

RESEARCH ARTICLE

Treatment of Varicose Veins with minimal invasive strategies

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Abstract

The mode of treatment of varicose veins has changed substantially over the last 20 years. Minimal invasive techniques have been established and seek the most gentle and safest way of treatment. Ultrasound is the basic instrument to guide these techniques. Endothermal ablation with laser or radiofrequency has become the standard technique for treatment of axial reflux. It requires local tumescence anaesthesia. Other, tumescencless techniques have been developed and established. Today there are many minimal invasive ways to treat varicosity. The treatment strategy can be tailored to the individual patient.

Key words: Varicose Veins, Chronic Venous Insufficiency, Minimal Invasive Treatment

Introduction

Varicose veins are common and frequently a medical problem¹. They are the main cause of chronic venous insufficiency (CVI)²⁻⁵. The mode of treatment of varicose veins has changed over the last two decades and is nowadays dominated by minimal invasive techniques. These techniques are based on ultrasound guidance and offer various advantages. Understanding venous duplex sonography is therefore crucial⁶⁻⁸. The main difference of all these techniques as compared to conventional surgery is that the treated varicose vein will be damaged and destroyed by different energies like chemical, laser, or mechanical energy. Therefore, it is rather wrong to talk about venous ablation as the vein remains inside the leg and will degenerate to a scar within months after treatment. It would be more appropriate to call it varicose vein destruction or damaging, which on the other hand does not sound very inviting when explained to the patient. However, it is important to understand this difference as it bears some consequences, which will be discussed later.

Ultrasound guidance of varicose vein treatment was first performed with sclerotherapy⁹. As a matter of fact, sclerotherapy is a rather old technique that underwent a sort of revival with the introduction of ultrasound. This allowed to perform precisely targeted injections of sclerosants for clinically not visible varicose veins as for example the great saphenous vein¹⁰. The door was opened to the minimal invasive, ultrasound guided approach and it was only a question of time that this way of treatment would take over the gold standard from conventional surgery as it is now obvious in various treatment guidelines¹¹.

Treatment Indication for Varicose Veins

Varicose veins may cause skin signs and symptoms and trigger complications such as superficial vein thrombosis or bleeding. Moreover, many patients feel disturbed by the aspect of varicosity. There are different types of varicose veins. The smallest are telangiectasias as spider veins and reticular veins, the first are tiny veins within the dermis, the later are small veins up to 3mm diameter underneath the skin, which are often visible as corona phlebectatica paraplantis around the medial or lateral malleoli (figure 1).

Figure 1



Figure 1: Corona phlebectatica paraplantis with multiple telangiectasias and reticular veins in the area of the medial malleolus. These changes have been recently introduced to the CEAP Classification as stage C 4c.

These veins may cause itching and burning as a local sensation. In case of corona phlebectatica paraplantaris they are a sign of an elevated venous pressure and may be a signal of the development of trophic changes. Larger varicose veins are truncal varices and their side branches (more than 3mm in diameter), e. g, the great (also named long) and the small (also named short) saphenous vein. They may cause more important symptoms and trigger chronic venous insufficiency, a remodelling of the skin and tissue due to the permeant venous hypertension leading to an inflammatory process. Chronic venous insufficiency is staged with the clinical classification of the CEAP classification ¹² (table 1). Medical indication to treat varicose veins is given if symptoms are reducing quality of life

or if there are signs of chronic venous insufficiency. Typical skin signs that merit medical treatment are venous oedema and trophic disorders such as eczema, hyperpigmentation (“dermite ocre”), lipodermatosclerosis, atrophy blanche as well as healed or active venous ulcers as a late complication. Acute complications of varicose veins are superficial vein thrombosis or bleeding due to the rupture. The indication to treat should be always in proportion to the general state of health. Nevertheless, the minimal invasive approach of treatment strategy should not lower the threshold to treat the patient. Especially in older, comorbid patients, a conservative treatment with compression and observation can be a valuable alternative.

Table 1

CEAP-Classification Clinical stage	Signs
0	No visible or palpable signs
1	Telangiectasias or reticular veins
2	Varicose veins (>3mm diameter)
3	Venous edema
4a 4b 4c	Hyperpigmentation ("Dermite ocre"), eczema Lipodermatosclerosis, atrophy blanche Corona phlebectatica paraplantaris
5	Healed venous ulcer
6	Active venous ulcer

CEAP for **C**linical, **E**tiological, **A**natomical, **P**athophysiological classification of venous disease

Clinical stage 0-6

Etiological: congenital, primary, secondary, no venous cause

Anatomical: superficial veins, deep veins, perforator veins, no venous location identifiable

Pathophysiological: reflux and/or obstruction, no pathophysiology identifiable

Ultrasound guided minimal invasive techniques

Sclerotherapy was quite popular until larger trials in the 70s of the last century revealed inferiority when compared to conventional surgery¹³. However, many therapists were feared of inadvertent intraarterial injection, which was more likely to happen without ultrasound control¹⁴. With the introduction of ultrasound and the development of microfoam – potentiating the effect of the sclerosant – sclerotherapy became popular again and was also applied to treat the saphenous trunks¹⁰. There was great enthusiasm for this kind of treatment as it is a very uncomplicated and economic method not requiring much equipment and time in experienced hands. It was hoped for an “all in one” method, comprising the treatment of the trunks, perforators and side branches in an outpatient setting¹⁵. With growing evidence, it became obvious that there is a relevant

amount of recanalization of the treated trunk, especially in larger veins. The recurrence after sclerotherapy compared to other methods like surgery and endothermal ablation was shown to be significantly higher in randomized controlled trials^{16 17}. The latest larger randomized controlled study by Brittenden et al. showed a complete success rate of only 43.4% after 6 months in the group treated with sclerotherapy while it was 82.3% and 78% for laser and surgery.

Moreover, there is an ongoing discussion about side effects of foam sclerotherapy^{18,19}. As the detergent foam is injected, it is meant to lead to an instant disruption of the endothelial layer within the varices provoking a “sclerophlebitis”. When larger volumes of foam are required side effects are more likely²⁰. Among these, cosmetic complications such as hyperpigmentation (10-30% of cases) are the most common and can last for months^{21,22}.

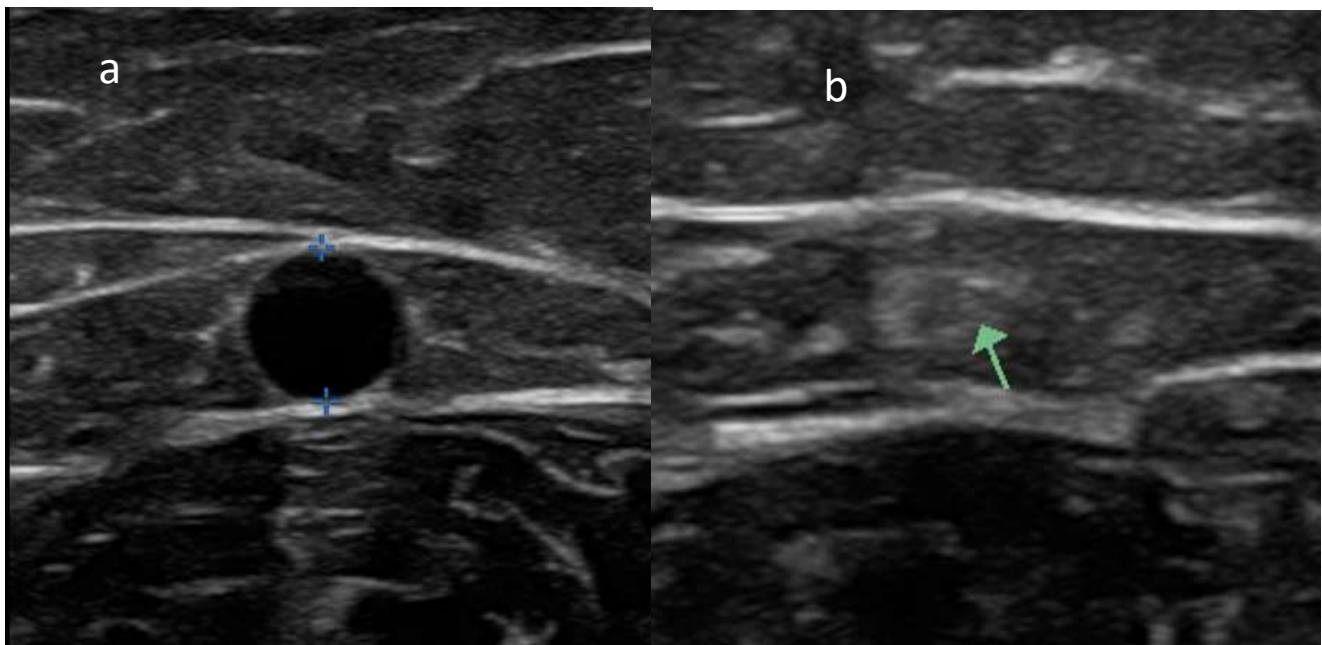


Figure 2: Cross-Section of an incompetent Great Saphenous Vein with a diameter of 8mm before (a) and 6 months after (b) endothermal laser ablation with a 1470nm laser device

However, it is recommended to avoid larger volumes of foam²⁰. As a matter of fact, it may be stated that sclerotherapy is a very effective and safe way of treating varicosity when we treat smaller veins requiring less sclerosant volume. Therefore, the role of sclerotherapy in modern minimal treatment strategies has changed from the desired “all in one” solution to an adjunctive method comprising other treatment modes like endothermal ablation. Nevertheless, sclerotherapy remains a very valuable solution for many kinds of non-truncal varicosity like for instance recurrent varices after surgical treatment.

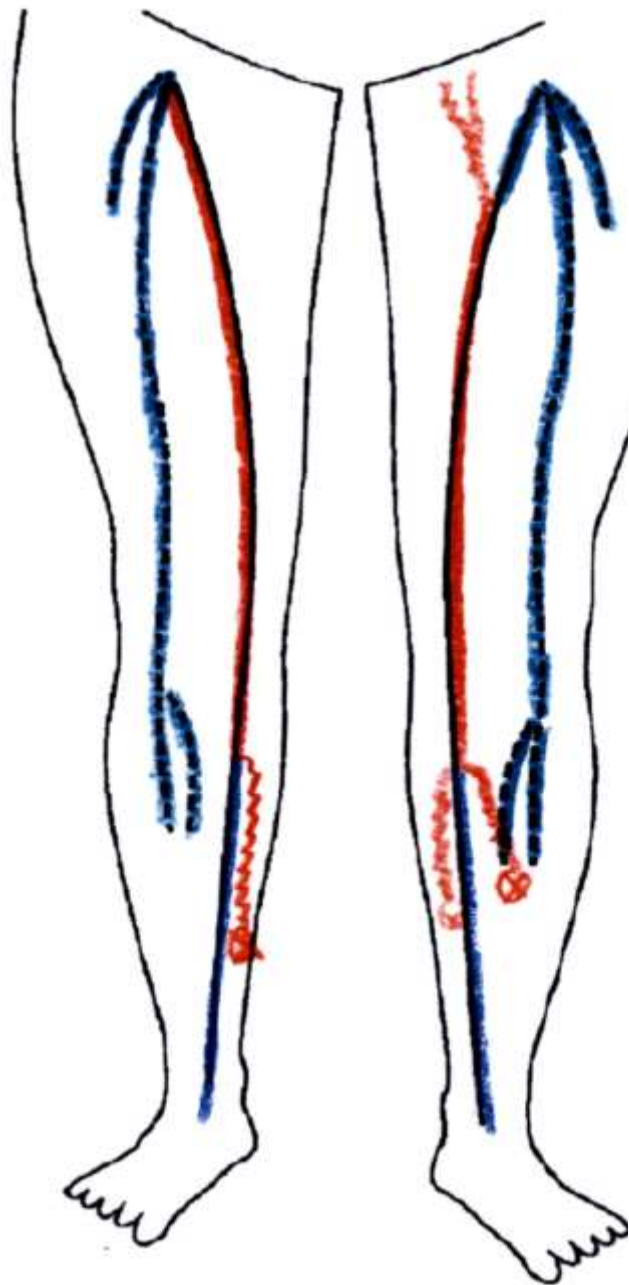
Endothermal ablation is today considered as the gold standard of treatment of the great and small saphenous veins. The method is based on laser energy or radio waves delivered at the tip of a wire-like probe. This energy is transformed into heat inside of the treated vein and causes destruction of the entire venous wall. This technique has been introduced around 20 years ago^{23,24}. Ever since a rapid development of technical details of the devices has improved their performance and safety. The aim of these technical progresses was to assure an effective and safe energy delivering causing complete destruction of the vein with a minimum risk of thermal damage in the surrounding tissue, thus enough heat to “cook” the vein without burning other structures. Numerous publications are available. Rasmussen et al were the first to report about non-inferiority regarding the outcome of this techniques when compared to classical surgery in a randomized controlled trial¹⁷. Laser as well as radiofrequency can be performed under local anaesthesia. This comprises a local tumescence infiltration with a generally saline/lidocaine-based liquid surrounding the vein and protecting the soft

tissue. Moreover, this tumescence volume enhances the energy effect by provoking a venous spasm. The spastic vein has a reduced endothelial surface and will be easier destroyed. The occlusion rates with modern endothermal devices are very satisfying and near a 100% in experienced hands. There is a number of publications underlining the dominant role of these techniques which have taken over the place of the first line treatment mode from conventional surgery^{16,25-27}. Apart from the treatment efficacy there is a high standard of safety. The posttreatment invalidation and pain are rather moderate²⁸. Beside sclerotherapy a few new **non-tumescence, non-thermal ablation** techniques have emerged in the last two decades. The aim of these techniques is to provide an even more gentle procedure not requiring any kind of anaesthesia, not causing any pain, and providing comparable results like the endothermal techniques. One of these methods is mechanical-chemical occlusion (Clarivein[®]). This device comprises a rotating tip scratching the endothelium of the treated vein while a sclerosant is injected at the same time. The idea of this technique is to enhance the effect of sclerotherapy, especially of use when larger veins are treated. The volume of the required detergent sclerosant can be minimized in these cases reducing the risk of side effects as stated above. However, the reported occlusion rates of this technique are below the ones seen after endothermal ablation^{29,30}. Therefore, this method has not become as widely used as laser or radiofrequency. Nevertheless, it is still an interesting option providing better occlusion rates as compared to sclerotherapy alone. The method is very safe. In fact, there is almost no risk of neural damage and loss of local

sensibility, which can occur after the endothermal techniques.

Another “tumescenceless” technique promoted within the recent years is the VenaSeal® system. A catheter is placed inside the vein, and a sort of glue (cyanoacrylate) will be released. The vein gets stuck and

degenerates. Results are very promising ³¹. More evidence is required to learn about long term outcome. Another issue with this technique are allergic reactions to the glue which will remain in the treated leg ³². Those reactions are rare, but the management can be complicated.



1

Complete incompetence of the Great Saphenous Vein from the junction to the proximal calf area, side branch and perforator insufficiency at the medial calf

Procedure: Endothermal ablation of the trunk, phlebectomy/sclerotherapy of the side branch/perforator

2

Incomplete incompetence of the Great Saphenous Vein triggered by pudendal varices coming from the lower pelvic region, side branches and perforator incompetence at the medial calf area

Procedure: Endothermal ablation of the trunk up to the proximal part of insufficiency, Sclerotherapy for the pudendal varices, phlebectomy/sclerotherapy for the calf varices

Red: Reflux

Blue: No Reflux

All named **ultrasound guided minimal invasive techniques** may be applied for

varicose veins which are eligible for a catheter insertion. This can be difficult in

recurrent varicose veins often showing a very tortuous anatomy. In these cases, direct needle puncture and insertion of a sclerosant remains a very valuable option.

Judging the described techniques is rather difficult and biased by personal experiences. In the end it is not too important which minimal invasive path is taken as there are many leading to the aim to exclude the treated varicosity from the venous circulation to reduce venous hypertension. The largest step to the minimal invasive treatment mode was the general change of the procedure from an act in the operating theatre to an ambulatory treatment in an outpatient setting guided by ultrasound. There will be new and other techniques in the future – like for example the microwave technique – seeking for the gentlest way to treat the incompetent veins.

Minimal invasive strategies are performed under local anaesthesia with the patient walking in and out. Nowadays almost all varicose veins, even if morphological important, can be treated in this way. Image A is showing two commonly encountered examples of varicose veins. In both cases endothermal heat can be used to treat the trunk. Even larger diameters of 1-2 cm are not a limit anymore. The authors have treated maximum diameters up to 2cm with a successful outcome. An important consideration although should be shared with the patient before treatment: The vein will remain in the leg after treatment and needs some time to regress to a score, especially when the diameter is important. Patients often report about some strange sensation at the site of the regressing vein. These sensations may last for months and will disappear with the time. After 1 year there is usually no more vein when looked for with the ultrasound

machine. Moreover, larger veins require more energy to be successfully ablated. Withely et al. reported that an laser energy application between 50-70 Joule per cm of the treated trunk will be most probably sufficient for reliable ablation when using higher wave lengths like 1470 nm³³. It has been shown that more energy application causes more pain in the aftermath of treatment (25). However, normal life can be continued right after treatment. Intense physical activity should be avoided for about two weeks.

The strategy of minimal invasive treatment of varicose veins usually combines various treatment modes. This can also be the case for the same vein and its various segments. For example, it may be interesting to applicate endothermal heat for the proximal, larger segment of the trunk in the thigh and use ultrasound guided sclerotherapy for the distal segment of the same vein. This way nerval damage of the saphenous nerve – closely accompanying the great saphenous vein from the proximal calf region down to the foot – can be avoided. Moreover, it can be reasonable to stage the treatment in various sessions. For example, treating a large trunc varicosity with endothermal heat and the biggest side branches with phlebectomy could be sufficient for a desired outcome. If not, ultrasound guided sclerotherapy can be applied several months later when it is obvious that there are relevant leftovers such as important side branches. The possibilities are multiple and certainly depended on the experience of the treating specialist.

To create a minimal invasive strategy, it is crucial to be familiar with the duplex ultrasound examination of the venous system. There are numerous anatomical patterns of varicose veins that can require or allow different treatment techniques. A sketch

should be created and serve as a treatment plan. The treatment options should be discussed with the patient. Nowadays these treatment options are like a menu where one or the other choice can be preferred.

Summary

Treatment techniques for varicose veins have substantially changed. Today the classical surgical approach is no more the treatment of

choice. Minimal invasive techniques applied with a strategy seeking for efficacy and safety at the same time are favourable and supported by robust scientific data. However, in the light of the growing treatment possibilities, the indication to treat varicose veins should always be made in proportion to the clinical relevance and the general state of health.

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