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Anesthesiology

A COMPARATIVE STUDY OF THE SUBCLAVIAN PERIVASCULAR APPROACH WITH LATERAL APPROCH USING 0.5% ROPIVACAINE IN SUPRACLAVICULAR BRACHIAL PLEXUS BLOCK

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ABSTRACT

Aim: To compare the subclavian perivascular approach and lateral approach of supraclavicular blockwith regards to the ease of performing the block, success rate, dermatomes spared, onset and duration of sensory/motor block and complications

Methods: In this prospective, randomised, controlled study sixty patients of both sexes, aged between 18 and 65 years, belonging to ASA grade I, II scheduled to undergo surgeries below the midarm, were divided into 2 groups, namely Group L and Group P consisting of thirty patients each. 30 ml of 0.5% ropivacaine was administered by the lateral approach in group L and by the subclavian perivascular approach in group P. The observations were analysed statistically, calculating the means, percentages, frequencies, standard deviation, chi-square and 'p' values.

Results: 28 patients (93.3%) in group L and 25 patients (83.3%) in group P had a successful block. The lateral approach was found to be technically easier with mean time taken to perform the block being 4+/-1.462 minutes compared to 6.57+/-1.813 minutes in the subclavian perivascular approach. There was no significant difference in the dermatomes spared or complications occurred. The onset of sensory and motor block was found to be earlier in the lateral approach (6.96+/-1.401 minutes, 8.89+/-1.792 minutes respectively) compared to the subclavian perivascular approach (8.24+/-1.451 minutes, 10.68+/-2.015 minutes). The duration of sensory/motor block in both the approaches was comparable.

Conclusion: The lateral approach of supraclavicular block is safe, technically easier and more successful with a lesser latency period compared to the subclavian perivascular approach.

KEYWORDS : Brachial plexus block, lateral approach, subclavian perivascular approach, supraclavicular block, ropivacaine.

INTRODUCTION

Pain, which happens to be one of the most fundamental biological phenomena has been defined as 'an unpleasant sensory and emotional experience associated with actual or potential damage' by the International Association for the Study of Pain.

Peripheral nerve blocks can provide ideal operating conditions when used judicially. Minimal interference with vital physiological functions, avoidance of polypharmacy, reduced incidences of post operative nausea, vomiting and better acceptance in patients with other comorbidities are the major advantages of this technique when compared to other conventional methods of providing anaesthesia.

The perivascular approach of supraclavicular block carries the highest incidence of pneumothorax among the various approaches to brachial plexus block. Inadvertent vessel puncture, brachial plexus injury and rarely phrenic nerve palsy or Horner's syndrome has also been reported with supraclavicular blocks.

Volker Hempel has described the method of supraclavicular brachial plexus block, where longitudinal placement of the needle is done in relation to the brachial plexus from lateral to medial with a high success rate and lesser complications.

Ropi vacaine is one of the newer local anaesthetic agents being used for peripheral neural blockade. Similar in onset and duration to bupivacaine with lesser toxic effects, ropivacaine is becoming the choice of local anaesthetic agent in brachial plexus blocks and other peripheral nerve blocks.

This study was designed to compare the time honoured, well proven subclavian perivascular approach and the recently described lateral approach of supraclavicular block with regards to the ease of performing the block, nerves spared, onset and duration, the success rate and complications involved.

AIM OF THE STUDY

To compare two different supraclavicular approaches of the brachial plexus block - the subclavian perivascular and the lateral approach, mainly with regard to the ease in performing the block, success rate, complication rate and the dermatomes spared.

MATERIALS AND METHODS

This prospective, randomised, controlled study was conducted in a tertiary care hospital after receiving the institutional ethical committee approval and informed written consent from sixty ASA I, II patients undergoing upper limb surgeries with supraclavicular brachial plexus block and who fulfilled the inclusion criteria. All the patients were randomly divided into two groups namely group P, group L.

Group P: 30 patients received 30 ml of 0.5% ropivacaine by the subclavian perivascular approach of supraclavicular block.

Group L: 30 patients received 30 ml of 0.5% ropivacaine by the lateral approach of supraclavicular block.

Inclusion Criteria:

- ASA status I, II
- Age between 18 and 65 years
- Surgeries on the distal end of arm, forearm and hand

Exclusion Criteria:

Exclusion criteria included patient refusal, known allergy to the drugs to be studied, any local infection/sepsis, coagulation abnormalities and history of convulsions or seizure disorders. Any patient with a sensory neuropathy/motor deficit in the limb to be operated was also excluded.

Methods:

Pre operative preparation:

Patients were preoperatively assessed and ASA risk stratified. Basic investigations like blood grouping/typing, haemoglobin, bleeding/clotting time, blood sugar, renal function test, urine routine, chest x-ray, ECG was done. The procedure was explained to the patient and written informed consent was obtained.

On arrival of the patient in the operating room, monitors like pulse oximeter, non-invasive blood pressure and ECG were connected and baseline values were recorded. Intravenous access was obtained in the opposite limb with 18G cannula. Inj. Glycopyrrolate 0.2 mg and Inj. Midazolam 1mg was given intravenously. The patient was made to lie supine with head turned to opposite side and arm pulled down gently. The site was painted and draped with all aseptic precautions, following which local anaesthetic was infiltrated around the point of needle entry.

Brachial plexus block was performed under strict aseptic precautions by subclavian perivascular approach or by lateral approach and 0.5% ropivacaine was administered slowly after repeated negative aspiration.

Evaluation of the block:
Evaluation of the degree of sensory blockade was done by Hollmen's scale and motor blockade by Lavoie's criteria.

The preliminary test for onset of anaesthesia was performed within five minutes of injecting the local anaesthetic drug and thereafter at every minute. Response to pin prick in the radial, median, ulnar and musculocutaneous nerves distribution in the distal arm and forearm were checked for first, followed by the tests to assess intensity of motor blockade.

Ease of performing the block was assessed as time interval between the first attempt at performing the block to the time when local anaesthetic was administered.

Onset of sensory block was assessed as the time interval between administration of drug and absence of sensation to pin prick. (Hollmen's ≥3)

Onset of motor block was assessed as the time interval between administration of drug and loss of flexion/extension movements in the arm (Lavoie's criteria≥66%).

Success of the block was determined by:
Complete: Intended surgical procedure being able to be performed with no sedation.

Incomplete: Intended surgical procedure being able to be performed with minimal sedation. The patient was intra-operatively sedated only after the block was already classified. When required, Inj Pentazocine (0.5 mg/kg), intermittent doses of Inj.Propofol (0.5 mg/kg) and Inj. Ketamine (0.5 mg/kg) was given intravenously to supplement the anaesthesia.

Failed block: Intended surgical procedure not being able to be perfomed under the block, or minimal sedation, and requiring conversion to general anaesthesia.

The duration of sensory block was determined as time interval between the onset of sensory block to the onset of pain. Once the patient complained of pain, Inj. Diclofenac 75 mg was given intramuscularly as rescue analgesia.

The duration of motor block was determined as the time interval between onset of motor block to the recovery of normal muscle power.
Patients were administered supplemental oxygen and intravenous fluids throughout the operative procedure.
Complications that arose due to the local anaesthetic drug, technique or patient factors during operative and post-operative periods were noted.

OBSERVATIONS AND RESULTS

Data analysis was done with the Epidemiological Information package (2008) using a computer. Using this software range, frequencies, percentages, means, standard deviations, chi-square and 'p' values were calculated. Pearson chi-square test was used to test the significance of difference between quantitative variables and Yate's test for qualitative variables. A 'p' value less than 0.05 is taken to denote a significant result.

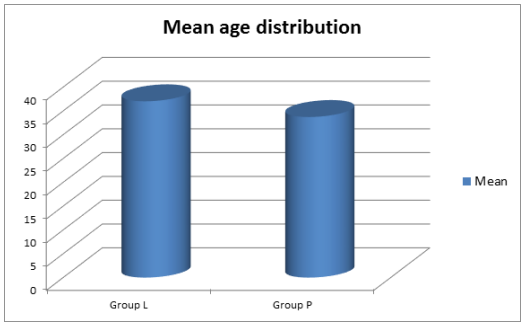
1.Age

Age distribution in group L varied from 18 to 65 years with a mean of 37.03 and standard deviation 12.28. In group P, age distribution varied from 18 to 55 years with a mean of 33.73 and standard deviation 11.44

Table 1: Age distribution(in years)

GROUP	N	Mean	Std. Deviation	Std. Error Mean	'p'
L	30	37.03	12.280	2.242	.286
P	30	33.73	11.444	2.089	Not significant

FIGURE-1



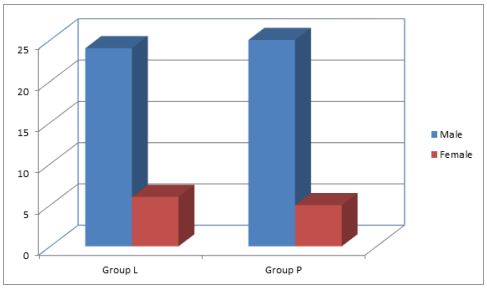
2. Sex

In group L, 24 patients were male and rest were female. In group P, 25 patients were male and rest were female as shown in Table 2, Figure 2.

Table2. Sex Distribution

		GROUP			
		L	P	TOTAL	'p'
F	COUNT	6	5	11	0.379 Not significant
	% within GROUP	20.0%	16.7%	18.3%	
M	COUNT	24	25	49	
	%within GROUP	80.0%	83.3%	81.7%	
TOTAL	COUNT	30	30	60	
	% within GROUP	100.0%	100.0%	100.0%	

Figure 2



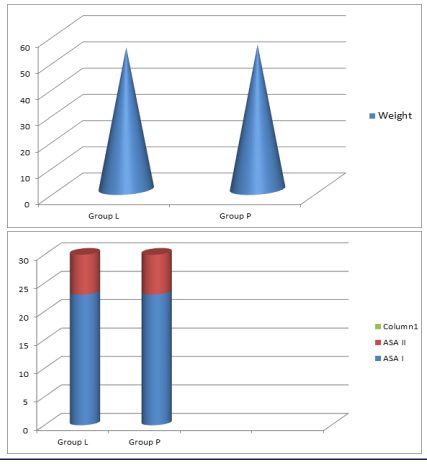
3. Weight

Group L had a mean of 54.03 kg with standard deviation 6.59 and group P had mean value of 55.10 kg with standard deviation 5.80.

Table 3: Weight distribution (in kg)

GROUP	N	Mean	Std. Deviation	Std. Error Mean	'p'
L	30	54.03	6.599	1.205	0.509
P	30	55.10	5.803	1.060	Not

Figure 3

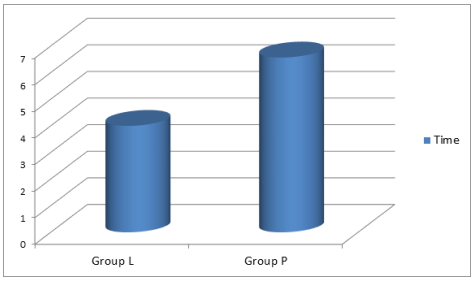


4. Ease in performing the block

The mean time taken to perform the block in group L was 4 minutes with a standard deviation of 1.46 while in group P it was 6.57 minutes with a standard deviation 1.813.

Table 4: Ease in performing the block (in minutes)					
GROUP	N	Mean	Std. Deviation	Std. Error Mean	'p'
L	30	4.00	1.462	.267	0.000
P	30	6.57	1.813	.331	SIGNIFICANT

FIGURE 4

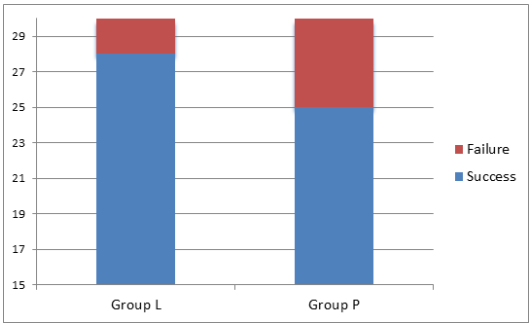


5. Success rate

Table5:Success rate					
		GROUP			
		L	P	Total	'p'
Failed	Count	2	5	7	0.045 Significant
	%within GROUP	6.7%	16.7%	11.7%	
Incomplete	Count	3	2	5	
	%within GROUP	10.0%	6.7%	8.3%	
Complete	Count	25	23	48	
	%within GROUP	83.3%	76.7%	80.0%	
Total	Count	30	30	60	
	%within GROUP	100.0%	100.0%	100.0%	

In group L, 25 (83.3%) of the 30 blocks were complete, 3 (10%) incomplete and 2 (6.6%) failed. In group P, 23 (76.7%) of the 30 blocks were complete, 2 (6.6%) incomplete and 5 (16.6%) failed.

FIGURE 5

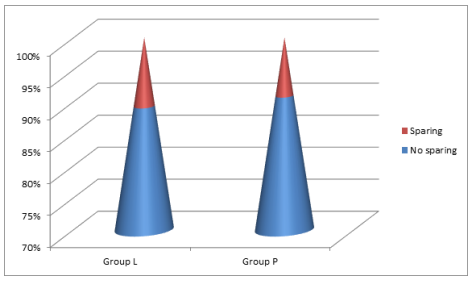


6.Dermatomal spared

In group L, 3 cases had sparing while in group P, 2 patients showed sparing

Table 6: Dermatomes spared					
		GROUP			
		L	P	Total	'p'
No	Count	25	23	48	0.456 Not significant
	% within GROUP	83.3%	76.7%	80.0%	
Yes	Count	3	2	5	
	% within GROUP	10.0%	6.7%	8.3%	
Failed block	Count	2	5	7	
	% within GROUP	6.7%	16.7%	11.7%	
Total	Count	30	30	60	

FIGURE 6



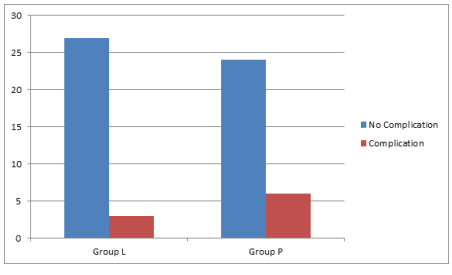
7.Complication rate

In group L, 3 cases out of the total 30 had a peri-operative complication. In group P, 6 patients out of 30 had a peri-operative complication.

Table 7: Complication rate

		GROUP			
		L	P	Total	'p'
No Complication	Count	27	24	51	0.278 Not significant
	% within GROUP	90.0%	80.0%	85.0%	
Complication	Count	3	6	9	
	% within GROUP	10.0%	20.0%	15.0%	
Total	Count	30	30	60	
	% within GROUP	100.0%	100.0%	100.0%	

FIGURE 7

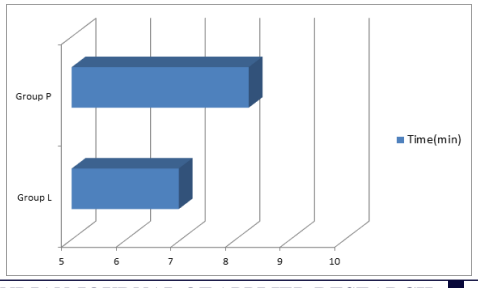


8.Onset of sensory blockade

Time taken for the onset of sensory block in group L was 6.96 minutes with standard deviation 1.40 and in group P it was 8.24 minutes with standard deviation 1.45.

Table 8: Onset of sensory blockade (in minutes)					
GROUP	N	Mean	Std. Deviation	Std. Error Mean	'p'
L	28	6.96	1.401	.265	0.002
P	25	8.24	1.451	.290	SIGNIFICANT

FIGURE 8

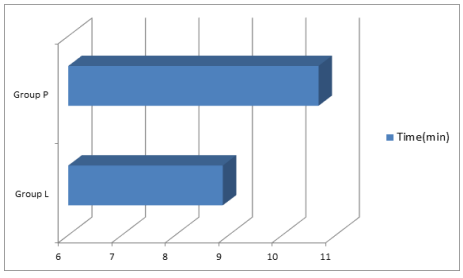


9.Onset of motor blockade

The mean onset of motor block in group L was 8.89 minutes with standard deviation 1.79 and in group P it was 10.68 minutes with standard deviation 2.01.

Table 9: Onset of motor block (in minutes)					
GROUP	N	Mean	Std. Deviation	Std. Error Mean	'p'
L	28	8.89	1.792	.339	0.001
P	25	10.68	2.015	.403	SIGNIFICANT

FIGURE 9



10.Duration of sensory and motor blockade

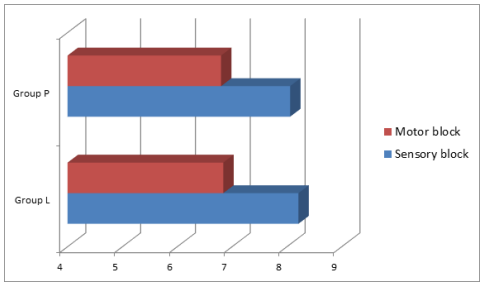
Mean duration of sensory and motor blockade in group L was respectively 8.21 hours with standard deviation 2.079 and 6.84 hours with standard deviation 1.800.

Mean duration of sensory and motor blockade in group P was respectively 8.06 hours with standard deviation 1.970 and 6.80 hours with standard deviation 1.831.

Table10: Duration of sensory/ motor blockade (in hours)

GROUP		N	Mean	Std. Deviation	Std. Error Mean	'p'
DURATION OF SENSORY BLOCK	L	28	8.21	2.079	.393	0.783
	P	25	8.06	1.970	.394	Not significant
DURATION OF MOTOR BLOCK	L	28	6.84	1.800	.340	0.938
	P	25	6.80	1.831	.366	Not significant

FIGURE 10



DISCUSSION

Various approaches have been described for brachial plexus block, like the supraclavicular, interscalene, infraclavicular and axillary. Supraclavicular technique is considered to be technically easy. Since the block is performed at a level where the plexus presents itself most compactly at the proximal division or trunk level, reliable and complete anaesthesia is provided for the upper extremity with short latency. The divisions of brachial plexus lie lateral, posterior and cephalic to the subclavian artery as they course over the first rib. This offers a consistent and valuable anatomic relationship when performing supraclavicular blocks by the subclavian perivascular approach. In the lateral approach, needle passes from lateral to medial at an angle of twenty degrees to the skin and parallel to the clavicle. Once the needle comes in contact with the nerves of brachial plexus, it either stimulates muscle contraction or elicits paraesthesia. The chances of stimulating needle hitting vital structures before the nerve bundle is remote. Needle is directed parallel to clavicle, and not inwards and downwards toward the inlet, as in perivascular approach. So, the incidence of pneumothorax is minimal.

In this study, it has been attempted to compare the subclavian perivascular approach and the lateral approach of supraclavicular block with respect to the ease in performing the block, success rate, dermatomes spared, onset and duration of sensory and motor blockade and complications.

On statistical analysis, difference in age distribution between the two groups was of no significance, the 'p' value being 0.286 ('p' more than 0.05). The weight and sex distribution was comparable in both groups, 'p' values being 0.509 and 0.739 respectively.

The mean time taken for performing the block was 4+/- 1.462 minutes in Group L and 6.57+/-1.813 minutes in Group P. The difference between the two groups was statistically significant with a 'p' value 0.000. ('p' less than 0.05)

This study shows that the lateral approach is a technically easier approach to supraclavicular block compared to the subclavian perivascular approach

Success rate:

Out of the 30 cases studied under lateral approach, 25 blocks were complete. 3 were incomplete requiring minimal sedation for successful completion of the surgical procedure and in 2 of the patients the block failed to take up completely requiring the conversion to general anaesthesia. In this study, complete and incomplete blocks were considered as successful blocks. Thus on statistical analysis, 93.3% of the blocks were successful and 6.6% failures.

Out of the 30 cases studied under perivascular approach, 23 of the blocks were complete. 2 patients required sedation and 3 failures were encountered in total. Thus statistically, 83.3% of the blocks were successful and 16.6% local anaesthetic drug is administered. In our study, it was decided to use a nerve locator as it offers certain theoretical advantages over the use of paresthesia. Carlo D. Franco et al, in his study with the neurostimulation technique in subclavian perivascular brachial plexus blocks, had a success rate of 97.2% with minimal incidences of neuropathy.

D.K Sahu et al, in his study, attributes the higher success rate of lateral approach on the needle placement and its path, which is parallel to the course of brachial plexus unlike that in the subclavian perivascular approach

Our results correlate with the studies conducted by D.K Sahu, Anjana Sahu et al, who achieved a success rate of 92% in their study with the lateral approach. Kothari et al had 98% success rate in his study with the lateral approach. Moore et al and Dupre et al had success rates of 92% and 89% respectively in their studies.

Brand, Papper et al had a success rate of 84.4% in their study where supraclavicular block was given in 230 cases. R.Bhat, S.R Sabapathy et al achieved a success rate of 85% with the subclavian perivascular approach of brachial plexus block which correlates with the results of this study.

Dermatomes spared:

In this study, among the successful blocks, sparing of the C8-T1 distribution was seen in 3 cases out of 28 in Group L and 2 cases out of 25 in Group P. The results show that there is no significant difference in the incidence of sparing in either of the approaches, 'p' value being 0.456

Fredrickson M.J, Young et al in their study, found upto 30% of the patients undergoing supraclavicular blocks to have ulnar nerve sparing.

This study shows that both the approaches have similar propensity to cause C8-T1 sparing with no specific advantage offered by one approach over the other.

Complication rate:

In group L, 3 cases had post operative nausea and vomiting. Out of the 3 patients, 2 had incomplete blocks who were supplemented with minimal sedation during the surgical procedure. The other patient was a case of failed block, in where general anaesthesia had to be administered. These patients were treated with Inj. Ranitidine 50mg and Inj. Ondansetron 4mg intravenously stat and b.d. It was noted that

there was no occurrence of any complication what so ever in the patients in whom complete blocks were obtained. Thus statistically, 10% of the patients in this study group had episodes of post operative nausea and vomiting.

In Group P, 5 patients had episodes of post operative nausea or vomiting. Of these, 4 had had general anaesthesia administered for failed blocks and one was intra-operatively sedated following a partial uptake of the block .We had 4 incidences of vessel puncture in the subclavian perivascular approach (13.3%), and 2 cases in the lateral approach (6.6%). However, in these cases it was possible to stop the bleeding by manual compression and then redirect the needle to perform the block successfully. There were no incidences of pneumothorax or Horner's syndrome in this study.

D.K Sahu et al in his study on lateral approach encountered vessel puncture in 5% of the cases. None developed pneumothorax in his study. Kothari et al in his study has described 8% incidence of vessel puncture. Moore et al described the incidence of pneumothorax in 1.5% of his cases. None of his patients developed Horner's syndrome, phrenic nerve palsy or recurrent laryngeal nerve blockade.

Onset of sensory blockade:
Mean onset of sensory blockade in Group L was 6.96 +/- 1.4 minutes and in Group P it was 8.24 +/-1.4 minutes. The difference between the two groups was statistically significant with a 'p' value 0.002. ('p' less than 0.05)

Stephen M. Klein, Roy A. et al in their study administered 25 patients with 30 ml of either 0.5% bupivacaine, 0.5% ropivacaine or 0.75% ropivacaine for interscalene brachial plexus block. The mean onset time of both motor and sensory blockade was <6 min in all groups. Duration of sensory blockade was similar in all groups.

Onset of motor blockade:
Mean onset of motor blockade in Group L was 8.89 +/- 1.7 minutes and in Group P it was 10.68+/-2.01 minutes. The difference between the two groups was statistically significant with 'p' value 0.001. ('p' less than 0.05).

Dilip Kothari et al, in his study on lateral approach found the onset of motor blockade to average 8 minutes.

Duration of sensory blockade:
Mean duration of sensory blockade in Group L was 8.21 +/- 2 hours and in Group P 8.06 +/- 1.9 hours. The difference between the two groups was statistically not significant with 'p' value 0.7. ('p' more than 0.05)

Hickey R, Hoffman J et al in their study comparing 0.5% ropivacaine and 0.5% bupivacaine in brachial plexus block found that the mean duration of sensory blockade with either of the drugs was between 9 to 10 hours.

Duration of motor blockade:
Mean duration of motor blockade in Group L was 6.84 +/- 1.8 hours and in Group P 6.80 +/- 1.8 hours. The difference between the two groups was statistically not significant with 'p' value 0.9. ('p' more than 0.05)

McGlade DP et al in his study on 0.5% ropivacaine in brachial plexus block found the median duration of motor block to be 6.5 to 7.5 hours.

Duration of Surgery:
The mean duration of surgery in Group L was 1.86 hours and in Group P 1.91 hours. The difference between the two groups was statistically not significant with 'p' value 0.742. ('p' more than 0.05)

Haemodynamics:
In this study, no significant difference was observed with respect to the pulse rate, mean arterial pressure or oxygen saturation after administration of the blocks, be either the lateral approach or the subclavian perivascular approach.

CONCLUSION
The lateral approach of supraclavicular block is safe, technically easier and more successful with a lesser latency period compared to the subclavian perivascular approach.

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