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Original Research Article

Subclavian vein catheterization: Comparative evaluation of supraclavicular versus infraclavicular approach in oncology patients

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ABSTRACT

Context: The subclavian vein is the preferred site for central venous catheter insertion because of its several advantages. Infraclavicular is the commonly used approach while supraclavicular is less popular approach for catheterizing the subclavian vein.

Aims: The aim of the study was to compare supraclavicular and infraclavicular approach of subclavian vein catheterization in terms of number of attempts, success rate, access time for catheterization and to record the complications associated with the procedure.

Materials and Methods: In this study, 120 patients of inclusion criteria were placed either in group supraclavicular (SC) or group infraclavicular (IC) for subclavian vein catheterization using modified Seldinger technique under general or local anaesthesia.

Chi square test was used to compare success rate and independent T test for access time of catheterization between two groups.

Results: First attempt success rate in group SC was 81.66% and in group IC was 66.66%. But overall success rate was 93.33% in group SC, whereas it was 90% in group IC. This was not statistically significant with p value of 0.5. Time taken for successful catheterization was 252.98 ± 76.27 seconds in group SC and 314.98 ± 121.28 seconds in group IC. This was statistically significant with p value of 0.001.

Right brachiocephalic vein tear was the only complication in entire study which occurred in group IC.

Conclusions: Subclavian vein catheterization via supraclavicular approach was a faster approach than infraclavicular, whereas both were comparable in terms of success rate.

1. Introduction

There are various indications of central venous catheter (CVC) insertion like volume resuscitation, central venous pressure monitoring, transvenous cardiac pacing, haemodialysis access, and hypertonic or irritant substance infusion.[1] The subclavian vein (SCV) has several anatomical advantages so it is the preferred site for CVC insertion. It has large diameter, absence of valves, and ability to remain patent and in a relatively constant position.[2,3]

Aubonic was first to describe SCV catheterization via the infraclavicular approach in 1952. This has become well established technique since then. In 1965, Yoffa described an alternate supraclavicular approach.[4] Supraclavicular approach is not widely used and taught method for unknown reason.[5,6] Supraclavicular approach has various advantages over infraclavicular approach. It gives a vast target area for puncture, relatively straighter pathway, a shorter depth from skin. It is associated with fewer incidence of arterial puncture and fewer complications of pleural puncture due to less proximity to lung. It is easily accessible with constant surface landmark.[7–9]

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In this study both these approaches were compared in terms of number of attempts, success rate and access time for catheterization. The complications associated with the procedure were recorded.

2. Materials and Methods

This study was performed after approval from the ethics committee. Written informed consent was obtained from all the patients or patient's relatives before the study. One twenty oncology patients who underwent SCV catheterization over one year were randomly divided into two groups of sixty patients each. Randomization was done by computer generated random number tables and divided into two groups Group supraclavicular (SC) and Group infraclavicular (IC).

2.1. Inclusion criteria

1. Either sex,
2. American Society of Anaesthesiologists (ASA) grade - I, II or III,
3. CVP monitoring, fluid or vasopressor infusion, intravenous chemotherapy or total parenteral nutrition.

2.2. Exclusion criteria

1. Infection at puncture site,
2. Deranged coagulation profile,
3. Contralateral pneumothorax,
4. Cervical spine trauma,
5. Age less than 18 years.

Complete blood count and coagulation profile were mandatory tests for this study. Post procedure, chest X ray was done to confirm the position of CVC in all patients. Procedure was carried out under general anaesthesia or local anaesthesia depending on the indications for which it was done.

CVC insertion done in the Trendelenburg position. This manoeuvre distends the SCV as fascia is lacking on its superior aspect. Air embolus can also be prevented in this position.[10] Ipsilateral arm is adducted and patient's head was turned to the contralateral side. Right or left SCV was selected for cannulation depending on the surgery. SCV was catheterized with modified Seldinger technique. 7Fr 16cm triple lumen central line catheter was used in all patients. Procedure was performed under all aseptic precautions after identification of the anatomical landmarks. In conscious patients it was done under local anaesthesia with 5-7 ml of 1% lidocaine. Whereas, in operative patients it was catheterized after GA.

2.3. Supraclavicular approach (Group SC)

For the success of the procedure, correct identification of the claviculosternomastoid angle is important. It is formed by the junction of the lateral head of the sternocleidomastoid muscle and the clavicle. If anatomy is not clear it can be identified by raising patient's head. The needle is inserted 1 cm lateral to the lateral head of the sternocleidomastoid muscle and 1 cm posterior to the clavicle and directed at a 45-degree angle to the sagittal and transverse planes and 15 degrees below the coronal plane aiming toward the contralateral nipple.[11] The needle bisects the claviculosternomastoid angle as it is advanced in an avascular plane, away from the subclavian artery and the dome of the pleura, entering the junction of the subclavian and internal jugular vein (IJV).[2,12,13] The bevel was kept upwards till aspiration of blood. This prevents trapping of guidewire against the inferior vessel wall. Later the bevel should be turned downwards to prevent guidewire entry into IJV.[6]

2.4. Infraclavicular approach (Group IC)

In this technique, puncture point is one cm below the junction of medial one third and lateral two third of the clavicle. Needle is directed towards the suprasternal notch and bevel is kept inferomedially to prevent guidewire entry into the opposite vessel or into the IJV.[6]

After guidewire cannulation, the catheter was overlayed from puncture point to second intercostal space in both groups. This is to determine the optimal length of catheter to be inserted.

The venepuncture was limited to two attempts only. Inability to cannulate in two attempts was labelled as failure and then alternative route was planned. The procedure was abandoned after arterial puncture. At the end of the procedure number of attempts, success rate, access time for catheterization and complications were noted down.

All patients were observed for 24 hours to rule out any complications.

2.5. Statistical methods

The success rate and number of attempts were summarised in terms of percentage. Descriptive statistics of access time of catheterization was analysed and presented in terms of mean with standard deviation.

Success rate between two groups was compared with Chi square test. Access time of catheterization between two groups was compared with independent T test.

3. Results

Demographic profile like age, weight and height were recorded (Table 1). The mean age in group SC was 55.22 ± 13.25 years and group IC was 55.40 + 14.12 years. The mean weight in group SC was 63.33 + 13.16 kgs and group IC was 60.27 ± 14.46 kgs. While mean height was 161.41 ± 9.53 cm and 159.91± 8.54 cm in group SC and group IC respectively.

Table 1: Demographic profile

Groups	Age (Years)	Height (cm)	Weight (Kg)
SC (n=60)	55.22 ± 13.259	161.41 ± 9.530	63.33 ± 13.164
IC (n=60)	55.40 ± 14.126	159.91 ± 8.547	60.274 ± 14.469

In group SC out of 60 patients, in 49 patients (81.66%) cannulations were attempted in first attempt, 7 patients (11.66%) in second attempt. And rest 4 patients (6.66%) were labelled as failed cannulation. Whereas in group IC, first attempt cannulations were done in 40 patients (66.66%), 14 patients (23.33%) were cannulated in second attempt. In 6 patients (10%) cannulations were not successful in two attempts (Table 2).

Table 2: Number of attempts

Groups→	SC		IC	
Attempts ↓	(n=60)	Percentage	(n=60)	Percentage
First	49	81.66	40	66.66
Second	07	11.66	14	23.33
Failure	04	06.66	06	10.00

Overall success of cannulation was 56 out of 60 patients (93.33%) in group SC. While in group IC it was 54 out of 60 patients (90%). This was not statistically significant with p value of 0.5 (Tables 3 and 4)

Table 3: Success rate

Groups →	SC		IC	
Result ↓	(n=60)	Percentage	(n=60)	Percentage
Successful	56	93.33	54	90
Failed	04	06.66	06	10

The access time describes the duration between first puncture to successful catheter placement. The mean access time in group SC was 252.98 ± 76.27 seconds as compare to 314.98 ± 121.28 seconds in group IC (Table 5). This is statistically significant with p value of 0.001 (Table 6).

In group SC, two failure were because of subclavian artery puncture and two were due to unsuccessful venepuncture. In group IC, three failure were because of unsuccessful venepuncture, two were due to inability to insert guide wire and one because of arterial puncture. There was only one complication in entire study. One patient in group IC had right brachiocephalic vein tear (Table 7).

There was no malposition of the catheter in group SC. In group IC, there were two cases of malposition of the catheter. One in right infraclavicular approach, where catheter was entered into right internal jugular vein. And one in left infraclavicular approach, where catheter was entered into right subclavian vein. In all other patients, the catheter tip was at proper position. The average length of catheter in group SC was 12.19 ± 1.03 cm and in group IC was 13.24 ± 0.86 cm (Table 8).

4. Discussion

In literature, infraclavicular approach and supraclavicular approach are described as the techniques of subclavian venous catheterization.[1,2,14,15] After changing the angle of insertion needle with different set of anatomical landmarks, Yoffa's original supraclavicular technique have been developed.[1] According to Sterner et al,[16] in case of initial unsuccessful attempt, overall success rates are high using alternate approach to subclavian vein catheterization and this is with less complication rate too. The familiarity of both approaches is the key to success.

In our study, both groups were comparable in demographic characteristics. In group SC first attempt success rate was 81.66%, second attempt success rate was 11.66% and 6.66% had failed cannulation. In group IC first attempt success rate was 93.33%, second attempt success rate was 90% and 10% had failed cannulation. But overall success rate in group SC was 93.33% whereas, 90% in group IC which is not statistically significant. This was comparable with S Govindswamy et al.[17] study. The failure rate in that study were only due to inability to locate vein. While in our study, there were several reasons for failure like inability to locate vein, arterial puncture and inability to insert guidewire.

The access time for successful cannulation in group SC were 252.98 ± 76.27 and in group IC were 314.98 ± 121.28 which was statistically significant with p value of 0.001. Similar to our results, Thakur et al,[6] documented that the time taken for successful cannulation via SC approach (4.30 ± 1.02min) is lesser than IC approach (6.07 ± 2.14) with statistical significance. Dronen et al also documented that SC approach was a better technique in terms of less difficulty in catheter insertion, a higher incidence of proper catheter tip location, low failure rate and less interference with cardiopulmonary resuscitation.[18]

In our study there was no catheter malpositioning in group SC. While in group IC, two cases of catheter malpositioning. In a larger study conducted by Sterner et al, there was significant higher incidence of catheter malpositioning in the IC group. There are different ways to prevent malpositioning of catheter like use of ultrasonography (USG) guided catheter insertion, more horizontal route of skin puncture, caudal direction of bevel and early suspicion of resistance while guide-wire insertion.[19] This study was conducted in oncology institute where central venous pressure monitoring is crucial monitoring technique perioperatively. In such cases SC approach gives added advantage of correct positioning.

There was right brachiocephalic vein tear in group IC which was the only complication in entire study. This

Table 4: Success rate - Chj square test

	Value	df	Asymptomatic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	.436a	1	.509		
Co tinuity Correctio	.109	1	.741		
Likelihood Ratio	.439	1	.508		
Fisher' Exact Te t				.743	.372
Linear-by-Linear Associatio	.433	1	.511		
N of Valid Cases	120				

a. 0 cells(0.0%) have expected count less than 5. The minimum expected countis 5.00.
b. Computed only for a 2x2 table

Table 5: Access time

Groups	Access Time (Seconds)
SC	252.98 ± 76.27
IC	314.98 ± 121.28

p- 0.001 (statistically significant)

Table 6: Access time - Independent samples test

	t-test for Equality of Means		
	t	df	P value
Access Time	3.352	118	0.001

Table 7: Failures and complications

		SC	IC
Failure	Failed Venipuncture	2	3
	Subclavian artery puncture	2	1
	Failed guidewire insertion	0	2
Complication	Hematoma	0	0
	eumothorax	0	0
	Hemothorax	0	0
	Vessel tear	0	1

Table 8: Length of catheter

	SC	IC
Average length (cm)	12.19 ± 1.03	13.24 ± 0.86

occurred in a patient of right thoracotomy. It was detected and repaired during thoracotomy uneventfully. Though ultrasound is less commonly used in subclavian venous access, perhaps due to poor visualization of the vein from acoustic shadowing from the overlying clavicle.[20] Complications can be minimised or timely detection can be possible with the help of USG guidance.[21]

5. Conclusion

We conclude, subclavian vein catheterization via supraclavicular approach is a faster way than infraclavicular approach, whereas both the approaches are comparable in terms of success rate.

6. Source of Funding

None.

7. Conflict of Interest

The author declares no conflict of interest.

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