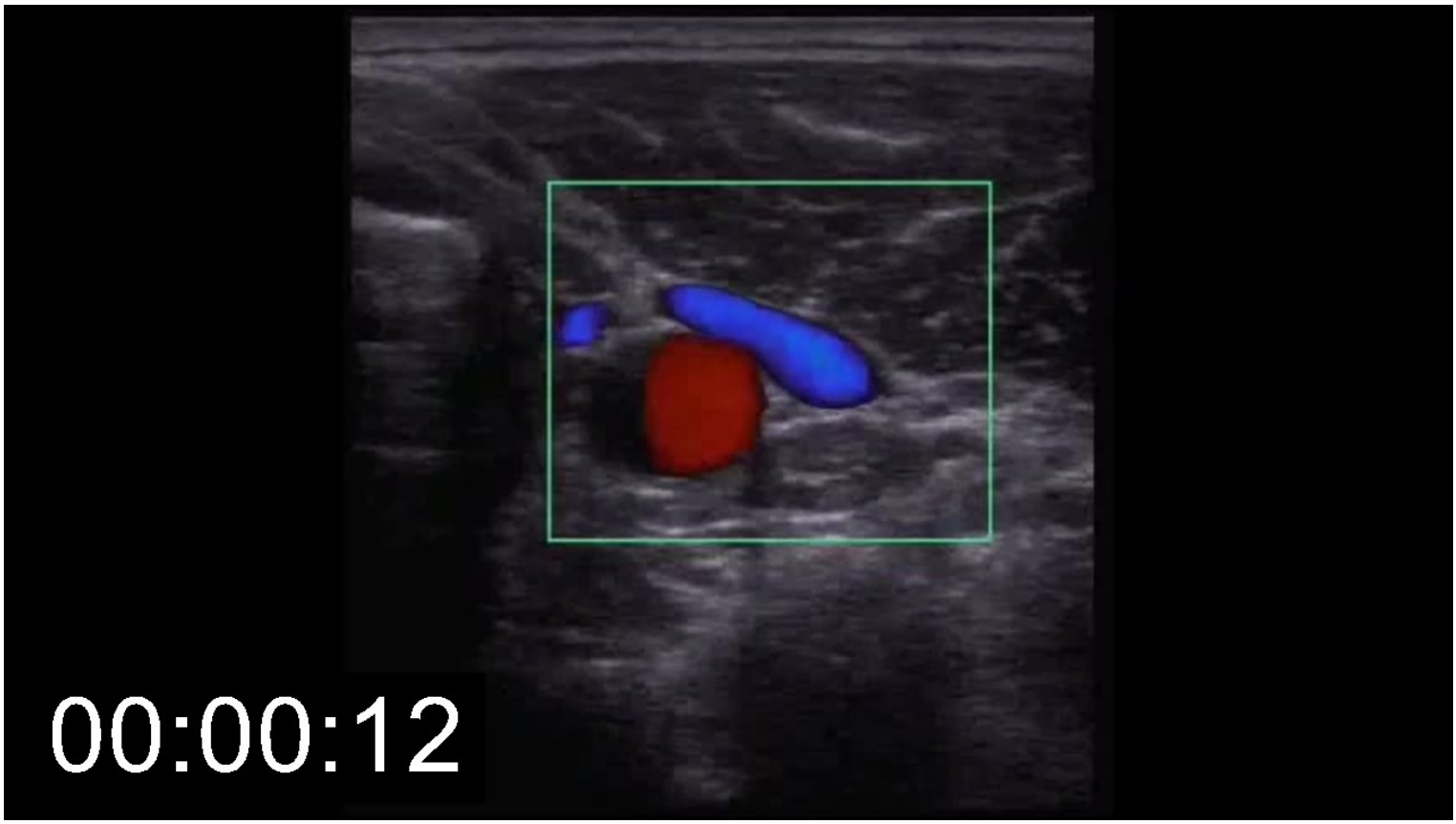
Chapter 11: Ultrasound-Guided Internal Jugular Central Venous Catheterization (CVC)

KEY IMAGES

Transverse view of neck vein and artery

Video 11-01: Transverse view of carotid and internal jugular

The anatomy of the right neck is visible in this clip acquired in the transverse view. The carotid can be seen medial, and has pulsatile flow. The heterogenous structure to the left of the carotid is the thyroid gland. The sternocleidomastoid muscle overlies both the carotid and internal jugular vein. The color of the flow does not indicate the oxygenation status of the blood, instead merely demonstrates whether blood is moving toward or away from the transducer, but in this case the carotid artery is red and the jugular vein is blue.



Play Video

Hand position, transverse

Video 11-02: Transverse view of carotid and internal jugular

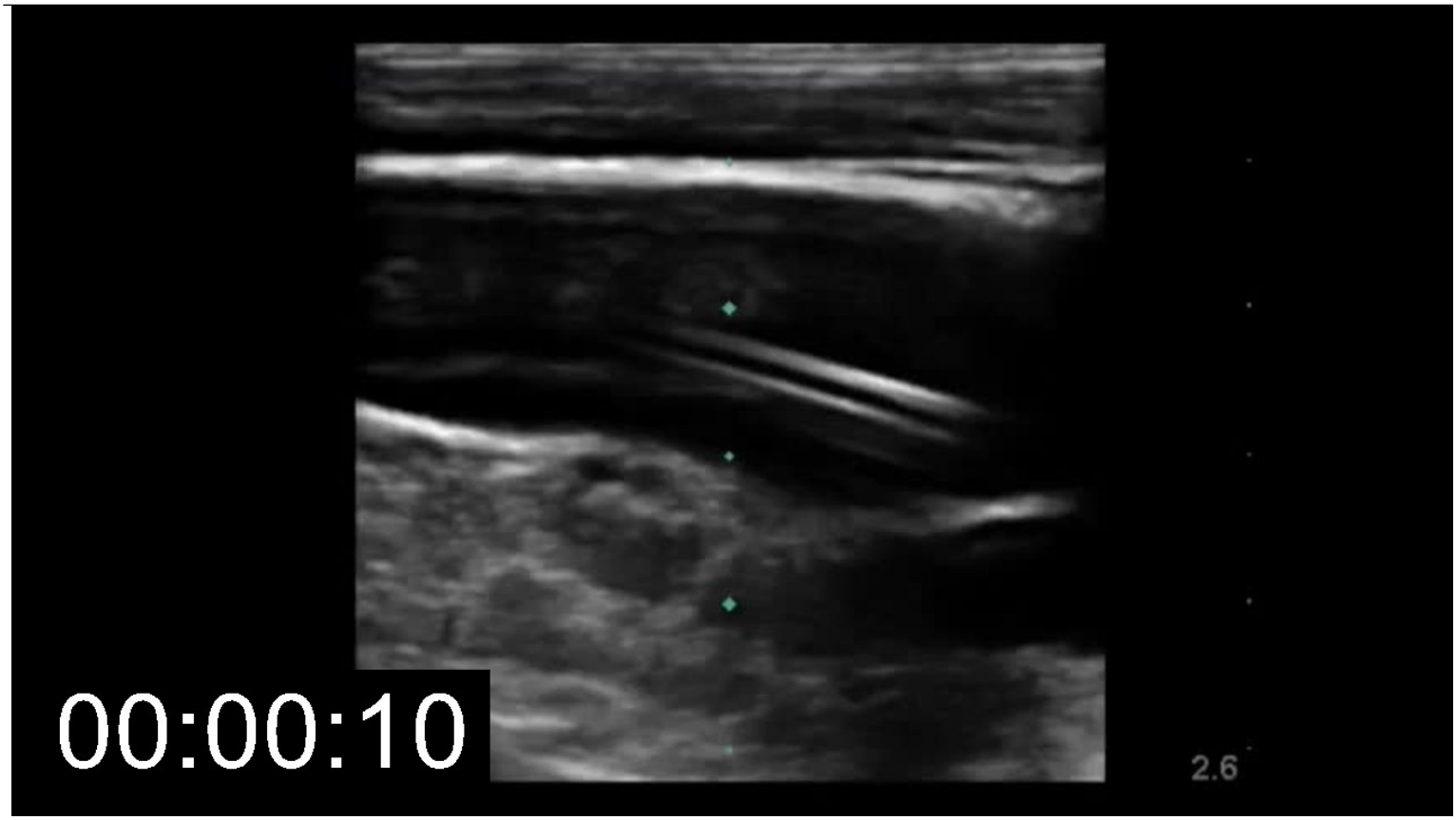
This video demonstrates an ideal patient setup and how to apply gel to the probe and to apply a sterile probe cover. 1 min, 41 secs 640 360

Play Video

Longitudinal view of vein with catheter

Video 11-03: Longitudinal view of the catheter in the vein

In the longitudinal axis a post procedural ultrasound can visualize the catheter and ensure that it remains within the internal jugular vein without penetrating the posterior wall.



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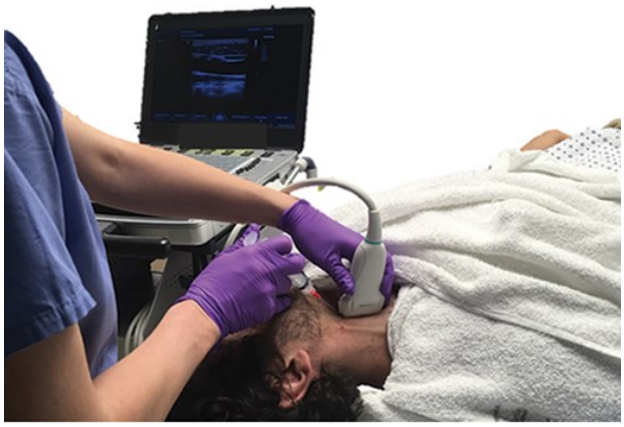
Hand position, longitudinal

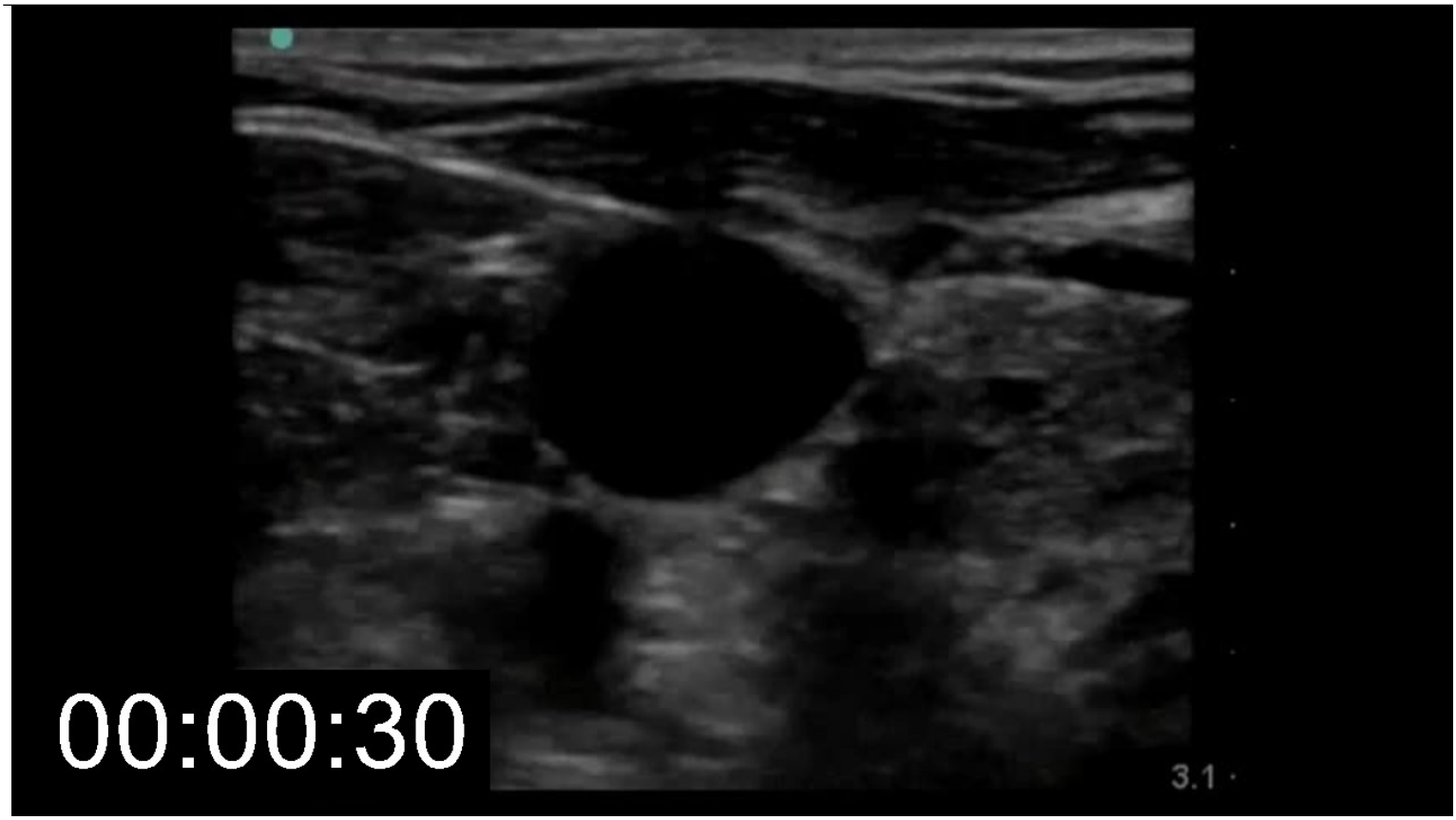
Figure 11-1



Transverse view of needle entering vessel

Video 11-04: Needle accessing the internal jugular vein in the transverse view

When the needle is about the enter the vein there will frequently be indentation of the superficial side of the vessel. Caution is required at this point, as too much pressure will result in a sudden release of that tension and the needle penetrating the posterior wall. In this case, once the vessel wall releases and the vein returns to a round shape the needle can be seen near (but not through) the posterior wall of the internal jugular vein.



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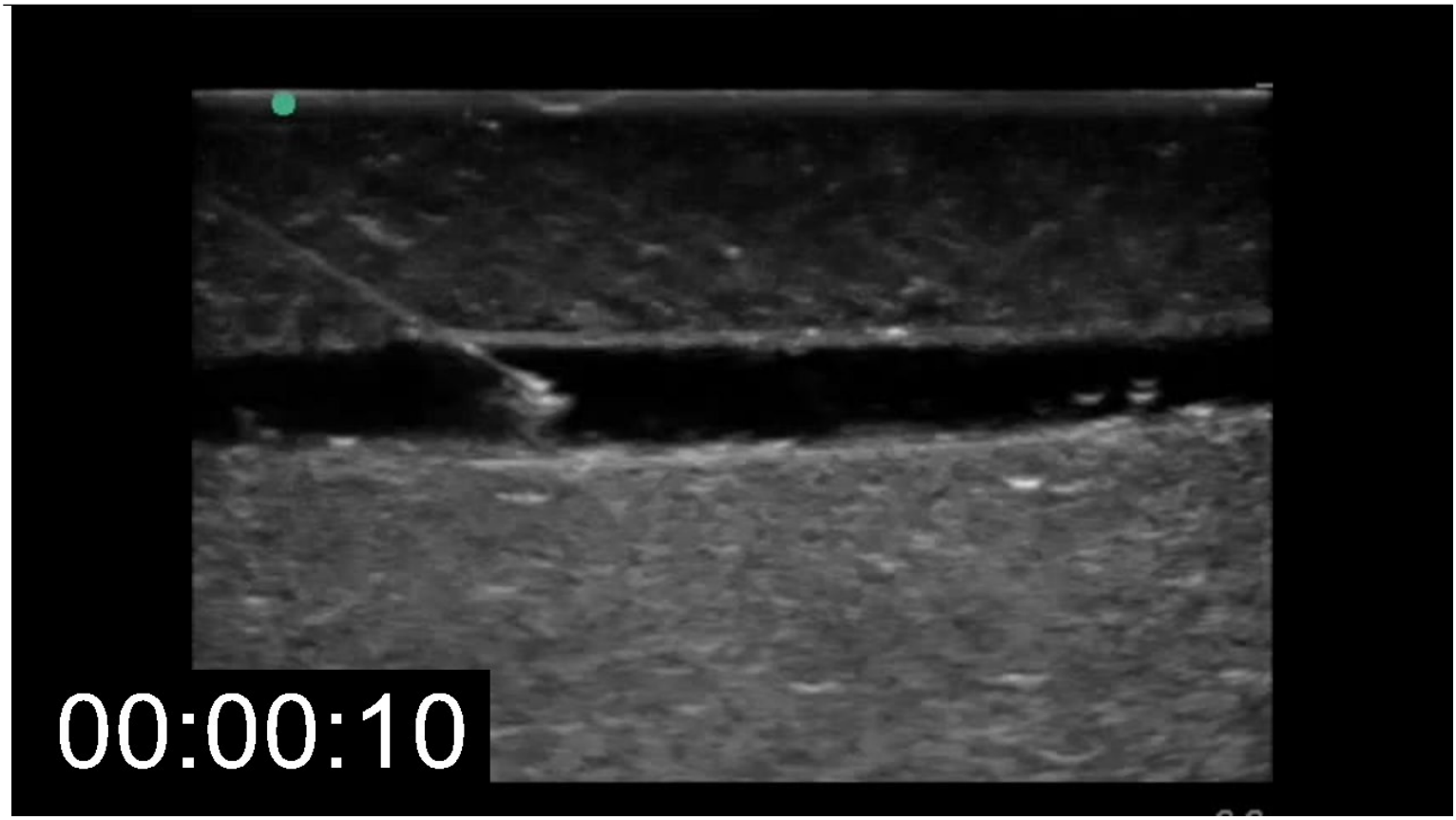
Longitudinal view of needle in vessel

Video 11-05: Needle accessing a vessel in longitudinal axis

In the longitudinal view the needle and the bevel can be visualized throughout the pass into the vessel.



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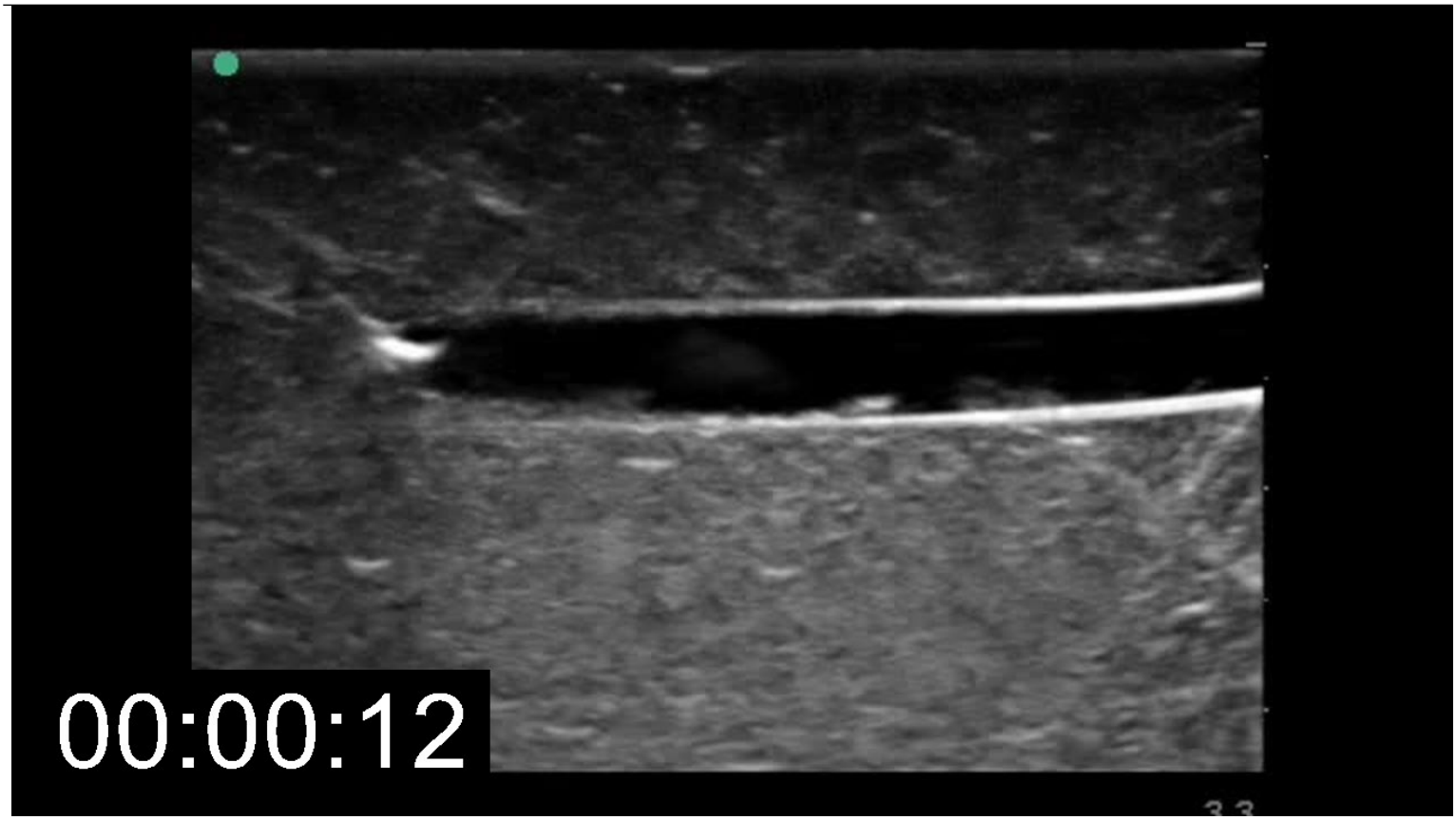
Longitudinal view of wire in vessel

Video 11-06: Wire entering the vessel in longitudinal view

Once in the vessel, the wire can be advanced. In the longitudinal view a confirmatory examination with ultrasound should show a gently curved wire lying against the posterior side of the vessel, not passing through the posterior wall.



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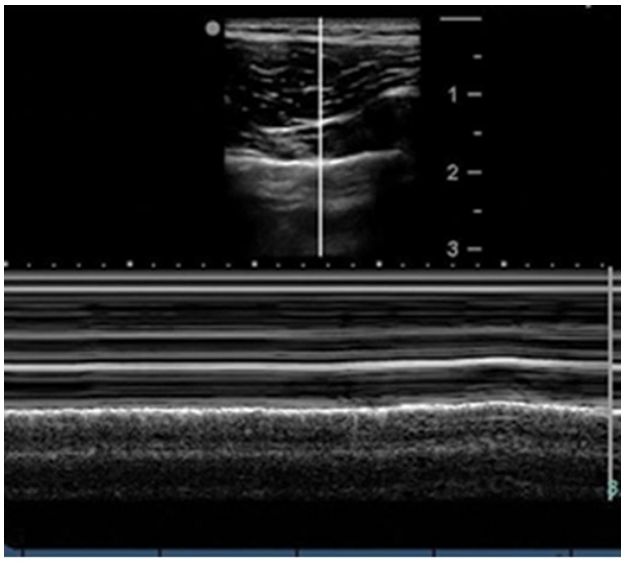
Lung sliding

Figure 11-2

Confirm lung sliding present BEFORE and after procedure.



ACQUISITION TIPS AND TECHNIQUE

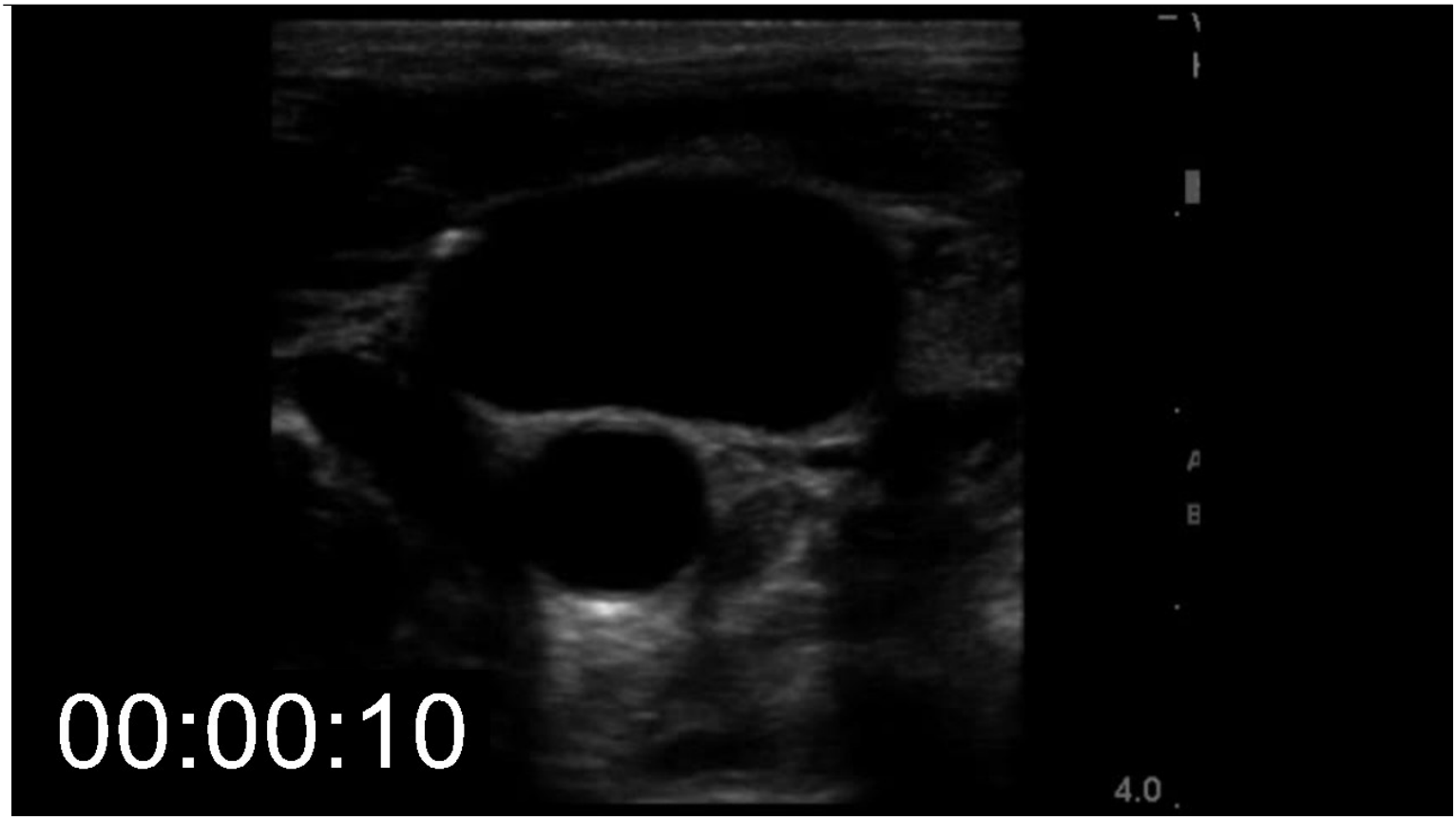
- The technique and skills for ultrasound-guided CVC of the internal jugular (IJ) vein (or any other vessel) are the same as those in Chapter 3 for peripheral venous access.

- In addition to the relative advantages of the two techniques described in Chapter 3 (in-plane and transverse), the probe footprint (transducer width) and anatomy (e.g., length of neck) will also influence choice of scanning plane.
- To maintain the sterile field, for a CVC, a commercial probe cover that also covers at least 24 inches of the transducer wire should be used. Standard sterile prep of the insertion site will also be needed.
- Position the patient as you would for a central line when doing your initial scan. Adjust the position of the US screen, the height of the bed, and the position of the table so that you are as comfortable as possible.
- All scanning should be done with the linear (or vascular) probe.
- Evaluate both sides of the body. Usually one side has an easier approach.
- Choose a puncture site that gives direct access to the vessel with minimal potential to puncture the carotid artery (CA) (the IJ next to the CA, not in front of or behind it). Sliding the probe anteriorly or posteriorly at any level may move the CA out of the way.
- The landmarks to identify the IJ are the heads of the sternocleidomastoid (SCM) muscle. Start at the apex of the triangle. For patient comfort, minimize the amount of SCM penetrated.
- Check compressibility and anatomy prior to the procedure.
- The probe should be perpendicular to the skin at all times.
- Use light pressure on the skin and ample gel; too much pressure can collapse the vein.
- Check for lung sliding before and after the procedure (see Chapter 6 for more details).
- Compress the vessel above and below your intended insertion site to look for thrombus.
- Confirmation of placement and absence of posterior-wall perforation can be performed using the linear probe to confirm placement inside the vein and cardiac ultrasound to visualize the right atrium.
- US guidance for subclavian CVC has the advantage of allowing line placement using visualization of the axillary vein.

Vein overlying artery (poor position)

Video 11-07: Internal jugular vein directly over carotid artery

Evaluation of the anatomy should be done in several positions. In some patients the internal jugular vein will completely lie anterior to the carotid artery, as in this example. Frequently, changing the angle of the patient's head, or using a more anterior approach with the ultrasound transducer (as compared to a lateral approach) can create a path for the needle with less risk of an arterial puncture.



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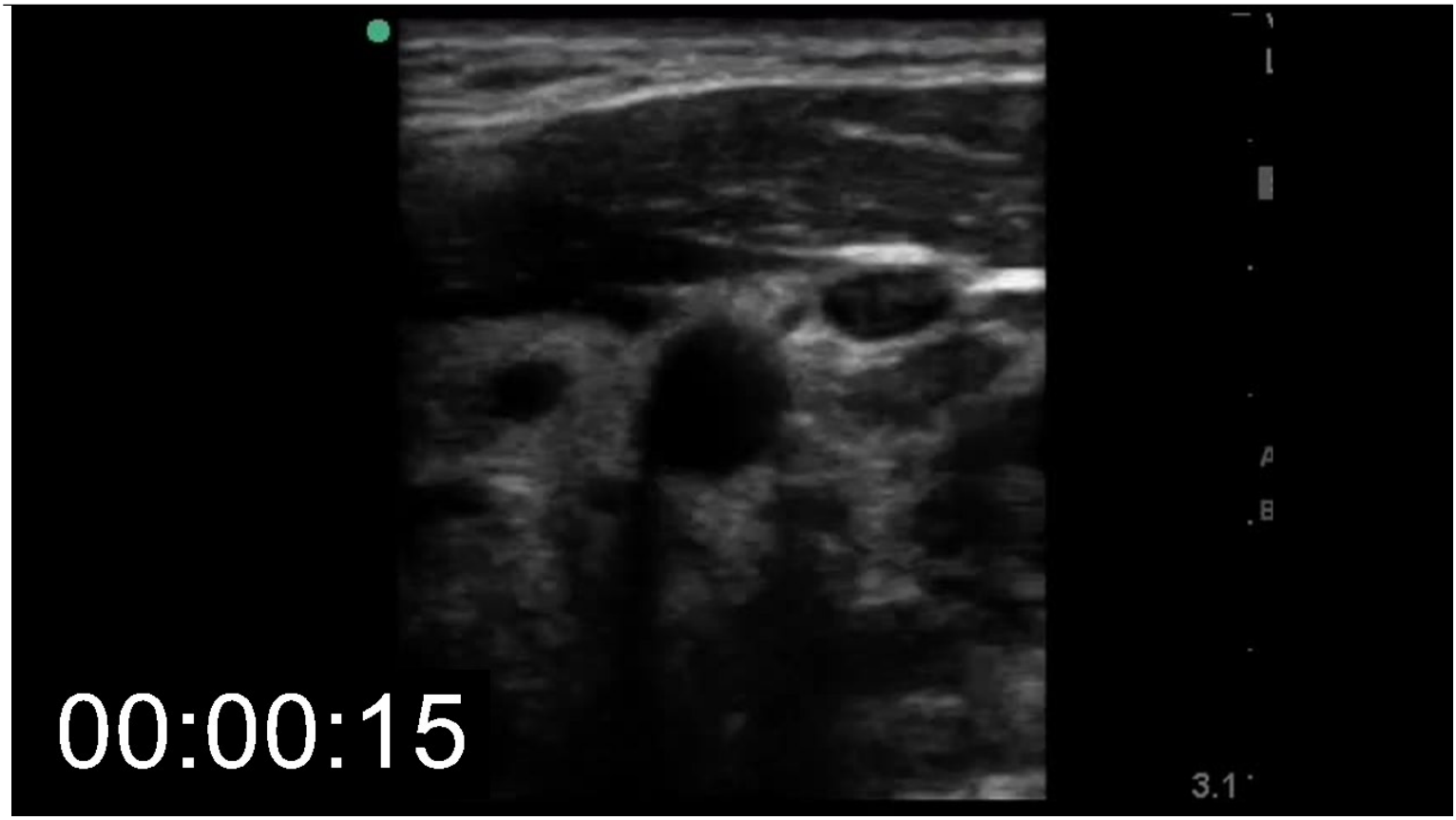
Vein adjacent to artery (improved position)

Video 11-08: Internal jugular vein net to carotid artery

Frequently patients do not have large internal jugular veins to target for a central venous catheter. In the case of a small vessel such as this one, the first step is to evaluate the other side of the neck to see if it is a larger target. If that is not possible, then ensuring that the vein is lateral to the artery (as in this video), instead of anterior to the artery, becomes essential to decrease risk of arterial puncture.



Play Video

Axillary vein

Video 11-09: Axillary vein transitioning to subclavian vein

In the longitudinal view it is possible t visualize the axillary vein as it travels underneath the clavicle an becomes the subclavian vein. This view allows safe guidance of a needle using the longitudinal approach directly into the vessel. Also, this allows visualization of the soft tissue deep tot the vein so that the operator knows the depth of the lung (would be visible as lung sliding of the pleura deep to the 2nd rib space.

Play Video

Hand position

Figure 11-3

Source: C. M. Baston, C. Moore, E. A. Krebs, A. J. Dean, N. Panebianco:
Pocket Guide to POCUS: Point-of-Care Tips for Point-of-Care Ultrasound, 1st edition.

INTERPRETATION AND PITFALLS

- Measure the depth of soft issue you will need to penetrate.
- Lidocaine should be injected along the anticipated CVC path under US guidance.
- Try to avoid penetrating a large quantity of muscle, lymph nodes, or other vessels.
- If lung sliding or B-lines were present before the procedure and are not present afterward, there should be very high suspicion for a pneumothorax. As with US-guided peripheral access, the most common error is failure to continuously monitor the location of the needle tip. Use the technique described in Chapter 3.

- Some practitioners use a “bounce” to identify the location of the needle. This technique may inadvertently advance the needle and therefore is not recommended. Sometimes, very gentle side-to-side motion can distinguish the needle tip from other structures.
- Neck veins have tough walls. If the anterior wall can be visualized bowing without needle penetration, a twisting motion or a steeper needle angle may facilitate puncture.
- If the bevel of the needle enters the vessel, there will be a “flash” of blood, but this does not confirm readiness for wire insertion. The entire bevel and needle must be in the lumen prior to wire insertion. Flatten the angle of the needle and continue to track the tip in the vein with ultrasound for at least a centimeter (see Chapter 3).
- Premature attempts to insert the guidewire without fully entering the vessel will result in procedural failure and likely hematoma formation.
- After the procedure, ultrasound can be used to check for complications such as pneumothorax (using lung sliding as described in Chapter 6) and postprocedural hematoma and thrombus (see image).

Figure 11-4

Measuring depth

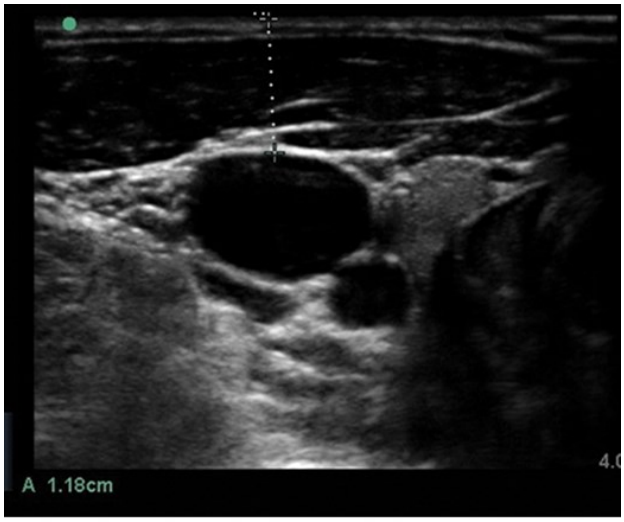


Figure 11-5

The two images below were taken at the same time. In the image on the left, the needle appears above the vessel. A search to find the needle tip identified it within the vessel lumen (image on the right).

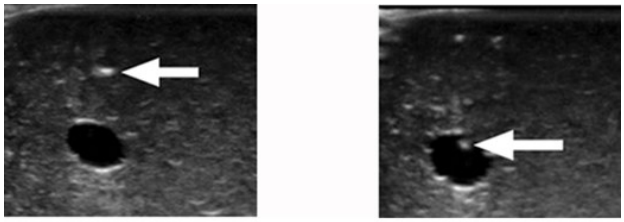
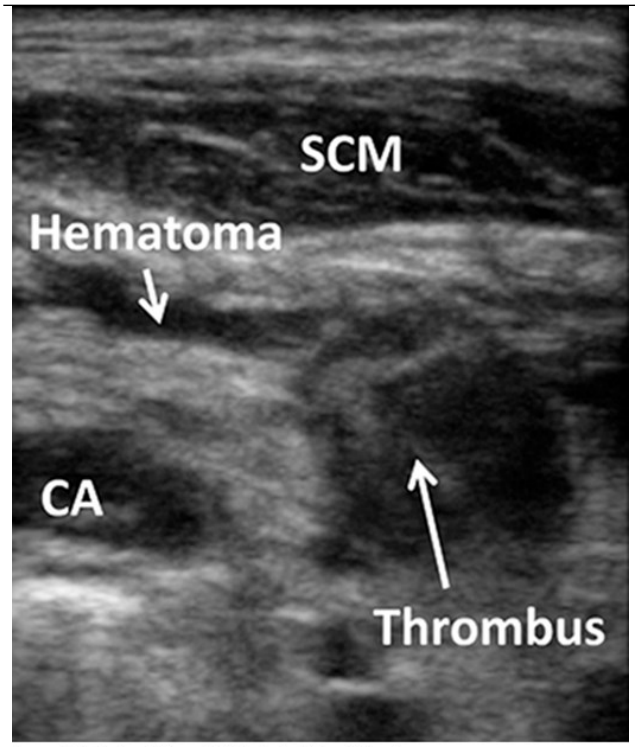


Figure 11-6



Source: C. M. Baston, C. Moore, E. A. Krebs, A. J. Dean, N. Panebianco:
Pocket Guide to POCUS: Point-of-Care Tips for Point-of-Care Ultrasound, 1st edition.

EXAMPLES OF PATHOLOGY

Video 11-10: Post procedural hematoma and thrombus of the internal jugular vein

Following a central line placement in this patient, a heterogenous fluid collection can be seen surrounding the internal jugular vein. In addition, the vein itself has become noncompressible and has signs of a thrombus at the site where the catheter previously rested in the vessel.

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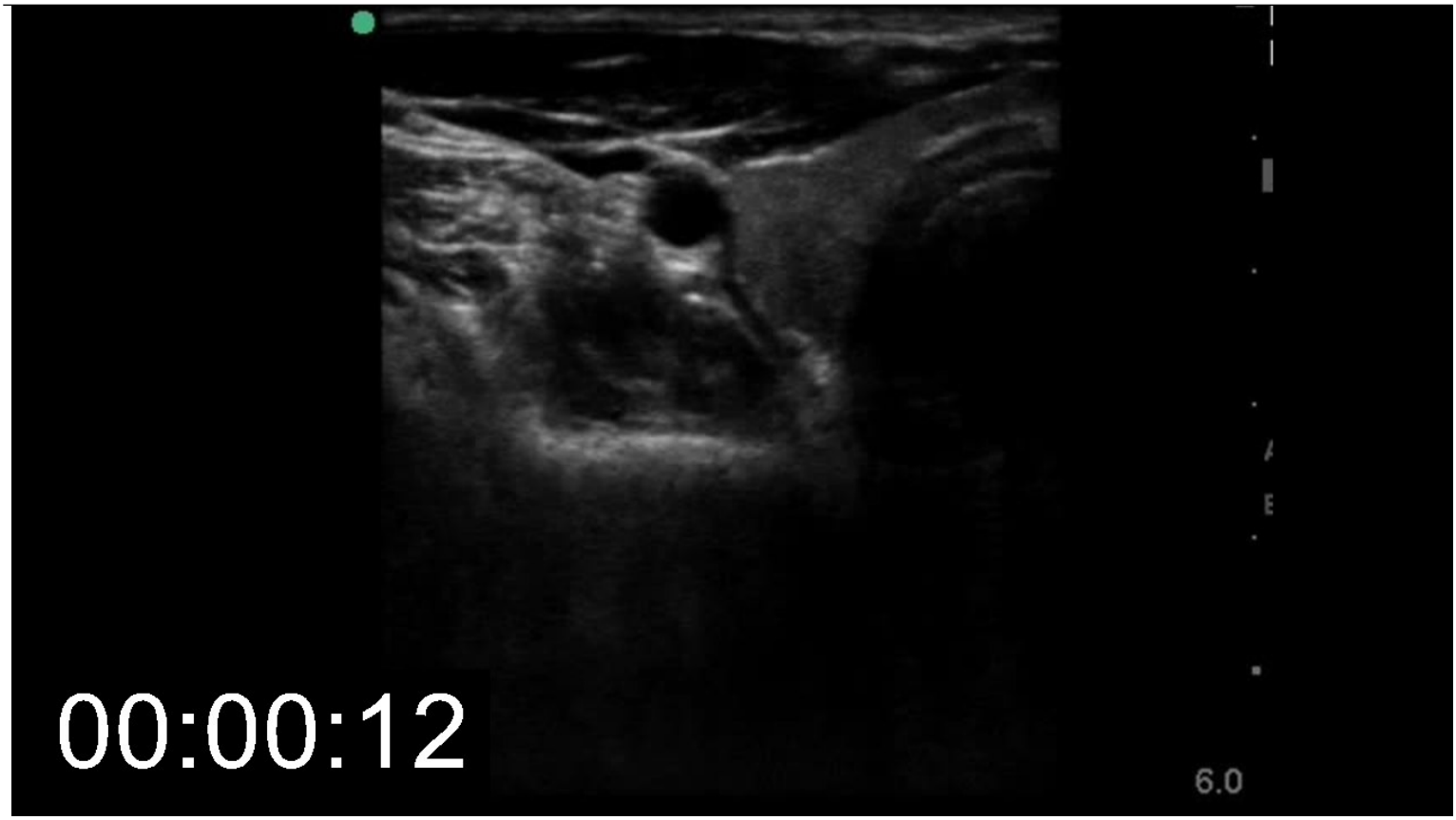
Video 11-11: Collapsing internal jugular vein

It is important to compress the internal jugular vein prior to attempting a procedure to ensure that there is no sign of a thrombus. In a patient such as this, however, even light pressure causes the vein to completely collapse. This should be accounted for when anticipating challenges of accessing the vessel. Patient positioning can help this issue, as inclining the patient so that the head is down will cause the jugular veins to fill.



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Video 11-12: Overlying sternocleidomastoid muscle body

This video was taken at a location where the thickest part of the sternocleidomastoid directly overlies the internal jugular vein. While this is not a safety issue, it can make the catheter less comfortable for the patient. Patient positioning can usually improve this, as having the patient change the angle of their head will move the muscle belly more than it moves the vessels.

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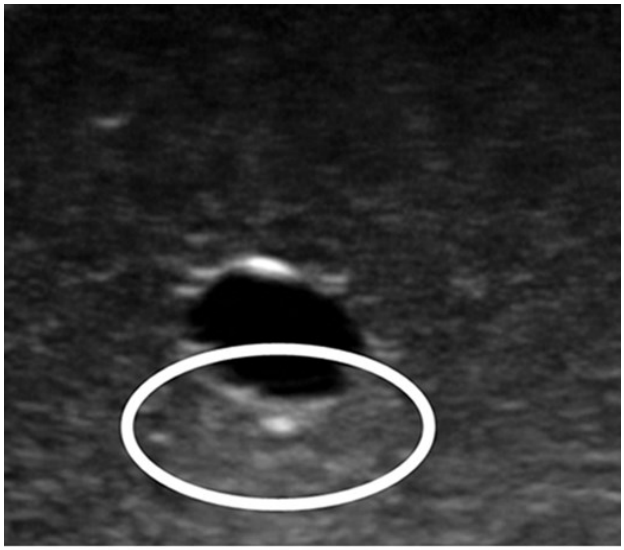
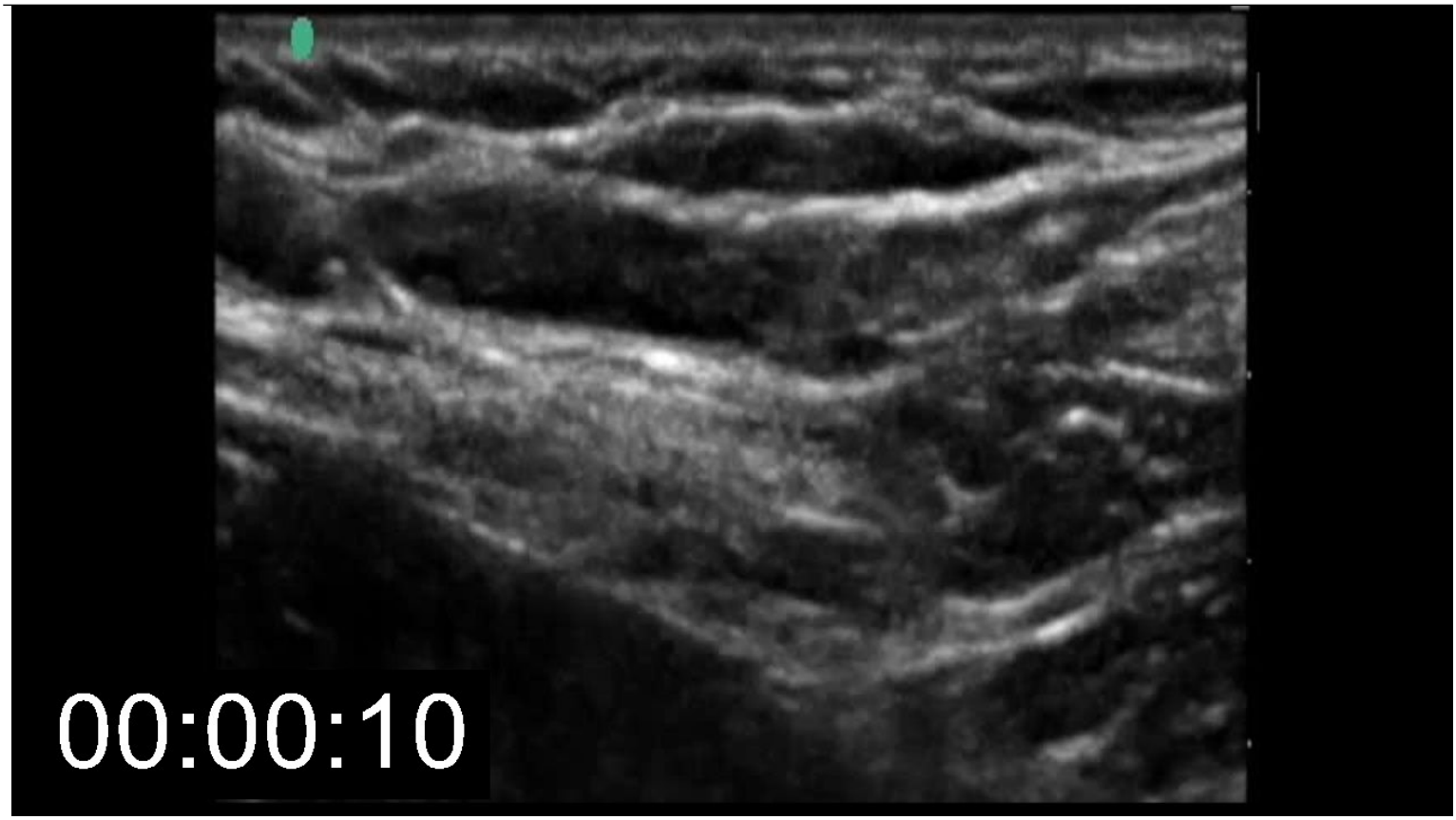
Needle penetrating the back wall in transverse position

Figure 11-7



Video 11-13: Catheter penetrating the posterior wall of the vessel in the long axis

In this video the catheter can be seen penetrating the posterior wall of the vein, lodging into the soft tissue and gradually forming a small hematoma.



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Bevel only partially in vein

Figure 11-8

This will cause failure to advance the wire.