ORIGINAL ARTICLE

Supraclavicular Brachial Plexus Block: Ultrasound Guided Technique Vs Nerve Stimulator Guided Technique

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Abstract

The present study was undertaken to compare the efficacy of US guided and NS guided supraclavicular brachial plexus block.120 patients undergoing elective surgeries on forearm and hand were randomly divided into 2 groups of 60 patients each. Group NS patients received the block guided with nerve stimulator and group US with ultrasound imaging using 30ml of 0.75% Ropivacaine in both the groups. We evaluated procedure time, onset of sensory and motor block. Ultrasound guided block resulted in shorter procedure time, onset time of both the sensory as well as motor blockade, lesser failure rate and lesser incidence lesser of minor post operative complications. No major complication was seen in any of the group. Ultrasound guided supraclavicular brachial plexus block takes less time to perform & has faster onset, less failure rate as compared to nerve stimulator guided one. Both the techniques are equally safe.

Key Words

Supraclavicular Block, Ultrasound Guided, Nerve Stimulator Guided

Introduction

The supraclavicular approach to the brachial plexus provides more consistent and effective regional anesthesia to the upper limb than other approaches to brachial plexus blockade. It, however carries an inherent failure rate even in experienced hands. These failures are partially attributable to the fact that traditional nerve localisation techniques (paresthesia illicitation, nerve stimulation and trans-arterial techniques) rely on anatomical assumptions that may be incorrect (1). Standard approaches, unfortunately are all blind techniques (2,3). This is risky, particularly for supraclavicular approach because of chance of Pneumothorax (4,5), vascular punctures, unintended intravascular injection with resulting local anesthetic systemic toxicity, Horner syndrome, Recurrent laryngeal nerve blockade and Phrenic nerve blockade. The peripheral nerve stimulator has been the gold standard for identifying needle nerve proximity but is having its own limitations. The failure rate in peripheral nerve stimulator assisted supraclavicular brachial plexus block varies from 1.2% to 12% (6). A dramatic inconsistency between the induction of paresthesia and the elicitation of motor response from nerve stimulation has been observed (7). Recently blocks performed using ultrasound guidance are more likely to be successful, take less time to perform, have faster onset and longer duration than those performed with peripheral nerve stimulator guidance (8) with few complications. Hence we carried out this study.

Material and Method

After institutional ethics ommittee approval and written informed consent 120 ASA 1-2 patients of either sex between age group of 18-60 years scheduled for elective surgeries of fore arm and hand were included in the study. Exclusion criteria was Patient refusal, Local anesthetic allergy, Infection at the site of needle entry, Neurological or vascular abnormality in operative limb, Pregnancy, Preexisting contralateral hemidiaphragmatic paralysis, Clinically significant coagulopathy, Body mass index more than 35, inability to cooperate secondary to decreased mental status. All the patients were kept fasting for 8

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hours before surgery and were premedicated with Tab alprazolam .25 mg before surgery and Tab ranitidine 150 mg on the morning of the surgery. In the operating room, iv access with 18 G cannula was established in non operative limb, an infusion of RL was started and standard monitoring equipment like ECG, NIBP, SPO2 were attached to the patient. Patients were randomly divided in two groups of 60 patients each. *GroupUS:* received ultrasound guided supraclavicaular brachial plexus blockade. *Group NS:* received nerve stimulator guided brachial plexus blockade. The patient was positioned supine with the head end of the OT table elevated to 30 degrees, ipsilateral shoulder down and the head turned to the opposite side. The operative limb was flexed at the elbow and if possible the wrist was supinated. The skin was disinfected with 10 % Povidone iodine and draped under all aseptic precautions. A 50 mm 22 G insulated needle STIMUPLEX A (MELSUGEN GERMANY) was used for both the techniques.30 ml of 0.75 % Ropivacaine was used for nerve blockade in both the techniques.

USG Guided Technique: The Site Rite 5 Ultrasound System manufactured by BARD, USA with the linear mid frequency 5 -10 MHZ probe covered with the tegaderm was used to scan the supraclavicular fossa in the coronal oblique plane, parallel and immediately posterior to the clavicle to obtain a short axis view of the neurovascular structure .The pulsating hypoechoic subclavian artery was identified lying above the hyperechoic first rib and the underlying pleura. The hypoechoic nerve structures were usually visuaized posterolateral above / adjacent to the artery. Once the artery, rib, pleura and plexus were simultaneously in view UAAP,the needle was advanced in plane from lateral to medial under the probe, until the brachial plexus sheath was penetrated and needle tip was positioned within the sheath compartment among the nerves. The aim was to guide the needle towards the corner pocket between the first rib inferiorly, supraclavicaular artery medially and the nerves superiorly. Thereafter 1-2 ml of the local anesthetic was injected and its spread at the time of injection was observed in the real time to confirm the correct placement of the needle. The local anesthetic was injected incrementally in aliquots of 3- 5 ml.

Nerve Stimulator Guided Technique: The nerve stimulator (STIMUPLEX, BRAUN GERMANY) was set to deliver the current of .8 to .9mA at a pulse frequency of 1 HZ and pulse duration of .1 m sec. After positioning the patient the point at which the clavicular head of sternocleidomastoid muscle inserts in the clavicle was identified. The block was performed at a distance of about one inch above the clavicle. The palpating finger was placed parallel to the clavicle and the point of needle entrance was located immediately cephalad to it, lateral to the artery. After local infiltration, the needle was inserted first perpendicular to the skin, usually a twitch of the upper trunk was found as evidence that the needle was approaching the plane of plexus. The direction of the needle was then changed to caudal advancing it parallel to midline with a slight posterior orientation. The muscular twitch responses were considered for the different divisions as the needle was advanced. The goal of the technique was to produce an isolated muscle twitch of the fingers.Wrist flexion and extension were also taken as acceptable responses. As soon as the twitch was observed the current strength was decreased to 0.5 mA with continued observation of the twitch .The stimulator was turned off at this point and the drug was injected with repeated aspiration of the blood .Once the patient received the block routine standard monitoring was done at ten minutes interval. The parameter evaluated were: *Procedure Time :* was the time from the placement of ultrasound probe to completion of local anesthetic injection in US group and insertion of needle to completion of local anesthetic injection in NS group.

Onset of the Sensory Block: was the time between the injection and the complete abolition of pin prick sensation. Patient was asked to compare a pinprick sensation at every 5min up to 30 min in the central sensory region of a presumably anesthetized nerve with the same stimulus on the contralateral arm. Sensory block score scale:Normal sensation = 0,Blunted sensation = 1, No sensation = 2 Score 2 was taken as onset of sensory block.

Onset of the Motor Block: was assessed every 5 min for 30 min by using Modified bromage scale for upper extremity: 0: Patient able to raise the extended arm to 90degress for 2 seconds.1:Patient able to flex the elbow and move the fingers but unable to raise the extended arm.2: Patient unable to flex the elbow but able to move the fingers.3: Patient unable to move the arm, elbow and fingers.

Block Evaluation at 30 Minutes: If there was sparing of one nerve field, the block was considered

Table1. Demographic Profile

Parameters	Groups Mean ± SD		P Value
	Group US (n = 60)	Group NS (n = 60)	
Age (in years)	33.05 ± 10.87	33.85 ± 10.76	0.686
Weight (in kgs)	57.92 ± 3.37	57.03 ± 3.57	0.166
Height (in meters)	1.67 ± 0.064	1.65 ± 0.745	0.2
Body Mass Index (BMI) (in kg/m^2)	20.77 ± 1.28	20.83 ± 1.37	0.827

Table 2. Mean Procedure Time

Group	Procedure Time (in minutes)
US(n=60)	7.1±2.08
NS(n=60)	14.75±2.58
P value	.0001

Table 4: Complications

Complication	Group US (N=60)	Group (n=60)	P value
Vascular Puncture	1(1.6%)	3(5%)	0.61
Post Operative Bruising	0(0%)	0(0%)	-
Systemic Local Toxicity	0(0%)	0(0%)	-
Horner Syndrome	0(0%)	0(0%)	-

Table 3. Block Evaluation

	Group US(n=60)	Group NS(n=60)
Mean Onset of Motor Block (min)	16.25+/-5.72	23.08+/-7.31
Complete Block	55 (91.66%)	51 (85%)
Sparing of one nerve territory (incomplete block)	3 (5%)	3 (5%)
Successful Supplementation at wrist/elbow	3	2
Sparing of more than over nerve field	1 (1.66%)	2 (3.33%)
No Block	1 (1.66)	4 (6.66)
Failed Block	2(3.33%)	7(11.66%)

incomplete and block supplementation was done either at elbow or at wrist, depending upon the spared territory. If there was sparing of more than one nerve field or failed block supplementation or no block effect, the block was considered failed block and General Anesthesia was administered. *Post Block Complication Rate:* Patients were observed for clinical features suggestive of: Pneumothorax, Vascular puncture, Post operative bruising at the site of the block, Systemic local anesthetic toxicity, Horner syndrome, Recurrent laryngeal nerve block.The patient was monitored for 2 hours post operatively in the recovery area.

The data so collected was analyzed with the help of statistical software Microsoft Excel. Qualitative variables were presented as percentages. Onset of block and procedure time was represented as Mean +/-SD. Chi - square and Student t-test were used to evaluate the statistical significance. A p value of <0.05 was considered statistically significant. All p values were two tailed.

Results

There were no significant differences between both the groups with respect to demographic parameters like age, weight, height and BMI (*Table1*) The groups were also comparable for sex and duration of surgery. The mean procedure time in group US was 7.1+/-2.08 minutes while in group NS was 14.75+/-2.58 minutes. The difference was found to be statistically highly significant (*Table2*). The difference in mean onset time of sensory block was found to be statistically significant since the p value was <0.05 in all nerve territories. The difference in mean onset time of motor block was statistically highly significant since the p value was < 0.05. (*Table 3*)

Complete block was attained in 55 (91.66%) patients in group US & in 51 (85%)patients in group NS at the end of 30 minutes.3(5%) patients each had an incomplete block in both the groups and were supplemented at elbow/ wrist. In group US, all the 3 patients had successful supplementation and were considered as incomplete block. In group NS, out of 3 supplementations given, 2 were successful. One failed supplementation was taken as failed block. At 30 minute, 1 patient in Group US had sparing of more than one nerve field and 1 patient (1.66%)had no block at all while in Group NS 2 patients(3.33%) had sparing of more than one nerve field and 4 patients(6.66%) had no block effect. (*Table*

3) The failure rate in group US was 3.33% (2 patients) while in Group NS was 11.66% (7 patients).General Anaesthesia was given in these cases.(*Table 3*) Vascular puncture was seen in 1 patient in group US while 3 cases in group NS had this complication. No other complications were seen in either group.

Discussion

Our study inferred that when ultrasound guided supraclavicular brachial plexus block is performed there is statistically and clinically significant reduction in Procedure Time.(*Table 2*).Similar results are reported by various authors (10-13). Sensory block onset in territory of musculocutaneous, radial, median, ulnar, medial cutaneous nerve of forearm was earlier in ultra sound (US) guided technique as compared to NS guided technique in our study. Zencirci B also reported that although not statistically significant, the sensory block onset was earlier in US group than in NS group (14). Motor block onset,as well, in our study was earlier in US group than NS group(*Table 3*) and the result was statistically significant. This result of ours is in agreement with that of Chan *et al* (10)

Block evaluation was noted at 30 mins in our study as complete block (sensory score of 2+motor score of 3) and incomplete block (sparing of one nerve field) (*Table 3*). Supplementation was done for incomplete block either at wrist or elbow, depending upon the spared territory. We noted 91.66% had complete block in US group while it was 85% in NS group. Stephan Kapral *et al* reported that satisfactory surgical anesthesia was attained in 95% patients in both groups, on comparing USG guided supraclavicular paravascular approach with USG guided axillary approach (15).Our results are thus in similarity to them. Higher success rate was demonstrated in group US (13). Stephan R. Williams et al reported that although at 30 mins 95% of patients in group US and 85%in group NS had a partial or complete sensory block of all nerve territories, the proportion of blocks in which all territories were completely anesthetized at 30 mins was 55% in group US and 65% in group NS (16).This may be attributable to the fact that many partial blocks completed after the end of evaluation period as well as the fact that not all territories were subjected to surgery in every case.

2.8% patients required supplemental distal block of single peripheral nerve and 2.6% of patients required general anesthesia due to failed block after USG guided supraclavicular brachial plexus block.They supplemented block for Ulnar nerve in six cases, median in five cases, radial in one case and musculocutaneous in one case(17).We also found ulnar nerve sparing to be more frequent in US group.We observed incomplete block at 30 mins in 5% of cases in both US group and NS group and these were supplemented. Out of these one in NS group had failed supplementation. In NS group median nerve was most commonly spared in our study. We observed that failed block(more than one nerve field sparing+failed supplementation+no block at all) in groupUS was 3.33% while in group NS it was 11.66%(*Table 3*).Surgery in these patients was performed under general anesthesia. In a study by Stephan R.Williams et al general anesthesia was required in no patient in group US and in 8% of patients in group NS(16).

In nerve stimulator guided technique the drug is injected by seeing muscle twitches which is innervated by the nerve in which small and distal nerves may escape from the effect of the drug resulting in inadequate block requiring general anesthesia. Patients were observed for clinical features suggestive of Pneumothorax,Vascular puncture, Post operative bruising at the site of the block, Systemic local anesthetic toxicity, Horner syndrome, Recurrent laryngeal nerve block. Our study found that the nerve stimulator guided technique is associated with slightly higher complication rate as compared to US guided blockade. Only 1 case in group US developed vascular puncture while 3 patients developed vascular puncture in group NS(*Table 4*) This could be attributed to the fact that USG guidance provided the opportunity to visualize the needle, the target and the structures to be avoided and also allows the real time visualization of the spread of local anesthetic solution. The possibility of creating a pneumothorax is concern when attempting supraclavicular brachial plexus block .In our study no clinically significant pneumothorax occurred in either group. .M.S.Abrahams et al in a meta analysis reported that very few studies compared the relative risk of complications between US and PNS groups. No major complication like pneumothorax, systemic local anesthetic toxicity or permanent neurological damage was reported by any of the studies (11).Chan *et al* also reported that no major complication occurred in their study although transient block paresthesia was observed in 13 patients in both group US and NS (13).

Conclusion

Hence we conclude that ultrasound guided supraclvicular brachial plexus block results in a shorter procedure time,faster onset of both sensory and motor blockade and less failure rate as compared to nerve stimulator guided brachial plexus block. Both techniques are equally safe as no major complication was observed.

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