ENDOVENOUS LASER TREATMENT OF THE SMALL SAPHENOUS VEIN. SINGLE-CENTRE EXPERIENCE STUDY

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ORIGINAL PAPER

Phlebological Review 2014; 22, 1: 6–10
DOI: 10.5114/pr.2014.46047

Submitted: 23.06.2014
Accepted: 30.06.2014

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ABSTRACT

Objectives: Endovenous laser treatment of incompetent great saphenous vein is widely described in the literature. Only a few studies, mainly with a limited number of patients and a short follow up are related to minimally invasive laser ablation of small saphenous vein. Our paper presents single centre experience of 140 small saphenous vein laser ablations with long term postoperative follow up.

Material and methods: The group of patients who underwent endovenous laser treatment of small saphenous vein consisted of 132 patients. Totally, 140 small saphenous vein laser ablations were performed (in some patients bilaterally). The endovenous laser ablation was carried out using the VenaCure diode laser, 1470 nm – AngioDynamics, Never Touch Fibre.

Results: We achieved very high efficacy of the procedure with 100% primary occlusion rate. Postoperative rate of significant complications was markedly low and included only 2 deep vein thromboses (1.4%), 2 late, spontaneous recanalizations (1.4%) and transient paresthesias did not exceed 9.8% (13 patients). Frequency of minor typical side effects of the procedure as ecchymoses and bruising (8.4%) and micropuncture site hematomas (23%) was typical for endovenous laser treatment procedures.

Conclusions: Endovenous laser treatment of small saphenous vein insufficiency is safe, quick, requires only a few hours of hospitalisation and provides very good cosmetic effect, quick recovery and fast return to normal activities. In opinion of authors the method seems to be advantageous to open surgery of short saphenous vein.

Key words: small saphenous vein, endovenous laser treatment, chronic venous disease.

INTRODUCTION

Chronic venous disease is one of the most common civilization-related diseases of the modern world. According to the epidemiological data, varicose veins of the lower limbs, which is the easiest form to diagnose, affects 2-56% of men and 1-73% of women. Researchers determined the relationship between the incidence of this form and age, gender, race, geographical location, and the level of industrialisation of society. The effect of venous insufficiency on health-related quality of life is substantial and comparable with other chronic diseases. It is mostly associated with insufficiency of the great saphenous vein; however, insufficiency of the small saphenous vein is responsible in 15% of patients with varicose veins [1].

Conventional surgery for small saphenous vein incompetence results in a high incidence of recurrence and is frequently associated with neurovascular injury. The introduction of new endovascular techniques such as endovenous laser treatment (EVLT) and radio frequency ablation (RFA) seems to be a very attractive alternative to surgery for patients, especially taking into account the high efficiency of the therapy, which exceeds 90%, and rare complications and recurrence [2, 3].

Endovenous thermal ablation of the great saphenous vein has become the preferred method of treatment for patients with symptomatic great saphenous vein reflux. In 2011, the Society for Vascular Surgery published Clinical Practice Guidelines recommending ablation rather than high ligation and stripping for treatment of great saphenous vein incompetence to the knee [4].

Although the safety and efficacy of small saphenous vein ablation has been validated by a small number of peer-reviewed studies, fewer published outcomes for this procedure exist in the current literature, in comparison to the great saphenous vein [5-7].

Anatomic differences between the saphenofemoral junction and the saphenopopliteal junction, as well as the proximity of the sural nerve to the small saphenous vein, are two reasons why study results of endovenous laser ablation of the great saphenous vein may not be applicable to the short saphenous vein. The purpose of this study is to report on the effectiveness and safety of laser ablation of the small saphenous vein from a large number of patients from a single centre.

Table 1. Preoperative patients' demographics

Parameter	Number (range)
Numbers of patients	132
Numbers of treated limbs	140
Mean age in years (range)	42 (19-71)
Gender (M/F)	27/105
Mean SSV diameter in mm (range)	6 (4-9)

Table 2. CEAP classification

CEAP Classification	Number (%)
C2	108 (82%)
C4	18 (13%)
C5	6 (5%)

MATERIAL AND METHODS

In the years 2009-2013 we performed more than 2500 procedures of laser ablation of insufficient great saphenous veins and small saphenous veins. The group of patients who underwent endovenous laser treatment of small saphenous veins consisted of 132 patients. In total, 140 small saphenous vein laser ablations were performed (in some patients bilaterally). Of these patients, 105 were female and 27 were men. Average age was 42 years. The demography and patient characteristics are shown in Table 1.

All of the patients in this group presented clinical symptoms of chronic venous disease related to small saphenous vein insufficiency, with varicose veins, significantly affecting their quality of life in terms of physical wellbeing and aesthetic issues. The staging of the chronic venous disease in this group of patients according to CEAP classification is shown in Table 2. Patients were qualified for EVLT treatment based on the results of colour Doppler ultrasound, which was performed in the standing position and revealed valvular insufficiency of the small saphenous vein and its saphenopopliteal junction. Based on ultrasound examination three anatomical types of small saphenopopliteal junction were distinguished: type 1 – direct junction of small saphenous vein with popliteal vein; type 2 – tributary Giacomini vein branching from small saphenous vein before its junction with popliteal vein; and type 3 – high junction of small saphenous vein with deep veins of the thigh. These anatomical variations of small saphenous vein junction with deep venous system are, in the opinion of the authors, crucial during preoperative planning of the procedure and are shown on Figs. 1, 2, and 3 (*illustrations © Marek Iłżecki*).

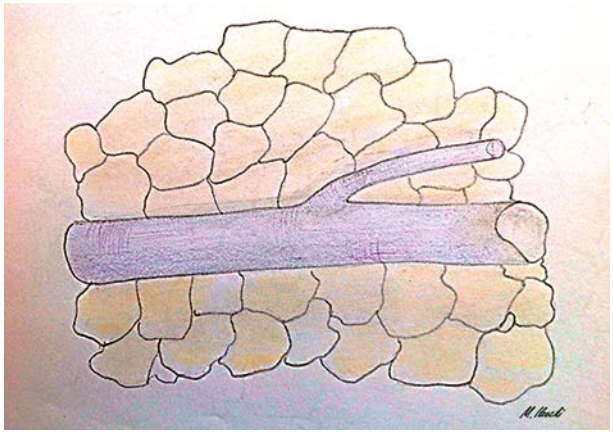

Fig. 1. Small saphenous vein – popliteal vein junction – type 1

The diameter of the small saphenous vein was on average 6 mm (range 4-9 mm).

Procedure description

All patients were hospitalised as one-day admissions. The procedure was performed with the patient a prone position.

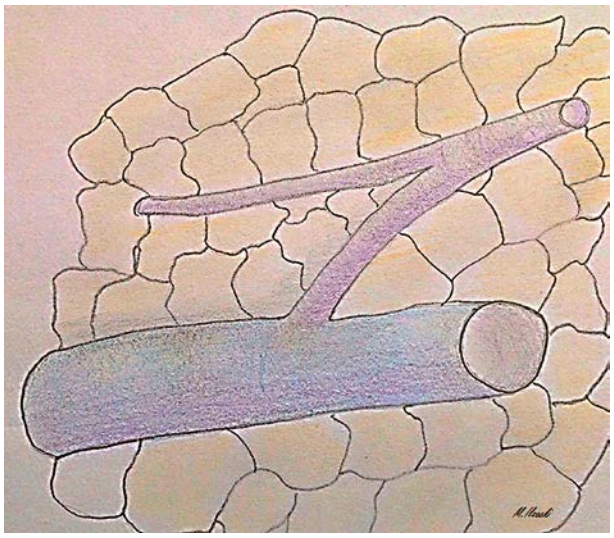

Fig. 2. Small saphenous vein – popliteal vein junction – type 2

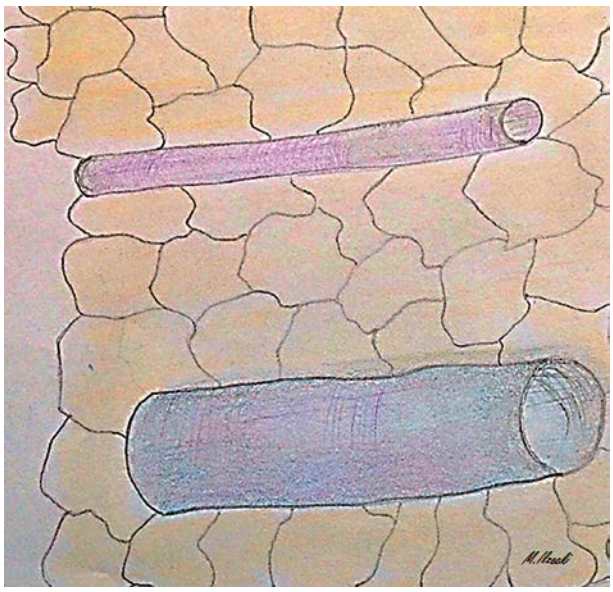

Fig. 3. Small saphenous vein – popliteal vein junction – type 3

The small saphenous vein was punctured in the middle segment under ultrasound control. Then, under ultrasound guidance, a guidewire and 4F sheath were advanced in the proximity of the junction with the popliteal vein. The guidewire was exchanged for a laser fibre via the sheath. The laser fibre tip was located 2 cm below the small saphenous-popliteal vein junction, which was confirmed by ultrasound. In case of the presence of Giacomini vein tributing to small saphenous vein, the laser fibre tip was positioned below the ostium of the Giacomini vein. Local tumescent anaesthesia was performed with 0.1% lignocaine in an average dose of 14 ml/cm. The anatomical and functional accuracy of tumescence was continuously controlled by ultrasound. In two patients allergic to lignocaine, bupivacaine in adequate concentrations was used.

The endovenous laser ablation was carried out using a VenaCure diode laser, 1470 nm – AngioDynamics, Never Touch Fibre. The small saphenous vein was ablated with a continuous wave of 6-12 W, retraction speed 4-5 mm/second, and total energy (linear endovascular energy density – LEED) 50-70 J/cm. Mean surgery duration time was 20 minutes. Patients were mobilised 15 minutes after the procedure and discharged home two hours later. Antithrombotic prophylaxis with low molecular weight heparin (Enoxaparin 1 × 40 mg subcutaneously) was applied for a period of 10 days. Standard prophylaxis with low molecular weight heparin was applied due to our experience with occasional, spontaneous occurrence of deep vein thrombosis in our much larger material with EVLT treatment of insufficient long saphenous vein. Second class compression therapy with stockings was administered during 7 days for 24 hours continuously, and then for 30 days only during the day. Technical parameters and other significant data related to the procedure are presented in Table 3.

Table 3. Operative data

Parameter (units)	Average (range)
Laser power (W)	9 (6-12)
LEED (J/cm)	50-70
Tumescence (ml/cm)	14 (12-20)
Procedure time (min)	20 (18-30)
Postoperative closure rate	100%
Compression stockings	100%
LMWH prophylaxis	100%

Table 4. Follow up data

Observation time in months	36
Pain duration in days: average (range)	4 (1-6)
Analgesia need in days: average (range)	6 (4-8)
Ecchymosis: number (%)	11 (8.4%)
Paraesthesia: number (%)	13 (9.8%)
Hematoma: number (%)	30 (23%)
DVT: number (%)	2 (1.4%)
PE: number (%)	0 (0%)
SSV recanalisation: number (%)	2 (1.4%)
Recovery time in days: average (range)	4 (2-6)

A total of 118 patients underwent the foam sclerotherapy of varicose veins just after laser ablation (1% Aethoxysclerol) or four weeks after the procedure, as a complementary treatment. None of the patients required mini-phlebectomy. Postoperative ultrasound control visits were carried out within 24 hours (postoperatively), 7 days, 30 days, 6 months, 12 months, and 24 months after surgery. The longest follow up was 36 months.

RESULTS

Endovenous laser treatment of insufficient small saphenous vein was performed in 132 patients. In total, 140 small saphenous veins were ablated (some patients underwent bilateral ablation). Primary success rate was achieved in 132 patients (100%). Postoperative control ultrasound examination confirmed the occlusion of the vein in all cases. Two patients (1.4%) developed deep vein thrombosis (DVT) in the femoral-popliteal segment, without clinical symptoms of pulmonary embolism (PE). Standard treatment with low molecular weight heparin and oral anticoagulant or rivaroxaban alone was introduced. Ecchymoses and bruising along the anatomical course of small saphenous vein were observed in 11 patients (8.4%). Transient paraesthesias related to thermal exposure of sural nerve were reported by 13 patients (9.8%). The most common side effects of the procedure were small haematomas in the site of micropuncture of small saphenous veins, which were observed in 30 patients (23%). These regressed spontaneously. On average, patients suffered from local pain for four days after ablation and required small doses of oral pain killers for six days. During the follow up period recanalisation of the vein occurred only in two patients (1.4%). Endovenous laser re-ablation performed in these patients after six months was successful. The average time of return to normal daily activities, including professional ones, was four days. Repeated sclerotherapy of recurrent varicose veins was needed in 2.8% of patients (4 cases) during the follow-up period. Follow-up data are presented in Table 4.

DISCUSSION

The treatment of superficial venous insufficiency has changed in the last decade. Conventional surgery for small saphenous vein incompetence results in a high incidence of recurrence (up to 52% at 3 years) and is frequently associated with neurovascular injury [8].

In many instances this is the result of inaccurate ligation of saphenopopliteal junction. Even in experienced hands, saphenopopliteal ligation is not always technically successful.

This is mainly due to the diverse anatomic anomalies of the saphenopopliteal junction and its proximity to the tibial and sural nerves [9].

The small saphenous vein lies in close relationship with surrounding nerves. Above the popliteal fossa the thigh extension of the small saphenous vein is in contact with the posterior femoral nerve (small sciatic nerve). In the popliteal fossa the termination of the small saphenous vein can be in contact with tibial or common peroneal nerves. When the small saphenous vein ends above the popliteal skin crease and is displaced laterally, the risk of nerve injury is increased. Below the popliteal crease, the sural nerve can join the small saphenous vein at a variable level, and at the ankle the nerve is always in contact with the small saphenous vein and may be wrapped around it [10].

Many complications of surgical stripping of the small saphenous vein have been described, along with damage to the sural nerve, the tibial nerve, and the common peroneal nerve [11, 12].

Ligation, with or without surgical stripping of insufficient saphenous veins has mostly been replaced by thermal and non-thermal endovenous therapies, due to their superior efficacy and less invasive character [13].

Results of EVLT for small saphenous vein insufficiency have repeatedly been described, with short-term occlusion rates ranging from 91% to 100% [14, 15].

Chaar found that veins measuring > 1 cm could be successfully treated with EVLT, with no increase in failure or complication rates, despite more energy being used for treatment. The routine use of tumescent analgesia in EVLT and RFA reduces the diameter of the veins by mechanical compression and vasospasm from the cold temperature of the tumescent solution. This provides better contact and approximation of the wall of the vein to the probe and optimal dissipation of energy [16].

Previous publications have suggested that larger veins may be associated with higher failure of EVLT in the great saphenous vein and the small saphenous vein. Kontothanassis *et al.* excluded small saphenous veins measuring > 13 mm from treatment with EVLT. They divided the veins treated into three categories based on size, with the largest veins being 9-13 mm in diameter [17].

Desmyttere *et al.* published the results of EVLT in 511 limbs and reported a success rate of 97% after four years of follow-up. They noted that all the failures occurred in larger veins (> 8 mm), but no statistical analysis was performed [18].

In our experience, the long-term occlusion rate reached nearly 100%, and only two patients required re-ablation.

Published literature contains conflicting rates of postoperative nerve injury following endovenous laser ablation of the small saphenous vein. Some studies report frequencies as high as 40%. The principal hypothesis of this study was that puncturing the small saphenous vein at the most distal point may increase post-operative nerve injury due to the close relationship between the small saphenous vein and the sural nerve at the level of the ankle [19].

Theivacumar *et al.* reported 3 temporary paraesthesia in a group of 65 patients with small saphenous vein incompetence [20]. However, Desmytte're *et al.* reported 40% temporary paraesthesia in a 147-patient series [21].

When these conflicting results were analysed, in Theivacumar's study the cannulation site was mid-calf or higher. They used a 810 nm diode laser, 12 W laser energy, and a LEED of 60-72 J/cm. In the Desmytte're group, they cannulated the small saphenous veins from mid-to-lower calf. A 980 nm laser, 10 W energy, and various LEEDs (50-90 J/cm) were used. Although Desmytte're's group used less energy (10 W vs. 12 W) and a higher wavelength (980 nm vs. 810 nm), their paraesthesia results were dramatically higher than reported in Theivacumar's study. In Desmytte're's group, there is no subgroup analysis to assess at which LEED the paraesthesia rate is increased. The main difference seems to be the puncture levels.

From previous experience with the 1470 nm laser and radial fibre, Doganci *et al.* predicted a 30% paraesthesia rate in the malleolar cannulation group compare to 6% using the mid-calf cannulation site, lasting two months in the first group and two weeks in the second group [22].

Persistent numbness is reported in 1.3-4.4% of cases [23, 24].

We observed paraesthesias in 9.8% of patients. The relatively low rate of this specific complication seems to be related to the site of puncture of the small saphenous vein that we chose – always in the middle segment of the vein. Average LEED in our group was 50-70 J/cm, and continuous laser energy was on average 9 W, thus lower values were used than these presented in Desmytte're's group.

Serious complications following EVLT are uncommon. Pulmonary emboli are extremely rare, with only one literature report found. Extension of a clot into deep veins has been noted by many investigators, with an incidence of 0-5.7% for the small saphenous vein. In our study we observed two cases (1.4%) of deep vein thrombosis at the femoral-popliteal level with mild severity of symptoms. The variability in the observation of deep vein thrombus is likely accounted for by different techniques, learning curve, the sensitivity of the equipment used to detect the thrombus, and the time interval between EVLT and imaging to look for thrombus. In most cases DVT is due to other risk factors such as deficiency of protein C and S, mutation of factor V, or long-term oestrogen therapy [25, 26].

Many studies describe the incidence of bruising and discomfort following EVLT, but it causes significantly less post-procedural discomfort and bruising compared to traditional surgical therapies. There are no clinically significant infections except for erythema at the access site

treated with oral antibiotics and steroids. There is one literature report of a phlegmonous infection of a limb treated with surgical drainage and antibiotics [27].

CONCLUSIONS

Endovenous laser treatment of the small saphenous vein is safe and effective. Low rate of complications, one-day hospitalisation, short recovery time, and quick return to professional activities makes this method, in our opinion, advantageous to open surgery.

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