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Ultrasound Guided Supraclavicular Brachial Plexus Block For Upperlimb Surgeries With Single Injection And Double Inhection. A Randomized Comparative Study.

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Abstract: ***Background:*** *Ultra sound guided supraclavicular block can be achieved either using single injection (SI) or double injection(DI) techniques. Local anesthetic (LA) deposition at the corner pocket through SI technique provides competent anesthesia but sparing of the upper trunks can occur. Our study hypothesized DI technique provides better blockade quality than single injection technique.*
Objective: *To compare the success rate of blockade in SI versus DI techniques and to compare the total anesthesia related time in the two groups.*
Methods: A randomized comparative study in two groups .Both the groups received ultrasound guided 30ml of 0.5% Ropivacaine. Group SI (N=60) received entire volume in the corner pocket. In group DI (N=60) the volume was divided , where 15ml was deposited in the corner pocket and the remaining 15ml was injected superior and lateral to the subclavian artery in the centre of brachial plexus during withdrawal. The success rate of blockade and total anesthesia related time were studied in both the groups.
Results: *Data of 120 patients were analyzed. The success rate of blockade between the SI (91.7%) and DI(96.7%) Group were comparable (p>0.05). The total anesthesia related time in SI group was significantly longer in comparison with DI group, with mean ±SD of 25.17±2.45 and 21.42±3.29 respectively (p<0.001).*
Conclusion: *This study demonstrated that the success rate in both the SI and DI techniques are comparable. However, a faster onset and hence a shorter total anesthesia related time has been observed with DI over SI technique. However, this difference may not be clinically relevant.*
Keywords: *single injection technique (SI),double injection technique(DI), Ultra sound guided supra clavicular block, Ropivacaine.*

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I. Introduction

The supraclavicular block(SCB) anesthetizes the brachial plexux in its most compact form, providing a complete and reliable blockade for upper extremity surgery.[1] The key requirement for successful regional anaesthetic block is precise needle position and proper delivery of the local anesthetic(LA). Before the advent of ultrasound (USG) in regional anesthesia , using the paraesthesia and peripheral nerve stimulator technique, it was impossible to verify precisely the location of the needle tip in relation to the nerves and how the LA was distributed.[2] This goal was most effectively achieved under sonographic visualization only. In addition, it helped avoid complications such as intra neuronal and intravascular injection.

Technique for USG guided SCB include injecting the entire volume of LA at the intersection of the first rib and subclavian artery(the corner pocket technique)[3] also known as single injection technique, whereby half the volume is deposited at the corner pocket and half is injected inside the neural cluster.[4,5,6]

Most practitioners are conservative while performing peripheral nerve blocks, avoiding intra neural injection as it may cause nerve damage.[7]USG guidance is theoretically beneficial in reducing intra neural injection,[8]but its consistency in keeping needle tip extra neural depends on practitioners skill and the imaging characteristics of the needle and tissue.

Minimal needle maneuvering inside the neuronal tissue is the goal of most USG practitioners. This is the rationale behind single rather than multiple injections. The USG guided corner pocket technique has been reported to have the highest success rate but the drawback of the technique is, it may miss the upper part of the plexus, resulting in incomplete block.[9] Cadaver and patient studies by using dye injections have demonstrated that injections into a single location does not result in the spread of injected dye into all the compartments.[10] Septae or a tight muscular membrane between the scalene muscles are found to separate roots of the plexus.[11]

Several studied comparing different approaches for brachial plexus block have demonstrated multiple injection techniques to be more successful, resulting in faster onset of anesthesia and higher success rates with no increased incidence of complications.[12]

However, these trails did not show consistent results regarding the onset of block or the nerves blocked. Some studies demonstrated that the incidence of parasthesia has been significantly with multiple injection nerve blocks, but with no reported adverse events.

Despite good success rates reported with these USG SCB using single or multiple injections, no consensus exists on the best technique to use. Hence the aim of the study is to compare the block success rate of SI and DI technique, USG guided SCB for upper limb surgery.

Aim and Objectives: To compare the success rate of blockade in group DI and SI. To compare the total anesthesia related time in the two groups.

Materials and Methods: A prospective randomized study done in Andhra medical college, King George Hospital,Visakhapatnam during the period of Jan 2018 and Jan 2019 after obtaining permission from institutional ethical committee in patients ASA grade I &II undergoing upper limb surgeries.

Inclusion criteria: Age between 18 and 70 years, ASA grade I& II and BMI between 20 and 35kg/square m^2.

Exclusion criteria includes pre-existing neuropathy, coagulopathy, hepatic and renal failure, allergy to LA, pregnancy and previous surgery in the supraclavicular fossa.

Sample size : A total no of 120 cases,60 in each group(n=60) who were scheduled for upper limb surgeries satisfying the inclusion criteria were included in the study. Sample size was achieved by using results in a study conducted by Amr M.A.Sayed etal[13] where at 10 min the percentage of patients who recorded grade I motor blockade were significantly higher in DI group(86%) compared to SI group(64%), p=0.013 with the power of 80% alpha error 5% and confidence interval of 95%.

Methadology:120 Patients scheduled for upper limb surgeries after a thorough pre anaesthetic examination are randomly allocated into two groups(n=60) based on the last digit in the out patient form into group SI with patients having even numbers and group DI patients having odd numbers. All patients received USG guided SCB block with 0.5% ropivacaine.Patients were monitored by ECG, pulse oximetry , and NIBP. Iv Midazolam (1-2mg) was given before surgery. All the blocks were performed by using sonosite ultrasound machine with a linear probe(8-12MHz).

All patients were placed in supine position with ultrasound probe positioned in supraclavicular fossa and scanned to locate subclavian artery and brachial plexus in a sterile manner. A skin wheal was raised with lignocaine 2%, once the artery,rib pleura and plexus were simultaneously in view, the needle was guided using in plane technique, towards the corner pocket between the first rib inferiorly, the subclavian artery medially and the nerve superiorly. Confirming the position of the needle 0.5% ropivacaine total volume of 30 ml is injected in the corner pocket in SI Group.

In group DI the volume was divided, where 15ml is deposited in corner pocket and during withdrawal of the needle the remaining 15ml was injected superior and lateral to the subclavian artery in the centre of brachial plexus.Data was collected by an assessor blinded to the patient s volume assignments.The extent of sensory and motor blockade was tested by a blinded observer, every 5 minutes until 30 minutes.

For both the techniques the following were recorded:

Imaging time: Defined as the time interval between contact of the ultrasound probe with the patient and the acquisition of a satisfactory picture.

The needling time: Defined as the interval between the start of skin wheal and the end of local anesthetic injection through the block needle.

Performance time: Defined as some of imaging and needling time.

Sensory blockade of the musculocutaneous, median, radial and ulnar nerves were assessed on the lateral aspect of the forearm, the volar aspect of the thumb, the lateral aspect of the dorsum of the hand and volar aspect of fifth finger. Graded according to a 3-point scale using a cold test: Grade 0=no block,Grade 1=analgesia(patient can feel touch not cold), Grade 2=anaesthesia(patient cannot feel touch.

Motor blockade of the musculocutaneous,radial,median, and ulnar nerves were evaluated by elbow flexion, thumb abduction, thumb opposition and thumb adduction, respectively.Motor block was also graded on a 3-point scale:Grade0=no block,Grade1=paresis, Grade2=paralysis.

Overall the maximum composite score is 16 points. The block was considered successful when a composite score of 14 was achieved. Composite score of less than 14 was considered as failure of blockade and was converted to generak anaesthesia. Onset time is defined as time required to obtain 14 points.The primary outcome was to compare the success rate of blockade in SI versus DI Group and the secondary outcome was to measure anaesthesia related time.

If in case surgery was unduly prolonged and the effect of the block wore off, rescue analgesia was given in the form of intravenous Fentanyl 1mcg/kg and infusion of propofol 50-100 mcg/kg/min.

Statistical analysis: Data was entered in Microsoft excel for statistical analysis.Quantitative variables were summarized using mean with standard deviation. Student t test has been used to find the significance of study parameters on continous scale between two groups on metric paremeters.Chi-square/Fischer exact test has been used to find the significance of study parameters on categorical scale between two or more groups, non-parametric setting for qualitative data analysis.p value of <0.05 is considered as statistically significant.

II. Results

Table 1 Demographic data

Mean &S.D	Group DI (n=60)	Group SI (n=60)	Total (n=120)	P value
age (years)	49.37±16.79	45.35±16.25	47.36±16.58	0.186
Weight(Kg)	67.90±10.23	68.43±8.57	68.17±9.40	0.757
Height(cm)	166.15±6.72	164.20±13.53	165.18±10.68	0.319
BMI(kg/m^2)	24.79±3.31	24.85±3.30	24.82±3.29	0.920

There is no significant difference with respect to age, weight ,height and BMI in both the groups.(p.0.05)

Table 2 Comparison of composite points of sensory and motor blockade in each group

Composite Points	Group DI (n=60)	Group SI (n=60)	Total (n=120)
12	2(3.3%)	5(8.3%)	7(5.8%)
14	7(11%)	7(11%)	14(11.7%)
15	2(3.3%)	0(0%)	2(1.7%)
16	49(81.7%)	48(80%)	97(80.83%)
Total	60(100%)	60(100%)	120(100%)

P=0.382, nil significant,Fisher exact test

The patients who did not achieve composite score of 14 were labelled as blockade failure and converted to general anaesthesia.

Table 3 Blockade failure in both SI and DI groups

Blockade Failure	Group DI (n=60)	Group SI (n=60)	Total (n=120)
No	58(96.7%)	55(91.7%)	113(94.2%)
GA	2(3.3%)	5(8.3%)	7(5.8%)
Total	60(100%)	60(100%)	120(100%)

P=0.439,nil significant.

Hence the above table showed that there is no difference in performance of block on both DI and SI techniques.

The secondry outcome of the study is to compare the total anaesthesia related time between DI and SI groups.The total anesthesia time is the sum off performance time and onset time.

Table 4: Comparison of imaging time, needling time and performance time distribution in two groups±

	Group DI (n=60)	Group SI (n=60)	Total (n=120)	P value
Imaging time(mins)	1.83±1.17	1.67±5.65	1.75±4.10	0.84
Needling time(mins)	2.36±1.15	1.43±0.71	1.89±1.06	<0.001
Performance time(mins)	4.25±2.28	2.40±0.99	3.32±1.99	<0.001

The performance time is significantly longer in DI group compared to SI group(p<0.001).

Table 5: Onset time

Onset time	Group DI (n=58)	Group SI (n=55)	Total (n=113)
<15(min)	11(19%)	0(0%)	11(9%)
15-25(min)	47(81%)	49(89%)	96(85%)
>25(min)	0(0%)	6(11%)	6(5.5%)
Total	58(100%)	55(100%)	113(100%)
Mean±SD	17.25±2.83	22.72±2.47	19.9±3.81

P<0.001,significant.student t test.

Two cases in DI and five cases in SI have been excluded. The DI group had a significantly faster onset with a p valve <0.001.

Table 6: Total anaesthesia related time

Total anaesthesia related time(mins)	Group DI (n=58)	Group SI (n=55)	Total (n=113)
<20	14(24.1%)	0(0%)	14(12.4%)
20-30	44(77.5%)	53(96.4%)	97(85.8%)
>30	0(0%)	2(3.6%)	2(1.7%)
Total	58(100%)	55(100%)	113(100%)
mean±SD	21.42±3.29	25.17±2.45	23.24±3.47

P<0.001.Significant student t test.

From the above table total anaesthesia related time was less in DI group compared to SI group which was statistically significant.

III. Discussion

In this prospective randomized trail we compared the DI technique with the SI technique for performing USG guided supraclavicular brachial plexus block. In our study we found that both the techniques provide similar success rate of surgical anaesthesia. The performance time was longer in group DI in comparision with with group SI probably because group DI required more maneuvering . However , the additional needle maneuvering did not lead to an increase in the incidence of vascular puncture, paresthesia or post operative neurologic deficits.

In comparison with a study done by Amr M.A. Sayed, Amr Sobhy[13], our current study demonstrated a shorter total anaesthesia related time in DI technique, despite having a longer performance time which was compensated by shorter onset time.

The results of our present study are in present agreement with a study conducted by Teckasuk W etal.[14] They compared DI technique with TII and concluded the total anaesthesia related time was shorter with TII group. The two methods achieved comparable rate of surgical anaesthesia. The DI group required fewer needle passes as well as shorter needling and performance time.

Injection of the drug directly into brachial plexus could lead to the formation of smaller satellite clusters, resulting in increase in the surface area of exposure of the nerves to the LA.[14] This could explain the faster onset of blockade in the DI group observed in the study.

However, safety regarding the direct placement of needle in the brachial plexus cluster is not established. In the observational study conducted by Bigeleisen etal, it was opined that the positioning of needle in the cluster was equivalent to intra neural placement.[15]

Thus they concluded that DI technique posed a larger risk of adverse neurological deficits. In another contrasting study done by Franco it was opined that the intra cluster injection of LA did not amount to true intra neural injection.[16]Irrespective of the fact whether LA injected into the neural cluster amounts to true intraneural injection, recent evidence supports the safety of DI technique.[17] There was no incidence of parasthesia or any other neurological outcome in our study, thus confirming the safety of DI technique.

Our study has some limitations. First, we found that the decrease in the total anaesthesia related time in the DI technique was approximately 4 mins. In a hospital with a busy setup where large number of upper limb surgeries are performed under regional anaesthesia, such a reduction could result in a clinically relevant reduction in anaesthesia related time over the course of the day. However we agree that such a difference may not be clinically relevant in a centre that performs lesser number of cases per day.

Second, we did not restrict to a single type of surgical procedure. In a study done by Arab etal[11] they focused on a single type of surgical procedure to eliminate any confounding factors arising from surgical stimulus or location of surgery.

Third, the blocks were performed by both senior anaesthesiologists trained in USG and residents. The DI technique required needle redirections thus increasing the level of difficulty among the residents and hence could have led to a longer performance time.

There were no complications such as hypotension, arrhythmias and desaturation noted in either groups. None of the surgical procedures in both the groups required rescue analgesia.

Conclusion: In conclusion this study demonstrated that the success rate in both SI and DI techniques are comparable. The DI technique results in a faster onset and hence a shorter total anaesthesia related time however it may not be clinically relevant.

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