Duplex ultrasound is first-line imaging for all patients presenting with signs or symptoms of pelvic venous insufficiency. The objective is to assess the inferior vena cava (IVC); bilateral common, external, and internal iliac veins; common femoral, femoral, and deep femoral veins; left renal vein; and bilateral gonadal veins to rule out thrombus, stenosis, compression, and incompetence.

**OUR CENTER’S PROTOCOL**

**Patient Preparation**
Ideally, the abdominal and pelvic vein scan should be performed in the morning following a 12-hour overnight fast. Patients are asked to prepare by avoiding fatty foods, gassy drinks, and dairy products the day before their examination and avoiding chewing gum and smoking on the day of their appointment. For insulin-dependent diabetic patients, a 4-hour fast can be allowed.

**Equipment and Parameters**
A high-resolution color Doppler ultrasound system allows for real-time assessment of the abdominal veins with both B-mode and spectral Doppler analysis. This must include adjustable range-gated Doppler to assess veins of varying sizes and real-time B-mode to allow monitoring of the phasic changes in vein diameters. A low-frequency, curved array transducer is usually required; however, higher frequencies might be needed in patients with a low body mass index. A tilt table is also required. The time frame for the scan is 45 to

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**Figure 1.** The optimal position for scanning the patient.
Patient Position and Ultrasound Settings

The optimal position for scanning patients is supine in a reverse Trendelenburg position (45°) with arms at their side or comfortably on their chest (Figure 1). A lateral decubitus position can also be utilized in difficult cases.

60 minutes, depending on operator experience and patient characteristics.

An abdominal venous preset is used to maximize the frame rate and to optimize focus. The pulse repetition frequency should be on the low setting, with the gain adjusted accordingly. The spectral Doppler sample volume is set to the size of the vein lumen, and Doppler angles for velocity measurements must be ≤ 60°.

**TECHNIQUE**

It is important to ensure that the probe pressure does not affect the diameter of the veins being assessed, as this can create a false-positive finding. Beginning at the level of the xiphoid process, locate the suprarenal IVC and scan the length to the common iliac vein (CIV) confluence, documenting patency, waveform patterns, and diameters. If evidence of narrowing is detected, place the patient in the left lateral decubitus position and reassess diameters (Figure 2).

Locate the left renal vein as it passes between the aorta and superior mesenteric artery or spine (be aware of a retroaortic left renal vein). Using B-mode and color Doppler, measure the diameter of the vein in the aortomesenteric region and compare it to the diameter near the renal hilum. Record velocities in the left renal vein at both sites to determine if there is compression of the left renal vein.

Follow the IVC in the transverse plane to visualize the confluence of the CIVs. Rotate the transducer to image the left CIV in a longitudinal view. Using B-mode, measure the diameter of the left CIV at the level of the overlying right common iliac artery (CIA) (Figure 3) in the mid segment and the lower segment. Utilizing spectral Doppler, record velocities in each segment.

Color Doppler can be used as a guide for measuring the diameter when the walls are not easily seen. Ensure that color settings allow for accurate depiction of the patent lumen to avoid color saturation. Examine the walls of the CIV for evidence of wall thickening, flow defects,
or any subtle wall abnormalities, particularly at the level where the CIA crosses anterior to the vein and immediately inferior to this region (Figure 4). Multiple scanning planes and acoustic windows should be utilized.

Continue to the internal iliac vein (IIV) and assess for patency and flow direction. Measure the diameter and record the velocity. To determine incompetence in the IIV, augment the upper thigh or apply hand pressure and release maneuver on the lower abdomen. The IIV may readily display incompetence without maneuvers in some cases. Continue to the external iliac vein (EIV), measure the diameter in the upper and lower segments as well as stenosed regions if present, record velocities, and assess phasicity of flow. If there is narrowing of the EIV at the inguinal region, reassess the diameter with ipsilateral knee flexion and external rotation of the hip. Measure diameters of the common femoral vein (CFV) as well as femoral and deep femoral veins, because these vessels will determine the inflow.

Locate the gonadal vein in the left iliac fossa as it crosses over the external iliac artery and EIV at the level of the CIA bifurcation or the termination at the left renal vein. Assess the visible segments for patency, competency, and size. The testicular vein is sometimes located more laterally in the pelvis than the ovarian. Assessment of the right iliac veins is performed in the same manner.

Postintervention assessment of iliocaval stents requires the measurement of in-stent diameter for residual and recurrent stenosis with B-mode imaging. The use of low-flow color Doppler, power Doppler, advanced dynamic flow, or an equivalent is required to demonstrate flow defects representing echoluent in-stent stenosis in most cases. In patients with in-stent stenosis, the diameter of the residual patent lumen and thickness of the defect should be measured. Color Doppler is often required in these cases due to poor definition of disease with B-mode imaging (Figure 5). Diameter measurements are obtained with a longitudinal view of the vein lumen; however, demonstration of area reduction can be useful in a transverse plane to demonstrate the severity of in-stent stenosis.

**TIPS RELATED TO PELVIC VENOUS OBSTRUCTION**

**Direct Observations**

- We have found that the normal iliac diameters are > 1 cm and the IVC is usually around 2 cm, so we consider any measurement < 1 cm to be indicative of obstruction. In terms of severity, we consider a > 50% reduction in diameter of the vein compared to the remainder of the ipsilateral iliac vein or the contralateral site significant; however, in our experience, an absolute measurement of stenosis ≤ 5 mm correlates very well with an area of ≤ 100 mm² on intravascular ultrasound (IVUS).
- Vein wall thickening and intraluminal abnormalities at the site of stenosis are highly indicative of severe
stenosis, especially if in combination with diameter reduction.

- We have found that the velocity ratio ≥ 2.5:1 for the iliac veins with turbulent flow is not as reliable as the diameter criteria.
- For the left renal vein, we use a 5:1 diameter and velocity ratio.

Indirect Observations

- Increased collateral circulation can be an indication of pelvic obstruction, although it is not always present.
- Altered waveforms can be found in the infrainguinal vessels (ie, continuous flow in the CFV or EIV). However, in the presence of collateral flow at the site of stenosis, waveforms may be normal.¹
- Retrograde flow can be present in the internal iliac and gonadal veins.
- Mild pulsatility of the venous waveform within the iliac veins can be observed.
- We often find disturbed or mosaic flow.

Report

Finally, a report is generated after the assessment that includes the direct and indirect observations (Table 1). Our diameter guide is supported by the findings from Neglen and Raju on the use of IVUS in which they suggested using the rule of 1 cm for the normal diameter of the iliac veins.⁵ Gagne et al also suggest that correcting a stenosis of > 50% correlates with symptom resolution.⁶

We believe all patients with signs and symptoms of chronic venous insufficiency should have a thorough assessment of the entire venous system before giving advice or establishing a management plan. Much in the same way that the aortoiliac system is a fundamental part of the assessment of lower limb arterial pathology, the iliocaval segment plays an important role in the development of chronic venous insufficiency and pelvic congestion syndrome, although it is still not fully defined.

Patients with advanced venous insufficiency features, unexplained lower limb edema, venous claudication, chronic pelvic pain, or history of previous venous thromboembolism benefit greatly from having assessment of their iliocaval system. The findings balanced against the clinical presentation can trigger IVUS assessment and treatment directly without the need for other noninvasive investigations such as CT venography or magnetic resonance venography at a much lower cost and with better safety profile.

CONCLUSION

Duplex ultrasound, using a diameter criteria within a dedicated protocol, can be a reliable, noninvasive, cost-effective, first-line imaging modality for the detection and follow-up of obstructive venous lesions in patients presenting with venous insufficiency. This accessible and safe tool can now help answer many research questions such as what makes a lesion significant, at what point does a lesion become pathogenic, and which patients might benefit from intervention. 

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