ORIGINAL ARTICLE

SUPRA-CLAVICULAR BRACHIAL PLEXUS BLOCK: ULTRA-SONOGRAPHY GUIDED TECHNIQUE OFFER ADVANTAGE OVER PERIPHERAL NERVE STIMULATOR GUIDED TECHNIQUE

Krutika B Rupera[1], Birva N Khara[1], Veena R Shah[2], Bina K Parikh[3]

Authors' Affiliation: [1]Assistant Professor, Anesthesiology, Pramukhswami Medical College, Karamsad; [2]Professor and Head, Anesthesiology, IKDRC, Ahmedabad; [3]Associate Professor, Anesthesiology, IKDRC, Ahmedabad
Correspondence: Dr. Krutika B. Rupera, Email: dr.krutika.shah@gmail.com

ABSTRACT

Introduction: Brachial Plexus block is an excellent anaesthetic option of upper limb surgery. The age old "Blind Paresthesia" technique and Peripheral Nerve Stimulation (PNS) may require multiple trial and error, not only increases block performance time and delays onset of anaesthesia, but also carries risk of damage to nerves or surrounding. Use of ultrasound to perform peripheral nerve block is a relatively new technique that is rapidly gaining popularity.

Methodology: This study was conducted among 60 patients suffering from chronic renal failure with ASA III scheduled for the creation of arterio-venous fistula which needed brachial plexus block. In one group (n=30) ultrasonography (USG) guided technique was used and in second group (n=30) Peripheral Nerve Stimulation (PNS) guided technique was used. Various parameters including procedure time, onset time for sensory block, duration of sensory block, onset time for motor block, duration of motor block, time to achieve complete block etc were observed.

Results: Overall success rate was higher in USG guided group as compared to PNS guided group, which was statistically significant ($p < 0.05$). Time to perform the block was significantly shorter in USG guided group ($p < 0.05$). Onset time for sensory block, onset time for motor block & time to achieve a complete block was also shorter in USG guided group (p value < 0.05). Duration of sensory & motor block was significantly prolonged in USG guided group ($p < 0.05$)

Conclusion: Ultrasonography guided supraclavicular brachial plexus block is quick to perform, offers improved safety & accuracy in identifying the position of the nerves to be blocked & of the structures.

Key Words: Brachial Plexus Block, Ultrasonography, Peripheral Nerve Stimulator, Subclavian artery

INTRODUCTION

Brachial Plexus block is an excellent anaesthetic option of upper limb surgery. Long lasting pain relief, a low incidence of nausea & vomiting and expedited hospital discharge are some of the clinical advantages for outpatients. Even though modern general anaesthesia is more certain, safer, faster and acceptable, regional anaesthesia has advantages like less interference with normal metabolic process & vital functions of body as compared to general anaesthesia. Regional anaesthesia is also preferred for surgery on patients who are less suitable for general anaesthesia like patients with full stomach, cardio-pulmonary disease, metabolic and endocrine disorders, pregnant patients etc.

The age old "Blind Paresthesia" technique that rely on anatomical landmarks and/or facial clicks are known to produce serious complications with high failure rates. Even the technique Peripheral Nerve Stimulation (PNS) which at least till today has been recommended as the gold standard for nerve identification in regional anaesthesia fails to ensure adequate level of nerve/plexus block.[1] Both these techniques may require multiple trial and error needle attempts which increases the block performance time & delays onset of anaesthesia. It also carries the risk of damage to surrounding anatomical structures i.e. blood vessels, pleura by direct by direct puncture with the needle tip. So an ideal technique which offers safety, accuracy & patient acceptance was constantly searched for.

The use of ultrasound to perform peripheral nerve block is a relatively new technique that is rapidly gaining popularity over more traditional techniques of peripheral nerve stimulators and paresthesia. USG allows the operator to see neural structures rather than just surro-

gating for what you cannot see like traditional methods. It also guides the needle under real-time visualization & navigates the needle away from sensitive anatomy like pleura, blood vessels etc. USG also monitors the spread of local anaesthetic under real time. By offering all these advantages ultrasonography increases the success rate of any regional anaesthesia techniques, decreases the procedure time and many complications. The correct perineural spread of local anaesthetic by USG provides safe, effective and efficient anaesthetic conditions.

The use of ultrasound for regional anaesthesia was first reported by La Grange et al in 1978, who performed superaclavicular brachial plexus blocks with a Doppler ultrasound blood flow detector.[1] Lack of suitable ultrasound machines delayed the introduction of this modality into common practice until the early 2000. Technological advances have resulted in the availability of numerous portable USG machines with decrease in price. Also the clinical understanding of anatomical sonography has greatly evolved over the past decade. So ultrasound imaging for nerve localization is an innovative application of an old technology which addresses many of the shortcomings of current techniques.

The objective of this study was to compare ulrasonography, a rapidly evolving technology with more conventional peripheral nerve stimulator technique for supraclavicular brachial plexus block.

METHODOLOGY

This study was conducted in a tertiary care hospital of Gujarat between August 2006 to October 2008. During this time, patients suffering from chronic renal failure with ASA III scheduled for the creation of arterio-venous fistula which needed brachial plexus block were enrolled in the study. There were 60 such patients who fulfil the selection criteria and ready to give written consent. They were randomly divided by sealed envelope technique in to 2 groups. In one group i.e. Group A (n=30) ultrasonography (USG) guided technique was used and in second group i.e. Group B (n=30) Peripheral Nerve Stimulation (PNS) guided technique was used.

Patients with past history of hypersensitivity reaction to local anaesthetic drugs, Peripheral vascular disease/ neuropathy involving upper limb, Infection at the local site, coagulation disorder or severe liver disease, Age <18 years and age > 60 years were excluded from the study. All standard methods and protocols were followed.

The parameters observed were – Procedure time, onset time for sensory block, duration of sensory block, onset time for motor block, duration of motor block, time to achieve complete block. Sensory block was evaluated on 3 point scale – Normal sensation : 0, Blunt sensation : 1, No sensation : 2. Motor block was evaluated by Bromage 3 point scale – Normal motor function : 0, Decreased motor strength compared to contralateral arm : 1, complete motor block : 2.

All patients were observed intraoperatively as well as postoperatively for the complications like vascular puncture, pneumothorax, nerve injury & LA systemic toxicity. Intraoperatively pulse rate, SpO2 and NIBP was recorded at every 15 min interval till the end of surgery. All patients were followed up in PACU for until complete recovery of sensory and motor function of the limb. Post block chest radiograph was obtained, if patient complained of respiratory distress.

Suitable statistical tests were applied to compare data and p-Value < 0.05 was considered statistically significant.

OBSERVATION:

The present study was carried out in 60 ASA III patients scheduled for creation of arterio-venous fistula during the period of 2006 to 2008.

The study population was randomly allocated to two groups –
Group A (n=30): USG guided supraclavicular block.
Group B (n=30): PNS guided supraclavicular block.

Table 1: Demographic and surgical characteristics of patients

Characteristics	Group A (n=30)	Group B (n=30)	p-Value
Age in years (Mean ± SD)	37.7 ± 12.25	41.63 ± 13.29	0.25
Weight in Kg (Mean ± SD)	48.37 ± 4.60	48.20 ± 4.90	0.89
Gender (Male: Female)	20:10	18:12	-
Surgical duration in minutes (Mean ± SD)	89 ± 16.40	87 ± 17.60	0.65

Table 1 shows that the groups were similar in patient characteristics like age, sex, weight and also duration of surgery.

Table 2: Success rate of the procedure

Assessment of Block	Group A (%)	Group B (%)	p-Value
Successful	29 (96.67)	24 (80.00)	0.047
Failed	1 (3.33)	6 (20.00)	0.043

In group A, 96.67% of blocks achieved surgical anaesthesia without supplementation compared to 80% in group B. Failure defined as supplementation required to achieve surgical anaesthesia, occurred in 1 patient in group A and and 6 patients in group B which were excluded from further statistical analysis.

The overall success rate was higher in USG guided group as compared to PNS guided group, which was statistically significant. (p-Value < 0.05)

Table 3: Characteristics of Block

Characteristics	Group A (n=29)	Group B (n=24)	p-Value
Procedure time (min)	4.55 ± 0.74	**5.71** ± 0.92	< 0.0001
Onset time for sensory block (min)	2.97 ± 0.72	3.63 ± 0.76	0.002
Onset time for motor block (min)	4.55 ± 0.78	5.13 ± 0.71	0.007
Time to achieve complete block (min)	13.17 ± 1.54	16.96 ± 1.83	< 0.0001
Duration of sensory block (hrs)	5.29 ± 0.82	4.73 ± 0.81	0.015
Duration of motor block (hrs)	5.05 ± 0.67	4.58 ± 0.73	0.02

From our study we observed that procedure time i.e. time to perform the block was shorter in USG guided group and the difference was statistically significant. (p-Value < 0.05)

The onset time for sensory block, onset time for motor block & time to achieve a complete block was also shorter in USG guided group as compared to PNS guided group & the difference was also statistically significant. (p-Value < 0.05)

The duration of sensory & motor block was significantly prolonged in group A compared to group B. (p-Value < 0.05)

It was found that no patients in Group A had any complications. While in group B, 3 (10%) patients had subclavian artery puncture, which was managed by sustained pressure for 5 to 10 minutes to reduce bleeding & subsequent hematoma. 1 (3.33%) in Group B had pneumothorax which was diagnosed in the post-operative recovery room when patient complained of chest pain with respiration.

Overall the rate of complications was lower in USG guided group than PNS guided group. This difference was statistically significant. (p-Value < 0.05)

DISCUSSION

In recent years, real time ultrasonographic guidance has been introduced for peripheral nerve blocks which is rapidly evolving and becoming increasingly more useful field of regional anaesthesia. It has also resulted in rejuvenation of unpopular blocks like superaclavicular brachial plexus block due to ability to visualize plexus, artery, first rib and pleura. This study compares different parameters between USG guided supraclavicular block with PNS guided supraclavicular block.

Procedure time in this study was 4.55 ± 0.74 min in USG guided group and 5.71 ± 0.92 min in PNS guided group which was highly significant. (p-Value < 0.0001)

These results are comparable with the study of Williams et al who reported the average procedure time of 9.8 min in nerve stimulator guided group & 5.0 min in USG guided group for supraclavicular brachial plexus block. (p-Value < 0.001)[2] These study results are in consistent with results of Anthony et al who reported that USG guided blocks were faster to perform.[3] The likely explanation for this shorter procedure time is that, ultrasound can determine the size, depth & exact location of the brachial plexus & its neighbouring structures. Also with USG guidance, positioning & if required repositioning of the needle is performed under direct vision and in real time as opposed to blind redirection & repositioning of needle with PNS.[4]

Onset time for sensory & motor block and time to achieve complete block was significantly lower in USG guided group as compared to PNS guided group. Nick Lo & Richard Brull et al reported that USG guidance can decrease block onset time for axillary brachial plexus block compared plexus block compared to a PNS guided block.[5] In a prospective study of supraclavicular brachial plexus block by William et al, at 30 min 95% of the patients in US group and 85% of the patients in NS group had a partial or complete sensory block of all nerve territories. (p-Value = 0.13)[2] Soeding et al also observed same result.[6]

Success rate in this study results was 96.67% in Group A as compared to Group B which was 80%. The difference was statistically significant. (p-Value – 0.047) This result is comparable with the study of Williams et al who reported success rate of 85% in USG guided group and 78% in PNS guided supraclavicular blocks.[2] Hopkins PM demonstrated an improved success rate using ultrasound guidance for any regional anaesthesia technique.[7] Vincent Chan et al found that the block success rate was higher in US guided group (82.8%) than NS guided group (62.9%) for axillary brachial plexus block.[8]

This study denotes that there is not a single case of any complication in USG guided block and it is 13.33% in PNS guided block. This difference is statistically significant. (p-Value < 0.05) Same results are observed in different studies. Hopkins PM observed that USG guided blocks resulted in fewer blood vessel punctures.[7] Marhofer et al also reported improved safety with three-in-one block using ultrasound guidance compared to the nerve stimulator assisted technique.[9]

CONCLUSION

From this study it is concluded that ultra-sonography guided supraclavicular brachial plexus block is quick to perform, offers improved safety & accuracy in identifying the position of the nerves to be blocked & of the structures. Wider availability of USG is likely to ensure even greater use in the future & will become gold standard for peripheral nerve blocks over the more conventional techniques.

REFERENCES

1. 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.

2. Williams SR, Chouinard P, Arcand G. Ultrasound guidance speeds execution and improves the quality of supraclavicular block. Anaesth Analg 2003; 97:1518-23.

3. Anthony R. Brown. Ultrasound versus peripheral nerve stimulator for peripheral nerve blockade: Pros and cons. Anaesthesiologia 2008; 31:S79-84.

4. Peras A, Chan VWS, Simon M. Brachial plexus examination and localization using ultrasound and electrical stimulation – a volunteer study. Anaesthesiology 2003; 99: 429-35.

5. Nick Lo, R. Brull. Evolution of ultrasound guide axillary brachial plexus blockade: reterospective analysis of 662 blocks. Can J Anesth 2008; 55(7): 408-13.

6. Soeding PE, Sha S, Roysc CE, Marks P, Hoy G, Royse AG. A randomized trial of ultrasound-guided brachial plexus anaesthesia in upper limb surgery. Anaesth Intensive Care 2005; 33:719-72.

7. Hopkins PM. Ulrasound guidance as a gold standard in regional anaesthesia. Br J Anaesth 2007; 98:299-301.

8. Chan VW, Perlas A, Mc Cartney CJ, Brull R, Xu D, Abbas S. Ultrasound guidance improves success rate of axillary brachial plexus block. Can J Anaesth 2007; 54: 176-82.

9. Marhofer P, Schrogendorfer K, Wallner T, Koinig H, Mayer N, Kapral S. Ultrasonographic guidance reduces the amount of local anaesthetic for 3-in-1 blocks. Reg Anesth Pain Med 1998; 23: 584-588.