Endovenous procedures in varicose veins

What is the best choice today?

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Keywords
Varicose veins, radiofrequency ablation, endovenous laser ablation, sclerotherapy

Summary
Over the past ten years endoveous treatment options for varicose veins have evovled considerably,offering clinicians a multitude of options to meet the needs of their patients . The endothermal ablation procedures have moved to the forefront as the choice modality for treating truncal reflux. Both radiofrequency ablation and endovenous laser ablation are widely accepted and interchangeable, showing comparable efficacy and safety. Although numerous endovenous laser wavelengths exist, the data indicates that the differences do not affect the efficacy or postoperative recovery of the procedure. The endovenous laser innovation that has shown early evidence of improved patient outcome is the jacket-tip fiber. The versatility of sclerotherapy makes it a critical component in the endovenous treatment of varicosities. Although not approved by the Food and Drug Administration (USA), the use of a foamed sclerosing agent is the fastest growing segment of sclerotherapy and an important treatment modality in the future of varicose vein treatment. Cutaneous lasers and intense pulse light devices contribute a crucial element, enabling clinicians to treat minute veins that may be impossible to treat with other therapies.

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Schlüsselwörter
Variköse Venen, Radiofrequenzablation, endovenöse Lasertherapie, Sklerotherapie

Zusammenfassung
In den vergangenen zehn Jahren haben sich die Behandlungsmethoden für variköse Venen erheblich entwickelt. Dadurch wird Ärzten eine Vielzahl von Optionen geboten, den Patientenbedürfnissen zu entsprechen. Bei der Behandlung der Stammveneninsuffizienz sind endotherme Ablationsverfahren zur Behandlungsmethode der ersten Wahl geworden. Sowohl Radiofrequenzablation als auch endovenöse Lasertherapie sind allgemein anerkannt und gegeneinander austauschbar. Beide weisen eine vergleichbare Wirksamkeit und Sicherheit auf. Zwar existieren zahlreiche endovenöse Laserwellenlängen, aber die Daten weisen darauf hin, dass unterschiedliche Wellenlängen keinen Einfluss auf die Wirksamkeit des Verfahrens bzw. die postoperative Rekonvaleszenz haben. Das Jacket-tip-fiber-Verfahren stellt eine innovative Form der endovenösen Lasertherapie dar und konnte bereits sehr früh nachweislich bessere Ergebnisse für den Patienten erzielen. Auf Grund ihrer Vielseitigkeit ist die Sklerotherapie eine entscheidende Komponente der endovenösen Varizenbehandlung. Dabei stellt die Schaumsklerotherapie, obwohl von der Food and Drug Administration (USA) nicht zugelassen, das am schnellsten wachsende Segment in der Sklerotherapie dar und wird in Zukunft eine wichtige Option für die Therapie variköser Venen bilden. Haut-Laser und hochenergetische Blitzlampen sind weitere entscheidende Elemente der Therapie und ermöglichen Ärzten, kleinste Venen zu behandeln, die anderen Therapieformen nicht zugänglich sind.

Endovenöse Verfahren bei Varikosis

Welches ist aktuell das beste Verfahren?

Mots clés
Varices des membres inférieurs, ablation par radiofréquence, traitement par laser endoveineux, sclérothérapie

Résumé
Depuis 10 ans les possibilités thérapeutiques pour les veines variqueuses ont considérablement évolué, offrant plusieurs options. Les méthodes de traitement endoveineux ont tendance à devenir peut-être le premier choix pour le traitement de reflux tronculaire. L'ablation par radiofréquence et le traitement par laser endoveineux sont largement répandus et donnent des résultats comparables en efficacité et en sécurité. Bien que de nombreuses variations de longueurs d'ondes existent pour le laser endoveineux, ces différences ne semblent pas influer sur l'efficacité de la guérison. L'innovation du laser endoveineux qui a montré les meilleurs effets provient de fibres enrobées (jacket-typ). Les résultats variables de la sclérothérapie en font une méthode discutable pour le traitement endoveineux de varicosités. Bien qu'elle ne soit pas reconnue par la FDA aux Etats-Unis, l'utilisation d'une mousse sclérosante reste le domaine prometteur de la sclérothérapie et une variante thérapeutique importante dans l'avenir du traitement des varices. Les lasers cutanés et les appareils à pulsation lumineuse intense restent utilisables pour le traitement de microvaricosités que l'on peut traiter par d'autres méthodes.

Méthodes thérapeutiques endoveineuses des veines variqueuses

Que choisir aujourd'hui ?

Surgical ligation and stripping has been the standard of treatment for varicose veins for many years. While outcomes have improved recently due to an enhanced understanding of the lower extremity venous anatomy, the failure rate for this approach is frequently reported between 20 and 30% (2, 36). Additionally, the procedure requires general anesthesia and a typical recovery time of several weeks before patients can return to their daily activities. In response to the need for a less invasive approach, numerous endovenous procedures have emerged over the past several years. These procedures can best be defined as minimally invasive, techniques that produce endothelial damage to a target vessel, resulting in thrombosis, fibrosis and complete eradication of the vessel.

The most prominent endovenous advancements are the relatively new endothermal devices:
- radiofrequency ablation and
- endovenous laser ablation.

Both of these methods have demonstrated clinical superiority to stripping and surgical ligation, as well as reduced recovery time and postoperative pain (46, 54). Endother-

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mal devices are appropriate for treating the following veins:

- saphenous vein trunks,
- saphenous vein tributaries:
  - anterior thigh circumflex,
  - intersaphenous vein,
- perforators.

Additionally, newly adopted sclerotherapy methods and procedures have surfaced in recent years that have greatly enhanced outcomes, compared to early sclerotherapy utilization. Ultrasound-guided sclerotherapy is extremely versatile and can be used to treat a multitude of veins: saphenous vein trunks, saphenous vein tributaries, perforators, and varicose veins not connected to saphenous vein trunks. Visual or surface sclerotherapy is generally reserved for smaller veins, including varicose veins, reticular veins, and telangiectasia.

Lastly, cutaneous lasers and intense pulse light (IPL) devices are gaining popularity largely due to convenience and ease of use. These technologies work by using a range of wavelengths to target different depths and diameters of vessels. Cutaneous lasers and IPL are primarily limited by vein size and have the capability to treat reticular veins less than 2 mm in diameter, as well as telangiectasia.

This paper reviews these endovenous procedures, discussing the latest methods, treatment strategies, and pros and cons of each procedure for the eradication of varicose veins.

From RFA to ClosureFAST™

Radiofrequency ablation (RFA) was initially approved for use in the U.S. in 1999, utilizing conscious sedation and requiring a relatively lengthy procedure time (54). The catheter did not have markings or measurements, making pullback difficult to judge. Pullback was also tedious, as the user was required to withdraw the catheter at a rate of 1–2 cm per minute, for an overall treatment time of 15–20 minutes. This technology has undergone several improvements since its inception and currently features a segmental ablation method using the ClosureFAST™ system (67), which is designed for the treatment of both the great and small saphenous veins. The ClosureFAST™ catheter is constructed with a 7 cm bipolar electrode affixed to the distal end, which must make direct contact with the vein wall to deliver radiofrequency energy. Contact with the vein wall results in endothelial destruction, occlusion through contraction of the vein wall collagen, and thrombus formation (68). Eventual fibrosis occurs within the vein, as well as new collagen matrix formation, which further constricts the vein lumen and secures successful vein closure(68).

The new segmental ablation technique has considerably improved the RFA procedure, markedly decreasing procedure time. The procedure is performed using local anesthesia, gaining access percutaneously with a 21 G needle under ultrasound guidance. When treating the great saphenous vein (GSV), a 0.018” guidewire is inserted into the vein and the needle is removed. Next, a 4 French micropuncture sheath is inserted over the wire and the inner cannula of the micropuncture sheath is removed, followed by the insertion of a 0.035” floppy/J wire. A 7 French × 7 cm or 11 cm sheath is advanced over the wire, the 0.035” wire is removed, and the 7 F ClosureFAST™ catheter is inserted and advanced to the predetermined point where treatment will begin. The optimal point when treating the GSV is just distal to the ostium of the superficial epigastric vein, or 2 cm below the saphenofemoral junction, determined by whichever is more peripheral (51). After confirming placement under ultrasound, perivenous tumescent anesthesia is administered via ultrasound guidance along the entire treatment length to compress the vein and protect the surrounding tissue from heat damage (51, 66). The authors recommend that a 10 mm fluid layer be created around the vein to create a 10 mm distance between the skin and the vein.

Fig. 1 RFG Plus Generator and ClosureFAST™ catheter

Anesthesia and compression

In addition to tumescent anesthesia, apposite compression should be applied by placing the ultrasound transducer longitudinally over the catheter electrode (37, 66). The segmental ablation technique treats each 7 cm segment independently for a 20 second treatment interval. The first treatment segment that is most proximal to the saphenofemoral junction requires the completion of two 20-second cycles to ensure successful ablation. After this initial segment is treated, the catheter is repositioned to treat the contiguous segment. This is accomplished by using the 6.5 cm stepped markers on the catheter shaft, which allow for a 0.5 cm treatment overlap to prevent gaps between treatment segments. The catheter is repositioned in this fashion until the target segment is treated, yielding an overall treatment time of 1 to 5 minutes, depending on the length of the target segment (51, 52). Following treatment, duplex ultrasound is used to assess the treated vein for absence of reflux and evidence of occlusion.

Due to its relatively short time on the market, there is limited efficacy and safety data pertaining to the ClosureFAST™ system at present. Deep vein thrombosis (DVT), the most prominent concern with the original Closure™ procedure, has been reported with an incidence ranging from 0.5 to 16% (31, 51). While 15 incidences of DVT using the ClosureFAST™ system were reported in 2007 on the FDA MAUDE Adverse Event Database (27), further studies need to be performed to access potential adverse events. The few studies that have been performed with ClosureFAST™ demonstrated a high rate of efficacy, with a

99.6% closure rate at 6 months (51), and a 96.2% closure rate at one year post-procedure (23). This novel segmental ablation approach has thus far demonstrated a high rate of efficacy and safety, providing a convenient and fast option for the treatment of varicose veins.

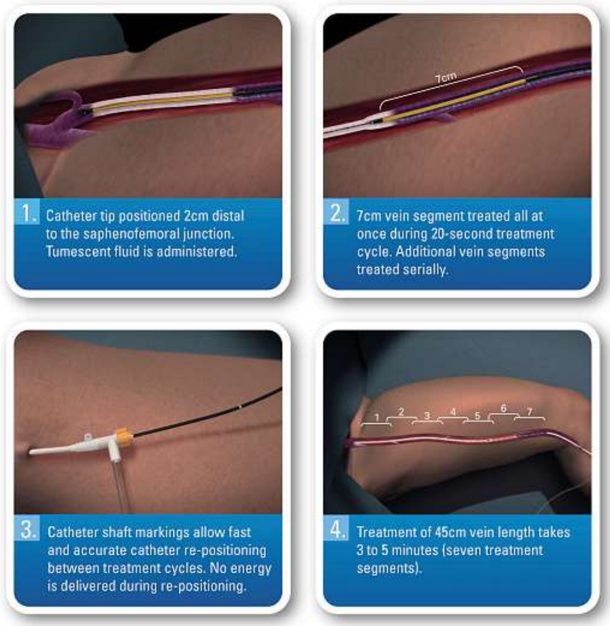

Fig. 2
RFA: segmental ablation procedure

ELA

In 2002, endovenous laser ablation (ELA) was approved for use in the U.S. for the ablation of the great saphenous vein. Early theories of this technology advocated a pulsed delivery of laser energy combined with manual compression during the delivery of energy (43); however, this was shown to cause profuse vessel perforations that contribute to increased pain and bruising postoperatively (33, 49). Treatment parameters were modified to deliver energy in continuous mode without compression, producing excellent results (41). Similar to RFA, this technology has undergone several improvements and modifications since its inception. ELA utilizes a 600-micron bare-tip or jacket-tip fiber to deliver laser energy in a continuous fashion to a target area, forming steam bubbles within the vein lumen (47, 48). Steam bubbles generate heat within the lumen of the target vessel which destroys the endothelial lining of the vessel, causing an inflammatory reaction. A subsequent thrombotic occlusion occurs that closes off the vein and leads to eventual fibrosis (48, 50).

One of the most prominent evolutions of ELA has been the introduction of numerous wavelengths, each of which has different absorption characteristics: The

- 810-nm wavelength is specific for hemoglobin absorption (34),
- 940-nm wavelength provides a balanced ratio between the light irradiated into the tissue and the absorption by hemoglobin and water (24),
- 980-nm wavelength is such that it is specific for hemoglobin and water (34),
- 1319/1320-nm wavelength is specific for water absorption, targeting collagen in the vein wall (20, 53),
- 1470-nm wavelength features an absorption coefficient in water that is 40 times greater than that of 810- and 980-nm wavelengths (16).

Although further research is needed, a small number of studies have compared various wavelengths, all of which revealed a trend of less postoperative pain and bruising with higher wavelengths (34, 39, 49).

The ELA procedure is very similar to the RFA procedure; access is gained in an analogous fashion using a 21 G needle under ultrasound guidance, followed by a microsheath. Upon removal of the inner dilator, a 0.035" guidewire is advanced to the saphenofemoral junction and the microsheath is removed. Based on the targeted treatment segment, a long sheath (typically 45 cm) is selected and back loaded over the guidewire. Once advanced to a point just distal to the superficial epigastric vein (34), the inner dilator and guidewire are removed and a 600-µm bare-tip or jacket-tip fiber is advanced into the sheath. The fiber is connected to the generator and held in place while the sheath is withdrawn to the locking mechanism of the fiber. This mechanism is designed to leave approximately 2 cm of the fiber outside of the sheath to prevent damage to the sheath. As with RFA, perivenous tumescent anesthesia is delivered, with the saphenous compartment being the target delivery area.

A second evolution of the ELA procedure relates to the catheter pullback method during the procedure. Early methods focused a pullback distance (centimeters or millimeters) per second, which delivered variable energy depending on the wattage at which the generator was set. In 2004, Timperman et al. (64) approached the procedure from a different perspective and evaluated the amount of energy (Joules) delivered per centimeter of vein treated. Their study found a direct correlation between energy delivered and treatment efficacy, with higher energy delivery per centimeter producing better results. Many experts now focus on total energy delivered and gauge pullback during ELA procedures according to Joules delivered per centimeter. Currently, 50 to 80 J/cm is the average treatment energy most often utilized for ELA procedures (6, 22, 34). Continuous pullback is used, watching the real-time energy readout on the generator and gauging speed with the 1 cm marks on the sheath. This method has proven to be more consistent than using time to gauge pullback because the same amount of energy is delivered in each case, regardless of the wattage.

Complications and outcome

The use of endovenous lasers in the continuous mode has demonstrated a relatively low incidence of procedure-related complications. The most common complication associated with ELA is ecchymosis, reported in the literature at levels ranging up to 78% (49). The mechanism of the ELA procedure that causes pain and bruising remains unclear, although some experts speculate that these complications are caused by vein wall perforations from laser energy (34, 50). Aside from laser wavelengths and pullback methods, a third novel adaptation to the ELA procedure involves laser fiber design. An innovative type of laser fiber that has shown an effect on vein wall perforations is the newly-introduced jacket-tip fiber. This technology features either a stainless steel or ceramic jacket that completely covers the tip of the fiber, with the end of the tip recessed within the jacket (5, 65). This design prevents the flat emitting face of the fiber tip from coming in contact with the vein wall (5, 65). At the time of publication, a pilot study had been reported, evaluating the efficacy and complications of jacket-tip fibers vs. bare-tip fibers (34). At 72 hours post-procedure, both groups demonstrated 100% success. However, the jacket-tip group reported lower pain and bruising scores (34). Since vessel perforations have been directly linked to bruising (50), the study concluded that the lower bruising scores expressed by the jacket-tip group could be attributed to less perforations (34). As with wavelength suppositions, a larger-scale prospective study needs to be performed to further evaluate these early results.

At present, the endovenous laser ablation procedure has demonstrated treatment outcomes and success rates that exceed those of all other modalities. Min et al. (41) reported the first long-term results using an 810-nm laser, with a 2-year closure rate of 93.4%. Since this initial data was reported, several studies evaluating different wavelengths have been published, reporting efficacy rates between 90.3% and 98% (22, 48, 50). As the data indicates, endovenous laser ablation for the treatment of venous reflux is a well-tolerated and efficacious treatment option.

Sclerotherapy

Considered the most versatile treatment option for venous ablation, sclerotherapy can be used to treat a large range of vein sizes, from telangiectasias to sizable varicose veins. Sclerotherapy is best defined as the introduction of a chemical into the lumen of a vein to cause endothelial damage, resulting in thrombosis and eventual fibrosis (63). With the advent of the endothermal procedures, the primary intent of sclerotherapy is to effectively eliminate the target vein after the highest point of reflux is treated with one of these new modalities. Sclerotherapy necessitates several different methods to deliver a sclerosing agent, depending largely on the diameter of the target vein. For smaller veins such as telangiectasias, venulectasias, and small reticular veins, liquid sclerotherapy is utilized to deliver direct injections into the target vein (9).

Fig. 3 Laser equipment:
a) AngioDynamics 980 Plus Laser, **b)** Biolitec Ceralas 810 Laser, **c)** CoolTouch CTEV 1320 Laser,
d) Diomed Delta 810 Laser, **e)** Dornier Medialis D 940 Laser, **f)** Sciton Pro-V 1319 Laser, **g)** Vascular Solutions VariLase 810 Laser

Larger reticular veins and other varicose veins may also be treated with liquid sclerotherapy using a higher concentration of a sclerosing agent, or with ultrasound-guided foam sclerotherapy.

Foam sclerotherapy entails the addition of air to a detergent sclerosing agent by means of agitation to produce a foam-like consistency, which allows for enhanced contact with the vein wall upon injection. Since the sclerosing agent must make contact with the vein wall to cause endothelial damage, the primary limitation of sclerotherapy treatment is vein diameter. Effective interaction with the vein wall may be impeded by blood flow within larger veins that dissipates and dilutes the agent upon injection. The notional advantage of foaming a sclerosing agent is that when injected, the blood is displaced, allowing the agent to make prolonged contact with the endothelium (70). This method produces a quick and efficient interaction with the vein wall, and should be reserved for treating reticular veins and varicose veins greater than 3 mm (13).

In developing a treatment plan, the clinician must consider whether to perform the liquid method, foam method, or a combination of both. As with all modalities, the primary goal with sclerotherapy treatment is to initially target the most proximal source of reflux and progress to the most distal (70). When selecting an agent, the strength of the agent should match the size of the vessel to be treated (70), while at the same time using the least amount of agent volume and concentration possible to treat the target vein (59).

Sclerosing agents

There is considerable debate concerning which sclerosing agent is preferred for the eradication of varicose veins. Part of this debate is related to legal limitations which vary according to the country in which a physician practices. Agents which have gained sizeable momentum in recent years are the detergent agents, sodium tetradecyl sulfate and aethoxyskerol, principally due to a long history of safety and efficacy, as well as new product developments. In 2004, Bioniche Pharma USA, Inc. (Belleville, Ontario, Canada) submitted and received approval for an abbreviated new drug application (ANDA) to market 1 and 3% sodium tetradecyl sulfate (Sotradecol®) in the U.S.(17). This agent is also widely available throughout Canada and Europe, as is Aethoxyskerol®. Aethoxyskerol® (also known as polidocanol) is extensively used throughout the world, despite its lack of FDA approval. BioForm Medical, Inc. (San Mateo, California), a medical aesthetics company, has licensed a distribution agreement with Kreussler Pharma (Wiesbaden, Germany) for the development and commercialization of Aethoxysklerol® in the U.S. (15). The drug is currently undergoing Phase III testing, and a U.S. launch is expected in 2008. In addition, BTG (London, United Kingdom) is in Phase II U.S. clinical trials and Phase III European trials to evaluate Varisolve®, a proprietary polidocanol microfoam (18).

For liquid sclerotherapy, the amount of detergent sclerosant injected per site is dependent upon the size of the vein. When using a detergent agent for larger varicose veins, 1 ml or less per site is advisable (63). Reticular veins on average require 0.25 to 0.5 ml per site (70), with telangiectasia necessitating 0.1 to 0.2 ml per injection (69). Injections should be made slowly and not more than a few centimeters from the puncture site, avoiding forceful pressure during delivery. The overall efficacy of liquid sclerotherapy is quite good. A 2002 prospective trial by Goldman (30) comparing Sotradecol® and Aethoxyskerol® reported a 70% rate of efficacy. Similarly, Belcaro et al. (11) described 10-year prospective results of 90.2% using liquid sodium tetradecyl sulfate.

The use of foam sclerotherapy has increased greatly since Monfreux (44) first depicted a method for producing foam in 1995. The foaming technique that is most commonly used today, and considered by many to be a superior procedure is the Tessari method (10, 19, 28, 61, 62). Two syringes are connected to a three-way stopcock, with 1 part sclerosing agent in one syringe and 4 or 5 parts air in the other syringe (28). A rapid back and forth mixture of the air and chemical between the syringes is performed 20 times to produce foam (28). This method yields a stable and durable foam that does not start significant coalescence until after the first 1–2 minutes (61), allowing the user ample time to deliver the foam. Prior to injection, a small amount of foam is injected to confirm intravenous needle placement under ultrasound. The amount of foam delivered is determined during injection, using ultrasound to visualize and confirm when the targeted vein is filled with foam. Outcomes using the Tessari method with detergent agents have produced extremely favorable results. Using sodium tetradecyl sulfate (STS), Frullini and Cavezzi (28) reported a success rate of 93.3%. Comparably, Bergan et al. (12) treated 328 lower extremity veins using polidocanol and described a complete absence of reflux in 79.8% of treated veins.

Catheter-directed foam sclerotherapy

A third and novel sclerotherapy technique that has limited reported use or data is catheter-directed foam sclerotherapy. Investigators using this method have described using either an end-hole catheter (35) or an infusion catheter (42) to deliver a foamed sclerosant. Similar to endothermal procedures, access is gained into the target vein and the catheter is advanced to the desired proximal point for treatment initiation. The published data is very positive, with a recent study by Almeida and Raines (3) reporting primary closure rates of 100% for Sotradecol® and 91% for compounded STS. The technique presents a large opportunity for future growth and applications, as it provides a lower-cost alternative to endothermal ablation.

Side effects

In addition to well documented efficacy, both liquid and foam sclerotherapy are well tolerated with few side effects. The majority of sclerotherapy-related complications can be considered minor in severity and are often transient in nature (45). The most common complications are hyperpigmentation, with a reported incidence of 10–30%

(29, 45), and telangiectatic matting, observed in 15 to 20% of patients (21, 29). The versatility of sclerotherapy, especially foam sclerotherapy, is moving the technique to the forefront as an endovenous procedure of choice. At present, there is a need for a more standardized delivery technique and a universal sclerosing agent, so that users of all skill levels can attain consistent results.

CL, IPL

Cutaneous lasers (CL) and intense pulse light (IPL) devices provide a non-invasive treatment option for small veins due to their ability to penetrate the skin without damaging the overlying skin or surrounding tissues (58). Acting as a chromophore, hemoglobin within the red blood cells of the target vein absorbs the light, converting it to thermal energy which in turn causes vessel destruction (8). Cutaneous lasers are available in wavelengths ranging from 532-nm to 1064-nm (56). Intense pulse light devices utilize a different mechanism than lasers, emitting a spectrum of light between 500 and 1200-nm, as opposed to a single wavelength (56). A cutaneous laser or intense pulse light device is selected to match the characteristics of the target vein. These devices have four parameters that are variable and must be appropriately selected for each vein: wavelength (related to vein depth), pulse duration (related to vein diameter), spot size (related to penetration of target vein), and fluence (4).

Indications for CL and IPL include vessels smaller than 3 mm in diameter, sclero-resistant vessels, telangiectatic matting, angiogenic flushing, and needle-phobic patients (38). Similar to other adjunctive procedures, truncal reflux and large varicosities are first eradicated using endothermal ablation prior to commencing treatment with CL or IPL (25). Following endothermal ablation, Sadick, Weiss, and Goldman (57) advocate that sclerotherapy next be performed to eliminate remaining vessels, reserving the use of CL or IPL for treatment of residual veins after all other modalities have been completed.

Prior to the procedure, a topical anesthetic cream may be applied to the target treatment area to enhance patient comfort. In addition, substantial research has shown that cooling the skin prior to, and during a procedure, protects the epidermis and enhances clinical results (7, 32, 56, 57). To initiate treatment, the handpiece is positioned over the target vein, avoiding compression of the vein. Spaced 1 to 2 mm apart, laser pulses are delivered one at a time, avoiding overlap. This procedure is repeated until the target veins have been treated. Although treatment with these devices typically requires 2 to 3 sessions, complete clearance after one treatment has been reported between 37% and 73.6% (14, 60). Veins treated with multiple sessions have demonstrated a higher efficacy, with a complete clearance ranging from 80% to 100% (55). The type and overall incidence of complications is variable and highly dependent upon usage of the correct settings and parameters for each laser to match the target vessel. The most frequently occurring complication is transient urticaria, presenting in a majority of patients after treatment, but typically resolving within a few hours (26). Telangiectatic matting is the next most common complication, reported at rates ranging from 27% to 94% (26, 40). When an appropriate treatment plan is employed by first eliminating proximal reflux, CL and IPL demonstrate excellent outcomes in treating small residual veins (1) (Tab. 1).

Tab. 1 Endovenous treatment options for varicose veins

<table>
<tr><th rowspan="2">method</th><th rowspan="2">RFA</th><th rowspan="2">ELA</th><th colspan="2">sclerotherapy</th><th rowspan="2">CL/IPL</th></tr>
<tr><th>liquid</th><th>foam</th></tr>
<tr><td>saphenous vein trunks</td><td colspan="2" rowspan="3">yes</td><td rowspan="2">no</td><td rowspan="5">yes</td><td rowspan="4">no</td></tr>
<tr><td>saphenous tributaries</td></tr>
<tr><td>perforators</td><td rowspan="4">yes</td></tr>
<tr><td>varicose veins not connected to saphenous</td><td colspan="2" rowspan="3">no</td></tr>
<tr><td>reticular veins</td><td><3 mm</td></tr>
<tr><td>telangiectasia</td><td>no</td><td>yes</td></tr>
</table>

Selection of treatment

While each of these endovenous treatment modalities have specific advantages and indications, there is significant overlap. The clinician must be selective and make decisions based on the needs of each individual patient when considering a treatment algorithm. The primary goal in treating venous insufficiency is to first treat the highest point of reflux. When selecting a treatment for a given venous problem, the risk-to-benefit ratio should weigh greatly in decision-making, considering possible complications, sympton relief, and cosmetic results. The highest point of reflux in the vast majority of patients is present in either the great saphenous vein or the small saphenous vein, hence making these veins the focus of many endovenous treatments. Patients with reflux in either of these primary superficial veins are candidates for an endothermal ablation procedure or ultrasound-guided foam sclerotherapy.

Atypical varicosities that demonstrate isolated reflux, such as perforators or tributaries, present in a much smaller percentage of limbs. An individual treatment plan must be developed for each case of atypical varicosities, as the anatomy of these varicosities can fluctuate significantly in each patient. In addition to atypical varicosities, telangiectasia may also be exhibited in patients who present with saphenous reflux. Currently, there is considerable debate over when adjunctive procedures should be performed in relation to initial treatment of truncal reflux. Some experts advocate staging, which entails performing adjunctive procedures at a later date after truncal reflux is eradicated. Conversely, others sustain that adjuvant therapies should be performed at the same time that truncal reflux is treated.

The author's approach is to perform the procedures at the same time if the varicosities are 6 mm or greater and involve the zone of truncal reflux. Combining the procedures in this instance will reduce the probability of developing a superficial thrombophlebitis in the enlarged varicose vein. If the varicosities are located outside of the truncal reflux zone of influence, or if the varicosities are less than 6 mm and involve the zone of influence, it is appropriate to stage the procedures.

The endovenous treatment options for varicose veins have evolved vastly in the past 10 years, offering clinicians a multitude of options to meet the needs of patients who present with varicose veins. The endothermal ablation procedures have moved to the forefront as the choice modality for treating truncal reflux. Both radiofrequency ablation and endovenous laser ablation are widely accepted and interchangeable, showing comparable efficacy and safety. Although numerous endovenous laser wavelengths exist, the data indicates that the differences do not affect the efficacy or postoperative recovery of the procedure. The endovenous laser innovation that has shown early evidence of improved patient outcome is the jacket-tip fiber. The versatility of sclerotherapy makes it a critical component in the endovenous treatment of varicosities. Although not approved by the Food and Drug Administration (USA), the use of a foamed sclerosing agent is the fastest growing segment of sclerotherapy and an important treatment modality in the future of varicose vein treatment. Cutaneous lasers and intense pulse light devices contribute a crucial element, enabling clinicians to treat minute veins that may be impossible to treat with other therapies.

Conclusion

Effective treatment does not necessarily entail choosing the best endovenous modality, but rather necessitates the clinician to choose the best treatment plan, coalescing multiple therapies to provide the best outcome for each patient.

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