

# A Comparative Study Of Internal Jugular Vein Cannulation- Central Approach Versus Subclavian Vein Cannulation – Infraclavicular Approach.

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## ABSTRACT

**Background:** Central venous cannulation is a commonly used perioperative procedure to monitor the critically ill patients. The aim of this study is anatomical landmark based cannulation of internal jugular vein and subclavian vein and to determine the outcome, technical ease, complication rate. Though ultrasound guided central venous cannulation may be the gold standard method, it may not be available everywhere. Anaesthesiology residents performed the procedure under the guidance of faculty members in operation theatres based on anatomical landmarks. **Methods:** We prospectively evaluated the performance of central venous cannulation by anaesthesiology residents through either internal jugular vein or subclavian vein based on the anatomical landmark guided techniques. Fifty patients posted for major surgeries were included in the study. **Results:** The success rate of the procedure, the numbers of attempts, complication rate between both groups are comparable to each other based on the statistical analysis. The time to perform internal jugular vein cannulation is significantly shorter than the time required for subclavian vein cannulation. **Conclusion:** In places where ultrasound imaging facilities are not available, anatomical landmark based techniques will help us to do the procedure. This study dispels the impression that Internal jugular vein is technically easier with reduced complication rate than subclavian vein cannulation. Results are comparable with each other.

**Keywords:** Cannulation, Central vein, Internal jugular vein, Subclavian vein, Complications.

## INTRODUCTION

The placement of a central venous catheter is a commonly used invasive monitoring method in all major surgeries and critically ill patients.<sup>[1]</sup> Cannulation of large central veins is most commonly performed using either the internal jugular vein or the subclavian vein through various approaches.<sup>[2]</sup> Several studies have reviewed different techniques and anatomic approaches to improve the success rate. Recently Ultrasound guided central venous cannulation has superseded the landmark based cannulation to improve the outcome and to decrease the complication rate.<sup>[3,4]</sup> But the availability of the ultrasound machine is not uniform in many centers, still in many centers landmark based technique is commonly used and routine use of ultrasound makes the trainees more dependent on this technology.<sup>[5,6]</sup> This study aims to compare between internal jugular vein –central approach and subclavian vein- infraclavicular approach based on the anatomical landmarks by anesthesiology residents.

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## Aim of the Study

To compare two different approaches of central venous cannulation-Internal Jugular vein cannulation by central approach versus Subclavian vein cannulation by infraclavicular approach based on the following parameters.

1. Outcome of the procedure
2. Technical ease
  - a) Number of attempts taken for successful insertion
  - b) Average procedure time
3. Immediate complications
  - a) Haematoma
  - b) Arterial puncture
  - c) Arrhythmias at insertion
  - d) Pneumothorax
  - e) Others or non specific like malpositioning of the catheter

## MATERIALS AND METHODS

This was a randomized double blinded study. Fifty patients in the age group of 15-83 years who were undergoing major surgeries who needed central venous line intraoperatively were included in the study. The study was conducted after institutional ethical committee approval and obtaining informed written consent from the patients. Procedural data was recorded in both cohorts by completion of the proforma.

The procedure was done under general anaesthesia. Randomization was performed by means of a

computer generated random numbers table and patients were stratified with regard to age, gender and body mass index. In both groups, right side vein was preferred over left side.

Internal Jugular vein-central approach-Anatomical landmarks-Group I

1. The sternal and clavicular heads of the sternocleidomastoid muscle.
2. Carotid artery

The structures are identified and marked. Internal Jugular vein lies between the two heads of sternocleidomastoid muscle, lateral and slightly anterior to carotid artery [Figure 1].



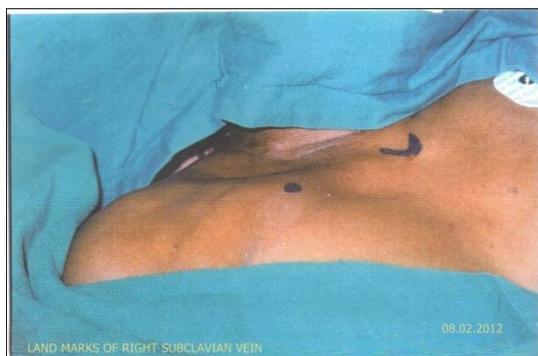
**Figure 1:** Landmarks of Right Internal Jugular Vein.

Subclavian vein- infraclavicular approach-Anatomical landmarks-Group II [Figure 2]

1. Mid clavicular point
2. Suprasternal notch

Technique of insertion: Seldinger technique<sup>[7]</sup>

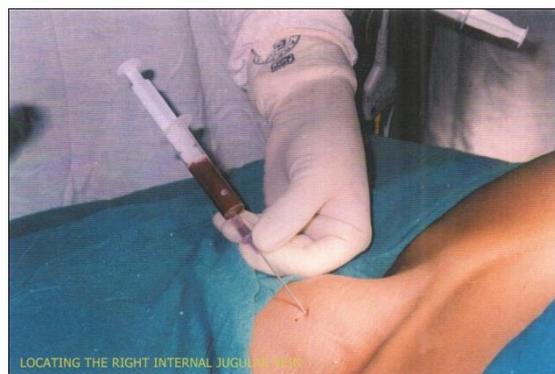
In both groups patients were placed in supine with 30° Trendelenburg's position, with head slightly turned to the opposite side, neck in extended position by keeping a small roll under the shoulder, arms by the side of the patient.



**Figure 2:** Landmark of Right Subclavian Vein.

Under strict aseptic precautions, the appropriate landmarks were identified and marked in both groups. In Internal jugular vein group, with the fingers of the left hand gently resting on the carotid artery pulsation, the introducer needle mounted on a 5 ml syringe containing heparinized saline is inserted at the apex of the triangle formed by the two heads

of the sternocleidomastoid muscle at an angle of 30 degrees from the plane of skin and directed towards the ipsilateral nipple. Once the skin is pierced, the tip of needle is flushed with few drops of saline to clear the skin debris, if anything present at the tip. The needle is advanced in the above said direction with a negative pressure maintained on the syringe. Once the vein entered, the sudden gush of nonpulsatile dark venous blood confirms intravenous position of the needle. [Figure 3] If the vein is not located with the initial attempt, additional needle passes may locate the vein by fanning laterally in a small arc from the point where the needle initially entered the skin. Once the needle enters in to the vein, further procedure of guide wire insertion, dilatation of the vein entry point, insertion of central venous catheter was done by Seldinger technique. ECG was monitored throughout the procedure to detect arrhythmias. Insertion of guide wire and catheter is restricted to 15 to 17 cm so as to place the tip of the catheter lie in the superior vena cava just above the right atrium. Catheter position was confirmed by x-ray chest, by free flow of fluids and central venous pressure monitoring. Catheter is secured in place and sterile dressing applied.<sup>[8]</sup>



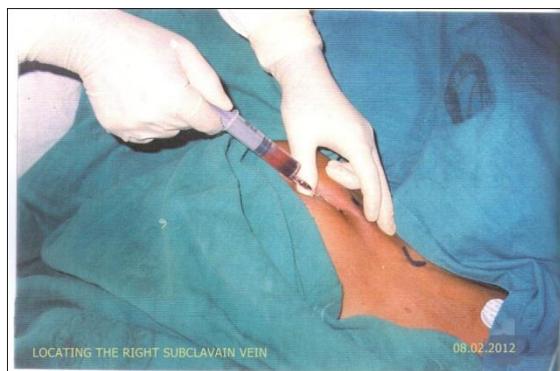
**Figure 3:** Locating the Right Internal Jugular Vein.

Subclavian vein cannulation:<sup>[9]</sup> Under strict aseptic precautions, the above said landmarks identified, skin was punctured with an introducer needle attached with a five ml syringe containing heparinized saline, two to three cm caudal to the midpoint of clavicle far enough from its inferior edge to avoid a downward angulation of the needle as it is walked under the posterior surface of the clavicle. The needle tip is directed towards the suprasternal notch. If the vein is not entered in the first attempt, the needle may be withdrawn and a second attempt is made in a slightly more cephaloid direction, while ensuring that the needle continues to hug the under surface of the clavicle as it is advanced [Figure 4]. Once the vein is punctured cannulation proceeds in a similar manner to that described for internal jugular vein cannulation using Seldinger technique.

**The parameters studied were defined as follows:**

**Outcome of the procedure**

A successful procedure was described as one resulting in established venous access via the chosen route.



**Figure 4:** Locating the Right Subclavian Vein.

**Number of attempts**

The number of attempts was defined as the number of times the needle was passed through the skin before venous access was obtained. Cannulation as recorded as easy or difficult depending on the number of attempts at cannulation. The procedure was considered easy if successful at the first attempt and without difficulty.

**Procedure time**

Procedure time was counted from the skin entry of locator needle to the successful insertion of central venous catheter.

**Complications**

Focus was given on the immediate complications related to catheter insertion.

- a) Haematoma - appearance of the swelling around the vein noted
- b) Arterial puncture- arterial puncture was identified by sudden gush of bright red blood with pulsatile nature into the syringe.
- c) Arrhythmias at insertion- was detected by monitoring the ECG during the procedure.
- d) Pneumothorax- was diagnosed by clinical observation intraoperatively and post-operatively by X-ray chest.

If the cannulation through one approach was unsuccessful, it was noted as failure in that approach and either the procedure was abandoned or alternate approach was tried. To analyse the data, Fisher Exact test and Chi-square test were used.

**RESULTS**

The patients in both groups were statistically comparable with respect to age, sex, weight and height to the other group [Table 1]. The success rate is 96% in group I and 84% in group II. The difference is not statistically significant ( $P > 0.05$  by

Fisher exact method). The procedure was abandoned in one case in group I due to kinking of the guide wire. In group II four cases were failed, of which in two cases left subclavian vein was cannulated, for one case right internal jugular vein was cannulated and for the remaining one case the procedure was abandoned due to excessive kinking of the guide wire .

On the first attempt in group I (internal jugular vein cannulation) was successful in 23 patients (92%). Second attempt was successful in one case (4%). In group II, subclavian vein cannulation was successful in 14 cases on the first attempt (56%). Second attempt was successful in six cases (24%). Third attempt was successful in one case (4%). The mean number of attempts in group I was 1.042 (range 1-2) and in group II was 1.381 (range 1-3).

The difference was statistically significant  $P < 0.05$ . The mean duration of cannulation in group I was 284.12 seconds, range (214-524 sec). The mean duration of group II was 301.81 seconds, range (176-630 sec). The difference was not statistically significant. ( $P \text{ Value} > 0.05$ ) [Table 2].

In group I no complications were observed. In group II –three cases of Haematoma, two cases of arterial puncture were observed [Table 3].

The difference in complication rate was not statistically significant ( $P \text{ Value} > 0.05$ ). Hematoma and arterial puncture by the introducer needle were managed conservatively by compression alone because it is usually self-limiting. Pneumothorax and malpositioning of the catheter were not observed as a complication. No significant morbidity occurred in this study related to central venous cannulation.

**Table 1:** Patient characteristics.

Patient Characteristics	Group I (IJV) Mean	Group II (SCV) Mean
Age (YRS)	40.16	39.96
Sex (M/F)	15/10	11/14
Weight (KGS)	48.48	45.24
Height (CMS)	155.04	154.76

**DISCUSSION**

Central venous cannulation is safe and has provided therapeutic advantages.

Success rate of our study was 96% in group I and 84% in group II. The difference is not statistically significant. Our observation is in concurrence with following studies

1. Central venous catheterization by Sznajder, Zveibil FR, Bitterman H, Weiner P, Burnztein (85.8% in internal jugular vein versus 88.9% in Subclavian vein cannulation)<sup>[10]</sup>
2. Comparison of Technical success and outcome by Sumana, Macdonald et al<sup>[11]</sup> (100% in Internal jugular vein cannulation versus 97% in Subclavian vein cannulation).

3. Percutaneous central venous catheterization by Bo-Linn GW et al<sup>[12]</sup> (86% in both internal jugular vein and subclavian vein cannulation)
4. Central venous cannulation in the intensive care unit, an analysis of 200 cases done by S.R. Hodarkar et al<sup>[13]</sup> (93.75% in internal jugular vein cannulation versus 94.1% in subclavian vein cannulation).

The technical ease of the procedure is assessed by studying the number of attempts for successful cannulation. The less number of attempts reduce haematoma formation and sepsis rate and also preserves the anatomy. The failure and complication rates increase as the number of percutaneous attempt increases, because after multiple punctures haematomas alter anatomic reference points, interfering with performance. In group I, the mean number of attempts for successful cannulation was 1.042. In group II, the mean number of attempts was 1.381. The difference is statistically significant. This was comparable to study by Iovino F et al<sup>[14]</sup> (3.1% in Internal jugular vein cannulation, 6.3% in

subclavian vein). Technical ease is due to the superficial position of internal jugular vein and its more definite landmarks. This was comparable to study done by Macdonald et al. In emergency situation rapid access to the central vein is most essential to resuscitate the patient. In our study the average procedure time is almost equal (284.12 seconds in group I versus 301.81 seconds in group II). The difference is not statistically significant. The immediate common complications were observed in both groups. The incidence of hematoma in Group I is 0% and that in Group II is 12%. The incidence of Arterial puncture in Group I is 0% and in Group II is 8%. In both groups no patient had arrhythmias since the guide wire and catheter were not inserted beyond 15- 18 cm. from the tip into the vein. In both groups, Pneumothorax and malpositioning of the catheter were not observed. The difference in complication rate is not statistically significant. This study was comparable to studies mentioned in [Table - 4].<sup>[11,10,15,14]</sup>

**Table 2:** Comparison of parameters.

PARAMETERS	GROUP I (IJV)	GROUP II (SCV)	P value
Outcome			
Success	24	21	0.174
Failure	1	4	
Number Of attempts			0.037
1	23	14	
2	1	6	
3	0	1	
Procedure Time (Sec)			0.470
<200 s	0	2	
200-400s	22	14	
400-600s	2	4	
600-800s	0	1	

**Table 3:** Comparison of parameters.

Complications	Group I (IJV)	Group II (SCV)
Hematoma	0	3
Arterial puncture	0	2
Arrhythmias	0	0
Pneumothorax	0	0

P Value – 0.0779

In contrast to our study, results of some previous studies reported different complication rates [Table

4] 5– 7.<sup>[16,17,13]</sup> The potential threats of major pleural and mediastinal complications due to central venous cannulation are self evident. The incidence of these complications are inversely related with the experience of the performer and positively related with emergency placement of the catheter. In this study, the complication rate in emergency settings could not be commented because the numbers of emergency cannulation are very few compared to elective procedure (6% Vs 94%).

**Table 4:** Comparison of parameters.

Studies	Complications					
	Haematoma		Arterial puncture		Pneumothorax	
	IJV	SCV	IJV	SCV	IJV	SCV
Macdonald S.S et al 2000 <sup>[11]</sup>	1.83%	1.04%	4.58%	3.12%	-	-
Sznajder J.J Zveibil FR et al <sup>[10]</sup>	1.6%	0%	3.9%	3%	0%	2.2%
Gracia Tornel et al <sup>[15]</sup>	0%	4.7%	3.22%	0%	0%	4.7%
Iovino F et al <sup>[14]</sup>	-	-	1%	2.7%	0%	3.1%
Abraham et al <sup>[16]</sup>	10%	0%	0%	14%	0%	14%
Ruesh S,Walder B et al <sup>[17]</sup>	-	-	3%	0.5%	1.3%	1.5%
S.R. Hodarkar et al <sup>[13]</sup>	-	-	6.25%	0.83%	2.5%	5%

There is a preference of cannulation for internal jugular vein over subclavian vein cannulation by

anesthesiology residents.<sup>[18]</sup> This study dispels this erroneous impression with similar success rate for

both routes and almost equal complication rates. This result was comparable to many previous studies by S.R. Hodarkar et al<sup>[13]</sup> Bernard and Stahl<sup>[19]</sup> and Sitzman et al<sup>[20]</sup>. However, the number of cases in our study is small and a larger group of patients needs to be studied before arriving at a definite conclusion.

## CONCLUSION

In this study, central venous cannulation through internal jugular vein- central approach was associated with comparable success rate, average procedure time and complication rate to Sub clavian vein cannulation- infra clavicular approach. The number of attempts for successful cannulation through internal jugular vein –central approach was significantly lower than that for subclavian vein cannulation- infra clavicular approach. The thorough knowledge of the anatomical landmarks of the different approaches will be really useful for the anaesthesiologists in emergency central venous access.

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