Either a two- or single-operator technique is acceptable. A single operator will use the dominant hand to advance and aspirate the needle while manipulating the transducer with the opposite hand. In a two-operator procedure, the cannulating operator will concentrate on the needle and syringe, and the probe will be held steady by the second operator.

Two techniques are commonly accepted for achieving ultrasound-guided vascular access. In the static technique, ultrasound is used to identify vascular structures in relation to external landmarks, and then the ultrasound device is set aside and cannulation performed in the usual manner. The dynamic technique involves real-time, direct visualization of entry of the needle into the vein by ultrasound and seems to be preferable, particularly when the venous structures are small. In this case, once the vein has been accessed (or a “flash” of blood is seen), the ultrasound device is set aside.

The probe most conducive to central venous access is a linear-array high-frequency (5- to 12-MHz) probe. Care should be taken to identify the side of the probe bearing the indicator mark that corresponds to the on-screen indicator. This will allow the most intuitive positioning of the probe during venous access such that medial on the patient is medial on the screen of the machine as viewed by the operator when attempting cannulation.

Once a site has been chosen, usually the internal jugular or femoral, it should be evaluated with ultrasound to identify the artery and the vein. When compared with their accompanying veins, arteries appear thick walled, more circular, and pulsatile on ultrasound. Arteries do not compress with light pressure. Veins are more irregular in shape, sometimes appearing triangular rather than round, and compress with light pressure (see Videos 1 and 2). Use of color Doppler can also aid in identification (see Video 3).

It is often easiest to begin with the probe in a transverse orientation. In this view, the vessels appear in cross section as round or oval structures (see Fig. 6.3). The depth of the target vessel and its relationship to surrounding structures can be determined. The vein should then be centered on the screen. This allows an external landmark, the center of the transducer, to be established. Pressure over this area with a blunt object, such as a fingertip, can confirm the correct location. The needle should then be inserted at a 45-degree angle to the skin...
Video 1  Demonstration of the Valsalva technique for distinguishing the internal jugular (IJ) vein from the carotid artery. When the patient performs a Valsalva maneuver, the IJ is seen to distend slightly, whereas the size of the carotid artery remains constant.

Video 2  Demonstration of the compression technique for distinguishing the femoral vein from the femoral artery. When the skin overlying the vessels is compressed with pressure, the vein is seen to collapse almost fully, whereas the artery deforms only slightly.

Video 3  Video demonstrating the use of color Doppler to identify vessels in the neck. The carotid artery, on the left of the screen, is clearly pulsatile. The internal jugular is seen to the right of the carotid artery.
should be taken to differentiate venous from arterial vessels in this view and to avoid accidental migration of the probe. In this approach the needle should enter the skin at one end of the probe (Fig. 6.7)—and therefore the ultrasound screen—and be advanced in plane toward the underlying vein along the long axis (Fig. 6.8). Similar pressure deformity and indentation of the vessel wall should be noted before it is punctured, and a flash of blood should again be sought (see Video 5).

Video 4 can be found on Expert Consult @ www.expertconsult.com.

The longitudinal approach is somewhat more challenging to master but allows better visualization of the needle along its entire length. The longitudinal view is obtained by rotating the probe 90 degrees from the transverse position to line up in parallel with the course of the vein (Fig. 6.6). Extra care should be taken to differentiate venous from arterial vessels in this view and to avoid accidental migration of the probe. In this approach the needle should enter the skin at one end of the probe (Fig. 6.7)—and therefore the ultrasound screen—and be advanced in plane toward the underlying vein along the long axis (Fig. 6.8). Similar pressure deformity and indentation of the vessel wall should be noted before it is punctured, and a flash of blood should again be sought (see Video 5).

Video 5 can be found on Expert Consult @ www.expertconsult.com.

An oblique approach has been described in which the vessels are imaged with an orientation inbetween the
Video 4  Video demonstrating the appearance of the needle tip as it approaches and enters the internal jugular vein in transverse orientation. The needle tip is seen as a hyperechoic (bright white) object moving toward the wall of the vessel.

Video 5  Video demonstrating the appearance of the needle as it approaches and enters the vessel in longitudinal orientation. The needle can be seen in its full length on the left side of the screen advancing toward the vessel.
difficult access, such as those undergoing dialysis or chemotherapy. The basilic vein is a usually a good option, even when other peripheral veins are unusable (Fig. 6.9). The extremity chosen should be positioned comfortably and a tourniquet applied to facilitate an initial ultrasound survey to identify candidate veins (Fig. 6.10). The operator localizes the vein (Fig. 6-11) and performs cannulation via the transverse or longitudinal approach, as described for central access. Because peripheral veins requiring ultrasound guidance for cannulation are often deeper structures, the use of longer catheters should be considered. It should also be appreciated that peripheral veins are much more likely to collapse with even light pressure from the ultrasound transducer.

Videos 6 and 7 can be found on Expert Consult @ www.expertconsult.com.

Ultrasonography is also commonly used for peripheral approaches to intravenous access, particularly in patients with
Video 6  Video demonstrating the oblique approach for placement of a central line. In this approach the vessel is seen similar to a transverse image, but the needle is seen on the right side of the image in its full length as it approaches and deforms the vessel.

Video 7  Video further demonstrating the oblique approach for central line placement. In this video the needle can be seen within the lumen of the vessel.
**Fig. 6.9** Schematic of the peripheral veins of the upper extremity. The basilic vein is a frequent target of ultrasound-guided access because it is easy to find, relatively easy to access, and frequently available.

**Fig. 6.10** Image of a sonographer scanning the area of the basilic vein. Note that the indicator is pointed toward the patient’s right. This ensures that the image that is seen on screen is true to the surface anatomy. In other words, the orientation of the anatomy seen on screen is the same as the orientation encountered by the operator.

**RED FLAGS**

Although bedside ultrasound improves the overall success of venous access and decreases complications, it is not without potential pitfalls.

When viewing vessels in the transverse orientation, only a small part of the needle can be visualized. Identifying and following the needle tip immediately after it enters the skin will avoid inadvertent arterial puncture. In the longitudinal orientation, the vein and artery are very closely opposed (see Fig. 6.4). Extra care should be taken to ensure that the vessel on screen is the target vessel.

Both the transverse and longitudinal orientations have limitations in localizing the needle tip. In the transverse orientation, the medial-to-lateral position of the tip can best be determined (Fig. 6.12), but the slope of the needle path may be difficult to appreciate. Conversely, in the longitudinal orientation, the slope can be appreciated, but the medial-to-lateral position may not be apparent (Fig. 6.13). A combination of these two approaches, or the oblique approach, may minimize these potential shortcomings.

It is also important to avoid reliance on any one aspect of the image to identify the structures. Variant vascular anatomy may make landmarks less reliable, and severe volume depletion may lead to a completely collapsed internal jugular vein with a compressible carotid. Multiple characteristics should be examined to confirm that the vessel in question is venous.

Even though visualization of the anatomy does make successful cannulation more likely, it is no guarantee. Inadvertent carotid puncture while using ultrasound guidance is well described, in particular as a result of a through-and-through venous puncture.²⁷,²⁸ Prudence and careful technique are always appropriate.
**Fig. 6.12** Schematic demonstrating the advantages of transverse orientation for vascular access. In this orientation, the left-to-right (or medial-to-lateral) placement of the needle can be identified. However, the slope of the angle of the needle is out of the plane of this orientation and cannot easily be appreciated. Failure to appreciate this shortcoming may result in inadvertent arterial puncture.

**Fig. 6.13** Schematic demonstrating the advantages of longitudinal orientation for vascular access. In this orientation, the slope of the angle of the needle can be identified. However, the right-to-left (or medial-to-lateral) placement of the needle tip cannot easily be appreciated.


**REFERENCES**

*References can be found on Expert Consult @ www.expertconsult.com.*
REFERENCES


