

A comparative study of supraclavicular versus infraclavicular approach for central venous catheterization

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ABSTRACT

Objective: Supraclavicular approach to subclavian vein catheterization is still being employed less often than traditional infraclavicular approach. The purpose of this study was to compare the two techniques regarding number of attempts, success rate of catheterization and complications associated with the procedure .

Place of study: Surgical Intensive Care Unit (SICU) of Rehman Medical Institute, Peshawar (Pakistan).

Duration of study: 1st June 2010 to 30th December 2010

Method: We included 144 adult patients of either sex undergoing central venous catheterization for various indications, selected by nonrandom sampling, in the study. They were divided into the supraclavicular and infraclavicular groups (72 in each group). Right subclavian vein of the patient was chosen in all patients for catheterization. Variables for comparison included number of attempts, success or failure of catheterization and complications associated with the procedure in each group. Statistical analysis was done by applying Chi-square test and Student's Independent Samples T-test.

Results: The overall success rate was 95.83% for right supraclavicular and 87.50% for right infraclavicular approach ($p > 0.05$). The number of successful attempts for supraclavicular and infraclavicular approaches were 1.13 ± 0.42 and 1.35 ± 0.69 respectively ($P = 0.029$). The complication rate was higher in the supraclavicular group, but the difference was not statistically significant.

Conclusion: The supraclavicular approach to subclavian vein cannulation was found to be a more successful method for adult central venous catheterization with complications comparable to the more commonly used infraclavicular approach.

Key Words: Central venous catheterization; infraclavicular approach; supraclavicular approach

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INTRODUCTION

Central venous catheter (CVC) placement is a routine procedure in the management of critically ill patients in Intensive Care Units (ICU) and Operating Rooms (OR). Central venous access is indicated when peripheral veins

are inaccessible, for volume resuscitation, administration of potent vasoactive drugs, frequent blood sampling, total parenteral nutritional support, hemodialysis, hemodynamic monitoring, transvenous cardiac pacing, and administration of long term chemotherapy.¹⁻³

The subclavian vein access has been the standard recommended approach for central venous catheterization both for short and long term use. The advantages are attributed to its large size, patient comfort and lowest rate of catheter related infections.^{4,5} It also carries a lower risk of thrombosis when compared to femoral or internal jugular vein cannulation.^{6,7}

Since the first report of percutaneous catheterization of the subclavian vein, the infraclavicular approach has been widely used.^{8,9} Unfortunately this approach is associated with a few well known complications like subclavian arterial puncture, pneumo- and hemothorax, which may be due to vague anatomical landmarks such as controversial skin entry points and ambiguous targets located far from the insertion site.¹⁰ Sometimes these complications are life-threatening.¹¹⁻¹³ Moreover, the approach is influenced by changes in patient's position and shoulder retraction.¹⁴

As an alternative, the supraclavicular approach for subclavian vein was suggested by Yoffa.¹⁵ This route to the subclavian vein has some distinct advantages over the infraclavicular approach. However, it is less often taught and utilized for reasons that are not clear¹⁴. Perhaps most of the practitioners have not been trained and taught this technique. Secondly, there may be a fear of directly entering into the pleural cavity and damage to vital structures, and there may be initial difficulty in identifying the landmarks, the angle and proper direction of the needle, resulting in failures.

We compared the two techniques regarding number of attempts, success rate of catheterization and complications associated with the procedure.

METHODOLOGY

This prospective, randomized, comparative study was conducted in the SICU of Rehman Medical Institute, Hayatabad, Peshawar (Pakistan) from 1st June 2010 to 30th December 2010. Permission was obtained from hospital ethical committee and informed consent was obtained either from the patient or from next of kins to carry out the procedure. A total of 72 patients, requiring subclavian vein catheterization for various indications, were included in each of the two groups by nonrandom selection. Right sided supraclavicular and infraclavicular approaches were used in Group A and Group B patients respectively. Both groups were studied with respect to number of attempts, success or failure of procedure and any complications

associated with the procedures. Size 16 or 18 G Arrow™ (Teleflex International Ireland) central venous catheters (Saldinger technique) were used in the study. Size of the catheter and single or triple lumen were selected according to need of the individual patients. Size 18 (No-33) and size 16 (No-39) catheters were used in Group A and size 18 (No-42) and size 16 (No-30) catheters were used in Group B patients. Each skin puncture was defined as an attempt and maximum 3 attempts were allowed in either approach and in case of failure, alternate approach (internal jugular) was used for catheterization. All successful cannulations were confirmed by post-procedure chest radiography.

Data were analyzed by SPSS version 15.0 for calculation of descriptive and inferential statistics. The Chi square test was used for comparing qualitative variables, while the Student's Independent Samples T-test was used to compare means. A $p < 0.05$ denoted significance.

PROCEDURE

Patients to be catheterized were placed in supine position with head turned to the left side. No roll towel was kept between interscapular region, nor a head down position was used in the study, as it was impracticable on ICU beds. Anterior region of neck and upper chest was cleaned with povidone-iodine solution. All aseptic precautions were used by the operator. Procedure site was draped with sterile towels. Lignocaine plain 1% solution (3-4 ml) was injected to anaesthetize the puncture site and subcutaneous tissue. The clavicolosternomastoid angle was identified either by asking the patient to raise his/her head or by palpation. Correct identification of this angle is critical to the success of supraclavicular approach. The needle with attached syringe was inserted at the clavicolosternomastoid angle, bisecting it in a direction, 10 degrees from the sagittal plane and 35 degrees posteriorly from the coronal plane. Needle was advanced behind the clavicle and directed towards the contralateral nipple. This approach allows for the shortest distance to the target vessel (2-3 cm) and for the first rib to act as a physical barrier to reduce the risk of pneumothorax. Bevel of the needle was directed medially (9 o'clock position) to facilitate threading of the guide wire in the direction of superior vena cava (Fig. 1). Right sided approach was used because of the lower location of pleural dome, more direct route to superior vena cava, being away from subclavian artery and absence of thoracic duct on this side.



Figure 1(a&b): Supraclavicular approach

Standard approach was used for the infraclavicular approach by selecting point of needle entry 1 cm below the clavicle at the junction of middle and medial third of the clavicle and directing the needle towards the suprasternal notch.

RESULTS

There were 54 males and 18 females in Group A, and 47 males and 25 females in group B; the differences were not statistically significant. The mean age of the patients in group A was 38.26 ± 8.72 years and in group B it was 40.42 ± 9.52 years ($p = \text{N.S.}$)

Results of the successful attempts and the frequency distribution of successful catheterizations are given in Table 1.

Table 1: Frequency distribution of No. of attempts

Attempts	Approaches n(%)		Total n(%) n=144	P value
	Supraclavicular n=72	Infraclavicular n=72		
1	62(86.11)	49(68.05)	111(77.08)	0.042
2	05(6.94)	06(8.33)	11(7.64)	
3	02(2.77)	08(11.11)	10(6.94)	
Unsuccessful	03(4.16)	09(12.50)	12(8.33)	

Overall success rate was 95.8% (69/72) for right supraclavicular approach and 87.5% (63/72) for right infraclavicular approach. Catheterization failed in 3 patients

(4.16%) in Group A and in 9 patients (12.50%) in Group B. Comparison of successful attempts is given in Table 2.

Table 2: Comparison of successful attempts of CVC (n=132)

Attempts	Supraclavicular (n=69)	Infraclavicular (n=63)	Total (n=132)	P value
Mean \pm SD	1.13 \pm 0.42	1.35 \pm 0.69	1.23 \pm 0.58	0.029

Malpositioning of catheter (threaded in contralateral subclavian) was noted in 2 patients in Group A and ipsilateral internal jugular vein in 1 patient in Group B, whereas pneumothorax and subclavian arterial puncture was encountered in 1 and 3 patients respectively in Group A; only 1 arterial puncture was seen in Group B as shown in Table 3. The complication rate was not significant within or inbetween the two groups.

Table 3: Comparison of complications in two Groups (n=72 each)

Complication	Group A n(%)	Group B n(%)	Total n(%)	P value
Malposition	2(2.80)	1(1.40)	3(2.08)	N.S.
Pneumothorax	1(1.40)	0	1(0.07)	
Arterial puncture	3(4.20)	1(1.40)	4(3.47)	
Total	6(8.33)	2(2.80)	8(5.55)	

DISCUSSION

Numerous modifications of Yoffa's original supraclavicular technique¹⁵ have been suggested and tested in cada ver studies and prospective case series. Garcia et al evaluated 83 attempts at subclavian vein catheterization using a modified supraclavicular approach.¹⁷ Successful catheterization was achieved in 98.6% of the attempts with 2 pneumothoraces and 3 subclavian artery punctures.

These findings are in agreement with our present study, where the right supraclavicular approach (as per Yoffa technique) showed success in 95.83% of cases, as compared to a success rate of 87.50% for the right infraclavicular approach. Moreover, the complication rates of the present study are also similar with 1.4% pneumothorax and 4.2% arterial punctures recorded, and total complications of 8.33% compared well to Yoffa's 6.02%.

Identification of landmarks was critical to the success of supraclavicular approach. We found that supraclavicular approach was comparatively easy in thin medium build patients but was difficult in obese patients with short necks. Further, difficulty was faced in unconscious patients who could not lift their head for identification of clavicolosternomastoid angle. In such cases manual palpation of the angle was used which usually led to success.

The literature demonstrates the effectiveness of the supraclavicular approach using Yoffa's original technique as well as modifications to landmarks, angles and patient position. No central venous access is without potential complications and no one technique is ideal for every patient.

Large scale, multicentre studies may help in better comparison between the two techniques. A thorough knowledge of anatomy and familiarity with multiple approaches is the route to successful CVC.

CONCLUSION

We conclude that the supraclavicular approach was the more successful method of central venous catheterization compared to the infraclavicular approach.

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