

#### **4 ULTRASOUND GUIDED INTERNAL JUGULAR VEIN CANNULATION IN CRITICALLY ILL PATIENTS IN ICU**

**AUTHORS:**

1) Dr. Sonal A. Shah ( Assistant professor , Anesthesia, V S Hospital, Ahmedabad

Address : ' VARDHAMAN'

NR. KADWA PATIDAR NI VADI,  
OPPO. TO JAIN TEMPLE,  
USMANPURA, ASHRAM ROAD,  
AHMEDABAD-14.

2) Dr. Timsi R. Satani (Assistant professor , Anesthesia, V S Hospital, Ahmedabad)

3) Dr. Kinjal H. Parmar (3<sup>rd</sup> year Resident, Anesthesia, V S Hospital, Ahmedabad)

4) Dr. Jay P. Patel (2<sup>nd</sup> year Resident, Anesthesia, V S Hospital, Ahmedabad)

5) Dr. Hetavi U. Contractor ( Senior Resident , Anesthesia, V S Hospital, Ahmedabad)

#### **Abstract**

##### **Introduction:**

Portable ultrasound machines are highly valuable in ICUs, where a patient's condition might not permit shifting the patient to the USG department for imaging and proper positioning may be difficult due to haemodynamic condition of patient. Traditionally central lines are put blindly using anatomical landmarks, which often result in complications such as difficulty in access, misplaced lines, pneumothorax, bleeding from inadvertent arterial punctures, etc. Ultrasonography provides "real time" imaging, i.e., the needle can be visualized entering the vein that may result in less associated complication.

##### **Aims:**

We performed a study regarded

- ease of cannulation
- time consumed
- associated complications

in USG guided IJV cannulation in ICU patients.

##### **Materials and Methods:**

The study was performed in a ICU. Twenty five patients were selected for IJV insertion. The right internal jugular vein (IJV) was cannulated in all. A portable ultrasound machine was used during cannulation. The vessels were visualized in the transverse section with the internal carotid artery (ICA) identified as a circular pulsatile structure, while the IJV as a lateral, oval nonpulsatile

structure). The needle was inserted perpendicular to the skin under visualization on the US screen. Central venous line was then inserted by the Seldinger technique.. in this we study parameters like time for insertion, attempts required, and complications encountered.

### **Results:**

The mean time to successful insertion was  $126.2 \pm 15.4$  sec in USG guided technique. Out of 25 patients, all (100%) cannulated successfully. Only in 1 patient carotid artery was punctured and was cannulated in 2<sup>nd</sup> attempt. success rate is 100%. 96% patients are cannulated in first attempt.

### **Conclusion:**

USG-guided CVC is thus easier, quicker, and safer than landmark approach.

**Keywords:** central venous cannulation, intensive care unit, ultrasound

### **INTRODUCTION**

Central venous (CV) access is a commonly performed procedure with multiple indications in routine and emergent situations. Access to the internal jugular vein (IJV), subclavian vein (SV), and femoral vein (FV) has typically been described in the emergency medicine and critical care literature using the traditional landmark-based approach. Studies using landmark-based methods have reported failure rates and complication rates as high as 30%<sup>[16]</sup> and 18.8%, respectively.

The use of ultrasonography for CV access was first described in 1978,<sup>[18]</sup> Doppler localization was used to mark the skin overlying the IJV. Not until 1986 was the use of real-time ultrasonographic guidance for IJV cannulation reported.<sup>[21]</sup> In the 2008 Emergency Ultrasound -Guidelines from the American College of Emergency Physicians (ACEP), ultrasonographic guidance for CV access was listed as a "core or primary emergency ultrasound application."<sup>[2]</sup> In 2010, Ortega et al elaborated the methodology to employ ultrasonography for locating the IJV, underlining the safety and reliability of the technique.<sup>[7]</sup> The use of ultrasonographic guidance during CV line placement has been demonstrated to significantly decrease the failure rate, complication rate, and number of attempts required for successful access.<sup>[1,5,8,19]</sup>

For IJV access, patients should be placed in a slightly Trendelenburg (10°) position. The head should be in a neutral position (maximum head rotation of 30°). A randomized trial comparing neutral head position to 45° neck rotation did not demonstrate any difference in rate of complications.<sup>[10]</sup> For operator-assisted IJV ultrasonographic guidance, the operator should stand on the ipsilateral side of the patient. The procedure should be performed from the head of the bed and the indicator of the probe should be kept pointing to the operator's left (this corresponds to the left side of the patient's body and is opposite of our traditional orientation). For cannulation of the right IJV, this probe orientation ensures that the vessel positions in the patient's neck (carotid to left, IJV to right) share the same orientation on the ultrasound display. The operator should have a clear view of the ultrasound image.

### **MATERIAL AND METHODS**

Twenty five critical care patients at the intensive care units of V S General Hospital, Ahmedabad, who needed central venous cannulation, who gave their informed Written consent.

## **Indications**

- Other peripheral sites are unavailable or inaccessible.
- A large-bore venous catheter is needed for rapid administration of fluid or blood products in emergent situations.
- For the infusion of vasopressors, sclerosing agents, or total parenteral nutrition with less risk to the vein.
- For placement of a pulmonary artery catheter or trans venous pacemaker.
- For continuous CV pressure and CV oxygen saturation monitoring during resuscitation.

## **Absolute Contraindications**

- Infection at insertion site
- Anatomic obstruction (thrombosis, anatomic variance)
- Superior vena cava syndrome

## **Relative Contraindications**

- Coagulopathy
- Systemic infection
- Presence of pacing wires or other indwelling catheters at insertion site
- Right ventricular assist device

## **METHODS**

Begin the procedure with proper scrubbing and universal precautions, including sterile gloves, gown, mask, cap, and protective eyewear.

Cleanse the patient's skin with an antiseptic such as a povidone iodine solution and ethyl alcohol. Sterile drapping done .

Vascular cannulation may be accomplished with the catheter-over-guidewire technique, which is more commonly known as the Seldinger technique.

The vessel to be cannulated may be located with ultrasonography via dynamic (real-time) method

### **Dynamic (real-time) method**

The dynamic method, shown below is performed with the aid of an assistant. , a portable ultrasound machine "Sonosite Micromaxx®" with a 7.5-MHz probe was used. A sterile sheath, commercially available, or glove with transmission gel (any sterile gel/lubricant may be used) inside should be unrolled over the ultrasound probe. Additional sterile transmission gel is then

placed on the outside of the probe cover. The probe is then placed on the patient's skin and the target vessel is identified. The vein is identified with several techniques, including phasic respiratory pulsations, ease of compressibility, and increased filling using the Valsalva maneuver. The vein to be cannulated should be centered on the ultrasound screen. Once the anticipated path of the needle is identified, the path can be anesthetized with lidocaine under ultrasonographic guidance. This part of puncture is anesthetized to minimize patient discomfort.

Next, the skin is punctured with a thin-walled percutaneous entry needle. Do not focus on the ultrasound monitor until the needle has entered into the skin. Focusing on the monitor prior to needle entry can lead to inadvertent needle sticks. Visual focus is then directed to the ultrasound monitor, where the needle appears sonographically as an echogenic line with reverberation or ring-down artifact. Often, the needle is not directly visualized; however, tenting of each tissue plane can be appreciated.

In the short-axis view, scan back and forth with the probe over the needle to locate the needle tip. Often, a longitudinal view can help localize the needle tip. After the needle is seen puncturing the vessel and a flash of blood is seen in the syringe, the ultrasound transducer may be set aside. Visualization of the guidewire using the longitudinal view within the target central vein verifies intravenous placement. This view minimizes the risk of puncture of the posterior vessel wall. In the event that the location of the wire cannot be verified (eg, in cases in which back-wall puncture of the vessel is suspected), the guidewire can be partially withdrawn and the curvature of the distal "J" portion of the guidewire can be visualized within the target vessel. After needle puncture of the vessel and guidewire placement, the entry needle is withdrawn, and the puncture site is enlarged with a No. 11 scalpel blade. A dilator may then be used to facilitate placement of the catheter. Venous blood return and easy flushing suggest accurate placement. A three way lumen port (certofix trio@ 715 ) inserted. Ultrasonography can also visualize the catheter and its relative location to the vein. After the catheter is in place, it is secured with either simple interrupted sutures. Post procedural chest radiography is necessary to confirm placement and evaluate for complications such as pneumothorax.

[Figure 1](#)

IJV and ICA as seen normally on scan (IJV = internal jugular vein, ICA = internal carotid artery)



[Figure 2](#)

On applying pressure with US probe, IJV gets compressed while ICA remains as such



## RESULTS

*Out of 25 patients, all (100%) cannulated successfully. In*

*Only 1 patient carotid artery was punctured and was cannulated in 2<sup>nd</sup> attempt.*

1) Mean access time of ijv by USG guided method is  $126.2 \pm 15.4$  seconds for 25 patients. Success rate is 100%.

2) 96% patients are cannulated in first attempt.

3) Complication rate is 4%.

Mean age group 49.2 yr (40 to 70 years).

Real time ultrasonography can be used to view the in vivo vascular anatomy of the neck and in ascertaining the size of IJV and its anatomical relations. These features make this instrument a useful tool to study various body positions and in finding out the position which maximize IJV diameter, thereby increasing the first pass success rate. In landmark technique, trendelenburg technique is used which may be difficult in many critically ill patients. So usg guided cannulation give this advantage.

## DISCUSSION

The USG approach had lower incidence of complications for cannulation of the internal jugular vein like pneumothorax, inadvertent vessel puncture, hydrothorax, hemothorax or misplaced cannula etc..

After three or more attempts at insertion, mechanical complications increase by six times compared with a single attempt<sup>[7]</sup>. In usg guided approach most patients are cannulated in 1<sup>st</sup> attempt with compared to conventional method. In usg technique access time required is much more lesser. in most patient where trendelenburg position may be difficult where usg comes like a gift.

As suggested *Int J Anat Res 2014, 2(4):757-60. ISSN 2321-4287 76* 83.3% patients in LMG technique was cannulated on the first attempt. When compared with the USG and LMG techniques for IJV cannulation on first attempt the results of Dimitrios Karakisis et al<sup>[6]</sup> 100% vs 94.4% and that was in Piero Antonio et al<sup>[13]</sup> 100% vs 91.6%. Wg Cdr R M Sharma et al<sup>[20]</sup> 100% vs 98% in USG and LMG technique. In Tista A et al<sup>[17]</sup> 100% vs 82%, and in Bart G. Deny et al<sup>[21]</sup> 78% vs. 43.3% for USG and LMG technique. Mallory et al<sup>[11]</sup> a with 85% vs. 15% respectively, the results obtained in our study were almost similar. There were no serious complications like pneumothorax or nerve injuries in either group when compared to the occurrence of pneumothorax in 2.4% vs 0% in Dimitrios Karakisis et al<sup>[6]</sup> study and Tista A. et al<sup>[17]</sup> study of 5.8% vs 0% in LMG technique and USG technique respectively.

A disadvantage associated with USG-guided CVC, is procedure-related increased incidence of infection. But the use of a two-operator technique with sterile self-adhesive plastic and povidone iodine solution has reduced the incidence of infection<sup>[15]</sup> This technique also require skills regarding ultrasoundThe use of ultrasound during CVC is limited and is most strongly associated with the availability and cost of the equipment<sup>[3]</sup>

Complications during central venous catheterization (CVC) are not rare and can be serious. The use of ultrasound during CVC has been recommended to improve patient safety.

## CONCLUSION

our observations and results, we came to the conclusion that the USG approach took lesser time, required lesser attempts, and had lower incidence of complications for cannulation of the internal jugular vein compared to conventional method . Regular use of USG for CVC will definitely benefit critically ill patients. It would be complimentary for any ICU to have portable USG facility, although a costly investment in a developing country like India, one must keep in mind that use of USG is a prudent approach as USG-guided CVC is easier, quicker, and safer than landmark approach. Similarly USG once started to be used generally is expected to be highly useful. The use of ultrasonography in experienced hands reduces the number of attempts and arterial punctures compared with the landmark method.

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