Diagnostic Ultrasonography for Peripheral Vascular Emergencies

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KEYWORDS

• Ultrasonography • Deep vein thrombosis • Arterial occlusion • Pseudoaneurysm • Aneurysm

KEY POINTS

- This article discusses how to differentiate the arterial from the venous system by ultrasonography, using real-time scanning, color Doppler, and pulsed-wave Doppler.
- This article describes the approach to detecting deep vein thrombosis in the acute care setting.
- Peripheral arterial aneurysm can present clinically as an asymptomatic pulsatile mass or acute limb-threatening ischemia. This article discusses the detection of peripheral aneurysms using ultrasonography.
- Pseudoaneurysms, while rare, do occur in the acute care setting. This article describes the ultrasonographic findings of pseudoaneurysm, and detection by ultrasonography of acute arterial occlusion.

INTRODUCTION

Regardless of whether an extremity is swollen, painful, tender, cool, pulseless, or possesses an enlarged mass, it is often caused by vascular abnormality. The bedside evaluation of peripheral vascular emergencies now relies on diagnostic ultrasonography more than any other laboratory or imaging modality. Having the skills to perform ultrasonography at the bedside not only expedites the care of seriously ill patients but also provides the clinician-sonographer the ability to examine other areas of the body that might be affected by acute disease of the peripheral vasculature.

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This article provides information needed for the use of ultrasonography in the diagnosis of emergent pathology of the peripheral vasculature. It covers the sonographic evaluation of deep vein thrombosis (DVT) and the peripheral arterial emergencies of aneurysm, pseudoaneurysm, and obstruction. Techniques and anatomy related to performing and interpreting these ultrasonography studies are emphasized. Aortic aneurysms and ultrasound-guided vascular access are discussed in another article elsewhere in this issue.

TECHNICAL CONSIDERATIONS OF PERIPHERAL VASCULAR SONOGRAPHY

Transducer Selection

Because peripheral vascular structures are relatively small and superficial, high-resolution ultrasound transducers are required. Linear-array, high-frequency transducers provide the best 2-dimensional image resolution, and are therefore preferred for these sonographic examinations (Fig. 1).

Color Doppler Ultrasonography

Even relatively inexpensive systems now have Doppler ultrasound capability. Color Doppler ultrasound technology uses the change in frequencies caused by blood flow to create corresponding images on the viewing screen. If the blood flow is moving toward the transducer, the return echo will have a higher frequency than was originally generated by the ultrasound system. When this occurs the ultrasound system will, by default, create a red image on the screen that represents the moving blood. If the blood flow is moving away from the transducer, the return echo will have a lower frequency than was originally generated by the ultrasound system. When this occurs, the ultrasound system will create a blue image on the screen (Fig. 2). With all Doppler imaging, the brighter the color, the faster the blood is moving. Color Doppler imaging only occurs within a relatively small area of the viewing screen referred to as the region of interest.

It is imperative for the clinician-sonographer to be correctly oriented to the vasculature. Typically the transducer should be oriented so that arterial flow is moving toward the probe and venous flow is moving away. If this is done, arterial blood flow will appear red and venous blood flow will appear blue. If the transducer is oriented so that the venous flow is moving toward the transducer, the color of arterial and venous blood will be reversed.

Fig. 1. Linear-array transducer with image of upper extremity vasculature.