



## Ultrasound-Guided Right Internal Jugular Vein Access

Brian D. Sites, MD  
Dept of Anesthesiology  
Dartmouth-Hitchcock Medical Center

### Abbreviations

Welcome to ultrasound-guided right internal jugular vein access. Here are some abbreviations used throughout this video: IJ = internal jugular vein, CA = carotid artery, SCM = sternocleidomastoid muscle.

### Why Ultrasound?

Why ultrasound? Evidence is strong that ultrasound increases accuracy and success. Morbidity associated with central venous access is common and serious. Ultrasound may decrease morbidity, especially in patients with atypical anatomy.

In a large meta-analysis conducted in 2003, consisting of over 16,000 participants and 18 trials, ultrasound was demonstrated to result in a dramatic reduction in failure rates, as well as a decrease in complication rates.

### Background Anatomy

The internal jugular vein lies anterior and lateral to the internal and then common carotid artery. More discussion can be found in the video on traditional right IJ central line placement by Dr. Hung. I want to stress that the important anatomical point is that the IJ anatomy is highly variable. You will see anatomical variations on ultrasound.

Here is the typical relationship of the IJ to the carotid. Screen right is lateral, screen left is medial. This is a short-axis image of the vascular structures. IJ, once again, is internal jugular vein, CA is carotid artery, SCM is sternocleidomastoid muscle. Of

note, the IJ tends to take on a more superficial and slightly lateral location in the carotid artery.

When the transducer is moved in a slightly medial direction, the operator can now see the trachea and the thyroid gland with respect to the carotid artery. The thyroid gland is a generally homogenous hyperechoic structure. It is very common to see cysts and abnormalities in the thyroid gland.

In the following video, we have removed all of the labels so that the student and the reviewer can be assured that they understand all of the anatomical structures without the benefit of labels.

### **Anatomical Variation**

This following cartoon demonstrates the various relationships between the carotid and IJ that exist. The normal appearance is indicated on the left-hand side of the cartoon. One can see a reversal in which the IJ is actually medial to the carotid. One can see a situation in which the IJ is either partially or completely overriding the carotid artery. The IJ can be very small with or without an override. A very attractive aspect of ultrasound is that the operator has a chance to identify these anatomical variations prior to ever inserting a needle into the patient. An example of a complete override is demonstrated here in which the IJ is actually wrapping around the carotid artery. It should be self-evident why puncturing the back wall of the IJ in this situation would be unattractive.

It should also be noted that surface landmarks have been demonstrated to be unreliable. There is a medial bias of greater than 3 to 4 mm. These problems are augmented by obesity, as well as prior neck procedures and surgery.

### **Technique I: Marking**

There are two primary techniques for placing a right IJ ultrasound-guided central line. The first technique is called the marking technique. In this technique, we simply image the internal jugular vein and carotid artery in short axis. We then confirm the patency of the IJ. It is also important to identify collateral targets such as the external jugular vein that may be in the way of a needle puncture. Using a pen, the operator marks both the course of the vein and the skin puncture site. It is important to identify the depth of the vein. The operator then puts away the ultrasound machine and proceeds conventionally.

The marking technique is demonstrated here. The attractive aspects of this technique are that, one, ergonomics are not an issue because this is not a live technique following your needle. Secondly, sterility is not an issue when using the ultrasound device. The operator has confirmed that the IJ is patent and has a normal anatomical relationship to the carotid and has marked the course of the

vein. The large arrows indicate both the proximal and distal marking sites. The small arrow indicates the anticipated needle puncture site; this was picked based on its lack of association with any collateral structures such as the external jugular vein.

## **Technique II: Real-Time Image Guidance**

The second technique is that of real-time ultrasound guidance. This is the recommended technique by most users. It allows the ability to steer the needle to the target. It usually utilizes the out-of-plane needle insertion technique. It also has the benefit that one can confirm the location of the wire in the IJ prior to dilatation. The following video demonstrates the real-time technique.

In this technique, the patient is placed in the Trendelenburg position with the head turned toward the contralateral side.

It is important to think of good ergonomics when setting up for the central line placement.

Following skin sterilization, a large drape is applied to the field.

Next, a sterile transducer cover is placed over the transducer. An elastic keeps the cover tight to the transducer.

Ultrasound gel is placed on the neck.

In order to distinguish the IJ from the carotid, compression reveals the IJ collapsing.

In addition, colored Doppler can help reveal pulsatile flow versus venous flow. The pulsatile flow is the arterial flow. In this case, the pulsatile flow is blue and the venous flow, non-pulsatile, is red.

The following represents short-axis imaging and the in-plane needle insertion technique.

Here we see the needle entering the skin. The IJ typically collapses as the needle contacts it. After blood is aspirated, the transducer is put down.

The next step is to detach the syringe from the needle. Once the syringe is detached from the needle, the guidewire can be inserted through the needle into the internal jugular vein, as demonstrated here.

A very attractive benefit of ultrasound is the ability to confirm that the wire is in the IJ prior to dilation. There are several steps to confirm wire placement. First, find part of the wire using the short-axis view, then rotate the transducer approximately 90 degrees in either direction, find where the wire enters the IJ, and confirm that it travels distal, then apply transducer pressure in the long-axis view to confirm compression of the IJ.

Here we see the wire in the IJ in short axis. With the transducer turned 90 degrees, we clearly see both the proximal and distal ends of the wire, then with transducer compression, we see the collapse of the IJ confirming wire placement. Next, a small skin nick is made with a scalpel in order to facilitate the insertion of the dilator over the wire. The objective is to dilate the skin and subcutaneous tissues, not necessarily the IJ itself.

Maintaining careful sterility, the dilator is removed, the wire is left in place, and the central line is then slid over the wire using what is known as the Seldinger technique.

The catheter should thread easily into the patient. The wire is then removed. The final steps would include aspirating and flushing ports, securing the catheter to the skin, and placing a sterile dressing on.

## **Clinical Pearls**

Colored Doppler may reveal no flow in the IJ if the angle of the beam is exactly perpendicular to the blood flow. This is based on the Doppler equation and is reviewed in detail in the introductory physics video. To deal with this, simply tilt the transducer slightly in either the caudad or cephalad direction.

It should be noted that blue does not necessarily mean vein and red does not necessarily mean artery. Colors map directionality of blood in addition to velocity. Therefore, depending on the transducer angle, venous flow rates, and machine scale settings, the IJ blood flow may appear blue, red, or a combination thereof.

The following video demonstrates how the color in the IJ can change with simple transducer angling.

The IJ is first red; then when the beam is perpendicular, no color; and then with some more tilting, the IJ is blue.

As is true for nerves, vascular structures are often associated with pathology. Common pathology includes IJ thrombosis, missing IJ, atherosclerotic lesions in the carotid, and perivascular lymphadenopathy.

The following is an example of an unexpected thrombosis of the right IJ discovered incidentally by ultrasound. In this short-axis image, we see a heterogeneous echogenicity that fills the IJ; this is the thrombosis. The long-axis view reveals carotid flow but no IJ flow.

Following the identification of this thrombosis, the operator decided to place the central line on the contralateral side. One can see in this video that the IJ is of normal size and caliber.

## **Summary**

In summary, ultrasound can facilitate right internal jugular vein central line insertion, image the vein in short axis, and use the out-of-plane needle insertion technique. Wire location can be confirmed using a long-axis imaging. Color Doppler can aid in distinguishing vein from artery.