Medical Science

25(113), July, 2021

The perineural injection and double perivascular infiltration techniques in ultrasound - guided axillary brachial plexus block: A comparison study

Luay Talib Abdulmunem[1], **Mohammad Asi Jabbar**[2]✉, **Mortada Abd Al-Hussian Jubara**[2,3]

To Cite:
Abdulmunem LT, Jabbar MA, Jubara MAA. The perineural injection and double perivascular infiltration techniques in ultrasound -guided axillary brachial plexus block: A comparison study. Medical *Science*, 2021, 25(113), 1780-1787

Author Affiliation:
[1]Specialist of Anesthesia, F.I.C.M.S., Baghdad Medical Office Al-Russafa, Ministry of Health/Environment, Al-Kindey Teaching Hospital, Baghdad, Iraq
[2]Specialist of Anesthesia, C.A.B.A., Al-Shaheed Ghazi Al-Harriri Hospital, Baghdad Medical City, Ministry of Health/Environment, Baghdad, Iraq
[3]Specialist of Anesthesia, F.I.C.M.S., House Nursing Private Hospital, Baghdad Medical City, Ministry of Health/Environment, Baghdad, Iraq

✉**Corresponding author**
Specialist of Anesthesia, C.A.B.A., Al-Shaheed Ghazi Al-Harriri Hospital, Baghdad Medical City, Ministry of Health/Environment, Baghdad, Iraq

Peer-Review History
Received: 15 June 2021
Reviewed & Revised: 16/June/2021 to 12/July/2021
Accepted: 13 July 2021
Published: July 2021

Peer-review Method
External peer-review was done through double-blind method.

ABSTRACT

Background: Axillary brachial plexus block is widely used regional anesthesia technique for surgical procedure involving upper limbs. Ultrasound-guided Axillary Brachial Plexus Block (ABPB) provided the same fate and complication rates like nerve stimulation option. *Aim of the study*: To compare the two techniques of double perivascular injection with the perineural method for axillary brachial plexus block, all guided by ultrasound using compare performance time, number of needle passes, complications, onset time, and success rate. *Patient and method*: A randomized clinical trial study conducted in the Orthopedics operating for a period of six months from July 2020 to June 2021. It included 60 adult patients scheduled for hand or wrist surgery with axillary brachial plexus block and randomly managed by either perineural or double perivascular infiltration techniques. *Result*: In this study, no difference among success rate duration of action and induction time were significantly longer in perineural group than that in double perivascular group. Proportion of patients that blocked by perineural procedure was significantly higher than double perivascular procedure. *Conclusion*: Both double perivascular and perineural ultrasound-guided ABPB are approximately having the same success rate. Double perivascular is less time consuming than perineural that may make it as alternative method.

Keywords: Perineural; Perivascular; Brachial plexus; nerve block

1. 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 composed of anterior primary rami of cervical vertebra 5-8 and thoracic vertebra 1 nerves, which pass through intervertebral foramina (Ambi et al., 2015). Axillary brachial plexus block (ABPB) is widely used regional anesthesia technique in upper limbs, because of smooth performance, clear

vascular landmark, and low rate of major complications (Badiger et al., 2017). Recently, several studies have demonstrated that ultrasound-guided ABPB provided same success and complication rates when compared with nerve stimulation method (Casati et al., 2007; Kumar et al., 2014). The ABPB involve localization of axillary artery then injection of anesthetics around the artery (Bernucci et al., 2012). Several studies concluded that 1 or 2 injections could be provide a complete block. The onset is faster with fewer injections, less discomfort and less pain feeling, but the concern about efficacy and the safety still remains questioned (Chan et al., 2007; Pfeiffer et al., 2008; Cho et al., 2014; Dai et al., 2018; Cho et al., 2015; Tran et al., 2012).

2. MATERIALS AND METHODS

Study design, and setting

This randomized clinical trial study conducted in the Orthopedics operating room at Baghdad Teaching Hospitals, Baghdad, Iraq, during six months from July 2020 to June 2021.

Sample size

The study included 120 adult patients (18 – 80 years), scheduled for hand or wrist surgery with ABPB and randomly allocated to one of two groups: PN group: Included 60 patients underwent ultrasound-guided ABPB by perineural (PN) injection technique and double PV group: Included 60 patients underwent ultrasound-guided ABPB by double perivascular (PV) infiltration technique.

Randomization was done as by consequence method as 1st patient was assigned as PN group, 2nd patient was assigned as double PV group, and continuing in this sequence until we had 60 patients in each group. Pregnant women, diabetic patients, patients with known hypersensitivity to local anesthetic agents, patients with contraindication to any drugs used in this study, patients already on analgesic drugs for any reason, patients with poor communication, and those with infection in injection area were excluded from this study. All patients were subjected to detailed thorough history (socio-demographic variables, previous medical, surgical, and drug history). Complete physical examination with vital signs measurement.

Procedure

Standard monitoring was the same for all patients including ECG, blood pressure, and pulse oximetry. Patients were in the supine position, and the arm was externally rotated with 90° shoulder abduction and 90° elbow flexion. Oxygen (6L/mint.) was supplied by mask. Sterilization of axillary area was performed with povidone-iodine solution. The block was done by in-plane technique utilizing a 50-mm needle (22-gauge) mixed with 2% lidocaine and 5 μg/mL of epinephrine. We used the Ezona® US. The ultrasound probe was placed on the axilla for visualized the artery and nerve. The 3-o'clock position was medial and the 9-o'clock position was lateral to the axillary artery. In this view, the 12-o'clock position sided anteriorly, while the 6-o'clock position was posterior (Cho et al., 2014).

In PN group: The individual nerve of axillary brachial plexuswas placed by needle tip. Then 8 mL of LA were injected.

In double PV group: Anteriorly, needle tip was positioned in the 12-o'clock of the axillary artery. About 12 mL of LA injected plus 12 mL, which posteriorly injected to A in the 6-o'clock direction.

Finally, the MC nerve was blocked separately guided byUS. LA was administered when the needle point was placed to the nerve in the coraco-brachialis muscle. The degree of sensory and motor blockade, the onset time, and the calculated induction time were measured by a blinded observer. The degree was evaluated according to each nerve movement and dermatome. It was estimated at 5 mints' intervals for 15 mints. With the final needle removal being, time zero. The pinprick test used to measured sensory blockade by graded tono block (0) and no pain sensation (1).

The sensory blockade of the median n. was measured on the palm side of 3rd finger, the ulnar n. on the palm side of 5thfinger, the radial n. in the lateral part of the back of the hand, and the MC n. in the lateral part of the forearm. Motor blockade was graded as follows: 0= No weakness; 1= Incomplete motor block; 2= Complete motor block.

Motor blockade of the median n. was measured by flexion of 2ndand 3rdfingers, the ulnar n. by flexion of 4thand 5thfingers, the radial n. by abduction of the thumb, and the MC n. by flexion elbow joint. Surgical anesthesia was obtained when the sensory blockade reached stage I in all 4 nerves and the motor blockade became stage I or II.

Statistical analysis

The data analyzed using SPSS version 25. The results figured as mean, SD and ranges. Categorical data presented by frequencies and percent. Student t-test (two tailed) was used to compare the continuous variables accordingly. Chi-square was used to assess

the difference between study groups by certain information, while Fisher exact test was used instead when the expected frequency was less than 5. A level of P value < 0.05 was considered significant.

3. RESULTS

In this study, age was ranging from 21 to 76 years with mean of (43.52 ± 8.44) years. Table 1 showed the mean of duration of action and induction time were significantly longer in PN group than that in double PV group (6.4 versus 3.32 mints., P= 0.001; and 10.55 versus 8.9 mints., P= 0.001 respectively). No significant differences (P ≥ 0.05) in age, BMI, time of onset, and number of needle pass between study groups.

Table 1 Comparison between study groups by certain general and clinical information

Variable	Study Group		P- Value
	PN Mean ± SD	Double PV Mean ± SD	
Age (Years)	44.11 ± 9.5	42.62 ± 7.9	0.583
BMI Level (kg/m^2)	26.31 ± 6.1	27.38 ± 5.7	0.32
Duration of action (Mint.)	6.4 ± 1.86	3.32 ± 1.27	0.001
Time of onset (Mint.)	5.02 ± 1.56	6.1 ± 2.04	0.122
Induction time (Mint.)	10.55 ± 2.27	8.9 ± 2.06	0.001
Number of needle pass	5.33 ± 1.02	4.88 ± 0.97	0.176

In this study, no significant differences (P ≥ 0.05) in gender and success (Figure 1) between study groups. Also, 50% of PN group and 56.7% of double PV group were operated for fracture reduction and the difference in operation type between study groups was statistically not significant (P= 0.332) as shown in figure (2), and table (2).

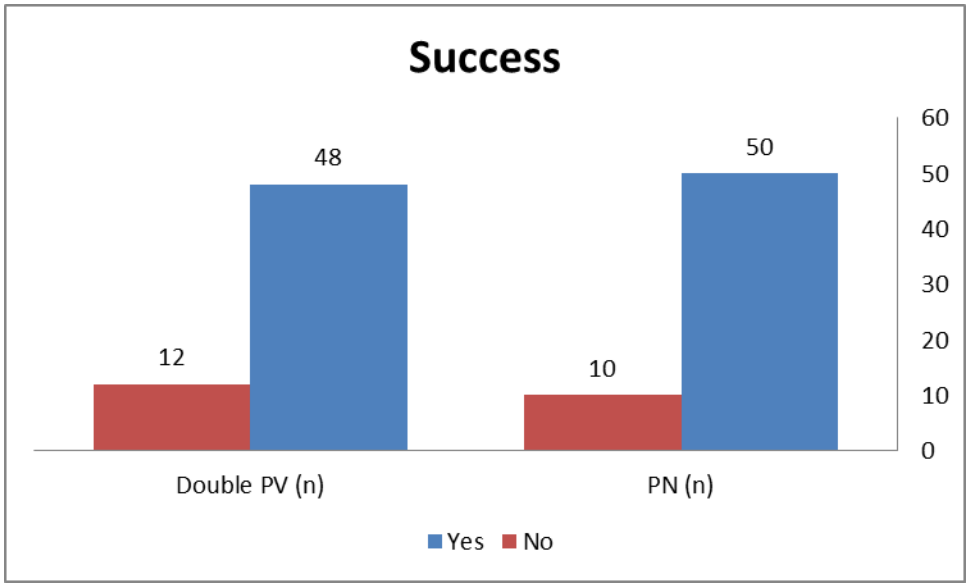

Figure 1 Comparison in success of operation between study groups.

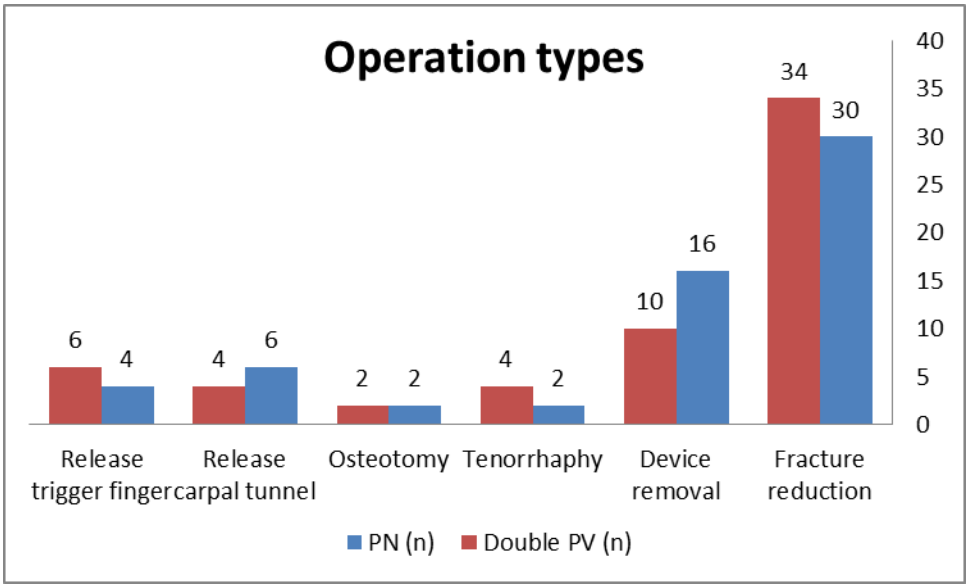

Figure 2 Comparison in type of operation between study groups.

Table 2 Comparison in gender and type of operation between study groups.

Variable	Study Group		Total (%) n= 120	P- Value
	PN (%) n= 60	Double PV (%) n= 60		
Type of operation				
Fracture reduction	30 (50)	34 (56.7)	64 (53.3)	0.332
Device removal	16 (26.7)	10 (16.7)	23 (21.7)	
Tenorrhaphy	2 (3.3)	4 (6.7)	6 (5)	
Osteotomy	2 (3.3)	2 (3.3)	4 (3.3)	
Release carpal tunnel	6 (10)	4 (6.7)	10 (8.3)	
Release trigger finger	4 (6.7)	6 (10)	10 (8.3)	
Gender				
Male	40 (66.7)	36 (60)	76 (63.3)	0.592
Female	20 (33.3)	24 (40)	44 (36.7)	
Success				
Yes	50 (83.3)	48 (80)	98 (81.7)	0.738
No	10 (16.7)	12 (20)	22 (18.3)	

As shown in table (3) and figure (3), after five mints from the procedure, the proportion of patients that blocked by PN procedure was significantly higher ($P < 0.05$) than that in double PV procedure for all nerves. For MC nerve, no statistical significant difference ($P= 0.347$) in sensory block between study groups. After, 10 and 15 mints no statistical significant differences ($P \geq 0.05$) in sensory block between study groups for all nerves.

As shown in table (4) and figure (4), after five mints from the procedure, the proportion of patients that completely blocked by PN procedure was significantly higher ($P < 0.05$) than that in double PV procedure for median and MC nerves. For ulnar and radial nerves, no statistical significant difference ($P \geq 0.05$) in motor block between study groups. After, 10 and 15 mints., proportion of patients that completely blocked by PN procedure was significantly higher ($P < 0.05$) than that in double PV procedure for all nerves except MC nerve after 15 mints. When there was no significant ($P = 0.278$) in complete motor block between study groups.

Table 3 Comparison in sensory block for certain nerves between study groups

Sensory blockade	Study Group		Total (%) n= 120	P - Value
	PN (%) n= 60	Double PV (%) n= 60		
Median nerve				
5 mints.	52 (86.7)	38 (63.3)	90 (75)	0.036
10 mints.	54 (90)	54 (90)	108 (90)	1.0
15 mints.	56 (93.3)	54 (90)	110 (91.7)	0.64
Ulnar nerve				
5 mints.	54 (90)	36 (60)	90 (75)	0.007
10 mints.	54 (90)	52 (86.7)	106 (88.3)	0.687
15 mints.	56 (93.3)	54 (90)	110 (91.7)	0.64
Radial nerve				
5 mints.	56 (93.3)	32 (53.3)	88 (73.3)	0.001
10 mints.	56 (93.3)	50 (83.3)	106 (88.3)	0.227
15 mints.	56 (93.3)	54 (90)	110 (91.7)	0.64
MC nerve				
5 mints.	50 (83.3)	44 (73.3)	94 (78.3)	0.347
10 mints.	54 (90)	52 (86.7)	106 (88.3)	0.687
15 mints.	56 (93.3)	54 (90)	110 (91.7)	0.64

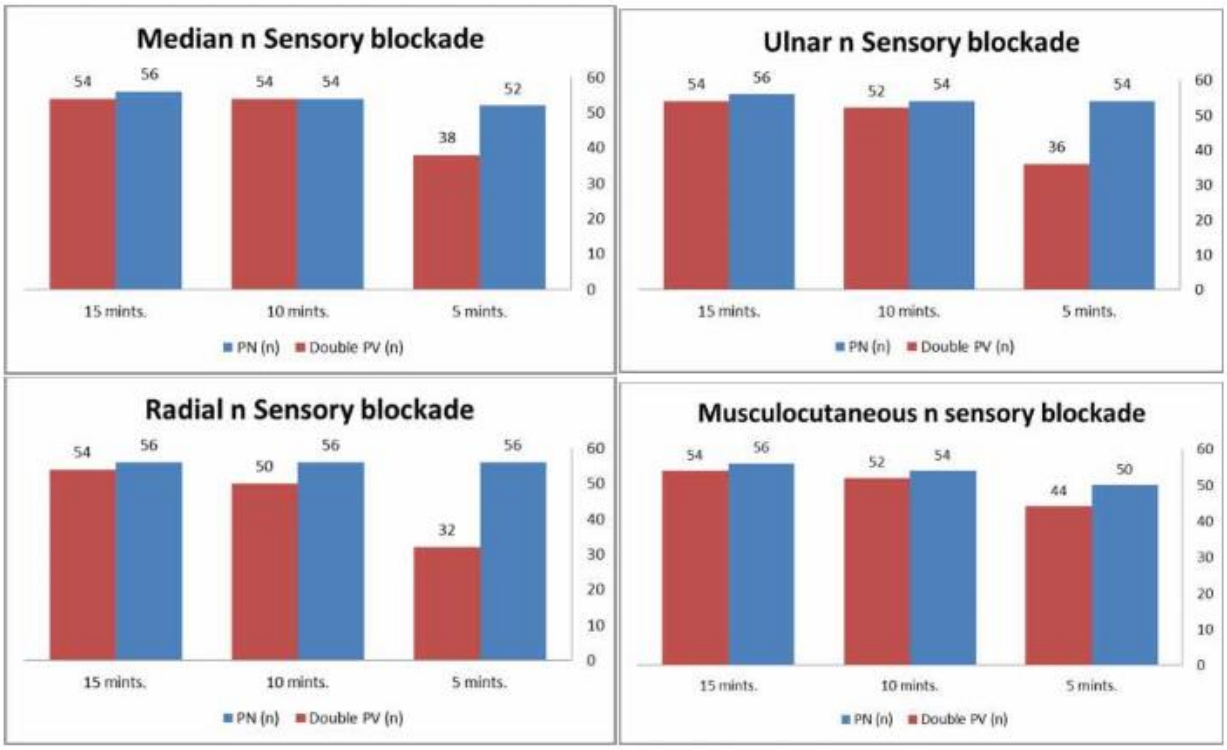

Figure 3 Comparison in sensory block for certain nerves between study groups

Table 4 Comparison in motor block for certain nerves between study groups

Motor blockade	Study Group		Total (%) n= 120	P - Value
	PN (%) n= 60	Double PV (%) n= 60		
Median nerve				
5 mints.	8 (13.3)	0	8 (6.7)	0.038
10 mints.	42 (70)	6 (10)	48 (40)	0.001
15 mints.	56 (93.3)	26 (43.3)	82 (68.3)	0.001
Ulnar nerve				
5 mints.	6 (10)	0	6 (5)	0.075
10 mints.	40 (66.7)	8 (13.3)	48 (40)	0.001
15 mints.	52 (86.3)	20 (33.3)	72 (60)	0.001
Radial nerve				
5 mints.	4 (6.7)	0	4 (3.3)	0.15
10 mints.	38 (63.3)	10 (16.7)	48 (40)	0.001
15 mints.	56 (93.3)	28 (46.7)	84 (70)	0.001
MC nerve				
5 mints.	24 (40)	4 (6.7)	28 (23.3)	0.002
10 mints.	46 (76.7)	28 (46.7)	74 (61.7)	0.016
15 mints.	54 (90)	48 (80)	102 (85)	0.278

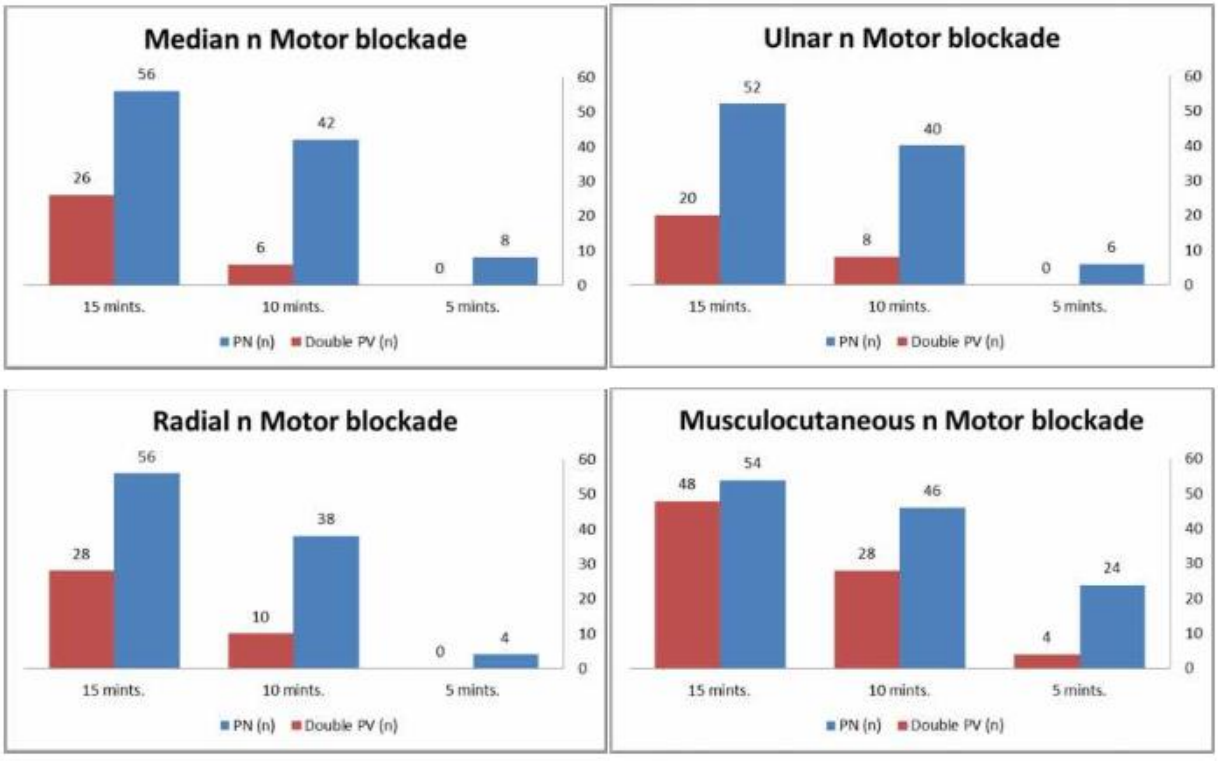

Figure 4 Comparison in motor block for certain nerves between study groups.

4. DISCUSSION

Blockade of brachial plexus is a better way for anesthesia in the upper limb. There are many approaches to blocking it, dependent on the indication, surgery or procedure, patient-specific body habitus, co-comorbidities, and anatomical variations (Dai et al., 2018).

In this study, mean of duration of action and induction time were significantly longer in PN than in double PV group (P= 0.001). Different findings noticed in Cho et al., (2015), in which performance time in PN group was significantly longer (P<0.05), but average onset time was not significant. The induction time was larger in PN group (P<0.05), with a significant difference in number of needle passes between both groups.

In Bernucci et al., (2012), no differences were found in terms of success rate (P ≥0.05). However, the PV technique needed significantly a fewer needle and the performance time was short. In contrast, PN resulted in a faster onset (P = 0.021). Tran et al., (2012) noticed a different finding, in which double PV required fewer needle passes (P = 0.001). These differences might explain by the fact that a longitudinal dispersion of local anesthesia through neurovascular sheath. Application of the PV methods, the use of US is necessary as it allows showing the tip of needle and LA dispersion through the blockade and ensures the correct dispersion (Ferraro et al., 2018).

In this study, the success rate was 83.3% in PN and 80% in double PV group. Similarly, success rate in Cho et al., (2014) was 84%, which was slightly lower than, Bernucci et al., (2012), recorded 92-96% success rate and Tran et al., (2012) study, who documented a 90-97.5% successful rate. Factors influencing the success rate are local anesthesia volume, time set for determining the success and probably topographical anatomy of nerves in relation to axillary artery. Furthermore, this study revealed after 5 mints, that blockade by PN were significantly higher (P < 0.05) than that in double PV. For MC nerve, no significant difference (P= 0.347) in sensory block. After, 10 and 15 mints, no significant differences (P ≥ 0.05) in sensory block between study groups for all nerves. Differently, Cho et al., (2012) found that all nerves were blocked more in PN group. There was no relation between MC nerve blockade and time period.

Furthermore, Ambi et al., (2015) reported different findings, as found that onset of mean time and the duration of mean of sensory block in PN group was significantly lower than that noticed in PV group (P<0.05). This study revealed that after 5 mints, patients blocked by PN were significantly higher for median and MC nerves. For ulnar and radial nerves, no significant difference in motor block (After, 10 and 15 mints., blockade by PN was significantly higher (P < 0.05) for all nerves except MC nerve after 15 mints (no difference in complete motor block). A difference reported in Cho et al., (2015), when found that all nerves at different minutes completely motor block in the PN group, while MC nerve block, a fewer patients had completely block than in the PN at 5 minutes.

On the other hand, a different findings observed in Ambi et al., (2015) study, as found that onset of mean time of motor block was significantly lower in PN group (P<0.05) and mean duration in same group was higher than that noticed in PV group (P<0.05). These discrepancies observed above might be due to the usage of composite score ofboth block analysis. The author in different studies had graded both blockades of the nerves in relation to a 3-point scale. The use of US has applied a redefinition for many blockades, and enhance the application methods to perform the same blockade. These techniques were effective as the peri-neural procedure and decreased the incidence of paresthesia during the blockade (Cho et al., 2015).

5. CONCLUSION

Both double perivascular and perineural ultrasound-guided ABPB are approximately similar in success rate. Double perivascular is less time consuming than perineural that may make it as alternative method.

Authors' contributions

Abdulmunem LT (study concept, methodology, manuscript writing and study supervision), Jabbar MA (data collection, data processing, manuscript revision, and study supervision), Jubara MAA (data collection, data processing, manuscript revision, and study supervision).

Funding

This study has not received any external fund.

Conflict of Interest

The authors declare that there are no conflicts of interests.

Informed consent

Given the nature of the study, an informed consent has been waived by the research committee of ethical approval.

Ethical approval

The Arab board council ethics committee was approved the study and written informed patient consent was obtained (number: 11119).

Data and materials availability

All data associated with this study are present in the paper.

REFERENCES AND NOTES

1. Ambi U, Bhanupriya P, Hulkund SY, Prakashappa DS. Comparison between perivascular and perineural ultrasound-guided axillary brachial plexus block using levobupivacaine: A prospective, randomised clinical study. Indian J Anaesth 2015; 59(10):658-63.
2. Bernucci F, Gonzalez AP, Finlayson RJ, Tran DQ. A prospective, randomized comparison between perivascular and perineural ultrasound-guided axillary brachial plexus block. Reg Anesth Pain Med. 2012; 37(5):473-7.
3. Casati A, Danelli G, Baciarello M, Corradi M, Leone S, Di Cianni S, Fanelli G. A prospective, randomized comparison between ultrasound and nerve stimulation guidance for multiple injection axillary brachial plexus block. Anesthesiology. 2007; 106(5):992-6.
4. Chan VW, Perlas A, McCartney CJ, Brull R, Xu D, Abbas S. Ultrasound guidance improves success rate of axillary brachial plexus block. Can J Anesth 2007; 54(3):176-82.
5. Cho S, Kim YJ, Baik HJ, Kim JH, Woo JH. Comparison of ultrasound-guided axillary brachial plexus block techniques: perineural injection versus single or double perivascular infiltration. Yonsei Med J 2015; 56(3):838-44.
6. Cho S, Kim YJ, Kim J-H, Baik H-J. Double-injection perivascular ultrasound-guided axillary brachial plexus block according to needle positioning: 12 versus 6 o'clock position of the axillary artery. Korean j anesthesiol 2014; 66(2):112-9.
7. Dai W, Tang M, He K. The effect and safety of dexmedetomidine added to ropivacaine in brachial plexus block: A meta-analysis of randomized controlled trials. Medicine (Baltimore) 2018; 97(41):e12573-e.
8. Ferraro LHC, Takeda A, Sousa PCCB, Mehlmann FMG, Junior JKM, Falcão LFDR. Estudo prospectivorandomizado de três diferentestécnicas para o bloqueio do plexobraquial via axilarguiado por ultrassom [Randomized prospective study of three different techniques for ultrasound-guided axillary brachial plexus block]. Braz J Anesthesiol 2018; 68(1):62-68.
9. Kumar LCA, Sharma CD, Sibi ME, Datta CB, Gogoi LCB. Comparison of peripheral nerve stimulator versus ultrasonography guided axillary block using multiple injection technique. Indian j anaesth 2014; 58(6):700.
10. Pfeiffer K, Weiss O, Krodel U, Hurtienne N, Kloss J, Heuser D. Ultrasound-guided perivascular axillary brachial plexus block. A simple, effective and efficient procedure. Der Anaesthesist 2008; 57(7):670-6.
11. 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(3):248-53.