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# A Comparative Study of Supraclavicular versus Infraclavicular Approach for Right Subclavian Vein Catheterization

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**Abstract**

*Background and Aim:* Supraclavicular approach to subclavian vein catheterization has become one of the forgotten techniques in anaesthesia practice. The aim of this study is to compare supraclavicular approach with infraclavicular approach to subclavian vein cannulation, with respect to time taken to identify and cannulate vein, number of attempts taken to cannulate, success rate and complications. *Method:* In this study, 60 patients were enrolled and their right subclavian veins were catheterized by either Supraclavicular approach (Group-A, n=30) or infraclavicular approach (Group-B, n=30). Parameters including time to locate the subclavian vein, number of attempts needed to successfully cannulate the vein, success rate, total access time and complications were recorded. *Results:* The mean time to identify Right Subclavican Vein in first attempt in Group A was 10.652 ± 3.926 seconds as compared to 15.550 ± 8.325 seconds in Group B. In Group A, 23 out of 30 patients (76.7%) were successful in first attempt compared to 20 out of 30 patients (66.7%) in Group B. The average number of attempts needed to successfully identify the right subclavian vein in Group-A was 1.24 ± 0.511 and in Group-B was 1.37 ± 0.688. The total access time for Group A was 197.069 ± 35.12 seconds and for Group B was 227.481 ± 61.22 seconds. Arterial puncture is more common in Group-A (3 out of 30) whereas malposition of the catheter was more common in Group-B (3 out of 30). *Conclusion:* Supraclavicular approach can be used as an effective alternate to infraclavicular approach for Subclavian Vein cannulation.

**Keywords:** Central Venous Cannulation; Subclavican vein; Supraclavicular approach; Infraclavicular approach.

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## Introduction

Central Venous Catheterization is one of the commonly performed interventions in Critical Care Units and Operating theatres. The indications for central venous catheterization are difficult peripheral venous catheterization, volume resuscitation, emergency transvenous pacemaker placement, flow directed Pulmonary artery catheterization, administering total parenteral

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nutrition, hemodynamic monitoring, central venous oxygen saturation monitoring, access for renal replacement therapy and for administration of ionotropes and veno-irritant medications.

The common sites of central venous catheterization are Internal Jugular vein, Subclavian vein and Femoral vein. The Subclavian vein catheterization has some advantages over other sites for central venous access because of easily identifiable bony landmarks, large size of vein, patient comfort, long term catheter maintenance with comparably lower rate of catheter related infections and thrombosis [1-4]. Subclavian vein cannulation is preferred in patients with hypovolemia, for long-term total parenteral nutrition (TPN) and in patients with elevated intra-cranial pressure who require hemodynamic monitoring. However, it should not be considered the primary choice in the presence of thrombocytopenia (platelets < 50,000), for acute hemodialysis and in patients ventilated with high PEEP (i.e., > 12 cm $H_2O$) [5].

The subclavian vein cannulation was initially performed by Aubaniac in 1952. Infraclavicular approach for Subclavian vein catheterization was introduced in 1962 by Wilson and colleagues and is widely practiced till now [6]. In 1965, Yoffa introduced the supraclavicular approach for Subclavian vein cannulation [7]. Supraclavicular approach for Subclavian vein cannulation was not widely practiced for a long time because of fear of directly entering into the pleural cavity, damage to vital structures, difficulty in identifying the landmarks and difficulty in positioning the needle, resulting in failures. However supraclavicular approach to subclavian vein cannulation can be equally performed in view of well defined anatomical landmark (the claviculosternomastoid angle); shorter distance from skin to vein; a larger target area; a straighter path to superior vena cava; less proximity to the lung and fewer complications.

Hence we conceptualized this study to compare supraclavicular approach with infraclavicular approach to subclavian vein cannulation, with respect to time taken to identify and cannulate vein, number of attempts taken to cannulate, success rate and complications.

## Materials and Methods

This prospective randomised control trial was conducted in a tertiary care teaching institute after getting Institutional ethical committee clearance. Sixty patients of either sex in the age group 18-75 years, who were in need of central venous catheterisation were enrolled into the study. Patients with local infection, coagulopathy, neck deformity (anatomical), trauma to chest, clavicle, neck, cervical spine and pregnancy were excluded from the study. Written informed consent was obtained from all the patients included in the study. Patients were allotted to either Group-A (Supraclavicular) or Group-B (Infraclavicular) by random number generation by computer, with 30 patients in each group. [Fig. 1]

After securing Peripheral Venous Access with 18G cannula and attaching monitors (ECG, NIBP, $SpO_2$), patients were premedicated with Inj. Midazolam 0.05 mg/kg. Patients were positioned in $15^0$ Trendelenberg position, head turned slightly to left, with arms kept to the side of the body. Patient's neck was cleaned with 7.5% Povidone Iodine and anaesthetised with 2 ml of 2% Lignocaine at site of skin puncture.

In Group-A, after preparing the patient, the 18G finder needle mounted on 5 ml heparin saline loaded syringe, was inserted 1 cm cephalad and 1 cm lateral to the junction of the lateral border of the clavicular head of sternocleidomastoid muscle with the superior border of clavicle (angle between clavicle and sternocleidomastoid). The needle was directed towards the line that bisects the claviculosternocleidomastoid angle with elevation $5^0$–$15^0$ below the coronal plane. The vein was usually occured between clavicle and the attachment of anterior scalene muscle with the first rib. Venipuncture was confirmed by free back flow of venous blood in the syringe. Once subclavian vein was punctured, catheterization was done by seldinger technique.

In Group-B, after preparing the patient, the 18G finder needle mounted on 5 ml heparin saline loaded syringe, was inserted 1cm below the midpoint of the clavicle and advanced towards the suprasternal notch under the posterior surface of the clavicle. After confirming free back flow of venous blood, catheterization was done by standard seldinger technique.

Each Skin Puncture was defined as an attempt and maximum 3 attempts were allowed in each approach for subclavian vein catheterization (i.e., Supraclavicular or infraclavicular approach). In cases of failure, Right internal jugular venous catheterization was done. Successful Catheterization was confirmed by free back flow of venous blood through all the ports.

## Results

Demograpic datas like age, gender between the two groups were comparable. The mean time to identify Right Subclavican Vein in first attempt [Table 1] in Group-A was 10.652 ± 3.926 seconds and in Group-B was 15.550 ± 8.325 seconds which was found to be statistically significant (p = 0.015). In Group-A, subclavian vein catheterisation was successful in 23 patients in first attempt, 5 needed second attempt and 1 patient needed third attempt whereas Group-B, it was successful in 20 patients in first attempt, 4 needed second attempt and 3 needed third attempt [Table 2]. There was failure to identify right subclavian vein by supraclavicular approach in 1 patient and by infraclavicular approach in 3 patients. The average number of attempts needed to successfully identify the right subclavian vein in Group-A was 1.24 ± 0.511 and Group-B was 1.37 ± 0.688 [Table 3]. The total access time for Group-A was 197.069 ± 35.12 seconds and for Group-B was 227.481 ± 61.22 seconds [Table 4]. The Complications observed during this study included, arterial Puncture in 3 cases (3 in Group-A and 0 in Group-B) and malposition of the catheter in 4 cases (1 in Group-A and 3 in Group-B) [Table 5].

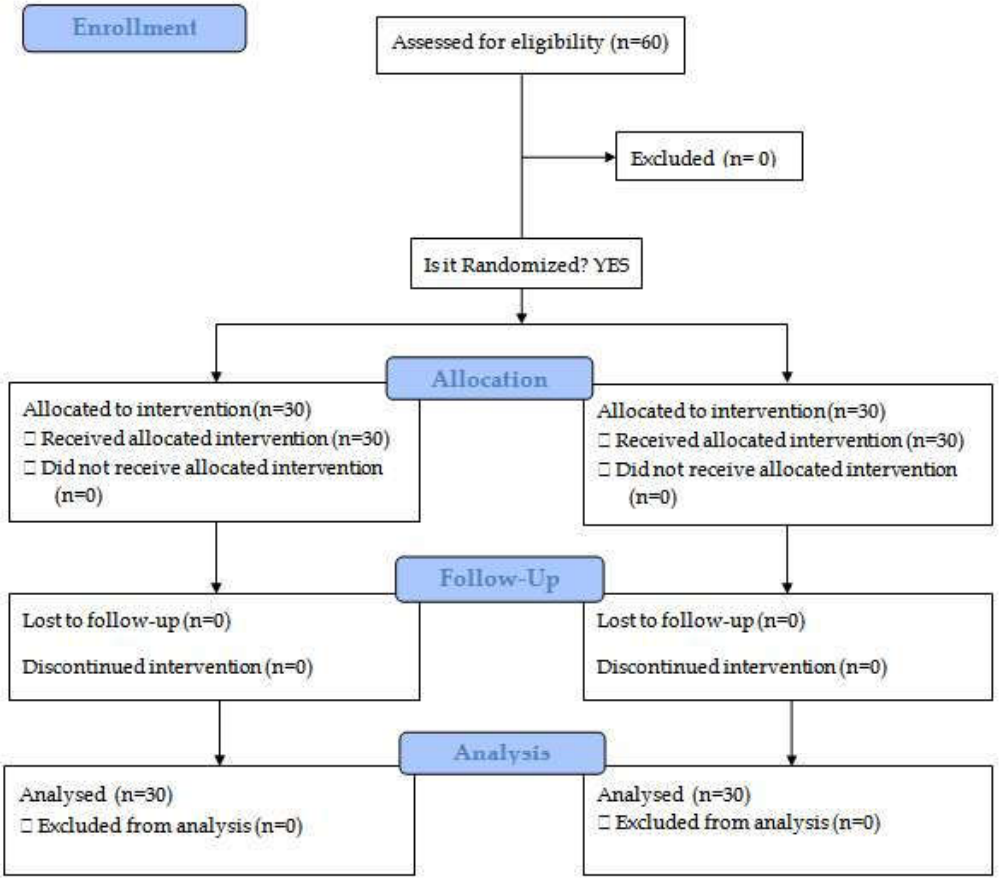


**Table 1:** Comparison of Time to identify Right Subclavian Vein in First Attempt

| Subclavian Vein | Group A (n=23) In secs | Group B (n=20) In secs | Total (43) In secs | t Value | P Value |
|---|---|---|---|---|---|
| Mean ± SD | 10.652 ± 3.926 | 15.550 ± 8.325 | 12.930 ± 6.748 | 2.5208 | 0.015* |

*- There is a Statistically Significant difference between Group A and Group B with respect to time to Subclavian Vein at 95% [p < 0.05]

**Table 2:** Comparison of number of attempts needed to successfully identify subclavian vein

| Attempts | Approaches n (%) | | Total n (%) n = 60 | Chi Square Test | p Value |
|---|---|---|---|---|---|
| | Group A n = 30 | Group B n = 30 | | | |
| One | 23 (76.7) | 20 (66.7) | 43 (71.7) | 2.320 | 0.509 NS |
| Two | 5 (16.7) | 4 (13.3) | 9 (15) | 3 df | |
| Three | 1 (3.3) | 3 (10) | 4 (6.7) | | |
| Unsuccessful | 1 (3.3) | 3 (10) | 4 (6.7) | | |

**Table 3:** Comparison of Successful Attempts

| Attempts | Group A (n=29) | Group B (n=27) | Total (56) | t Value | p Value |
|---|---|---|---|---|---|
| Mean ± SD | 1.24 ± 0.511 | 1.37 ± 0.688 | 1.3 ± 0.601 | 0.800 | 0.427 NS |

**Table 4:** Comparison of Total Access Time

| Total Access Time | Group A (n=29) In Secs | Group B (n=27) in Secs | Total (46) In Secs | t Value | p Value |
|---|---|---|---|---|---|
| Mean ± SD | 197.069 ± 35.12 | 227.481 ± 61.22 | 211.732 ± 51.33 | 2.300 | 0.0253* |

**Table 5:** Comparison of Complications

| Complications | Group A n (%) | Group B n (%) | Total n (%) | Chi Square Test | p Value |
|---|---|---|---|---|---|
| Nil | 25 (86.2) | 24 (88.9) | 49 (87.5) | 6.958 4 df | 0.138 NS |
| Arterial Puncture | 3 (10.3) | 0 (0) | 3 (5.4) | | |
| Malposition into Lt. SCV | 0 (0) | 2 (7.4) | 2 (3.6) | | |
| Malposition of Catheter to Rt. IJV | 0 (0) | 1 (3.7) | 1 (1.8) | | |
| Malposition to ipsilateral axillary vein | 1 (3.4) | 0 (0) | 1 (1.8) | | |
| Total | 29 (100) | 27 (100) | 56 (100) | | |

## Discussion

The time taken to identify the subclavian vein by supraclavicular and infraclavicular approaches was not compared in any of the studies conducted so far. We have measured time to cannulate subclavian vein in our study, since it is one of the important factors in deciding route of central venous cannulation, especially in emergencies. The time to identify right Subclavian vein by supraclavicular approach was 10.65 ± 3.926 secs, whereas in infraclavicular approach, it was 15.55 ± 8.325 secs, which was statistically significant with the p-value of 0.015.

The number of attempts required to successfully cannulate right Suclavian vein by Supraclavicular approach was 1.24 ± 0.511 whereas by infraclavicular approach was 1.37 ± 0.688. Even though, the number of attempts needed to successfully identify subclavian vein was statistically insignificant (p-value-0.427), the percentage of patients in whom cannulation was successful in first attempt was comparatively greater in supraclavicular approach. The percentage of patients in whom subclavian vein was cannulated in first, second and third attempt in supraclavicular approach was 76.6% (23/30), 16.6% (5/30), 3.33% (1/30), where as in Infraclavicular approach it was 66.6% (20/30), 13.3% (4/30), 10% (3/30) respectively. These findings are comparable to the results obtained by SafdarHussain et al. [8], where first attempt success rate with supraclavicular approach was 86.11% (62 out of 72 patients) whereas with infraclavicular approach was 68.05% (49 out of 72 patients). The mean numbers of attempts needed were 1.13 ± 0.42 and 1.35 ± 0.69 in the supraclavicular and infraclavicular approach groups respectively. In the case series reported by Tomarz Czarnik et al. [9] on 370 mechanically ventilated patients, the first attempt success rate was even higher (88.9%) for Right subclavian vein cannulation.

The total access time to cannulatesubclavian vein was 197.069 ± 35.12 seconds and 227.481 ± 61.22 seconds in Supraclavicular approach and Infraclavicular approach respectively. There is a statistically significant difference (p-value of 0.0253) in the total time to access vein between

supraclavicular and infraclavicular approaches. This value is comparable with the results of the study conducted by Anil Thakur et al. [10], in which the mean access time was 4.30 ± 1.02 minutes in Supraclavicular approach and 6.07 ± 2.14 minutes in Infraclavicular approach.

In our study, success rate in subclavian vein cannulation by Supraclavicular approach is better than infraclavicular approach, though it was not statistically significant. Among the 30 cases done in each group, cannulation was successful in 29 cases (96.7%) in Group A and 27 cases (90%) in Group B. Aysu Kocum [11] achieved 98% and 92% success rate in subclavian vein cannulation by Supraclavicular and infraclavicular approach respectively. Study conducted by Sterner S et al. [12] have shown success rate of 84.5% in supraclavicular approach and 80% in infraclavicular approach. Hussain S et al. [8], conducted study on 144 patients and concluded that the overall success rate was 95.83% for right supraclavicular approach and 87.50% for right infraclavicular approach for subclavian vein cannulation. Dronen S et al. [13] have proved that supraclavicular approach to the subclavian vein cannulation is associated with fewer failures that by infraclavicular approach even during cardiopulmonary resuscitation. The case series conducted so far by different people between 1965 to 2004 have shown varying failure rates by supraclavicular approach ranging between 0.0% to 20.6%, with an average of 3.2% failure in the total of 13,309 pts (422 cases failure).

The complications observed during the course of this study were Arterial puncture and malposition of the central venous catheter. Statistically, there was no difference among the two groups with respect to complication rate. In our study, complication rate in Supraclavicular approach was 13.8% while in Infraclavicular approach was 11.1%. We encountered three instances of arterial puncture and one instance of malposition of Catheter to right axillary Vein in supraclavicular approach, whereas we had three instances of malposition of Catheter (catheter tip was found to be in Lt. Subclavian vein in two instances whereas catheter tip was in right internal jugular vein in one patient). The commonest complication during subclavian vein cannulation by supraclavicular approach was inadvertent arterial puncture (160 patients), as per data collected from 13,309 patients between 1965 to 2004. Arterial puncture is more common when the needle insertion site is more lateral and cephalad than usual. Other complications included 39 cases of Pneumothorax, 37 cases of Malposition of the Catheter and 9 cases of lymph leak.

## Conclusion

The Supraclavicular approach to Right Subclavian vein is found to be a better technique compared to infraclavicular approach with regard to the time taken to identify & catheterise the vein, number of attempts taken and the success rate with comparable complication rate. Hence, Supraclavicular approach to subclavian vein cannulation can be used as alternate method to conventional infraclavicular approach.

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