

Comparison Between Supraclavicular and Infraclavicular Approach in Subclavian Vein Catheterization in Tertiary Center of Nepal

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ABSTRACT



Introduction: Central vein catheterization can be introduced in subclavian vein (SCV), internal jugular vein or femoral vein for volume resuscitation and invasive monitoring technique. Due to anatomical advantage and lesser risk of infection subclavian vein is preferred. Either supraclavicular (SC) or infraclavicular (IC) approach could be used for subclavian vein catheterization. The aim of the study was to compare SC and IC approach in ease of catheterization of SCV and record the complications present if any.

Methods and materials: This was a hospital based comparative, interventional study conducted from November 2016 to October 2017 in Operation Theater in Bir Hospital. In this study, 70 patients for elective surgical cases meeting the inclusion criteria were randomly enrolled. Then samples were equally divided by lottery into either supraclavicular or infraclavicular approach groups. The Access time, cannulation success rate, attempts made for successful cannulation of vein, easy insertion of catheter and guide wire, approximate inserted length of catheter and associated complications in both groups were recorded. Data was entered in statistical software SPSS 16. Chi-square test was used. P value < 0.05 was considered significant.

Results: The mean access time in group SC for SCV catheterization was 2.12 ± 0.81 min compared to 2.83 ± 0.99 min in group IC (p-value= 0.002). The overall success rate in catheterization of the right SCV using SC approach (34 / 35) was better as compared with group IC (33 / 35) using IC approach. First successful attempt in the SC group was 74.28% as compared with 57.14% in the IC group.

Conclusion: The SC approach of SCV catheterization can be considered alternative to IC approach in terms of landmark accessibility, success rate and rate of complications.

Keywords: central venous catheterization, infraclavicular approach, subclavian vein cannulation, supraclavicular approach

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INTRODUCTION

Central venous catheterization (CVC) is a major intervention in critically ill patients. CVC is used for numerous purposes, including central venous pressure monitoring, volume resuscitation, hemodialysis access, drug administration and sampling site for repeated blood testing.¹ Central lines can be introduced into the internal jugular, subclavian, femoral veins or from vein emerging the ante cubital fossa.² SCV catheterization by infraclavicular approach and alternate supraclavicular approach has been described.^{3,4}

SCV has large diameter (1-2 cm), absence of valves, remain patent and relatively in constant position which are the anatomical advantage compared to other vein catheterization.⁵ Besides other advantages include consideration in patient requiring long-term intravenous therapy, has lower risk of infection, easy insertion in immobilized patients with cervical brace, less patient discomfort. During cardiopulmonary cerebral resuscitation (CPCR) with SCV catheterization there is less interference in airway management.⁶ Central vein catheterization should not be done in patients with coagulopathy disorder. Since it increases the risk of hematoma and also causes difficulty in applying pressure to subclavian artery following puncture.⁷

For SCV catheterization, IC approach is most widely practiced. However SC approach to the SCV catheterization has some distinct advantages which includes definite landmark (the clavico-sternomastoid angle), distance from skin to vein (0.5-4 cm) is shorter and straighter path to the superior vena cava and comparatively away from the lung. Furthermore, fewer incidence of arterial; pleural puncture and malposition are reported with SC approach.^{7,8} For central vein catheterization in either approach patient is kept in Trendelenburg position and head is tilted in fifteen degree.²

The position distends the vein and aids in cannulation while head tilt increase diameter 20-25% in internal jugular vein and 8- 10% in SCV.⁹

SCV catheterization is widely used yet there are less data available comparing two approaches in terms

of ease of insertion and complication associated with them. Therefore this study is aimed to compare the ease of catheterization in terms of successful cannulation time, success rate, access time and associated complications in SCV catheterization using SC versus IC approach.

MATERIALS AND METHODS

Following ethical approval from institutional review committee (IRC) and after patient's written informed consent comparative, interventional study was conducted at Operation Theater in Bir Hospital from November 2016 to October 2017.

For Sample size calculation, 95% confidence interval and power of 90% was considered. From study Thakur et al., mean access time in group SC (4.30 ± 1.02 minutes) versus (6.07 ± 2.14 minutes) in group IC was taken. $d=6.07-4.30=1.77$ minutes, $SD=2.14$.

For estimating sample size: $n=\{2(Z_{\alpha}+Z_{\beta})^2 \times SD^2\}/d^2$,

Where n, the number of patients in each group, Z_{α} , constant at given alpha error, Z_{β} , constant at given beta error, SD, standard deviation, d= difference between two mean.

Taking Z_{α} as 1.96, Z_{β} as 1.282, SD as 2.14 and $d=1.77$

It is calculated that 31 patients in each group would be required to have 95% confidence interval and power of 90%. 35 patients were taken in each group considering 10% dropouts, i.e. total seventy patients.

Total of seventy samples were randomized by lottery system and divided equally in either supraclavicular or infraclavicular approach group. Patients with age group above fifteen, both gender group and elective surgical cases were included in the study. Prior to surgery all elective cases were kept nil per oral from midnight. Patients with requirements of emergency venous access, infection at insertion and coagulopathy disorder ($INR>1.5$, $platelet<100000/cumm$) were excluded from the study.

The performer in either of the techniques was a primary researcher. In the Operation Theater following intravenous (IV) access, baseline vital along with ECG rhythm prior to catheterization were noted. The Trendelenburg position was maintained

and the head was tilted to fifteen degrees. Anterior region of the neck and upper chest was cleaned and draped. Lignocaine (1%) without adrenaline solution (5 ml) was injected to anaesthetize the puncture site for both the techniques.

Supraclavicular approach: Patient head was either raised or by palpatory claviculo- sternomastoid angle was identified. Bevel of the needle was directed medially to facilitate guide wire towards the superior vena cava.

Infraclavicular approach: Venipuncture was done 1 cm below the clavicle at the junction of middle one third and lateral two third of the clavicle, directing the needle towards the supra-sternal notch. The needle was used to feel the clavicle and was advanced just under the clavicle directed towards the sternal notch.

In both approaches, following skin puncture, aspiration was done and if free flow of blood was present, the needle was considered to be in the correct position. Then the dilatation of the tissue plane was done after which guide-wire was passed and the catheter was rail-roaded over it. The time from the skin puncture to blood aspiration via the catheter immediately following the guide-wire removal was considered successful cannulation time. If the puncturing needle was completely withdrawn out of the skin surface it was regarded to be an unsuccessful attempt. If the operator was unable to cannulate the vein in three attempts then the procedure was considered as a failure.

Modified Seldinger technique was used for cannulation. Overlaying catheter from the puncture site to second intercostals space was used to determine the optimal length of the catheter. Post procedure chest X-ray was obtained in all patients to confirm catheter position which was just above the carina and to rule out any complication.

In case of failure in all three attempts in either of the techniques the alternate technique was taken as the rescue technique. Hemodynamic variables i.e. heart rate, systolic, diastolic, mean arterial blood pressure and changes in rhythm in electrocardiogram (ECG) were recorded after correct placement. Complications like carotid artery puncture and local

site hematoma if present were recorded. Chest X-Ray was done to confirm pneumothorax and hemothorax was not present. The complications were managed as per the hospital protocol. Patients were followed up for insertion site inflammation, infection or any other complication till the removal of catheter. Data was entered in statistical software SPSS 16 Chi-square test. *P* value < 0.05 was considered significant.

RESULTS

Among the seventy participants in the study, thirty seven participants were male and thirty three participants were female. In supraclavicular group the mean age group was 39.23± 15.98 years and weight was 54.11± 12.49 kg while in infraclavicular group mean age was 42.94± 16.43 years and weight was 59.54± 12.17 kg [Table- 1].

Table-1: Demographic characteristics

Characteristics	Supraclavicular approach	Infraclavicular approach
Age (years)	39.23±15.98	42.94±16.43
Sex		
Male	16	21
Female	19	14
Weight(Kg)	54.11±12.49	59.54±12.17

The success rate in catheterization of right SCV using SC approach was 100% as compared with group IC which was 88.57% and was statistically significant(*P*<0.039) (Table 2).

Table 2: Comparison of rate of success between SC and IC approach

Rate of success	* SC (%)	*IC (%)	<i>P</i> value
Successful	35(100%)	31(88.57)	0.039
Unsuccessful	-	4 (11.42)	

*SC: Supraclavicular; IC: Infraclavicular

Successful cannulation time in SC approach was less and significant when compared to infraclavicular approach (Table 3).

Table 3: Comparison of successful cannulation time between two approaches

Variables	SC	IC	<i>P</i> value
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Time in minutes	1.9(1.68-2.28)	2.6(2.20-3.35)	<0.001
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Successful catheterization was when the procedure could be done in the first three attempts and when the attempt was more than three then it was considered to be the failed catheterization. In supraclavicular approach twenty six out of the thirty five cases had successful catheterization in first attempt with no failed catheterization. In the infraclavicular approach nineteen cases had successful catheterization in the first attempt; eleven cases had three attempts of catheterization while four cases failed catheterization and had to go for an alternative approach (Table 4).

Table 4: Comparison of number of attempts in catheterization

Attempts	SC (%)	IC (%)	P value
First	26(74.28)	19(54.28)	0.138
Second	8(22.85)	1(2.85)	
Third	1(2.85)	11(31.42)	
Unsuccessful	-	4(11.42)	

Most common complications observed between two groups were hematoma and arrhythmia. Both complications were higher in IC approach than to SC approach. No cases of arterial puncture, hemothorax and pneumothorax were observed in either of the group (Table- 5).

Table-5: Complications in two different groups during the procedure

Complications	SC (%)	IC (%)
Hematoma	1(2.85%)	2(2.85%)
Arrhythmias	2(5.71%)	3(8.57%)
Artery puncture	-	-
Hemothorax	-	-
Pneumothorax	-	-

All successful SCV catheterizations, i.e. thirty five patients in SC group and thirty one patients in IC group were associated with easy insertion of guide wire. The catheter tip location was confirmed by post procedure X-ray. In both groups, the catheter tip was found to be in proper position.

DISCUSSION

Comparative study between supraclavicular

and infraclavicular approach in subclavian vein catheterization was done on the basis of cannulation time, number of attempts, success rate and the complications observed.

In this study, demographic variables like age, sex and weight were comparable in both the group.

The success rate in cannulation of the right SCV using the SC approach was 100% and in the group with IC approach was 88.57%. The success rate in SC approach is considered to be higher due to constant position of the subclavian vein and easy access, low or negative intravascular pressure, have large diameter (12 to 25) mm and absence of valves or sclerotic changes.⁵ The success rate was comparable to the studies.¹⁰⁻¹⁴ The study was also comparable but result was relatively higher than to study Dronen et al.¹⁵ Our study was conducted on elective cases while study done by Aziz N et al¹⁴ was conducted in patients requiring cardiopulmonary resuscitation.

In this study, in supraclavicular approach minimum time taken was 1.68 minutes and maximum time taken for successful cannulation was 2.28 minutes whereas in supraclavicular approach minimum time taken was 2.20 minutes and maximum time taken was 3.35 minutes which was statistically significant ($P<0.001$). This may be due to anatomical advantage as subclavian vein is close proximity to the skin, and the right-side vein catheterization has straighter path into the subclavian vein.⁷The successful cannulation time was less in our study compared to study^{10,12} because our study has defined successful catheterization time only till guide wire removal while the other two studies had included the insertion time till successful placement of the catheter and fixation.

In our study there was no failed SC approach and maximum of the cases were successfully catheterized in the first attempt. In the IC approach four patients could not be catheterized. This study was comparable to study by Thakur et al¹⁰ but differed from Kocum et al¹² study as the infraclavicular approach was successful.

In our study there was one case of hematoma in each group. The occurrence of the hematoma can be

attributed to the repeated attempts of venous access. Arrhythmias observed in SC approach were two (5.71%) whereas in group IC was three (8.75%). The occurrence of the arrhythmia was due to deep insertion of the guide wire. Our study was similar to the study by Thakur et al¹⁰ while study done by Dronen et al¹⁵, Kocum et al¹² had cases of arterial puncture. Similar to study^{10,12,14} there was no pneumothorax and hemothorax observed in our study.

Limitation: The limitation in this study was small sample size and the study was done in a single center.

CONCLUSION

The SCV catheterization by SC approach could be alternative to IC approach as it requires less time for successful cannulation, has higher success rate and less complications.

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