

Varicose veins and their management

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Abstract

Varicose veins are common and affect a significant proportion of the UK population. They negatively impact on patients' quality of life and are an important cause of morbidity. Treatment has been shown to improve the quality of life in those affected, and is endorsed by international clinical practice guidelines. In the UK, traditional techniques of saphenofemoral and saphenopopliteal junctional ligation with or without stripping have been largely superseded by minimally invasive, day surgery techniques under local anaesthesia. The most commonly performed include radiofrequency ablation and endovenous laser ablation, both endothermal techniques which may be associated with procedural discomfort and complications relating to the use of thermal energy. More recently, novel techniques, including mechanochemical ablation and cyanoacrylate glue, have entered the clinical arena with promising results. Saphenous sparing techniques also exist, selectively disconnecting refluxing points between the superficial and deep venous systems (CHIVA) or by removing incompetent tributaries via selective phlebectomy (ASVAL). This article discusses the epidemiology, diagnosis and management of varicose veins, including the latest endovascular and targeted open surgical techniques.

Keywords Ablation; cyanoacrylate; endovenous; haemodynamic; laser; mechano-chemical; radiofrequency; sclerotherapy; surgery; varicose veins

Definition

Varicose veins are tortuous, dilated, superficial veins greater than 3 mm in diameter. They can occur in any area of the body,

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but most commonly affect the lower limb. Varicose veins are a manifestation of chronic venous disease (CVD), a term that describes a spectrum of presentations characterized by signs and symptoms associated with a poorly functioning superficial and/or deep venous system. In addition to their clinical sequelae, varicose veins present an important quality of life and functional burden to patients, with the prevalence of self-reported depression and anxiety more than double that reported in the general population. Varicose veins also represent a significant financial expenditure to society. Their management costs approximately £50–60 million per annum and venous ulcers, which can result as a longstanding complication of venous disease, are responsible for up to 2% of the annual healthcare budget expenditure of Western societies.

Epidemiology

CVD is extremely common, with similar incidences worldwide; spider veins (fine, dilated intradermal venules approximately 1 mm in diameter) affect up to 80% of the population³ and the reported incidence of varicose veins is variable, ranging from 20% to 64%. More severe presentations of CVD include skin changes, such as lipodermatosclerosis or haemosiderin deposition, and venous ulceration, which affects 1–2% of the population but increases to over 4% in those over 65 years of age.¹

Risk factors associated with venous disease include age, family history, previous deep vein thrombosis (DVT) and congenital conditions such as Klippel-Trenaunay syndrome. Female gender has been reported as a risk factor, although studies have shown a similar prevalence in males and females. Obesity and orthostasis have been associated with varicose veins, although there is currently insufficient evidence to support a causative role.

Varicose veins occur because of impairment of venous return associated with reflux, obstruction or calf muscle-pump failure. The exact aetiology of the condition is unclear and different theories exist to explain this. The descending theory describes valvular failure as the initiating event, resulting in an increase in venous pressures in the truncal vein, with resulting vein wall dilatation and varicosity formation. However, truncal reflux may be present without junctional incompetence, suggesting that this may not be the primary aetiological mechanism.² The ascending theory describes primary vein wall failure as the initiating event, leading to valve leaflet separation and the development of reflux. Inflammation, hypoxia, extracellular matrix degradation and shear stress have all been implicated in the development of vein wall failure and are currently the topic of research efforts to better understand the pathophysiology of disease. Regardless of which theory is correct, the result is an increase in distal venous pressures, leading to the cutaneous changes typical of the disease.

Primary varicosities may be associated with incompetence in the superficial venous system and in areas connecting to the deep system (saphenofemoral junction (SFJ), saphenopopliteal junction (SPJ) or perforating veins). They most commonly occur in the great (GSV) and/or small saphenous vein (SSV) distribution (Figure 1); however, visual inspection can be misleading.

Secondary varicosities arise as a result of a preceding insult that has resulted in venous hypertension in the superficial



Figure 1 Varicose veins in the (a) long saphenous and (b) short saphenous vein distribution.

system. Examples are DVT, deep venous incompetence or pressure on the pelvic veins from an intra-abdominal mass. The underlying pathology is best investigated by venous duplex and ultrasound abdomen/pelvis.

Diagnosis

Patients with varicose veins present with symptoms including pain, heaviness, swelling, aching, restless legs, cramps and itching. These correlate well with disease severity³ and tend to be worse at the end of the day. Leg elevation helps reduce the associated swelling, whereas walking significantly improves the symptoms, due to calf-pump action reducing venous pressure.

Assessment of the arterial, neurological and musculoskeletal systems may be relevant to rule out differential diagnoses in varicose vein patients. A history of DVT, previous leg trauma, venous surgery and a family history of DVT and hypercoagulable states are important.

Examination

When examining the patient with varicose veins, it is important to assess for other features of venous disease, including progressive skin changes, superficial thrombophlebitis, ulceration and the presence of bleeding varicosities.

Prolonged venous hypertension can result in skin changes, including venous eczema, lipodermatosclerosis and haemosiderin deposition. Ultimately, patients can develop venous leg ulceration and atrophie blanche (scarring at sites of previous ulceration) (Figure 2); these are most commonly found the malleolar, or gaiter area.

Superficial thrombophlebitis, or superficial vein thrombosis (SVT), describes a pathological inflammatory–thrombotic process in a superficial vein. This is characterized by pain, erythema and tenderness over the affected vessel, and can be the primary presentation of varicose vein disease; importantly, it may also be

associated with immobilization, trauma, active malignancy, autoimmune disease and a history of venous thromboembolism (VTE). Patients with SVT are at increased risk of developing VTE, with estimates ranging from 6% to 44% having an associated, or developing, a DVT. Because of this, historical treatment with anti-inflammatory drugs and analgesia is not sufficient. A recent Cochrane review summarizing data from 7296 patients with SVT found that prophylactic dose fondaparinux was associated with a lower incidence of VTE, SVT recurrence and extension, with no increased risk of bleeding compared to placebo. Rivaroxaban appeared to be effective, but was associated with a non-significant increased risk of non-major bleeds, leading the authors to conclude that this treatment modality requires further evaluation in the context of appropriately powered studies.



Figure 2 Venous ulceration over the medial malleolus (gaiter area).

Similarly, non-steroidal anti-inflammatory drugs and low molecular weight heparin require further evaluation. The review authors advise prophylactic dose fondaparinux as a treatment option for SVT, given for 45 days.⁴

Large, prominent varicosities may be prone to bleeding, either spontaneously or as a result of trauma. This is an indication for urgent treatment; rarely, they are associated with fatal haemorrhage.

The patient should be assessed initially standing, allowing the veins to fill. A full neurovascular examination should be carried out. Handheld Doppler (HHD) was previously used as an adjunct to assess for the presence and level of incompetence. However, it is not an accurate tool and cannot be depended upon – at the SFJ and SPJ the reported sensitivity has been as low as 56% and 23%, respectively.

Classification and outcome measurement

The CEAP (clinical, etiology, anatomy, pathophysiology) classification was developed in 1994 to describe the clinical presentation and aetiology of lower-limb venous disease. The adoption of this system has allowed a standardized approach, enabling correlation between different studies and units (Box 1). This classification is descriptive in nature and should not be used as an outcome measure following treatment, as it is rather static

CEAP classification of lower venous disease

Clinical classification

- C0: no visible or palpable signs of venous disease
- C1: teleangectasia or reticular veins
- C2: varicose veins
- C3: oedema
- C4a: pigmentation or eczema
- C4b: lipodermatosclerosis or atrophie blanche
- C5: healed venous ulcer
- C6: active venous ulcer
- S: symptomatic, including ache, pain, tightness, skin irritation, heaviness, muscle cramps
- A: asymptomatic

Aetiological classification

- Ec: congenital
- Ep: primary
- Es: secondary (post thrombotic)
- En: no venous cause identified

Anatomical classification

- As: superficial veins
- Ap: perforator veins
- Ad: deep veins
- An: no venous location identified

Pathophysiological classification

- Pr: reflux
- Po: obstruction
- Pr,o: reflux and obstruction
- Pn: no venous pathophysiology identifiable

Box 1

(e.g. a patient with skin changes will still be a CEAP clinical class 4 following treatment).

The venous clinical severity score (VCSS) is a useful physician reported clinical assessment tool providing a measure of severity. The VCSS scores nine hallmarks of venous disease in order of severity from 0 to 3, and provides an adjunct to the CEAP classification; its use is endorsed by the Society of Vascular Surgery and American Venous Forum.⁵

Quality of life (QoL) measures are part of the assessment of patients with varicose veins. Both disease specific and generic assessments should be performed to obtain a holistic assessment of QoL impact.⁶ The Aberdeen Varicose Vein Questionnaire is completed by the patient and comprises of 13 questions ranging from physical symptoms to social effect and cosmesis. Other disease-specific tools include the Chronic Venous Insufficiency Questionnaire-20 (CIVIQ-20) and the Venous Insufficiency Epidemiological and Economic Study (VEINES) Symptom and QoL assessments. Generic QoL measures include the Short Form Health Survey (SF-36, SF-12, SF-8) and the EuroQoL-5 domain survey. Good correlation has been shown between the AVVQ and CIVIQ-14 and the VCSS and generic QoL scoring systems.

Imaging

The gold-standard imaging technique is colour duplex ultrasound. This non-invasive, dynamic imaging modality allows both anatomical and haemodynamic assessment of the deep and superficial venous systems, indicating the level and nature of incompetence. Guidelines of the Society for Vascular Surgery (SVS) and the American Venous Forum (AVF), the European Society of Vascular and Endovascular Surgery (ESVS) and the National Institute for Health and Care Excellence (NICE), recommend that patients with varicose veins should all have preoperative duplex ultrasound scanning.^{5–7} Venography should be used only in cases with inconclusive duplex results. Magnetic resonance venography (MRV) and computerized tomographic venography (CTV) may be used to assess the abdominal and pelvic veins in complex cases where the site of venous incompetence is not in the lower limbs.

Referral and treatment

NICE guidelines recommend referral of patients with symptomatic primary (or recurrent) varicose veins, skin changes, superficial venous thrombosis and venous leg ulceration. These criteria recognize the significant impact of varicose vein disease on quality of life, and are less stringent than those provided by previous recommendations. Although associated with an increase in referrals,⁷ access to secondary care is still an issue for many patients, particularly those with venous leg ulceration. This was highlighted by the EVRA trial, which excluded 1772 patients eligible for the study on the basis that they had an ulcer duration of greater than 6 months, representing 29% of the total exclusions from the trial. The authors remarked that this delay was likely a reflection of failures in the referral pathway from primary to secondary care.⁸

Over the last two decades, major advances have been made in the treatment of varicose veins, with a shift from open techniques towards minimally invasive outpatient procedures. An ideal treatment for varicose veins should be effective, cheap,

safe, performed in day surgery, with low recurrence rates and good clinical outcomes.

Open surgery

Open surgery has been performed for varicose veins since the late 1800s, when Friedrich von Trendelenburg performed a mid-thigh open ligation of the GSV in a patient with an incompetent SFJ. Recent advances in minimally invasive surgery have led to endovenous ablation becoming the treatment of choice, with the proportion of open surgery performed dropping from 83% in 2006 to under 25% in 2015.

Surgery for varicose veins can be performed under general, local or regional anaesthesia and should be a day-case procedure in all but special cases.

Sapheno-femoral and sapheno-popliteal junction ligation

Sapheno-femoral junction ligation was described by John Homans in 1916. It consists of a groin incision and dissection down to the SFJ. Tributaries are identified, isolated and divided beyond secondary branch points. The GSV should be ligated flush with the common femoral vein via a transfixion suture or double tie. Despite addressing the main point of reflux in cases of SFJ incompetence, duplex studies have revealed ongoing reflux in the remaining segment of GSV. Stripping the GSV in combination with SFJ ligation, has resulted in a 60% reduction in re-intervention after 11 years.

Sapheno-popliteal junction ligation involves making an incision in the popliteal fossa, dissection to the SPJ, which is ligated or transfixed. SPJ ligation is less successful, with high recurrence and complication rates, particularly relating to common peroneal nerve damage resulting in foot drop, which is a cause of litigation.

The risks of open ligation ± stripping include bleeding, infection, haematoma formation, nerve damage (saphenous, common peroneal and sural), numbness, paraesthesia, recurrence (including full truncal vein recurrence) and venous thromboembolism. The incidence of nerve lesions may be as high as 40% in full GSV stripping; a significant reduction has been reported when stripping to the knee is performed. The rate of DVT in open SFJ ligation and stripping is 0.54%. Neovascularization is seen with all open surgical ligations, despite multiple techniques trialled to stop this phenomenon. It is not due to poor surgical technique. It is not seen with ablation techniques (see below), indicating that the very action of dissection causes the formation of scar tissue and new vessels. This would suggest that minimal dissection and ligation (as in vein harvesting) is the ideal.

Ambulatory conservative haemodynamic management of varicose veins (CHIVA)

The French acronym CHIVA (Cure Conservatrice et Hémodynamique de l'Insuffisance Veineuse en Ambulatoire) describes a minimally invasive, saphenous-sparing strategy first described in 1988 by Franceschi and colleagues. Haemodynamic surgery is based upon the premise that varicose veins arise secondary to a dysfunction in the venous drainage hierarchy, which normally allows venous flow to drain from tributaries, to the truncal vein, to the deep venous system. The formation of pathological venovenous shunts allows reflux between the

superficial and deep systems. The aim of CHIVA is to disrupt these shunts by interrupting the refluxing venous outlets without compromising the saphenous vein. The technique relies on precise preoperative anatomical and haemodynamic duplex mapping of the areas of reflux, allowing the operator to identify specific targets to ligate that will enable disconnection of the venovenous shunt and restoration of hierarchical venous drainage.

In experienced hands CHIVA is more effective than saphenous stripping, with reduced long-term recurrence. A retrospective comparison of CHIVA to EVLA reported significantly reduced pain scores, bruising and residual varicosities in the CHIVA group. There are currently no studies comparing CHIVA with RFA and it remains the preserve of specialist centres.

Ambulatory selective varices ablation under local anaesthesia (ASVAL)

ASVAL removes the venous reservoir by targeting superficial varicosities. Via this technique, multiple phlebectomies are performed on varices without intervening on the refluxing saphenous veins. Postoperative reduction in saphenous vein reflux, improvement in symptoms, with up to 88.5% of patients free from variceal recurrence on 4-year follow-up has been reported.¹⁷ Isolated phlebectomies appear to improve venous haemodynamics by reducing GSV reflux duration, peak velocity and diameter. Ten-year follow-up data of 360 limbs reveals absence of saphenous reflux in 64.4%, absence of clinical recurrence in 68.8%, absence of re-intervention in 76.7% and functional improvement in 69.9% of cases.⁹

Compression hosiery

Compression has been used since biblical times and reported in the literature since the 1950s. It works by applying graded external pressure to the skin (greatest at the ankle and reducing at the calf and thigh) and the superficial venous system, reducing the venous reservoir in the dilated veins. Compression also increases venous flow in the lower limbs, reducing venous stasis and reflux. This reduction in pressure permits improved capillary pressure differentials and improved arterial inflow. The combination of physiological effects translates in reduced CVD symptoms and prevention of deterioration of skin changes associated with venous hypertension.

There is no formula for the amount of pressure required to improve a specific symptom; however, generally the more severe the clinical picture the higher the class of stockings used (Table 1). British class II and III compression have been shown to confer symptomatic benefit in patients with varicose veins and class II below-knee stockings are most commonly prescribed.

Classifications of compression hosiery

	British	European
Class I	14–17 mmHg (light)	18–21 mmHg
Class II	18–24 mmHg (medium)	23–32 mmHg
Class III	25–35 mmHg (strong)	34–46

Table 1

There is, however, a lack of high-quality evidence regarding the effect of compression hosiery on varicose veins. Studies are heterogeneous, using different types of stockings in different patient groups with unclear methodology. A 2013 Cochrane systematic review concluded that there was insufficient high-quality evidence to determine whether using compression stockings as the sole and initial treatment of varicose veins was of benefit, and that large randomized controlled studies are required to determine the effectiveness, if any, and provide guidance on the type of compression to be used.¹⁰

Patients do report symptomatic relief after wearing compression hosiery. However, this is very subjective and the effect is limited to the period during which the stocking is worn. In addition, patients often find them uncomfortable, difficult to apply and remove, and cosmetically unsightly; non-adherence rates are as high as 33%.¹⁰ Risks of compression include skin necrosis in poorly fitted stockings, particularly in patients with diabetes or peripheral vascular disease; compression hosiery should not be used in patients with an ankle brachial pressure index (ABPI) < 0.9.

Importantly, good-quality stockings are expensive (£50–100 per pair), and require the patient to wear them every day for life, with replacements at 3–6 monthly intervals. With the average patient attending in their fifties, this translates into a significant cost in the longterm.

Conversely, numerous randomized controlled trials (RCTs) have shown that surgical intervention in varicose vein disease is cost effective and yields important QoL improvements.¹¹ The use of compression in uncomplicated varicose veins is therefore not recommended, except for specific cases where the patient cannot receive intervention (e.g. during pregnancy).⁷

Sclerotherapy

The practice of sclerotherapy involves injecting a small volume of sclerosant into a vein and applying compression, resulting in occlusive fibrosis without clot formation. There are three kinds of sclerosants:

- chemical irritants (chromated glycerine)
- osmotic (hypertonic saline)
- detergent (sodium tetradecyl sulphate (STS) and polidocanol (POL)).

In the UK STS (1–3%) and POL (0.5–3%) are more widely used, particularly for small reticular or spider veins. Sclerotherapy was initially used in its liquid form (LS), via the ‘air-block’ technique. However, as sclerosant is deactivated by blood contact, liquid sclerotherapy suffered poor occlusion rates due to rapid protein binding. The practice went out of fashion with the publication of randomized controlled studies showing poor long-term results compared to surgery.

The advent of foam sclerotherapy (FS) reintroduced this practice. FS still utilizes STS or POL but converts it from its liquid phase to foam by mixing it with air. Two syringes are connected by a three-way tap with liquid sclerosant and air (ratio 1:4). The mixture is oscillated between them until foam is produced (Tessari technique). Proprietary foam also exists in the form of Varithena [BTG International Ltd], generated by a canister system with a mixture of oxygen, carbon dioxide and low nitrogen content.

The advantage of FS is increased potency of the sclerosant (allowing smaller volumes to be used), as the foam ‘displaces’ blood in the vein (increasing the contact area between foam and vein wall, increasing fibrosis and reducing thrombosis). This allows the treatment of truncal veins and large varicosities.

FS is more effective than LS with a similar side-effect profile and can be delivered accurately under ultrasound guidance. Reports comparing its effectiveness to open surgery are contradictory with some stating it is less effective and other RCTs suggesting it is just as effective as surgical stripping with high-ligation at 2-year follow up.¹¹ The CLASS trial, a randomized study recruiting 798 participants with varicose veins, found that quality of life improvement following intervention was significantly lower with foam sclerotherapy compared to surgery, and occlusion rates lower than for surgery and laser.¹² A further randomized trial comparing endovenous ablation, foam and stripping in GSV disease found that at 4 years, more recanalizations occurred in the foam sclerotherapy group.¹³ It is of course vastly cheaper to perform, and occlusion rates do not necessarily perfectly correlate with symptomatic improvement.

POL endovenous microfoam has been the subject of recent trials. The VANISH randomized controlled studies demonstrated that POL microfoam was safe, yielding symptomatic improvement compared to placebo, even at 1-year follow-up. A further trial found that patients in the intervention arm experienced greater symptom relief and improved appearance in varicosities compared to placebo.¹⁴

Complications of foam sclerotherapy include anaphylaxis, DVT, skin pigmentation and tissue necrosis, thought to be due to excessive injection pressure leading to arteriolar compromise. Neurological complications are rare but when present can be serious, in the form of cerebrovascular accident (CVA), transient ischaemic attack (TIA), blurred vision or migraine. CVA and TIA have been reported in extremely low numbers. The underlying mechanism for these complications is still unclear. Paradoxical gas embolism via a right to left cardiac shunt has been proposed, although air bubble generation is also present in other ablative techniques, including endovenous ablation. An alternative explanation is that the production of endothelin and inflammatory mediators at the treatment point is the causative factor. Despite being rare, risks of CVA and TIA should always be explained when consenting patients for treatment with FS.

The SVS and AVF guidelines recommend FS to treat tributaries and as an option for the treatment of the incompetent saphenous vein.⁵ Current NICE guidelines recommend using ultrasound-guided FS (UGFS) as second line treatment following endothermal ablation.⁷

Endovenous ablation

The use of catheter-based methods as described below has converted venous intervention from the operating theatre to the treatment room, from general anaesthetic to local anaesthetic and has hugely improved access to treatment.

Thermal ablation

Radiofrequency ablation (RFA): is a technique by which thermal energy (85–120°C) is employed to seal the incompetent vein

via heat damage. RFA of the GSV was described by Goldman in 2000.

The vein is cannulated under ultrasound guidance using the Seldinger technique and the endovenous catheter is inserted to approximately 2 cm from the junction between the superficial and deep systems (Figure 3a). Tumescant anaesthesia is instilled under ultrasound guidance (Figure 3b) with the aim of surrounding the vein, separating it from the surrounding structures in order to avoid thermal injury and compressing it on the catheter to maximize energy transfer to the vein wall, reduce power requirements and providing pain relief. Once adequate coverage is obtained and the temperature at the probe tip is reduced (25°C) the RFA system can be activated and treatment started.

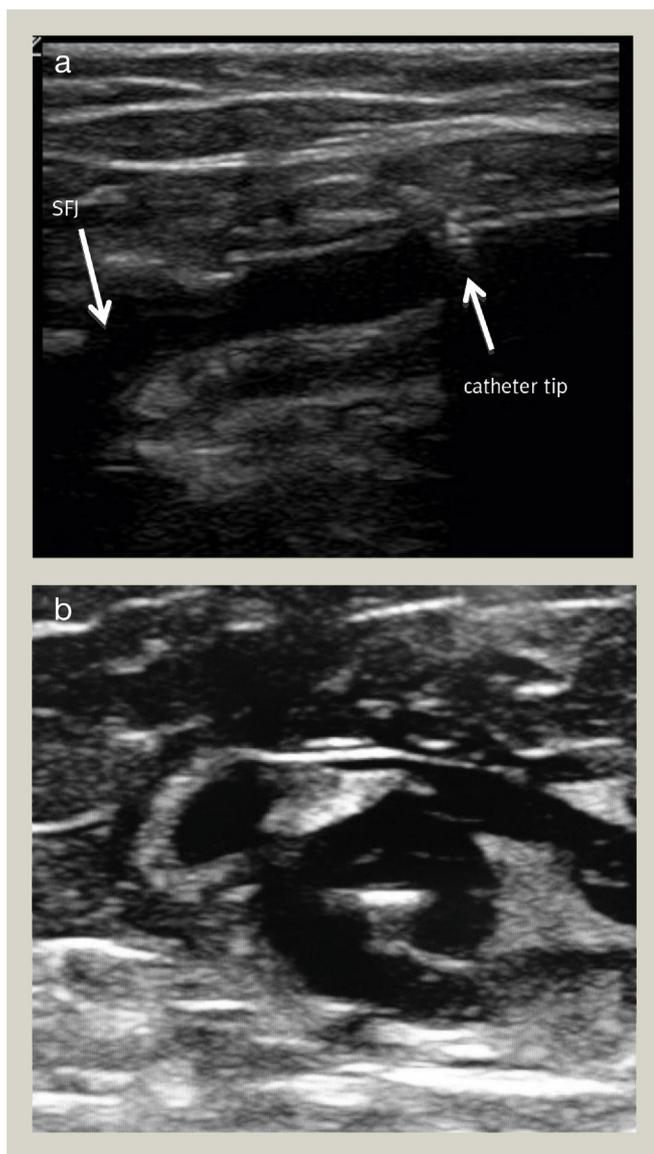


Figure 3 Ultrasound images of endovenous ablation. (a) Longitudinal view of saphenofemoral junction (GSV on the right of the screen joining the femoral vein on the left). Note the hyperechoic catheter tip at the far right of the screen positioned approximately 2 cm from the junction. (b) Tumescant anaesthesia. The catheter is hyperechoic; note the vein is collapsed onto the catheter and surrounded by hypoechoic of tumescant anaesthetic.

The patient should be placed in the Trendelenburg position and extrinsic compression can be used to ensure vein wall/catheter apposition to maximize treatment efficacy.

The catheter tip is active during treatment, heating the vein segment over 20 seconds at a temperature of 120°C. Depending on the system used, for a 7 cm catheter tip, the treatment rate is 0.35 cm/s, with visual and auditory feedback to notify when the treatment is complete. The catheter has an inbuilt feedback mechanism that enables delivery of consistently high temperatures and ongoing ablation by adjusting energy delivery. Usually two rounds of treatment are given in the segment closest to the junction to ensure an adequate seal. Subsequently, the catheter is pulled back after each treatment.

The early RFA systems required continuous pullback at a rate of 3 cm/min resulting in a treatment rate of 0.05 cm/s, making it a longer procedure with potentially less consistent ablation as the rate of continuous drawback could be difficult to gauge. The new generation catheters are superior with respect to reduced rates of DVT and obliteration of the GSV.

A meta-analysis comparing open and endovascular treatment of varicose veins found that at 3 months there was no difference in recurrence rates between open surgery, EVLA or RFA, although endovenous ablation conferred a faster return to work.¹⁵ Prospective randomized studies revealed that RFA has comparable results to high-tie and stripping with regards to recurrence both in the short, mid and long-term.¹¹ RFA was better tolerated by patients and associated with a quicker recovery period and improved quality of life scores. RFA has been shown to be a minimally invasive, safe and effective procedure for the treatment of varicosities.

When consenting patients for this procedure, they must be warned of the risk of bleeding, infection, nerve damage (due to direct thermal injury to the saphenous/sural nerve) and DVT. Risks specific to RFA are difficulty with cannulation, guidewire passage and catheterization through tortuous segments, superficial burns, pigmentation and phlebitis.

Bipolar radiofrequency induced thermotherapy is another type of endothermal ablation. The main differences are that the vein is heated to lower temperatures (85°C) and the system requires a continuous pull-back technique. Its efficacy has been demonstrated in the incompetent saphenous veins, particularly when performed by a skilled operator.

Endovenous laser ablation (EVLA): uses laser (light amplification by stimulated emission of radiation) and fibre-optic catheter technology to generate thermal energy. It acts by heating the vein wall and blood, reaching temperatures of up to 800°C; this is not dependent on the laser wavelength itself but on the speed of pullback and on the power supplied. Unlike RFA, the catheter does not have a feedback mechanism to maintain a constant temperature. To prevent under- or over-treatment it is important to maintain constant pullback at a rate of 1 cm every 5 seconds (0.2 cm/s); using 14W power the energy delivery is 70 J/cm. The procedure for EVLA is the same as for RFA in terms of vein catheterization and use of tumescant anaesthesia.

EVLA is effective for saphenous vein surgery, with impressive clinical outcomes that are at least comparable to, if not better than open surgery.¹⁶ As with RFA, patients tend to prefer the endovenous option, with improved satisfaction, reduced

postoperative pain and quicker return to work. Two-year follow-up has revealed durable results. EVLA short-term outcomes are equivalent to high-tie and ligation, with reduced postoperative pain and bruising. RFA and EVLA have similar outcomes, with >90% GSV occlusion rates.¹⁶ A recent meta-analysis reported similar outcomes in terms of safety, efficacy, quality of life and occlusion rates, although RFA may have a reduced risk of overall complications.¹⁷ EVLA can be used in the GSV and SSV, as well as for branch varicose veins.

Complications include bruising, induration, numbness, thermal burns and superficial thrombophlebitis. It is more expensive than conventional surgery, requiring additional equipment in the form of eye goggles, fibre-optic catheters, micropuncture kit and a protected room. The catheters are very small (0.5–1 mm diameter) and can be difficult to navigate up a tortuous vein. The rate of post-operative DVT is 0.5%.

Overall, RFA and EVLA have been demonstrated to be more cost effective than open surgical techniques for the treatment of varicose veins with similar improvement in quality of life. NICE, hence, recommends their use as first line treatment for truncal vein incompetence.⁷

Steam therapy (steam varicose System:™): in endovenous steam ablation (EVSA) a catheter delivering pulsated steam reaching temperatures of 120°C causes endothelial destruction and fibrosis. A pilot study revealed a 65% occlusion rate at 6 months, with the remaining 35% showing small-segment recanalization that was not clinically relevant. A subsequent study of 20 patients with GSV incompetence demonstrated occlusion rates of 96% at 6-month follow-up, with most patients returning to normal activity within 3 days. A 2014 randomized controlled trial comparing EVLA with EVSA in 227 limbs revealed non-inferiority of EVSA in terms of truncal occlusion (>90%) and quality of life measures at 1 year. Interestingly, EVSA patients reported reduced pain following the procedure and greater procedural satisfaction. Further studies comparing steam to other types of endothermal ablation are awaited.

Non-thermal ablation

Mechano-chemical endovenous ablation (MOCA): delivered by the ClariVein® device (Vascular Insights, Madison, CT, USA), MOCA is a hybrid system composed of a rotating tip with simultaneous injection of liquid sclerosant. It does not use thermal energy, thus obviating the need for tumescent anaesthesia. The procedure is performed under local anaesthetic with percutaneous puncture under ultrasound guidance. The basic principles are as for endovenous ablation, with venous cannulation via a percutaneous puncture technique and catheter insertion up to 2 cm from the SFJ.

The ClariVein® device causes local mechanical damage via a wire placed at its tip, which rotates at 3500 rpm, abrading the intima of the vein, causing venospasm. Liquid sclerosant (STS or POL) is infused through an opening at the catheter tip, close to the rotating wire and the catheter is pulled back at a rate of 1–2 mm/second. Closure rates at 8 months have been reported as high as 96.7%. A separate study reported closure rates as follows: at 3 months GSV 90.8%, SSV 96%; at 6 months GSV 86.9%, SSV 90.9%; and at 1 year GSV 84.8%, SSV 94.3%. A systematic review on MOCA revealed

anatomical success rates (defined as closure of the treated vein on duplex) of 92% at 6 months and 91% at 12 months. Longer term occlusion rates in the literature are reported as 91% at 2 years and 87% at 3 years, with complications such as nerve damage reported in <0.2%.¹⁸

Compared to RFA, the Venefit versus Clarivein trial revealed a reduction in maximum intraprocedural pain scores during truncal ablation for MOCA, on both visual analogue scale and number scale. Occlusion rates, clinical severity scores, and quality of life scores at 1 and 6 months were comparable between the two groups.¹⁹ Further comparative results with RFA are awaited with the results of the Mechanochemical endovenous Ablation versus RADiOfrequeNcy Ablation (MARADONA) trial. Comparative results with laser ablation are awaited with the Laser Ablation versus Mechanochemical Ablation (LAMA) trial, though early reports are of similar outcomes.

Cyanoacrylate glue ablation: there are currently two cyanoacrylate glue (CAE) techniques, the VenaSeal Closure System (Medtronic, Minnesota) and the VariClose system (Biolas, Ankara, Turkey). The two systems differ in the methodology of ablation and the polymerization rates of the glue, with the former delivering glue with a slow polymerization rate with a segmental pull back and the latter characterized by a more rapid polymerization and constant pull back technique.

The multicentre European Saphoon Closure System Observational Prospective (eSCOPE) study delivering VenaSeal for GSV treatment revealed 6- and 12-month occlusion rates of 94.3% and 92.9%, respectively, with improvement in quality of life and clinical severity scoring following intervention; 11.4% of patients experienced phlebitis. Overall, this trial demonstrated the safety of this procedure.

The VeClose randomized controlled trial comparing RFA and cyanoacrylate adhesive (CAE) randomized 222 patients with a 3-month occlusion rate of 96% in the thermal ablation group compared to 99% for the NTNT. Postoperative bruising was significantly reduced in the CAE group. Two-year occlusion rates showed that CAE is comparable to RFA (95.3% vs 94.0%), with similar quality of life improvements. A further recent trial comparing CAE to RFA in patients undergoing both GSV, SSV, ATV and perforator treatment revealed a 100% treatment success in the CAE group and 99% in the RFA group. Five percent of the CAE group reported phlebitis compared to 16% of the RFA group, with comparable VTE rates. Of note, superficial infections from glue clumps requiring excision and drainage were reported in three patients at a maximum of 8 week follow up. The WAVES study of 50 patients achieved a 99% 3 month occlusion rate.

Compared to EVLA, the VariClose system demonstrated occlusion rates of 95.8% compared to 92.2% at 1-year follow-up. Operative time and periprocedural pain were reduced compared to EVLA; postoperative bruising was also significantly less in the CAE group.

Comparative trial results are awaited for cyanoacrylate (CAE) glue versus MOCA. A systematic review on the VariClose® system reported that CAE was a feasible, effective and safe treatment modality for GSV incompetence, but that longer term studies were required (maximum reported 30 months).

Conclusion

Varicose veins are a common condition and their management has changed with the advent of thermal ablation, with equivalent quality of life improvement noted. Endovenous ablation also offers the possibility of day-case interventions and more rapid return to normal activities. Long-term data is beginning to show that endovenous ablation may have reduced technical recurrence rates. The non-thermal methods, are showing similar effectiveness and improvement in quality of life without the risks of thermal nerve damage. Longer term studies will provide a better indication as to their merits. ♦

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