. Then, the current was decreased from 1mA to 0.3mA gradually and the responses were noted to avoid intraneural injections. Motor responses at 0.4- 0.6mA were accepted and local anaesthetic agent was injected after careful aspiration. Needle position adjusted as per the motor responses. Then the needle withdrawn carefully and redirected towards superficial components and drug injected after careful aspiration to avoid intravascular injection.

Results:

Table 1: Comparison of block execution time between two groups

Block execution time (min)	Group-A (N=30)	Group-B (N=30)	Total (N=60)	P value
Mean ± SD	6.55 ± 1.23	10.30 ± 1.11	8.43 ± 2.22	<0.001
Range	5.00 – 10.35	7.40 – 12.30	5.00 – 12.30	

Table 1 compared the block execution time between Group A and Group B, with 30 participants in each group. The mean block execution time in Group A was 6.55 ± 1.23 minutes, whereas in Group B it was significantly longer at 10.30 ± 1.11 minutes, resulting in an overall mean of 8.43 ± 2.22 minutes. This difference was statistically significant ($p < 0.001$). The execution time ranged from 5.00 to 10.35 minutes in Group A and from 7.40 to 12.30 minutes in Group B, with a combined range of 5.00 to 12.30 minutes across all participants.

Table 2: Comparison of additional analgesic required between two groups

Additional analgesic required	Group-A (N=30)	Group-B (N=30)	Total (N=60)	P value
No	29 (96.7%)	28 (93.3%)	57 (95.0%)	0.55
Yes	1 (3.3%)	2 (6.7%)	3 (5.0%)	

Table 2 compared the requirement for additional analgesia between Group A and Group B, each comprising 30 participants. In Group A, 29 participants (96.7%) did not require additional analgesics, while 1 participant (3.3%) did. In Group B, 28 participants (93.3%) did not require additional analgesics, and 2 participants (6.7%) did. Overall, 57 participants (95.0%) did not require additional analgesia, whereas 3 participants (5.0%) did. The difference between the groups was not statistically significant ($p = 0.55$).

Table 3: Comparison of time taken to onset of sensory block between two interventional group

Onset of sensory block (min)	Group-A (N=30)	Group-B (N=30)	Total (N=60)	P value
Mean ± SD	8.43 ± 0.66	8.49 ± 1.26	8.46 ± 1.00	0.80
Range	7.40 – 10.40	7.20 – 12.00	7.20 – 12.00	

Table 3 compared the time taken for the onset of sensory block between Group A and Group B, each consisting of 30 participants. The mean onset time in Group A was 8.43 ± 0.66 minutes, while in Group B it was 8.49 ± 1.26 minutes, with an overall mean of 8.46 ± 1.00 minutes. The difference in onset time between the two groups was not statistically significant ($p = 0.80$). The onset time ranged from 7.40 to 10.40 minutes in Group A and from 7.20 to

12.00 minutes in Group B, resulting in an overall range of 7.20 to 12.00 minutes.

Table 4: Comparison of time taken to onset of motor block between two interventional group

Onset of motor block (min)	Group-A (N=30)	Group-B (N=30)	P value
Mean ± SD	12.13 ± 0.71	12.25 ± 0.51	0.45
Range	11.08 – 13.42	11.67 – 13.33	

Table 4 presented a comparison of the time taken to achieve the onset of motor block between the two interventional groups. Group-A recorded a mean onset time of 12.13 ± 0.71 minutes, while Group-B had a slightly higher mean of 12.25 ± 0.51 minutes. The onset time ranged from 11.08 to 13.42 minutes in Group-A and from 11.67 to 13.33 minutes in Group-B. The difference between the groups was not statistically significant, as indicated by a p-value of 0.45

Table 5: Comparison of duration of sensory block between two interventional group

Duration of sensory block (hrs.)	Group-A (N=30)	Group-B (N=30)	Total (N=60)	P value
Mean ± SD	10.69 ± 0.63	10.89 ± 0.59	10.79 ± 0.61	0.21
Range	9.08 – 11.58	9.58 – 11.83	9.08 – 11.83	

Table 5 compared the duration of sensory block between Group A and Group B, each consisting of 30 participants. The mean duration of sensory block in Group A was 10.69 ± 0.63 hours, while in Group B it was slightly longer at 10.89 ± 0.59 hours, resulting in an overall mean duration of 10.79 ± 0.61 hours. The difference between the groups was not statistically significant (p = 0.21). The duration ranged from 9.08 to 11.58 hours in Group A and from 9.58 to 11.83 hours in Group B, with a total range of 9.08 to 11.83 hours across all participants.

Table 6: Comparison of duration of motor block between two interventional group

Duration of Motor Block (hrs.)	Group-A (N=30)	Group-B (N=30)	P value
Mean ± SD	8.87 ± 0.63	8.74 ± 0.60	0.416
Range	7.17 – 10.17	6.75 – 9.08	

Table 6 compared the duration of motor block between the two interventional groups. Group-A had a mean duration of 8.87 ± 0.63 hours, while Group-B had a slightly lower mean duration of 8.74 ± 0.60 hours. The duration ranged from 7.17 to 10.17 hours in Group-A and from 6.75 to 9.08 hours in Group-B. Statistical analysis using an unpaired t-test revealed that the difference between the groups was not statistically significant, with a p-value of 0.416.

Discussion:

Demographic Profile: In the present study, the mean age of patients in Group A was 40.83 ± 11.61 years and those in group B was 38.17 ± 11.39 years (P=0.37). There was no statistically significant difference between the mean ages of two groups.

The gender distribution in present study, Group A had 14 (46.7%) male cases and 16 (53.3%) were female cases where in Group B 15(50%) were male cases and 15(50%) were female cases. No significant difference was observed in the gender distribution of the cases between the groups (P-Value=0.80). The mean body mass index of patients in Group A was 22.80 ± 0.93 and in Group B was 22.45 ± 1.13 which was statistically insignificant. (p= 0.19) In our study, in Group A 15 (25%) patients were of ASA-I category and 15 (25%) patients of ASA-II category while in Group B 15 (25%) patients were of ASA-I category and 15 (25%) patients of ASA-II category. There was no statistically significant difference between the ASA grading. In our study, the duration of surgery in group A was 110.00 ± 12.32 mins and group B subjects had a duration of 111 ± 23.46 mins. (p = 0.76), which was also not statistically significant.

Block Execution Time: In this study, the average block execution time in the ultrasound-only group (Group A) was 6.55 ± 1.23 minutes, reflecting the rapidity and efficiency of performing supraclavicular brachial plexus blocks under ultrasound guidance. The block execution time in the combined guidance group (Group B) was longer, averaging 10.30 ± 1.11 minutes. This increase compared to the ultrasound-only group (6.55 minutes) is expected due to the additional procedural steps required for nerve stimulation, including nerve response identification and adjustment of needle position based on motor response.

This finding is strongly supported by Williams SR et al. (2003), who reported that ultrasound-guided blocks took significantly less time (mean 5.0 minutes) compared to landmark-based neurostimulation techniques (9.8 minutes, p = 0.0001) [5]. Our results are in line with theirs, confirming that ultrasound improves procedural efficiency.

Ratnawat et al. (2016) similarly found a mean execution time of 6.27 ± 1.10 minutes in the ultrasound group, which was significantly shorter than the 8.0 ± 1.53 minutes observed in the PNS group ($p < 0.0001$) [6].

Collectively, these studies reinforce the conclusion that ultrasound reduces the time required to perform a block. While, the combined approach yielded a 100% first-attempt success rate, its extended execution time poses practical considerations in busy clinical environments.

This aligns with Abhinaya et al. (2017), who reported a longer block performance time in supraclavicular blocks with combined guidance (11.53 ± 2.90 min) compared to infraclavicular blocks (9.57 ± 3.19 min), where fewer adjustments were necessary [7].

Alfred et al. (2018) found that ultrasound-guided blocks alone were significantly faster (11.57 ± 2.75 min) than PNS-guided blocks (21.73 ± 4.84 min, $p < 0.05$), suggesting that each added modality can introduce procedural delays if not performed efficiently [8].

Onset Of Sensory Block: In Group A, the mean onset time for sensory block was 8.43 ± 0.66 minutes, indicating a rapid onset of anaesthetic action when guided by ultrasound. This demonstrates the value of real-time local anaesthetic deposition near nerve structures, facilitating faster pharmacodynamic action due to precise delivery. In Group B, the onset of sensory block was 8.49 ± 1.26 minutes. This value is nearly identical to that of Group A, with no statistically significant difference between the two ($p = 0.80$). While neurostimulation was used to confirm needle placement, it appears to offer no additional benefit in hastening the onset of sensory blockade when ultrasound is already being used.

This mirrors the observation of Ratnawat et al. (2016), who found that sensory block onset was significantly faster in the ultrasound group (6.46 ± 1.02 minutes) than in the PNS group (7.68 ± 1.33 minutes, $p < 0.0001$) [6]. Jamwal et al. (2016) similarly reported faster sensory onset with ultrasound (7.5 ± 1.5 minutes) than nerve stimulator (10.2 ± 2.3 minutes, $p < 0.001$) [9].

Yadav et al. (2020) recorded an even faster sensory onset in ultrasound-guided blocks (4.97 ± 0.73 minutes) compared to 7.12 ± 0.86 minutes with PNS ($p < 0.05$), again reinforcing ultrasound's superiority in reducing onset time [10]. Alfred et al. (2018) found that the onset of sensory block was significantly faster with ultrasound (12.83 ± 3.64 min) versus PNS (16 ± 3.57 min, $p < 0.05$), though both values were longer than in our findings, potentially due to variation in drug concentration or patient factors [8].

The findings of our study fall well within the range of previously published results and support the continued use of ultrasound for achieving a faster onset of anaesthesia.

Onset Of Motor Block: The onset of motor block in Group A was 12.13 ± 0.71 minutes. This is slightly faster than Group B (12.55 ± 0.51 minutes), and the difference approached not statistical significance ($p = 0.45$). This trend suggests that ultrasound alone may expedite motor block onset due to rapid and focused anaesthetic delivery. Yadav et al. (2020) also reported faster onset in ultrasound (7.21 ± 0.77 min) versus PNS (9.42 ± 1.06 min, $p < 0.05$) [10]. In contrast, Alfred et al. (2018) noted a longer motor block onset (23 ± 4.27 min with ultrasound and 27 ± 3.85 min with PNS, $p < 0.05$), likely due to using lower concentration anaesthetics or delayed absorption [8]. Regardless, the trend consistently favors ultrasound as the quicker technique. The present study's findings confirm that ultrasound alone achieves faster motor block onset, likely due to immediate and precise drug deposition—one of the most critical factors in block onset timing.

Duration Of Sensory Block: In this study, the mean duration of the sensory block in the ultrasound-only group (Group A) was 10.69 ± 0.63hours. This prolonged duration is clinically advantageous, ensuring extended postoperative analgesia and reduced need for systemic analgesics. The mean duration of sensory block in Group B was 10.89 ± 0.59 hours, slightly shorter than in Group A (10.69 hours), though the difference was not statistically significant ($p= 0.21$). This suggests that the addition of a nerve stimulator does not significantly impact the duration of sensory blockade when ultrasound is already used for anatomical guidance.

These results align with findings from Srinivas HT et al. (2019), who reported a significantly longer sensory block duration in the ultrasound group (10.12 ± 1.14 hours) compared to 7.41 ± 0.68 hours in the PNS group ($p < 0.0001$) [4]. Although slightly shorter than our results, their trend supports the superior duration of blocks achieved with ultrasound.

Ratnawat et al. (2016) also observed extended sensory block duration in the ultrasound group (8 hours) compared to the PNS group (7 hours), attributing this difference to more accurate anaesthetic deposition under direct visualization [6].

Alfred et al. (2018) further validated this with sensory block durations of 8.00 ± 0.89 hours in the ultrasound group versus 7.25 ± 1.41 hours in the PNS group ($p < 0.05$) [8].

Rathod et al. (2024), who found that ultrasound guidance resulted in longer sensory blockade (8 hours) than PNS (7 hours, $p < 0.05$), with no

reported benefit from using both modalities together [88]. Likewise, Srinivas HT et al. (2019) concluded that ultrasound alone provided more durable sensory block effects than PNS and highlighted its superior precision in anaesthetic placement [4].

In summary, the addition of a nerve stimulator offers no meaningful improvement in sensory block longevity over ultrasound alone. This finding suggests that real-time visual confirmation remains the most reliable factor for effective, long- lasting regional anaesthesia.

Duration Of Motor Block: Group A showed a mean motor block duration of 8.87 ± 0.63 hours, providing sustained postoperative immobility and analgesia for upper limb procedures. This duration supports efficient surgical recovery and reduced analgesic demand. The prolonged duration is likely due to precise anaesthetic targeting enabled by ultrasound.

This is consistent with findings from Yadav et al. (2020), who reported a motor block duration of 270.21 ± 10.69 minutes in the ultrasound group, significantly longer than the PNS group (235.81 ± 16.16 minutes, $p < 0.05$) [10]. Rathod et al. (2024) also observed longer motor block in the ultrasound group (7 hours) compared to the nerve stimulator group (6 hours, $p < 0.05$), indicating that ultrasound alone is more than sufficient to achieve long-lasting motor blockade [11].

Overall, the motor block duration achieved with ultrasound is clinically favorable and comparable or superior to previous studies, confirming that ultrasound guidance maximizes both block reliability and longevity.

In Group B, the mean duration of motor block was 8.87 ± 0.60 hours—slightly longer than Group A. Although the difference was not statistically significant ($p = 0.176$), the trend may suggest that precise motor nerve confirmation contributes to slightly prolonged effect.

This outcome is in line with Khobragade et al. (2021) showed longer motor block duration in the ultrasound group (12.1 ± 1.8 min onset; 7 hours duration) compared to PNS (16.5 ± 2.4 min onset; 6 hours duration, $p < 0.05$), suggesting that direct visualization plays a larger role than functional confirmation [12].

Since both groups in our study used ultrasound, the marginal increase in Group B might be due to the operator getting better at using it with more practice, but this improvement did not lead to better results in patient care.

Intraoperative Analgesia Requirement: In this study, the ultrasound-guided supraclavicular brachial plexus block (Group A) demonstrated excellent intraoperative analgesic efficacy. Out of 30 patients, 29 (96.7%) did not require any additional intraoperative analgesia. This outcome strongly indicates that ultrasound guidance facilitates effective and sustained nerve blockade sufficient for the entire duration of upper limb surgery. In the ultrasound plus peripheral nerve stimulator guided block (Group B), 28 of 30 patients (93.3%) did not require intraoperative analgesia, while 2 patients (6.7%) did. This is slightly inferior to the ultrasound-only group (96.7%), but the difference is clinically marginal and statistically nonsignificant ($p = 0.54$). These findings are similar, to that of Williams SR et al. (2003), who reported that 85% of patients receiving ultrasound-guided blocks with neurostimulation achieved surgical anaesthesia without requiring any supplementary agents ($p = 0.28$) [5]. In another comparative trial, Jamwal et al. (2016) observed that ultrasound-guided supraclavicular blocks resulted in a significantly lower failure rate (3.3%) compared to nerve stimulator-guided blocks (8.3%), with fewer patients requiring rescue analgesics during surgery [9]. These studies reinforce that ultrasound not only increases block accuracy but also improves its effectiveness over time. A broader perspective is provided by Rathod et al. (2024), who demonstrated a similarly high effectiveness of ultrasound-guided blocks in terms of maintaining surgical anaesthesia, reporting a success rate of 97.5% with minimal need for intraoperative analgesic supplementation [11]. Their study confirmed that the visualization capabilities of ultrasound aid in more precise local anaesthetic deposition, which contributes to superior intraoperative block performance.

Block Effectiveness: In terms of overall block effectiveness, Group A had 96.7% of blocks deemed "totally effective" (29 out of 30), while Group B had 93.3% (28 out of 30). No conversions to general anaesthesia occurred in either group, and only a small number of patients required supplemental intraoperative analgesia—one in Group A and two in Group B. The difference in effectiveness was statistically nonsignificant ($\chi^2 = 0.35$, $p = 0.54$). These findings are consistent with those of Williams SR et al. (2003), who reported surgical anaesthesia without supplementation in 85% of their ultrasound-guided group, compared to 78% in the neurostimulator group ($p = 0.28$) [5]. The improvement in our study may reflect modern ultrasound resolution and technique standardization. Srinivas HT et al. (2019) and Rathod et al. (2024) also reported higher success rates with ultrasound (96.67% and 97.5% respectively) than with PNS (80% and 90%, respectively), confirming that ultrasound improves block reliability across settings [4][11]. Taken together, our data supports the conclusion that both ultrasound and combined guidance techniques are highly effective. However, ultrasound alone is sufficient to achieve near-complete success, suggesting that nerve stimulation

may be reserved for select or challenging cases rather than routine use.

Complication Rate: In this study, ultrasound-guided supraclavicular brachial plexus blocks (Group A) demonstrated a 100% complication-free profile. This confirms the high safety margin offered by real-time imaging and precise needle placement inherent to ultrasound technology. Also, there are no complications in ultrasound with peripheral nerve stimulation group (Group B). The absence of complications in Group B reflects the strong safety profile of combined ultrasound and nerve stimulator techniques.

Similarly, Williams SR et al. (2003), showed that the combination of ultrasound and neurostimulation reduced risk of complications like pneumothorax, which was more commonly associated with landmark-based techniques ($p < 0.05$) [5]. Their study supports the premise that visualization paired with nerve response yields a safer technique.

Jamwal et al. (2016) also reported fewer complications in the ultrasound group compared to the PNS group, although they did not combine the two modalities [9]. Nevertheless, their findings support the view that visualization is the most important determinant of safety. Our results suggest that adding a nerve stimulator does not compromise safety and may even enhance operator caution.

Studies like Surendran S et al. (2022) further bolster this claim, reporting four complications in the PNS Group Bd none in the ultrasound group, demonstrating the protective effect of visualization in block performance [13].

All these studies suggests that ultrasound-guided supraclavicular blocks, when performed by skilled operators, offer both high efficacy and a significantly reduced risk of complications. In addition, peripheral nerve stimulation can further decrease the chances of neural injuries and increases safety.

Conclusion

The findings demonstrated that both techniques are highly effective and safe, but with meaningful differences in certain clinical parameters that carry practical implications. The clinical takeaway from this study is clear: ultrasound-guided supraclavicular brachial plexus block is a reliable, efficient, and safe technique that does not require augmentation with peripheral nerve stimulation for routine use. The added time and complexity introduced by nerve stimulator use were not associated with statistically significant improvements in block duration or intraoperative analgesic effectiveness. Therefore, in typical adult patients undergoing elective upper limb surgery with identifiable anatomical landmarks, the use of ultrasound alone can be considered not only sufficient but preferable.

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