

Original Research Article

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

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ABSTRACT

Background: Central venous cannulation is a commonly performed procedure in neurosurgical patients to maintain the hemodynamic stability in the intraoperative period. It is used for infusion of intravenous fluids, vasopressors central venous pressure monitoring and detection of air embolism. Subclavian vein is commonly performed as there are minimal effects of positioning on it. Supraclavicular approach to subclavian vein cannulation is not as frequently employed as the infraclavicular approach. The purpose of this study was to compare the supraclavicular approach versus the infraclavicular approach in terms of number of attempts, success rate of catheterization and complications associated with the procedure.

Methods: About 150 patients undergoing various neurosurgical procedures were enrolled in the study. They were divided into two groups. 75 patients underwent right supraclavicular catheterization of subclavian vein while as 75 patients underwent right infraclavicular catheterisation of the subclavian vein. The number of attempts for cannulation, success or failure of catheterization and any complications associated with the procedure or in the postoperative period were noted in each group. The data was compared between the two groups by using Chi-square test and Student's Independent Samples T-test.

Results: The right supraclavicular vein was successfully cannulated in 90.66% while as the right infraclavicular vein was successfully cannulated in 96% of the patients ($p > 0.05$). Malpositioning of catheter (threaded in contralateral subclavian) was noted in 4 patients in Group S and ipsilateral internal jugular vein in 2 patients. Pneumothorax was encountered in 1 patient in the group S undergoing supraclavicular subclavian vein cannulations while as subclavian arterial puncture was seen in 4 patients who underwent infraclavicular arterial puncture.

Conclusions: There was no difference in successive cannulations between right the supraclavicular and right infraclavicular veins. The rate of complications between the two approaches was comparable.

Keywords: Subclavian vein catheterisation infraclavicular approach, Supraclavicular approach

INTRODUCTION

Central venous catheter (CVC) is routinely placed in major neurosurgical procedures. The common central venous catheterisations performed are internal jugular vein and subclavian vein. The central venous catheterisations in the operating room is mainly

performed for infusion of intravenous fluids, administration of inotropes, central venous pressure monitoring and diagnosis and treatment of air embolism.¹ The subclavian vein access has commonly been used for cannulation during various surgical procedures. It is preferred over internal jugular vein as there are fewer chances of infection, better patient comfort and a lower

risk of thrombosis. Other anatomic advantages of the subclavian vein for central access include its large diameter, absence of valves, and ability to remain patent and in a relatively constant position.^{2,3}

Aubaniac's gave the original description of subclavian vein catheterization via the infraclavicular approach in 1952. In 1965 an alternate supraclavicular approach was described by Yoffa. The supraclavicular approach is less taught and less practiced in the clinical practice.^{4,5}

The infraclavicular approach for subclavian catheterisation is widely used. Unfortunately, this approach is associated with a few well known complications like subclavian arterial puncture, pneumo- and hemothorax. This mainly results from vague anatomical landmarks such as controversial skin entry points and ambiguous targets located far from the insertion site.⁶ The position of the shoulder may also affect the ease of the central venous cannulation. Kitagawa found that lowered shoulder position increases both overlap and proximity between the clavicle and the subclavian vein, producing a more constant relation between the clavicle and the subclavian vein, without affecting the vein diameter. The proper use of a lowered shoulder position should thus increase the safety and reliability of subclavian venipuncture compared with other shoulder positions.⁷

Though the supraclavicular approach to the subclavian vein has some distinct advantages over the infraclavicular approach, this is a less taught and less practiced approach. There is a fear of entering the pleural cavity and a difficulty in proper angulation and proper needle directions has resulted in failures and discouraged the practitioners from using this approach. In this study, authors compared the success rate, number of attempts, and complications associated with the supraclavicular and the infraclavicular catheterisations.

METHODS

The study was conducted at Sheri Kashmir Institute of Medical Sciences Soura, Srinagar. An informed consent was taken from all the participants after explaining the main objectives and the possible complications associated with the procedure. All patients were subjected to detailed clinical history, and a complete general physical and systemic examination. Routine investigations such as complete haemogram, kidney function tests (serum urea, serum creatinine), liver function tests (serum albumin, serum bilirubin, Alkaline phosphatase, Serum glutamic pyruvic transaminase (SGPT, serum glutamic oxaloacetic transaminase (SGOT), urine examination, coagulation profile, electrocardiogram and chest X-ray (PA view) were carried out in all patients. A total of 150 patients, requiring subclavian vein catheterization for various neurosurgical procedures were included. The patients were randomly divided into 2 groups. Patients in group S underwent right supraclavicular subclavian

catheterisation and patients in group I underwent right infraclavicular subclavian catheterisation. Patients with infection at puncture site, deranged coagulation profile, contralateral pneumothorax, trauma to clavicle and upper ribs, distorted anatomy of the neck or clavicle and cervical spine trauma were excluded from the study.

The two groups were studied with respect to the success or failure to do the subclavian cannulation, number of attempts, and any complications associated with the procedures. A certofix trio V 715 (7 french gauge 15 cms) central line (B braun) was used. Each skin puncture was defined as an attempt. A maximum of 3 attempts were allowed for either approach. In case a failure an attempt was made to catheterise the internal jugular vein. A chest x ray was done in all patients in the postoperative period to confirm the position of central venous catheter and the development of any complication. Data were analyzed by SPSS version 15.0. The Chi square test was used for comparing qualitative variables, while the Student's Independent Samples T-test was used to compare means. A $p \leq 0.05$ denoted significance.

Patients to be catheterized were placed in supine position with head turned to the left side. A small towel roll was placed in between interscapular region. The antero lateral portion of the neck was cleaned with povidone-iodine solution followed by an alcohol based solution. The procedure site was draped with a sterile towel. In supraclavicular approach the point of needle insertion was 1 cm cephalad and 1 cm lateral to the lateral margin of clavicular head of sternocleidomastoid (SCM) muscle with the superior margin of clavicle which forms the clavisternomastoid angle.⁵ The bevel was kept upwards to prevent trapping against the inferior vessel wall. After successful aspiration of blood was achieved, the bevel was turned downwards, to prevent the J-tipped guidewire to migrate upwards into IJV. For the infraclavicular approach, a puncture appoint 1 cm below the clavicle at the junction of medial 1/3 and lateral 2/3 of was taken for the infraclavicular approach. The bevel was kept inferomedially so that the J-tipped guidewire would not migrate to the opposite subclavian vessel or into the ipsilateral internal jugular vein (IJV).

A modified Seldinger technique was used for cannulation. The optimal length of the catheter was determined by overlaying the catheter from the puncture site to second intercostal space. All central venous catheterisations were done by the same neuro anesthesiologists who had a more than 5 years' experience. Cannulation was performed using modified Seldinger technique. Post-procedure chest X-ray was obtained in all patients to confirm catheter position and to rule out any complication.

RESULTS

There were 55 males and 20 females in Group S, and 50 males and 25 females in group I, the differences were not

statistically significant. The mean age of the patients in group S was 49.34±7.61 years and in group I it was 51.37±8.13 years (p=N.S.). The mean weight of group S was 64.47±5.67 kgs and of group I was 64.34±5.38 kgs and the mean height was 158.56±45cms and 159.34±56 cms respectively (Table 1).

Table 1: Demographic profile.

Demographic data	N=75 Group S	N=75 Group I	p value
MF Ratio	55:20	50:25	NS
Age (Years)	49.34±7.61	51.37±8.13	NS
Weight (kgs)	64.47±5.67	64.34±5.38	NS
Height (cms)	158.56±45	159.34±56	NS

Legend: Group S: Supraclavicular vein cannulations, Group I: infraclavicular vein cannulations, NS: not significant

It was observed that most of the supraclavicular and infraclavicular catheterisations were performed successfully without any complications in the first attempt. There was no difference in between the two groups with ease and success of cannulation. The results of the successful attempts and the frequency distribution of successful catheterizations are given in Table 2.

The overall success rate was 90.66% (68/75) for right supraclavicular approach and 96.00% (72/75) for right infraclavicular approach. Catheterization failed in 7

patients (9.33%) in Group I and in 3 patients (4.00%) in Group B. Comparison of overall successful attempts is given in Table 3 and the overall complication rate is given in Table 4.

Table 2: Frequency distribution of number of attempts.

Attempts	Group S		Group I	
	N=75	Percentage	N=75	Percentage
First	60	80.00	63	84.00
Second	6	8.00	6	8.00
Third	2	2.66	3	4.00
Un-successful	7	9.33	3	4.00

Pearsons chi-square = 1.87, degrees of freedom = 3; P = 0.599. Legend: Group S: Supraclavicular vein cannulations, Group I: infraclavicular vein cannulations, NS: not significant.

Table 3: Comparison of successful attempts of subclavian CVC (n=150).

Result	Group S		Group I	
	N=75	Percentage	N=75	Percentage
Successful	68	90.66	72	96.00
Failure	7	9.33	3	4.00

Pearsons chi-square = 1.71; degrees of freedom = 1; probability = 0.190. Legend: Group S: Supraclavicular vein cannulations, Group I: infraclavicular vein cannulations, NS: not significant.

Table 4: Comparison of complications in two groups.

Complication	Group S N=75		Group I N=75	
	Numbers	Percentage	Numbers	Percentage
Contralateral subclavian catheterisation	4	5.33	3	4.00
Ipsilateral internal jugular vein catheterisation	2	2.66	2	2.66
Pneumothorax	1	1.33	0	0
Subclavian arterial puncture	0	0	4	5.33
Total	7	9.33	9	12

Pearsons chi-square = 0.280; degrees of freedom = 1; probability = 0.597. Legend: Group S: Supraclavicular vein cannulation, Group I: infraclavicular vein cannulation, NS: not significant.

Malpositioning of catheter (threaded in contralateral subclavian) was noted in 4 patients in Group S and ipsilateral internal jugular vein in 2 patients. Pneumothorax was encountered in 1 patient in the group S undergoing supraclavicular subclavian vein cannulation.

In the group I, 4 arterial punctures were seen, 3 patients had contralateral subclavian vein cannulation and 2 patients ipsilateral internal jugular vein cannulation. Pneumothorax was not seen in any patient.

DISCUSSION

Central lines are being commonly used for various neurosurgical procedures. The commonly used large central veins are subclavian and the internal jugular vein. Femoral vein is rarely used for cannulation because of the increased chances of infection associated with it. The subclavian vein has been found to have an ease for insertion, a lower complication rate and an increased level of patient comfort. A lower incidence of catheter-related infection and thrombosis has been reported than femoral or internal jugular vein cannulation.⁸ The

supraclavicular catheterisation is done less than the infraclavicular catheterisation. It may be due to misconceptions that central venous access over the clavicle may be more dangerous than the infraclavicular approach.⁹ Subclavian catheterization may have the advantages of a straight route into superior vena cava, lower complications of plural or arterial puncture and an appropriate path to central vein during CPR without interruption of it.¹⁰ The disadvantages and complications of subclavian vein have also been reported in the form of pneumothorax, haemothorax, subclavian artery puncture and haematomas at the puncture site. Delayed complications as catheter embolisation, venous thrombosis, endocarditis, myocardial perforation and pulmonary embolus have been reported.¹¹ Authors conducted a study to evaluate the ease of SCV catheterisation using SC and IC approach. It was observed in our study that the demographic profile including, age, sex body habitus (weight and height) was similar in between the two groups.

It was observed that most of the supraclavicular and infraclavicular catheterisations were performed successfully with ease in the first attempt. There was no difference in between the two groups with ease and success of cannulation. 80 percent of cannulations were performed in the first attempt in the supraclavicular approach while as 84 percent cannulations were performed in the infraclavicular approach. Similarly, 90 percent of successive cannulations were performed in the supraclavicular approach while as 96 percent of cannulations were performed in the infraclavicular approach. Though there was a better success rate seen with supraclavicular catheterisation when compared with the infraclavicular catheterisation, this success rate was not of any clinical or statistical significance. Our results were similar to the previous studies that were published by Thakur et al.¹²

Thakur et al observed that the SC approach of SCV catheterisation is comparable to IC approach in terms of landmarks accessibility, success rate and rate of complications.¹² However they observed that access time in SC approach is less as compared to IC approach which is important where quick as well as immediate access of the central venous system is required. Authors did not observe the access time taken for catheterisation in this study.

Tarbiat et al, tried to compare the supraclavicular versus infraclavicular Subclavian Vein Catheterization in Coronary Artery Bypass Graft Surgery.¹³ The authors found that the success rate in first attempt supraclavicular approach was (78.6%) was lower than the infraclavicular approach (94.3%). The authors interestingly noted that the overall success rate in two attempts was comparable. This was in contrast to our results. These differences may be due to the different levels of expertise and acquaintance of the physician who is involved in cannulations. The body habitus and the demographic

profile of the patients may also lead to the observed differences. Hussain et al found that the supraclavicular approach to subclavian vein cannulation was more successful when compared with the infraclavicular approach.¹⁴ The overall success rate was 95.8% for right supraclavicular approach and 87.5% for right infraclavicular approach. This was again in contrast to the results that were observed in our study. In this study, authors found that the rate of complications between supraclavicular and infraclavicular approach was comparable also.

In the supraclavicular approach four patients had a contralateral catheterisation, and 2 internal jugular vein catheterisation. In the infraclavicular approach 3 patients had contralateral subclavian vein catheterisation while as 2 patients had ipsilateral jugular vein catheterisation. Pneumothorax seen in one patient who had supraclavicular catheterisation while as subclavian arterial puncture was seen in 4 patients who underwent infraclavicular arterial puncture. These complications were insignificant between the two groups.

CONCLUSION

Authors concluded that the rate of success for cannulations, in our study between infraclavicular and supraclavicular groups was similar with a comparable rate of complications between the two groups. The approach (supraclavicular or infraclavicular) may not determine the success rate and complications between the two groups but what is important is the expertise, optimal positioning and acquaintance with the particular approach.

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