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A COMPARATIVE STUDY OF SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK USING NERVE STIMULATOR VERSUS ULTRASOUND GUIDED METHOD IN INDIAN POPULATION.

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Abstract

Background: Peripheral nerve blocks can be performed by several methods. The present study was undertaken to compare peripheral nerve stimulator and US guided supraclavicular block for upper limb orthopedic surgeries in Indian population.

Method: A total 50 patients undergoing upper limb surgeries were enrolled in the study and randomly divided into two groups of 25 patients in each group. Group PNS (Nerve stimulator guided) and Group USG (USG guided) supraclavicular brachial plexus block.

Results: The mean time for block execution in group USG was less (4.12±1.53) compared to group PNS (7.98±1.78), ($P<0.05$). The mean time of onset of sensory and motor block as well as mean time taken for complete sensory and motor block in group USG was less as compared to group PNS and this was statistically significant, ($P<0.05$). The quality of sensory and motor block in group PNS was poor as compared to group USG, ($p<0.05$). Intra and post-operative haemodynamic parameters of patients from Group USG were more stable as compared to Group PNS at different time intervals with no statistical significance, ($P>0.05$). Majority of patients among Group USG had bradycardia (16%) than group PNS (8%). Most of the patients among Group USG had good success rate (96%) compared to group PNS (76%) with statistically significant difference, ($p<0.05$).

Conclusion: The supra clavicular brachial plexus block using ultrasound guided method is an improved nerve block technique due to visualization of nerves with more success, decreased complication rate, and less time consuming, smaller volume of local anaesthetic agent required, as compared to nerve stimulator.

Keywords: Supraclavicular block; Nerve stimulator guided; USG guided; Orthopedic; Sensory; Motor block

Introduction

Brachial plexus block is a common technique to provide anaesthesia for surgery of, arm, forearm, and hand [1]. Various approaches like supraclavicular, interscalene, infraclavicular and axillary have been used for blocking brachial plexus block are associated with rapid onset and reliable anaesthesia [2]. Among these approaches, supraclavicular block is one of the most commonly practiced approach for

brachial plexus block since it provides consistent and predictable anaesthesia of the entire upper extremity [3]. However, supraclavicular approach is easiest and most effective approach to block the brachial plexus. The classical approach of using paresthesia to identify the nerve cluster using anatomical landmarks may be associated with a higher failure rate and injury to the nerves or vascular structures [4].

A nerve stimulator (NS) connected to an appropriate needle allows better localization of the brachial plexus by locating the nerves using a low-intensity electric current (up to 2.5 mA) for a short-duration (0.05–1 ms) with an insulated needle to obtain a defined response of muscle twitch or sensation and to inject local anesthetic solution in close proximity to the nerve.6 This technique, however, did not reduce the risk of injury to surrounding structures [5].

Ultrasound guided peripheral nerve block is an advanced technique in which there is non-invasive visualization of internal structures, including nerves to be blocked, under an image produced by ultrasound which required essential skill for the performance of block. With the advent of US guidance, this technique saw resurgence in the late 1990s. As it provides real-time view of the block needle, the brachial plexus and its spatial relationship to the surrounding vital structures, it not only increased the success rates, but also brought down the complication rates [6]. Moreover, accurate position of needle under USG guidance delivers local anaesthetic drug in correct place near the nerves. Observation of spread of drug surrounding the nerves is predictive of successful block [7]. The overall confirmation of a peripheral nerve depends on its course and surrounding tissue.

Local anaesthetics produce anaesthesia by inhibiting excitation of nerve endings or by blocking conduction in peripheral nerves. This is achieved by anaesthetics reversibly binding to and inactivating sodium channels [8, 9]. There are a limited studies regarding the comparison of these two methods in Indian population. Therefore, the present comparative study of supraclavicular brachial plexus block was conducted using nerve stimulator versus ultrasound guided method in Indian Population.

Materials and Methods

After obtaining Institutional Ethical Committee approval and written informed consent from all the patients, this hospital based comparative study was conducted in the Department of Orthopaedics operation theatre and Department of Anaesthesiology at a tertiary care hospital over period of two year from August 2020 to October 2022. A total 50 patients of either sex, aged between 18-60 years, belonging to ASA Grade I and II and who were scheduled for upper limb surgical procedures were included in the study. The computer assisted randomization of patients were done and divided into 2 groups of 25 subjects each. Group PNS - For nerve stimulator guided supraclavicular brachial plexus block and Group USG - For ultrasound-guided supraclavicular brachial plexus. Patients with significant coagulopathies and other contra-indications for supraclavicular brachial plexus block, diabetic neuropathy, psychiatric patients, patient refusal for the procedure, presence of neurological lesions in the upper limb to be operated upon and patient allergic to amide local anaesthetics were excluded from the study.

Patients undergone routine pre-anaesthetic evaluation and were premedicated with Tab. Diazepam I0 mg on the previous night of surgery (oral). Preliminary investigations included complete blood count (HB%, TLC, DLC, ESR, PCV), blood grouping and cross-matching, blood sugar levels (random and post-prandial), blood urea, serum creatinine and uric acid, LFT, ECG, chest X-ray; 2D- Echo, CT scan were done if required. Local anaesthetic sensitivity test was done. Routine NPO protocols were followed. An Intravenous line was secured on the opposite side of the limb undergoing surgery. Blocks was performed under standard monitoring with pulse oxymetry, non-invasive blood pressure measurement, heart rate and ECG. The patients were positioned supine with the arms by the side and head turned to the opposite side by 45°. The proposed site of the block was aseptically prepared and draped. Both groups received 1:1 mixture of 0.5% bupivacaine and 2% lignocaine with 1 :200000 adrenaline. The amount of local anaesthetic injected was calculated according to the body weight and not crossing the toxic dosage (Inj. Bupivacaine 2 mg/kg, Inj. lignocaine with adrenaline 5- 7 mg/kg).

The following Parameters were compared between the two groups are block execution time, time of onset of sensory and motor block, time of complete sensory and motor block, quality of sensory and block, success rates and number of pricks required, intraoperative haemodynamic monitoring, post block complications. The failed blocks were supplemented with general anaesthesia.

GROUP PNS: In this group, the positive electrode of the NS was attached to an ECG lead and stuck on the ipsilateral arm. The subclavian artery was palpated and immediately lateral to it, an intradermal wheal was raised with I % lignocaine (2 mL) using a 24 G needle. A 22 G insulated stimuplex needle 5 cm attached to the negative electrode of the NS was inserted through the skin wheal in a backward, inward, and downward direction. NS was set to deliver a current of 1.5 mA in the internal mode. After finger flexion was elicited with stimulation, the current was reduced in steps of 0.4 mA till the presence of a muscle twitch with 0.6 mA was observed and no twitch with a current of 0.2 mA was observed. This confirms the proximity of the needle tip to the nerve and the drug was injected after negative aspiration for air or blood. The sensory and motor block then assessed for every 2 min till the onset of block and every 5 min thereafter for 30 min. Any failure in establishing the block was converted to general anaesthesia.

GROUP USG: A Sonosite EDGE II linear probe HFL38xl (6-13 MHz) with SN no. Q5B67G ref no P203 l 1-20 was used for conducting the block in every case. It was available in the Department. The probe was inserted into a sterile plastic sheath so as to maintain sterility. It was placed in the coronal oblique plane in the supraclavicular fossa. The subclavian artery, vein, and the brachial plexus was visualized. The brachial plexus and its spatial relationship to the surrounding structures was scanned. The pie Next, the skin was anaesthetized at the proposed site of entry with I % lignocaine (1-2 rnL) and a 22 G, 50 mm needle connected to a 10 cm extension line 42 and primed with the drug. It was inserted from the medial to the lateral direction and the needle movement was observed in real-time. Once the needle reaches the plexus, after negative aspiration, the drug was injected, and the spread of the drug was observed. When necessary, the needle repositioned to achieve an ideal perineural distribution of the drug. The following parameters was observed time for the procedure, the number of skin puncture, the onset of sensory and motor blocked, quality of sensory and motor blocked, duration of analgesia, and for any post block complications.

Statistical Analysis

Continuous variables were presented as Mean ± S.D and categorical variables was expressed in frequency and percentage. Age, intraoperative vital parameters, Block execution time, Time for sensory block onset, Time for complete sensory block, Time for motor block onset and Time for a complete- motor block between 2 groups will be compared by using unpaired t-test. The number of pricks in 2 groups was compared by using the non-parametric Mann Whitney U test. Success, failure and supplementation, complications compared by applying Fisher exact T-test. Categorical variables between 2 groups were compared by performing Pearson's chi-square test. The parametric data was analysed with student "t" test and the nonparametric data was analysed with the Chi square test. A P value < 0.05 was be considered significant.

Observations and Results

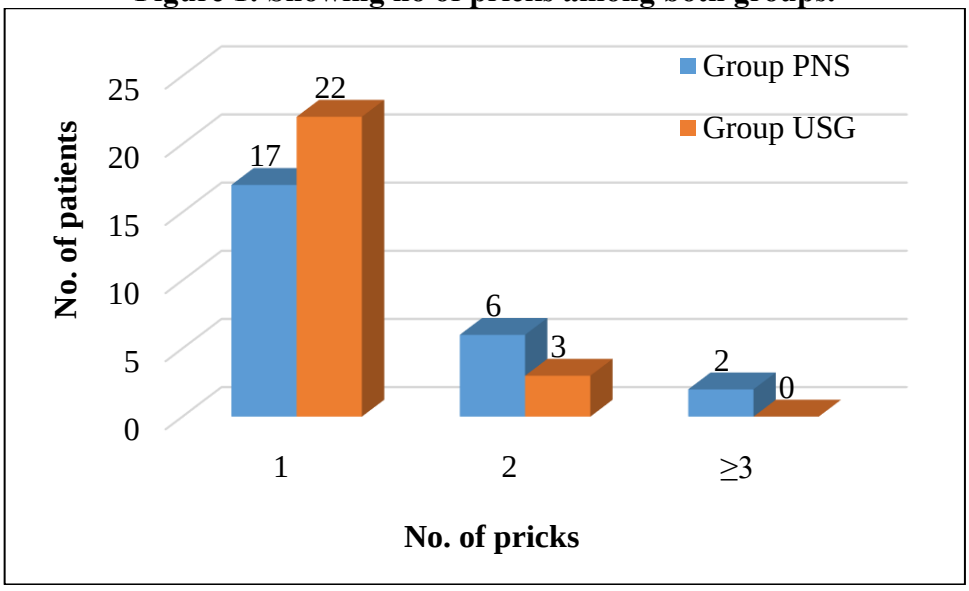
A total of 50 patients undergoing upper limb surgeries were enrolled in the study and randomly divided into two groups of 25 patients in each group. Both the groups were comparable and found no significant difference with respect to demography data of patients, type and duration of surgery as shown in table 1. Out of total 50 patients, radius ulna fracture procedures were done in majority in Group PNS (40%) and Group USG (44%) with was not statistically significant difference.

Table 1: Demographic profile of the patients, type and duration of surgery

Demographic data		Group PNS	Group USG	P value
Age (years)	Mean	35.84 ± 12.24	36.02 ± 12.44	>0.05
Sex	Male	15 (60%)	14 (56%)	>0.05
	Female	10 (40%)	11 (44%)	
ASA	I	18 (72%)	19 (76%)	>0.05
	II	07 (28%)	06 (24%)	
Anthropometry	Weight	56.52 ±7.13	54.36 ±6.54	>0.05
	Height	168.32±11.12	166.38±10.36	>0.05
	BMI	21.73±5.18	22.84±5.43	>0.05
Type of surgery	Radius ulna	10 (40%)	11 (44%)	>0.058
	Colles	06 (24%)	05 (20%)	
	Supracondylar humerus	04 (16%)	03 (12%)	
	Radius	03 (12%)	03 (12%)	
	Ulna	01 (04%)	03 (12%)	
	Olecranon	01 (04%)	00 (00%)	
Mean duration of surgery (minutes)		90.72 ±34.73	94.17 ±42.83	>0.05

Out of total 50 patients, it was observed that majority of patients required single prick both groups i.e., 17 (68%) and 22 (88%) among Group PNS and Group USG respectively, (Figure 1). There was no difference when two groups were compared statistically with respect to number of pricks. (p>0.05). The mean time for block execution in group USG was less (4.12±1.53) compared to group PNS (7.98±1.78) and this difference in in two groups was statistically significant, (P<0.05).

Figure 1: Showing no of pricks among both groups.



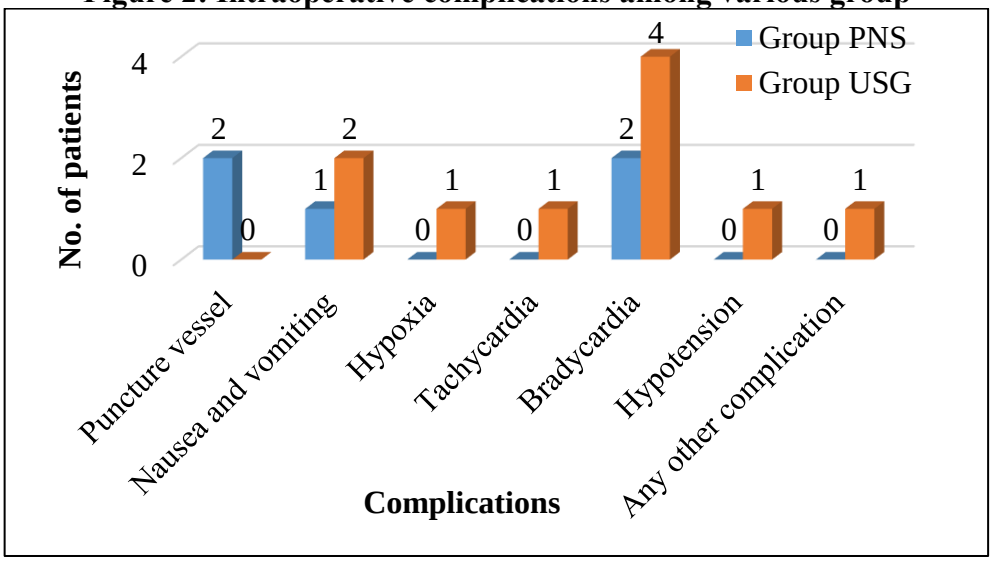
The mean time of onset of sensory and motor block as well as mean time taken for complete sensory and motor block in group USG was less compared to group PNS and this difference in two groups was statistically significant, (P<0.05). However, the quality of sensory and motor block in group PNS was poor as compared to group USG with statistically significant difference, (p<0.05) as shown in table 2.

Table 2: Comparison of block characteristics between two groups

Block characteristics (min)		Group PNS	Group USG	P value
Onset of Sensory block		4.12 ±1.09	3.18 ±1.63	<0.05
Onset of Motor block		6.38 ±1.03	5.71 ±1.28	<0.05
Time taken for complete sensory block		10.52 ±2.19	9.02 ±1.04	<0.05
Time taken for complete motor block		16.31 ±2.43	14.23 ±2.18	<0.05
Quality of sensory block	0	00 (0.0%)	00 (0.0%)	<0.05
	1	06 (24.0%)	01 (4.0%)	
	2	19 (76.0%)	24 (96.0%)	
Quality of motor block	0	00 (0.0%)	00 (0.0%)	<0.05
	1	05 (20.0%)	00 (0.0%)	
	2	20 (80.0%)	25 (100.0%)	

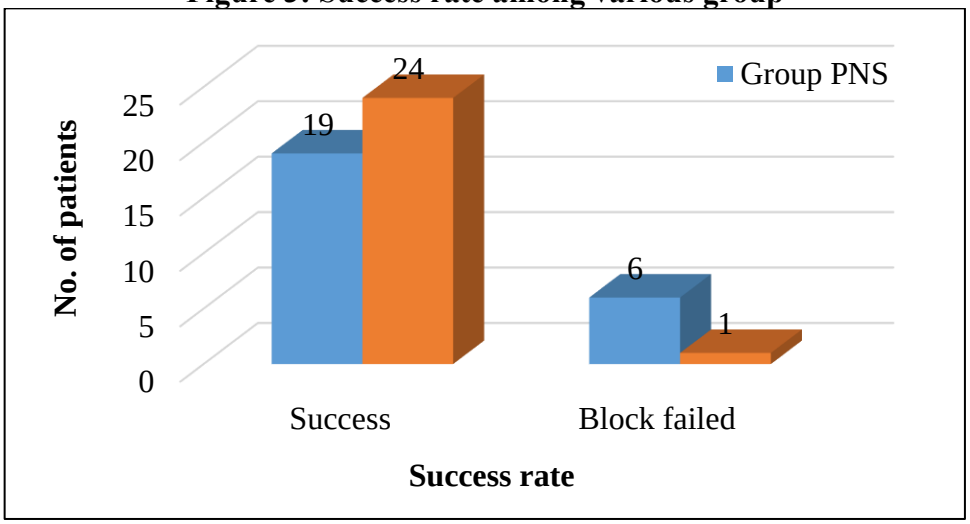
Intra and post-operative haemodynamic parameters (HR, SBP, DBP, MAP, SPO2 and RR) of patients from Group USG were more stable as compared to Group PNS at different time intervals with no statistical significance, (P>0.05). The majority of patients among Group USG had bradycardia (16%) compared to group PNS (8%). The nausea & vomiting among group PNS (4%) was less compared to group USG (8%) with no statistically significant difference. (p>0.05) PNS group shows 2 (8%) patients with puncture vessel, (Figure 2).

Figure 2: Intraoperative complications among various group



Most of the patients among Group USG had good success rate (96%) compared to group PNS (76%) with statistically significant difference, (p<0.05), (Figure 3).

Figure 3: Success rate among various group



Discussion

In the present study, demographic profile of the patients was comparable and found no significant difference between two groups. Out of total 50 patients, radius ulna fracture procedures were done in majority in Group PNS (40%) and Group USG (44%). The mean duration of surgery in patients in Group PNS was 90.72 ±34.73 minutes and in Group USG was 94.17 ±42.83 minutes. There was no statistically significant difference in type and duration of surgery, ($P > 0.05$). These findings are comparable with the previous studies [10, 11].

The mean time for block execution in group USG was less compared to group PNS and this difference in two groups was statistically significant, ($P<0.05$) Similar results are found in study conducted by Ratnawat A et al [10], Rupera KB et al [12] and Duncan M et al [13]. The mean time of onset of sensory and motor block as well as mean time taken for complete sensory and motor block in group USG was less as compared to group PNS and this was statistically significant, ($P<0.05$). These findings are in accordance with the study done by Ratnawat A et al [10], Rupera KB et al [12] and Singh G et al [14]. The likely explanation for shorter procedure time, fast onset for sensory as well as for motor blockade could be that ultrasound can determine the size, depth and exact location of the brachial plexus and its neighbouring structures. Also with USG guidance, positioning and if required repositioning of the needle is performed under direct vision and in real time as opposed to blind redirection and repositioning of needle with PNS [15].

Out of total 50 patients, it was observed that majority of patients showed good quality of sensory block i.e., 19 (76%) and 24 (96%) among Group PNS and Group USG respectively. Similarly, most of the patients showed good quality of motor block i.e., 20 (80%) and 25 (100%) among Group PNS and Group USG respectively. However, the quality of sensory and motor block in group PNS was poor as compared to group USG, ($p<0.05$). Out of total 50 patients, majority of patients required single prick both groups i.e., 17 (68%) and 22 (88%) among Group PNS and Group USG respectively. The single prick in group PNS was less as compared to group USG and there was no difference when two groups were compared statistically with respect to number of pricks. ($p>0.05$).

In the present study, the mean intraoperative heart rates, systolic blood pressure, diastolic blood pressure, mean arterial blood pressure, SPO2 and respiratory rate of patients from Group USG were more stable as compared to Group PNS at different time intervals with no statistical significance, ($P>0.05$). Similarly, the mean post-operative heart rates, systolic blood pressure, diastolic blood pressure, mean arterial blood pressure, SPO2 and respiratory rate of patients from Group USG compared to Group PNS at different time intervals shows no statistical significance, ($P>0.05$) This finding is in accordance with Ratnawat A et al [10] and Harikumar A et al study [11].

Most of the patients among Group USG had bradycardia (16%) compared to group PNS (8%) whereas the nausea & vomiting among group PNS (4%) was less compared to group USG (8%) with no

statistically significant difference, ($p>0.05$), this is comparable with the other studies [10, 11. 14]. There was no incidence of nerve injury and pneumothorax in both the groups. Similar studies with no or less incidence of complications by US technique has been shown by other studies [10, 16, 17]. This could be because ultrasound facilitates the identification and avoidance of important structures, and direct visualization of local anaesthetic spread may reduce dosages and result in selective blocks with higher accuracy and fewer complications [12, 15].

Maximum patients among Group USG had good success rate (96%) compared to group PNS (76%) with statistically significant difference, ($p<0.05$) which is comparable with the study done by Ratnawat A et al [10] and Rupera KB et al [12]. The advantages of US guidance in brachial plexus blocks, as it can determine the size, depth, and exact location of the plexus and its neighboring structures. A pre- block anatomical estimation can be done, which can help avoid complications and improve success rates as well as provide confidence to the anesthesia provider. Yet another advantage of US guidance is that, due to the correct needle placement and visualization of the spread of drug, smaller than usual amount and volume of drug can be used to achieve a satisfactory and dense blockade.

Conclusion

The supraclavicular brachial plexus block using ultrasound guided method is an improved nerve block technique due to visualization of nerves with more success, decreased complication rate, and less time consuming, smaller volume of local anaesthetic agent required, as compared to nerve stimulator. The advantages of US guidance are that a pre-block anatomical estimation can be done, which can help avoid complications and improve success rates as well as provide confidence to the anesthesia provider.

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