Section: Anesthesiology

Original Research Article

COMPARISON OF ULTRASOUND-GUIDED SUPRACLAVICULAR AND INFRACLAVICULAR BLOCKS FOR UPPER EXTREMITY SURGERIES

Jeyadharani K[1], M. Kawin Kumar[1], Ramkumar P.A[1], Naveen[1]

[1]Department of Anesthesiology, Sri Muthukumaran Medical College Hospital and Research Institute, Chennai, India

Received : 27/11/2023
Received in revised form : 30/01/2024
Accepted : 16/02/2024

Keywords:
Bupivacaine, supraclavicular block , infraclavicular block, upper limb surgeries, Ultrasound-Guided, Post-Operative Analgesia.

Corresponding Author:
Dr. M. Kawin Kumar,
Email: kawinkumar8419@gmail.com

DOI: 10.47009/jamp.2024.6.1.376

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2024; 6 (1); 1900-1904

Abstract

Background: With the introduction of ultrasound-guided techniques and regional anesthesia branch blooming in recent years, the ultrasound-guided block technique has become more prevalent than the traditional blind approach because ultrasound-guided techniques are under direct vision; hence, risks associated with the conventional block method have been reduced, and success rate also increased. Regional nerve blocks are thought to be a better form of anesthesia for upper limb surgeries because they provide better intra-operative and prolonged postoperative pain relief, minimizing the stress response and minimizing anesthetic drug requirements. The supraclavicular approach is an easy and effective upper extremity block carried out at the division level with little or no sparing of dermatomes. Infraclavicular brachial plexus block is traditionally performed at the lateral infraclavicular fossa (LIF), where the cords are separated from one another, and there is substantial variation in the position of the individual cords relative to the axillary artery. The objective is to compare the block performance time, overall effectiveness, commonly escaped nerves, and the incidence of adverse events in ultrasound-guided supraclavicular and infra-clavicular blocks. **Materials and Methods:** 200 ASA I and ASA II patients, aged from 17 to 70 years, underwent elective upper limb surgeries. 2 groups of 100 each were separated and named supra clavicular block, and the other group infraclavicular block. Before the start of the study, all the patients were given a well-detailed explanation of the procedure, and written informed consent was to be obtained from the patients and attendees. All the details were recorded in a prepared proforma. **Result:** Block performance time and readiness of surgery required for ultrasound infraclavicular block is shorter compared to ultrasound-guided supraclavicular block. The onset of complete motor and sensory blockade is equal in both blocks. Complications are slightly more in the supraclavicular block. **Conclusion:** The ultrasound-guided infraclavicular block is more satisfactory and has better results than the supraclavicular block in comparison to block performance time, readiness of surgery, onset, and fewer complications.

INTRODUCTION

Pain is a fundamental biological phenomenon. The International Association for the Study of Pain has defined pain as an unpleasant sensory and emotional experience associated with actual or potential tissue damage.[1,2] The art and science of anesthesia are leased and developed to relieve surgical and chronic pain.

Regional nerve blocks are thought to be better than general anesthesia because they prevent the unwanted stress of laryngoscopy and tracheal intubation and the adverse effects like postoperative nausea, vomiting, sore throat, and dizziness of general anesthetic drugs.[1,3] It provides better intra-operative and prolonged postoperative pain relief, minimizing the stress response and minimizing anesthetic drug requirements. They are beneficial to patients with various cardiorespiratory co-morbidities.

Brachial plexus block provides a wonderful alternative to general anesthesia for upper limb surgeries. It achieves ideal operative conditions by providing complete and prolonged pain relief, muscle relaxation, stable intraoperative hemodynamics, and adequate sympathetic block. The sympathetic block decreases postoperative pain, vasospasm, and edema. Different approaches are used for the brachial plexus block.

ISSN (O): 2687-5365; ISSN (P): 2753-6556

They are

1. Interscalene approach
2. Supraclavicular approach
3. Infraclavicular approach
4. Axillary approach

Among these, the supraclavicular approach is an easy and effective upper extremity block carried out at the division level with little or no sparing of dermatomes. The first supraclavicular block by Kulenkampff was performed in 1912. Problems with classical paraesthesia technique (blind) are injury to nerve, surrounding vascular structures, and pleura, and they are associated with a high failure rate.

Infraclavicular brachial plexus block is traditionally performed at the lateral infraclavicular fossa (LIF), where the cords of the brachial plexus lie deep to the pectoral muscles and adjacent to the second part of the axillary artery. However, at the LIF, the cords are separated from one another,[1-6] there is substantial variation in the position of the individual cords relative to the axillary artery, and all three cords are rarely visualized in a single ultrasound window.[6] Infraclavicular brachial plexus block provides sufficient anesthetic and analgesic effect for lower arm surgery.[5] The infraclavicular approach is not only advantageous for inserting a perineural catheter but also has a shorter procedure time compared to other approaches, including supraclavicular and axillary approaches.[3-9] Therefore, ultrasound-guided infraclavicular brachial plexus block has been increasingly used since the first report in 2004.[10,11]

To limit those drawbacks, diverse strategies and techniques have been described. A nerve stimulator came into use, which allowed better localization of nerves. But still, this technique is also associated with the risk of injuring vessels and pleura, leading to pneumothorax.

But ultrasound is the only method that offers a safe block of the best quality by giving the real-time location of the nerve plexus, vascular structures, and pleura, as well as continuous visualization of the needle during its advancement and drug spread.[7] Ultrasound has improved success rate with excellent localization and improved safety margin.[7] To avoid all those problems associated with the block technique, the ultrasound-guided technique was used. This study is designed to compare the efficiency of ultrasound-guided technique for supra clavicular and infraclavicular brachial plexus block with regards to block performance time, readiness of surgery, onset of block, and incidence of complications in both the blocks.

MATERIALS AND METHODS

Study Design and Setting: This prospective, randomized, single-blind study was conducted between July 2023 and December 2023 at Sri Muthukumaran Medical College Hospital & Research Institute. The study protocol was approved by the Institutional Ethical Committee Board, and written informed consent was obtained from all the participants.

Participants: A total of 200 adult patients scheduled for elective upper limb surgeries were selected for this study. The inclusion criteria were ASA grade 1 & 2, aged between 17-70 years and with a total body weight of 40-80kg. Excluded criteria were the patient's denial of participation in the study, the patient with coagulopathy/peripheral neuropathy, and allergy to local anesthetics.

Randomization and Blinding: Participants were randomly assigned and grouped using computer-generated random numbers. Each patient was randomly allocated into one of the two groups of 100 patients, each using computerized random numbers.

GROUP SC: Supraclavicular brachial plexus block was given with ultrasound guidance.

GROUP IC: Infraclavicular brachial plexus block given with ultrasound guidance. Block was performed with 15 ml of 0.5% bupivacaine and 15 ml of 2% lignocaine with adrenaline 1:2, 00,000 in both groups.

Preanaesthetic evaluation: The pre-anesthetic evaluation was conducted for all the patients. The patients were treated accordingly if there was any significant comorbid medical illness. Routine investigations such as Hemoglobin (Hb%), bleeding time, clotting time, serum urea, serum creatinine, blood sugar, electrocardiography (ECG), and chest X-ray PA view were done. As per the fasting guidelines, all the patients were kept nil per oral. A tablet of alprazolam 0.5 mg was given to all patients the night before surgery. Written and informed consent was taken.

In the operating room: The peripheral intravenous line was accessed using an 18G intravenous cannula. Intravenous fluid was started for all patients and was shifted to the operating room. Monitors like pulse oximetry, non–invasive blood pressure monitor, and electrocardiogram (ECG) were connected, and baseline parameters were recorded for all patients. Injection midazolam 0.01mg/kg intravascular was given as pre-procedure as an anxiolytic. With the head end of the table elevated, the patient was made to lie in a supine position, and head turned to the opposite side, arm adducted for supraclavicular approach, abducted for infraclavicular approach, and hand extended along the side towards the ipsilateral knee as far as possible. A folded sheet or small pillow was positioned underneath the shoulder, making the location more approachable.

Group SC, Ultrasound[3,4,11]: In group SC, real-time visualization of the vessels, nerves, and bones with an "in-plane approach" block was performed. This procedure was done using a Sonoray ultrasonogram machine with a 10-6 MHz transducer by using a 20G stinoplex needle.

Group IC, ultrasound guidance: In group IC, after a real-time visualization block was performed. This procedure was also done using a sonoray ultrasonogram machine with a 10.6 MHz transducer by the "in-plane approach" using a 20G complex

ISSN (O): 2687-5365; ISSN (P): 2753-6556

needle. The arm is abducted to 90 degrees. It isn't always obligatory to discover all cords. Instead, injecting the local anesthetic in a U-shaped pattern surrounding the artery (cephalad, posterior, and caudal) is enough to block all three cords. The transducer is positioned in the parasagittal plane to identify the axillary artery, which can be made in between 3-5 cm, and if it is done, the hyperechoic cords of the brachial plexus are identified. By aiming the needle towards the posterior aspect of the axillary artery crossing the pectoralis group of muscles, and by careful aspiration, 1 to 2 ml of local anesthetic is injected, thereby confirming the needle placement properly and all the three cords are blocked by spreading 30 ml of local anesthetic.

Assessment of parameters: All the patients were monitored for block performance time, readiness for surgery, onset of complete motor and sensory block, and incidence of complications.

Time taken for the procedure: In both groups, the time taken for the procedure was calculated from the time of insertion of the needle to its removal.

Assessment of sensory blockade: Hollmen's sensory scale was used to evaluate sensory blockade: Sensory block was assessed by pinprick with 23G hypodermic needle in skin dermatomes supplied by four major nerves (radial, median, ulnar, and musculocutaneous nerves) once every minute for an initial 5 minutes and then every 2 minutes up to 10 minutes and then every 5 minutes for 30 minutes and every half an hour after that.

Assessment of motor blockade: Lavoie's scale was used for the evaluation of motor blockade:

0% block - flexion and extension in both the hand and arm against resistance

33% block - flexion and extension in both the hand and arm against gravity but not against resistance

66% block - flexion and extension movements in the hand but not in the arm

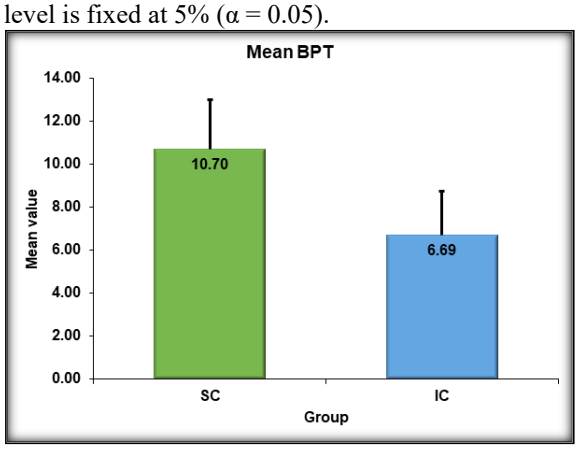
100% block - no movement in the entire upper limb.

Statistical Analysis: Data were analyzed using appropriate statistical tests, including independent sample t-tests, and chi-square tests. P-values < 0.05 were considered statistically significant.

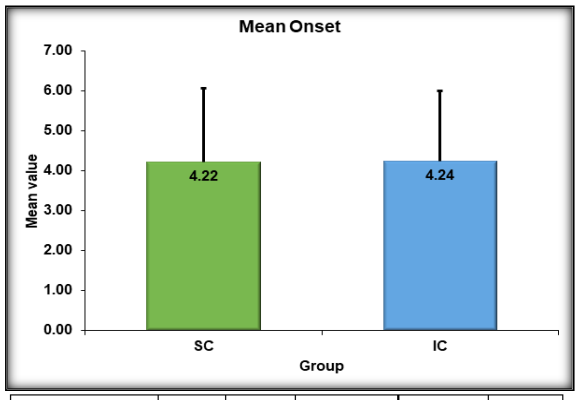
RESULTS

	Group	N	Mean	Std Dev	p-value
BPT	SC	100	10.6952	2.29851	**<0.001**
	IC	100	6.6868	2.07543	

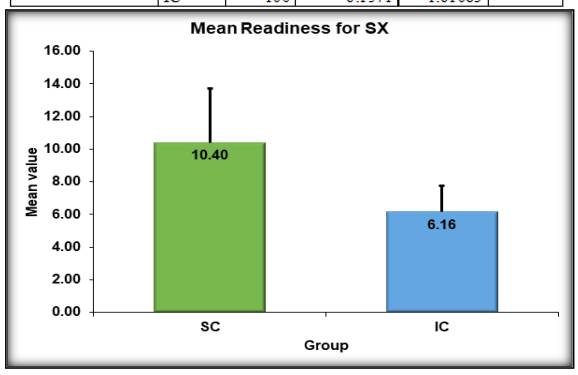
The results of the normality tests, Kolmogorov-Smirnov and Shapiro-Wilks tests, reveal that all the continuous variables follow a normal distribution. Therefore, to analyze the data, parametric methods are applied. To compare mean values between groups, independent samples t-test is applied. To compare proportions between study and control groups, the chi-square test is applied. If any expected cell frequency is less than five, then Fisher's exact test is used. To analyze the data, SPSS (IBM SPSS Statistics for Windows, Version 26.0, Armonk, NY: IBM Corp. Released 2019) is used. The significance level is fixed at 5% ($\alpha = 0.05$).

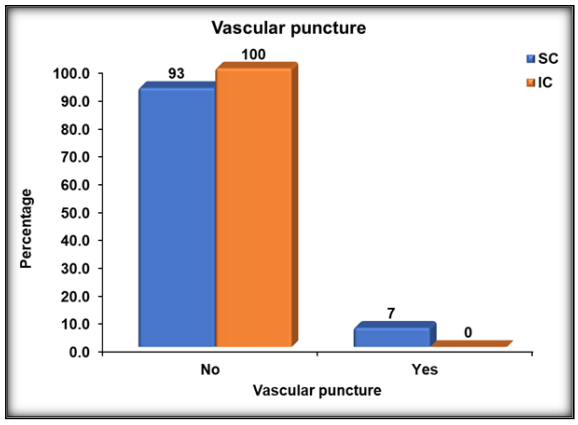


	Group	N	Mean	Std Dev	p-value
Onset	SC	100	4.2177	1.84318	0.930
	IC	100	4.2402	1.77168	



Readiness for SX	SC	100	10.4010	3.30535	**<0.001**
	IC	100	6.1571	1.61083	





ISSN (O): 2687-5365; ISSN (P): 2753-6556

Table 1:

		Group						p-value
		SC		IC		Total		
		N	%	N	%	N	%	
Vascular puncture	No	93	93.0	100	100.0	193	96.5	<0.014
	Yes	7	7.0	0	.0	7	3.5	
	Total	100	100.0	100	100.0	200	100.0	

DISCUSSION

Brachial plexus block has emerged as a better alternative approach to general anesthesia for upper limb surgeries. It is also known as "spinal anesthesia of the upper limb", which avoids unwanted general anesthesia drugs and their side effects, laryngoscopy, and intubation.[12]

In our study, brachial plexus block was done by using bupivacaine with lignocaine adrenaline, a local anesthetic with the advantage of earlier onset at a lower dose.[13]

In the supraclavicular approach, the blockade was done at the level of the distal trunk–proximal division, where the brachial plexus is compact, so even a small volume of local anesthetic injection produces rapid onset of reliable as well as dense blockade of the brachial plexus.[14]

In the infraclavicular (coracoid approach), the blockade was done at the level of the cord, which has the added advantage of avoiding complications like pneumothorax, and it also offers a blockade of musculocutaneous and axillary nerves. There is almost nil chance of pneumothorax by this approach, which also offers rapid onset of the complete blockade and almost nil complication when compared to the supraclavicular approach.[15]

All demographic variables between group SC and group IC were comparable. In our study, the mean of the block performance time in group SC 10.69 mins and group IC 6.68 mins was found to be statistically significant.[16] This study confirmed that the infraclavicular approach was earlier compared to the supraclavicular approach. This finding correlates with that of Abhinaya et al. in July 2017.[1] The block performance time and statistical significance also correlate with Koscielniak et al,[8] reported that an ultrasound-guided infraclavicular block had a faster onset and better surgical anesthesia. However, our study deviates from the study of Chun Woo Yang et al,[17] in 2010 and Arcand et al,[2] showing supraclavicular with infraclavicular blocks and reported no significant difference in the block performance time. Even though there is an earlier onset sensory and motor blockade in group Ic when compared to group SC, they are statistically insignificant.

In our study, the success rate was 93 %, and this correlates with the study of Abhinaya et al in July 2017 93.3%,[15] and only two cases of pneumothorax (in group SC) but vascular puncture were noted in SC group and no other complications documented (fewer complications) in our study. Abhinaya et al. in July 2017.[5] However, our study devoids complications like Horner's syndrome and diaphragmatic paresis, which deviates from the study of Yang et al. in 2010 and Arcand et al shows the above-mentioned complication.[2,17]

Our study shows that the supraclavicular approach has more complications compared to the infraclavicular approach. This deviates from the study of Perlas et al,[18] who reported that an ultrasound-guided supraclavicular block is associated with a high success rate and low complication rate with no pneumothorax in a series of 510 consecutive patients.

So in our study, we compare the supraclavicular versus infraclavicular approach to brachial plexus block using ultrasound for upper limb surgeries. We found that the infraclavicular approach was fast (early onset of complete sensory and motor blockade),[1] and had a good quality blockade with the least complications. However, there are only limited studies currently available for brachial plexus block by using ultrasound.

Summary

This study shows that: The time to perform infraclavicular block is less than supraclavicular block and significant statistically.

The onset of sensory and motor block in both approaches is equal and statistically insignificant.

However, the comparable time taken for the onset of complete motor and sensory block was equal in the infraclavicular approach compared with the supraclavicular approach

Time taken for the readiness of surgery was earlier in group IC compared with group SC and is statistically significant.

A complication of vascular puncture is more in group SC but statistically significant.

Pneumothorax is not statistically significant in this study.

There is a statistically significant difference in the readiness of surgery of the block between both groups IC & SC.

CONCLUSION

So, in our study, we compared the supraclavicular versus infraclavicular approach to brachial plexus block using ultrasound for upper limb surgeries. We found that the infraclavicular approach was fast (early onset of complete sensory and motor blockade) and had a good quality blockade with the least complications.[5]

ISSN (O): 2687-5365; ISSN (P): 2753-6556

REFERENCES

1. Abhinaya, et al.: Supraclavicular vs. Infraclavicular block,Indian Journal of Anaesthesia | Volume 61 | Issue 7 | July 2017
2. Arcand G, Williams SR, Chouinard P, Boudreault D, Harris P, Ruel M, Girard F. Ultrasound-guided infraclavicular versus supraclavicular block. Anesth Analg. 2005 Sep;101(3):886-890. doi: 10.1213/01.ANE.0000159168.69934.CC. PMID: 16116009.
3. Brenner, D., Iohom, G., Mahon, P. & Shorten, G. Efficacy of axillary versus infraclavicular brachial plexus block in preventing tourniquet pain: a randomized trial. Eur. J. Anaesthesiol. 36, 48–54. https://doi.org/10.1097/eja.0000000000000928 (2019).
4. Carty S, Nicholls B: Ultrasound guidance for regional anesthesia. Contin Educ. anaesthesiacrit care pain 2007;7:20.4
5. Chin, K. J., Alakkad, H., Adhikari, S. D. & Singh, M. Infraclavicular brachial plexus block for regional anesthesia of the lower arm. Cochrane Database Syst. Rev. 28, CD005487. https://doi.org/10.1002/14651858.CD005487.pub3 (2013).
6. Di Filippo A, Orando S, Luna A, et al. Ultrasound identification of nerve cords in the infraclavicular fossa: a clinical study. Minerva Anestesiol. 2012;78:450–455
7. Grey AT. Ultrasound guidance for regional anesthesia. In: Miller RD, editor Miller's anesthesia 7th ed. Philadelphia: Churchill living stone Elsevier, 2010 p1675-86
8. Koscielniak-Nielsen ZJ, Frederiksen BS, Rasmussen H, HesselbjergL. A comparison of ultrasound-guided supraclavicular and infraclavicular blocks for upper extremity surgery. ActaAnaesthesiol Scand 2009; 53: 620-6.
9. Mariano, E. R. et al. A randomized comparison of infraclavicular and supraclavicular continuous peripheral nerve blocks for postoperative analgesia. Reg. Anesth. Pain Med. 36, 26–31. https://doi.org/10.1097/AAP.0b013e318203069b (2011).
10. Morgan clinical anesthesiology, peripheral nerve blocks;2008;325-337
11. Ootaki, C., Hayashi, H. & Amano, M. Ultrasound-guided infraclavicular brachial plexus block: an alternative technique to anatomical landmark-guided approaches. Reg. Anesth. Pain Med. 25, 600–604. https://doi.org/10.1053/rapm.2000.18184 (2000).
12. "PART III: Pain terms, A current list with definitions and notes on usage" [PP 209-214]. Classification of chronic pain, second edition, IASP task force on taxonomy, edited by H. Merskey, N. Bogdue IASP press, Seatle,1994.
13. RAJ PP Historical aspects of regional anesthesia 1st ed chapter 1 in the textbook of regional anesthesia, 2002 may p3-15
14. SauterAR,SmithHJ,StubhaugA,DodgsonMS, Klaastad Ø. Use of magnetic resonance imaging to define the anatomical location closest to all 3 cords of the infraclavicular brachial plexus. Anesth Analg. 2006;103: 1574–1576.
15. Tran DQ, Russo G, Muñoz L, Zaouter C, Finlayson RJ. A prospective randomized comparison between ultrasound-guided supraclavicular, infraclavicular, and axillary brachial plexus blocks, Reg \anesth pain med2009;34:366-71.
16. Tran DQ, Munoz L, Russo G, Finlayson RJ. A trick shot to the corner pocket.
17. Yang, et alA comparison of infraclavicular and supraclavicular approaches to the brachial plexus using neurostimulation. Korean J Anesthesiol 2010 Mar; 58(3): 260-266
18. Yang CW, Kwon HU, Cho CK, Jung SM, Kang PS, Park ES,et al. A comparison of infraclavicular and supraclavicular approaches to the brachial plexus using neurostimulation.Korean J Anesthesiol 2010;58:260-6.

ISSN (O): 2687-5365; ISSN (P): 2753-6556