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**ORIGINAL RESEARCH**

# The effects of single injection technique with triple injection technique of supraclavicular approach to brachial plexus under ultrasound guidance in paediatric patients aged 6-12 years

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**ABSTRACT**
Ultrasound-guided technology for supraclavicular block in paediatric population over traditional techniques had a good success rate. But it still remained unclear whether triple injections(TI) was superior to single injection(SI).So, study had been carried out to compare success rate, onset time of block, procedure time of block, complications and conversion rate to General anesthesia in both groups.

It was prospective, randomized, double blinded comparative study, conducted after obtaining approval from institutional ethical committee and written informed consent from patients' attenders. Patients of age 6-12yrs, undergoing upper limb surgeries under Supraclavicular block with ASA-1 status were included in study. Patients with drug allergy or upper respiratory tract infections were excluded. Patients were randomly assigned into 2groups, Group SI and TI with 50 patients each.

Combined success rate of the block was not significant in both TI and SI group (86% in SI vs 84% in TI,P=0.779).Onset time of block in TI group was faster(mean=9.98min) than SIgroup(12.84min).Performance time of block wassignificantlylonger in TI(mean=8.90min) than SI group(mean=5.10min). Conversion to General Anaesthesia due to block failure was minimal and not significant in either groups and no complications were seen in our study.

**Key words:**Brachial block, paediatric anesthesia



## INTRODUCTION

Peripheral nerve blockade has become an integral part of regional anaesthesia and pain medicine. Brachial plexus block is a safe and reliable technique to provide regional anaesthesia for surgeries of the upper limb. It provides effective and comfortable intra-operative conditions and good post-operative analgesia[1].

Brachial plexus can be blocked by four approaches the supraclavicular, the interscalene, the infraclavicular and the axillary approach[2]. The supraclavicular approach to brachial plexus block is also known as "Spinal anaesthesia of the arm" as it produces complete sensory and motor blockade of the arm, forearm and hand and is therefore, our approach of choice[3].

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Initially nerve blocks were performed based on landmarks and by eliciting paraesthesia [4]. These methods were associated with high failure rates and injury to the nerves and surrounding structures. Nerve stimulator was invented for higher success rate and to decrease the complications [5]. This technique ensured a better blockade thanconventionalparaesthesiatechnique.Butboththese methodscancauseneurovascular injuries leading to vascular injury, permanent nerve damage and injury to the pleura leading to pneumothorax [6].

Real time ultrasound guidance for supraclavicular approach enables precise needle placement and visualisation of drug spread. This offers significant advantages compared with conventional methods such as peripheral nerve stimulation, nerve mapping, pure landmark-based methods or paraesthesia. It shortens sensory onset time, improves the quality and the duration of blocks, reduces the rate of complications and enables a reduction of the volume of local anaesthetic given[7,8].

Various injections techniques of ultrasound guided brachial plexus block have been described. Injection of the total volume of the drug at the intersection of first rib andsubclavianarterytheso-called"cornerpocket"[9],dualinjectiontechnique[10],subfascial injection[11], multiple injection technique where the needle is redirected todeposit the drug in all regions of the brachial plexus block[12].

Studies comparing single injection and dual injection have shown comparable success rates for both the techniques but the dual injection technique has a faster onset time that reduces the anaesthesia related time [13]. A recent study introduced a novel targeted intracluster injection technique with a shorter onset time thatcan considerably reduce anaesthesia time [14].

Studies have been carried showing the efficacy, safety and successful rate of supraclavicular block using ultrasound guided approaching paediatric population aged between 6 months to 6 years.

## METHODOLOGY

### SOURCE OF DATA

It is a prospective, randomized double blind study in pediatric patients of American Society of Anesthesiologists (ASA) physical status I and physical status II between age group of 6 to 12 years posted for elective upper extremity surgery under Supraclavicular block.

### STUDY DESIGN

Prospective, randomized double blind study.

**SAMPLE SIZE:** 100

- 50 for each group.
- (50 for Single Injection-SI and 50 for Triple Injection-TI).

### INCLUSION CRITERIA

1. Age-6 to 12 years of either sex.
2. Patients belonging to American Society of Anesthesiologists (ASA)-Grade I and II.
3. Mallampatti Class I and II.
4. Patients undergoing elective surgeries under Supraclavicular Brachial Block.

### EXCLUSION CRITERIA

1. Patients with Cardiorespiratory illness or congenital heart disease.
2. Patients with any known allergy to Local Anesthetics.
3. Patients with anticipated difficult airway.
4. Patients' attender's refusal for the procedure.
5. Patients with active Upper Respiratory Tract Infection (URTI).
6. Patients with accidental vascular injury.

### PROCEDURE

After obtaining necessary institutional ethical committee approval and informed written consent from parents, 100 patients satisfying the inclusion and exclusion criteria were randomly allocated into two groups of 50 patients each using a computer-generated random number table.

**GROUP SI:** Single Injection Technique.

**GROUP TI:** Triple Injection Technique.

After thorough pre-anaesthetic check-up and necessary laboratory testing, patients were kept nil orally for 4-6 hours before surgery.

On the day of surgery, patients were shifted to preoperative room. A patent 20-22G intravenous line was secured. Before giving premedications, vitals were recorded.

Patients were sedated with IV Inj. Midazolam (0.05-0.25 mg/kg) and were transferred to the operation theatre under observation.

AllpatientsweresupplementedwithOxygen(4-6 L/min)throughafacemask. Premedicated with InjGlycopyrrolate 0.004mg/kg and InjOndansetron 0.1mg/kg.

Vitals were recorded after premedications.

Intermittent dose of 0.5 mg/kg of Propofol was injected intravenously to sedate the patient during the procedure as per the requirements.

- A portable ultrasound machine (GE ULTRASOUND HEALTHCARE) with a 8 to 18 MHz linear transducer probe was used for all patients.
- Under aseptic precautions, the supraclavicular area was scanned for the best view of the brachial plexus.
- In this view, the brachial plexus was viewed superficially and lateral to the subclavian artery and was visualized as a group of hypoechoic halos (bunch of grapes pattern) surrounded by hyperechogenic thin rim of connective tissue.
- In single injection technique, the needle (26x1 1/2G, 38mm) was advanced in- plane toward the brachial plexus and when the tip was visualized

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adjacent to the hypoechoic shadows, a mixture of Inj. Lidocaine Hydrochloride 2% and Inj. Bupivacaine Hydrochloride 0.5% was injected in the sheath surrounding brachial plexus after frequent negative aspirations.

- While injecting the drug, spread of the drug around the plexus was visualized through the sonographic view.
- In triple injection technique, the tip of the needle was inserted in-plane into three different positions that is 11 o'clock, 7 o'clock and 5 o'clock and the drug was injected.

## RESULTS

**Table 1: Comparison of time required to perform the block procedure (Block Procedure time) in SI group and TI group**

| | Group SI | | Group TI | | Z | p value |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| **Block Procedure time** | 5.10 | 1.20 | 8.90 | 1.23 | -15.620 | **0.001(Significant, p<0.05)** |

Mean block procedure time in Single Injection group was 5.10 minutes and in Triple Injection group was 8.90 minutes. When we compared both the groups, the p-value was 0.001 which is statistically significant p value is less than 0.05.

**Table 2: Comparison of Onset time of block in SI group and TI group**

| | Group SI | | Group TI | | Z | p value |
|---|---|---|---|---|---|---|
| | Mean | SD | Mean | SD | | |
| **Onset time of block** | 12.84 | 2.07 | 9.98 | 1.49 | 7.301 | **0.001(Significant, *p*<0.05)** |

Mean onset time of block in Single Injection group was 12.84 minutes and in Triple Injection group was 9.98 minutes. When we compared both the groups, the p-value was 0.001 which is statistically significant p value is lessthan 0.05.

**Table 3: Comparison of Block achieved in SI group and TI group**

| | | Group SI | | Group TI | | Total | Chi-square value | p-value |
|---|---|---|---|---|---|---|---|---|
| | | No. of cases | Percentage | No. of cases | Percentage | | | |
| Block achieved (Y/N) | N | 7 | 14.0% | 8 | 16.0% | 15 | 0.078 | 0.779(NotSignificant, p>0.05) |
| | Y | 43 | 86.0% | 42 | 84.0% | 85 | | |
| Total | | 50 | 100.0% | 50 | 100.0% | 100 | | |

43 patients in SI group and 42 patients in TI group achieved successful block. When we compared both the groups, the p-value was 0.156 which was not significant.

**Table 4: Comparison of General Anaesthesia conversion rate(block failure) in SI group and TI group**

| | | Group SI | | Group TI | | Total | Chi-square value | p-value |
|---|---|---|---|---|---|---|---|---|
| | | No. of cases | Percentage | No. of cases | Percentage | | | |
| **General Anaesthesia conversion rate** | N | 43 | 86.0% | 42 | 84.0% | 85 | 0.078 | 0.779(NotSignificant, p>0.05) |
| | Y | 7 | 14.0% | 8 | 16.0% | 15 | | |
| Total | | 50 | 100.0% | 50 | 100.0% | 100 | | |

Patients in SI group and 8 patients in TI group experienced block failureand the anaesthetic procedure was converted to General Anaesthesia. When we compared both the groups, the p-value was 0.156 which was not significant.

**Table 5: Comparison of Complications in SI group and TI group**

| | | Group SI | | Group TI | | Total | Chi-square value | p-value |
|---|---|---|---|---|---|---|---|---|
| | | No.of cases | Percentage | No. of cases | Percentage | | | |
| Complications (Y/N) | N | 50 | 100.0% | 50 | 100.0% | 100 | 0.000 | 1.000(NotSignificant, p>0.05) |
| | Y | 0 | 0.0% | 0 | 0.0% | 0 | | |
| Total | | 50 | 100.0% | 50 | 100.0% | 100 | | |

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No patients in either group had any complications.

## DISCUSSION

The primary outcomes measures were to evaluate the success rate and to assess complications between SI and TI technique. Success rate between both the groups were evaluated on hemodynamic parameters, block procedure time, onset time of block, block achieved, adverse reactions and conversion rate to general anesthesia.

The block procedure time was 5.10 minutes in the single injection group and 8.90 minutes in the triple injection group. This difference was statistically significant. Since the TI group required multiple injections, the needling time was more. This was similar to the study by Techasuket*et al*. wherein there was a significant difference inthe mean block performance time which was more in targeted intracluster group 11.2 minutes compared to 9 minutes in double injection group.

The mean duration of onset time of block was faster in the TI group (9.98 minutes) compared to SI group (12.84 minutes) and this difference was statistically significant. This is similar to the study done by Arab *et al*. where the triple injection technique and single injection technique were compared and there was significant difference between the groups with a faster onset at 10, 15 and 20 minutes in the triple injection group.

This difference between the studies based on onset time of block may be due to the difference in the technique of double injection block. In the study by Techasuket*et al*. half the volume was injected in the main neural cluster and the remaining half in the corner pocket formed the subclavian artery and the first rib. In our study, the volume of drug was injected in the corner pocket, along the superior aspect of the brachial plexus and was continue till drug completely surrounded the plexus with local anaesthetic and therefore may have produced faster onset of blockade.

The success rate for surgical blockade was comparable. It was 86 % for the single injection group and 84% for the triple injection group. This was not statistically significant and concluded that both the techniques were equally efficacious. This finding was similar to that of Techasuket*et al*. who had a success rate of 93.3% and 100% in the double injection and targeted intracluster injection which was not statistically significant. In the study by Arab *et al*. the success rates of triple injection and single injection technique were equivalent and also were similar to our study.

Complications like pneumothorax and local anaesthesia systemic toxicity was not observed in any of the patients in our study. Conversion rate to General anaesthesia due to block failure was also minimal and not statistically significant in both thegroups.

Moayeri*et al*. [15]studied the anatomy of brachial plexus and the connectivetissue surrounding it and found that the fascial sheath and the epineurium were thin and difficult to separate. Intracluster injection was then intraepineural injection in accordance with the study. But Franco had argued in an editorial that this was not true and intracluster injection was not intraneural injection[16]. But further studies were needed to delineate the connective tissue anatomy around the brachial plexus.

The introduction of ultrasound has enabled us to picture the drug spread and thereby prevent intraneural injection but this was not failed proof as various instances of nerve puncture and intraneural injection had been recorded in ultrasound guided nerve blocks even in expert hands[17, 18]. Thus, less needle manoeuvring during ultrasound guided injection was safer and should be our intent.

## CONCLUSION

The conclusion carried out on the study done on paediatric patients to compare Single Injection vs Triple Injection using ultrasound guided supraclavicular block approach was that Single Injection technique group had shorter performance time but Triple Injection technique had short block onset time. Both groups resulted in successful block with no statistical difference. There were no complications seen in our study. The requirement of conversion to general anaesthesia due to block failure was also minimal and not statistically significant.

Hence, both the techniques, Single Injection and Triple Injection techniques used in ultrasound guided supraclavicular block approach were equally successful but with their own advantages and disadvantages.

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