Original Research Article

Indian Journal of Anesthesia and Analgesia
2019; 6(2) (Part - II): 660-664
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.6219.44

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

Srinivas HT[1], Girish BK[2], Vaibhav Nagar[3], Nivetha Babu[4]

[1]Associate Professor, [2]Assistant Professor, [3,4]Junior Resident, Department of Anaesthesiology, JSS Medical College and Hospital, JSS Academy of Higher Education, Mysuru, Karnataka 570015, India.

Abstract

Background: There are many advantages of ultrasound guided supraclavicular brachial plexus block over the peripheral nerve stimulator guided supraclavicular brachial plexus block. Ultrasonography allows the operator to visualize the neural structures and the surrounding structures. It also guides the needle under real time visualization and navigates the needle away from the sensitive anatomy like pleura, blood vessels etc. *Objective*: A Comparative Study between Ultrasound and Peripheral Nerve Stimulator Guided Supraclavicular Brachial Plexus Block in Adult Patients for Elective Upper Limb surgeries. *Methodology*: A prospective comparative study of 60 Patients who were undergoing upper extremity surgery was carried out in the Department of Anesthesiology, JSS Medical College and Hospital, Mysuru, India during the period of November 2016 to July 2018 to compare the ultrasound and peripheral nerve stimulator guided supraclavicular brachial plexus block in adult patients for elective upper limb orthopedic surgeries. *Results*: The mean time to administer block was 10.17 ± 1.58 minutes in group-US and 10.67 ± 2.58 minutes in group PNS (p=0.57). Thus, in Group US and Group PNS time taken to administer block was statistically not significant. The total duration of sensory block was 10.12 ± 1.14 hours in group-US and 7.41 ± 0.68 hours in group PNS (p<0.0001). The block was successful in 96.67% of patients in group US and 80% in group PNS, which was statistically significant (p<0.05). *Conclusion*: It was concluded that the ultrasound guided supraclavicular brachial plexus block is more efficient, accurate and safer than the peripheral nerve stimulator guided brachial plexus block as it is characterized by a shorter time of onset and prolonged duration of sensory and motor block.

Keyword: Peripherl Nerve Stimulator; Brachial Plexus; Nerve Blockade.

How to cite this article:

Srinivas HT, Girish BK, Vaibhav Nagar et al. A Comparative Study Between Ultrasound and Peripheral Nerve Stimulator Guided Supraclavicular Brachial Plexus Block in Adult Patients for Elective Upper Limb Orthopaedic Surgeries. Indian J Anesth Analg. 2019;6(2):660-664.

Introduction

Even though modern general anesthesia is safer, faster and acceptable, regional anesthesia has its own advantages like less interference with normal metabolic process and vital functions of body as compared to general anesthesia.

In 1885, William Steward Halsted and Hall first described the technique of brachial plexus block through interscalene approach for upper limb surgeries. Supraclavicular approach for brachial plexus block was first described by Kulenkampff in 1911. The most commonly used regional anesthetic technique to provide surgical anesthesia for upper extremity surgeries [1].

Corresponding Author: Girish BK, Assistant Professor, Department of Anaesthesiology, JSS Medical College and Hospital, JSS Academy of Higher Education, Mysuru, Karnataka 570015, India.

E-mail: drgirishbk@gmail.com

Received on 24.01.2019, **Accepted on** 06.03.2019

The supraclavicular brachial plexus block has proven to be an important, safer and effective alternative to general anesthesia in surgeries of upper extremity. It includes blocking of the brachial plexus where it is most compactly arranged, with relatively less requirement of the anesthetic solution and rapid onset of action [2]. It provides ideal conditions for surgery, maintains stable intraoperative hemodynamics and extends analgesia in the postoperative period.

Different technical modalities are being used for identifying and locating the brachial plexus in the supraclavicular area. Conventional methods include electric stimulation and patient reported paresthesia which rely on surface landmark identification in semi blind manner. Both these techniques may require multiple trial and error needle attempts which increases the procedure time and delays onset of anesthesia. It also carries the risk of damage to surrounding anatomical structures like blood vessels and pleura by direct puncture with needle tip [3,4]. So an ideal regional anesthesia technique which offers safety, accuracy and patient acceptance was constantly looked for.

La Grange et al. in 1978 first used ultrasound for regional anesthesia that performed supraclavicular brachial plexus blocks with Doppler ultrasound blood flow detector. Now the ultrasound guided technique is regularly being used in many other hospitals for administering regional anaesthesia [5].

There are many advantages of ultrasound guided supraclavicular brachial plexus block over the peripheral nerve stimulator guided supraclavicular brachial plexus block. Ultrasonography allows the operator to visualize the neural structures and the surrounding structures. It also guides the needle under real time visualization and navigates the needle away from the sensitive anatomy like pleura, blood vessels etc. Ultrasonography also monitors the spread of local anesthetics under real time. By offering all these advantages ultrasonography increases the success rate of supraclavicular brachial plexus block, decreases the procedural time and other complications. Thus, providing safer, effective and efficient anesthetic conditions [6]. The ultrasound machine was not available in many of the hospitals till recently resulting in brachial plexus block being administered using peripheral nerve stimulator guided technique despite many short comings associated with the technique. Hence, a study was required to know whether the ultrasound guided technique has more advantages over peripheral nerve stimulator guided technique.

The aim of the study was to compare the efficacy of supraclavicular brachial plexus block using ultrasound guided method over the peripheral nerve stimulator method.

An alternate hypothesis was made before starting our study that ultrasound guidance increases the success rate and decreases the complications when compared to peripheral nerve stimulator guided technique.

Objective

A Comparative Study Between Ultrasound and Peripheral Nerve Stimulator Guided Supraclavicular Brachial Plexus Block in Adult Patients for Elective Upper Limb surgeries.

Materials and Methods

A prospective comparative study of 60 Patients who were undergoing upper extremity surgery was carried out in the Department of Anesthesiology, JSS Medical College and Hospital, Mysuru, India during the period of November 2016 to July 2018 to compare the ultrasound and peripheral nerve stimulator guided supraclavicular brachial plexus block in adult patients for elective upper limb orthopedic surgeries.

Sample size was decided using a difference of 10% (with the formula below) and with power 0.8 and alpha 0.05. A value of 27 per group was obtained. Considering dropouts sample size of 30 per group was taken. Patients of either sex, aged between 18-75 years, with body mass index <30 kg/m^2, belonging to ASA-PS class I & II posted for orthopedic surgeries involving upper limbs were included in the study, while patients with infection at the proposed site of block, pregnancy, pre-existing neurological deficits, patients with significant coagulopathies, allergy to amide local anesthetics and severe pulmonary pathology were excluded.

All the patients underwent a thorough pre-anesthesia checkup which included detailed history taking, general examination and systemic examination. Routine investigations like hemoglobin, urine examination, blood sugar, blood urea, serum creatinine, bleeding time and clotting time were carried out for all patients. ECG, Chest X-Ray were carried out in patients above 40 years of age. 30 ml of 1:1 mixture of 0.5% bupivacaine and 2% lidocaine with adrenaline was used in both the groups. Patients were randomly allocated using shuffled sealed opaque envelope technique into one

of the following two groups depending upon the technique they were about to receive for brachial plexus block.

Results

Our study was conducted on 60 patients posted for elective upper limb surgeries. They were divided into two equal groups with 30 subjects in each group.

Group PNS: Peripheral nerve stimulator was used to locate the brachial plexus.

Group US: Ultrasound machine was used to locate the brachial plexus.

Table 1: Socio-demographic Profile of the study subjects

Socio-demographic Profile	Group PNS	Group US	p-value
Number of patients	30	30	
Age (in years, Mean ± SD)	32.80 ± 14.01	40.87 ± 16.99	>0.05
Sex (Male: Female)	26:4	22:8	>0.05

Table 2: Comparison of Study parameters in both the groups

	Group	Mean	Standard Deviation	p-Value
Block execution time * (in minutes)	PNS	10.67	2.48	0.57
	US	10.17	1.58	
Time of onset of sensory blockade + (in minutes)	PNS	6.79	1.76	<0.0001
	US	3.63	1.33	
Time of onset of motor blockade ┼ (in minutes)	PNS	8.79	1.61	<0.0001
	US	6.17	1.82	
Total duration of sensory blockade ** (in hours)	PNS	7.41	0.80	<0.0001
	US	10.12	1.14	
Total duration of motor blockade § (in hours)	PNS	6.58	0.68	<0.0001
	US	8.50	0.93	

* The block execution time is defined as the time from the start of probe placement to the removal of the needle after local anaesthetic administration.

┼ The time of onset of motor block is defined as the time of removal of the needle to the time when patient had weakness of any of the three joints – shoulder, elbow or wrist upon trying to perform movements.

+ The time of onset of sensory block is defined as the time of removal of needle to the time when patient first said he/she had reduced sensation in the area of any of one of the four nerves- median, radial, ulnar and musculocutaneous when compared to the opposite limb.

** The total duration of sensory block was defined as the time interval between brachial plexus injection of local anaesthetic and the first post-operative VAS score of ≥ 4 requiring rescue analgesia.

§ The total duration of motor blockade was defined as the time interval between the local anaesthetic administration and complete recovery of motor function in all nerve distributions.

The mean time to administer block was 10.17 ± 1.58 minutes in group-US and 10.67 ± 2.58 minutes in group PNS (p=0.57). Thus, in Group US and Group PNS time taken to administer block was statistically not significant. The mean time for onset of the sensory block was 3.63 ± 1.33 minutes in group-US and 6.79 ± 1.76 minutes in group PNS (p<0.0001). Thus, onset of sensory block was statistically significant in group US. The mean time for onset of the motor block was 6.17 ± 1.82 minutes in group-US and 8.79 ± 1.61 minutes in group PNS (p<0.0001). Thus, onset of motor block was statistically significant in group US.

The total duration of sensory block was 10.12 ± 1.14 hours in group-US and 7.41 ± 0.68 hours in group PNS (p<0.0001). Thus, duration of sensory block was statistically highly significant in group US.

The total duration of motor block was 8.50 ± 0.93 hours in group-US and 6.58 ± 0.68 hours in group PNS (p<0.0001). Thus, the duration of motor block was statistically highly significant in group US.

Table 3: Outcome of the study

		Group PNS	Group US	p-value
Assessment of block	Successful (%)	24 (80)	29 (96.67)	0.047
	Failed (%)	6 (20)	1(3.33)	0.043

A successful block is defined as achieving complete sensory and motor block in areas supplied by all the four nerves (Bromage scale 2). The block was successful in 96.67% of patients in group US and 80% in group PNS, which was statistically significant (p<0.05).

Table 4: Modified Bromage Scale

- Grade 0 – Normal motor function with full flexion/extension of elbow, wrist and fingers
- Grade 1 – Decreased motor strength with ability to move fingers and/or wrist only
- Grade 2 – Complete motor blockade with inability to move fingers

There was no complication noted in either of the groups. Thus, both the groups were comparable based on complications.

Statistical analysis

All the qualitative data were analysed using chi-square test. The quantitative data were analysed using unpaired-t test. Results were expressed as Mean ± SD. p-values < 0.05 were taken as statistically significant and values < 0.001 were taken as highly significant. All analyses were done using SPSS version 2.0 statistical software.

Discussion

Supraclavicular brachial plexus block is an effective, time tested regional anesthetic technique for surgeries of upper extremities. It is not only an excellent alternative, but also offers several perioperative advantages over general anesthesia like reduced stress response, lesser blood loss, superior surgical conditions, optimal postoperative analgesia. It reduces the incidence of postoperative nausea and vomiting, providing early ambulation and reduced length of hospital stay, leading to satisfactory patient acceptance and improved clinical outcomes. Various methods were introduced to provide peripheral nerve block like paresthesia method, peripheral nerve stimulator guided technique and ultrasound guided technique. In recent years, the ultrasound guided method is increasingly preferred for administering regional anesthesia as it is associated with lesser complications and higher success rate.

In our study, no significant difference was found in between both the groups in terms of age, gender, ASA grade of patients. Similar demographic results were found in the studies conducted by Duncan Met al. [7], Ratnawat A et al. [8] and Rupera KB et al. [9]. This helped us to alleviate confounding factors like distribution of drug, its metabolism, excretion and action which may otherwise be affected by the age of the patients.

The Block Execution time in our study was comparable to the study conducted by Duncan M et al. [7], in which the time taken to execute block was 7.27 ± 3.88 minutes and 8.8 ± 1.73 minutes in Group US and NS respectively. In a study conducted by William S R et al. [10], the average time to execute the block was significantly shorter in Group US (5.0 ± 2.4 minutes) than in Group NS (9.8 ± 7.5 minutes). The block execution time was defined as the time between the first needle insertion and its removal at the end of the block in the study conducted by William S R et al. [10] while in our study, block execution time was calculated from the time of initial scanning to the removal of needle in Group US and the time from the insertion of needle to its removal in Group PNS. Thus, the mean block execution time was comparable to the studies conducted by Duncan M et al. [7] and William S R et al. [10].

The time of onset of sensory block was found was found to be similar to the results observed by Rupera KB et al. [9] in which onset time for sensory block was 2.97 ± 0.72 minutes and 3.63 ± 0.76 minutes in group US and group PNS respectively. Similar results were found by Jamwal A et al. [11] in which the onset of sensory block was significantly less in ultrasound guided technique. In a study conducted by Rupera KB et al. [9], the mean time of onset of motor block was found to be significantly less in group US (4.55 ± 0.78 minutes) as compared to group PNS (5.13 ± 0.71 minutes) while Ratnawat A et al. [8] found the mean time of onset of motor block to be 8.10 ± .02 minutes and 9.94 ± 1.28 minutes in group US and group PNS respectively which was statistically significant but higher than that of our study.

Ratnawat et al. [8] also observed that the mean duration of sensory and motor block was 8 and 7 hours respectively in group US and 7 and 6 hours respectively in group PNS, which was statistically significant and comparable to our study. In the study conducted by Singh S [12], similar results were found in which the duration of sensory block was significantly more in ultrasound guided technique in comparison to peripheral nerve stimulator technique.

Singh G et al. [13], in his study noted the mean duration of sensory and motor block in group US was 397.931 ± 67.325 minutes and 343.448 ± 60.843 minutes and in paresthesia group it was 352.22 ± 87.501 and 305.19 ± 60.088 minutes respectively which was statistically significant and comparable to our study.

Rupera KB et al. [9] found success rate of 80% in group PNS and 96.67% in group US. This difference was statistically significant and comparable to our study. Singh G et al. [13] found the block was successful in 90% in group US and 73.33% in paresthesia group.

In nerve stimulator guided technique, the drug is injected by observing muscle twitches which is innervated by the targeted nerve. At the same time, small and distal nerves in the targeted nerve bundle may escape from the effect of the drug or the drug may be deposited just outside the brachial sheath resulting in inadequate or patchy block requiring rescue analgesia or general anesthesia. In contrast, Ultrasound guided brachial plexus block employs

real time visualization of needle placement and drug spread around the targeted nerve plexus resulting in higher success rate.

Conclusion

It was concluded that the ultrasound guided supraclavicular brachial plexus block is more efficient, accurate and safer than the peripheral nerve stimulator guided brachial plexus block as it is characterized by a shorter time of onset and prolonged duration of sensory and motor block. It also has higher success rate with less complications as compared to the later technique.

References

1. Kulenkampff D, Persy MA. Brachial plexus anesthesia: its indications, technique and dangers. Ann Surg. 1928;87:883-91.
2. Cousins M, Bridenbaugh P, Lippincott P. Neural Blockade in Clinical Anaesthesia and Management of Pain. Anaesthesiology. 1981;55(4):490-94.
3. Sahu DK, Sahu A, Lateral approach for supraclavicular brachial plexus block. Indian J Anaesth 2010;54(3):215-8.
4. Brown DL, Cahill DR, Bridenbaugh LD. Supraclavicular nerve block: Anatomic analysis of a method to prevent pneumothorax. Anesth Analg. 1993;76:530-34.
5. La Grange P, Foster P, Pretorius L. Application of the Doppler ultrasound blood flow detector in supraclavicular brachial plexus block. Br J Anaesth 1978;50:965-7.
6. Carty S, Nicholls B. Ultrasound guided regional anesthesia. Contin Educ Anaesth Crit Care Pain. 2007;7(1):20-24.
7. Duncan M, Shetti A, Tripathy D, Roshansingh D, Krishnaveni N.A comparative study of nerve stimulator versus ultrasound guided supraclavicular brachial plexus block. Anesth Essays Res. 2013;7(3):359-64.
8. Ratnawat A, Bhati F, Khatri C, Srinivasan B, Sangwan P, Chouhan D. Comparative study between nerve stimulator guided technique and ultrasound guided technique of supraclavicular nerve block for upper limb surgery. Int J Res Med Sci. 2016;4(6):2101-06.
9. Rupera KB, Khara BN, Shah VR, Parikh BK. Supra-Clavicular Brachial Plexus Block: Ultra-Sonography Guided Technique Offer Advantage Over Peripheral Nerve Stimulator Guided Technique. Natl J Med Res. 2013;3(3):241-4.
10. Williams S, Chouinard P, Arcand G, Harris P, Ruel M, Boudrealt D et al. Ultrasound Guidance Speeds Execution and Improves the Quality of Supraclavicular Block. AnesthAnalg. 2003; 97:1518-1523.
11. Jamwal A, Mukta J, Manisha M, Mehta A, Gulati S. Supraclavicular Brachial Plexus Block: Ultrasound Guided Technique Vs Nerve Stimulator Guided Technique.JK Sci. 2016;18(1).
12. Singh S, Goyal R, Upadhyay KK, Sethi N, Sharma RM, Sharma A. An evaluation of brachial plexus block using a nerve stimulator versus ultrasound guidance: A randomized controlled trial. J AnaesthesiolClinPharmacol. 2015;31(3):370-4.
13. Singh G, Mohammed YS. Comparison between conventional technique and ultrasound guided supraclavicular brachial plexus block in upper limb surgeries. IJSS. 2014;2(8):169-76.