



## COMPARATIVE STUDY OF CONVENTIONAL LANDMARK GUIDED AND USG GUIDED CENTRAL VENOUS CANNULATION IN CARDIAC SURGERY PATIENTS.

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### ABSTRACT

Vascular cannulation is the cornerstone of monitoring for most serious illness. Cannulation by percutaneous route became the urgent, elective and emergency central venous catheterization approach most preferred by anesthesiologists and many intensivists. In patients coming for cardiac surgery placement of central venous catheter is of utmost importance because of nature of the disease, risk of surgery and cardiopulmonary bypass, and postoperative ICU stay.

This study represents our experience with two different techniques used for central venous cannulation viz. anatomical landmark guided technique versus ultrasonography (USG) guided technique with respect to feasibility, speed and complications.

The mean access time in landmark group was 68.7 sec + SD 48.98. Whereas in USG group it was 45.17 sec + SD 25.61. Mean number of attempts in landmark group was 2.03+SD1.13 compared to 1.37+SD 0.72 in USG group. The percentage of successful first attempt cannulation was 36.66% in landmark group whereas in USG group it was 73.33%.

The study validates that ultrasound-guided technique is superior and improves over the traditional landmark-guided technique for the cannulation of right internal jugular vein.

**KEYWORDS :** Central venous cannulation, IJV cannulation, USG guided cannulation

### INTRODUCTION

With advanced knowledge in medical monitoring, ever increasing value has been placed on the establishment of a central venous catheter. During the past forty years, there has been an enormous increase in the use of central venous catheterization and cannulation device for various indications<sup>1</sup>.

Although considerable attention was directed towards the importance of right atrial pressure monitoring during the later half of the 19th century, it was not until the 1950's and 1960's that the application of the principles governing the adequacy of cardiac function led to the monitoring of central venous pressure and cardiac performance<sup>2</sup>.

The central venous catheterisation techniques has allowed

1. Optimal adjustment of circulatory variables by direct hemodynamic measurements and volume replacement.
2. Infusion of a wide variety of pharmacologically active agents which cannot be satisfactorily infused via peripheral veins.
3. Provision of intravenous nutrition for prolonged period of time<sup>1</sup>.
4. Better management of seriously ill and hypovolemic patients as well as patients undergoing cardiovascular surgery.
5. It is indispensable in the treatment of shock, regardless of the cause and is great advantage during operation when the replacement of moderate or large amount of blood or fluid is anticipated.
6. Also provides a long term continuous intravenous route and a source for withdrawal of multiple blood samples, obviating the necessity and discomfort of multiple vein puncture.
7. It has made the use of venous cut down virtually obsolete.
8. In addition, patients at risk for venous air emboli may have central venous catheters placed for aspiration of entrained air.
9. Central venous access is also required to initiate transvenous cardiac pacing, temporary haemo-dialysis or pulmonary artery catheterization for more comprehensive cardiac monitoring

Vascular cannulation is the cornerstone of monitoring for most serious illness<sup>3</sup>. Cannulation by percutaneous route became the urgent, elective and emergency central venous

catheterization approach most preferred by anesthesiologists and many intensivists<sup>4</sup>.

In patients coming for cardiac surgery placement of central venous catheter is of utmost importance because of nature of the disease, risk of surgery and cardiopulmonary bypass, and postoperative ICU stay.

Since its introduction into clinical practice in late 60's, percutaneous venipuncture or cannulation of right internal jugular vein has been the method preferred by anesthesiologists for central venous cannulation. Reasons for this preference of right internal jugular vein includes,

1. Consistent, predictable anatomic location.
2. Readily identified, palpable landmarks.
3. Short, straight course to the superior vena cava.
4. Position at the patient's head providing intra-operative accessibility.
5. High success rate.

This study represents our experience with two different techniques used for central venous cannulation viz. anatomical landmark guided technique versus ultrasonography (USG) guided technique with respect to feasibility, speed and complications.

### AIMS AND OBJECTIVES

#### AIMS:

To compare conventional landmark guided and USG guided central venous cannulation with respect to

- 1) Number of attempts
- 2) Time required for procedure
- 3) Accidental carotid artery puncture

#### OBJECTIVES:

- 1) Reduction in complications associated with central venous cannulation.
- 2) To find a better technique for central venous cannulation.

### MATERIALS AND METHODS

**Type of study :** Prospective randomised controlled study  
**Sample size :** USG guided technique – 30 cases Conventional technique- 30 cases

**INCLUSION CRITERIA :** Patients posted for cardiac surgery

**EXCLUSION CRITERIA :**

Patients with any neck swelling or deformity or any condition which makes landmark technique non feasible.

**METHODOLOGY :**

Central venous cannulation

1) With conventional anatomical landmark guided technique

Procedure is done under all aseptic precautions. Patients are given proper position with a shoulder pad to achieve extension of neck .Patients head is turned to opposite side of desired side. Head end of table is lowered by 15 to 30 degree.

The anaesthesiologist stands at head end of patient. Proper sized cannula is attached to syringe. By following anatomical landmarks skin puncture is made and cannula is inserted further while creating negative pressure in syringe till venous blood is aspirated. The syringe is detached and proper sized triple lumen guide wire is introduced through cannula and cannula is removed. Then with the help of a dilator skin puncture bore is widened. Triple lumen central venous catheter is threaded over guide wire and guide wire is removed. Position of catheter is confirmed by aspirating venous blood through all 3 lumens. Triple lumen is then fixed with 3 skin stitches.

2) With USG guided technique

Procedure is done under all aseptic precautions. Patients are given proper position with a shoulder pad to achieve extension of neck .Patients head is turned to opposite side of desired side. Head end of table is lowered by 15 to 30 degree.

The anaesthesiologist & radiologist stands at head end of patient. Proper sized cannula (20 G or 22 G) is attached to syringe. The USG probe is placed on the neck of the patient in such a way that thyroid gland , carotid artery , internal jugular vein of same side are visualised on USG monitor (Out of plane approach). Skin puncture is made with the help of USG guidance and cannula is further advanced towards IJV under continuous USG guidance until venous blood comes in syringe. The syringe is detached and proper sized triple lumen guide wire is introduced through cannula and cannula is removed. Then with the help of a dilator skin puncture bore is widened. Triple lumen central venous catheter is threaded over guide wire and guide wire is removed. Position of catheter is confirmed by aspirating venous blood through all 3 lumens. Triple lumen is then fixed with 3 skin stitches.

**OBSERVATIONS AND RESULTS**

There were 30 cases each between landmark-guided technique and ultrasound guided technique for insertion of Central Venous Catheter, who were randomly selected with inclusion and exclusion criteria keeping in mind. The data collected in this study was analyzed statistically by computing percentages and descriptive statistics viz., mean, standard deviation, and standard error of mean. The difference in mean between the ultra sounded- guided (USG) technique and landmark-guided (LMG) technique was tested using independent Student's t-test and Chi-square test and is considered statistically significant whenever  $p \leq 0.05$ .

**Comparison**

**1) Time required for cannulation**

Technique	Mean time (sec)	Standard deviation	SE <sub>mean</sub>
Landmark	68.7	48.98	8.94
USG	45.17	25.61	4.67

It can be noticed here that the mean access time of landmark technique was much higher (mean time 68.7 sec) than that of USG technique ( mean time 45.17 ), which is observed to be statistically highly significant ( $p < 0.005$ ). T test for equality of means;  $p = 0.023$ .

**2) Number of attempts**

Technique	Mean no of attempts	Standard deviation	SE <sub>mean</sub>
Landmark	2.03	1.13	0.206
USG	1.37	0.72	0.131

It can be noticed here that the mean number of attempts of landmark technique was much higher (mean 2.03) than that of USG technique ( mean 1.37 ), which is observed to be statistically highly significant ( $p < 0.005$ );  $p = 0.008$ .

**3) Number of attempts required for successful cannulation**

Successful cannulation in	No. of patients		Total
	Landmark technique	USG technique	
1 <sup>st</sup> attempt	11	22	33
2 <sup>nd</sup> attempt	12	6	18
3 <sup>rd</sup> attempt	4	1	5
4 <sup>th</sup> attempt	1	1	2
5 <sup>th</sup> attempt	2	0	2

**4) Accidental carotid artery puncture**

Accidental carotid puncture	Technique		Total
	Landmark	USG	
Yes	13 (43.3%)	3 (10%)	16 (26.7%)
No	17 (56.7%)	27 (90%)	44 (73.3%)
Total	30	30	60

It is observed that during cannulation of IJV carotid artery is accidentally punctured on number of occasions. In our study accidental carotid artery was punctured in 13 (43.3%) cases in landmark group compared to 3 (10%) cases in USG group and the difference is statistically significant, Pearson chi- square test,  $p = 0.004$ , ( $< 0.05$ ).

**DISCUSSION**

There are several techniques of CVC. There are various studies and data of different approaches and sites of central venous cannulation (8,11,13,14,15,16,17,20,21,22,23,24). In this study of two different techniques were employed, viz anatomical landmark guided technique vs ultrasound guided technique. The knowledge of anatomy of neck is vital and the relationship of the IJV to the sternocleidomastoid muscle and carotid artery is the key for understanding the position of the vein in the neck. In practice, surface markings are always not reliable means of locating the internal jugular vein as its position, particularly in a lateral plane tends to vary considerably; Thomas Surez et al<sup>26</sup>

**Study parameters**

**1) Number of attempts**

a) Number of attempts taken for successful cannulation

With USG technique more veins were entered on the first attempt. In our study 73.33% of USG technique vs. 36.66% of LMG technique was cannulated on the first attempt. This in comparison with Bart G.Deny et al<sup>28</sup> 78% vs. 43.3% on first attempt , Mallory et al<sup>4</sup> with 85% vs.15% on first attempt , Curt D et Al<sup>27</sup> ,54.6% vs. 34.4% on first attempt,Slama M et al<sup>56</sup> ,43% vs 26% on first attempt and Troianos et al<sup>25</sup> 73% vs 54% on first attempt.

A maximum of 5 attempts were attempted in LMG technique compared with 4 maximum attempts in USG group.

Apart from first attempt, second attempt (40%) and third attempt (13.3%)were maximum attempts taken for successful cannulation in landmark group compared with second attempt (20%) was the maximum cannulation attempt in USG group, compared with Curt D et al<sup>27</sup> where fourth attempt (39.8%) and second attempt (15.1%) in landmark group vs fourth attempt (20.2%) and second attempt ( 17.7%) in USG group.

Agarwal et al<sup>28</sup> report 12.5% patients in USG group requiring more than one attempt versus 32.5 % patients in landmark group.

## b) Mean number of attempts

Mean number of attempts required for cannulation in our study in landmark group were  $2.03 \pm SD 1.13$  versus  $1.37 \pm SD 0.72$  in USG group ( $p=0.008$ , highly significant) compared to Dimitrois K et al<sup>23</sup>

$2.6 \pm SD 2.9$  versus  $1.1 \pm SD 0.6$  ( $p < 0.05$ ), Turker G et al<sup>30</sup>

$1.42 \pm SD 0.92$  versus  $1.08 \pm SD 0.33$  ( $p < 0.05$ ), Agarwal A et al<sup>28</sup>

$1.53 \pm SD 1.2$  versus  $1.2 \pm SD 0.48$  ( $p=0.03$ ) in landmark and USG group respectively.

## 2) Time required for procedure

The access time was shorter in USG technique with a mean  $68.7$  seconds  $\pm SD 48.98$  compared with control of mean  $45.17$  seconds  $\pm SD 25.61$  ( $p= 0.023$ ) compared to Curt D et al<sup>27</sup>,  $269$  seconds in landmark group versus  $150$  seconds in USG group, Dimitrois K et al<sup>23</sup>  $44 \pm SD 95.4$  in landmark group versus  $17.1 \pm SD 16.5$  in USG group,

Agarwal A et al<sup>28</sup>,  $176.43$  seconds  $\pm SD 23.48$  in landmark group versus  $145$  seconds  $\pm SD 16.98$  in USG group, Slama M et al<sup>31</sup>,  $235$  seconds  $\pm SD 408$  in landmark group versus  $95$  seconds  $\pm SD 174$  in USG group.

Such a big variation in time required could be ascribed to different definitions of 'time' in different studies.

## SUMMARY

The present study was to evaluate ultrasound-guided technique against conventional landmark technique for cannulation of right internal jugular vein with regard to safety, speed, feasibility & complications. A total of 60 cases were cannulated who were grouped into landmark guided technique cases and ultrasound guided technique group of each 30 cases. The operator was experienced and constant throughout the study.

The mean access time in landmark group was  $68.7$  sec +  $SD 48.98$ .

Whereas in USG group it was  $45.17$  sec +  $SD 25.61$ .

Mean number of attempts in landmark group was  $2.03 + SD 1.13$  compared to  $1.37 + SD 0.72$  in USG group.

The percentage of successful first attempt cannulation was  $36.66\%$  in landmark group whereas in USG group it was  $73.33\%$ .

The carotid artery puncture was observed in  $43.33\%$  of case in landmark and  $10\%$  of cases in USG.

## CONCLUSION

The study validates that ultrasound-guided technique is superior and improves over the traditional landmark-guided technique for the cannulation of right internal jugular vein by

- 1) decrease number of attempts
- 2) increase in the speed of access of the vein for cannulation,
- 3) increase in the success rate of cannulation
- 4) decrease in carotid artery punctures and hematoma formation

There are few and less serious complications during cannulation of right internal jugular vein with ultrasound guidance which are significantly less than landmark guided technique.

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