

Superficial Veins: Treatment Options and Techniques for Saphenous Veins, Perforators, and Tributary Veins

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Superficial venous insufficiency is a common cause of lower-extremity symptoms of pain and swelling. A thorough understanding of the superficial venous anatomy, as well as gaining knowledge of treatment approaches, can direct one's approach to providing an appropriate treatment for desired and durable outcomes. This article reviews the details of anatomy and treatment of the saphenous veins, perforator veins, and tributary veins. Tech Vasc Interventional Rad 17:82-89 © 2014 Elsevier Inc. All rights reserved.

Saphenous Veins

Clinical Evaluation of the Patient

Before performing any treatment, a directed history and physical examination of the pelvis and lower extremities should be obtained and documented.¹ This should include the patient's age, gender, medications, prior vein treatment, as well as medical, surgical, family, and pregnancy history. Other historic factors that may be important to elicit are occupations requiring prolonged sitting or standing, obesity, physical activity requiring heavy straining, neuromuscular disorders causing foot muscle pump dysfunction, history of leg trauma, clotting disorders, deep vein thrombosis (DVT) and superficial vein thrombosis, congenital vascular malformations, and connective tissue laxity.² One should also assess for symptoms of venous disease, which include aching, tiredness or heaviness in legs, pain, throbbing, cramping, swelling, itching, or restless legs. Venous insufficiency symptoms are frequently relieved by leg elevation, activity, graduated compression stockings (GCSs), or cold compresses. Bursting pain with activity may be a symptom of iliac vein obstruction.

A targeted physical examination of the legs and in some cases the pelvis should be performed, which includes

visual inspection and selective use of transillumination. Physical examination findings include tortuous or dilated reticular veins; varicose veins; edema; skin changes such as discoloration, rash, eczema, or induration; and healed or active ulcerations. It is important to distinguish venous edema (aka phleboedema, which is brawny nonpitting edema) from other common causes of lower-extremity swelling, such as heart disease, renal dysfunction, and liver dysfunction as well as lymphedema. It is also important to recognize lipedema, which consists of symmetric enlargement of the lower extremities with soft fatty tissue and minimal edema sparing the feet.³

A carefully performed Doppler ultrasound (DUS) focused on the superficial venous system will elucidate underlying causes of varicose veins to adequately remove the source of venous hypertension in patients who are candidates for treatment.⁴ Guidelines from the American College of Phlebology and Intersocietal Accreditation Commission exist for a complete examination of the superficial venous system. DUS is typically performed with a high-frequency linear transducer (7.5-15 MHz). Standing and reverse Trendelenburg positions improve the ability to detect reflux and increase the caliber of refluxing veins compared with supine positioning. Color Doppler is used to rapidly determine the direction of blood flow. Spectral (pulsed wave) Doppler should be used to demonstrate the magnitude, duration, and direction of flow in refluxing veins. The criteria for retrograde flow in superficial veins and perforator veins are 0.5 seconds and 0.3 seconds, respectively. However, much longer periods of retrograde flow or reflux are commonly seen, extending for several seconds.

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Multiple scoring systems exist for the physician to assess the patient's clinical status and for the patient to report the severity of their symptoms. These include the Clinical, Etiologic, Anatomic, Pathophysiologic (CEAP) classification; the revised venous clinical severity score (VCSS); and several patient-reported metrics, including generic instruments such as the 36-Item Short Form Health Survey and several disease-specific instruments such as the Aberdeen Varicose Vein Questionnaire, Chronic Venous Insufficiency quality of life Questionnaire, Venous Insufficiency Epidemiological and Economic Study, and VVsymQ (the latter being the only instrument meeting Food and Drug Administration guidelines for use in device and drug trials). The CEAP classification is a common descriptive platform for reporting patient status in chronic venous disease.⁵ The classification scheme is detailed in the Table. CEAP is physician generated and relatively static; once a patient has had an ulcer they can never be better than a C5, despite treatment. As a result, it is less useful as a tool to follow disease severity after therapy. VCSS is another physician-generated scale assessing disease severity. It includes assessments of the typical signs and symptoms of venous disease rated on a scale of 0-3, including pain, varicose veins, venous edema, skin pigmentation, inflammation, induration, number of active ulcers, size of active ulcers, ulcer duration, and compression therapy.⁶ VCSS poorly delineates the lower end of the disease spectrum.

A thorough understanding of superficial venous anatomy and anatomical variations of the lower extremities is critical to performing an accurate examination and guiding future treatment.⁴ The great saphenous vein (GSV) is the most commonly involved superficial vein in reflux and varicose veins. The anterior accessory GSV is a common channel within the saphenous space that can be responsible for anterior thigh varicose veins, which are present in 14% of patients with varicose veins.⁷ The small saphenous vein (SSV) begins on the lateral aspect of the foot and ascends posteriorly between the heads of the gastrocnemius muscle. The cephalad or thigh extension of the SSV is variable in its connection to the deep venous system and anatomy at the saphenopopliteal junction (SPJ), but it is present in 95% of patients⁷ (Fig. 1).

Common femoral vein waveforms should be assessed bilaterally to identify evidence for an iliac vein stenosis or occlusion. An evaluation of the deep venous system for thrombosis or insufficiency in the common femoral, femoral, and popliteal veins should also be included in the DUS examination.⁴

Table CEAP Classification

C0	No visible or palpable signs of venous disease
C1	Telangiectasias or reticular veins
C2	Varicose veins
C3	Edema
C4a	Pigmentation or eczema
C4b	Lipodermatosclerosis or atrophie blanche
C5	Healed venous ulcer
C6	Active venous ulcer

It is important to understand the patient's goals of treatment before initiating any therapy as managing expectations to achieve the desired outcome will lead to the perception of much better results by the patient.

Indications and Contraindications for the Treatment of Saphenous Veins

Indications for treatment include clinically significant symptoms of venous insufficiency and current or prior venous ulceration as well as DUS showing axial reflux greater than 0.5 seconds in duration and a patent deep venous system. Absolute contraindications include restricted mobility and deep venous obstruction with the superficial system vital to allow venous return. Ablation can be performed to treat veins causing venous ulceration in the setting of DVT if the deep system is adequate to return blood. Relative contraindications include allergy and severe coagulopathy or thrombophilia. If a patient has an allergy to lidocaine, an amide local anesthetic, use of an ester local anesthetic such as benzocaine is suggested. Methylparaben antiseptic preservative can cause an allergy when using lidocaine in a multiuse vial, and epinephrine can cause an adverse reaction such as palpitations.

Patients with a history of thrombophlebitis, DVT, known thrombophilia, or obesity are candidates for treatment with DVT prophylaxis.⁸ Prophylaxis is most commonly performed with low-molecular-weight heparin before or at the beginning of the procedure, although no evidence is available to support this practice. A risk assessment scale such as the Caprini Assessment tool may make this assessment more objective. A score of greater than 8 has been suggested as a valid indication for prophylaxis.⁹

Venous Ablation Equipment

Saphenous vein ablation consists of using either a radio-frequency ablation (RFA) system or endovenous laser ablation (EVLA) system. ClosureFast (Covidien, Mansfield, MA) is the most commonly used RFA system.

EVLA can be performed with multiple different laser fiber designs (ie, bare tip fibers, jacket tip fibers, and radial fibers) and diameters available from a variety of vendors. Laser generators exist with multiple different wavelengths including lower wavelengths that are considered hemoglobin specific and include 810, 940, 980, and 1064 nm. Higher wavelengths are considered water specific and include 1320 and 1470 nm. Although it is still not definitively established in the literature, some authors suggest that the higher wavelength lasers are considered to produce similar efficacy at lower power settings with less postprocedure symptoms.¹⁰

Procedural Steps

Treatment of the GSV, anterior accessory GSV, and SSV is performed in a similar fashion (Fig. 2). These procedures are typically performed in an outpatient office setting without the need for oral or intravenous sedation. However,

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