



Original Research Article

A comparative observe of infraclavicular and supraclavicular brachial plexus the usage of neurostimulation and ultrasound as additional tool

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ABSTRACT

Peripheral nerve blocks (PNB) are getting significant recognition for intraoperative and postoperative pain control because of their distinct advantage over general anaesthesia. There are different ways to a brachial plexus block. The coracoid infraclavicular approach is feasible in almost all patients. A prospective randomized control trial was performed to compare the clinical effect of infraclavicular and supraclavicular brachial plexus block using a nerve stimulator for upper limb surgery. Sixty patients receiving upper limb orthopedic surgery under infraclavicular or supraclavicular brachial plexus block were enrolled in this study. The supraclavicular brachial plexus block was performed using nerve locator and ultrasound technique with 40 ml of 0.5% bupivacaine 1.5 mg/kg, lignocaine 2% with adrenaline 4mg/kg and distilled water. This study observed which nerve types were stimulated, and scored the sensory and motor blockage. The quality of the block was assessed intra-operatively and postoperatively with modified Lovette rating scale and McGill's pain score. The duration of the sensory, motor block and the complications were assessed. The patient's satisfaction with the anesthetic technique was assessed after surgery.

Conclusions: In our study we observed similar effect in both infraclavicular and supraclavicular brachial plexus block. The infraclavicular approach may be preferred to the supraclavicular approach as complications are fewer with infraclavicular approach but expertise is needed in infraclavicular block.

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1. Introduction

Peripheral nerve blocks (PNB) are getting significant recognition for intraoperative and postoperative pain control because of their distinct advantage over general anaesthesia. PNB is devoid of side effect such as somnolence, nausea, vomiting and hemodynamic variability. It has the added advantage in day care surgery facilitating early discharge from hospital. When combined with general anaesthesia it permits a lighter plane of anaesthesia, avoids excessive use of opioids and enables early recovery. PNB provides a high degree of patient and surgeon satisfaction as a result of superior pain

control. There are different ways to a brachial plexus block like Interscalene, supraclavicular, infraclavicular and axillary. Compared to the axillary technique, coracoid infraclavicular block at mid clavicular level can anesthetize all three brachial plexus cords with few complications and avoids sparing of musculocutaneous and thoracobrachial nerves. The coracoid infraclavicular approach is feasible in almost all patients. Coracoid infraclavicular block also has advantages of both the supraclavicular and axillary approaches. The compact anatomical distribution of plexus allows anaesthetist to use a single injection to block the plexus and is free of pneumothorax and vascular complications.¹ Distributions of supraclavicular and infraclavicular plexus block approaches are similar.² Ultrasound guided PNB are gaining big popularity in

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regional anaesthesia because of the benefits of direct visualization of cords, vascular systems and real time guidance to needle thereby lowering the complications.^{3,4}

2. Materials and Methods

A prospective comparative study was carried out in 60 patients undergoing orthopedic upper limb surgeries on elbow, forearm, wrist and hand. Informed written consent was obtained from patients who were included in this study. ASA 1 to 2, 14 to 60 years of age, and weight ranging from 20 kg to 65 kg scheduled to undergo orthopedic surgery of the elbow, forearm, or hand under brachial. The exclusion criteria included local sepsis, pre existing neuropathy, bleeding disorders, coexisting lung, heart, liver, or kidney disease, pregnancy, allergy to local. The patients were randomly allocated to receive either a supraclavicular plexus block (group I, n = 30) or a coracoid infraclavicular plexus block (group II, Standard monitoring (non-invasive blood pressure, pulse oximetry and ECG) was commenced upon arrival to the operation theatre. A 22-gauge insulated stimulation 55 mm needle connected to a nerve stimulator was used for blocks (Stimuplex B® Braun nerve locator and 10 cm Stimuplex® D disposable single). The initial nerve stimulator settings were 5 mA with impulse duration of 0.1 ms. The needle insertion was done under ultrasound guidance (Phillips i33 with linear L 12-3 Probe). The needle position was considered perfect when the motor response in the hand or wrist was elicited and twitches remained visible with a current of 0.5 mA. Disappearance of muscle twitches after 0.3 mA confirmed that the needle was not entering the nerve directly. 40 ml of 0.5% bupivacaine 1.5 mg/kg, lignocaine 2% with adrenaline 4mg/kg and distilled water injected slowly (60 s) with intermittent aspiration. The coracoid infraclavicular approach was performed on flat patient with the upper arm along the body with the elbow flexed and the hand resting on the chest. After identifying the landmarks, the puncture site was marked as shown in the figure 1 and 2.⁵ The coracoid process is identified as the first bony prominence that is felt while palpating from acromioclavicular joint medially, below the clavicle. The needle insertion point is 1.5 cm below and 1.5 cm medial to the bony prominence of coracoid process. The supraclavicular brachial plexus block was performed in accordance to the original procedure reported by Brown et al.⁶ The patient was placed in the supine flat position with their head turned to the opposite side. The point at which the lateral border of the sternocleidomastoid muscle joins the upper aspect of the clavicle was marked, and a needle was inserted at this point in a direction that is perpendicular to the table. The needle was advanced until desired motor response was obtained.

If a motor response in the hand or wrist was not obtained in first attempt and/ or the first rib was not contacted, the needle was redirected cranially in steps until a motor

response in the hand or wrist was obtained or until it was angled approximately thirty degrees. If contact with the brachial plexus was still not made, the needle was redirected caudally in steps until a motor response was obtained or until an angle of thirty degree was reached toward feet side. Ultrasound was used if no motor response was obtained to locate the cords and direct needle accordingly. The desired response is considered when wrist palmar flexion, wrist dorsiflexion, interphalangeal joint extension or metacarpophalangeal joint flexion was noted.

Sensory block was assessed by pin pricking sensation and compared to the contralateral arm. Sensory blockade was graded on the scale from 100% to normal sensation to 0% no sensation. The motor block was evaluated in each nerve territory and scored according to Modified Lovett's rating scale^{7,8} as shown in Table 2. The time of onset of block, duration of sensory block and duration of motor block was also assessed.

Table 1: Lovett's rating scale for qualification of muscular force

Score	Muscular force
6	Normal muscular force
5	Slightly reduced muscular force
4	Pronounced reduction in muscular force
3	Slightly impaired mobility
2	Pronounced mobility impairment
1	Almost complete paralysis
0	Complete paralysis

The quality of the block was evaluated in the intraoperative period: (1) satisfactory block- surgery without patient discomfort or the need for anaesthetic supplementation; (2) unsatisfactory block - a sensory region involved in the surgery was not completely anesthetized and the block was supplemented with the continuous infusion of propofol at 50 µg/kg/min, or Ketamine 1 – 2 mg/kg bolus or inj Fentanyl 1 – 2 mcg/kg iv and (3) complete failure - if the patient still experienced pain despite supplementation, general anesthesia was induced by the attending anesthesiologist.

Patients were monitored for 24 hrs for any pain and complication. Post operative chest X-rays were taken after one hr and after 24 hrs to exclude possibility of pneumothorax.

2.1. Statistical analysis

The data was analyzed with SPSS statistic computer software. Statistical analysis was performed using a Mann-Whitney rank sum test, Student's t-test, unpaired t-test and χ^2 where appropriate. A P value < 0.05 was considered statistically significant.

3. Results

All 60 patients fulfilled criteria of completion of the study. There was no statistically significant difference in

the demographical data, type of surgery, between the two groups (Table 1).

Table 2: Demographic and surgical characteristics

Parameter	Group I	Group II
Age	30 ± 15	32 ± 14
weight	51.8 ± 12	48 ± 14
Male/Females	14/16	13/17
Type of surgery		
Radius Plating	9	12
Ulna Plating	10	8
Radius Ulna Nailing	6	5
Below elbow amputation	3	2
Wrist tendon repair	2	3

Table 3 shows the mean time of onset of sensory block which is significantly early in group I i.e. mean 6.01 min with p value < 0.0001 and shows the mean time of onset of motor block which is significantly early in group I i.e. mean 7.81 min compared to group II mean value 10.94 min with p value < 0.01 . There was no significant difference in sensory blockade over time between two groups Table 4. There is no significant difference in motor blockade in both groups in Radial, Ulnar and Median nerve territory. Significant sparing is seen in musculocutaneous nerve supplied muscles in group II when compared with Lovett's score (Table 5).

There was no hemodynamic variability in two groups but the higher respiratory rate has been seen in group I (Table 6). Complication like pneumothorax and vascular puncture is seen in group I. the conversion to general anaesthesia is seen more in group II but it was not statistically significant (Table 7).

Table 3: Onset of Sensory and motor block

(in Min)	Group I	Group II	'P' Value
Mean time onset of sensory block	6.01	9.92	0.0001
Mean time onset of motor block	7.81	10.94	0.0001

Table 4: Mean duration of sensory and motor block

(in hrs)	Group I	Group II	'P' value
Mean duration of sensory block	5.43	5.76	0.98
Mean duration of motor block	4.98	5.32	0.836
'P' value		>0.05	

4. Discussion

The study showed no much clinical differences in both the approaches i.e. supraclavicular and coracoid infraclavicular

approach except for the high incidence of vascular complication (6 patients) and the pneumothorax (1 patient) with the supraclavicular approach. A brachial plexus block can be performed using several different approaches. Selection of the particular approach is determined by the surgical site innervations, risk of regional anesthesia-related complications, as well as the preference and experience of the procedure performing anesthesiologist. Other factors can be taken into consideration, together with the reliability, ease and rapidity, and patient consolation in the block performance. The supraclavicular approach to the brachial plexus offers an advantage, particularly a faster onset of a denser block with a single injection using less local anesthesia volume.⁹ In this study, both strategies showed similar outcomes in terms of total sensory block rates and exceptionally dense block. At 10 min, complete analgesia of all territories was achieved in 92% ($n = 26$) and in 89% ($n = 25$) of patients in group I and II, respectively. The onset of both motor block and sensory block is faster in supraclavicular approach. Adequate surgical analgesia in the coracoid infraclavicular approach was reported by Kilka et al.¹⁰ Neuburger et al reported adequate surgical anaesthesia in 95% of patients at 30 min using 40 ml of prilocaine 1.5% and 10 ml of bupivacaine 0.5%.¹¹ There are no reports comparing the supraclavicular with coracoid infraclavicular approach using neurostimulation techniques. Several studies had compared the supraclavicular approach with the infraclavicular approach with ultrasound. Arcand et al.¹² compared ultrasound-guided supraclavicular with infraclavicular blocks and reported no significant difference in either the block performance or onset times or block efficacy. In contrast, Koscielniak et al.¹³ reported that an ultrasound guided infraclavicular block had a faster onset, better surgical efficacy and fewer adverse events than a supraclavicular block. The higher respiratory rate was seen during intraoperative period in supraclavicular approach and this was attributed to hemi-diaphragmatic palsy in supraclavicular block. When the complication rates between the supraclavicular and infraclavicular approaches are compared, a deterioration in diaphragmatic movements can be rated as 100% for interscalene,¹⁴ 50% to 77% for supraclavicular,^{15,16} 24% to 26% for proximal infraclavicular,¹⁷ and 0% for more distal infraclavicular blocks like axillary.^{18,19} A pneumothorax is a serious complication and is associated with the supraclavicular approach. This has also been reported after interscalene block,²⁰ the chance of pneumothorax are virtually nil in coracoid infraclavicular block.²¹ The musculocutaneous nerve sparing was seen in infraclavicular approach in this study. This can be reduced with dual injection technique as mentioned in fuzziar R et al study.²²

This study had some limitations. A single anesthesiologist performed all the blocks. Although this eliminates the inter-operator variability, it might limit generalizing the

Table 5: Motor blockade in two groups

Nerve Groups	Lovett's score					
	Ulnar			Radial		
	I	II	'P' value	I	II	'P' value
0 min	5.90	5.92	0.772	5.96	5.88	0.236
5 min	4.17	4.48	0.106	4.31	4.44	0.330
10 min	2.52	2.68	0.349	2.14	2.16	0.822
30 min	1.17	1.20	0.799	1.10	1.12	0.848
60 min	0.17	0.36	0.121	0.14	0.24	0.340
90 min	0.07	0.24	0.080	0.07	0.2	0.157
Nerve Groups	Median			Musculocutaneous		
	I	II	P' value	I	II	'P' value
0 min	5.93	5.96	0.651	5.90	5.92	0.772
5 min	4.45	4.48	0.850	4.21	4.32	0.354
10 min	2.21	2.20	0.956	2.17	2.52	0.006 *
30 min	1.31	1.32	0.941	1.17	1.48	0.015 *
60 min	0.17	0.24	0.547	0.28	0.72	0.006 *
90 min	0.10	0.08	0.772	0.10	0.52	0.001 *

* Statistically significant.

Table 6: Intra-operative respiratory rate

Time in Minutes	0	5	10	30	60	90	'P' Value
Group I	15.21	16.34	17.28	17.24	17.59	16.45	<0.05 significant
Group II	15.16	15.32	15.36	15.44	15.16	15.32	
'P' value	0.920	0.026	0.001	0.001	0.001	0.032	

Table 7: Complications

	Vascular puncture	Pneumothorax	General Anaesthesia
Group I	6	1	1
Group II	0	0	5
'P' value	0.010	0.971	0.085

results. The failure rate in the infraclavicular approach might be due to more experience with the supraclavicular approach than with infraclavicular approach at that time.

5. Conclusion

In conclusion, the results suggest that the onset of both sensory and motor block are faster in supraclavicular approach than infraclavicular approach to the brachial plexus but the supraclavicular block caused a pneumothorax. The infraclavicular approach may be preferred to the supraclavicular approach as complications are fewer with infraclavicular approach but expertise is needed in infraclavicular block.

6. Declaration of Conflicting Interest

The authors declared that there are not any potential conflicts of interest with reference to the analysis, authorship, and/or publication of this text.

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