Varicose Veins

15

Akhil Khetarpal and Malcolm K. Sydnor

Pathophysiology

The lower extremity venous system is composed of a deep system and a superficial system (Fig. 15.1). The deep system is composed of three paired tibial veins that join to form the popliteal vein(s), femoral vein(s), deep femoral vein, and common femoral vein. These veins run alongside similarly named arteries (refer to Chap. 6 for more information on vascular anatomy). The superficial veins receive blood from the superficial tissues and ultimately drain into the deep system. The major superficial veins are the great saphenous vein (GSV), which flows from the dorsum of the foot, anterior to the medial malleolus, along the medial calf and thigh and into the common femoral vein at the saphenofemoral junction, and the small saphenous vein (SSV), which flows from the posterior calf into the popliteal vein at the saphenopopliteal junction. The superficial veins are connected to the deep veins by perforating veins throughout the leg [1].

Venous flow from the extremities is low pressure and slow but facilitated by the presence of a series of one-way valves in the deep and superficial veins. When the valves are damaged, they become leaky and blood begins to flow retrograde toward the foot rather than antegrade toward the heart. This is called reflux, and it can occur in both the deep and superficial system; it is the primary cause of symptoms of chronic venous insufficiency [2, 3]. Unfortunately, there is no reliable method to repair venous valves. Deep venous reflux causes more severe symptoms than superficial venous insufficiency. While it is important to be aware of the presence of deep venous reflux, the primary treatment for deep venous reflux is compression therapy. Superficial venous reflux is eminently treatable and the more common cause of varicose veins. Superficial veins carry little blood flow and therefore can be blocked or removed to treat venous disease. There is secondary redirection of superficial blood flow to other superficial veins or deep veins.

Key Point
First-line treatment of deep venous reflux is compression therapy.

Valvular incompetence most commonly begins at the saphenofemoral (great saphenous vein) or saphenopopliteal (small saphenous vein) junction and leads to progressive peripheral reflux in one of the saphenous veins. Over time this reflux-induced venous hypertension spreads to superficial tributaries of the saphenous veins, which become dilated and tortuous; these are called varicose veins when larger than 6 mm in diameter.

Key Point

- Varicose veins, superficial veins dilated to >4 mm
- Reticular veins, smaller varicose veins, approximately 2 mm
- Spider veins, smallest varicose veins, 0.3–1.5 mm

Smaller varicose veins are called reticular veins, and the smallest varicose veins are called spider veins [4]. Spider and reticular veins often occur without saphenous reflux and can be treated with sclerotherapy or surface laser treatment. However, when they occur in the presence of varicose veins, the patient should be evaluated for underlying saphenous reflux.

Varicose veins are seen in approximately 10–30% of the population. Higher incidence is seen in females older than age 45. No significant ethnic disparities have been found in

A. Khetarpal · M. K. Sydnor (✉)
VCU Health System, Department of Radiology, Richmond, VA, USA
e-mail: akhil.khetarpal@vcuhealth.org; malcolm.sydnor@vcuhealth.org

N. A. Keefe et al. (eds.), *IR Playbook*, https://doi.org/10.1007/978-3-319-71300-7_15

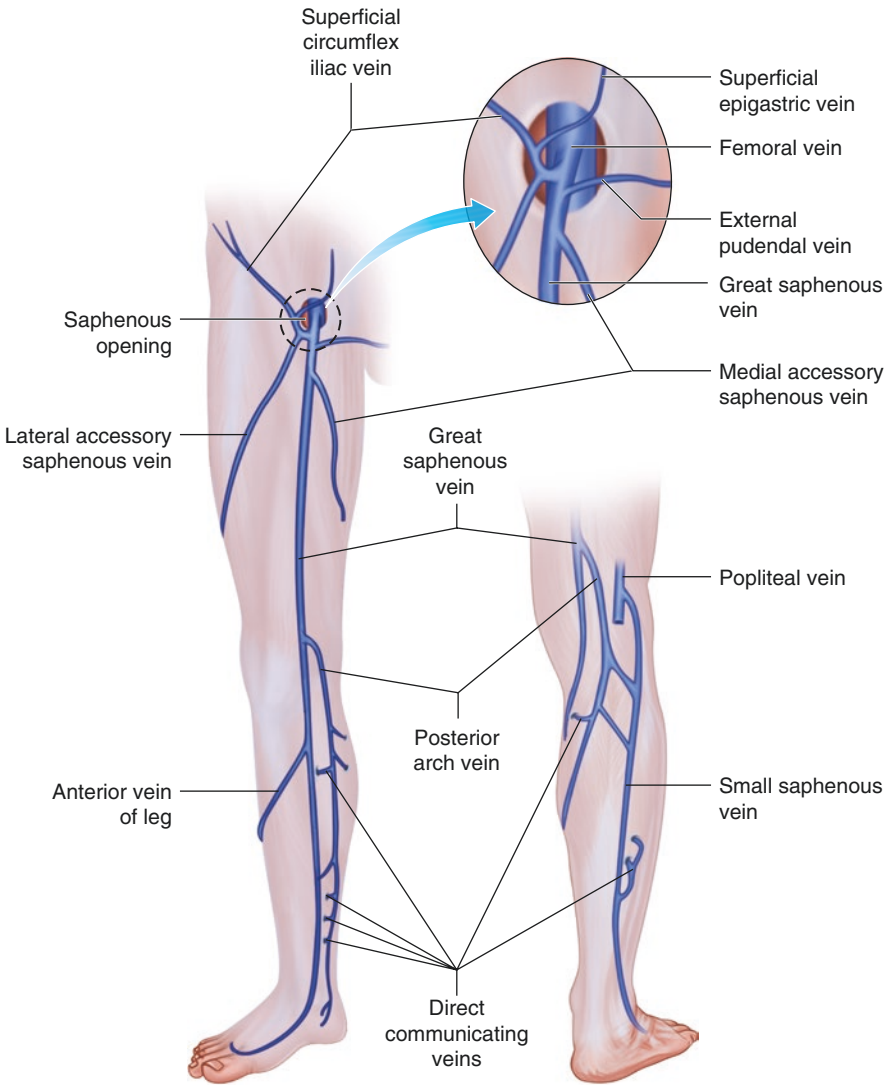

Fig. 15.1 Diagram of lower extremity venous anatomy

the incidence of varicose veins [5]. In women, the appearance of varicose veins can often be traced back to pregnancy due to compression of pelvic veins by a gravid uterus. At clinical presentation, the varicosities are typically large in caliber and number and may be associated with ankle edema, medial ankle pigmentation changes, and worsening associated reticular spider veins. There may a lag in presentation of a decade or more. Symptoms include leg fatigue or heaviness, which worsens with prolonged standing. The clinical presentation of patients with saphenous insufficiency can vary widely in age and severity, but the most consistent sign is the presence of varicose veins in the medial thigh or leg. Patients with varicose veins associated with advanced symptoms including pigmentation, swelling, and ulceration are more likely to have concomitant deep venous insufficiency (Table 15.1).

Any condition that causes lower extremity venous hypertension can result in valvular incompetence and subsequent varicose veins (Table 15.2).

Table 15.1 Signs and symptoms of varicose veins

Symptoms	Signs
Pain (aching sensation and muscle cramps)	Edema
Tightness	Skin pigmentation/thickening
Heavy sensation of involved extremities	Atrophie blanche/ lipodermatosclerosis
	Venous ulceration (shallow, irregular borders)

Table 15.2 Varicose vein associations and risk factors

Associations	Risk Factors
Increased age	Prior episode of deep or superficial venous thrombosis
Female	Central venous obstruction
High estrogen levels	May-Thurner syndrome
Multiparous	Prolonged standing
Family history	Prior varicose vein treatment

Table 15.3 CEAP classification of chronic venous disorders [4]

Clinical classification	
C_0	No visible or palpable signs of venous disease
C_1	Telangiectasias or reticular veins
C_2	Varicose veins
C_3	Edema
C_{4a}	Pigmentation or eczema
C_{4b}	Lipodermatosclerosis or atrophie blanche
C_5	Healed venous ulcer
C_6	Active venous ulcer
S	Symptomatic including ache, pain, tightness, skin irritation, heaviness, muscle cramps, and other complaints attributable to venous dysfunction
A	Asymptomatic
Etiologic classification	
Ec	Congenital (e.g., Klippel-Trenaunay syndrome)
Ep	Primary
Es	Secondary
En	No venous cause identified
Anatomic classification	
As	Superficial veins
Ap	Perforator veins
Ad	Deep veins
An	No venous pathology identifiable
Pathophysiologic classification	
Pr	Reflux
Po	Obstruction
Pr,o	Reflux and obstruction
Pn	No venous pathology identifiable
Specific description of venous segments involved can be added to CEAP classification system	

In order to standardize the diagnostic criteria for chronic venous disorders, the Clinical-Etiology-Anatomy-Physiology (CEAP) classification of chronic venous disorders was created (Table 15.3). This classification helps to create a systemic approach to clinical decision-making in the treatment of varicose veins.

An important concept to understand in the CEAP classification scale is the difference between primary and secondary venous insufficiency. Primary classification refers to an idiopathic cause of venous valvular incompetence, while a secondary classification refers to post-thrombotic, traumatic, mechanical, or thermal/chemical causes of venous valvular incompetence [3].

Clinical Indication

Patients with chronic venous disease are often seen in an outpatient setting and not infrequently self-referred. With a focused history and physical examination, the experienced vascular specialist can quickly determine the etiology of the patient's symptoms. For example, arterial disease will present with a history of claudication or rest pain and diminished pulses, while venous disease will present with lower extremity fatigue, swelling, and varicose veins. Neurogenic disease may present as radiating pain down the leg. If the patient has no varicose veins, ankle edema, and ankle pigmentation, they can usually be reassured that their symptoms are not venous in origin [6].

Key Point

- Arterial disease: claudication or rest pain and diminished pulses
- Venous disease: lower extremity fatigue, swelling, varicose veins
- Neurogenic disease: radiating pain

For patients suspected of having saphenous insufficiency, a focused history should be obtained including characterization of the complaint as well as any history of varicose veins, edema, pigmentation changes, peripheral arterial disease, prior lower extremity procedures or surgeries, prior history of DVT, and use of compression stockings.

After a thorough history and physical examination, all patients suspected of having superficial venous insufficiency undergo a duplex ultrasound (US). This study is critical to confirm saphenous insufficiency, look for deep venous reflux, and exclude DVT. The saphenous venous system (greater and small) and the deep venous system are evaluated in a systemic and segmental order to determine the level of venous valvular incompetence. It is important to map out the pathway of insufficiency between the superficial and deep veins.

An objective measure of valvular incompetence is obtained in an upright patient by compressing the leg just peripheral (toward the toes) to the vein segment being evaluated and then releasing pressure and monitoring the degree of retrograde or reversal of flow seen on duplex US (Fig. 15.2). Reversal of flow greater than 0.5 s is diagnostic of valvular incompetence in the superficial venous system. Reversal of flow greater than 1.0 s is diagnostic of valvular incompetence in the deep venous system [7].

Key Point

- Valvular incompetence in superficial venous system, reversal of flow greater than 0.5 s
- Valvular incompetence in deep venous system, reversal of flow greater than 1.0 s

Once a pathologic saphenous vein(s) has been identified, a treatment plan is developed with the patient based on the CEAP and patient's expectations.

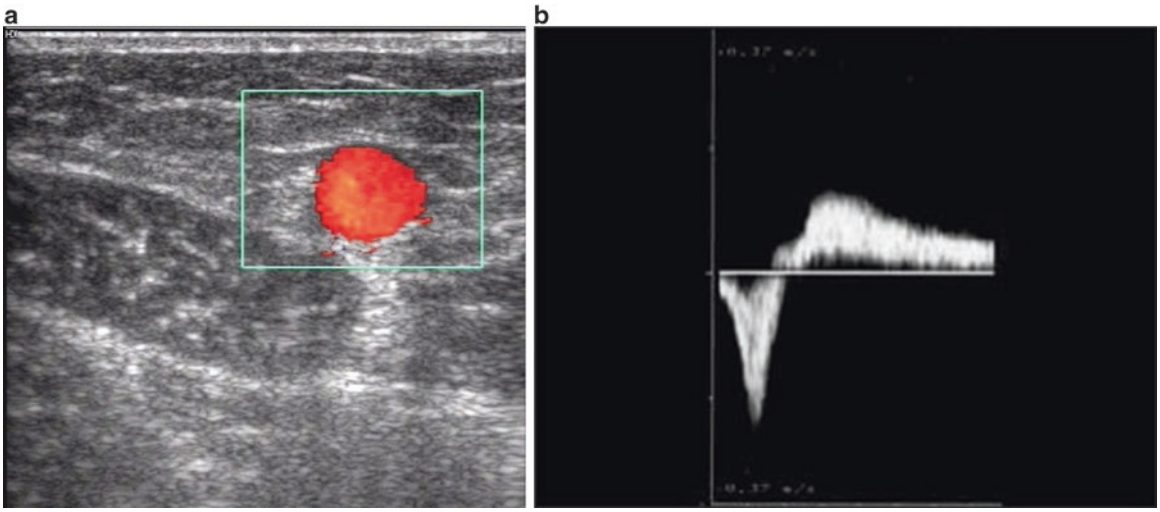

Fig. 15.2 (**a**) Color Doppler US demonstrating reflux in the GSV. Red color is usually used to indicate reversal of flow. (**b**) Doppler waveform demonstrating antegrade flow (below horizontal line) followed by reversal of flow with several seconds of reflux (above horizontal line) in the GSV

Conventional Therapy

Conservative management of varicose veins involves avoiding prolonged sitting or standing, leg elevation when possible, regular aerobic exercise, prescription-strength compression stockings, and wound care. Depending on the nature of their work, avoiding prolonged standing or sitting can be difficult for many patients. Leg elevation involves elevation of the feet to at least the level of the heart, which also can be difficult during the day. These maneuvers have been shown to increase antegrade venous blood flow rates, decrease skin edema, and promote the healing of chronic venous insufficiency related skin ulceration [8].

Exercise theoretically helps promote the antegrade flow of venous blood by promoting the calf pump mechanism and should be encouraged. However, it is also important to be aware of the limited exercise ability of patients with more severe manifestations of chronic venous insufficiency (e.g., lower extremity ulceration) [9]. Compression stockings are an important noninvasive adjunct to the treatment of varicose veins. Compression stockings are a form of external compression devices that provide a pressure gradient along the length of stocking with resultant increase in venous antegrade flow. Multiple randomized controlled trials have demonstrated the benefit of compression stockings in the treatment of chronic venous insufficiency, particularly in patients with skin ulceration [10]. Compression stockings are available in a spectrum of pressure strengths with recommendations for the prescribed pressure gradient based on the severity of disease. The proximal-distal pressure strength for treatment of varicose veins is commonly 20–30 mmHg or 30–40 mmHg [11]. Contraindications to the use of compression stockings include moderate to severe peripheral arterial disease and cellulitis, highlighting the importance of performing a thorough physical exam including an examination of the arterial system in this patient population [12]. The benefit of therapy with compression stockings is highly dependent on patient compliance. Beyond covering the offending veins, there remains debate on the relative importance of knee-high, thigh-high, or waist-high stockings. Lastly, proper wound care must be provided to patients with skin ulceration.

> **Key Point**
> Exclude peripheral arterial disease as a cause of lower extremity symptoms before prescribing compression stockings.

Saphenous vein stripping is the traditional surgical method for treating saphenous vein reflux. Surgical exposure of the saphenofemoral junction is performed followed by ligation and separation of the saphenous vein near the deep vein junction. An incision is next made at the distal level of desired vein removal, and a vein stripping probe is inserted into the distal aspect of the vein and pulled through the vein and removed through the incision at the proximal end. As this device inverts the vein, it separates it from the surrounding tissues, "stripping" the vein as it is pulled through. This operation can be effective but is more invasive and has higher morbidity than newer percutaneous approaches. In addition, there is increased risk of damage to the saphenous nerve when vein stripping is performed to a below the knee level [6]. Therefore, saphenous stripping has been almost completely replaced by endovenous thermal ablation.

Systematic reviews and meta-analysis of multiple randomized controlled trials have shown no statistically significant difference in primary failure or varicosity recurrence rates between endovenous radiofrequency ablation and

endovenous laser ablation compared with surgical vein stripping. In addition, these endovenous therapies demonstrate lower rate of complications including DVT, post-procedural infection, hematoma, pain, and time to return to normal activity making them the preferred method [13].

Interventional Therapy

Endovascular treatment of varicose veins focuses on symptom relief and cosmetic results. The treatment plan usually consists of a combination of:

- Endovenous thermal ablation (EVTA) or commercially available forms of cyanoacrylate
- Ambulatory phlebectomy (AP)
- Ultrasound-guided foam sclerotherapy (USGFS)
- Sclerotherapy of visible veins
- Surface laser treatment of reticular veins and spider veins

It is occasionally appropriate to ablate more than one saphenous vein in a single setting, but more commonly the more severely affected saphenous vein is ablated, and associated surface varicosities are treated at the same visit with AP or USGFS. Some providers choose to ablate one saphenous vein only and treat the residual surface varicosities at a later date. If a patient has both GSV and SSV insufficiency vein in the same leg, it is generally advisable to treat the GSV first and treat the more peripheral vein (SSV or perforator) at a later date.

Endovascular treatment of saphenous reflux must target the most central extent of the superficial venous insufficiency to prevent early varicose vein recurrence. When surface varicosities are the result of saphenous reflux, the saphenous vein must be treated first. When spider or reticular veins are the result of refluxing surface varicosities, the saphenous vein must be treated first followed by the surface varicosities.

If a patient presents with pain and fatigue secondary to an incompetent saphenous vein and there are no varicosities, then that patient will only require EVTA of the saphenous vein. If they have a refluxing saphenous vein and symptomatic surface varicosities, then they will require EVTA of the saphenous vein with adjunctive therapy for the surface varicosities. The treatment of the additional varicose veins may be performed during the EVTA procedure, or they can be treated as needed at a subsequent visit.

Adjunctive therapies include AP and USGFS or both. When a patient has numerous long-standing surface varicosities, USGFS is often the best choice because many of the veins will be scarred down and difficult to remove with AP and they may require an overwhelming number of incisions which would take a prohibitive amount of time as USGFS can be performed much more efficiently. When a patient has a limited amount of surface varicosities and is most interested in the best cosmetic result, AP is the superior choice. Many patients will benefit most from a combination of AP and USGFS. While small incisions are left behind with AP, multiple thrombosed varicosities which take months to resorb are left behind after USGFS leading to delayed cosmetic results.

These procedures are commonly performed in the outpatient setting. Most patients who only require EVTA +/− USGFS can undergo the procedure with local anesthesia only and do not require conscious sedation. AP, on the other hand, can be very painful and requires adequate conscious sedation.

While other therapies are emerging that do not require tumescence (injection of dilute lidocaine around the treated vein), EVTA remains the standard treatment for the saphenous vein. This is a catheter-directed therapy performed under ultrasound guidance. The basic maneuver is to access the GSV around the knee or the SSV in the mid-calf and advance the catheter up to 1–2 cm below the saphenofemoral junction or saphenopopliteal junction, inject tumescent anesthesia around the entire course of the saphenous vein, and then pull the catheter peripherally while it emits heat to damage the intima and thrombose the vein. The purpose of tumescent anesthesia is to prevent pain while "burning" the vein, protect the overlying skin, protect the surrounding structures including nerves and arteries, and collapse the vein over the catheter in order to treat it most effectively. The two types of EVTA utilize either laser energy (endovenous laser ablation) or radiofrequency energy (radiofrequency ablation). Neither has been proven to have great advantages over the other [14]. While some busy practices use both technologies, many offices have one or the other based on user preferences. There is increasing interest in a proprietary formation of cyanoacrylate which appears to be very effective at occluding the saphenous vein without the side effects of thermal injury [15].

The overall success rate for EVTA in the treatment of varicose veins is very high. Randomized controlled trial studies demonstrate a greater than 90% success rate for EVTA (both with endovenous laser ablation and radiofrequency ablation) defined as absence of reflux in the GSV with no recurrent varices at 1 and 3 years [16]. The incidence of major complications such as DVT for EVTA is less than 1% [17, 18].

Key Point
The major complication of EVTA is DVT, which occurs in <1 % of patients.

Important contraindications to EVTA include acute DVT and hypercoagulable states. Acute DVT causes an obstruction to the outflow in the deep venous system so one would not want to occlude the superficial venous system which is the only outflow tract from the extremity in that scenario [19]. Patients who have a hypercoagulable disease are predisposed to have clot extend into the deep venous system after the saphenous vein is closed [20].

Key Point
Contraindications to EVTA

- Acute DVT
- Hypercoagulable states

Key Point
Complications of EVTA/USGFS/AP

- DVT
- Bleeding
- Infection
- Paresthesia
- Nerve damage
- Skin burns

The How To: Endovenous Thermal Ablation (EVTA)

This section will explain the steps involved in EVTA, USGFS, and AP for treatment of varicose veins. These procedures are done on an elective outpatient basis and only after a thorough discussion of the risks of the procedure during the consent process. The most substantial risk is DVT if the heat-induced thrombus extends into a deep vein. This risk is less than 1% but all patients should be counseled on the signs and symptoms of DVT. Additional risks include bleeding, infection, paresthesia, nerve damage, and skin burns [17, 21].

1. The surface varicosities to be treated with adjunctive techniques are outlined on the skin with an indelible marker prior to EVTA.
2. Sterile preparation and draping of the leg undergoing treatment is performed with the patient in the supine position. Trendelenburg position can be used to help increase distention of veins targeted for treatment.
3. Sonographic exclusion of DVT is performed and documented. The course of the saphenous vein is reviewed under real-time US guidance, and an appropriate access site is chosen based on size and tortuosity of the target saphenous vein. This is often at the level of the knee for the GSV or the mid-calf for the SSV.
4. Using US guidance, a 21-gauge micropuncture needle is used to access the vein. The access is upsized to a short 7F sheath for radiofrequency ablation or a long 5F sheath for endovenous laser ablation via the Seldinger technique (refer to Chap. 8 for more information). Newer techniques may use smaller sheaths up to 4F.
5. The radiofrequency ablation catheter alone or laser is advanced in the saphenous vein to a point 1–2 cm below the saphenofemoral or saphenopopliteal junction. The laser fiber is advanced through the previously placed laser sheath, and the laser/sheath combination is pulled back to the desired starting position. The position of the laser fiber tip or radiofrequency ablation catheter tip is confirmed and documented with ultrasound (Fig. 15.3a).
6. The skin is marked at approximately 5- to 10-cm increments along the entire length of the catheter, and the skin is anesthetized at the leading ends of the marks. Tumescent anesthesia (40 mL of 1% lidocaine in a 500 mL bag of normal saline) is then liberally injected from peripheral to central in the perivenous space along the entire length of the catheter under ultrasound guidance (see Fig. 15.3b).
7. The ablation device is activated, and ablation is achieved by withdrawing the device through the length of the vein. With endovenous laser ablation, this is performed with a slow steady pullback of the sheath. With radiofrequency ablation, this is performed in 7-cm segments with two cycles centrally and then one cycle for the remainder of the 7-cm segments.
8. Steri-Strips are applied to the incision and injection sites followed by a sterile dressing and compression stockings.

The How To: Ultrasound-Guided Foam Sclerotherapy (USGFS)

1. The varicosities that are to be treated are marked using an indelible marker.
2. Sterile preparation and draping of the leg undergoing treatment is performed with the patient in the supine position.
3. The veins to be treated are localized by physical examination and with US guidance.
4. The sclerosant (e.g., 1 cc of 1% sodium tetradecyl sulfate or 1% polidocanol) is mixed into a foam solution with four parts air using two syringes and a three-way stopcock.
5. Using a 25- or 27-gauge butterfly needle, the foam is injected directly into the varicosity at a 30-degree angle under US guidance with compression placed proximal and distal to the varicosity being treated in order to contain the sclerosing agent in the varicosity.
6. Pressure is held at the injection site(s) for approximately 10 min while the limb is elevated.
7. Completion US is performed to make sure a significant amount of foam has not entered the deep venous system.

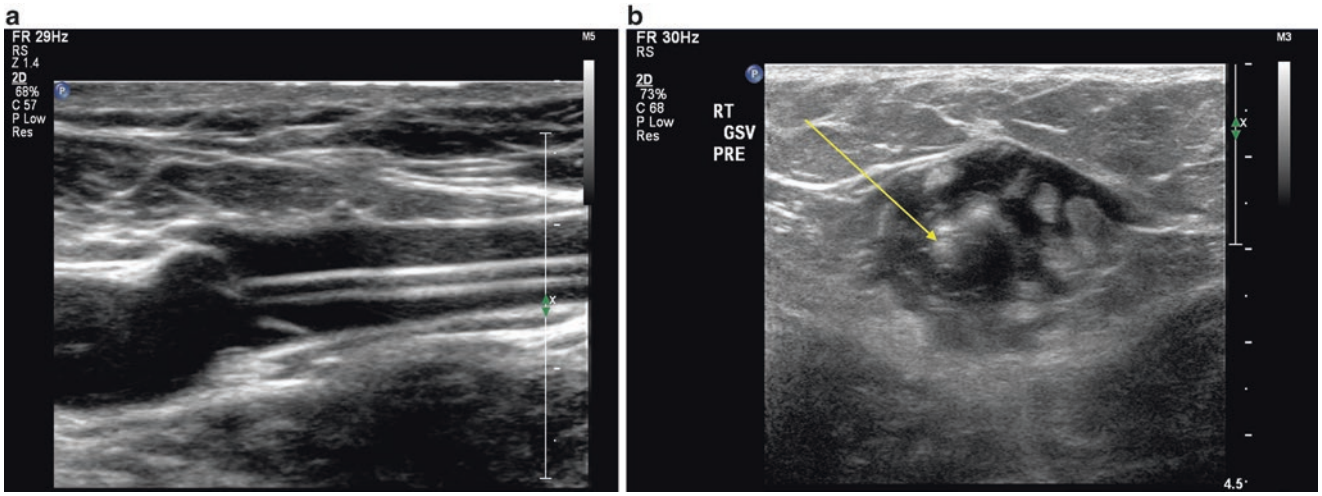

Fig. 15.3 (**a**) Endovenous laser ablation procedure of the GSV, longitudinal view of the laser sheath after being positioned near the saphenofemoral junction. Note that ultrasound demonstrates two walls of the sheath. (**b**) Endovenous laser ablation procedure of the GSV, axial view after tumescent anesthesia has been injected into the perivenous space in order to collapse the vein around the ablation device

The How To: Ambulatory Phlebectomy (AP)

1. The varicosities to be treated are marked using an indelible marker (upright is often easier).
2. Sterile preparation and draping of the leg undergoing treatment is performed with the patient in the supine position.
3. Ultrasound can be used to help identify the varicosities if necessary. Local anesthetic is injected for pain control. Tiny incisions are made near the varicosities, and the tissues are dissected with a blunt microspatula.
4. The vein is captured with a #2 Mueller hook or similar device (similar in appearance to a crochet hook) and pulled through the small incision.
5. This process is repeated centrally and peripherally, and the vein is gently pulled back and forth and removed through the incisions. Sometimes long segments of veins can be removed in total, especially if there is a layer of adipose tissue between the dermis and the vein. If the veins are scarred against the dermis, then they can be difficult to remove so they are disrupted as much as possible.
6. Incisions are closed with Steri-Strips and a sterile dressing, and compression stockings are applied to the extremity.

After completion of the EVTA and adjunctive procedures, the patient is encouraged to ambulate normally and wear the compression stockings overnight for the first night and then daily for the first 10 days. Follow-up ultrasound should be performed in the first week to confirm closure of the saphenous vein and confirm the absence of DVT. Maximum benefit is usually achieved at 6 weeks, and follow-up at 6 months post-procedure will provide an opportunity to identify early recurrence.

References

1. Meissner MH. Lower extremity venous anatomy. Semin Interv Radiol. 2005;22(3):147–56.
2. Meissner MH, Eklof B, Smith PC, Dalsing MC, DePalma RG, Gloviczki P, Moneta G, et al. Secondary chronic venous disorders. J Vasc Surg. 2007;46(Suppl S):68S–83S.
3. Eklof B, Perrin M, Delis KT, Rutherford RB, Gloviczki P. American Venous Forum; European Venous Forum; International Union of Phlebology; American College of Phlebology; International Union of Angiology. Updated terminology of chronic venous disorders: the VEIN-TERM transatlantic interdisciplinary consensus document. J Vasc Surg. 2009;49(2):498–501.
4. Eklöf B, Rutherford RB, Bergan JJ, Carpentier PH, Gloviczki P, Kistner RL, et al. American Venous Forum International Ad Hoc Committee for Revision of the CEAP Classification. Revision of the CEAP classification for chronic venous disorders: consensus statement. J Vasc Surg. 2004;40(6):1248–52.
5. Callam MJ. Epidemiology of varicose veins. Br J Surg. 1994; 81(2):167–73. Review
6. Rasmussen TE, Clouse WD, Tonnessen BH, Hallett JW. Handbook of patient care in vascular diseases. Philadelphia: Lippincott Williams & Wilkins; 2008.
7. Coleridge-Smith P, Labropoulos N, Partsch H, Myers K, Nicolaides A, Cavezzi A. *Duplex* ultrasound investigation of the veins in chronic venous disease of the lower limbs--UIP consensus document. Part I. Basic principles. Eur J Vasc Endovasc Surg. 2006;31(1):83–92. Review
8. Abu-Own A, Scurr JH, Coleridge Smith PD. Effect of leg elevation on the skin microcirculation in chronic venous insufficiency. J Vasc Surg. 1994;20(5):705–10.
9. Araki CT, Back TL, Padberg FT, Thompson PN, Jamil Z, Lee BC, et al. The significance of calf muscle pump function in venous ulceration. J Vasc Surg. 1994;20(6):872–7. discussion 878-9
10. O'Meara S, Cullum N, Nelson EA, Dumville JC. Compression for venous leg ulcers. Cochrane Database Syst Rev. 2012;11:CD000265.
11. Nelson EA, Bell-Syer SE. Compression for preventing recurrence of venous ulcers. Cochrane Database Syst Rev. 2014;9:CD002303.
12. Mosti G, Iabichella ML, Partsch H. Compression therapy in mixed ulcers increases venous output and arterial perfusion. J Vasc Surg. 2012;55(1):122–8.

13. Siribumrungwong B, Noorit P, Wilasrusmee C, Attia J, Thakkinstian AA. Systematic review and meta-analysis of randomised controlled trials comparing endovenous ablation and surgical intervention in patients with varicose vein. Eur J Vasc Endovasc Surg. 2012;44(2):214–23.
14. He Z, Zheng C, Zhang H, Yu MA. Comparison of ultrasound-guided endovenous laser ablation and radiofrequency for the varicose veins treatment: An updated meta-analysis. Int J Surg. 2017;39:267–75. [Epub ahead of print]
15. Bozkurt AK, Yılmaz MFA. Prospective comparison of a new cyanoacrylate glue and laser ablation for the treatment of venous insufficiency. Phlebology. 2016;31(1 Suppl):106–13.
16. Rasmussen L, Lawaetz M, Serup J, Bjoern L, Vennits B, Blemings A, et al. Randomized clinical trial comparing endovenous laser ablation, radiofrequency ablation, foam sclerotherapy, and surgical stripping for great saphenous varicose veins with 3-year follow-up. J Vasc Surg Venous Lymphat Disord. 2013;1(4):349–56.
17. Meissner MH, Gloviczki P, Bergan J, Kistner RL, Morrison N, Pannier F, et al. Primary chronic venous disorders. J Vasc Surg. 2007;46(Suppl S):54S–67S.
18. Biemans AA, Kockaert M, Akkersdijk GP, van den Bos RR, de Maeseneer MG, Cuypers P, et al. Comparing endovenous laser ablation, foam sclerotherapy, and conventional surgery for great saphenous varicose veins. J Vasc Surg. 2013;58(3):727–34.e1.
19. Jacobs CE, Pinzon MM, Orozco J, Hunt PJ, Rivera A, McCarthy WJ. Deep venous thrombosis after saphenous endovenous radiofrequency ablation: is it predictable? Ann Vasc Surg. 2014;28(3):679–85.
20. Raffetto JD, Eberhardt RT. Benefit of anticoagulation for the treatment of lower extremity superficial venous thrombosis. J Vasc Surg Venous Lymphat Disord. 2015;3(2):236–41.
21. Chwała M, Szczeklik W, Szczeklik M, Aleksiejew-Kleszczyński T, Jagielska-Chwała M. Varicose veins of lower extremities, hemodynamics and treatment methods. Adv Clin Exp Med. 2015;24(1):5–14.