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Ultrasound Versus Nerve Stimulator-guided Technique of supraclavicular nerve block for upper limb surgery: A prospective randomized comparative study

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ABSTRACT

Background: Peripheral nerve stimulator (PNS) guided and ultrasound (US) guided techniques allows better localization of the nerve/plexus. Ultrasound for supraclavicular brachial plexus block has improved the success rate of the block with excellent localization as well as improved safety margin. **Aims and Objectives:** To compare peripheral nerve stimulator guided technique and ultrasound guided technique of supraclavicular brachial plexus block for upper limb surgeries. **Materials and Methods:** We carried a prospective randomized single blind comparative study in 100 patients requiring upper limb surgeries. Supraclavicular brachial plexus block was given using 0.5% Ropivacaine. The sample were randomly allocated in to two groups of 50 each. Group US patients received supraclavicular brachial plexus block under ultrasound guidance and in Group PNS patients, nerve stimulator guided technique was used. The parameters assessed were procedure time, onset and duration of sensory and motor blockade and complications. **Statistical Analysis:** Independent t- test was used to compare mean between groups; Chi- square test for categorical variables. **Results:** The procedure time was 8.2±1.32 minutes in group PNS and 6.34±1.02 minutes in group US ($p<0.0001$). The onset of sensory and motor block was 7.79±1.21 minutes and 9.63±1.41 minutes in group PNS and 6.53±1.13 minutes and 8.01±1.18 minutes respectively in group US ($p<0.0001$). The time to achieve complete block was 17.02±1.31 minutes in group PNS and 14.82±1.24 minutes in group US ($p<0.0001$). The duration of sensory and motor block was 7 hours 10 minutes and 6 hours 15 minutes for group PNS and 8 hours and 7 hours respectively in group US. The success rate was 90% in group PNS and 96% in Group US. None of the patients in either groups developed any complications. **Conclusion:** The ultrasound- guided supraclavicular brachial plexus block can be done quicker, with a faster onset of sensory and motor block compared to nerve stimulator technique for supraclavicular brachial plexus block for upper limb surgeries.

Key Words: Nerve stimulator, Supraclavicular block, Ultrasound, Upper limb surgery.

Introduction

Kulenkampff first described the classical supraclavicular approach to the brachial plexus. Various other approaches were later introduced like axillary, interscalene, posterior approach and infraclavicular approach. Supraclavicular brachial plexus block provides consistently effective regional anaesthesia to the upper extremity.[1, 2]

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The use of Ultrasound for nerve blocks was first reported by La Grange P et al in 1978, who performed supraclavicular brachial plexus block with the help of a Doppler USG blood-flow detector to aid identification of the subclavian artery and vein.[3]

Therefore brachial plexus block can be performed by nerve stimulator (NS)-guided or ultrasound (US)-guided technique. The peripheral nerve stimulator (PNS) 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. The classical approach using PNS technique is a blind technique and may be associated with a higher failure rate and injury to the nerves and surrounding structures. Consequently, the supraclavicular block remained less popular among other approaches to the brachial plexus. 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.[4-7]

In this prospective randomized study, we compared US-guided supraclavicular brachial plexus block with the NS-guided technique and evaluated the parameters of onset, quality of sensory and motor block, success rate, block execution time, failure rate, and complications if any noticed.

Materials and Methods

We carried a prospective randomized single blind comparative study on 100 patients requiring upper limb surgeries. The study was carried in the department of anaesthesiology, Prathima Institute of Medical Sciences, Karimnagar, Telangana state, from January 2016 to April 2018, after obtaining institutional ethical committee approval and consent from all the participants.

Inclusion Criteria

1. Patients aged between 18 and 60 years
2. Patients with ASA Grade I and II

Exclusion Criteria

1. Patients with ASA grade III, IV and V,
2. Patients with known hypersensitivity to local anaesthetics, opiod addicts,
3. Patients with systemic diseases, bleeding disorders,
4. Patients with anatomical abnormality at the regional site, and neurodeficit involving brachial plexus.

For randomization, a computer-generated sequence of random numbers and a sealed envelope technique was employed. Patients were randomly allocated into two groups to receive supraclavicular brachial plexus block using either nerve stimulation (group PNS, n= 50) or ultrasound (group US, n=50) guidance. After routine pre anaesthetic evaluation, all patients were pre medicated with injection Midazolam 0.03mg/kg, given 5 minutes before procedure. Both the groups were injected with ropivacaine (0.75%) 20 ml + Normal saline 10 ml.

In PNS group, an insulated needle was inserted about one inch (2.5 cm) lateral to the insertion of the sternocleidomastoid (SCM) in the clavicle or one thumb breath lateral to SCM and local infiltration of one ml of 2% lignocaine was done at the proposed puncture site. The needle was connected to nerve locator by the electrodes and was properly grounded with the help of ECG leads. Stimulation was started with an intensity of 2.0 mA and a pulse width of 100 μs. Once a muscle twitch of the fingers that is clearly visible, the intensity was gradually reduced to 0.5mA. In the presence of inadequate response repositioning of the needle was done in the anteroposterior plane, either slightly more posterior or slightly more anterior, but always parallel to the midline.

In US group, a 5cm, 22-G, insulated needle was used. A linear high frequency US probe (M turbo 11mm broad band linear array, 6-14MHz) covered with sterile cover was used. The probe was moved laterally to visualize the plexus as it passes over the first rib. The needle was then slowly advanced under direct visualization, towards the angle formed by the first rib and the subclavian artery. Local anaesthetic is seen as a hypoechoic (dark) shadow projecting from the tip of the needle.The parameters recorded were procedure time, block start time (needle insertion), time to achieve complete sensory blockade, motor blockade, duration of surgical procedure, duration of analgesia and any adverse effects or complications.

Data were analysed using IBM SPSS Statistics software version 20.0. Independent t- test was used to compare mean between groups; Chi- square test for categorical variables. A P value of <0.005 was considered as significant.

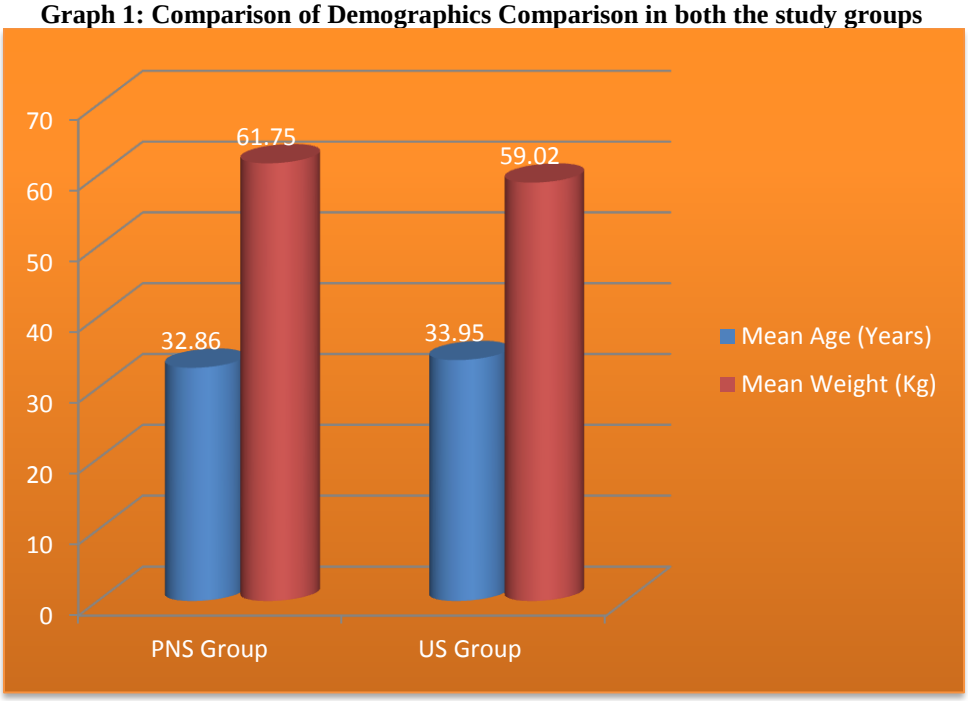
Results

Demographic variables age and gender and mean weight, and ASA grade of the patients in both the groups was comparable, the difference being statistically insignificant (Table 1 and Graph 1). Most of the cases reported for surgery were due orthopedic cases, mainly fore arm bone fractures.

Table 1: Comparison of Demographics Comparison in both the study groups

Parameter		Group PNS (50)	Group US (50)	P value
Mean Age (Years)		32.86±13.08	33.95±14.65	0.6956
Mean Weight (Kg)		61.75±10.74	59.02±7.05	0.1362
Gender	Male	35	35	1.213
	Female	15	15	
ASA	Grade I	42	39	0.4467
	Grade II	8	11	

Graph 1: Comparison of Demographics Comparison in both the study groups



The mean duration of surgery in group PNS and group US was 57.12±19.23 minutes, 61.02±17.24 minutes respectively. The difference was >0.05 i.e. statistically insignificant (Table 2 and Graph 2).

The mean duration of onset of sensory and motor block was 7.43±1.54 minutes and 9.64±1.68 minutes in group PNS where as in group US onset of sensory and motor block was 9.64±1.68 minutes and 7.92±1.25 minutes. The difference being statistically significant (P<0.0001: Table 2 and Graph 2).

The mean duration of time to achieve complete block in group PNS was 15.93±1.74 minutes and in group US, it was 13.42±1.45 minutes. The difference being statistically significant (P<0.0001: Table 2 and Graph 2).

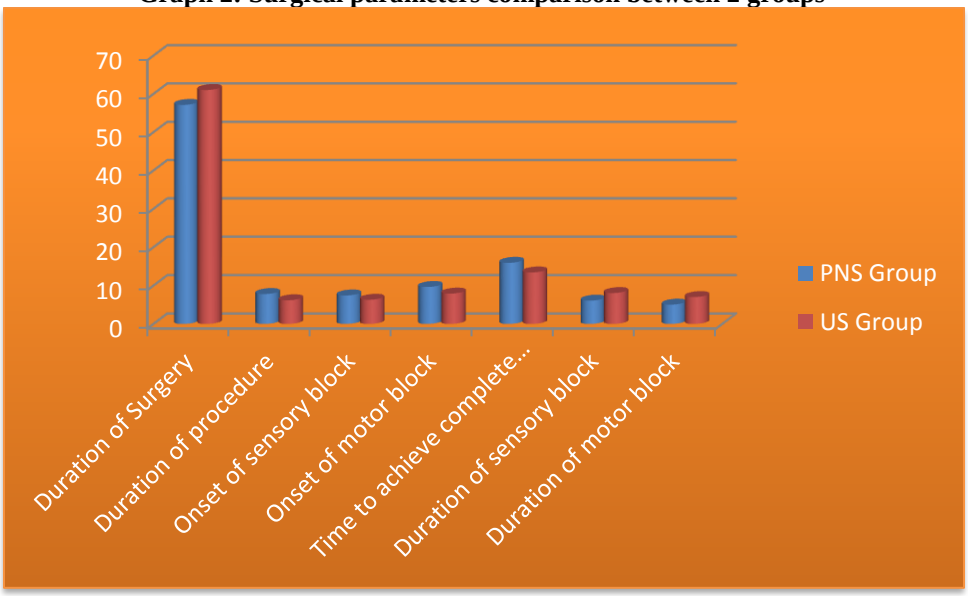
The mean duration of sensory and motor block in group PNS was 6.08±2.52 hours and 5.03±2.56 hours and in group US, it was 5.03±2.56 hours and 7.01±1.81 hours. The difference being statistically significant (P<0.0001: Table 2 and Graph 2).

Table 2: Surgical parameters comparison between 2 groups

Parameter	Group PNS (50)	Group US (50)	P value
Duration of Surgery (in minutes)	57.12±19.23	61.02±17.24	0.2882
Duration of procedure (in minutes)	7.8±1.86	6.18±1.35	<0.001
Onset of sensory block (in minutes)	7.43±1.54	6.31±1.15	<0.001
Onset of motor block (in minutes)	9.64±1.68	7.92±1.25	<0.001
Time to achieve complete block (minutes)	15.93±1.74	13.42±1.45	<0.001
Duration of sensory block (in hours)	6.08±2.52	8.06±1.82	<0.001

Duration of motor block (in hours)	5.03±2.56	7.01±1.81	<0.001

Graph 2: Surgical parameters comparison between 2 groups

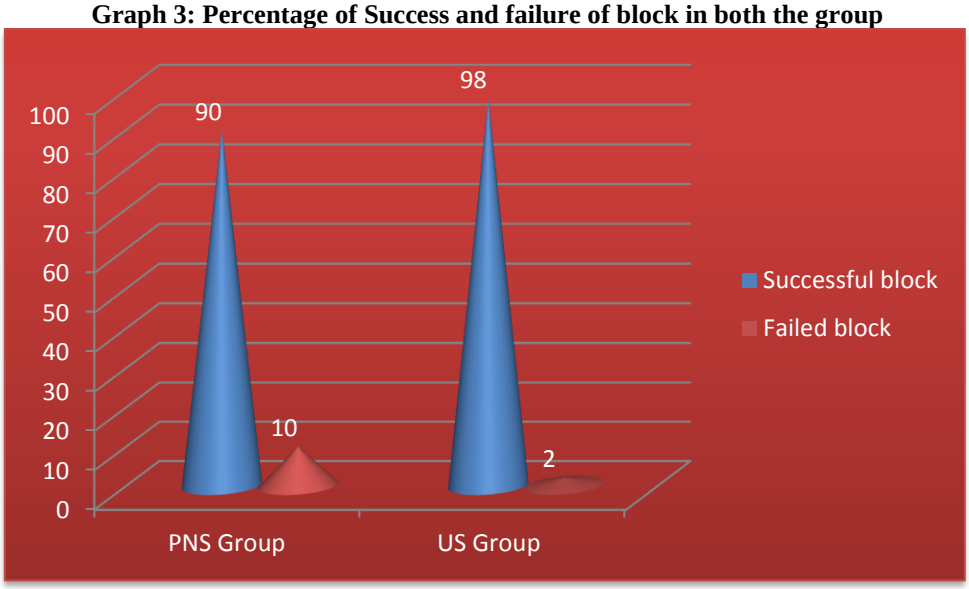


The block was successful in 90% in group PNS and 98% in group US. This difference was found statistically insignificant (p=0.090) (Table 3 and Graph 3). When complications were assessed, Incidence of artery puncture was 10% in PNS group compared to nil in US group. Nausea and respiratory distress in 10% in PNS group compared to nil in US group. There was no significant difference in HR, SBP, DBP, MAP, and SpO2 during the intra/post-operative period.

Table 3: Success and failure of block in both the groups

Groups	Successful block	Failed block	P value
Group PNS (50)	**45 (90%)**	5 (10%)	0.090
Group US (50)	49 (98%)	1 (2%)	

Graph 3: Percentage of Success and failure of block in both the group



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Discussion

This prospective randomized study was aimed at determining how useful US guidance is when compared with NS guidance for performing a supraclavicular brachial plexus block. A successful brachial plexus block depends not only on the

technique used, but also on the experience of the anesthetist, amount and type of drug injected, the level of motivation of the patient, and the definition of a successful block. Brachial plexus block is an easy and relatively safe procedure for the upper limb surgeries.[8-10]

This study was done in patients undergoing upper limb surgeries with the similar demographic profile. We found that both groups were comparable with respect to age, gender, weight and ASA grade of the patients. No significant difference was found in between two groups. Similar demographic results were found in earlier studies.[4]

Our finding of significantly lower mean time for procedure in US group as compared to PNS group was in accordance to Ratnawat A et al, Rupera KB et al and Williams SR et al.[4, 6, 12]

The mean onset time for sensory and motor block was found significantly less for group US as compared to group PNS. Our findings are similar to those of Rupera KB et al and Singh G et al.[9, 12]

The mean time to achieve complete block in US group was shorter than PNS group. This is in accordance to Ratnawat A et al and Rupera KB et al.[4, 12] This might be due to the fact 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.[13]

That mean duration of sensory and motor block was significantly more in US group than PNS group. This is in accordance to Ratnawat A et al and Rupera KB et al. This might be due to the deposition of the right drug, in the right dose, in the right place in ultrasound.[4, 12]

In our study the block was successful in 90% in PNS group and 98% in US group. Ratnawat A et al found the block to be successful in 90% and 97.5% in PNS and US groups respectively.[4] Whereas Rupera KB et al found success rate 96.67% and 80% in US and PNS groups respectively.[12] Singh G et al, found block to be successful in 90% and 73.33% in US and PNS groups respectively.[9]

When complications were assessed, Incidence of artery puncture was 10% in PNS group compared to nil in US group. Nausea and respiratory distress in 10% in PNS group compared to nil in US group. Our findings are in accordance to Ratnawat A et al and Singh G et al.[4, 9] This may be due to 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 by ultrasound.

Conclusion

The US-guided technique was found significantly better than PNS for supraclavicular brachial plexus block in parameters like procedure time, onset of sensory and motor block, time to achieve complete block, duration of sensory and motor block, success rate of block and incidence of complications. A larger study may be required to analyze the advantages of using US in performing supraclavicular brachial plexus blocks, which could help justify the cost of purchase of the US machine.

References

1. Kulenkampff D, Persy MA. Brachial plexus anesthesia: its indications, technique and dangers. Ann Surg. 1928;87:883-91.
2. Neal JM, Gerancher JC, Hebl JR, Ilfeld BM, McCartney CJ, Franco CD et al. Upper extremity regional anesthesia: essentials of our current understanding, 2008. Reg Anesth Pain Med. 2009;34:134-70.
3. La Grange P, Foster P, Pretorius L. Application of the doppler ultrasound blood flow detector in supraclavicular brachial plexus block. BJA 1978;50:965-7.
4. Ratnawat A, Bhati FS, Khatri C, Srinivasan B, Sangwan P, Chouhan DP. Comparative study between nerve stimulator guided technique and ultrasound guided technique of supraclavicular nerve block for upper limb surgery. Int J Res Med Sci 2016;4:2101-6.
5. Duncan M, Shetti AN, Tripathy DK, Roshansingh D, Krishnaveni N. A comparative study of nerve stimulator versus ultrasound-guided supraclavicular brachial plexus block. Anesthesia, Essays and Researches. 2013;7(3):359-364.
6. Williams SR, Couinard P, Arcand G, Harris P, Ruel M, Boudreault D, et al. Ultrasound guidance speeds execution and improves the quality of supraclavicuar block Anesth Analg. 2003;97:1518–23.
7. McCartney CJ, Brull R, Chan VW, Katz J, Abbas S, Graham B, et al. Early but no long term benefit of regional compared with general anaesthesia for ambulatory hand surgery. Anesthesiology. 2004;101:461-7.
8. Carty S, Nicholls B. Ultrasound guided regional anaesthesia, Oxford journals, medicine. British J Anaesth 2007;7:20- 4.
9. Singh G, Mohammed YS. Comparison between conventional technique and ultrasound guided supraclavicular brachial plexus block in upper limb surgeries. IJSS. 2014;2(8):169-76.

10. Honnannavar KA, Mudakanagoudar MS.Comparison between conventional and ultrasound-guided supraclavicular brachial plexus block in upper limb surgeries. Anesth Essays Res 2017;11:467-71.

11. Alfred VM, Srinivasan G, Zachariah M.Comparison of ultrasound with peripheral nerve stimulator guided technique for supraclavicular block in upper limb surgeries: A randomized controlled trial. Anesth Essays Res 2018;12:50-4.

12. Rupera KB, Khara BN, Shah VR, Parikh BK. Supra-Clavicular Brachial Plexus Block: Ultra-Sonography Guided Technique Offer Advantage Over Peripheral Nerve Stimulator Guided Technique. Natl J Med Res. 2013;3(3):241-4.

13. Simpson G, Nicholls B. Use of ultrasound in chronic pain medicine. Part 1: neuraxial and sympathetic blocks. Contin Educ Anaesth Crit Care Pain. 2013;13:145-51.

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