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Original Research Article

Comparison of infraclavicular brachial plexus block with supraclavicular brachial plexus block in upper limb surgeries using peripheral nerve stimulator

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ABSTRACT

Background: The supraclavicular approach to brachialplexus block (SCB) is indicated for operations of upper extremity distal to the shoulder; the infraclavicular block (ICB) is indicated for operations of distal arm, elbow, wrist, and hand. Objective of the study was to compare the infraclavicular brachial plexus block with supraclavicular brachial plexus block in upper limb surgeries using peripheral nerve stimulator.
Methods: This prospective study was conducted among 78 patients, 39 in each group in infraclavicular block and supraclavicular block, posted for various upper limb surgeries on elective or emergency basis and compare both the groups for block performance time, onset of block, quality of block, duration of block, pulse rate, mean arterial pressure post-operative complication.
Results: Duration of surgery, quality of block and success rate was almost similar in both the groups. The block performance time for infraclavicular block was more as compared to supraclavicular block. The duration of block is more in infraclavicular group as compared to supraclavicular group. The onset of sensory blockade, as well as motor blockade, was slightly earlier in supraclavicular group. Hemodynemic parameters were also almost similar in both groups. Our study encounters higher number of complications among supraclavicular group.
Conclusions: Supraclavicular route require less time to perform the block and have a rapid onset of sensory and motor block, but the duration of sensory and motor blockage is less as compared to infraclavicular route. Both the groups have a similar quality of block and success rate, but the supraclavicular route is associated with various complications compared to infraclavicular route.

Keywords: Brachial plexus block, Infraclavicular block, Regional anesthesia, Supraclavicular block, PNS

INTRODUCTION

Because of cost-effectiveness of peripheral nerve blocks, it is safe in critical situations. Using brachial plexus block (BPB) is a blind method associate with a higher failure rate and injury to the nerves. Peripheral nerve stimulator and ultrasound (US) techniques permit a time-tested and exceptional localization of the nerves and the surrounding structures.[1,2]

Benefits of successful block over general anesthesia is reduces morbidity and mortality associated with general anesthesia, provides excellent post-operative pain relief and decrease the duration of hospital stay.[3] The supraclavicular approach to brachialplexus block (SCB) is indicated for operations of the upper extremity distal to the shoulder; the infraclavicular block (ICB) is indicated for operations of the distal arm, elbow, wrist, and hand.[4,5]

In upper limb surgeries, both supraclavicular and ICBs can be utilized. The ICB was introduced in early 20th century as alternative to axillary block. The infraclavicular approach anesthetizes the brachial plexus at the level of cords, coraciod approach is most popular because of a consistent bony landmark, less chance of vascular puncute or pneumothorax. Present study conducted with the objective to compares the infraclavicular BPB with SCB in upper limb surgeries using peripheral nerve stimulator.[22,23]

METHODS

Study setting and duration

This study was conducted in department of anesthesiology, Surat Municipal Institute of Medical Education and Research, Surat, Gujarat from July 2017 to August 2018.

Study design and study population

This prospective study enrolled 78 patients, 39 in each group (group-I – ICB=39, group-II – supraclavicular block=39), patients having ASA I/II posted for various upper limb surgeries on elective or emergency basis. Inclusion criteria was age group: 14 to 66 years of either gender, ASA grade: I or II, weight: 45 to 85 kg, normal sensory and motor function in operating limb and patient giving informed written consent. Exclusion criteria was age below 14 years, patient's refusal, Infection at the site of injection, clinically significant coagulopathy, severe pulmonary pathology and pre-existing motor and sensory deficit.

Anaesthesia technique: induction, maintenance and recovery

Pre anesthetic checkup was performed the day before and on the day of surgery. Basic routine investigations like hemoglobin, renal function tests, serum electrolytes, random blood sugar and chest X-ray PA view were done and recorded. all patients were premedicated with injection glycopyrrolate 0.004 mg/kg and injection midazolam (1 mg) intravenously. Emergency surgeries with full stomach were given injection ondansetron (4 mg) intravenously. On arrival to the operation theatre monitor (ECG, pulse oximetry, NIBP) would be attached to the all patients and baseline parameters noted.

Technique

Group I-infraclavicular block

Infraclavicular brachial plexus was given by coracoid approach which is described and popularized by Wilson. The block was performed with patient lying supine with his/her head turned in direction opposite the limb to anaesthetized. The arm to be blocked laid in neutral position along the body. The coracoid process was identified by palpation, elevating and lowering the affected arm. As the arm is lowered, the coracoid process meets the fingers of the palpating hand. The coracoid process marked and with help of ruler, the point of entry of the needle 2 cm, caudal and 2 cm medial to coracoid process decided. Using a sterile technique, a 22-gauge 50 mm insulated short bevel stimuplex® needle was inserted perpendicular to skin and connected to a peripheral nerve stimulator (Fisher and Paykel) that was programmed with following variable: current 1 mA and frequency 2 Hz. The needle was advanced with the knowledge that the plexus would be at about 4 to 6 cm. of depth. In the absence of upper extremity motor response, the needle was redirected either cephalad or caudal but never medially to avoid pleura puncture. In the presence of an upper extremity motor response, the intensity of the current was than progressively reduced to 0.5 mA and the needle was advanced till the achievement of twitches of the muscle of the hand and after clearly visible twitches of all finger either in flexion or extension considered as the only adequate response. 15 ml of injection lignocaine with adrenaline (1.5%) solution and 15 ml injection bupivacaine 0.5% were injected after frequent negative aspiration.

Group II - supraclavicular block

Supraclavicular block was given by conventional technique described and popularized by Bonica et al. The block was performed with patient lying supine with his/her head turned in the direction opposite the limb to be anesthetized. The arm to block laid in neutral position along the body. Feel the pulsation of subclavian artery which is often palpable and always lateral to the outer border of sternocledomastoid muscle. By using the 25-gauge needle with 5 ml syringe a wheal raised with 0.5% 2 ml lignocaine 1 cm above the midpoint of clavicle. Now palpate the pulsation of the subclavian artery just lateral to it. 22-gauge 50 mm insulated short bevel stimuplex® needle was inserted through a wheel downward, inward and set the current of 1 mA at 1 hZ in peripheral nerve stimulator (Fisher and Paykel). The needle was advanced till the achievement of twitches of the muscle of the hand and after clearly visible twitches of all finger either in flexion or extension considered as the only adequate response.

Measurement tools

Vital parameters like blood pressure (BP), pulse rate (PR), SpO_2 were monitored every 15 minutes. Any complications like vascular puncture, hematoma, pneumothorax, drug toxicity was noted. Monitoring of patient in post-operative room for adverse effects or side effects during post-operative period till baseline haemodynamics value achieved.

Data analysis

Qualitative data were expressed as percentages and proportions. Quantitative data were expressed as mean and

standard deviation. The differences between two groups with respect to continuous variables were analysed using unpaired t-test while categorical variables were analysed using Chi-square test. All the statistical tests were performed in Epi Info 3.5.1 software by CDC, USA. P value <0.05 was considered as statistically significant while p value <0.01 was considered as statistically highly significant.

Ethical consent

Before proceeding with study, appropriate ethical clearance was obtained from hospital ethics committee. Each patient was included in the study only after informed consent.

RESULTS

Table 1 shows that 6 4.1% and 61.5% participants belonged to age group 21-40 years and 28.2% and 33.3% were belonged to age group 41-60 years in supraclavicular and infraclavicular group respectively (p>0.05). Around 74.4% and 84.6% participants were male and 25.6% and 15.4% were female in supraclavicular and infraclavicular group respectively (p>0.05). Around 5.1% participants of supraclavicular group were admitted in emergency (p>0.05). Around 82.1% and 61.5% participants belonged to ASA group I and 17.9% and 38.5% were belonged to ASA II in supraclavicular and infraclavicular group respectively (p>0.05). Almost 7.7% and 7.7% participants have history of TB and 5.1% and 2.6% history of HYN in supraclavicular and infraclavicular group respectively (p>0.05).

Table 2 shows that duration of surgery was 71.9 min with 22.08 SD and 70.8 min with 23.8 SD in supraclavicular and infraclavicular group respectively (p<0.05). Block performance time was 12.4 min with 1.63 SD and 6.87 min with 2.1 SD in supraclavicular and infraclavicular group respectively (p<0.05). Onset of anesthesia was 13.3 min with 1.3 SD and 10.1 min with 1.1 SD in supraclavicular and infraclavicular group respectively (p<0.05) regarding sensory block. Onset of anesthesia was 17.9 min with 2.0 SD and 11.97\min with 1.97 SD in supraclavicular and infraclavicular group respectively (p<0.05) regarding motor block.

Duration of block was 4.97 hr with 0.71 SD and 4.45 min with 0.51 SD in supraclavicular and infraclavicular group respectively (p<0.05) regarding sensory block. Duration of block was 5.84 hours with 0.76 SD and 5.17 hours with 0.64 SD in supraclavicular and infraclavicular group respectively (p<0.05) regarding motor block. Failed effect of block was noted in 4 and 4 participants in supraclavicular and infraclavicular group respectively (p>0.05).

Table 3 shows that shows that pre operative mean pulse rate was 89.05±4.82 beats/min in group-I and 86.00±7.05 beats/min in group-II. Intraoperative mean pulse rate was 88.69±4.54 beats/min in group-I and 86.97±6.37 beats/min in group-II. Pre operative mean respiratory rate was 15.41±1.09/min in group-I and 14.49±2.04/min in group-II. Intraoperative mean respiratory rate was 15.38±1.07/min in group-I and 14.54±1.86/min in group-II. There was no statistically significant difference in pre operative and intraoperative mean pulse rate and respiratory rate in both the groups(p>0.05). Pre operative mean systolic blood pressure was 126.23±8.15 (mmHg) in group-I and 128.12±6.09 in group-II. Pre operative mean diastolic blood pressure was 82.12±4.22 (mmHg) in group-I and 84.2±6.28 (mmHg) in group-II. Intraoperative mean systolic blood pressure was 124.22±6.27 (mmHg) in group-I and 122.34±7.05 (mmHg) in group-II. Intraoperative mean diastolic blood pressure was 79.28±4.23 (mmHg) in group-I and 81.21±3.22 (mmHg) in group-II. There was no statistically significant difference in blood pressure in preoperative and intraoperative period in both the groups (p>0.05).

Figure 1 shows that total number of complications were 9 (23.1%) in group-II and 2 (5.1%) in group-I. In group-II 1 (2.6%) patient had aphonia, 1 (2.6%) patient had convulsion, 4 (10.3%) patients had hematoma and 3 (7.7%) patients had vascular injury. In group-I 2 (5.1%) patients had hematoma and no patients had vascular injury, aphonia and convulsion.

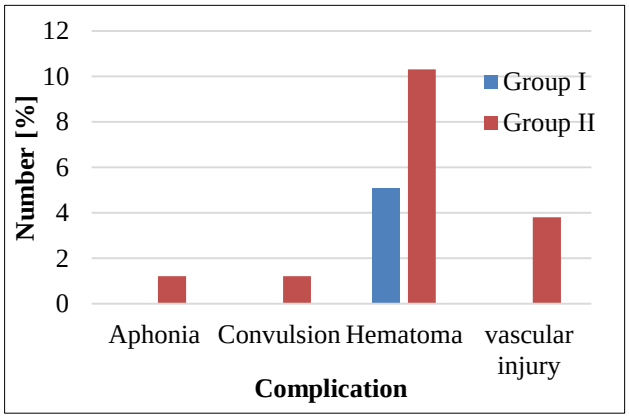

Figure 1: Comparison of perioperative complication (N=78).

Table 1: Demographic parameters of study participants (N=78).

Parameters	Group I	Group II	P value
Age group (in years)			
0-20	3 (7.7)	2 (5.1)	0.82*

Continued.

Parameters	Group I	Group II	P value
21-40	25 (64.1)	24 (61.5)	
41-60	11 (28.2)	13 (33.3)	
Gender			
Male	29 (74.4)	33 (84.6)	0.4*
Female	10 (25.6)	6 (15.4)	
Surgery			
Emergency	2 (5.10)	0 (0. 0)	0.47**
Planned	37 (94.9)	39 (100)	
ASA grade			
I	32 (82.1)	24 (61.5)	0.07*
II	7 (17.9)	15 (38.5)	
History			
Anemia	1 (2.6)	1 (2.6)	0.7*
Hypertension	2 (5.1)	1 (2.6)	
Obesity	1 (2.6)	1 (2.6)	
Smoker	2 (5.1)	0 (0.0)	
TB	3 (7.7)	3 (7.7)	
Tobacco chewing	2 (5.1)	2 (5.1)	
Alcoholic liver disease	0 (0.0)	1 (2.6)	

*Chi-square test, **Fisher exact test

Table 2: Comparison of clinical parameters (N=78).

Parameters	Group I	Group II	P value
Duration of surgery (min)	71.92±22.08	70.76±23.82	0.002*
Block performance time (min)	12.35±1.63	6.87±2.10	0.001*
Mean onset of anesthesia (min)			
Sensory block	13.28±1.27	10.05±1.10	0.02*
Motor block	17.94±1.96	11.97±1.97	0.01*
Duration of block (min)			
Sensory block	4.97±0.71	4.45±0.51	0.001*
Motor block	5.84±0.76	5.17±0.64	0.002*
Effect of block			
Failed	4 (10.3)	4 (10.3)	1.0**
Incomplete	2 (5.1)	2 (5.1)	
Complete	33 (84.6)	33 (84.6)	
Supplementation			
Propofol and mask ventilation	3	2	1.0***
GA intubation	3	4	

*Student 't' test, **Chi-square test, ***Fisher's exact test

Table 3: Comparison of hemodynamic parameters (N=78).

Parameters	Group I	Group II
Pre-operative		
PR	89.05±4.82	86.00±7.05
RR	15.41±1.09	14.49±2.04
SBP	126.23±8.15	128.12±6.09
DBP	82.12 ±4.22	84.2±6.28
Post-operative		
PR	88.69±4.54	86.97±6.37
RR	15.38±1.07	14.54±1.86
SBP	124.22 ±6.27	122.34±7.05
DBP	79.28±4.23	81.21±3.22

DISCUSSION

One of the important roles of anesthesiologist is to provide analgesia during surgery as well as in the post operative period. The effective management of perioperative pain is to ensure that the patients get relief at the appropriate time without any complication.[7]

Regional block techniques avoid the unwanted effects of anesthestic drugs used during general anesthesia and hemodynamic stress response during laryngoscopy and intubation and reduction in hospital stay. These techniques are especially beneficial for patients with various cardio respiratory comorbidities.[8]

Present study found that highest number of participants were in young age group in both the group. Male: female ratio was 1:0.34 and 1:0.18 in both groups respectively. Most of participants of both the groups were belonged to ASA grade I. TB was most common history among participants. The difference of age, gender, ASA grade and history was statistically not significant among both the groups.

In small hospital, reginal anesthesia is less popular than general anesthesia in surgical anesthesia. Due to better provision of superior pain control in the immediate postoperative period in regional anesthesia. In the era of ultrasound-guidance the peripheral nerve block is a safe, highly effective, minimally invasive, and cost-effective method of anesthesia.[9-12]

Duration of surgery was almost similar in both the groups. This finding is correlate with the study done by Stav et al, Kilic et al and Abhinaya et al.[13-15]

The block performance time for ICB was almost doubled to supraclavicular block. The additional less minutes captivated for the supraclavicular block may be because the needle was targeted at two points in supraclavicular block, whereas the local anaesthetic was deposited at only one point in ICB. The mean block performance time of 5.7 min in the supraclavicular group and 5.0 min in the infraclavicular group was reported in one study.[16] The success rate of the BPB was similar among the two groups in our study. The success rate of 93% in infraclavicular group compared with only 78% in supraclavicular block with ultrasound guidance was reported in one study.[16] However, three other studies quoted a success rate of around 95% for ultrasound-guided supraclavicular blocks.[17-19] A success rate of 90–95% for ultrasound-guided ICB was quoted in few studies.[20,21] All these findings are similar to the success rate of our study.

In our study, we found that the onset of sensory blockade, as well as motor blockade, was slightly earlier in the supraclavicular group. This finding is not correlate with the study done by Abhinaya et al and according to this study, supraclavicular block had a significantly poorer block of the median and ulnar nerves but a better block of the axillary nerve.[15]

Present study found significant difference in duration of block in both the groups ($p<0.05$) with least time in group-S. Hemodynamic parameters were also almost similar in both the groups. Our study encounters higher number of complications among supraclavicular group. This finding is correlate with the study done by Stav et al, Kilic et al and Abhinaya et al.[13-15]

Limitations

A single anaesthesiologist performed all the blocks. Although this eliminates the interoperator variability, it might limit generalizing the results.

ICB perform only for below elbow surgery, not useful in children, coracoid process identification may be difficult in obese patients so more experience is needed to give ICB.

CONCLUSION

From our study we can conclude that BPB is a simple, safe and economical anesthetic technique for upper limb surgery with least complication, if due precautions are taken. Supraclavicular route requires less time to perform the block and have a rapid onset of sensory and motor block, but the duration of sensory and motor blockage is less as compared to infraclavicular route. Both the groups have a similar quality of block and success rate, but supraclavicular route is associated with various complications like vascular injury, hematoma, aphonia and pneumothorax as compared to infraclavicular route. Infraclavicular route of BPB with coracoid approach under guidance of PNS is a safe alternative to conventional SCB regarding duration of analgesia, complications and patient's satisfaction.

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Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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