

# Cannulation of Internal Jugular Vein in Neutral Head Position

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## Summary

An approach to cannulate right internal jugular vein in neutral head position is described for situations where head rotation and extension are contraindicated. Venous puncture was made immediately lateral to the carotid artery at the level of cricoid cartilage and directed caudad. In 40 patients studied, the right internal jugular vein of 97.5% of the patients were successfully located by the finder needle. The mean (SE) number of puncture attempts to locate the vein was 1.3 (0.1) per patient. In 72.5% (29 patients), the veins were located exactly at the predicted point after the first attempt. However the overall success rate for cannulation by the angiocath cannula was 87.5% and short term complication rate was 5.0%. We conclude this technique is a reliable, safe alternative for central venous access, especially in patients where cervical spine movement is contraindicated or restricted.

**Key Words :** Internal jugular vein; cannulation, neutral head position

## Introduction

Central venous cannulation with wide bore and relatively short cannula is important in critically ill patients for emergency therapeutic interventions including massive volume resuscitation, infusion of vasoactive agents, monitoring of central haemodynamic parameters and temporary transvenous pacemaker insertion. Cannulation of large central vein is usually performed via either internal jugular or subclavian vein. Subclavian vein cannulation potentially involves higher risk of life threatening complications like pneumothorax, haemothorax and uncontrolled hemorrhage. On the other hand, cannulation of internal jugular vein using the standard approach requires head turning, neck extension and application of sand bag in between the shoulders. This may not be advisable in patient with possible unstable cervical neck injuries or limited neck movements. An approach to cannulate the internal jugular vein that keeps the head and neck in neutral position and uses bony and cartilaginous landmarks would definitely be useful in these patients. The aim of

this study was to determine the success rate, the ease of cannulation and complications in internal jugular cannulation where the patients' head are kept in neutral position.

## Methods

Institutional approval was obtained. Adult surgical and intensive care unit patients who required central venous cannulation were included in this study. The right internal jugular vein was cannulated in neutral head position by the first author with an observer to ascertain patient head position. Demographic data were recorded along with the number of needle passes required to locate the internal jugular vein, the angle of insertion, the length of the finder needle passed and the number of cannulating attempts. The distance between suprasternal notch and right mastoid process in neutral head position was recorded as an indirect indicator for the length of the patient's neck.

The patient was placed in a slight Trendelenberg

position (10-20 degree) with the head and neck in neutral position. The procedure was performed under aseptic condition with the operator standing at the patient's head end. The cricoid cartilage was identified with the operator's left index finger and the right carotid pulse was palpated by running the finger laterally at the same level. The insertion point was identified as just lateral to the palpating left index finger at the cricoid level (Fig. 1). A 22-gauge finder needle attached on a 3mls syringe was inserted at the angle of 60° - 80° while the palpating left index finger releases its exerted pressure on the skin overlying the carotid artery. While maintaining negative pressure by aspirating, the finder needle was directed caudad in parallel with median sagittal plane. Once the internal jugular vein was located as shown by free flow of dark venous blood, cannulation proceeded by using 16-gauge

3 1/4" angiocath needle inserted just inferior to the finder needle in the same direction.

If the first attempt in locating the vein was unsuccessful, subsequent attempts were performed 2-4mm lateral to the first insertion point. Seldinger technique was not used routinely because guide wires were not always readily available during the initial period of the study. Catheters were inserted by a twisting maneuver if a guide wire was not used. After cannulation, central venous placements were verified by chest x-ray or waveform analysis.

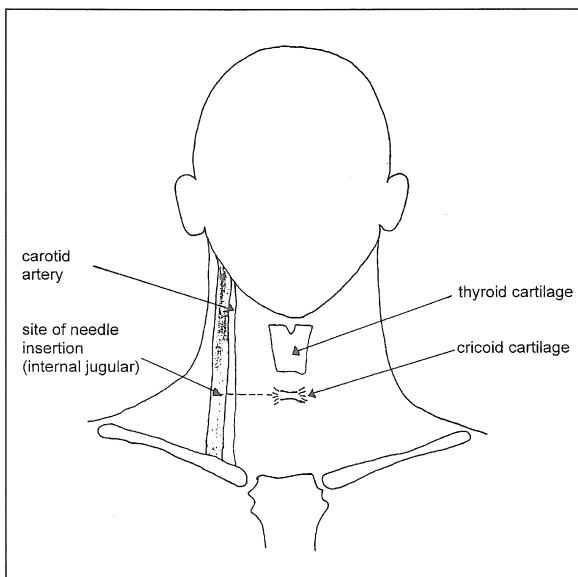
## Results

A total of 40 patients were studied. The demographic data are shown in Table I. The mean distance between sternal notch and mastoid process with the head in neutral position was 19cm (range 16 - 22cm).

There was only one failure in locating the vein by the finder needle, the success rate in locating the vein was 97.5%. The mean (SE) number of needle passes required to locate the vein was 1.3 (0.1) per person (Table II). However, cannulation was not successful in four patients despite the vein being successfully located by the finder needle. The overall success rate of cannulation was 87.5% (35 patients), mean (SE) number of cannulation for each patient was 1.5 (0.1). Twenty-two patients were successfully cannulated without guidewire.

The length of finder needle inserted to locate the vein ranged from 1 - 3cm with a mean of 2.3cm. The insertion angle of the approach needle was mainly 70 - 80 degree to the skin. The internal jugular veins were located exactly at the described point at the first attempt in 29 out of 40 patients (72.5%).

Two patients were awake during the procedure and both have been successfully cannulated. The others were intubated and sedated with or without paralysis. The only patient in whom attempt to locate the vein was unsuccessful had relatively short neck, with a sterno-mastoid distance of 16cm. For the 4 patients in whom cannulation failed despite the vein was successfully located, guide wires were used in 2 of them; three of these patients subsequently had successful cannulation



**Fig. 1 : Anatomical landmark for needle insertion.**

**Right carotid pulsation identified by the operator's left index finger at cricoid level, needle insertion made just lateral to the palpating finger while it releases its exerted pressure on the skin and directed caudad; parallel with the median sagittal plane**

in conventional position. The internal jugular vein of the remaining 1 patient was not able to be located again due to haematoma formation.

Two patients developed complications without physiological sequelae; Both had haematoma formation (5.0%), one of whom resulted from carotid artery puncture (2.5%).

## Discussion

Although there are more than 15 techniques described<sup>1</sup> for cannulation of the internal jugular vein, almost all of these techniques require head rotation and neck extension. The advantages of cannulating the internal jugular vein in neutral head position are not limited to

patients with suspected cervical neck injury. There is no associated diminution in venous blood flow and anatomical changes as which may occur with extreme head rotation<sup>2</sup>. This approach may also be useful in patients with vertebro-basilar insufficiency.

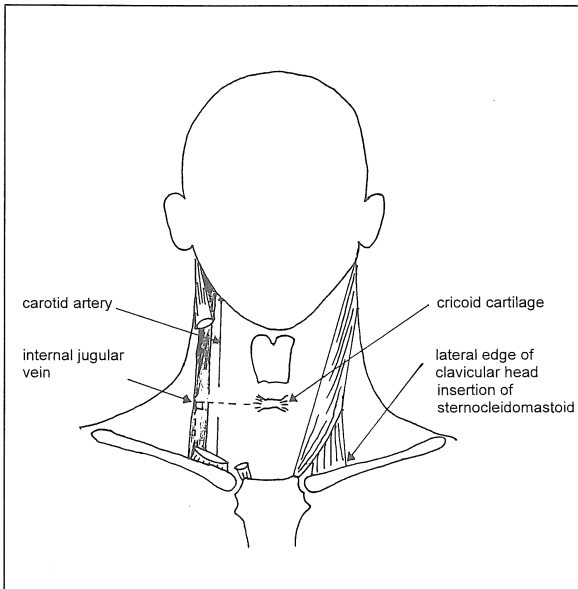
Willeford and Reitan first described neutral head position for placement of internal jugular catheters<sup>3</sup> in 1994; Their insertion landmark was at the intersects of the two perpendicular lines that are drawn horizontally from the cricoid cartilage and the other vertically from the lateral edge of the clavicular head insertion of sternocleidomastoid muscle (Fig 2). The landmarks used is very useful in patients with prominent sternocleidomastoid muscle where the carotid artery may be buried and its pulsation is difficult to be felt at cricoid level with the head in neutral position. In this

**Table I**  
**Mean age and weight, mean distance between suprasternal notch and right mastoid process of the patients**

	Male	Female	Total
Number of patient	22	18	40
Mean (SE) age in years	51 (4)	43 (5)	47 (3)
Mean (SE) weight in kg	60.1 (1.9)	50.7 (2.2)	55.8 (1.6)
Mean (SE) sterno-mastoid distance in cm	19.0 (0.3)	18.4 (0.4)	18.8 (0.3)

**Table II**  
**Success rate, total number and mean (SE) of needle insertion/cannulation per patient**

	Success rate (number of patients)	Total number of needle insertion/cannulation	Mean (SE) number of needle insertion/ cannulation per patient
Locating finder needle	97.5% (39)	50	1.3 (0.1)
Cannulating angiocath needle	87.5% (35)	51	1.5 (0.1)



**Fig. 2. KL Willeford and JA Reitan identification landmarks**  
**A line drawn in cephalad direction from the lateral edge of clavicular head insertion of sternocleidomastoid muscle and intersects with the line drawn horizontal from the cricoid cartilage, forming a right angle. Needle insertion made at the intersection point of the two lines and directed caudad**

study, we used a point at the level of cricoid just lateral to the carotid pulsation. This landmark is useful in patients who has unnoticeable sternocleidomastoid muscle (especially females in neutral head position) where the lateral edge of the clavicular head insertion of the sternocleidomastoid muscle difficult to be identified. In this situation, the carotid pulsation is easily felt at cricoid level and make accurate placement of catheter possible. We believed this is the same point of needle insertion as that described by Willeford and Reitan.

The Trendelenburg position has been shown to increase the diameter of the internal jugular vein ultrasonically. The internal jugular vein is also significantly larger caudad to the cricoid level<sup>2</sup>; cannulation through low

approach at the level of inferior bulb just above the clavicle may not be associated with better success rate despite the larger vessel size<sup>1</sup>. Thus insertion at the cricoid level is considered optimal as the vein is widened inferiorly and there are fewer chances in causing pneumothorax.

The internal jugular veins are easily compressed with minimal external pressure, the advancing cannulating needle may sometimes compress the vein and thus may only aspirating blood during withdrawal<sup>4</sup>; for the same reason, pressure exerted by the palpating finger will definitely reduce the diameter of internal jugular vein. In this study, the carotid artery was initially palpated to locate the landmark, but pressure was released during needle insertion so as not to compress the vein.

It has shown that no more than 4cm of needle needed to be inserted to locate the vein in most case<sup>2</sup>. The mean skin to vein distance of 2.3cm is not a measure of the perpendicular distance from the skin to the vessel, but rather of the distance traveled by the finder needle at 60° to 80° to the skin. This distance is slightly shorter and comparable with study done under ultrasound guidance (2.59cm) for conventional methods where the cannulating needle at approximately 30° to the skin<sup>1</sup>. Chance of successful cannulation diminishes with each needle pass<sup>5</sup>, making cannulation unlikely after 5 unsuccessful needle pass, after which the procedure should be abandoned.

The main disadvantage involved in this technique is the limited space available for cannulation. The patient's mandible may obstruct the area especially if the neck is short. The patient's abducted arm while on the operating table may further narrow the area available for cannulation. Cannulation may require passage through the sternocleidomastoid muscle and thus more resistance encountered. The time required for cannulation may be slightly longer than the standard technique although this was not investigated in this study.

The success rate (97.5%) for locating the vein and the average number of needle pass (1.3) per patient were comparable with the results of K.L. Willeford and J.A. Reitan study, as well as other conventional methods without ultrasound guidance<sup>2</sup>. The success rate for cannulation (87.5%) in this study would definitely

improve with routine use of Seldinger technique. The complication rate in this group of patients was comparable to that of other techniques; the reported incidence of carotid artery puncture during internal jugular vein cannulation is 2 - 11%<sup>1,5,6</sup>.

### Conclusion

In conclusion, cannulation of internal jugular vein with the head and neck in neutral position is a valuable alternative method for central venous cannulation especially in patients with suspected cervical spine injury. Although it is technically more difficult in patients with short neck, the overall success rate is good and is not associated with increased rate of complications.

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