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Imaging of Lower Extremity Venous Insufficiency

- An estimated 22–29% of the Western population has a diagnosis of varicose veins; approximately 5% have manifestations of severe chronic vascular disease, such as skin changes or venous ulcers.
- Duplex ultrasound is the primary tool for diagnosing venous insufficiency and contributes to disease disease classification.
- In cases in which pelvic venous disease is suspected, MR venography (MRV) or CT venography (CVT) may diagnose the cause.

Varicose veins are common in Western populations, affecting an estimated 22–29% of the population. About 5% of these people have venous edema, skin changes, or venous ulcers. Varicosities are more commonly found in women, and the Framingham study showed that 10% of women younger than 30 years and 77% of women older than 70 years have varicose veins. Risk factors include family history, advancing age, pregnancy, obesity, and prior deep vein thrombosis (DVT). Certain congenital syndromes, including Klippel-Trenauney and Parker Weber syndromes, are also contributors to venous disease.

In mildest cases, chronic venous disease is mainly cosmetic, in the form of spider veins (telangiectasia) or non-symptomatic varicose veins. However, other cases of varicose veins are associated with itching, pain, a feeling of lower extremity heaviness, and muscle cramping. In some cases, venous disease progresses, resulting in edema, skin pigmentation changes, lipodermatosclerosis, and venous ulcers. Severe chronic venous disease can lead to chronic pain, disability, lower quality of life, and early retirement. Clinical severity is broken into criteria using the CEAP classification system (Table 1).

Table 1. CEAP Classification for Chronic Venous Disease

Clinical classification	
C0	No visible or palpable signs of disease
C1	Talengiectasis or reticular veins
C2	Varicose veins
C3	Edema
C4a	Pigmentation or eczema
C4b	Lipodermatosclerosis or atrophic blanche
C5	Healed venous ulcer
C6	Active venous ulcer
S	Symptomatic, including ache, pain, tightness, skin irritation, heaviness, muscle cramps, and other complaints attributable to venous dysfunction
Etiologic classification	
Ec	Congenital
Ep	Primary
Es	Secondary (post thrombotic)
En	No venous cause identified
Anatomic classification	
As	Superficial veins
Ap	Perforator veins
An	No venous location identified
Pathophysiologic	
Pr	Reflux
Po	Obstruction
Pr,o	Reflux and obstruction
Pn	No venous pathology identifiable

In the legs, blood must flow against the force of gravity, which is achieved by a combination of the muscular action of calf muscles and the presence of venous valves found every 3–5 cm along the vein. In chronic venous disease, the veins stretch and swell. As a result, the valves no longer function, and the veins become incompetent. When larger veins are affected, they develop varicosities while smaller veins form spider veins. Most primary varicosities occur in the great saphenous vein (GSV), a superficial vein that runs from the ankle to the common femoral vein. They can also occur in the small saphenous vein (SSV) and in perforator veins. Reticular veins, which form a network of small veins

parallel to the skin, drain the skin and subcutaneous tissue. Altogether, these superficial veins only carry a relative small proportion of blood; 90% of blood flows through deep veins.

While most varicose veins are attributed to primary changes, some are secondary to other problems, such as vein damage due to deep vein thrombosis, venous outflow obstruction in the iliac veins, arterial aneurysms, pelvic or abdominal masses, inflammatory processes, or retroperitoneal fibrosis.

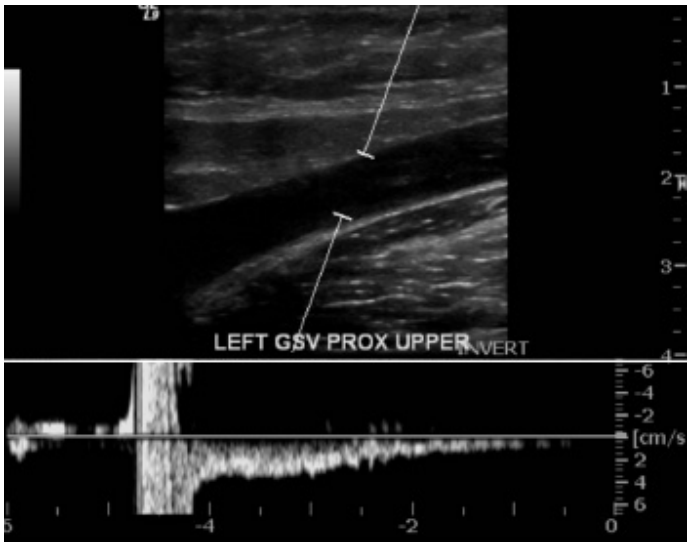

Figure 1. Doppler ultrasound image shows reflux lasting 2.5 seconds, indicative of venous insufficiency in the left great saphenous vein.

Duplex Ultrasound

Duplex ultrasound is the primary imaging method for the diagnosis and staging of venous insufficiency. Venous evaluation should be performed with the patient standing or on a tilt table in the reverse Trendelenburg position so that venous blood flow works against gravity, and valve functionality can be observed. The complete duplex screening examination includes compressibility, venous flow, and reflux time. Standard evaluation for DVT is performed first, followed by examination for reverse blood flow. Reflux can be elicited by either the Valsalva maneuver or by manual compression of the vein distal to the point of examination. Abnormal flow is diagnosed if reflux lasts longer that 0.5 seconds in the SSV or the GSV or longer than 1 second in the deep veins (Figure 1). Perforating veins are considered abnormal if the diameter of the vein is greater than 3.5 mm, and reflux lasts longer that 0.5 seconds.

Patients with simple varicose veins rarely require imaging studies apart from duplex ultrasound but either CT venography (CTV) or MR venography (MRV) may be used when pelvic venous obstruction or stenosis is suspected.

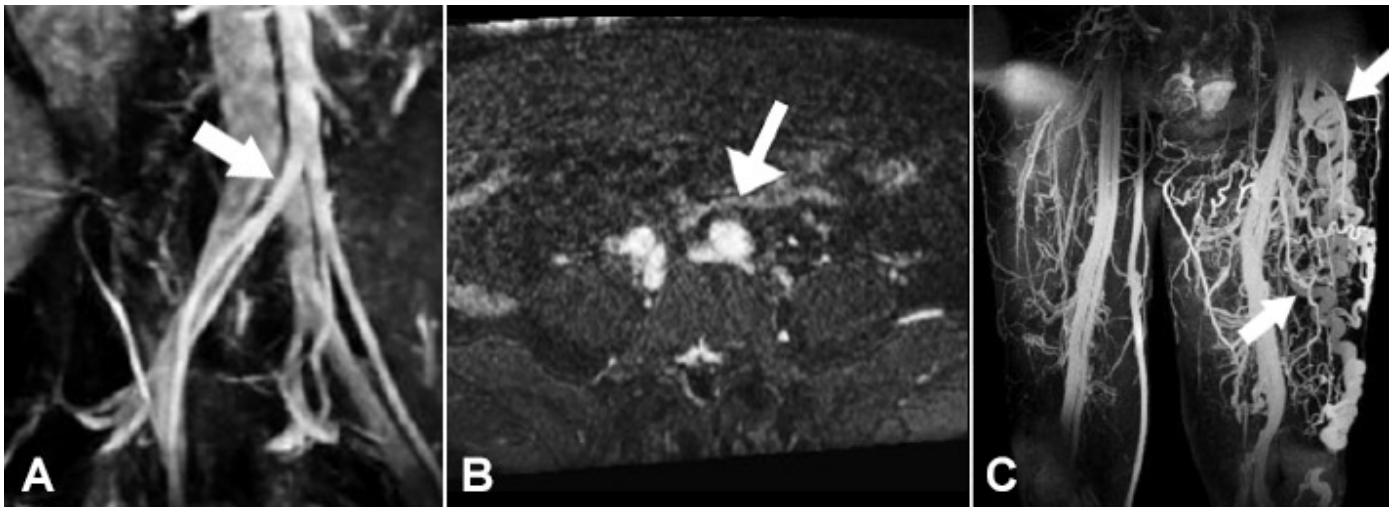

Figure 2. Three-D MR angiography (MRA) of a patient with pelvic symptoms. **(A, B)** Pelvic MRA shows compression of the left iliac vein by the left iliac artery (arrow). **(C)** MRA of the legs shows extensive varicosities in the left leg (arrows).

CT Venography and MR Venography

If duplex ultrasound detects reflux in the deep veins, the problem may be due to pelvic or abdominal obstruction, which can be caused by stenosis, occlusion, or atresia. In patients with a history of DVT, an occlusive lesion may be present in the iliac veins or the vena cava, or recanalization may be incomplete. In other patients who have symptoms of pelvic pain, blood flow may be restricted by iliac vein compression (May-Thurner syndrome) (Figure 2), pelvic congestion syndrome (Figure 3), or vascular malformations or masses. In these cases, three-dimensional imaging with CTV or MRV may be helpful in diagnosis and selection of appropriate treatment.

CTV is commonly used to assess patients with DVT and provides high-resolution images that show stenosis and thrombi. It can also detect common iliac vein compression. However, MRV using a blood pool contrast agent has

several advantages over CTV for evaluating pelvic and abdominal vasculature. MRV provides accurate visualization of the venous anatomy, comparable to conventional venograms, with high venous contrast, high spatial resolution, and the ability to evaluate subtle details of veins walls and intraluminal changes. MRV has the additional advantage of using no ionizing radiation.

Scheduling

Duplex ultrasound evaluation of venous insufficiency is performed on the main campus of Massachusetts General Hospital in Boston, at the Vascular Center at MassGeneral Waltham, and in the MGH Chelsea Healthcare Center. MRV and CTV is performed at Mass General Imaging - Waltham, Mass General Imaging - Chelsea, and the main campus. Appointments can be made through Epic (inside the Partners network) or Physician Gateway (outside the Partners network) or by calling 617-726-8396.

Figure 3. Pelvic MR venography (MRV) of a patient with symptoms of venous congestion shows enlarged and dilated left gonadal vein.

Further Information

For further information on the role of imaging in the care of patients with varicosities and other manifestations of chronic venous disease, please contact Gloria Salazar, MD, Division of Interventional Radiology, Department of Radiology, Massachusetts General Hospital, at 617-643-0239.

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