Original Research Article

Indian Journal of Anesthesia and Analgesia
2018; 5(9): 1482-1486
DOI: http://dx.doi.org/10.21088/ijaa.2349.8471.5918.9

Supraclavicular Versus Infraclavicular Approach of Subclavian Vein Cannulation in ICU Patients

Asha Anand[1], Balwinderjit Singh[2], Iqbal Singh[3], Arwinderpal Singh[4]

[1]Assistant Professor [2]Professor [3]Professor and Head [4]Associate Professor, Department of Anaesthesia, Punjab Institute of Medical Sciences, Jalandhar, Punjab 144006, India.

Abstract

Background: Subclavian vein is generally preferred in ICU for central venous access. Infraclavicular and supraclavicular approaches are the two techniques of subclavian venous catheterisation. Infraclavicular approach to subclavian vein has been widely used. The supraclavicular approach is less often used though this approach of subclavian vein catheterisation has some distinct advantages. So aim of our study was to compare the supraclavicular and infraclavicular approaches of subclavian vein cannulation in terms of success rate and safety profile. *Methods:* A total of 60 critically ill patients aged between 20-60 years of either sex admitted in ICU, where central venous catheterisation was indicated were enrolled in the study. Group I included 30 patients where right Subclavian vein cannulation was performed using Supraclavicular approach. Group II included 30 patients where right Subclavian vein cannulation was performed using Infraclavicular approach. The parameters recorded in the study included success rate of cannulation, number of attempts to cannulate the vein, time required to obtain the access and the various complications. *Statistically Analysis:* The results of the study were compiled, tabulated and compared statistically using unpaired *t*-test and Pearson's Chi-square test. *Results:* The first attempt success rate in Group I (supraclavicular group) is significantly higher than in Group II (Infraclavicular group). The time required to access is also less in Group I (supraclavicular) as compared to Group 11 (infraclavicular) and is statistically significant. *Conclusion:* We concluded that supraclavicular approach has high first attempt success rate and also the time required to access is less as compared to infraclavicular approach.

Keywords: ICU; Subclavian Vein; Supraclavicular Approach; Infraclavicular Approach.

How to cite this article:

Asha Anand, Balwinderjit Singh, Iqbal Singh et al. Supraclavicular Versus Infraclavicular Approach of Subclavian Vein Cannulation in ICU Patients. Indian J Anesth Analg. 2018;5(9):1482-86.

Introduction

Critical care and emergency medicine has progressed leaps and bounds in the last few decades offering favourable outcome even in terminally ill or moribund patients. Majority of patient presenting in critical care unit needs central venous access for various purposes including difficult peripheral catheterisation, volume resuscitation, central venous pressure monitoring, parentral nutrition, administration of ionotropes and hyperosmolar medications and as haemodialysis access [1]. Commonly the internal jugular, subclavian, or femoral veins are accessed for central venous cannulation.

Subclavian vein because of large diameter, relatively constant position and valveless course makes it most suitable for central venous access in ICU patients [1,2]. It also has reduced risk of catheter-related infection and thrombosis as compared to femoral or internal jugular vein

Corresponding Author: Balwinderjit Singh, Professor, Department of Anaesthesia, Punjab Institute of Medical Sciences, Jalandhar, Punjab 144006, India.
E-mail: drbalwinder2000@yahoo.co.in

Received on 12.06.2018, **Accepted on** 22.06.2018

cannulation, less interference with endotracheal intubation and and also decreased patient discomfort on long term intravenous treatment [3].

Subclavain vein can be either accessed by Infraclavicular (IC) approach or supraclavicular (SC) approach [2,4]. Infraclavicular approach to subclavian vein has been extensively used and has become well known and practised technique. In 1965, Yoffa described novel supraclavicular approach for subclavian vein access [2]. This technique although not enjoyed much popularity at that time due to some unknown reasons but it offers a definite superiority over infraclavicular approach. It has a well-demarcated landmark (the clavisternomastoid angle), a shorter and straighter path to the superior vena cava and reduced incidence of arterial puncture, pneumothorax and inadvertent catheter malposition [1,2,5-9]. Also in supraclavicular approach there is less interruption of CPCR than infraclavicular approach [10,11].

Hence we hypothesized that supraclavicular approach can be better alternative for subclavian vein cannulation as compared to infraclavicular approach. So, we have conducted this prospective randomized study to compare the ease and success rate of subclavian vein cannulation using SC versus IC approach as primary parameters, and to record the incidence of complications related to either approach as secondary parameters.

Material and Methods

Our study was registered with clinical trials registry-India (CTRI/2018/04/013195).After approval from the institutional ethical committee and obtaining informed written consent from patient or his/her attendant, the present prospective study was conducted on 60 adult critically ill patients of either sex admitted in ICU requiring central venous catheterisation. Routine investigations including complete haemogram, BT, CT and coagulation profile were done in all the patients. Our exclusion criterion were patients with infection at puncture site, abnormal blood coagulation profile, pneumothorax, trauma to clavicle and upper ribs, distorted anatomy of the neck or clavicle and cervical spine trauma.

Patients were randomly divided into two groups of 30 each using computer generated random numbers.

Group I (SC): Right SCV catheterisation was performed using SC approach.

Group II(IC): Right SCV catheterisation was performed using IC approach.

Patients were placed in trendelenburg position to reduce the risk of air embolism and to engorge the subclavian vein. Under all aseptic precautions, after cleaning with povidone iodine and draping, local infiltration was done with 2 ml of 2% lignocaine at the puncture site.

For infraclavicular approach, the needle was inserted nearly 1 cm inferior to the junction of medial 1/3 and middle 1/3 of the clavicle and directed towards the suprasternal notch.

In supraclavicular approach, the needle was inserted 1cm cephalad and 1cm lateral to the lateral border of clavicular head of sternocleidomastoid (SCM) muscle and directed towards the line bissecting the clavisternomastoid angle. For delineating the claviculosternomastoid angle patients head was raised actively by patient or passively with the help of assistant.

After aspirating and confirming free flow of venous blood, cannulation was performed using modified Seldingers technique. The procedure was performed by the anaesthetist well versed with both the approaches. After maximum of two attempts, the procedure was abandoned and alternate approach was considered. To confirm catheter position and to rule out any potential complications, chest X-rays were done in all the patients. The access time (time consumed for successful placement of catheter after the initial skin puncture), cannulation success rate of each approach, number of cannulation attempts and complications like pneumothorax, haemothorax, arterial puncture, haematoma, arrhythmias and cardiac arrest were recorded. All the data was collected, sampled and analyzed using unpaired *student t*-test and Pearson's Chi-square test.

Results

Sixty patients were included in the study depending upon the inclusion and exclusion criterion. There was no significant difference observed in demographic parameters ie age, weight and gender between the two groups as shown in Table 1.

The technique success in both the groups was comparable although first attempt success rate was higher in I group as compared to group II as shown in Table 2.

The mean access time taken for the cannulation

in group I (SC) catheterisation was 6.25±1.05 min and in Group II (IC) was 7.75±1.50 min. On intergroup comparison data was statistically significant as shown in Table 3.

In terms of complications, there was no statistically significant difference observed between the two groups. There occurred one haematoma incidence found in both the groups and a single episode of pnemothorax occurred in group II. Results are illustrated in Table 4.

Table 1: Demographic profile

Demographic variables	Group I(SC)	Group II(IC)	P-value
Age in years	42.27±8.34	46.74±6.45	>0.05
Weight in kg	57.65±11.46	62.42±8.73	>0.05
Gender(M/F)	18/12	16/14	>0.05

Table 2: Technique Success

	Methods used		
	SC (Group I)	IC (Group II)	P-Value
1st attempt	26	22	<0.05
2nd attempt	3	6	
Failure of technique	1	2	>0.05

Table 3: Access time

	(Group I)	(Group II)
Access (MIN)time	6.25±1.05	7.75±1.50

Table 4: Complications

	(Group I)	(Group II)
Pneumothorax	nil	1(3.33%)
Haemothorax	nil	nil
Arterial Puncture	nil	nil
Haematoma	1(3.33%)	1(3.33%)
Arrythmias	nil	nil

Discussion

Central venous catheterisation is the commonly performed procedure in the management of critically ill patients in the ICU. It is required for various purposes like monitoring of Central venous pressure, fluids resuscitation, ionotropic support, frequent blood sampling, haemodialysis access and transvenous cardiac pacing [1]. Commonly internal jugular, subclavian, or femoral veins are preferred for central venous access, but right sided subclavian vein is usually preferred due to various anatomical advantages, decreased chances of thrombosis and less patient discomfort [3]. In literature, two techniques of subclavian vein cannulation (supraclavicular and infraclavicular) are advocated we conducted this study to compare the ease of cannulation of SCV using SC versus IC approach, success rate of each technique and to record the incidence of complications.

In our study demographic variables namely age, weight and gender were comparable in both the groups. In terms of success rate, overall success rate was 96.65% (29/30) in Group I (SC) and was 93.3% (28/30) in Group II (IC) in our study. First attempt success in the SC group was 89.6% (26 out of 29) as compared to 78.57% (22 out of 28) in the IC group. On intergroup comparison though overall success rate was comparable in both the groups but the first time success rate was significantally higher in supraclavicular approach as compared to infraclavicular approach . Czarnik et al also observed high first attempt success rate i.e. 85.6% to be replaced with (85.6%) during supraclavicular method of subclavian vein cannulation in 370 mechanically ventilated patients [12]. Similarly, Dronen et al conducted study in 76 patients undergoing CPR and observed 90% success rate in group SC and 84% in group IC and also documented that there is less interuuption of CPR during SC approach [10]. Kores et al. also showed that SC method is better as it has high success rate and is relatively easy to secure [13]. They observed overall success of 97% in SC and 94% in the IC approach . Lu et al also conducted study on infants and observed high success rate in SC group [14].

Mean access time was 6.25±1.05 in group I and 7.75±1.50 in group II .On intergroup comparison data was found to be statistically significant. Our results are in accordance with the study done by M Iqbal et al, Thakur et al in which they documented that SC approach of SCV catheterisation was a better technique than IC approach [15,16].

Subclavian vein cannulation is a risky procedure as various complications i.e. pneumothorax, haemothorax, subclavian artery puncture, haematoma at the puncture site, venous thrombosis and pulmonary embolism can occur during cannulation [3, 17-19] .

In our study, there occurred single incidence of haematoma (3.33%) in group I (SC) and one episode of haematoma (3.33%) and pneumothorax (3.33%) in group II (IC) respectively. Overall complication rate was less in SC group as compared to IC group in our study. Results are in accordance with the

study done by Sterner et al. in which overall complication incidence in SC group was 2.04% and 5.09% in IC group [20]. In the study done by Kores et al. there occurred incidence of 2.8% subclavian artery puncture in both the groups and incidence of 1.4% pneumothorax observed in IC group and incidence of 1.4% each of haematoma and haemopneumothorax, observed in SC group [14].

Nevare et al during his study of 178 supraclavicular approach of subclavian vein cannulation also observed single incidence of pneumothorax and one malposition and the overall complication rate was just 0.56% [21]. In the study done by Czarnik et al. where SCV catheterisation was done using SC approach there occurred 3 subclavian artery punctures and 3 contralateral subclavian vein catheterisation and the overall complication rate was 1.7%. They observed no life-threatening complication during the study [12].

In our study we found that supraclavicular approach of subclavian vein cannulation is less time consuming and has high first time success rate as compared to infraclavicular approach

Conclusion

We concluded that first time success rate in supraclavicular approach is significantally higher and the time taken for supraclavicular cannulation is significantally less as compared to infraclavicular approach. Moreover this approach required less interruption of Cardiopulmonary resuscitation. So as in critically ill patient where quick access is required supraclavicular approach can be preferred as compared to infraclavicular approach.

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