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Original Article

Comparison between Perivascular and Perineural Ultrasound-guided Axillary Nerve Block for Forearm Surgeries: A Randomized Controlled Study

M Balamurugan[1], M Shanmugasundaram[1], R Priyadharshini[2]

[1]Assistant Professor, Institute of Anaesthesiology, Government Rajaji Hospital, Madurai Medical College, Madurai, Tamil Nadu, India,
[2]Post Graduate, Institute of Anaesthesiology, Government Rajaji Hospital, Madurai Medical College, Madurai, Tamil Nadu, India

Abstract

Introduction: Brachial plexus block has evolved in procedures for upper limb surgeries when William Halsted performed it for the first time in 1884. Brachial plexus is formed by anterior primary rami of C5 to C8 and T1 nerves which emerge from intervertebral foramina.

Objective: The objective of this study was to compare ultrasound-guided perivascular (PV) and perineural (PN) axillary nerve block.

Materials and Methods: This prospective randomized comparative study was done in 50 patients posted for forearm surgery. This study was done to compare two techniques axillary block under ultrasound guidance. They were divided into two groups, namely, PN and PV group. In PN group, the median, ulnar, and radial nerves are blocked separately. In PV group, the local anesthetic is injected dorsal to the axillary artery. Intraoperatively, the imaging time, needling time, performance time, number of needle passes, vascular puncture, and onset of sensory and motor blockade were observed and recorded.

Results: According to this study, both PN and PV techniques have similar success rate. However, the performance time and number of needle passes were less in PV technique. Hence, the procedure-related pain was less in PV group.

Conclusion: The PV technique provides a simple alternative to axillary block under ultrasound guidance.

Key words: Axillary nerve block, Perivascular, Perineural, Ultrasound-guided

INTRODUCTION

Brachial plexus block has evolved in procedures for upper limb surgeries when William Halsted performed it for the first time in 1884. Brachial plexus is formed by anterior primary rami of C5 to C8 and T1 nerves which emerge from intervertebral foramina. They form roots between scalene muscles, trunks beneath the floor of posterior triangle, divisions behind the clavicle, and cords at the outer border of the first rib enter the axilla with the axillary artery.

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Use of image guidance for locating the peripheral nerve and neurofascial plane improves the success of this block with fewer complications. There are various techniques of imaging for nerve blocks. Among that ultrasound technique seems to be most reliable for nerve blocks. Ultrasound use was first described, in 1978, for supraclavicular brachial plexus block with the help of Doppler to detect blood flow. The nerve structures were first identified by Kapral, in 1994, visualized brachial plexus under ultrasound guidance. Ultrasound technology improved dramatically in last few years and leads to better understanding of sonoanatomy. Ultrasound-guided technology provides a good anatomy

Corresponding Author: Dr. M Balamurugan, Institute of Anaesthesiology, Government Rajaji Hospital, Madurai Medical College, Madurai, Tamil Nadu, India. Phone: 91-9443135904. E-mail: mbalan75@gmail.com

of the area of interest in real time.[1] This imaging helps to visualize neural structures such as nerve plexus and peripheral nerves and the surrounding structures such as blood vessels and pleura help to pass the needle toward the target nerves or facial plane, and visualize the extent of local anesthetic spread.[2] Ultrasound guidance allows visualization of the penetrating needle and nerve as well as a reasonable estimate of the spread of local anesthetic drugs.[3] In this study, we compared ultrasonography-guided perineural (PN) and perivascular (PV) axillary brachial plexus block (AXB) using compare performance time, number of needle passes, complications, onset time, success rate.

MATERIALS AND METHODS

This prospective randomized study was done to compare the PN and PV AXB under ultrasound guidance. This study was approved by the Ethical Committee of Hospital, and written informed consent was obtained from parents of the each patient. 50 patients of either sex undergoing surgery of forearm, wrist, and hand. 25 patients in each group were randomly allocated into two groups, namely, PV and PN group. The patients on either sex with the age group of 18-65 years with American Society of Anesthesiologists (ASA) physical status I, II, and III posted for elective upper limb surgeries were included in the study. This study was done in patients posted for arteriovenous fistula surgery. Patients with history of bleeding disorders, patients on anticoagulant therapy, with local infection, with documented neuromuscular disorders, with respiratory compromise, with known H/O allergy to local anesthetic drugs, and H/O psychiatric illness were excluded from the study. The detailed pre-anesthetic check-up was done on all patients, and relevant hematological, biochemical, and radiological investigations were carried out for all patients as per surgical requirements. Anesthesia equipment was checked, and resuscitative equipment and drugs were kept ready. In the operation theater, monitors such as pulse oximetry and non-invasive blood pressure were attached. Baseline values of parameters such as mean arterial pressure (MAP), pulse rate, and oxygen saturation (SPO_2) were recorded.

Sterile standard anesthesia tray prepared with the sterile towels, 4 × 4 gauze pack, local anesthetics mixture 12 ml of 0.5% bupivacaine, 6 ml of 2% lignocaine and 6 ml of sterile water, sterile gloves, one 2 cc 25 gauge needle for skin infiltration, one 23 gauge needle and 10 ml syringe for local anesthetic injection. Esaote ultrasound machine with probe frequency range of 10-15 MHz was used for the procedure.

Procedure

Patients were positioned supine with the shoulder abducted at 90° and the elbow flexed. The ultrasound probe was applied in a sterile fashion in the axilla. Betadine was used as a medium of interface to view the nerve structures. A high-frequency linear array probe of 10 MHZ frequencies was used for axillary block. Short axis views with sufficient compression to collapse the axillary vein was used to visualize neurovascular bundle. After obtaining a satisfactory image, a skin wheel was raised. In both groups, in-plane technique was used, in which the entire shaft and tip of needle were visible. In PV group, the needle is advanced until its tip is reached dorsal to axillary artery and the 24 ml of the local anesthetic mixture is deposited dorsal to the artery. A silhouette sign is sought to confirm proximity of needle tip to the artery. Silhouette sign is defined as blurring of arterial wall due to contiguity of blood and local anesthetic. In PN group, the median, ulnar, and radial nerves are blocked separately with 8 ml of local anesthetic mixture each.

The following parameters were assessed:

1. Imaging time: Defined as the time required to visualize axillary artery in PV group. In PN group, imaging time is defined as time needed to visualize all three nerves
2. Needling time: Time interval between the start of skin wheel and the end of local anesthetic injection
3. Performance time: Defined as the sum of imaging time and needling time
4. Number of needle passes
5. Vascular puncture
6. Time of sensory and motor blockade.

Motor and sensory blockade were assessed every 5 min up to 30 min. Sensory blockade of median, ulnar, and radial nerves was graded according to a 3 point scale using cold test (0 = No block; 1 = Analgesia - the patient can feel touch, not cold 2 = Anesthesia - the patient cannot feel touch). Sensory blockade was assessed in palmar aspect of the thumb for median nerve, in lateral aspect of the dorsum of the hand for radial nerve, and in palmar aspect of the fifth finger for ulnar nerve. Motor blockade of median, ulnar, and radial nerves was graded using 3 point scale (0 = no block; 1 = paresis; 2 = paralysis). Motor blockade was assessed by thumb abduction for radial nerve, thumb opposition for median nerve, and thumb adduction for ulnar nerve.

Sedation and rescue analgesics were not given during the procedure. If there was an inadequate motor or sensory block, the surgical procedure was completed with local infiltration. Intraoperatively, heart rate, MAP, and SPO_2 were recorded throughout the operation and were monitored at an interval of 5 min.

OBSERVATION AND RESULTS

The demographic profiles of the two groups were comparable in terms of age, sex distribution, and ASA physical status (Table 1). Imaging time was significantly higher in PN group compared to PV group. The imaging time in PV group was 19.8 s and in PN group was 111.6 s which was statistically significant ($P = 0.001$). Needling time was significantly prolonged in PN group compared to PV group. The needling time in PV group was 273.8 s and in PN group was 601.2 s which was statistically significant ($P = 0.001$). The performance time in total prolonged in PN group compared to PV group. The performance time in PV group was 293.6 s and in PN group was 712.8 s which was statistically significant ($P = 0.001$). As we expected the PV technique required fewer needle passes with mean value 1.4 compared to PN technique with mean value 5.16. The number of vascular punctures was less in PN group (2) than PV group (6) (Table 2). There was a higher rate of sensory anesthesia of median, radial, and ulnar nerve in PN group at 10, 15 min compared to PV group. However, there were no differences observed between two groups after 20 min (Table 3). There was a higher rate of the motor blockade of median, ulnar, and radial nerve in PN group at 5, 10, and 15 min compared to PV group, and there was no significant difference after 20 min (Table 4).

DISCUSSION

Ultrasound is very useful in direct visualization of nerve structures, and it is highly useful in targeted drug injection. In this study, the PV and PN group have comparable success rate and surgical anesthesia. However, the performance time and a number of needle passes are less in PV group compared to PN group. The onset time of sensory and motor blockade is faster in PN group, but it is comparable after 15 min. The incidence of vascular puncture is higher in PV group.

Imasogie *et al.*[4] compared a 2-injection PV to a 4-injection PN AXB and observed similar rates of surgical anesthesia but a shorter performance time with the PV technique. However, these authors used surgical anesthesia as the primary outcome and failed to record the number of needle passes.

Chan *et al.*[5] compared combined ultrasound and nerve stimulation technique with ultrasound alone for AXB. They found that combination of modalities lengthened the performance time without improving the power of axillary block. They concluded that ultrasound alone improves success rate rather than a combination of modalities. In this study, we used ultrasound without nerve stimulator which showed success rate.

Table 1: Demographic details and ASA physical status

Variables	Group PV	Group PN	*P* value
Age (years), mean±SD	48.44±12.11	45.28±11.31	0.345
Gender (male/female)	16/9	17/8	0.432
ASA I/II/III	0/14/11	0/16/9	

P value≤0.05 is significant. PV: Perivascular, PN: Perineural, SD Standard deviation, ASA: American Society of Anesthesiologists

Table 2: Observation and results of the study in seconds (mean±SD)

Variables	Group PV	Group PN	*P* value*
Imaging time	19.8±3.67	111.6±16.5	0.001
Needling time	273.8±41.56	601.2±62.74	0.001
Performance time	293.6±41.17	712.8±62.15	0.001
Vascular puncture (yes/no)	6/19	2/23	

**P* value≤0.05 is significant. PV: Perivascular, PN: Perineural, SD: Standard deviation

Table 3: Number of patients achieve score 2 of sensory block in minutes

Time (min)	Number of patients radial nerve blocked		Number of patients median nerve blocked		Number of patients ulnar nerve blocked	
	PV	PN	PV	PN	PV	PN
5	3	5	1	10	1	11
10	10	15	6	20	8	20
15	20	23	20	23	18	24
20	23	23	23	24	24	25
25	24	25	23	24	24	25
30	25	25	25	25	25	25

PV: Perivascular, PN: Perineural

Table 4: Number of patients achieve score 2 of motor block in minutes

Time (min)	Number of patients radial nerve blocked		Number of patients median nerve blocked		Number of patients ulnar nerve blocked	
	PV	PN	PV	PN	PV	PN
5	1	4	0	4	0	4
10	10	18	9	15	10	15
15	20	24	20	23	22	23
20	23	24	24	24	23	24
25	23	25	24	25	25	25
30	24	25	24	25	25	25

PV: Perivascular, PN: Perineural

Casati *et al.*[6] proved that compared to nerve stimulator ultrasound guidance decreases the number of needle passes and reduces procedure-related pain. In this study, we compared number of needle passes mainly to decrease procedure-related pain with success rate.

Tran *et al.*[7] and Fu Chaoliu *et al.* compared double injection axillary block with multiple injections under ultrasound guidance, and they concluded with similar result in this study that double injection technique with fewer needle passes provides simple alternative to ultrasound-guided axillary block.

CONCLUSION

The PV and PN ultrasound-guided axillary block has comparable success rates. Because of fewer needle passes and less imaging, needling and performance time the PV technique can be preferred over a PN technique.

REFERENCES

1. Christophe JL, Berthier F, Boillot A, Tatu L, Viennet A, Boichut N, *et al*. Assessment of topographic brachial plexus nerves variations at the axilla using ultrasonography. Br J Anaesth 2009;103:606-12.
2. Tran QH, Clemente A, Doan J, Finlayson RJ. Brachial plexus blocks: A review of approaches and techniques. Can J Anaesth 2007;54:662-74.
3. O'Donnell BD, Iohom G. An estimation of the minimum effective anesthetic volume of 2% lidocaine in ultrasound-guided axillary brachial plexus block. Anesthesiology 2009;111:25-9.
4. Imasogie N, Ganapathy S, Singh S, Armstrong K, Armstrong P. A prospective, randomized, double-blind comparison of ultrasound-guided axillary brachial plexus blocks using 2 versus 4 injections. Anesth Analg 2010;110:1222-6.
5. Chan VW, Perlas A, McCartney CJ, Brull R, Xu D, Abbas S. Ultrasound guidance improves success rate of axillary brachial plexus block. Can J Anaesth 2007;54:176-82.
6. Casati A, Danelli G, Baciarello M, Corradi M, Leone S, Di Cianni S, *et al*. A prospective, randomized comparison between ultrasound and nerve stimulation guidance for multiple injection axillary brachial plexus block. Anesthesiology 2007;106:992-6.
7. Tran DQ, Pham K, Dugani S, Finlayson RJ. A prospective, randomized comparison between double-, triple-, and quadruple-injection ultrasound-guided axillary brachial plexus block. Reg Anesth Pain Med 2012;37:248-53.

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