Section: Anesthesia

Original Research Article

COMPARISON BETWEEN SINGLE-POINT AND DOUBLE-POINT INJECTION TECHNIQUES IN SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK

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Received : *05/01/2023*
Received in revised form : *03/02/2023*
Accepted : *15/02/2023*

Keywords:
Supraclavicular block, Double injection, Single injection technique, LA, Brachial plexus block, Ultrasonography.

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DOI: 10.47009/jamp.2023.5.2.30

Source of Support: Nil,
Conflict of Interest: None declared

Int J Acad Med Pharm
2023; 5 (2); 140-144

Abstract

Background: In most upper limb procedures, the supraclavicular block is the most widely used brachial plexus block to give surgical anaesthesia. So, this study attempted to compare the effects of single injection and double injection techniques in Ultrasound Guided Supraclavicular plexus block among elective upper limb surgeries. **Materials and Methods:** This Prospective Study (Randomised double, blinded study) was conducted at the Department of Orthopedics and Department of Anaesthesia, Govt Villupuram Medical College, Mundiyampakkam, for one year (November 2019 – November 2021). Patients undergoing upper limb surgeries were enrolled on the study. Sixty patients were randomly allocated into two groups using simple randomization. Lots were numbered serially from 1 – 60 with S (30) coding and D (30). Group S received a single-point injection technique, and Group D received a double-point injection. **Result:** In the study, males contributed more among both groups. The difference between Group D and Group S based on gender and procedure was insignificant. 96.7% of participants achieved successful block in group D whereas 90% of participants in group S, but the result shows insignificant results. The double injection technique had higher success rates, faster onset of sensorimotor block, prolonged duration of the sensorimotor block, higher total anaesthesia time, high procedural time and adverse events like paraesthesia and neurological dysfunction compared with the single injection technique. **Conclusion:** DI technique had comparatively higher success rates than the SI technique, although adverse events were reported high, which procedural skills can reduce.

INTRODUCTION

The brachial plexus block is a common way to anaesthetize the upper limb. Interscalene, supraclavicular, infraclavicular, and axillary methods could all be used to block the plexus at different levels.[1] The supraclavicular block is the most widely used brachial plexus block to give surgical anaesthesia due to its total sensory and motor blockade of the arm, forearm, and hand.[2] In the supraclavicular approach, the brachial plexus is firmly structured as a cluster, resulting in a rapid onset and dense block.[3] The accompanying risk of pneumothorax, which Kulenkampff first established in 1911 as a landmark-based strategy, was likely the reason for the technique's demise. However, this can now be reduced with modern imaging.[4] The single-point injection is the most common procedure for depositing drugs around the brachial plexus, but multiple punctures during the block can increase the risk of nerve damage. Reduce the number of pricks attempted when providing the block to avoid this issue.[5,6] Injecting the whole volume of local anaesthesia (LA) at the intersection of the first rib and the subclavian artery (the "corner pocket" technique) or the complete volume of LA at cluster are two techniques for ultrasonography (USG) -guided supraclavicular block (SCB). The single-injection (SI) technique is also known as this.[7] The precise needle location and proper distribution of local anaesthetics are essential for a successful localised anaesthetic block, and ultrasonography (USG) has been used to improve the block quality, reduce the minimum volume, and reduce latency.[8] A comparison of axillary, infraclavicular, and supraclavicular approaches to ultrasound-guided brachial plexus blockage. The number of injections found that one injection resulted in a lower rate of

ISSN (O): 2687-5365; ISSN (P): 2753-6556

procedural paraesthesia than multiple injections.[9] The double injection (DI) and single injection techniques (SI) have a faster onset and longer sensory and motor block duration. There have been very few studies comparing these approaches. Although researchers have compared single-point and two-point injection procedures and found that both had high success rates, it is still controversial which of the two techniques is preferable. DI technique has some neurological dysfunction compared with the SI technique. Some research suggests that DI had success rates and prolonged block duration. So, this study attempted to compare the effects of single injection and double injection techniques in Ultrasound Guided Supraclavicular plexus block among elective upper limb surgeries.

Aim

The study aims to compare the effects of single and double injection techniques in Ultrasound Guided Supraclavicular plexus block.

MATERIALS AND METHODS

This Prospective Study (Randomised double, blinded study) was conducted at the Department of Orthopedics and Department of Anaesthesia, Govt Villupuram Medical College, Mundiyampakkam, for one year (November 2019 – November 2021). Patients undergoing upper limb surgeries were enrolled on the study. Sixty patients were randomly allocated into two groups using simple randomization. Lots were numbered serially from 1 – 60 with S (30) coding and D (30). The participants were asked to select the slot during the interview session but were blinded to which group they belonged. They were allocated to S or D group based on their selection. Group S received a single-point injection technique, and Group D received a double-point injection. The patients undergoing plexus block were explained about the study, and a written consent form was obtained. Inclusion criteria: Patients of American Society of Anesthesiologists (ASA) physical status I and II, patients aged 20 to 50 years of both gender, Body mass index (BMI) ≤30 kg/m2, and posted for elective elbow, arm, forearm, orthopaedic surgeries were included. Exclusion criteria: Patients posted for emergency surgeries, patients posted for surgeries in hand and wrist, rib fracture, patients with a previous history of Supraclavicular block, patients with co-morbid conditions like psychological disorders, coagulopathies, neuropathy and nerve injury, patients with known allergy to local anaesthetics and any infection at the puncture site, and patients who are unwilling and non-cooperative were excluded. 0.5% Bupivacaine vial and 2% lignocaine with adrenaline vial drugs were used. Patients were interviewed in the Department of Anaesthesia regarding their physical and mental status. Investigations were recommended for blood parameters (random blood sugar, blood urea, serum creatinine, urine complete, Chest X-ray and Electrocardiogram) for assessing their physical status based on ASA physical status I and II and reviewed. Patients with abnormal test reports were excluded. They have explained the procedure neglecting the drugs used and the technique. Before surgery, the patients were given injections of Inj. Ranitidine 50 mg and Inj. Ondansetron 8 mg. According to the standard ASA guidelines, the patients underwent a comprehensive preoperative evaluation and were kept on nil per oral. Anxiolysis was performed the night before surgery with alprazolam 0.5 mg orally. Patients were welcomed into the operating room and attached to devices such as a pulse oximeter and a non-invasive blood pressure monitor, where their baseline values were recorded. Using an 18G intravenous cannula, an IV infusion (Ringer Lactate solution 500 ml) was started in the contralateral forearm. Emergency medications and intubation kits were kept if the patient needed to be resuscitated. 15 ml of 0.5 percent Bupivacaine and 15 ml of 2% lignocaine with 1 in 2,00,000 adrenaline solution were utilised for 30 ml of local anaesthetics. Data was entered as a Master Chart in Microsoft Excel and analysed using quantitative and qualitative variables in SPSS software. Quantitative variables were evaluated as Mean and Standard Deviation and analysed using the Independent T-test to compare groups S and D. Qualitative variables were quantified as proportions and analysed using the chi-square test to compare groups S and D.

RESULTS

Among 60 participants in Group D, 50 percent (15 ml) of total local anaesthesia volume was deposited in the corner pocket. The remaining 50 percent (15 ml) was placed superolateral to the subclavian artery inside the major neural cluster.

Table 1: Gender, procedure, and composite score among participants

		Group D	Group S	P-value
Gender	Male	17 (44.7%)	21 (55.3%)	0.284
	Female	13 (59.1%)	9 (40.9%)	
Procedure	Open reduction with internal fixation of both forearm fracture	6 (20%)	4 (13.3%)	0.236
	Open reduction with K wire fixation of forearm fracture	11 (36.7%)	9 (30%)	
	Closed reduction with K wire fixation	8 (26.7%)	6 (20%)	
	Open reduction with internal fixation with plating of distal humerus fracture	2 (6.7%)	9 (30%)	
	Wound debridement of the forearm	3 (10%)	2 (6.7%)	
Composite score	≥ 14	29 (96.7%)	27 (90%)	0.301
	< 14	1 (3.3%)	3 (10%)	

ISSN (O): 2687-5365; ISSN (P): 2753-6556

In the study, males contributed more in this study among both groups. The difference between Group D and Group S based on gender was insignificant. There is no significant difference in procedure between groups. The composite score was calculated based on a complete sensory and motor block of all four nerves. Points≥ 14 were labelled as a successful block. 96.7% of participants achieved successful block in group D whereas 90% of participants in group S, but the result shows insignificant results [Table 1].

Table 2: Parameters among participants

	Group D		Group S		P-value
	Mean STD	Min-Max	Mean STD	Min-Max	
Age group	30.03 ± 7.609	17-42	34.90 ± 7.779	20-50	0.017
BMI	25.180 ± 2.195	21-30	25.960 ± 2.0507	22-30	0.354
No of the Needle pass	2.33 ± 0.844	1-4	1.87 ± 0.973	1-4	0.052
Total procedural time	7.43 ± 2.569	3-14	6.13 ± 2.285	3-10	0.043
Block performance time	4.17 ± 1.487	2-7	2 ± 0.830	1-3	0.001
The onset of sensory block in radial nerve	10.93 ± 3.216	6-20	11.33 ± 5.429	5-25	0.730
The onset of sensory block in the ulnar nerve	9.67 ± 4.371	5-20	10.83 ± 2.916	5-15	0.195
The onset of sensory block in the median nerve	9.67 ± 2.916	5-15	11.17 ± 3.640	5-15	0.083
The onset of motor block in musculocutaneous nerve	6 ± 2.034	5-10	7.33 ± 2.537	5-10	0.029

The mean age of participants in Group D was 30.03 ± 7.609, and 34.90 ± 7.779 years among Group S participants. The majority of the participants belonged to 30 – 39 years. The difference between Group D and Group S based on age group was significant. 73.3% of Group D participants and 66.7% of Group S participants were overweight (23 – 27.5) based on Asian – BMI classification. The difference between Group D and Group S based on BMI was insignificant. 50% and 36.7% underwent two needle passes in both groups, with insignificant results. The mean total procedural time was 7.43 ± 2.569 minutes and 6.13 ± 2.285 minutes among Group D and Group S participants, respectively. The total procedural time was prolonged in Group D compared with group S and the result was significant statistically. The block performance time in group D was 4.17 ± 1.487 and 2 ±0.830 minutes in group S participants. The block performance time was longer in group D than in group S, and this result was statistically significant. The onset of sensory block in the radial, ulnar, median, and musculocutaneous nerve was faster among group D than group S, but this result was not statistically significant [Table 2].

Table 3: Sensory and motor blockade among participants

Nerve	Scale	Group D	Group S	P-value
Radial	0	0	0	0.301
	1	1 (3.3%)	3 (10%)	
	2	29 (96.7%)	20 (90%)	
Ulnar	0	0	0	0.161
	1	1 (3.3%)	4 (13.3%)	
	2	29 (96.7%)	26 (86.7%)	
Median	0	0	0	0.301
	1	1 (3.3%)	3 (10%)	
	2	29 (96.7%)	26 (86.7%)	
MC	0	0	0	0.301
	1	1 (3.3%)	3 (10%)	
	2	29 (96.7%)	26 (86.7%)	

On a 3-point scale, sensory blockade of the musculocutaneous, median, radial, and ulnar nerves was scored using a cold test. 0 indicates no block, 1 shows analgesia (patient can feel touch but not cold), and 2 indicates anaesthesia (patient cannot feel touch & cold). A higher proportion of Group D participants attained complete sensory blocks than Group S participants, but the result was insignificant. Group DI achieved sensory blockade of score two in 96.7%, 96.7%, 96.7%, and 96.7%, respectively, in the musculocutaneous, median, radial, and ulnar nerves, Group SI achieved sensory blockade of score two in 90%, 86.7%, 86.7%, and 86.7%, respectively. A three-point scale was used to rate motor blockade: 0 = no block, 1 = paresis and 2 = paralysis. A higher proportion of Group D participants attained complete motor blocks than Group S participants, but the result was insignificant. Group DI achieved a motor blockade of score two in 96.7%, 96.7%, 96.7%, and 96.7%, respectively. Group SI achieved motor blockade of score two in 90%, 86.7%, 86.7%, and 86.7% in the musculocutaneous, median, radial, and ulnar nerves, respectively [Table 3].

Table 4: Onset and duration among participants

	Group D		Group S		P-value
	Mean STD	Min-Max	Mean STD	Min-Max	
The onset of motor block in radial nerve	7.33 ± 2.857	5-15	7.67 ± 3.651	5-15	0.695
The onset of motor block in the ulnar nerve	7 ± 2.491	5-10	7.5 ± 2.543	5-10	0.445
The onset of motor block in the median nerve	6.17 ± 2.151	5-10	7.33 ± 2.857	5-15	0.079
The onset of motor block in musculocutaneous nerve	6 ± 2.034	5-10	7.33 ± 2.537	5-10	0.029

ISSN (O): 2687-5365; ISSN (P): 2753-6556

Duration of sensory block	169.83 ± 21.939	132-210	136 ± 15.636	102-162	0.001
Duration of motor block nerve	136.37 ± 14.620	102-162	102.10 ± 14.23	76-125	0.001
Time to first rescue analgesia	838.4 ± 5.418	830-849	807.5 ± 5.290	800-818	0.957
Total anaesthesia time	25.57 ± 4.960	17-35	22.77 ± 4.861	14-35	0.031

The onset of motor block in the radial, ulnar, and median nerve was faster among group D participants than group S participants, but this result was not statistically significant. The onset of motor block in the musculocutaneous nerve was 6 ± 2.034 minutes and 7.33 ± 2.537 minutes among groups D and S, respectively. The onset of motor block was faster among group D participants than among group S participants, and this result was statistically significant. The duration of the sensory block was 169.83 ± 21.939 minutes and 136 ± 15.636 minutes among group D and group S respectively. Duration of sensory block was more prolonged among group D participants than group S participants, and this result was statistically significant. The duration of the motor block was 136.37 ± 14.620 minutes and 102.10 ± 14.23 minutes among group D and group S respectively. Duration of motor block was more prolonged among group D participants than group S participants, and this result was statistically significant. In group D, the time to first rescue analgesia was 838.4 ±5.418 minutes and 807.5 ± 5.290 minutes in group S administered participants, but the result was insignificant.

The total anaesthesia time was 25.57 ± 4.960 minutes and 22.77 ± 4.861 minutes among groups D and S. Total anaesthesia time was more prolonged among group D participants than group S participants. This result was statistically significant [Table 4].

Complications

10% of group D participants and 10% of group S participants reported paresthesia. None of the participants reported neurological dysfunction, hoarseness of voice, vascular puncture and pneumothorax.

DISCUSSION

The successful block rate is higher in group D (96.7%) participants than in Group S (90%) participants in our study. The onset of sensory block in radial, ulnar, median and musculocutaneous nerve was quicker in the double injection technique compared with the single injection technique. Choudary et al.[3] found that the onset of sensory block in group D was 7±1.5 minutes and 10.6±2.7 minutes in group S. In a study by Vallapureddy et al.10 compared to the SI group, the DI group experienced a much faster onset which shows similar results to our study. Kamat et al.[11] reported that Sensory and motor block onset times were 11.09±2.47 minutes and 17.69±3.40 minutes, respectively, among patients administered the double injection technique. Guragol et al.12 reported that the mean onset time was 17.25±2.83 minutes and 22.72±2.47 minutes, respectively, among DI and SI groups. Choi et al.13 found that the DI group's block onset time was not substantially different from the SI group's (10 [5–17.5] vs. 20 [6.25–30] minutes, P = 0.142). Sayed et al.14; found that the dual-injection group achieved early initial sensory block in 60% of patients (P = 0.028) and motor block in 86 percent of patients (P = 0.013) at 5 and 10 minutes, respectively. It was noticed that similar findings in Choudary et al.3, Guragol et al.[12] Choi et al.[13] and Sayed et al.[14] studies showed that the onset of sensory and motor block was faster in the double injection technique than the single-injection technique. Sayed et al.[14] reported insignificant results, which might be due to sample size. In our study, the duration of sensory block and motor block was more prolonged among group D participants than group S participants, and this result was statistically significant. Choudary et al.[3] and Mahanti et al.[15] reported the same results as our study results: the duration of sensory block and motor block was more prolonged in the double-injection technique than in the single-injection technique. Our study shows block performance time was higher in group D than in group S technique. In a study by Vallapureddy et al.10, the performance time was less than one minute in 35 % of SI patients and 15% of DI patients. Pallath et al.16 reported that the block time in Group B (198.57 ±19.56 sec) was longer than in Group A (151.53±14.37 sec). Guragol et al.[12] reported that the mean performance time was 4.25±2.28 minutes and 2.40±0.99 minutes, respectively, among DI and SI groups, which was significant. Pallath et al.[16] and Guragol et al.[12] studies found consistent results that block performance time was higher in the DI than in the SI technique. Vallapureddy et al.[10] Pallath et al.[16] and Choi et al.[13] studies reported similar findings as our study that the proportion of achieving complete sensory and motor block in the double injection technique was higher than in the single-injection technique. In our study, total procedural time was higher in group D than in group S. Mahanti et al.[15] studies found that among 100 patients allocated to each group, group D had a significantly quicker onset and significantly longer procedural time than group S. The procedural time was 9.12 ± 1.92 minutes in group D and 8.36 ± 1.86 minutes in group S like our study results. Kamat et al.[11] reported that the mean procedure performance time was 14.60±2.74 minutes among patients administered the double injection technique. Choi et al.[13] found that the procedure time (median [interquartile range]) was similar in the DI and SI groups (5.5 [4.75–8] vs. 5 [4–7] minutes, respectively; P = 0.137) in a randomised controlled experiment which was a contrast to our study results might be due to sampling methods and sample size. In group S, the process took less time (179 ±104 vs 275 ±137 secs; P 0.01) than in group D, according to the Roy et al.[17] studies. Sayed et al.[14] found that the

ISSN (O): 2687-5365; ISSN (P): 2753-6556

single-injection group had a significantly shorter overall procedure time (P = 0.043). Total procedural time in the dual-injection technique was 122.67±57.28 minutes and 156.33 ±67.99 minutes. Roy et al.[17] and Sayed et al.[14] showed similar results: total procedural time was higher in the DI than in the SI technique. Our study reported paresthesia in the DI technique. Sayed et al.[14] found that the dual group had a paresthesia rate of 52 percent (P = 0.042), with no neurological side effects. But Guragol et al.[12] studies reported no adverse events in both group. The operator's skills could reduce these reported events in the double injection technique.

CONCLUSION

DI technique had better success rates, faster onset, and prolonged duration but reported some adverse events. So, it was concluded that the DI technique had higher success rates than SI techniques, although procedural skills can reduce adverse events reported highly in the DI technique. Both techniques can be used for administering anaesthesia for upper limb surgeries.

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ISSN (O): 2687-5365; ISSN (P): 2753-6556