Diagnosis of Iliac Vein Obstruction With Duplex Ultrasound

Criteria used during duplex ultrasound examination to identify iliac vein obstruction.

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Venous obstruction most often occurs due to thrombosis, extrinsic compression, or when both conditions are present. Obstruction of the iliac veins has a significant impact because it is responsible for the highest outflow resistance, venous claudication, and higher deep vein thrombosis recurrence. It also causes more prevalent and severe postthrombotic symptoms, impairing the quality of life of the patients, and poses a marked financial burden to society. Therefore, prompt and accurate diagnosis is necessary to facilitate the management of patients.

Obstruction is a dynamic entity associated with increased resistance to outflow due to energy loss when blood travels from one area to another. Most often, symptoms are present when the patient is walking; however, diagnosis of obstruction may be controversial because all imaging tests are performed with the patient in the supine position, which only shows morphologic but not dynamic changes. Venous pressure measurements at rest and during exercise are better indicators of the hemodynamic impact but may underestimate the chronic effect of somewhat compensated obstruction. All tests are patient and operator dependent, but duplex ultrasound may be the most. More importantly, formal training for ultrasound detection of obstruction is lacking, and rigorous training and experience are necessary to perform accurate evaluation. The exam starts at the common femoral vein (CFV) union and finishes with the inferior vena cava (IVC). Diagnosis with duplex ultrasound is based on specific direct and indirect criteria listed in Table 1[1-9] and detailed in the sections that follow.

TABLE 1. CRITERIA FOR DETECTING ILIAC VEIN OBSTRUCTION WITH DUPLEX ULTRASOUND

Direct[1-5]
▪ Planimetric diameter stenosis (measure the diameter reduction with calipers)
▪ Velocity ratio > 2.5 (poststenotic to prestenotic vein velocity ratio)
▪ Luminal changes (material inside the lumen; compression of both)
Indirect[1-9]
▪ Nonphasic flow in the proximal CFV
▪ Asymmetrical flow pattern in the CFVs
▪ Nonphasic flow during Valsalva maneuver
▪ Low or no velocity augmentation in CFV during thigh compression or dorsi/plantar flexion
▪ Presence of collateral veins
▪ Reverse flow in the ipsilateral internal iliac vein
▪ Cephalad flow in the inferior epigastric vein
▪ Reversed flow in the deep external pudendal vein
▪ Difficulty in compressing the CFV

Abbreviations: CFV, common femoral vein.

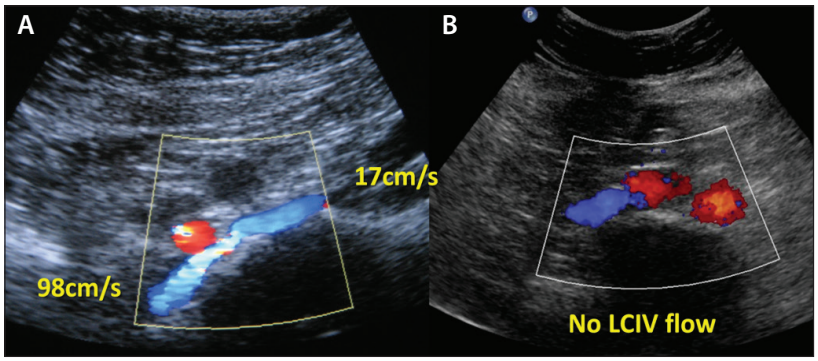

Figure 1. Compression of the left common iliac vein (CIV) by the right common iliac artery (CIA) over the fifth lumbar vertebra (A). The vein velocity ratio is 5.8. Narrowing of the CIV is apparent with mosaic color due to aliasing from the high velocity. No flow is seen in the left CIV, whereas normal flow is observed in the right CIV (B). This is a less common type of compression where both the right and left CIA compress the left CIV.

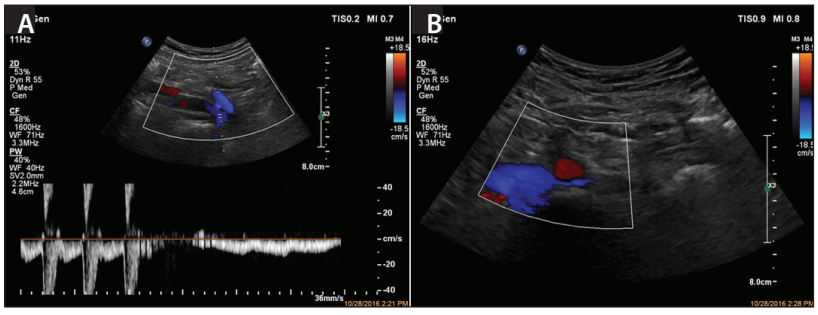

Figure 2. Reverse flow is seen in the left internal iliac vein (A) in a patient with tight stenosis of the ipsilateral CIV (B). The internal iliac vein has the same color as the internal iliac artery. The Doppler waveform demonstrates flow in the same direction in both vessels. The left CIV diameter measures only 2 mm at the site of compression, whereas the distal part of the vein measures 14 mm.

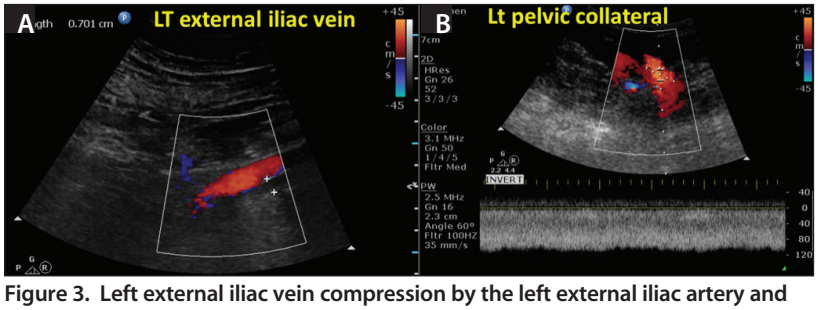

Figure 3. Left external iliac vein compression by the left external iliac artery and chronic vein occlusion, with the diameter measuring 7 mm (A). The patient had chronic iliofemoral obstruction with edema, pain, and skin damage. The ipsilateral CIV was patent, filling from the left internal iliac vein. A large pelvic collateral vein is seen with nonphasic, high-velocity flow (> 100 cm/s) (B).

DIRECT CRITERIA

Planimetric evaluation and luminal changes are very important because they allow direct imaging and evaluation of the obstruction. Stenosis and occlusion can be differentiated this way. Additionally, the diameter of the veins can be measured, luminal material indicating previous thrombosis with partial or no recanalization can be seen, and extrinsic compression and the type of compression producing the stenosis or occlusion can be assessed. Acute and recurrent thrombosis and extrinsic compression and thrombosis can be directly assessed. When present, the velocity ratio is important because it indicates > 50% diameter stenosis and has been validated by three studies using intravascular ultrasound. However, the absence of the velocity ratio cannot exclude obstruction, as the vein may be occluded, have long stenosis, or be partially recanalized. When velocities or diameters are being measured, it is very important that the pressure applied by the ultrasound transducer does not affect the measurements, as too much pressure may lead to disease overestimation.

INDIRECT CRITERIA

When indirect signs are detected, they always indicate some form of obstruction. However, they cannot differentiate between stenosis and occlusion, extrinsic compression, or luminal changes. Therefore, direct imaging of the affected veins is important. The presence of phasic flow and good augmentation cannot exclude obstruction.

DISCUSSION

Our group and others have identified many patients with obstruction, sometimes with occlusion of iliac vein still having normal CFV phasicity and flow augmentation. Imaging of the inflow and the IVC are important, as this information is needed for proper patient management. The inflow veins, including the femoral, deep femoral, and CFV, are examined for patency because adequate inflow is necessary before stent placement to relieve iliac vein obstruction. Evaluation of the IVC is performed to determine patency. When present, the type of obstruction and anatomic variations such as aplasia,

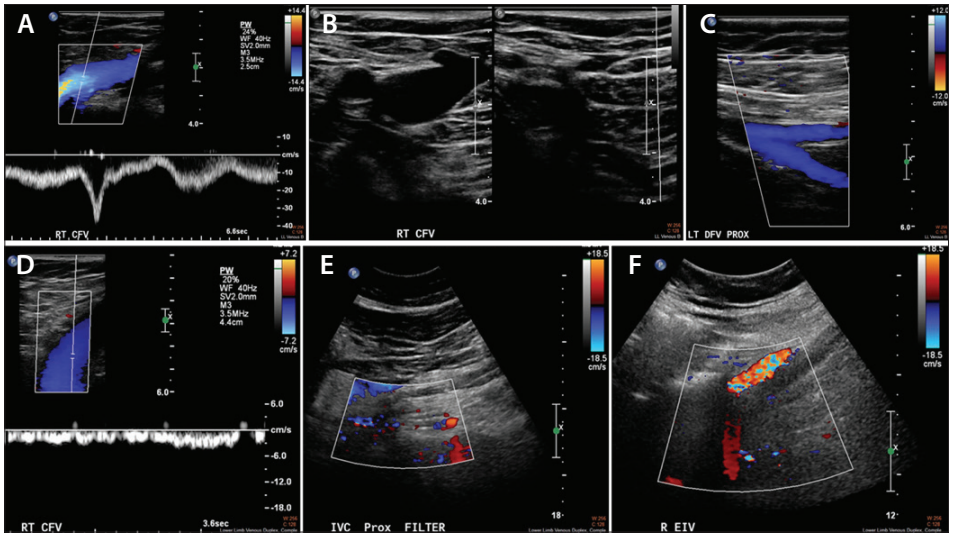

Figure 4. Normal femoral veins are seen in a patient without vein obstruction (A–C). The CFV has phasic flow with good augmentation (phasic flow cannot exclude obstruction). The CFV is easily compressed. The distal CFV, femoral, and deep femoral veins in the contralateral side are normal. There is low nonphasic flow with poor augmentation in the CFV (D–F). This patient has an IVC filter with chronic occlusion that extends into the iliac veins (F).

TABLE 2. AREAS OF ILIAC VEIN COMPRESSION*

Common iliac veins
▪ Right common iliac artery on left common iliac vein
▪ Right common iliac artery on right common iliac vein
▪ Left common iliac artery on left common iliac vein
External iliac veins
▪ Right external iliac artery on right external iliac vein
▪ Right internal iliac artery on right external iliac vein
▪ Left external iliac artery on left external iliac vein
▪ Left internal iliac artery on left external iliac vein
▪ Inguinal ligament on right external iliac vein
▪ Inguinal ligament on left external iliac vein
*More than one type of compression may exist.

hypoplasia, left-sided cava, and duplication are reported because they are also important for the treatment plan. Understanding the vein anatomy and the surrounding structures is paramount. The areas of vein compression are listed in Table 2.

Many types of compression are observed and do not include other types from tumors, aneurysms, or hematomas. Several duplex ultrasound images are displayed to make an informed diagnosis of iliac vein obstruction. Figures 1 and 2 demonstrate examples of patients with vein compression, and Figures 3 and 4 show patients with different forms of vein occlusion.

CONCLUSION

Ultrasound is a great method for diagnosing venous obstruction. It is practical, cheap, has no side effects, can be easily repeated, and some dynamic testing is possible. It offers direct imaging as well as indirect criteria, which are very useful for detecting obstruction. However, it is the most operator-dependent imaging method, and there is a lack of formal, rigorous training worldwide. Furthermore, there are no robust diagnostic criteria for defining hemodynamically significant obstruction in a great number of patients. Further, work is needed to establish and also translate such findings with the clinical improvement of the patients. ■

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Disclosures: None.