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Supraclavicular Brachial Plexus Block for Creation of AV Fistula: Nerve Localization by Paraesthesia versus Electrical Nerve Locator

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Abstract

Introduction: Regional nerve block anaesthesia offers many clinical advantages that contribute to improved patient outcome and lower healthcare costs.In patients with End Stage Renal Disease, a permanent vascular access through surgical construction of an arteriovenous fistula (AVF) is essential. However, many of these patients have severe comorbidities, which can lead to serious complications during general anesthesia. Brachial plexus block attenuates the side effects of general anesthesia in patients undergoing AVF construction. Our aim was to compare two methods of nerve localisation – elicitation of paresthesia versus nerve locator with regards to technical feasibility and ease of nerve localization, onset and the time to establish complete surgical anaesthesia and to determine the success rate,quality of block and failure rate between the two methods. *Materials and Methods:* A randomized controlled trial was conducted in to a near 1200 bed tertiary care hospital. The study population included patients who underwent AV fistula creation between a specified six months period. After obtaining written informed consent, patients fulfilling the study criteria were allocated randomly into two groups. Group (1) P – where nerve localization will be carried out by paresthesia technique. Group (2) PNL – where nerve localization will be done by peripheral nerve locator. The patients in both groups were monitored for the onset, duration, success or failure of block, sequelae and such other variables as required for fulfilling the objectives. *Results:* In paresthesia group the time to localise the nerve was observed to be significantly less ($p<0.05$) as compared to the nerve locator group.The time for onset of block, latency of block, complete surgical analgesia, duration of surgical analgesia and postoperative analgesia did not show any statistical significance ($p>0.05$) between the paresthesia and nerve locator groups. The paresthesia group had nine cases and nerve locator group had four cases who required supplementation to achieve complete surgical analgesia. The success rate of nerve block was 91.1% in nerve locator group compared to 80% in paresthesia group. *Conclusion:* Peripheral nerve locator appears to be more useful particularly when the block of deep seated plexus or nerves is desired. Although nerve locator may not help in improving the onset of block, latency of block or time to achieve complete surgical anaesthesia, the success ofperipheral nerve locator can be attributed to a lesser risk of tissue injuries like vascular punctures and direct nerve trauma.

Keywords: Brachial Plexus Block; Paresthesia; Peripheral Nerve Locator.

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Introduction

Regional nerve block anaesthesia offers many clinical advantages that contribute to improved patient outcome and lower healthcare costs. Regional anaesthesia is particularly desirable in elderly and high risk patients. It is increasingly used for day care anaesthesia [1]. In patients with End Stage Renal Disease, a permanent vascular access

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through surgical construction of an arteriovenous fistula (AVF) is essential. However, many of these patients have severe comorbidities, which can lead to serious complications during general anesthesia. Brachial plexus block attenuates the side effects of general anesthesia in patients undergoing AVF construction [2]. Regional blocks also improve the success of vascular access procedures by producing significant vasodilatation, greater fistula blood flow, sympathectomy-like effects, and decreased maturation time [3].

Our aim was to compare two methods of nerve localization – elicitation of paresthesia versus nerve locator with regards to technical feasibility and ease of nerve localization, onset and the time to establish complete surgical anaesthesia and to determine the success rate, quality of block and failure rate between the two methods.

Materials and Methods

A randomized controlled trial was conducted in a 1200 bed tertiary care hospital. The study population included patients who underwent AV fistula creation between a specified six months period.

The inclusion criteria were

ESRD patient for AVF procedure

ASA grade III

Weight between 45- 65 kg age >18 years

Communicable and cooperative

Exclusion Criteria

History of allergy to local anesthetic drugs, Pre-operative neurological deficit, Psychiatric disorder, Coagulation disorder, Uncontrolled seizure, Pregnant and lactating women.

Dependent variables considered are:

1. Time to localize nerve
2. Onset of block
3. Latency of block
4. Complete surgical anaesthesia.

Independent variables considered in this study are:

1. Medical diseases
2. Medication history
3. Duration of renal disease
4. Any drugs affecting nerve block

Study tools

1. A proforma including the independent and dependent variables and bio-socio-demographic variables
2. Anaesthetic medications and procedures:

   a. Regional anesthetic drug-

A 30 ml compound solution of Inj.Lignocaine 2% with epinephrine 1:200000 and Inj. Bupivicaine 0.5% as single injection technique was used [4].

b. Peripheral nerve locator- INNERVATOR 232 from Fisher & Paykel Healthcare Ltd, Auckland, New Zealand.

Procedure

After obtaining ethical approval and written informed consent, patients fulfilling the study criteria were allocated randomly into either of the two groups.

Group 1: P – where nerve localization will be carried out by paresthesia technique.

Group 2: PNL – where nerve localization will be done by peripheral nerve locator.

After standard safety precautions, proper positioning and skinwheal with local anaesthetic, a 22 G hypodermic needle was inserted at the midpoint of clavicle lateral to subclavian pulsation targeting the first rib and eliciting paresthesia of forearm or fingers as we proceeded [5]. In the PNL group, 22G stimuplex needle was used at the same location as the paresthesia method while observing muscle twitch and directing towards a position where twitch is observed with minimal current between 0.1 mA to 1 mA [6,7,8]. Once achieved, the drug mixture is delivered through the needle. The patients in both groups were monitored for the onset, duration, success or failure of block, sequelae and such other variables as required for fulfilling the objectives. After the completion of the procedure, patients were shifted to the post operative recovery room for observation.

Operational Definitions

Time to localize nerve –was taken as time in minutes from the insertion of the needle through the skin to onset of paresthesia or first motor response.

Latency of block was taken as the time from injection of local anaesthetic drug to loss of pinprick sensation in the anatomical distribution of the concerned nerve.

Complete surgical analgesia- The block was defined complete when surgical analgesia was observed at 30 min in all the sensory areas in the anatomical distribution of the nerve. The patient was declared ready for surgery when surgical analgesia was achieved.

Supplementation- After 30 minutes, in case of incomplete block, supplementation in the form of local skin infiltration and or analgesic (Inj.Fentanyl 1mcg/kg) was given and sensory assessment continued. These cases were noted as failure of blocks [8].

Duration of Surgical analgesia - adequate until completion of procedure.

Sequelae: Follow-up visits was taken at 24 and 48 hours after the surgery. Any neurological sequel was recorded during these visits as well as till the patient is discharged from the hospital.

Data Analysis: The obtained data was analyzed using SPSS 16.0 version. Mean, standard deviation and t test for continuous data and chi square tests for categorical data was used to compare the two groups.

Results

Ninety adult patients in the age group of 18-75 years were randomly allocated to either paresthesia technique (Group P, n=45) or peripheral nerve locator technique (Group PNL, n=45).The patients distributed in these two groups were comparable to their age distribution, gender distribution and weight distribution.

In paresthesia group the time to localise the nerve was observed to be significantly less ($p<0.05$) as compared to the nerve locator group. However in the paresthesia group three patients could not report paresthesia at all.

The time for onset of block, latency of block, complete surgical analgesia, duration of surgical analgesia and postoperative analgesia did not show any statistical significance ($p>0.05$) between the paresthesia and nerve locator groups. The paresthesia group had nine cases and nerve locator group had four cases who required supplementation to achieve complete surgical analgesia. The success rate of nerve block was 91.1% in nerve locator group compared to 80% in paresthesia group. In the present study no neurologic dysfunction was observed in either of the groups. (Table 1).

Comparing the two groups, the difference in time to localize nerve is statistically significant i.e less

Table 1: Baseline characteristics of the study population

Variables	Paresthesia	Peripheral nerve locator	Total
Age	No: (%)	No: (%)	No: (%)
15-30	3 (6.7)	1 (2.2)	4 (4.4)
31-45	12 (26.7)	9 (20.0)	21 (23.3)
46-60	17 (37.8)	19 (42.2)	36 (40.0)
61-75	12 (26.7)	16 (35.6)	28 (31.1)
Gender Male	29(64.4)	30(66.7)	59(65.6)
Female	16(35.6)	15(33.3)	31(34.4)
Weight			
45-50	20 (44.4)	24 (53.3)	44 (48.9)
51-55	7 (15.6)	1 (2.2)	8 (8.9)
56-60	8 (17.8)	10 (22.2)	18 (20.0)
61-65	10 (22.2)	10 (22.2)	20 (22.2)

Table 2: Mean time for nerveblock in the study groups

Variable	Paresthesia Mean (SD)	Peripheral nerve locator Mean (SD)	P value
Time to localise the nerve(min	1.85 (1.45)	2.53 (1.38)	p<0.05
Onset of block	2.33(1.65)	2.1(1.46)	p>0.05
Latency of block(min)	11.28(4.88)	10.44(4.53)	p>0.05

Table 3: Distribution of Success of nerve localisation in the study groups

		P	PNL	p value*
Successful localization	Present No: (%)	42(93.3)	45(100)	p>0.05
	Absent No: (%)	3(6.7)	0	
Complete surgical analgesia	Present No: (%)	36(80)	41(91.1)	p>0.05
	Absent No: (%)	9(20)	4(8.9)	

*Chi square test

Table 4: Frequency of Vascular puncture in the study groups

Method	Vascular puncture		
	No	Yes	Total
P	37	8	45
	82.2%	17.8%	100.0%
PNL	43	2	45
	95.6%	4.4%	100.0%
Total	80	10	90
	88.9%	11.1%	100.0%

$\chi^2 = 4.050$, df = 1, $p<0.05$

time is required to localize the nerve in P group as compared to PNL group. Eventhough PNL has faster onset of block, the difference between the two groups is not statistically significant. The table shows that there is no significant difference in latency of block between the two groups though the latency of block is lesser with PNL. (Table 2)

The table 3 shows that the nerve could be successfully located in all the patients (100%) in which nerve locator was used, but there is no significant difference in the proportion of patients with successful nerve localisation in two groups (Z =1.8).

The table 3 shows that the complete surgical analgesia was higher (91.1%) in the nerve locator group compared to the paresthesia group (80%) but there is no significant difference in the attainment of complete surgical analgesia between the two groups. χ^2=2.248, df=1, p>0.05.

Immediate complication i.e vascular puncture was significantly higher in the paresthesia group compared to the nerve locator group (Table 4).

Discussion

This prospective study was designed to evaluate patients undergoing supraclavicular brachial plexus block for creation of AV fistula either by paraesthesia or with PNL technique.

Study was conducted by random allocation of patients into either paraesthesia (Group P, n=45) or PNL (group PNL, n= 45) technique.

The two groups selected for this study were found to be comparable with respect to age, sex, and weight distribution.

In our study, in (group P) patients the nerve localization by paraesthesia was successful only in 80% of patients as compared to nerve locator 91.1%.

When paraesthesia is not elicited, there is an uncertainty regarding the proximity of the drug deposition with respect to the nerve. This may result in injecting additional dose or volume of local anaesthetic which theoretically puts the patient at a risk of local anaesthetic overdose. Use of PNL may reduce the possibility of such uncertainties.

In our study, time to localize a deep seated nerve in paraesthesia group was found to be significantly less compared to that with nerve locator. This can be explained on the fact that anaesthesiologists are more conversant with paraesthesia technique as compared to PNL. Secondly, while using PNL one goes stepwise frequently changing the current strength till the desired point of muscle contraction at a minimal current output. This naturally will need more time compared toparaesthesia. However, with experience this gap can be nullified.

There is no significant difference in the onset of block, latency of block and time to achieve complete surgical anaesthesia between the two groups. In a study of axillary nerve block done by Sia and Bartoli in 2000,they showed that when multiple injection technique is used the time to perform the block ,

onset time of primary block, time to achieve readiness to surgery and total anaesthetic time is significantly shorter in group PNL than group paraesthesia [9].

As shown by Horlocker in his study the success rate with the paraesthesia technique (90%) were significantly higher as compared to nerve stimulator technique (83%) [10]. Similarly, Shroeder and collegues reported that paraesthesia technique during axillary blockade resulted in significantly higher success rate [11]. Goldberg and collegues, found that for axillary blockade, transarterial, paraestheisa and nerve stimulator technique all resulted in similar success rate (70-80%)[12]. Correspeondingly McClain and collegues investigated brachial plexus blockade with interscalene approach and found that utilizing paraesthesia versus a nerve stimulator resulted in comparable success rates (70-80%) [13]. In our study success rate for PNL was found to be 91.1% compared to 80% for paraesthesia. Four cases in PNL and nine cases in paraesthesia group failed and required supplementation.

The results of our study show that use of PNL leads to higher success rate for performing local anaesthetic block as compared to paraesthesia. The results correlate with the study done by Sia and Bartoli comparing success rate of multiple injection axillary brachial plexus block performed by using two methods of nerve localization, paraesthesia elicitation or nerve stimulation [14].

In our study even though the failure rate was lower with PNL group, it was not statistically significant.

The incidence of vascular puncture was higher in paresthesia group (8 cases) as compared to PNL group (2 cases), which might lead to ischaemic damage to brachial plexus. Use of PNL might reduce these problems [12].

No neurological dysfunction was reported in this study. This might be due to the limited number of patients in this study. Although elicitation of paresthesia may represent direct needle trauma and theoretically increase the risk of neurologic injury, there are no prospective, randomized clinical studies that definitely support this hypothesis.

Conclusion

Regional anaesthetic techniques are gaining interest and use in present day clinical practice because of their inherent advantages over general anaesthesia.

The use of peripheral nerve locator in the process of nerve blocks is evaluated in the present study. It appears to be more useful to improve the result of the block particularly when the block of deep seated plexus or nerves is desired. Although nerve locator may not help in improving the onset of block, latency of block or time to achieve complete surgical anaesthesia, the success of peripheral nerve locator can be attributed to a lesser risk of tissue injuries like vascular punctures and direct nerve trauma.To overcome the problems of failed block or inadvertent local anaesthetic toxicity peripheral nerve locator is being considered and used in low resource setting.

Use of peripheral nerve locator for nerve blocks therefore appears to promise a better quality of surgical anaesthesia along with improved patient comfort and safety without possible side effects.Use of regional blocks may also improve the success of vascular access procedures by producing significant vasodilatation, greater fistula blood flow, sympathectomy-like effects, and decreased maturation time.It is proposed that the use of good quality nerve locator, meticulous nerve localisation technique and a large experience in this field is likely to give more promising results. This will help the anaesthesiologists, interested in regional anesthesia to achieve a reasonable high standard in giving quality regional blocks, along with an increased patient safety and acceptability.

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