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Minimally invasive options in the treatment of saphenous varicose veins

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Abstract

Varicose vein is a commonly seen condition in general practice. Patients seek medical advice for cosmetic and health concerns. Duplex ultrasound is becoming an essential tool for evaluating patients with venous disease. Treatment options for saphenous varicose veins are progressing and becoming less invasive. Besides open surgery with ligation and stripping, saphenous varicose veins may now be treated with endovenous ablation techniques including radiofrequency ablation (RFA) or endovenous laser therapy (EVLT). The introduction of ultrasound-guided foam sclerotherapy (UGFS) allows for effective treatment of saphenous veins, perforating veins, and larger varicose tributaries. As techniques continue to evolve, varicose veins can be treated at an earlier stage, with patients enjoying shorter recovery times, an earlier return to work, and better cosmetic outcomes. Minimally invasive therapy has strengthened the armamentarium of surgeons in the modern management of varicose veins.

Introduction

New technologies and improvements in established methods have had dramatic effects in the manner in which superficial venous diseases are diagnosed and treated. The development of ultrasound imaging techniques in the 1970s, followed by the addition of colour flow Doppler allowed doctors to gain a better understanding of venous physiology and pathophysiology, from which the advances in minimally invasive treatment derive.

This paper will review the three techniques currently in use for the treatment of varicose vein resulting from superficial venous reflux (Figure 1); namely ultrasound-guided foam sclerotherapy (UGFS), endovenous laser therapy (EVLT), and radiofrequency ablation (RFA).

The objective of this review is to inform clinicians about the commonly used minimally invasive therapies for truncal varicosities, to describe the procedures, and to review their efficacy and safety. Description of the classification of chronic venous disease will be discussed in the next issue.

Duplex Ultrasound

The most important imaging study for patients with varicose veins is the duplex ultrasound (Figure 2). B-mode ultrasound imaging is done using a high frequency, usually 7.5–10 MHz, transducer. Colour flow scanners allow direct visual representation of flow with a change of colour from red to blue depending on whether the flow is toward or away from the probe. Duplex imaging is usually done for the deep veins to exclude any problems with old occlusive disease or reflux in the deep veins. The great and small saphenous veins are examined for patency and reflux. Also, the perforating veins are examined to check that there is normal flow from superficial to deep veins. Reflux is best demonstrated with the patient in the standing position.

Figure 1. Varicose vein of the great saphenous vein.

Figure 2. Varicose vein marked with ultrasound guidance.

Duplex examination is especially useful for the obese patient and patients with recurrent varicose veins. Patients with subjective complaints in excess of physical findings also benefit from duplex examination. It is important to evaluate the deep system in patients with a history of deep vein thrombosis and in those with severe stasis with skin changes. The duplex examination is essential in planning for treatment. It is important to identify the specific points of reflux so that treatment is appropriate and reduces the chance of recurrence.

Open Surgery and Minimally Invasive Treatment Options

Treatment of saphenous varicose veins usually consists of treatment of the superficial system. Treatment options include open surgery, endovenous ablation techniques, and sclerotherapy. Open surgical techniques can be used to treat the great saphenous vein, small saphenous vein, or the venous tributaries. Endovenous ablation is a newer minimally invasive technique that is used to ablate the great and small saphenous vein. Sclerotherapy can be used to treat the saphenous veins, but is most effective for treatment of the tributary veins and smaller reticular and spider veins.

1. Open surgical treatment for varicose veins

Open surgical treatments for varicose veins have been the most common procedures since the late 1800s. Traditionally, a small transverse or oblique incision is made over the groin area and the saphenous vein, and all the tributaries at the saphenofemoral junction are divided and ligated. The great saphenous vein is divided and ligated flush with the common femoral vein. Stripping of the saphenous vein allows interruption of the perforating veins in the thigh, which can significantly reduce the recurrence rate. Careful duplex mapping and ligation of all significant perforating veins may reduce recurrence. More current data suggest that the incidence of saphenous nerve injury is reduced if the great saphenous vein is stripped only to the level of the knee and this is the technique used in modern practice [1].

Varicosities involving the small saphenous system are less common and often unrecognized. The insertion of the small saphenous vein into the popliteal vein is often variable and therefore it is helpful to mark the saphenopopliteal junction preoperatively using duplex ultrasound. Many surgeons prefer division and ligation of the small saphenous vein at the saphenopopliteal junction, with a small transverse incision over the popliteal fossa, in order to avoid injury to the sural nerve.

Open surgery for saphenous varicose veins is widely performed and is effective in the majority of cases. However, published recurrence rates after surgery range from 7% to 70% [2-6], which may be due to neovascularization, double saphenous vein system, technical failure [7], and/or incomplete procedure [8,9]. Other disadvantages of surgical therapy are the use of general or epidural anaesthesia, presence of scars, postoperative down-time, wound infection, neurological injury [10] and lymphatic complications. As open surgery is not a perfect solution to varicose veins, new minimally invasive techniques have been developed aiming at a better outcome.

2. Endoluminal ablation of the saphenous vein

Endovenous saphenous ablation is a newer, minimally invasive, procedure that can be performed in the hospital or in the clinic setting with mild or no sedation required. The procedure is done under ultrasound guidance with the administration of local anaesthesia. The current methods for endovenous saphenous ablation include RFA and EVLT.

a. ***RFA*** (Figure 3) of the saphenous vein uses the VNUS Closure Catheter (VNUS Medical Technologies, Sunnyvale, CA). The procedure uses radiofrequency waves to destroy the saphenous endothelium and denatures the vein wall collagen in a bloodless field, resulting in the formation of a fibrous cord with obliteration of the vein [11,12]. Under ultrasound guidance, the saphenous vein is accessed percutaneously near the knee. A 7F introducer sheath is placed inside the vein and the radiofrequency catheter of less than 3 mm diameter is introduced through the sheath up to 2 cm from the saphenofemoral junction. Tumescent anaesthesia, a dilute mixture of saline and lidocaine, is infused along the course of the saphenous vein to help in obtaining better contact of the vein wall with the catheter and to provide a thermal buffer between the saphenous vein and the skin. Electric energy in the electrode is converted to heat energy, and is transmitted

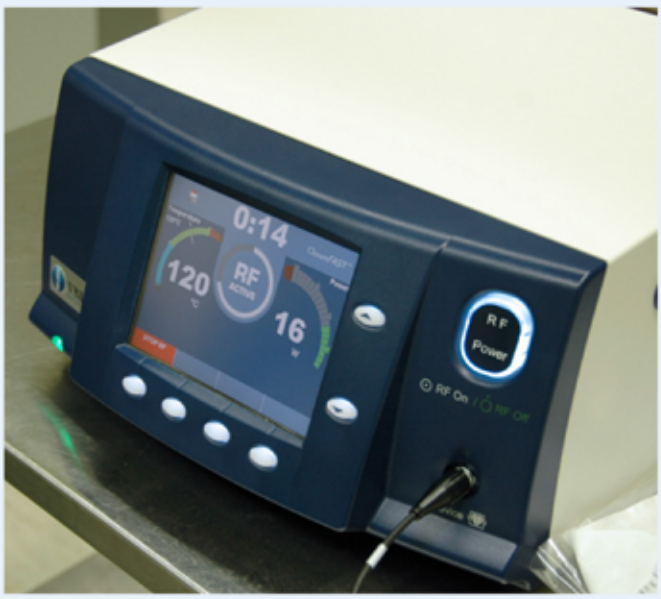

Figure 3. RFA machine.

to the vein wall. The catheter is slowly withdrawn and the entire saphenous vein in the thigh is treated. Follow-up ultrasound is done to confirm successful ablation of the saphenous vein and to evaluate the common femoral vein for evidence of deep vein thrombosis or proximal extension of thrombus into the femoral vein.

Recently, a new catheter (VNUS Closure Fast) has been introduced, which has a 7 cm therapeutic distal tip that heats up to 120°C. This technique is much faster than the previous VNUS catheter and ablation of the great saphenous vein only takes a few minutes. The devices can be used on the great saphenous vein and small saphenous vein as well as incompetent perforating veins. However, because of the rigidity and size of the catheter, to avoid perforation, caution is in necessary in treating tortuous and relatively small varicose veins.

Since 2000, several case series have been published showing that RFA can be successfully used in the treatment of lower extremity varicosities [13-17]. The technical results of VNUS Closure Fast are good, with 93% ablation (total or partial occlusion of the saphenous vein) at 3 years [18]. Three small randomized clinical trials have compared RFA with vein stripping and demonstrated that the therapies were about equally effective; however, patients treated with RFA reported less postoperative pain and physical limitations, faster recovery, fewer adverse events, earlier return to work and normal activities, and superior quality of life compared with patients who underwent surgical stripping [19-21]. Early complications of the Closure technique included thrombus extension from the proximal great saphenous vein in 0.8% of patients, with 1 case of pulmonary embolus. Potential complications include numbness along the medial thigh, which occurs in approximately 18% of patients, with most resolving in 6 months to 1 year [10,22].

b. ***EVLT*** (Figure 4) of the saphenous vein is a newer form of technology that works in a fashion very similar to the RFA procedure. A laser fibre is inserted into the saphenous vein under ultrasound guidance. The wavelengths used in EVLT target deoxygenated haemoglobin and/or water and range between 810 and 1500 nm [23]. It initiates a non-thrombotic occlusion by direct and indirect thermal injury to the vein wall, causing endothelial denudation, collagen contraction and later fibrosis [24]. Early occlusion rates of 100% on duplex ultrasound following EVLT are common and can be maintained as high as 97% at 3 years [23,25].

The high temperatures of laser energy induce multiple microperforations of the venous wall that often result in pain and ecchymosis. These common adverse events disappear spontaneously within 2 weeks.

Figure 4. EVLT machine.

Although minimally invasive techniques may reduce side effects associated with surgery (e.g. wound infection and scarring), it may be associated with specific adverse events such as deep vein thrombosis and skin burns (if tumescent anaesthesia is not properly used). However, the likelihood of deep vein thrombosis is less than 1% [26,27]. Skin burns are also rare and may occur if the energy level is too high, if superficial veins are treated, and/or the cooling effect of tumescent anaesthesia is insufficient. Caution is warranted for the extrafascial part of the truncal varicose veins and the cutaneous exit site of the laser fibre. Superficial thrombosis, dysesthesia, haematoma, cellulitis, and arteriovenous fistulae have been reported after EVLT [28-33].

3. Ultrasound-guided foam sclerotherapy

Although very effective for spider veins and reticular veins, sclerotherapy has been less effective for the truncal veins and larger varicosities. The introduction of foam sclerotherapy has greatly improved the usefulness of sclerotherapy for the saphenous veins, perforating veins, and larger tributary veins. The detergent type of sclerosants, such as sodium tetradecyl sulfate and polidocanol, may be transformed into fine-bubbled foam by special techniques and injected directly into the vein. The foam acts to completely displace blood away from the vein wall, allowing better contact of the sclerosant with the endothelium. The use of foam creates a greater volume to be injected at the same dose as the liquid foam, which permits a larger segment of vein to be filled and treated. The viscous nature of the foam makes it safer than the liquid agents for the treatment of the larger veins, as drainage into the deep system is reduced. The use of foam for the treatment of incompetent great saphenous veins produces improved results and a decrease in the incidence of recurrent varicose veins when compared with liquid agent sclerotherapy [34].

When treating the saphenous veins near their junction with the deep system, perforating veins, and more deeply situated varicosities, the addition of duplex ultrasound guidance has been used as an addition to the spectrum of methods used for sclerotherapy of varicose veins. Using a 7.5 MHz probe, the vein to be sclerosed is punctured under direct visualization with the patient lying supine. The needle is easily visualized and the intravascular injection can be controlled. Compression, manually or using the ultrasound probe, can prevent the flow of sclerosant into the deep veins. The vessel spasm that occurs with successful injection can be seen with duplex ultrasound and can be used to assess the efficacy of the injection. Foamed sclerosants are especially well seen with duplex ultrasound.

This technique is indicated in primary (linear and tortuous) great and small saphenous veins, previously treated varicosities and recurrences after surgery (i.e. neovascularization). Varicosities with small and large diameters can be treated with UGFS but saphenous veins with diameters of 10 mm or more may require multiple treatments and large volumes of foam [38].

Compared with classic liquid sclerotherapy, foam sclerotherapy is about 4 times more effective because of increased contact time with the venous wall, increased surface area of the venous wall, and venous spasm [34]. However, several session of UGFS are usually necessary for the truncal varicosities to occlude [35,36]. Only data from case series [40,41] are available, with very few comparative studies published. A series with UGFS in 1411 limbs showed occlusion in 88% of great saphenous veins and 82% of small saphenous veins after a mean follow-up of 11 months [36]. Smaller series showed 69% complete sclerosis in 99 limbs after 24 months of follow-up [39], 44% occlusion in 211 limbs after 5 years of follow-up [40], and 88% occlusion in 143 limbs after 6 weeks of follow-up [35]. Several prospective randomized clinical trials are ongoing that compare UGFS with surgery.

Extravenous injection of foam may cause local cutaneous side effects such as hyperpigmentation and, rarely, skin necrosis. A few weeks following therapy, patients may experience a string-like induration of the injected vein due to venous obliteration. Systemic complications are rare, reported are myocardial infarction, anaphylaxis, deep vein thrombosis, pulmonary embolism, visual disturbance, headache, and one case of stroke [39,40].

Discussion

Each of the minimally invasive therapies can be performed in outpatient settings. EVLT and RFA can be performed using local tumescent anaesthesia (Figure 5), and UGFS does not require anaesthesia. In contrast to UGFS, EVLT and RFA should be performed in a sterile environment. Each of the minimally invasive techniques requires ultrasound experience, preferably by the surgeon.

Figure 5. Endovenous ablation under ultrasound guidance.

Small, short-term comparative studies suggest that EVLT and RFA are equally effective compared with vein stripping but are more appreciated by patients [31]. Because none of the minimally invasive techniques seem to be associated with neovascularization, long-term studies are likely to show a clinical benefit for these new procedures compared with ligation and stripping [32], especially in the treatment of the small saphenous veins [41]. UGFS is very promising in the treatment of saphenous recurrences after vein stripping because these veins are tortuous and often have a relatively small diameter, and the anatomic situation is altered. Of the minimally invasive techniques, EVLT is a good option in veins with very large diameter (Figure 6), whereas UGFS often requires 3 or more treatment sessions and the RFA catheters are designed for a maximum diameter of 12 mm, except for the new Fast version of RFA. In small and symptomatic insufficient saphenous veins (diameter <4 mm), UGFS is indicated. A recent meta-analysis reported that the success rates of UGFS, RFA, and EVLT are about 78%, 84%, and 95% after 3 years, respectively [32].

Figure 6. The needle-sized wound of endovenous ablation therapy.

Recurrence of varicose veins after stripping is thought to be due to neovascularization at the saphenofemoral junction and occurs in about one fourth of the patients after 5 years [42]. This has been studied using ultrasound but has not been documented for UGFS, EVLT, and RFA, probably because these techniques, in contrast to surgery, do not disrupt the endothelial lining and/or do not eliminate other feeding veins into the saphenofemoral junction. This difference may explain the high long-term success rates of the 3 procedures. Endovenous therapies show anatomic failure in about 10% of patients, with (partial) recanalization of the treated vein.

Both minimally invasive therapy and open surgery for varicose veins have their strengths and weaknesses. The two together have strengthened the armamentarium of vascular surgeons in the modern management of varicose veins.

Conclusion

With the many alternatives available for managing saphenous varicose veins, many patients can now be treated with minimally invasive options. Most of these procedures can be performed in an office setting depending on the patient's preference. Patients can be active almost immediately. These new procedures have excellent functional, as well as cosmetic results and are more acceptable to patients than open operations, which require general or regional anaesthesia. Open surgery, however, is still a very effective treatment, and sometimes may be the only treatment option in some advanced cases. Minimally invasive options in the treatment of saphenous varicose veins are actually complementing open surgery in the overall management of varicose veins. Full ranges of treatment options are now available for patients with varicose veins. Treatment should be tailored to each patient depending on the disease stage and patient's preference. However, additional comparative studies are needed among these techniques, standard surgical therapy, and other new therapies. These studies should include patient-reported outcomes and cost-effectiveness analyses so that firm recommendations can be made in the future. It is important that physicians dealing with varicose veins today should have the knowledge and skills on both minimally invasive therapy and open surgery, in order to provide a comprehensive management for patients with varicose veins.

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Q&A

Answer these on page 16 or make an online submission at: www.hkmacme.org

Please indicate whether the following questions are true or false

1. Duplex scan ultrasound is seldom used for assessment for site of reflux in patients with varicose veins.
2. Traditional open surgery involves a small incision made over the groin area, with the division and ligation of the saphenofemoral junction and all its tributaries.
3. Recurrence is not uncommon after open surgery; the reported rate ranges from 7% to 70%.
4. RFA of the saphenous vein uses the radiofrequency energy to heat up the vein wall directly.
5. Randomized clinical trials have compared RFA with vein stripping and demonstrated that RFA was not effective.
6. The wavelengths used in EVLT target deoxygenated haemoglobin and/or water, which causes indirect thermal injury to vein wall.
7. Complications like superficial thrombosis, haematoma, and pain are less common in RFA or EVLT than in open surgery.
8. In UGFS, detergent sclerosants, such as sodium tetradecyl sulfate and polidocanol, may be transformed into fine-bubbled foam by special techniques and injected directly into the varicose vein to occlude the vein.
9. UGFS can only treat small varicosities, but not varicose veins due to saphenous reflux.
10. Saphenous varicose veins can be treated with open surgery, RFA, EVLT and UGFS. There is not enough evidence to show which treatment is the best.

ANSWERS TO MAY 2009

Posterior cruciate ligament (PCL) injuries — An update on current management – part 1

1. True	2. False	3. True	4. True	5. True
6. False	7. False	8. True	9. True	10. False