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"Study Of Comparison Of Anatomical Landmark Guided And USG Guided Supraclavicular Brachial Plexus Block In Upper Limb Surgeries"

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Abstract
Background *Regional anaesthesia is increasingly used for upper limb surgeries, with the supraclavicular brachial plexus block offering dense anaesthesia and prolonged analgesia. Traditionally performed using anatomical landmarks, the technique can be less precise and carries risks like vascular puncture or pneumothorax. Ultrasound guidance enhances safety and success by providing real-time visualization of nerves and vessels. While literature supports the advantages of ultrasound-guided blocks, factors like cost and operator skill influence technique choice. This study aimed to compare the efficacy and safety of anatomical landmark versus ultrasound-guided supraclavicular blocks.*
Aims & Objectives *To compare the efficacy, success rate, block characteristics, and complication rates of ultrasound-guided versus anatomical landmark-guided supraclavicular brachial plexus blocks in upper limb surgeries.*
Material & Methods *This 18-month interventional study at Muzaffarnagar Medical College compared ultrasound-guided and anatomical landmark-guided supraclavicular brachial plexus blocks in 100 ASA I/II patients undergoing upper limb surgeries. Patients were randomized into two groups and monitored for block onset, duration, success rate, and complications. Data were analysed using SPSS v20, with $p<0.05$ considered statistically significant.*
Results *In this study of 100 patients undergoing upper limb surgeries, 50 received ultrasound-guided blocks (Group 1) and 50 received anatomical landmark-guided blocks (Group 2). Both groups were demographically comparable. Group 1 showed significantly faster onset of sensory (3.82 vs 6.18 min) and motor block (5.20 vs 8.28 min), and longer duration of both sensory (9.04 vs 6.52 hrs) and motor blocks (8.12 vs 5.38 hrs) with $p<0.001$. Procedure time was shorter in Group 1 (4.65 vs 9.38 min), and rescue analgesia was needed later (10.88 vs 7.56 hrs). No complications occurred in Group 1, while 4% in Group 2 had vascular puncture, confirming better efficacy and safety of ultrasound guidance.*
Conclusion: *This study compared anatomical landmark and ultrasound-guided supraclavicular brachial plexus blocks for upper limb surgeries. Although the ultrasound-guided technique took slightly longer, it resulted in faster onset of sensory and motor block, better hemodynamic stability, and reduced need for additional analgesia. Despite two minor complications, it proved safer and more effective. While the landmark method offered longer block duration, ultrasound guidance remains the more precise and reliable clinical option.*
Keywords: *Supraclavicular brachial plexus block, Ultrasound-guided anaesthesia, regional anaesthesia.*

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I. Introduction

Regional anaesthesia is gaining prominence as a safe, cost-effective, and efficient option for upper limb surgeries, particularly in ambulatory settings. [1] Among the regional techniques, supraclavicular brachial plexus block is widely preferred for procedures involving the distal arm, forearm, and hand due to its ability to provide

dense anaesthesia, excellent muscle relaxation, and prolonged postoperative analgesia. [2, 3] Historically, supraclavicular blocks were performed using anatomical landmarks such as the clavicle's midpoint and subclavian artery to locate the brachial plexus near the first rib. [5] While effective, this landmark-based technique is blind, often requiring multiple needle attempts and posing risks like vascular puncture, nerve injury, or even pneumothorax, especially in the presence of anatomical variations or local trauma. [4,5,6]

To improve accuracy and safety, ultrasound guidance has emerged as a superior technique, allowing real-time visualisation of nerves, blood vessels, and needle placement, thereby increasing success rates and reducing complications. [7,8] Though the concept of ultrasound-guided nerve blocks was introduced in 1978, widespread use followed only after advancements in sonographic technology during the 1990s. [9] Current literature supports the superiority of ultrasound guidance in regional anaesthesia, with studies highlighting its benefits in terms of precise nerve localization, fewer needle passes, faster onset times, and lower complication rates. [6,8,10] Ultrasound also allows real-time monitoring of local anaesthetic spread, reducing the chances of intraneural or intravascular injection. However, considering factors such as equipment availability, operator expertise, cost, and the learning curve associated with sonographic interpretation, both techniques remain in use across various clinical settings. In resource-limited environments, the anatomical landmark method may still be preferred despite its limitations, particularly where ultrasound machines or trained personnel are unavailable.

This study was undertaken to compare the efficacy, safety, and success rates of the anatomical landmark-guided versus ultrasound-guided supraclavicular brachial plexus block in upper limb surgeries.

II. Aim & Objectives

1. To compare the effectiveness and success rate of supraclavicular brachial plexus block performed using ultrasound guidance versus the anatomical landmark technique in upper limb surgeries.
2. To assess and compare the onset time, duration of block, and incidence of complications between the two techniques.

III. Material And Methods

This hospital-based interventional study was conducted in the Department of Anaesthesiology and Critical Care at Muzaffarnagar Medical College, Muzaffarnagar, over a period of 18 months, including 12 months of data collection and 6 months of analysis. A total of 100 patients, aged 18–50 years, classified as ASA Grade I or II, and scheduled for elective upper limb surgeries lasting over 30 minutes, were enrolled after obtaining ethical clearance and informed consent. Patients with coagulopathies, neuropathies, ASA Grade III/IV status, allergies to local anaesthetics, or infection at the injection site were excluded.

Participants were randomly divided into two equal groups (n=50) using the closed envelope technique: Group 1 received the block under ultrasound guidance, while Group 2 received a supraclavicular brachial plexus block using the anatomical landmark technique. All blocks were performed under aseptic conditions using a combination of 12.5 ml of 0.5% bupivacaine and 12.5 ml of 2% lignocaine with adrenaline (1:200,000), diluted with saline to a total volume of 40 ml. Standard monitors were applied, and patients were premedicated with midazolam, glycopyrrolate, and ondansetron prior to the block. No additional sedation was administered until the block evaluation was complete. Patients were monitored intraoperatively and postoperatively for block characteristics (onset, duration), number of needle attempts, success rate, and any complications. Data collection was done at 3-minute intervals for the first 15 minutes, then every 30 minutes for at least 8 hours postoperatively. Statistical analysis was performed using SPSS v20, with Student's t-test used for continuous variables and the Chi-square test for categorical data. A p-value <0.05 was considered statistically significant.

IV. Results

The present study included a total of 100 patients undergoing upper limb surgeries, with 50 patients each in the ultrasound-guided group (Group 1) and the anatomical landmark-guided group (Group 2). Table 1 demonstrates the socio-demographic profile of participants revealed no statistically significant differences between the two groups with respect to gender, religion, or place of residence. The majority of participants in both groups were male (82% in Group 1 and 84% in Group 2) and urban residents (70% and 74% respectively). Most patients belonged to the age group of 31–40 years, followed by 20–30 years.

When comparing the onset and duration of sensory and motor blocks, Table 2 shows the ultrasound-guided group showed significantly better outcomes. The onset of sensory block was faster in Group 1 (3.82 ± 1.18 minutes) compared to Group 2 (6.18 ± 1.64 minutes), with a p-value < 0.001. Similarly, motor block onset was quicker in the ultrasound-guided group (5.20 ± 1.41 minutes) than the landmark-guided group (8.28 ± 2.16 minutes), which was also statistically significant ($p < 0.001$). The duration of sensory and motor blocks was longer in Group 1 (9.04 ± 0.82 hours and 8.12 ± 0.94 hours respectively) compared to Group 2 (6.52 ± 0.74 hours and 5.38 ± 0.76 hours), again with p-values < 0.001, indicating superior efficacy of the ultrasound technique.

Further, the ultrasound-guided group demonstrated a significantly shorter mean procedure time (4.65 ± 0.83 minutes) as compared to the landmark-guided group (9.38 ± 1.02 minutes), with a p-value < 0.001 in Table 3. In terms of postoperative pain control, the time to first rescue analgesia was significantly longer in Group 1 (10.88 ± 0.75 hours) than in Group 2 (7.56 ± 0.80 hours), highlighting the prolonged analgesic benefit associated with ultrasound guidance. Regarding complications, Figure 1 illustrates that no complications were reported in the ultrasound-guided group, whereas two patients (4%) in the anatomical landmark-guided group experienced vascular puncture. This difference was statistically significant (p < 0.05), emphasizing the safety advantage of ultrasound-guided techniques.

Table 1: Socio-demographic details of participants (N=100)

S.No	Variable	Category	Group 1 (USG Guided) n (%)	Group 2 (AL Guided) n (%)	p-value
1	Gender	Male	41 (82.0%)	42 (84.0%)	0.990
		Female	9 (18.0%)	8 (16.0%)	
2	Religion	Hindu	42 (84.0%)	43 (86.0%)	0.078
		Muslim	2 (4.0%)	2 (4.0%)	
		Others	6 (12.0%)	5 (10.0%)	
3	Residence	Rural	15 (30.0%)	13 (26.0%)	0.091
		Urban	35 (70.0%)	37 (74.0%)	
4	Age group	<20 years	1 (2.0%)	1 (2.0%)	0.306
		20–30 years	11 (22.0%)	10 (20.0%)	
		31–40 years	33 (66.0%)	30 (60.0%)	
		41–50 years	5 (10.0%)	9 (18.0%)	

Table 2: Baseline Vital Parameters and Weight

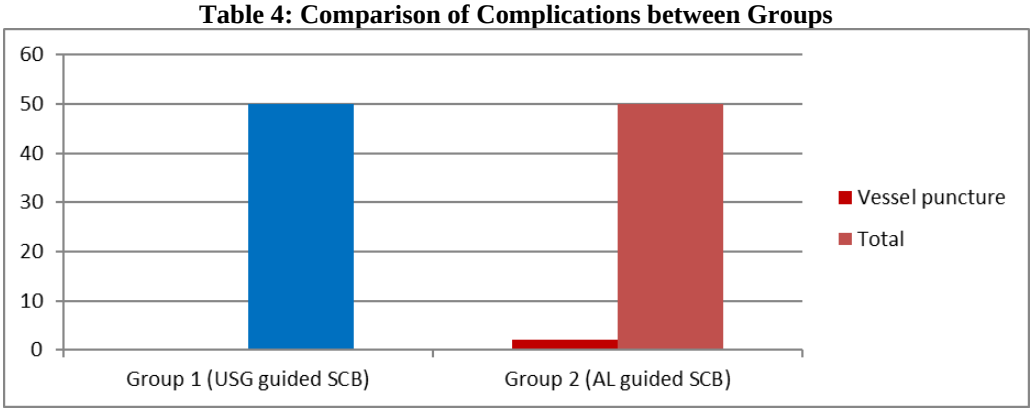
S.No	Parameter	Group 1 (Mean ± SD)	Group 2 (Mean ± SD)	p-value
1	Onset of Sensory Block (min)	3.82 ± 1.18	6.18 ± 1.64	<0.001
2	Onset of Motor Block (min)	5.20 ± 1.41	8.28 ± 2.16	<0.001
3	Duration of Sensory Block (hrs)	9.04 ± 0.82	6.62 ± 0.74	<0.001
4	Duration of Motor Block (hrs)	8.12 ± 0.94	5.38 ± 0.76	<0.001

Table 3: Mean Procedure Time and Time to First Rescue Analgesia

S.No	Parameter	Group 1 (Mean ± SD)	Group 2 (Mean ± SD)	p-value
1	Procedure Time (min)	4.65 ± 0.83	9.38 ± 1.02	<0.001
2	Time to First Rescue Analgesia (hrs)	10.88 ± 0.75	7.56 ± 0.80	<0.001

***p-value<0.05 is significant**

Table 4: Comparison of Complications between Groups



V. Discussion

In our study, both groups had comparable demographic profiles. Most patients were between 31–40 years of age, with an insignificant difference between the groups. Similar findings were noted by Kumari M et al. [4] and Shilpashri AM et al. [10], where age distributions across USG and anatomical landmark groups were not statistically different. Likewise, gender distribution showed a male predominance in both groups with no significant variation, consistent with the observations of Kumari M et al. [4] and Shilpashri AM et al. [10]. The average weight also showed no significant intergroup difference, aligning with Kumari M et al. [4]. Hemodynamic parameters revealed interesting findings: Group 2 (landmark) had significantly higher pulse rate and SBP, while DBP was higher in Group 1 (USG). This contrasts with Alfred VM et al. [11] and Kumari M et al. [4], who reported no significant difference in heart rate or blood pressure between the groups. The ultrasound-guided group had a shorter procedure time compared to the landmark group, with results statistically significant. This matches

findings from Shilpashri AM et al. [10], although contrasts with Kumari M et al. [4], who reported longer procedure time with USG.

When it came to onset of blockade, USG provided significantly quicker sensory and motor block onset. These findings were supported by Shilpashri AM et al. [10], Kumari M et al. [4], Dureja J et al. [12], and Raghove P et al. [13], all of whom noted faster onset in USG blocks. This is likely because the USG technique allows for precise deposition of aesthetic near the nerve plexus under real-time visualization, unlike the landmark approach which relies on perivascular spread. Similar conclusions were reached by Williams et al. [14] and Honnannavar et al. [15].

Duration of blockade was also significantly longer in the USG group for both sensory and motor components. This aligned well with Kumari M et al. [4], Shilpashri AM et al. [10], Dureja J et al. [12], and Raghove P et al. [13]. Although Honnannavar et al. [15] also observed longer sensory block with USG, the difference wasn't statistically significant in their studies. Need for additional analgesia was minimal in both groups, but significantly lower in the USG group. Similar trends were observed by Shilpashri AM et al. [10], where no block failure occurred in the USG group, while landmark blocks had a 13.3% failure rate. Chan VWS et al. [16] and Dureja et al. [12] also found higher success and fewer patchy effects with USG techniques. Regarding complications, the USG group had no vessel punctures, while two such cases occurred in the landmark group. This reinforces the advantage of USG in avoiding vascular structures, as demonstrated in studies by Shilpashri AM et al. [10], Kapral S et al. [17], and Honnannavar et al. [15].

In summary, ultrasound guidance proved superior across most clinical outcomes: faster and more effective block onset, longer duration, fewer complications, and reduced need for supplemental analgesia. When performed by trained professionals, USG should be the preferred method for supraclavicular brachial plexus blocks.

VI. Conclusion

This study compared anatomical landmark-guided and ultrasound-guided supraclavicular brachial plexus blocks in patients undergoing upper limb surgeries. While the ultrasound-guided technique took slightly more time to perform, it offered several advantages. It showed a faster onset of sensory and motor blockade, better hemodynamic stability, and significantly reduced the need for additional analgesia. Although there were two minor complications (vessel punctures) in the ultrasound group, overall, it proved to be a safer and more effective method. The anatomical landmark technique provided a longer duration of block, but the precision, real-time visualization, and overall safety of the ultrasound-guided approach make it a more reliable choice in clinical settings.

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