ISSN (Print) : 2348–263X
ISSN (Online) : 2348-2648
MVP Journal of Medical Sciences, *Vol 4(2), 135–140, July-December 2017* DOI: 10.18311/mvpjms/2017/v4i2/11033

Comparison of Success Rate of Classical Supraclavicular Brachial Plexus Block with and without Nerve Stimulator

Sayali Patil[1] and Alka Koshire[2*]

[1]PG Resident, Department of Anaesthesia, Dr. Vasantrao Pawar Medical College Hospital & Research Centre, Nashik - 422003, Maharashtra, India; drsayalip@gmail.com
[2]Professor & Head, Department of Anaesthesia, Dr. Vasantrao Pawar Medical College Hospital & Research Centre, Nashik - 422003, Maharashtra, India; alkakoshire15@gmail.com

Abstract

Introduction: Brachial plexus block has now evolved into valuable and safe alternative to general anesthesia for upper limb surgeries. The nerve stimulation technique make use of electric current to elicit motor stimulation of nerves and confirm the proximity of the needle to the nerve, thereby avoiding the discomfort caused due to paresthesia leading to good success rate, even when the pa-tient is uncooperative or uncommunicative. **Aim and Objectives:** To compare between paresthesia technique and use of nerve locator in performing supraclavicular brachial plexus block with respect to success and complication rate. **Materials and Methods:** A comparative study was conducted at department of Anesthesia of a tertiary care centre. A total of 100 patients undergoing upper limb elective surgery were included after satisfying inclusion and exclusion criteria. The anesthetic method employed was Brachial plexus block by Supraclavicular Approach: using paresthesia technique (Group A: 50 subjects) and; by using Nerve Stimulator technique (Group B: 50 subjects). Both the groups of patients were studied for performance time, sensory block, and motor block and for success rate. Statistical analysis was done using SPSS ver. 21. **Results:** Onset of sensory and motor block were significantly faster in nerve stimulator group as compared to paraesthesia group ($p<0.05$), also the duration of block was more in nerve stimulation group (7.28 vs 6.54 hrs; p-0.057). Failure of block was seen in 22% patients with paraesthesia technique as compared to 14% with nerve stimulation (p-0.44). No difference was observed between the groups on the basis of complication rate (10% vs 2%; p-0.2). **Conclusion:** Onset of sensory and motor block was shorter and duration of analgesia was longer with nerve stimulation group. Nerve stimulation was found more effective than paraesthesia with respect to degree of success and complication rate.

Keywords: Brachial Plexus Block, Nerve Stimulator, Paresthesia

1. Introduction

Regional anesthesia has much to offer for the patients, surgeons and anesthesiologists because of its inherent simplicity, preservation of consciousness, avoidance of airway instrumentation, rapid recovery and significant postoperative analgesia. The supraclavicular block is one of the several techniques used to accomplish anesthesia of the brachial plexus. The block is performed at the level of the brachial plexus trunks where the majority of sensory, motor and sympathetic innervations of the upper extremity is carried in just three nerve structures confined to a very small surface area. Consequently, typical features of this block include rapid onset, predictable and dense anesthesia[1,2].

Regional blockade at the brachial plexus provides effective and reliable anesthesia and analgesia for upper extremity surgeries. However, success is highly dependent upon the precise localization of neural structures. Historically, this was accomplished through the elicitation of one or more paresthesia. The exclamation, "No paresthesia, no anesthesia" became the mantra of many (though not all) of our founding fathers[3]. Clinicians in opposition to paresthesia techniques often cite an increased risk of neurologic complications postoperatively by proclaiming "more the paresthesia, more the dysesthesia".

The nerve stimulation technique relies on the use of electric current to elicit motor stimulation of nerves and confirm the proximity of the needle to the nerve. In

*Author for Correspondence

addition to a good success rate, there are other advantages in this method[4]. A patient need not be subjected to the discomfort of paresthesia when the nerve is stimulated to produce a motor twitch because motor fibers have a lower electrical threshold than sensory fibers. Another point in favour of nerve localization by electrical stimulation is that a satisfactory block may be performed when the patient is uncooperative, or uncommunicative, as a result of a psychotic state, coma, or language barrier and it can be given in any position. Regional block with the aid of a nerve stimulator can also be performed under general anesthesia, especially in children[5].

The present study was thus conducted to compare between paresthesia technique and use of nerve locator in performing supraclavicular brachial plexus block with respect to its onset action, duration of action, success rate, performance time onset, immediate complications and post-operative neurological symptoms.

2. Aim and Objectives

To compare between paresthesia technique and use of nerve locator in performing supraclavicular brachial plexus block with respect to success and complication rate.

3. Methods

A prospective Randomized control study was conducted on 100 patients at the Department of Anesthesia, Medical College and tertiary health care centre for the period of 2 years (Dec 2014 to Dec 2016). Patients scheduled to undergo upper limb surgeries under Brachial Plexus Block were included in the study after fulfilling the inclusion and exclusion criteria.

A written and informed consent was taken from all. Each and every patient received pre medication. The anesthetic method employed would be Brachial plexus block by Supraclavicular Approach: Using Paresthesia/ Nerve Stimulator technique. The local anesthetic solution employed was: Lignocaine with Adrenalin 2% 15cc + 2cc $NaHCO_3$ + 5cc of Normal Saline + 20cc Bupivacaine 0.5%

Both the groups of patients were studied for success rate, performance time, onset of sensory blockade & motor blockade, duration of sensory & motor blockade and the postoperative complications.

In **Paresthesia group (P),** an intradermal wheal was raised just above the palpating finger with a 24G needle. A 5 cm 22G short bevel needle connected to a syringe was inserted through the skin wheal and advanced slowly Backwards (posteriorly), slightly Inward (Medially) and Downward (caudal) [BID] gradually towards first rib so that the shaft of the needle and syringe are almost parallel to the patient's head. The patient was instructed to say "yes" when he feels a sensation of "tingle" or "electric shock" down the arm and tell verbally where he feels it. Paresthesia was sought in the digits of the hand or wrist, if obtained; after negative aspiration for air and blood, local anaesthetic was injected. If paresthesia was not obtained and needle touched the first rib, we walked the needle posteriorly or towards vertebra to elicit paresthesia. If not, we repeated the procedure.

In **Nerve Stimulator group (N),** Frequency was set at 1 Hz as 2 Hz may cause unpleasant and vigorous muscle twitches. Positive electrode was connected to ECG lead and negative electrode to a port in the needle. The needle used was 50 mm size, fully insulated except at tip. The landmarks, puncture site and direction of the needle were the same as that used in the paresthesia group. We began at 1.5 mA current strength; twitch of the fingers being observed; with the clear motor twitch of all fingers taken as end motor response. As soon as we observed the twitch the current strength was decreased to 0.5 mA with continued observation of twitch. Even at 0.5 mA current if we get a satisfactory twitch of all fingers, the simulator was turned off, and the drug injected with repeated aspiration for blood. If the finger twitch disappeared on decreasing the current strength, needle position was adjusted by one to two millimetres in such a way as to elicit the twitch response and again the procedure repeated.

The following parameters were studied.

- Onset of sensory block.
- Duration of sensory blockade.
- Onset of motor block.
- Duration of motor blockade.
- Hemodynamic parameters.
- Side effects and complications.

4. Results

Overall majority of the subjects were between 21- 60 years of age (84%) in both the groups. No difference was observed between the groups as per age distribution.

Table 1. Distribution of study subjects based on age group

Age Group (years)	Method of Block		Total
	PNS	Paraesthesia	
</= 20	5	6	11
	10.0%	12.0%	11.0%
21-40	28	24	52
	56.0%	48.0%	52.0%
41-60	14	18	32
	28.0%	36.0%	32.0%
> 60	3	2	5
	6.0%	4.0%	5.0%
Total	**50**	**50**	**100**
	100.0%	**100.0%**	**100.0%**
p- value - 0.812			

Table 2. Distribution of study subjects based on Gender

Gender	Method of Block		Total
	PNS	Paraesthesia	
Female	13	12	25
	26.0%	24.0%	25.0%
Male	37	38	75
	74.0%	76.0%	75.0%
Total	**50**	**50**	**100**
	100.0%	**100.0%**	**100.0%**
p- value - 1.0			

Male predominance was seen in present study (75%) in both the groups. No difference was observed between the groups as per gender distribution.

Table 3. Comparison of mean age between study groups

Group	Mean	SD	SEM	p- value
Paraesthesia	39.52	14.99	2.12	0.5
PNS	37.50	14.87	2.10	

Mean age of subjects in Paraesthesia and Nerve stimulator group was 39.52 years and 37.5 years respectively (p-0.5).

Table 4. Comparison of mean duration of block performed between study groups

Duration of Block Performed (min.)	Mean	SD	SEM	p- value
Paraesthesia	11.46	3.36	0.48	0.177
PNS	10.56	3.25	0.46	

Mean time required for performing block was more with Paraesthesia technique as compared to Nerve stimulator (11.46 vs 10.56 mins; p-0.177). The difference however was not significant.

Table 5. Comparison of mean time for onset of sensory block between study groups

Onset of Sensory Block	Method of Block	Mean	SD	SEM	p- value
Median	Paraesthesia	13.59	1.64	0.23	<0.01
	PNS	11.01	1.46	0.21	
Radial	Paraesthesia	13.37	1.59	0.22	<0.01
	PNS	11.19	1.29	0.18	
Ulnar	Paraesthesia	13.22	1.57	0.22	<0.01
	PNS	12.04	1.54	0.22	
Musculocutaneous	Paraesthesia	13.87	1.76	0.25	<0.01
	PNS	12.70	1.68	0.24	

Mean onset of sensory block was significantly faster with nerve stimulator technique for all the nerves involved in the block. The time taken through nerve stimulator technique was between 11-12 minutes for all the nerves while it was between 13-14 minutes with paraesthesia technique (p<0.01).

Table 6. Comparison of mean time for onset of motor block between study groups

Onset of Motor Block (min.)	Mean	SD	SEM	p- value
Paraesthesia	20.98	2.83	0.40	<0.01
PNS	17.42	2.58	0.36	

Mean onset of motor block was also significantly faster with nerve stimulator technique as compared to paraesthesia group (17.42 mins vs 20.98 mins; p<0.01).

Table 7. Comparison of mean duration of block between study groups

Duration of Block (hrs.)	Mean	SD	SEM	p- value
Paraesthesia	6.54	1.88	0.30	0.057
PNS	7.28	1.59	0.24	

Total duration of block was more with Nerve stimulator technique as compared to Paraesthesia technique (7.28 hours vs 6.54 hours; p-0.057). The difference however was not significant.

Table 8. Distribution of subjects based on failure of block

Failure of Block	Method of Block		Total
	PNS	Paraesthesia	
No	43	39	82
	86.0%	78.0%	82.0%
Yes	7	11	18
	14.0%	22.0%	18.0%
Total	**50**	**50**	**100**
	100.0%	**100.0%**	**100.0%**
p- value - 0.436			

Failure of block was seen in 14% patients of nerve stimulator group as compared to 22% in paraesthesia group (p-0.436).

Table 9. Distribution of subjects based on complications

Complications	Method of Block		Total
	PNS	Paraesthesia	
No	49	45	94
	98.0%	90.0%	94.0%
Hematoma	0	4	4
	0.0%	8.0%	4.0%
Pneumothorax (PNX)	1	1	2
	2.0%	2.0%	2.0%
Total	**50**	**50**	**100**
	100.0%	**100.0%**	**100.0%**
p- value - 0.20			

Hematoma was seen in 0% and 8% patients while pneumothorax occurred in 2% patients each in nerve stimulator and paraesthesia group respectively (p> 0.05).

Table 10. Distribution of subjects based on grade of sensory block

Grade of Sensory Block	Method of Block		Total
	PNS	Paraesthesia	
Normal	4	5	9
	8.0%	10.0%	9.0%
Blunting of Sensation	3	6	9
	6.0%	12.0%	9.0%
Total Sensory loss	43	39	82
	86.0%	78.0%	82.0%
Total	**50**	**50**	**100**
	100.0%	**100.0%**	**100.0%**
p- value - 0.52			

No difference was observed between both the study groups with respect to grade of sensory block achieved. Total sensory loss was seen in 86% and 78% patients of nerve stimulator and paraesthesia group respectively (p-0.52).

Table 11. Distribution of subjects based on grade of motor block

Grade of Motor Block	Method of Block		Total
	PNS	Paraesthesia	
No Blockade	4	7	11
	8.0%	14.0%	11.0%
Elbow level	7	3	10
	14.0%	6.0%	10.0%
Wrist Level	9	8	17
	18.0%	16.0%	17.0%
Finger Level	30	32	62
	60.0%	64.0%	62.0%
Total	**50**	**50**	**100**
	100.0%	**100.0%**	**100.0%**
p- value - 0.47			

No difference was observed between both the study groups with respect to grade of motor block achieved. Motor block till level of fingertips was seen in 60% and 64% patients of nerve stimulator and paraesthesia group respectively (p-0.47).

5. Discussion

Peripheral nerve blocks are cost effective anaesthetic techniques used to provide anaesthesia and analgesia while avoiding hemodynamic consequences and airway instrumentation of general anaesthesia. Brachial plexus block is a relatively safe and an easy procedure for upper limb surgeries. Supraclavicular approach has been routinely used in our institution for upper limb surgeries and it has proven to be a safe technique as well. The block is usually given after eliciting paresthesia. Paresthesia technique was used till recently and presently nerve stimulator is made available in our institution. Frequently cited disadvantages of paresthesia technique include mainly patient discomfort while eliciting paresthesia and that its success is highly dependent on the cooperation of the patient. The objectives of this study are to compare between paresthesia technique and use of nerve locator in performing supraclavicular brachial plexus block in terms of performance time, sensory blockade, motor blockade, success rate and associated complications.

5.1 Demography Distribution

Male predominance was seen in present study (75%) in both the groups. No difference was observed between the groups as per gender distribution. Mean age of subjects in Paraesthesia and Nerve stimulator group was 39.52 years and 37.5 years respectively (p-0.5).

In a similar study by Sathyam et al[6], there were no clinical or statistically significant differences in the demographic profile of patients in either group. In another such study by Bansal et al. mean age in Paraesthesia and Nerve stimulator group was 46.1 years and 43 years respectively (p>0.05) with males predominance in both groups (M:F - 41/14 and 37/18). Similarly no difference in demographic profile was seen in studies by Liguori et al.,[7] Franco et al.,[8] and Baranowski et al[9].

5.2 Time for Performing Block

Mean time required for performing block was more with Paraesthesia technique as compared to Nerve stimulator (11.46 minutes vs 10.56 minutes; p-0.177). The difference however was not significant. Similar observations were also made in the study by Bansal et al,[10] where mean time required for performing block was more with Paraesthesia

technique as compared to Nerve stimulator (13.0 minutes vs 6.25 minutes; p<0.05). Similar observations were also made by Baranowski et al. where time required by nerve stimulation technique was significantly less (p<0.01)[8]. While Sathyam et al., noted no significant difference between the two techniques in the mean duration of performing block[6].

5.3 Onset of Sensory Block

To determine the onset of analgesia and anesthesia, we performed our assessment at the sensory areas of the median, ulnar, radial and musculocutaneous nerves and found that the onset of analgesia and anaesthesia in radial, median and ulnar nerve distributions were shorter in the nerve stimulator group than the paresthesia group. Mean onset of sensory block was significantly faster with nerve stimulator technique for all the nerves involved in the block. The time taken through the nerve stimulator technique was between 11-12 minutes for all the nerves while it was between 13-14 minutes with paraesthesia technique (p<0.01).

In a study by Sathyam et al., time required for sensory block in paresthesia group was 13.6 minutes and 11.08 minutes in nerve stimulator group for radial nerve distribution. In median nerve distribution it was 11.04 minutes in nerve stimulator group and 13.65 minutes for paresthesia group. Along the distribution of ulnar nerve paresthesia group showed an onset time of 14.95 minutes and nerve stimulator group 11.24 minutes (p<0.01 for all)[6]. Our results also concurs with study conducted by Carlo D Franco who found anesthesia onset in all four major nerves to be within 10.9+5.4 for nerve stimulation group[8] .

5.4 Onset of Sensory and Motor Block

Mean onset of motor block was also significantly faster with nerve stimulator technique as compared to paraesthesia group (17.42 minutes vs 20.98 minutes; p<0.01). In a study by Sathyam et al. the paresthesia group showed a greater onset time of 19.44 minutes than nerve stimulator group (17.72 minutes). The difference however was statistically not significant. Liguori et al., also observed slightly greater onset time in paraesthesia group, the difference was not significant[6].

5.5 Total Duration of Block

Total duration of block was more with Nerve stimulator technique as compared to Paraesthesia technique (7.28 hours vs 6.54 hours; p-0.057). The difference however was not significant. We found a longer duration of analgesia using nerve stimulator. This is probably due to the fact that nerve locator allowed more precise and closer deposition of local anaesthetic around the nerve. The duration of analgesia has not been compared in many of the studies. Mean duration of blockade in paresthesia group was comparable to the studies by Sathyam et al.,[6] and Carlo D Franco et al[8].

5.6 Grade of Sensory and Motor Block

In present study, both the groups i.e., paraesthesia and nerve stimulation, were comparable with respect to grade of sensory and motor block achieved. In a study by Baranowski et al., comparison was made between brachial plexus block by one of three techniques; insertion of a catheter into the brachial plexus sheath (n = 25), use of paraesthesia (n = 50) or use of the nerve stimulator (n = 25) to localise the plexus. They observed no difference between the groups with regard to grade of sensory and motor block achieved. Similar results were also observed by Bansal et al[9].

5.7 Failure of Block

Failure of block was seen in 14% patients of nerve stimulator group as compared to 22% in paraesthesia group (p-0.436). In a study by Bansal et al., the failure rate was seen in 6.3% patients of nerve stimulator group as compared to 12.8% in paraesthesia group (p> 0.05). Study by Baranowski et al., also does not demonstrate a statistical difference between the failure rates of the two groups[10]. However, Sathyam et al., observed that failure of block and conversion to general anaesthesia occurred more frequently in the paresthesia group[6].

5.8 Complications

In present study, there was no neurological complications following peripheral nerve blocks i.e., post block neuralgia in any of the group.

Sathyam et al., also observed no incidence of any neurological injury in any of the group[6]. Bansal et al., observed neurological injury in 2 and 1 patient (out of 55 each) in nerve stimulator and paraesthesia group respectively (p> 0.05). Liguori et al., observed the incidence of Postoperative Neurologic symptoms (PONV) using the NS technique as 10.1% (11/109), whereas the incidence with the MP technique was 9.3% (10/108) (not significant)[7].

Fear of pneumothorax limits the use of supraclavicular technique. The incidence of pneumothorax with the classic supraclavicular technique ranges from 0.5% to 6%[11]. In present study, pneumothorax occurred in 1

patient each in nerve stimulator and paraesthesia group respectively (p> 0.05). Many authors have studied the anatomy of brachial plexus and analysed methods to prevent pneumothorax. These include use of several modifications of supraclavicular block such as modified lateral technique[6] or plumb bob approach. We believe that avoidance of supraclavicular block for fear of pneumothorax is detrimental to our patients because this technique provides an unrivalled rapid onset of predictable upper extremity anaesthesia, which is an advantage in a busy surgical practice.

In our study, Hematoma was seen in 0% and 8% patients in nerve stimulator and paraesthesia groups respectively. This finding is supported by Niazi Gazani Masoud et al[11]. He found that hematoma prevalence is more in paraesthesia technique due to instances of multiple insertions and there was a significant relationship between times of insertion and hematoma development. Similar results were also observed by Sathyam et al.,[6] and Franco et al[8].

6. Conclusion

From our study it was concluded that onset of sensory and motor block was shorter in nerve stimulator group. Also duration of analgesia was longer with nerve stimulator group. No difference was observed between the groups with respect to degree of success and complication rate. We therefore advocate the use of the nerve stimulator technique for routine brachial plexus blockade.

7. References

1. Moore D. Supraclavicular approach for block of the brachial plexus. Moore D, editor. Regional block. A handbook for use in the clinical practice of medicine and surgery. 4th ed. Springfield: Charles C Thomas Publisher; 1981.p. 221–41.
2. Labat G. Regional anaesthesia. Its technic and clinical application. Philadelphia: WB Saunders Company; 1922.
3. Winnie AP. Historical consideration. Plexus Anaesthesia. 1984; 1:43–116,192–202.
4. Liguori GA, Zayas VM, Ya Deau JT. Nerve localisation techniques for interscalene brachial plexus blockade: A prospective, randomised comparison of mechanical paresthesia versus elec-trical stimulation.
5. Chapman GM. Regional nerve block with the aid of a nerve stimulator. Anesthesia. 1972; 27:185–93. https://doi.org/10.1111/j.1365-2044.1972.tb08195.x
6. Sathyan N, Hedge H, Padmanabha S, Anish KA. Brachial plexus Block: A Comparison of Nerve locator versus paraesthesia technique. Journal of Dental and Medical Sciences. 2014; 13(1):6–10. https://doi.org/10.9790/0853-131100610
7. Liguori GA, Zayas VM, YaDeau JT, Kahn RL, Paroli L, Buschiazzo V, Wu A. Nerve localiza-tion techniques for interscalene brachial plexus blockade: A prospective, randomized comparison of mechanical paresthesia versus electrical stimulation. Anesthesia and Analgesia. 2006 Sep 1; 103(3):761–7. https://doi.org/10.1213/01.ane.0000229705.45270.0f PMid:16931693
8. Franco CD, Vieira ZE. 1,001 subclavian perivascular brachial plexus blocks: Success with a nerve stimulator. Regional Anesthesia and Pain Medicine. 2000 Feb 29; 25(1):41–6. https://doi.org/10.1097/00115550-200001000-00008
9. Baranowski AP, Pither CE. A comparison of three methods of axillary brachial plexus anaesthe-sia. Anaesthesia. 1990 May 1; 45(5):362–5. https://doi.org/10.1111/j.1365-2044.1990.tb14776.x PMid:2356931
10. Bansal P, et al. Comparison of interscalene brachial plexus blockade by eliciting multiple point paresthesia and electrical nerve stimulation techniques: a prospective, randomized trial. The In-ternet Journal of Anesthesiology. 2009; 23(2):1–6.
11. Masoud NG, Taghi MM, Reza MG, Maarouf A, Seyedabolhasan S, Naser G. Complications of supraclavicular block of brachial plexus using compound classic and perivascular techniques. Rawal Med J. 2007 Jan; 32:60–2.