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Original Research Article

Comparison of landmark technique versus ultrasound guided technique for supraclavicular brachial plexus block in upper limb surgeries: A prospective randomized trial

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ABSTRACT

Background: Brachial plexus block is a widely used regional anaesthesia technique for upper limb surgeries, with regional techniques gaining popularity over general anaesthesia. Recent advancements in anatomical sonography have improved the understanding and application of ultrasound-guided techniques. Ultrasound enables accurate needle placement /and real-time monitoring of drug distribution, enhancing the effectiveness and safety of the procedure.

Objective: The objective of this study is to compare the effectiveness of supraclavicular brachial plexus block using the landmark technique and ultrasound-guided technique in terms of procedure time, onset and duration of sensory and motor blockade, effectiveness of the block, and complication rate.

Materials and Methods: This prospective, randomized controlled study included 60 patients aged between 18 and 60 years, of either sex, belonging to ASA grade I and II, and undergoing elective or emergency upper limb surgeries (elbow, forearm, and hand surgeries). The patients were divided into two groups: Group LM (Landmark technique) and Group US (Ultrasound technique). Each patient received a supraclavicular brachial plexus block using either technique with 25ml of 0.5% ropivacaine, and relevant parameters were recorded.

Results: The success rate was higher in Group US compared to Group LM, and no complications were observed. The onset of blockade was significantly faster, and the duration of the block was longer with the ultrasound-guided technique compared to the landmark technique. However, the time taken to administer the block was longer with the ultrasound technique.

Conclusion: Ultrasound-guided supraclavicular block is a safer technique with a higher success rate, providing more effective and prolonged block compared to the conventional landmark technique.

1. Introduction

Brachial plexus block is a well-established, safe, and effective anaesthesia technique for upper limb surgeries in the distal half of the arm, forearm, and hand.[1] It offers dense anaesthesia of the brachial plexus, providing optimal surgical conditions by ensuring complete muscle relaxation, stable intraoperative hemodynamic, sympathetic block, and prolonged post-operative analgesia. Among the different approaches to brachial plexus block, the supraclavicular approach is ideal for achieving anaesthesia of the entire upper extremity distal to the elbow. It is often referred to as the "Spinal of the arm"[2] due to its ability to provide comprehensive anaesthesia in this region. The technique was first described by Kulenkampff in 1912.[3]

In recent years, regional anaesthesia techniques have gained popularity over general anaesthesia due to their cost-effectiveness, performance, safety, reliability, and

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postoperative benefits. However, the traditional landmark technique for supraclavicular brachial plexus block is a blind technique that often requires multiple needle attempts, resulting in increased procedure time, patient discomfort, and a higher risk of failure and complications such as nerve and vascular injury.[4]

To address these challenges, the use of peripheral nerve stimulators was introduced, allowing for better localization of nerves and the brachial plexus.[5,6] However, this technique still carries the risk of injury to surrounding structures.[7,8] The advent of ultrasound technology and improved understanding of anatomical sonography have revolutionized regional anaesthesia.[9] Ultrasound-guided techniques enable precise needle placement, visualization of nerve/plexus structures, and real-time monitoring of local anaesthetic distribution.[8] Ultrasound-guided supraclavicular brachial plexus block offers a higher success rate, improved safety, and a lower incidence of complications.

Given these advancements, this study aims to compare the efficacy and success rate of supraclavicular brachial plexus block using the landmark technique and ultrasound-guided technique.

2. Materials and Methods

A prospective, randomized study was conducted between October 2017 and October 2019 after obtaining ethical committee clearance and institutional approval. Sixty patients scheduled for upper limb surgeries were included in the study based on inclusion and exclusion criteria. All patients underwent routine pre-anaesthetic evaluation and received premedication. Intravenous access was established with a 20G IV cannula on the opposite side of the limb undergoing surgery. The patients were randomly allocated to two groups, with 30 patients in each group:

1. Group LM (Landmark): Landmark technique of supraclavicular brachial plexus block.
2. Group US (Ultrasound): Ultrasound-guided supraclavicular block.

2.1. Procedure

The supraclavicular brachial plexus block was performed under aseptic conditions using 25ml of 0.5% ropivacaine as the local anaesthetic. A 2% lignocaine skin infiltration was administered at the site of the block needle puncture to reduce patient discomfort.

Position: The patient was placed in a supine position with the head turned to the opposite side of the intended block, and the arm was adducted and gently pulled down. A pillow or folded sheet was used to create a prominent field below the shoulder.

2.2. Landmark technique

The subclavian artery was palpated in the supraclavicular fossa, and a subcutaneous wheal was raised with 2% lignocaine using a 25G needle, slightly lateral to the artery. An 18G needle was then inserted through the skin wheal in a backward, inward, and downward direction. When paraesthesia was elicited, the needle was withdrawn by 1 to 2mm, and the drug was injected. In the absence of paraesthesia, the drug was injected near the first rib using a walk-over technique.

2.3. Ultrasound technique

With the patient in the proper position, the skin was disinfected, and the ultrasound transducer was placed superior to the clavicle to obtain a cross-sectional view of the subclavian artery. The brachial plexus appeared as a collection of hypoechoic oval structures (grape-like) lateral and superficial to the artery. An 18G block needle was inserted in-plane after local infiltration toward the brachial plexus, in a lateral to medial direction. The needle's entrance into the brachial plexus sheath was often felt with a palpable "pop" as the needle passed through the paravertebral fascia/brachial plexus sheath. After careful aspiration negative for blood, the required volume of local anaesthetic was injected in small aliquots. The needle was then redirected, and the remaining drug was injected to completely surround the plexus.

The time taken for the procedure, onset of sensory blockade, onset of motor blockade, and duration of sensory and motor blockade were noted. Intraoperatively, hemodynamic were monitored at regular intervals. Following surgery, the patients were monitored to assess the duration of motor and sensory blockade. Motor recovery was evaluated by asking patients to move their fingers, and sensory recovery was assessed using pinprick sensation.

The following parameters were recorded:

1. Time taken for the procedure: The interval between the preparation of the parts and the administration of the total dose of the local anaesthetic.
2. Onset of sensory blockade: The interval between the time of injection of the test drug and the absence of pinprick sensation.
3. Onset of motor blockade: The interval between the time of injection of the drug and the development of motor weakness in the blocked limb.
4. Duration of sensory block: The interval between the onset of sensory blockade and the time the patient first experiences sensation in the blocked limb.
5. Duration of motor blockade: The interval between the onset of motor blockade and the time the patient first experiences movement in the blocked limb.
6. Failure of block: Inadequate or patchy analgesia even after 30 minutes of drug administration. In such cases,

general anaesthesia was administered.
7. Grading of sensory blockade: I: No difference; II: Some difference, but pinprick sensed in blocked arm; III: No pinprick in blocked arm.
8. Grading of motor blockade: I: Normal power; II: Reduced power; III: Complete loss of power.

Data was tabulated in Microsoft excel and later SSPS V22 software was used for analysis of data. Continuous measurements are presented as mean ± SD, and categorical measurements are presented as numbers (%). Significance was assessed at a 5% level of confidence using the chi-square test and independent sample t-test.

3. Observation and Results

The prospective, randomized, comparative study was conducted on 60 patients aged between 18-60 years posted for upper limb surgeries to compare the conventional & Ultrasound guided supraclavicular brachial plexus block in terms of time taken for the procedure, onset & duration of sensory & motor blockade, success rate & complications.

There were no clinical or statistically significant differences in the demographic profile of patients in either group (Tables 1 and 2)

3.1. Age

The average age was 34.07±10.59 yrs. in group LM, and 39.67±15.62 yrs. in group US. There was no significant difference in age between the two groups.

Table 1: Age distribution in study group

Group		Mean	SD	t value	p value
Age	Group LM	34.07	10.59	-1.626	0.110
	Group US	39.67	15.62		

3.2. Sex distribution

No significant sex predominance was seen in either group.

Table 2: Sex distribution in study group

Sex	Group		Total	p value
	Group LM	Group US		
Male	16	19	35	0.432
	53.3%	63.3%	58.3%	
Female	14	11	25	
	46.7%	36.7%	41.7%	
Total	30	30	60	
	100.0%	100.0%	100.0%	

3.3. Time taken for procedure

The mean time taken for the procedure to administer a block by conventional landmark technique (group LM) was 325.50 seconds (5min 40 seconds) whereas for the same using an ultrasound (group US) was 604.67 seconds (10.06mins). This was clinically and statistically significant. (Table 3)

Table 3: Time taken for procedure

		Mean	SD	t value	p value
Time taken for procedure (in seconds)	Group LM	325.50	70.81	-10.772	<0.05
	Group US	604.67	123.03		

3.4. Onset of sensory and motor blockade

The mean time of onset of sensory blockade in group LM was 12.92 ±1.57 minutes. In group US it was 8.53±2.19min. Onset of sensory was faster with ultrasound technique and the results are clinically and statistically significant. The onset of motor block in group LM was 17.07±1.69 minutes and 13.36±1.71 minutes in US group. Onset of motor was markedly delayed in landmark group and the results are statistically very significant (Table 4).

Table 4: Onset of sensory and motor blockade

		Mean	SD	t value	p value
Onset of sensory	Group LM	12.92	2.19	8.49	<0.0001
	Group US	8.53	1.57		
Onset of Motor	Group LM	17.07	1.69	8.141	<0.0001
	Group US	13.36	1.71		

3.5. Duration of motor and sensory blockade

In group LM the mean duration of motor blockade was 431±76.66 min where as in group US it was 518±94.79 min. The duration of motor blockade was significantly shorter in group LM when compared to group US. The results are statistically significant. In group LM the mean duration of sensory blockade was 506.53±91.82 min and in group US was 578±99.46min. The duration of blockade was longer in ultrasound group compared to landmark group. It is statistically and clinically significant (Table 5)

3.6. Effectiveness of the block

All the blocks were performed under the cover of sedation. The block was successful in 86.7% of patients in group

Table 5: Duration of motor and sensory blockade

		Mean	SD	t value	p value
Duration of motor blockade	Group LM	431.92	79.66	3.6601	0.006
	Group US	518.33	94.79		
Duration of Sensory blockade	Group LM	506.53	91.82	2.778	0.0075
	Group US	578	99.46		

LM compared to 100% in US group. Total failure of block occurred in 13.3% in LM group. No block failed in US group. This was clinically significant (Table 6).

Table 6: Effectiveness of the block

	Group		Total	
	Group LM	Group US		
Incomplete	4	0	4	**p value**
	13.3%	0%	6.67%	0.012
Complete	26	30	56	
	86.7%	100%	93.33%	
Total	30	30	60	
	100.0%	100.0%	100.0%	

3.7. Complications

Incidence of vessel puncture/ hematoma was 16.7% in LM group where as it was nil in US group, and this was statistically significant with a p value of 0.019. None of our cases in both groups had nerve injury or pneumothorax (Table 7).

Table 7: Complications

Complications	Group		Total	p value
	Group LM	Group US		
Present	5	0	5	
	16.7%	0.0%	8.3%	
Absent	25	30	55	0.019
	83.3%	100.0%	90%	
Total	30	30	60	
	100.0%	100.0%	100.0%	

4. Discussion

Regional anaesthesia techniques, particularly brachial plexus blocks, have gained widespread popularity due to their advantages over general anaesthesia, including reduced exposure to anaesthetics and improved patient outcomes in terms of mortality and morbidity.[10]

Peripheral nerve blocks, such as the supraclavicular approach to brachial plexus block, offer cost-effective anaesthesia and analgesia while avoiding airway instrumentation and hemodynamic consequences associated with general anaesthesia.[10] These techniques provide excellent analgesia for an extended duration, reducing the need for additional analgesics during the postoperative period. Consequently, regional anaesthesia techniques have gained increased popularity due to factors such as patient satisfaction, cost-effectiveness, and favourable postoperative recovery profiles.[11]

However, the proximity of the brachial plexus to the pleura at the supraclavicular level presents a major concern for anaesthesiologists, as it significantly increases the risk of pneumothorax.[12] The incidence of pneumothorax after a supraclavicular block is approximately 0.5% to 6%, although this risk diminishes with increasing experience.[12] To address this concern, Lanz et al. introduced a technique directed near the first rib, targeting the trunks and divisions of the brachial plexus, which provides the most reliable, uniform, and predictable anaesthesia for upper extremity surgeries.[13] Consequently, the supraclavicular approach has become one of the most popular techniques for upper limb blocks. The choice of using either paraesthesia or a nerve stimulator to guide the block depends on the preferences and skills of the anaesthesiologist.

Frequently cited disadvantages of paresthesia technique include patient discomfort on eliciting paresthesia and that its success is highly dependent on the cooperation of the patient. The supraclavicular approach is best avoided when the patient is uncooperative or cannot tolerate any degree of respiratory compromise because of underlying disease. Other complications include frequent phrenic nerve block (40% to 60%), Horner's syndrome, and neuropathy. The presence of phrenic or cervical sympathetic nerve blockade normally requires only reassurance. Although nerve damage can occur, it is uncommon and usually self limited.[14]

The paraesthesia-based method and nerve stimulator-based methods are both blind methods; an advanced technique like use of ultrasound allows direct visualization of the nerves, the block needle, and local anesthetic distribution. This imaging modality has proven highly useful to guide targeted drug injections and catheter placement. The last several years have witnessed a tremendous increase in the use of ultrasound guidance for regional anesthesia.[15]

4.1. Time taken for procedure

Mean time to perform the ultrasound guided block 10.06 min was significantly longer than the landmark technique 5.40 mins. Both the techniques of blockade was done

by consultants. As the consultants were familiar with the landmark technique, the time taken for the block was relatively less for landmark technique whereas the ultrasound was of a newer skill. It took longer time. This can be explained by lesser experience and skills in ultrasound. The use of ultrasound in regional anaesthesia requires the acquisition of new knowledge and skills, as it has got longer learning curve.

The use of ultrasound guidance in daily clinical practice requires high level ultrasonographic equipment and a high degree of training.[9] The learning curve of US guided blocks may require 15-20 procedures, following which the performance time improves for all inexperienced users.[16] Williams et al,[17] in one of the studies examining the number of brachial plexus blocks needed to attain a reasonable degree of proficiency with technique estimated that at least 62 blocks should be performed to achieve a success rate of 87%. This number of blocks usually not allowed to most residents to complete their learning curve during residency. The longer duration for block performance found in group US can be explained by the moderate skills in using ultrasound.

4.2. Onset of sensory and motor blockade

The onset of sensory blockade and motor blockade was significantly faster in USG group compared to LM group. The onset of sensory in landmark was 12.92 ± 1.57min and 8.53±2.19 min with ultrasound technique. Similarly, the onset of motor blockade in landmark was 17.07 ±1.69 min and 13.36 ±1.71 min with ultrasound.

In the study conducted by Jagdish Dureja et al the onset of sensory and motor blockade was significantly less using US guided technique (9 min± 33s and 14 min±3s respectively) while the same were significantly higher using conventional (11min±31s and 17min±1s) and nerve stimulator technique (20 min ±1s and 22 min ±06s).[18] Similarly in study conducted by Raghove P et al[19] found that onset of sensory and motor block was earlier in USG group compared to conventional group.[12]

Delayed onset of action in Landmark technique is considered because of the blind approach and injection of drug perivascularly with expectation that it would spread around the nerves. With use of ultrasound, drug is deposited under direct visualisation in close proximity to the nerve plexus which hastens the action of block. Onset of motor paralleled that of sensory blockade and it was similar to studies conducted by Williams et al, Honnannavar et al and Veeresham et al.[17,20,21]

4.3. Duration of sensory and motor blockade

In our study the duration of sensory blockade and motor blockade was more in ultrasound group compared to landmark group. The duration of sensory in landmark was 506.53 ±92.82 min and 578 ±99.46 min with ultrasound technique. Similarly, the duration of motor blockade in landmark was 413.92 ±79.66 min and 518.33 ±94.79 min with ultrasound and it was statistically very significant. This can be explained by precised injection of drug closer to the plexus resulting in dense blockade.

In the study conducted by Dureja et al they observed the higher duration of analgesia in both ultrasound and nerve stimulator group compared to conventional group.[18] Similarly, Raghove P et al found USG guided block provided longer lasting analgesia.[19] In studies conducted by Veeresham et al and Honnannavar et al the duration of sensory was more with Ultrasound compared to landmark but not statistically significant.[20,21]

4.4. Effectiveness of the block

The block was successful in 86.7% of patients in group LM and was 100% in US group. Total failure of block occurred in 13.3% in LM group. All the cases were operated under the sedation of IV Midazolam. The failed blocks were given general anaesthesia. We considered block as complete when analgesia was present in all areas supplied by the four major nerves and incomplete when there was absence of sensory block in at least one neural distribution and/or the need of another anaesthetic technique to allow surgery.

Vincent W S Chan et al found the block was successful in 95% cases after one attempt[14] in USG guided block.[22] Dureja et al observed that there was higher incidence of patchy effect requiring intravenous anaesthetic supplementation in Conventional group compared to Nerve stimulator or Ultrasound guided techniques.[18]

High success rate with USG can be explained by direct visualisation of the plexus under ultrasound and drug injection around the plexus under real time monitoring. However, it should be considered that success of either techniques depends on the experience and skills of the anaesthesiologist performing the block and co-operation of the patient.

4.5. Complications

None of our study groups had nerve injury, pneumothorax or local anaesthetic toxicity. Vessel puncture was 16.7% (5 cases) in LM group where as it was nil in US group, and this was statistically significant. Karpal et al had no complications in their study of ultrasound guided supraclavicular brachial plexus block.[23] In 2003 Dilip Kothari administered 250 supraclavicular block by eliciting paraesthesia, 6% of his cases had vessel puncture during procedure, he found block can be administered successfully in these patients once pressure stopped the bleeding.[24] In study conducted by Veeresham et al, they observed vessel puncture in 16.67% cases in conventional group with no complications in ultrasound guided technique.[21]

Honnannavar et al[16] had 3.33% nerve injuries and 16.67% vessel injuries in their conventional technique group and had nil complications in USG group.[20]The use of ultrasound allows for better identification and avoidance of vascular structures, reducing the risk of vessel puncture.

Limitations of our study include the small sample size and the use of only experienced consultants to perform the blocks, which may limit generalizability to less experienced practitioners. Future research with larger sample sizes and involving residents or trainees could further explore the learning curve and proficiency attainment with ultrasound-guided techniques.

5. Conclusion

Our study demonstrates that the ultrasound-guided technique for supraclavicular brachial plexus block offers several advantages over the landmark technique. Although the procedural time was longer for ultrasound guidance, it provided faster onset and longer duration of sensory and motor blockade. The success rate was higher, and complications such as vessel puncture were eliminated with ultrasound guidance. Therefore, ultrasound-guided techniques should be considered as the preferred approach for supraclavicular brachial plexus blocks, provided that the anaesthesiologist has the necessary skills and training.

6. Source of Funding

None.

7. Conflict of Interest

None.

References

1. Gray A. Ultrasound guidance for regional anesthesia. In: Miller RD, editor. Miller's Anesthesia. Philadelphia, Pa: Elsevier, Churchill Livingstone; 2010. p. 1675–86.
2. Butterworth JF, David MC, Wasnick JD. Clinical Anesthesiology. 5th ed. New York: McGraw-Hill Medical Publishing; 2013. p. 985–7.
3. Kulenkampff D. Brachial plexus anaesthesia: its indications, technique, and dangers. *Ann Surg*. 1928;87(6):883–91.
4. Carty S, Nicholls B. Ultrasound-guided regional anaesthesia. *Continuing Educ Anaesth Crit Care Pain*. 2007;7(1):20–4.
5. Fanclli G, Casati A, Garancini P, Torri G. Nerve stimulator and multiple injection technique for upper and lower limb blockade: failure rate, patient acceptance, and neurologic complications. *Anesth Analg*. 1999;88(4):847–52.
6. Haleem S, Siddiqui AK, Mowafi HA, Ismail SA, Ali QA. Brief reports: nerve stimulator evoked motor response predicting a successful supraclavicular brachial plexus block. *Anesth Analg*. 2010;110(6):1745–6.
7. Mak PH, Irwin MG, Ooi CG, Chow BF. Incidence of diaphragmatic paralysis following supraclavicular brachial plexus block and its effect on pulmonary function. *Anaesthesia*. 2001;56(4):352–6.
8. Brown DL, Cahill DR, Bridenbaugh LD. Supraclavicular nerve block: anatomic analysis of a method to prevent pneumothorax. *Anesth Analg*. 1993;76(3):530–4.
9. Marhofer P, Chan VWS. Ultrasound-guided regional anesthesia: current concepts and future trends. *Anesth Analg*. 2007;104(5):1265–9.
10. Neal JM, Gerancher JC, Hebl JR, Ilfeld BM, Mccartney CJ, Franco CD, et al. Upper extremity regional anesthesia: essentials of our current understanding, 2008. *Reg Anesth Pain Med*. 2008;34(2):134–70.
11. Kaye AD, Urman RD, Rappaport Y, Siddaiah H, Cornett EM, Belani K, et al. Multimodal analgesia as an essential part of enhanced recovery protocols in the ambulatory settings. *J Anaesthesiol Clin Pharmacol*. 2019;35(Suppl 1):40–5.
12. Kumari A, Gupta R, Bhardwaj A, Madan D. Delayed pneumothorax after supraclavicular block. *J Anaesthesiol Clin Pharmacol*. 2011;27(1):121–2.
13. Lanz E, Theiss D, Jankovic D. The extent of blockade following various techniques of brachial plexus block. *Anesth Analg*. 1983;62(1):55–8.
14. Ghodki PS, Singh ND. Incidence of hemidiaphragmatic paresis after peripheral nerve stimulator versus ultrasound guided interscalene brachial plexus block. *J Anaesthesiol Clin Pharmacol*. 2016;32(2):177–81.
15. Marhofer P, Harrop-Griffiths W, Kettner SC, Kirchmair L. Fifteen years of ultrasound guidance in regional anaesthesia: part 1. *Br J Anaesth*. 2010;104(5):538–46.
16. Kim SC, Hauser S, Staniek A, Weber S. Learning curve of medical students in ultrasound-guided simulated nerve block. *J Anesth*. 2014;28(1):76–80.
17. Williams SR, Chouinard P, Arcand G, Harris P, Ruel M, Boudreault D, et al. Ultrasound guidance speeds execution and improves the quality of supraclavicular block. *Anesth Analg*. 2003;97(5):1518–23.
18. Dureja J, Siwach RC, Singh J, Chaudhry G, Bansal P. Comparative Evaluation of Techniques in Supraclavicular Brachial Plexus Block: Conventional Blind, Nerve Stimulator Guided and Ultrasound Guided. *Int J Sci Stud*. 2016;3(12):125–8.
19. Raghove P, Singh K, Taxak S, Ahlawat M, Hooda S. Comparison of Ultrasound Guided Technique with Conventional Landmark Technique for Supraclavicular Brachial Plexus Nerve Block in Patients Undergoing Upper Limb Surgery. *Int J Pharmacol and Clin Sci*. 2016;5(1):1–4.
20. Honnannavar KA, Mudakanagoudar MS. Comparison between Conventional and Ultrasound-Guided Supraclavicular Brachial Plexus Block in Upper Limb Surgeries. *Anesth Essays Res*. 2017;11(2):467–71.
21. Veeresham M, Goud U, Surender P, Kumar P. Comparison between conventional technique and ultrasound guided supraclavicular brachial plexus block in upper limb surgeries. *J Evol Med Dent Sci*. 2015;4(37):6465–76.
22. Chan VW, Perlas A, Rawson R, Odukoya O. Ultrasound-guided supraclavicular brachical plexus block. *Anesth Analg*. 2003;97(5):1514–7.
23. Kapral S, Greher M, Huber G, Willschke H, Kettner S, Kdolsky R, et al. Ultrasonographic guidance improves the success rate of interscalene brachial plexus blockade. *Reg Anesth Pain Med*. 2008;33(3):253–8.
24. Kothari D. Suraclavicular brachial plexus block: A new approach. *Indian J Anaesth*. 2003;47:2878.

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