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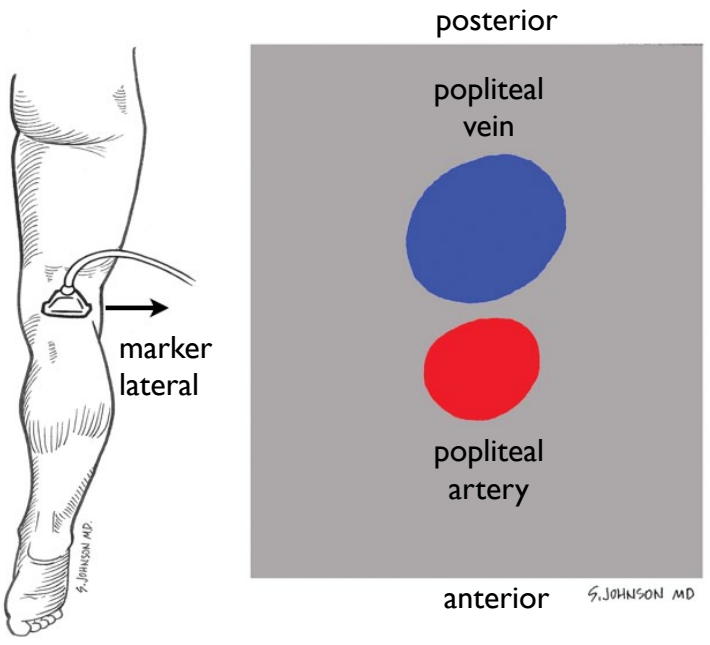
Rapid Ultrasound in SHock: The RUSH Protocol

EVALUATION OF THE "PIPES"

Last month, we began our discussion of the final part of the RUSH protocol, the evaluation of the "pipes." In that installment, we focused on ultrasound examination of the aortic artery. This month, as we conclude our series on RUSH, we continue our discussion of the use of bedside ultrasound to evaluate the "pipes"—specifically, to evaluate the veins for deep vein thrombosis (DVT). In addition, we demonstrate the utility of this exam in the hands of the emergency physician.

Figure 1. Ultrasonography of the Popliteal Vessels



ULTRASOUND DETECTION OF LEG DVT

Bedside ultrasonography for the detection of DVT of the leg is an advanced imaging study, but the necessary techniques are readily learned by emergency physicians who have an interest in sonography. The bedside exam comprises a two-point limited evaluation of the deep veins of the leg, with special attention to the proximal femoral vein and the popliteal vein. Elements of the more comprehensive, radiologist-performed exam are mentioned later in this article. Research has shown that the abbreviated bedside ultrasound evaluation of the leg retains excellent sensitivity in the diagnosis of DVT, while allowing for exam expediency.[1]

Veins have valves interspersed along their course, and most DVTs form in the areas behind the valves of the calf veins, where blood flow is often turbulent. Three smaller calf veins join together to form the popliteal vein, which lies just posterior to the knee joint in the popliteal fossa. While imaging of the calf veins can be difficult due to the small caliber of the vessels, the popliteal vein can be readily seen on ultrasound exam. Therefore, the popliteal vein, with the probe placed at the popliteal fossa, is the most inferior position for the bedside exam, as well as for most standard radiologist-performed DVT exams. In the popli-

Continued on next page >>

"Emergency Ultrasound" presents clinical cases involving the diagnostic use of bedside ultrasound in the emergency department. Cases can be explored in more detail on the Web in the SoundBytes section of CMEDownload.com, which can be accessed directly at www.sound-bytes.tv. Instructional videos detailing the components of the RUSH exam are available for download.

Rapid Ultrasound in SHock: The RUSH Protocol

Figure 2. Ultrasonography of the Femoral Vessels

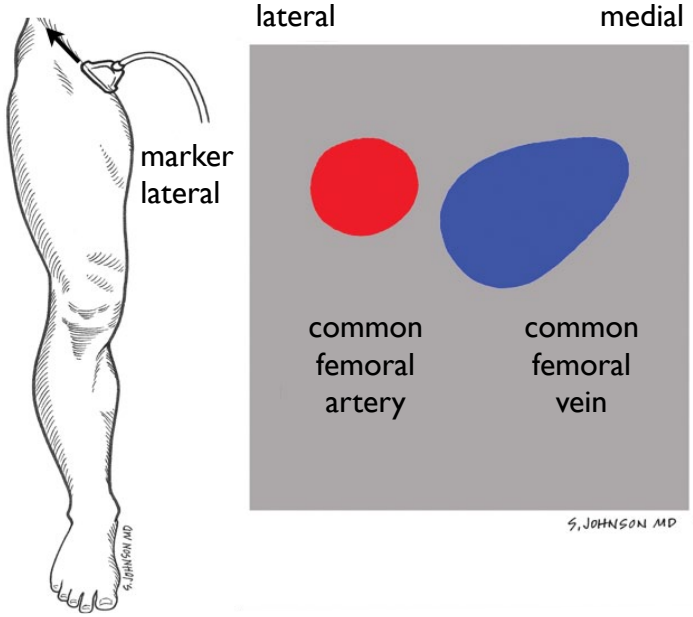
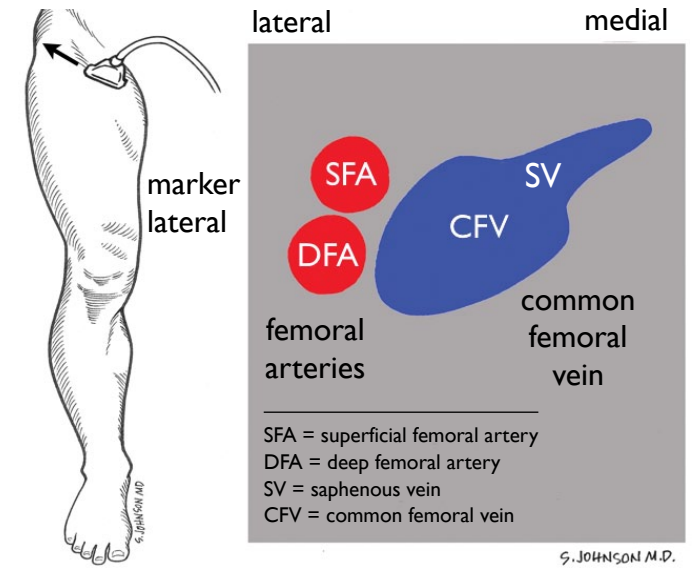


Figure 3. Bifurcation of the Femoral Vessels



teal fossa, the popliteal vein is seen posterior to the paired popliteal artery (Figure 1). The vessel should be imaged throughout its course in the popliteal fossa, usually for a distance of 3 to 5 cm. The popliteal vein then continues up the leg to form the superficial femoral vein in the thigh. The common femoral vein, which can be easily imaged at the superior aspect of the thigh, is formed by the coalescence of the superficial and deep femoral veins. The saphenous vein, a superficial vein of the leg, can often be seen draining into the common femoral vein. In the superior thigh, the common femoral vein will be seen just medial to the common femoral artery (Figure 2). The femoral vein should be imaged for 4 to 6 cm beginning high in the leg, just below the inguinal ligament, moving inferiorly through its junction with the saphenous vein (Figure 3), down to the level of bifurcation into the superficial and deep femoral veins.

In standard B mode, or grayscale imaging, the sonographer identifies the femoral and popliteal arteries and veins by looking for their circular and dark, or anechoic, appearance in the short-axis/transverse view. Typically, this exam is performed using a high-frequency linear array transducer at 8 to 12 MHz. Arterial pulsations and color flow Doppler imaging can help differentiate artery from vein. Clot may be seen as echogenic material within the vein lumen; however, this is not necessary for diagnostic purposes, as the gold standard examination for identifying DVT is a compression examination. When the probe is used to apply firm pressure to the normal femoral and popliteal veins, the vessels should completely collapse and the

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vein walls should touch each other. When a DVT is present, pressure on the vessel will fail to collapse the vein, and the walls will not meet on compression (Figure 4). It is crucial to look for complete collapse of the vein lumen with probe compression, as some chronic DVTs may cause partial recanalization of the vein and are identifiable only by the failure of the vessel walls to meet completely. In general, bedside ultrasonography performed by emergency physicians for diagnosis of leg DVT should be directed toward detection of acute clot, as a chronic DVT may be difficult to recognize and is better evaluated with a formal study performed by a radiologist.

Correct positioning of the patient during the DVT exam is vital; the proper position can lead to distention of the venous structures and a more informative evaluation. For the femoral vein exam, the torso should be elevated in relation to the leg. For the popliteal vein exam, it is optimal to move the patient to the side of the bed, positioning the leg so that it hangs over the bedside. The sonographer can then sit in a chair in front of the patient and position the probe behind the knee, stabilizing the knee with the other hand during the compression part of the exam.

CONCLUSION

With use of modern high-resolution ultrasound machines, bedside sonography can often image the actual clot, although the appearance may vary with the age of the clot. Fresh clot can appear more echogenic, or bright, on exam. Additional ultrasound techniques, such as

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Rapid Ultrasound in SHock: The RUSH Protocol

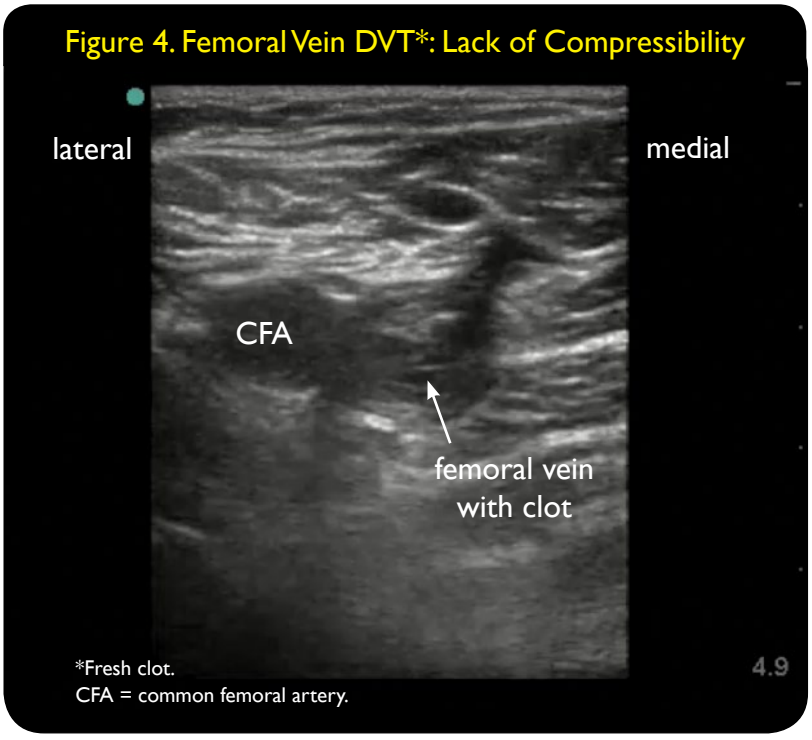

Figure 4. Femoral Vein DVT*: Lack of Compressibility

*Fresh clot.
CFA = common femoral artery.

augmentation of venous flow on color Doppler exam with compression of the calf and respiratory variation, may be included in a comprehensive, radiologist-performed exam. However, these elements do not substantially enhance the accuracy of the standard compression exam for detection of DVT. Figure 4 illustrates the utility of compression techniques in ultrasonography of the femoral vein to demonstrate a DVT of the common femoral vein; the image was taken with direct probe pressure over the vein.

REFERENCE

1. Bernardi E, Camporese G, Büller HR, et al. Serial 2-point ultrasonography plus D-dimer vs whole-leg color-coded Doppler ultrasonography for diagnosing suspected symptomatic deep vein thrombosis: a randomized controlled trial. *JAMA*. 2008;300(14):1653-1659.

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