Lateral Vs Classical Approach of Supraclavicular Brachial Plexus Block for Orthopedic Surgeries below Mid-Humerus: A Comparative Study

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ABSTRACT

Introduction: Supraclavicular brachial plexus block with classical approach is used to provide anaesthesia for orthopaedic upper limb surgeries. This approach is safe but not devoid of complication, therefore we compared a alternative lateral approach with classical approach in terms of sensory and motor blockade, tourniquet tolerance and complication.

Material and Methods: After obtaining the ethics committee approval 64 patients posted for orthopaedic surgeries below mid humerus under supraclavicular block were enrolled. They were divided into two groups (32 each), Group C received classical approach and Group L received lateral approach with the help of nerve stimulator. A mixture of adrenalized 2% lignocaine (5-7mg/kg) and plain 0.5% bupivacaine (2mg/kg)(total volume 30 ml) was used. Onset time of sensory and motor block, duration of sensory and motor block, duration of analgesia, tourniquet tolerance and complications (if any) were noted and compared in both the groups. Quantitative data were compared by using unpaired T test and qualitative data by using Chi-Square test and Fisher's Exact test (2X2 tables).

Results: The mean times to onset of sensory and motor blockade and the mean duration of sensory and motor blockade did not differ between the two groups. Mean duration of analgesia with lateral approach is found to be longer but statistically not significant. Tourniquet tolerance was good and no pneumothorax observed in lateral approach.

Conclusion: Lateral approach has shown to be a safe alternative to classical approach for supraclavicular brachial plexus block in terms of adequacy of block, tourniquet tolerance and complications.

Keywords: Brachial plexus block, Lateral supraclavicular approach, Classical supraclavicular approach

INTRODUCTION

Peripheral nerve block is always a safe alternative to general anaesthesia. Patient remains awake, oriented and with intact airway reflexes throughout the procedure. Brachial plexus block is administered by various approaches viz. supraclavicular, interscalenous, infraclavicular and axillary routes for upper limb surgeries. The major advantage of supraclavicular block is that, the nerves are tightly packed in this area giving a very fast and deep block. Hence it is called as "The Spinal anaesthesia of the Arm".[1] The supraclavicular approach to the brachial plexus characteristically is associated with the rapid onset of anaesthesia and a high success rate. Supraclavicular classical approach blocks the entire arm distally till mid arm level. The risk of pneumothorax, phrenic nerve palsy and vascular puncture are some serious and annoying complications associated with this approach which need to be managed promptly. Any deficiency in managing these complications increases morbidity and could be hazardous to the life. Therefore various approaches have been studied to avoid these complication. Though, ultrasound is a gold standard and safe technique to block brachial plexus under direct vision but it is still not easily accessible in periphery and remote areas and anaesthesiologists have to depend on landmark technique. Volker et al.[2] had described a *lateral* approach to reach the brachial plexus in supraclavicular route, where plexus is the first structure to be encountered in the line of injection and then subclavian artery and then pleura.[2] Its use for supraclavicular block was further studied by Dilip Kothari[3] and D K Sahu[4], who concluded in their studies that blocking the brachial plexus through lateral approach is associated with less risk of puncturing vessel and pleura and is a safe technique. Due to limited research literature available on lateral approach, We have done a prospective randomized open level study, to know the success rate and associated complications of classical and lateral approach of supraclavicular brachial plexus block.

MATERIAL AND METHODS

This randomized, prospective and open level study was carried out after approval from local ethics committee. Sixty four adult patients of American Society of Anesthesiologists (ASA) grade I and II, of either gender, between the age group of 18-60 years, posted for upper limb surgery below mid-humerus under brachial plexus block were enrolled for the study. Patients were randomly allocated to one of the two groups (computer generated-Research Randomizer). Group

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C (n= 32) included patients who received Classical approach of brachial plexus block and in Group L (n= 32) patients received lateral approach of brachial plexus block. Brachial plexus block was performed by supraclavicular block technique assisted with nerve stimulator. Pregnant Patients, patients with respiratory compromise, infection at the site of injection, allergy or hypersensitivity to drugs used in study were excluded from this study.

An informed and written consent was taken. Nil by mouth status and site of operation was confirmed prior to the procedure. In the operation theatre anaesthesia machine, suctioning equipment, difficult intubation cart with emergency drugs were checked and kept ready. Patients were wheeled to the operation theatre and standard monitors such as pulse oximetry, electrocardiography (ECG), noninvasive blood pressure (NIBP) were attached. Baseline pulse rate, blood pressure, respiratory rate and oxygen saturation were recorded. Intravenous access with 18G intravenous cannula was secured and an intravenous ringer lactate fluid was started at the rate of 10 ml/kg/hour. Patients received oxygen supplementation through polymask. Patients were pre-medicated with intravenous inj. Ondansetron 4 mg and Inj. Ranitidine 50 mg. In both groups, blocks were performed according to standard procedure using a short bevelled 22G, 100mm sheathed needle, with a nerve stimulator guided technique (B Braun, Stimuplex, Germany). Electrical current was initially set at 1 to 1.5mA with a frequency of 2 Hz and pulse duration of 0.1msec. The intensity of current was slowly decreased until contraction of forearm muscles or biceps was obtained at 0.4 to 0.6mA. Once the plexus was located, an assistant administered the drug. A cough from the patient was considered a warning sign that the pleura is being contacted by the needle. The patient was placed in a supine position, with the head turned away from the side to be blocked. A small pillow or folded sheet was placed below the shoulder to make the field more prominent. The arm to be anesthetized was adducted. Under all aseptic precautions, An intradermal wheal was raised with 1% lignocaine at the selected point. Block was performed with either of the following two techniques. A mixture of Adrenalized lignocaine 2% (5-7 mg/kg) and Bupivacaine 0.5% (2 mg/kg) diluted with normal saline to make total volume of around 30 ml was used in both approaches. Monitoring for patient's vitals was done throughout the procedure. In the 'Classical approach technique'-The posterior triangle was identified in the neck which is bounded anteriorly by the posterior border of the sternocleidomastoid and posteriorly by the trapezius and base is formed by the clavicle. A mark was made approximately 1.5 to 2.0 cm above the midpoint of the clavicle. A 22-gauge, 4-cm needle was directed in a caudate, slightly medial, and posterior direction until a paresthesia or motor response was elicited or till the first rib was encountered. If the subclavian artery encountered, the needle was withdrawn and reinserted in a more postero-lateral direction that usually results in paresthesia or motor response. After localization of the brachial plexus, with negative aspiration of blood or air, incremental dose of local anaesthetic was given.

In 'Lateral approach technique' A point 1 cm above the clavicle at a junction of inner 2/3 and outer 1/3 of the clavicle was chosen for the performance of block.(Figure 1) The point is about 1 cm medial to border of trapezius muscle. The path is behind the omohyoid muscle and parallel to clavicle in the interscalene plane between anterior scalene and medial scalene muscle. The omohyoid muscle can be identified by rolling the index finger in the posterior triangle of the neck in normal built patients though it is not obvious in all cases. With anaesthesiologist standing at the head end, slightly towards the side, a 5 cm long 22 SWG needle was inserted through the wheal directed medially and inwards at the angle of 20º to the skin, parallel to clavicle avoiding the external jugular vein till paresthesia was elicited in the hand. After negative aspiration, local anaesthetic was injected slowly. After injecting the local anaesthetic, the block was assessed for both sensory (using pin-prick) and motor (using muscle power) sensations. Demographic variables like Gender, Age, and Mean Weights of all patients were noted. Success rate was measured in terms of adequacy of sensory and motor blockade, tourniquet tolerance and complications related to the procedure.

Sensory block: It was assessed on following observations –
No sensation on pin prick:- Totally effective
Sensation, but no pain:- Partially effective
Pain '+' or discomfort '+':- Failure of block
Onset of analgesia was recorded by subjective feeling of loss of pain, heaviness, tingling and numbness after deposition of local anaesthetics. Skin was pricked with 25 G needle every 3 min. to test the sensation. The time interval from completion of drug injection to complete loss of sensation (No pain from pin prick) was recorded.

Degree of motor block: It was assessed every 5 minutes for first thirty minutes and graded as follows-
Grade 1: ability to flex and extend the forearm
Grade 2: ability to flex and extend wrist and finger
Grade 3: ability to flex only fingers
Grade 4: inability to move forearm, wrist, and finger.
(Grade 1 – Failed block, Grade 2 and 3 – Partially Effective blockade and Grade 4 – Totally Effective blockade)
The block was considered failed if complete sensory and/or motor block was not achieved after 30 minutes and G.A was given. In case of partially effective blockade, Sedation in the form of intravascular inj. Ketamine (0.5mg/kg) was administered.
Total duration of motor blockade was considered from the onset of successful block to complete recovery of movements of all muscles and joint group i.e. fingers, wrist and elbow.

Total duration of analgesia: It was measured in minutes from appearance of 1st complaint of pain / discomfort by the patient after the onset of a successful block.

Tourniquet tolerance: It was assessed and graded as follows,
Good -tolerated without discomfort,

Pain and Discomfort-Patient complained of pain and discomfort.

Complication: During the procedure, complications, if any, including vessel injury, hematoma, nausea and vomiting, dyspnoea, fall in respiratory rate or oxygen saturation, any symptom /sign of local anaesthetic toxicity, ECG changes, and sedation were monitored and recorded. A routine chest roentgenogram was also taken 10-14 hours after block for all patients.

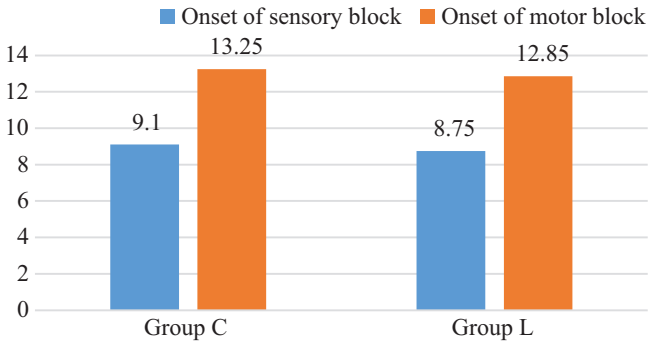
STATISTICAL ANALYSIS

Quantitative data was presented with the help of Mean, Std. Deviation, comparison among study group was done with Unpaired T test. Statistical analysis was done with software Epi info version 7.2 and observations are presented in the form of charts and graphs. Qualitative data was presented with the help of Frequency and Percentage table, association among study groups was assessed with the help of Chi-Square test and Fisher's Exact test (2X2 tables). *P* value less than 0.05 was taken as significant level.

RESULTS

In our study, we found demographic variables like Gender, Age, and Mean Weights and also mean duration of surgery were comparable between the two groups (*P*>0.05). In our study, the mean time to onset of sensory blockade for classical approach is 9.10±1.12 minutes and for lateral approach is 8.75±0.96 minutes, however the difference was not statistically significant (*P* value = 0.13) (Graph 1). The mean time to onset of motor blockade for classical

Figure-1: Landmark of lateral supraclavicular approach; Bottom: SCM: sternocleidomastoid muscle, C: clavicle bone, X: entry point of needle



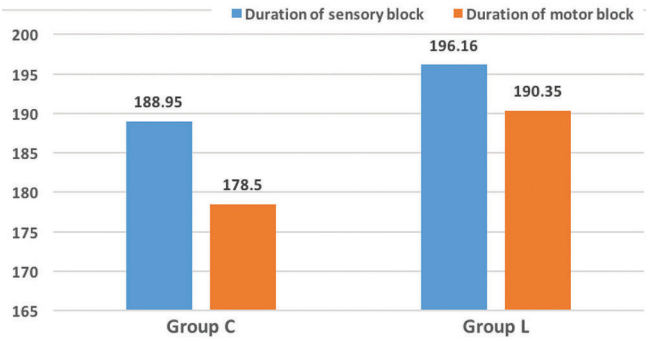
Graph-1: Comparison of mean onset of time (in minutes) of sensory and motor block in both the groups

Parameters	Group C (classical) Time (Minutes) mean±SD	Group L (Lateral) Time (Minutes) mean±SD	P-value
Age (years)	41.81±15.35	39.65±10.67	0.51
Weight (kg)	65±6.55	68±7.25	0.08
Male:Female ratio	22:10	20:12	0.59
Onset of Sensory block	9.10±1.12	8.75±0.96	0.13
Onset of Motor block	13.25±1.32	12.85±1.42	0.24
Duration of Sensory block	188.95±28.45	196.16±30.25	0.32
Duration of Motor block	178.50±32.75	190.35±25.45	0.11
Duration of Analgesia	256.46±42.63	277.58 ±46.87	0.051

Table-1: Comparison of Demographic and Assessment parameters in both groups

		Group C N (32)	Group L N (32)
Tourniquet tolerance	Good	18(56.3%)	26(81.2%)
	Pain with discomfort	14(43.7%)	6(18.8%)
	Total	32	32
Adequacy of block	Totally effective	22(68.7%)	28(87.5%)
	Partially effective	10(31.3%)	4(12.5%)
	Total	32	32
Complications	Vessel puncture	8(25%)	2(6.25%)
	Postoperative nausea-vomiting	10(31.3%)	4(12.5%)
	Pneumothorax	1(3.1%)	0
	Total	32	32

Table-2: Comparison of tourniquet tolerance, adequacy of block and complications in both the groups



Graph-2: Comparison of duration (in minutes) of sensory and motor block in both the groups

approach was 13.25±1.32 minutes and for lateral approach was 12.85±1.42 minutes (not statistically significant *P* value= 0.24) (Graph 1). The mean duration of sensory and motor blockade for classical approach of supraclavicular block was 188.95±28.45 minutes and 178.50±32.75 minutes respectively. The mean duration of sensory and motor blockade for lateral approach was 196.16±30.25 minutes and 190.35±25.45 minutes respectively. Mean duration of sensory and motor blockade with both approaches was found to be comparable and statistically not significant (*P* value = 0.32 and 0.11 respectively) (Graph 2). The mean duration of analgesia for classical approach is 256.46±42.63 minutes and for lateral approach is 277.58 ±46.87 minutes. Mean duration of analgesia with lateral approach is found to be longer and statistically not significant (*P* value = 0.051). 56.3% of patients in Group-C and 81.2% of patients in Group-L had good tourniquet tolerance for up to 120 minutes. (*P*<0.05, statistically significant). In our study, 68.7% of patients in Group-C and 87.5% in Group-L had totally effective and successful blockade (*P* <0.05, statistically significant). 31.3% of patients in Group-C and 12.5% in Group-L had partial blockade. 25% in Group-C and 6.25% in Group-L had vascular puncture but after the application of sustained pressure to stop bleed, block could be performed successfully (*P* value = 0.01). 6(18.7%) patients had episode of post-operative nausea vomiting (PONV) in group C and 4(12.5%)% patients had PONV in group L. 3.1% patients i.e. 1 patient in group C developed pneumothorax with breathlessness in the post-operative period and was managed with Intercostal drainage insertion while none in Group L. (Table 1, 2)

DISCUSSION

Peripheral nerve blocks are always cost effective anaesthetic techniques used to provide excellent quality of anaesthesia and analgesia besides avoiding all the consequences of general anaesthesia.[5] Of the various approaches described for supraclavicular brachial plexus block, conventional approach is popular and is also associated with rapid onset and reliable sensory and motor blockade. In spite of the advantages, fear of complications like pneumothorax, inadequate blockade and rate of conversion to general anaesthesia, other complications associated with local anaesthetics limits the usefulness of this block.[6] Ultrasound guided techniques provide more predictable blocks with almost nil complications because the local anaesthetic is deposited under direct visual guidance of real time ultrasound image.[7] Availability of ultrasound machine in centres of developing countries is still not very common and landmark guided blocks still play a pivotal role. The divisions of the brachial plexus lie posterior, cephalic, and lateral to the subclavian artery, as they course over the first rib offering a consistent and valuable anatomic relationship during placement of supraclavicular blocks.[8]

In our study we compared the success and failure rate of two approaches of supraclavicular block i.e. 'Classical' and 'Lateral'. Paresthesias were elicited in all the patients of both groups using nerve stimulator guided technique because of unavailability of ultrasound facility for performing blocks at our centre.

In our study, Onset of sensory blockade with lateral approach was found to be earlier in comparison to classical approach. The results we found were similar to the study of Prasad PK et al[9] where time of onset of sensory blockade with lateral approach was found to be 8.5±1.25 minutes. In another similar study, A Kumar et al[10] found the time of onset of sensory blockade with lateral approach to be 7.33±4.17 minutes and with classical approach 11.77±4.07 minutes. Similarly Sahu and Sahu[4] found that average time for complete analgesia with lateral approach was 7.61±2.82 minute. In lateral approach; the needle passes from lateral to medial side at an angle of 20º to skin and parallel to clavicle, so it first meets the brachial plexus nerves eliciting paresthesia and hence drug deposition in the close proximity of trunks could be the reason for relatively earlier onset of blockade in our study.

In our study, we found the mean onset of motor block in both approaches comparable. Ranganathan KD, Natarajan K, Anandan H in their comparative study found time of onset of motor block with lateral approach to be 11.87±1.68 minutes.[11] Dr. Kothari[3] found average onset time for complete motor loss was 6-8 minutes, with an average duration of 120-150 minutes with lateral approach. Sahu and Sahu[4] found that average onset time for motor loss was 11.70±2.50 minutes and complete motor loss was present in 74 (90%) cases. In the Lateral approach, the block is performed where the brachial plexus is presented most compactly at the proximal division or trunk level. This compactness may explain the block's historic reputation of providing short latency and the most complete and reliable anaesthesia for upper limb surgery.

The mean duration of sensory and motor blockade also did not differ between the two groups. Similar results of duration of analgesia were found by Prasad PK et al[9] in their study where duration of analgesia with classical approach was found to be 220.68±15.25 minutes and with lateral approach to be 225.52± 18.28 minutes. A Kumar et al[10] found duration of analgesia with lateral approach was found to be 180.8±38.43minutes. Similarly Dr. Kothari[3] found average duration of analgesia was 180-200 minutes. Sahu and Sahu[4] found duration of analgesia was 2-12 hours as observed by patient's first call for supplement analgesia.

In our study, tourniquet tolerance good in lateral approach

and no supplementation of anaesthesia was given for this. The results were similar to Prasad PK et al[9] study where, 56% patients in classical group had good tourniquet tolerance while 80% in Lateral group had Good tourniquet tolerance. It suggests good analgesia of axillary and medial cutaneous nerve of arm.[12,13]

In our study, Majority of the patients had pain relief immediately after injection of drug. Partial block managed with 0.5mg/kg of intravenous ketamine. Prasad P.K et al[9] in similar study had found results comparable to our results. They found that 64% patients in classical group had totally effective block while 88% in Lateral group had totally effective block. Nishiyama N, Naqanuma K et al.[14], in their study of lateral approach under fluoroscopic guidance, reported that the success rate of their study was 95%. In lateral approach, placing needle parallel to the course of brachial plexus and near the most compact plexus of nerves, could be the reason for higher success rate. No patient had a failed block in our study.

Prasad PK et al[9] in their study found complications like vessel puncture in 24% patients with classical approach while 4% patients with lateral approach; 4% had Horner's syndrome with classical approach while none had Horner's syndrome in lateral group; 20% had PONV in classical group and 12% had PONV in lateral group. In lateral approach needle is directed parallel to clavicle not inwards and downwards towards inlet, so the incidence of pneumothorax is nil.[3]

In lateral approach, the needle passes from lateral to medial side at an angle of 20º to skin and parallel to clavicle. Once the needle meets the nerves of brachial plexus, it stimulates muscles contractions or elicits paraesthesia and then reaches to the other structures, hence chances of cervical and thoracic epidural blockade[15], total spinal anaesthesia[16], inadvertent injection into the vertebral artery, Horner syndrome and an incidence of recurrent laryngeal nerve blockade are very remote. In our study we encountered no serious sequelae like pleural puncture, pneumothorax or any other cardiorespiratory side effects requiring active intervention, when lateral approach was used. This approach blocks all the nerves of the plexus with the same frequency because at this level, trunks and cords are bundled together and the distance involved in the spread of local anaesthetic to the nerve structure is short and nearly equal.

CONCLUSION

With statistically significant better results in terms of adequacy of blockades, tourniquet tolerance and low risk of complications with lateral approach, it can be said that, lateral approach seems to be a preferred approach for supraclavicular block over conventional classical approach. Also in other specific cases like patients with burns, contractures or infections at the site of injections of classical approach, this lateral approach with a different site of injection may come in as a convenient option.

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