Original Paper

ULTRASOUND GUIDANCE IMPROVES THE QUALITY AND SPEEDS EXECUTION OF SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK

Ershad R[1], Rahman MA[2], Islam MS[3], Islam MS[4], Hossain MPA[5], Siraj SB[6]

Abstract

Introduction: Brachial plexus block has proven to be a valuable method of providing anaesthesia of upper extremity. Ultrasound guidance increases the proportion of successful blocks, reduce the incidence of complications such as pneumothorax and neuropathy and decrease the block execution time.

Objective: In this we assessed the quality, safety and execution time of supraclavicular block of the brachial plexus using ultrasound guidance compared with a supraclavicular technique that used anatomical landmark.

Methods: A cross sectional prospective study was carried out at Combined Military Hospital, Chittagong during June 2011 to May 2012. Patients were randomly selected into two groups of 30 each. Group US was given supraclavicular brachial plexus block with 0.5% plain Bupivacaine and 0.2% Lignocaine (2:1) under the guidance of two dimensional ultrasonic image. Group AS was given the same block using the anatomical land mark of subclavian artery. Motor block was evaluated using forearm extension and flexion, sensory block was evaluated by comparing the cold, hot and pinprick sensation. Measured outcomes included block execution time, time of onset of motor and sensory block of musculocutaneous, median, radial and ulner nerves and the proportion of blocks in which surgical anaesthesia was achieved. Supplementation and need for General anaesthesia were also documented and evaluated.

Results: The onset of motor and sensory block of musculocutaneous, median, radial and ulner nerves were evaluated over a 20 minute period. Efficacy was more and onset time was significantly shorter in US group than the AS group. At 20 min 30% of patients in group US had block while none in AS group had >90% block (p = < 0.05).The block was performed in an average of 08 minute in group US and 12 minute in Group AS (p= < 0.05), surgical anaesthesia without supplementation was achieved in 21 patients in Group US and 07 patients in group AS. 06 patients in Group US and 13 patients in Group AS required General anaesthesia (p= <0.05).

Conclusion: Ultrasound guided Supraclavicular block can provide more complete block with more rapidity and less chance of procedure related complication than supraclavicular block using the anatomic location of subclavian artery.

Key-words: Brachial plexus block, ultrasound guidance, supraclavicular block.

Introduction

Brachial plexus block has proven to be a valuable method of providing anaesthesia for surgery of arm, forearm and hand. Successful brachial plexus blocks rely on proper techniques of nerve localization, needle placement and local anaesthetic injection. Standard approaches used today are all blind techniques that rely on surface landmarks before needle insertion and elicitation of paresthesia[1-3]. Often multiple trial & error needle attempts are necessary, resulting in procedure related pain and complication[4]. This is risky particularly for the supraclavicular approach because of the chance of Pneumothorax[1].

1. **Lt Col Reza Ershad**, MBBS,MCPS,DA,FCPS, Graded Specialist in Anaesthesiology, CMH, Ctg Cantt. 2. **Maj Md Aminur Rahman**, MBBS,DA,FCPS, Graded Specialist in Anaesthesiology, CMH, Ctg Cantt. 3. **Brig Gen Md Saiful Islam**, MBBS,MCPS,FCPS, Professor of Anaesthesiology, AFMC, Dkaka Cantt. 4. **Col Md Saiful Islam**, MBBS,FCPS, Classified Specialist in Radiology and Imaging, CMH, Ctg Cantt. 5. **Lt Col Md Parvez Altaf Hosain**, MBBS, FCPS, Graded Specialist in Anaesthesiology, CMH, Saidpur Cantt. 6. **Maj Sadat Bin Siraj**,MBBS,MCPS,DA,FCPS, Graded Specialist in Anaesthesiology, CMH, Ctg Cantt.

Ultrasound guidance for brachial plexus blocks can potentially improve rate of success and reduce complication rates along with shortened procedural time[5-8]. Ultrasound imaging can help to localize the brachial plexus accurately as a characteristic hypoechoic "honey comb appearance" lateral to the hypoechoic pulsating subclavian artery above the horizontal 1st rib which is seen as a white horizontal hypoechoic bar. This helps to accurately guide the needle to the target nerves, minimizing accidental injury to the pleural dome & subclavian artery.

The present study was designed to compare supraclavicular blockade using ultrasonic guidance to supraclavicular blockade using a surface anatomy approach. It was hypothesized that ultrasound guidance would increase the proportion of blocks allowing pain free surgery without supplementation or the need for general anaesthesia, decrease execution time and reduce the incidence of complications such as pneumothorax.

Materials and Method

A prospective cross sectional study was carried out at Combined Military Hospital Chittagong during June 2011 to May 2012. Sixty patients who presented for surgery of distal arm, forearm or and were randomly selectd into two groups after taking informed consent. Group ultrasound (US) includes 30 patients and were given supraclavicular block by ultrasound guidance. Group anatomical landmark (AS) includes 30 patients who received supraclavicular block using the anatomical land mark. A sample size of 30 patients per group was calculated to show a significant difference in the proportion of surgical blocks between groups, assuming 69% successful blocks in group AS[5] and 89% successful blocks in Group US based on a review of the literature[4], accepting a probability of type 1 error of 0.05 and a probability type 2 error of 02.

Exclusion criteria included clinically significant coagulopathy, infection at the injection site, allergy to local anaesthetics, severe pulmonary pathology, age <18yr, mental incapacity precluding informed consent or preexisting loss of force of sensation in the operative limb. No sedation was given until evaluation of the block was complete. If patients desired then preoperative sedation was given by Inj medazolam 2.5 to 5 mg.

All blocks were performed with standard monitoring (pulse oximetry, non invasive blood pressure monitoring). The anaesthetic solution consisted of Inj Bupivacaine 0.5% plain and Inj lignocaine 2% in 2:1 volume. 30-35 ml of anaesthetic solution was injected when paresthesia was elicited or confirmed by the patient in the distal forearm and hand. Supraclavicular block in group US is performed with the technique described in a recent review, using a 7.5 MHZ ultrasonic scanning head[6]. Supraclavicular blocks in Group AS was performed using the anatomical landmark of subclavian artery (Subclavian perivascular approach)[7].

Measured out comes included block execution time, time of onset of motor & sensory block of musculo-cutaneous, median, radial and ulnar terminal nerves, the proportion of blocks in which surgical anaesthesia was achieved, proportion of blocks that were supplemented, the proportion of cases in which general anaesthesia was necessary. For the purpose of the study block execution time is defined as the loss of both sensory and motor sensation all over the arm. The duration of post block analgesia defined by the interval between block completion and ingestion of first postoperative analgesic. For the purpose of this study block execution time was ascertained by the interval time between the first needle insertion and its removal at the end of injecting anaesthetic solution. Evaluation of motor and sensory block was performed every 5 min in all nerve dermatomes. Motor block was evaluated using forearm extension and flexion. Sensory block was evaluated by comparing the cold hot & pin prick sensation.

A post block radiograph was done to exclude pneumothorax in every patient. After assessing the quality of block Inj Ketamin 25 mg I/V was given in a sedation dose in few occasions.

Datas are expressed as percentages of successful blocks, as means 1 SD or proportions with 95% confidence intervals as appropriate. Student's t test was done. P<0.05 was considered as significant.

Result

Total 60 patients were included in the study in two groups. Groups US includes 30 patients who were undergone brachial plexus block under guidance of ultrasonogram. Group AS includes 30 patients who were given brachial plexus block by anatomical landmark.

The onset of motor and sensory block of musculocutanous, median, radial and ulner nerves were evaluated over 20 minute period. At 20 minutes in group US 9 (30%) patients had 70% to 79% block, 12 (40%) patients had 80% to 89% block and 09 (30%) patients had 90% to 99% block. In group AS 60% to 69% block was achieved in 13 (43.33%) patients, 70% to 79% block achieved in 11 (36.66%) patients, 80% to 89% block was achieved in only 06 (20%) patients (Table-I).

Table-I: Efficacy of blocks

Percentage of blocks	US (n=30)	Percentage of blocks	AS (n=30)
70%-79%	09 (30%)	60%-69%	13 43.33%
80%-89%	12 (40%)	70%-79%	11 36.63%
90%-99%	09 (30%)	80%-89%	06 20%
Total	30	Total	30

Onset time of the block is 8 min in group AS and 12 min in group (Table-II).

Table-II: Onset of adequate block in minutes

Onset time	Group US	Group AS	P value
	8 min	12 min	<.005

In group US out of 30 patients 6 (20%) were needed general anaesthesia and in group AS out of 30 patients 13 (43.33%) patients had to be given general anaesthesia (Table-III).

Table-III: Cases where general anaesthesia had to be given.

	US	AS	Total
GA	06 (20%)	13 (43.33%)	19
No GA	24 (80%)	17 (57.67%)	41
Total	30	30	60

Anaesthetic supplementation had to be given for 9 (30%) patients in Group US and 23 (76.6%) patients in Group AS (p=0.001) which is highly significant (Table-IV).

Table-IV: Cases where anaesthetic supplementations were needed.

	US	AS	
Supplementation	09 (30%)	23 (76.67%)	32
No supplementation	21 (70%)	07 (23.33%)	28
Total	30	30	60

Discussion

Ultrasound guidance for accurate nerve localization is very useful in supraclavicular approach for brachial plexus block. Real time ultrasound imaging can help guiding the needle to reach the target with good accuracy. Needle movement is very useful under visual guidance with the help of ultrasonic probe.

Table-V: Analysis of blocked Territories

	US Group	AS group				
	10 min	20 min	30 min	10 min	20 min	30 min
Redial N	70%	90%	95%	55%	80%	90%
Median N	40%	50%	80%	40%	70%	70%
Ulnar N	30%	60%	70%	50%	55%	60%
Musculo						
Cutaneous N	70%	93%	100%	75%	90%	95%

Our prospective randomized study demonstrates the importance of ultrasound guidance for proper and accurate execution of supraclavicular brachial plexus block. In US group 30% patients achieve 90-99% motor and sensory blockage, while none of the patients among AS group could achieve >90% blockage, which is statistically quite significant.

Ultrasound guided block allowed statistically and clinically significant reduction in procedural time and improved better quality than blind technique. The success rate in this study was observed as sufficient surgical anaesthesia provided without supplementation in US group in 70% while in AS group supplementation required in 76.66% cases which is also quite significant. General anaesthesia was needed only in 20% cases in US group while it was needed in AS group in 43.33% cases.

Sensory block in the median & ulnar territories often took more than 30 minutes; the longer evaluation period in the Kapral et at al's study showed that up to 50 minutes may be necessary to attain maximum block with single shot ultrasound guided supraclavicular block[4]. For the group AS, the success rate as defined above can be compared with neuro stimulation guided supraclavicular block. A successful block may also be defined as the one providing complete anaesthesia of all target nerves. In our study considering the number of cases ultrasonic landmarks proved to be extremely reliable guides, blocks in group US took in average <8 minutes to perform. Whereas the average time in group AS was 12 minutes.

Though in our study none of the patients in both the groups developed any complication but the possibility of unintentional occurrence of pneumothorax is one of the remote possibilities in US group. Where as in AS group there may be more chance of this complication. Another important complication in AS group is neuropathy though we in our study have not faced such complication[9]. A study examining the number of brachial plexus blocks should be performed to achieve a success rate of 87%[10].

Using ultrasound guidance for specifying the location of the target nerves of each patients, their relation to the neighbouring structures and the path of the needle by which local anaesthetic will be injected is more safe and successful in nerve blockade within the limited exposure provided by a typical residency program for trainee anaestheists[11].

Conclusion

The success rate and accuracy of supraclavicular block in ultra sound guidance is much higher than using subclavian perivascular approach. Time of onset and efficacy of block is also higher in ultrasound guidance group in comparison to blind approach (Subclavian perivascular approach). The complications are also significantly lower in ultrasound guidance approach. The recommendation of this study is to incorporate nerve stimulator with ultrasound guidance to further decrease complications and increase the accuracy.

References

1. Kulenkampf D. Anesthesia of brachial plexus. Zentralbl Chir 1911; 38:1337-50.
2. Bridendaugh LD. 1988,"The upper extremity: Somatic blockade", Neural blockade, Philadelphia, 387-416.
3. Wedel DJ, Miller RD, 2000," Nerve blocks ", Churchill Livingstone, 1520-48.
4. Kapral S, Krafft P, Eibenberger K, et al. Ultrasound guided supraclavicular approach for the regional anaesthesia of the brachial plexus. Anaes Analg, 1994; 78:507-13.
5. Moorthy SS, Schmidt SI, Dierdorf SF, et al. A Supraclavicular lateral paravascular approach for brachial plexus regional anaesthesia. Anaesth Analg 1991: 72:241-4.
6. De Andres J, Sala-Blanch X. Ultrasound in the practice of brachial plexus Anaesthesia. Reg Anaesth pain Med 2002;27:77-89.
7. Winnie AP, Collins VJ. The subclavian perivascular technique of brachial plexus anaesthesia. Anaesthesiology 1964;25:353-63.
8. Lanz E , Theiss D. The extent of blockade following various techniques of brachial plexus block. Anaesth analg 1983;62:55-8.
9. Moore DC et al . 1957, " Regional block" lL : Charles C.
10. Konrad C, Schupferg. Learning manual skills in Anaesthesiology : is there a recommended number of cases for anaesthetic procedure? Anaesth Analg1998; 86:635-9.
11. Chan VW. Nerve localization –seek,but not so easy to find? Reg Anaesth Pain Med 2002;27:245-8.