Treatment of recurrent varicose veins of the great saphenous vein by conventional surgery and endovenous laser ablation

Laura van Groenendael, MD,[a] J. Adam van der Vliet, MD, PhD,[c] Lizel Flinkenflögel, MD,[a] Elisabeth A. Roovers, PhD,[b] Steven M.M. van Sterkenburg, MD,[a] and **Michel M.P.J. Reijnen, MD, PhD,[a]** *Arnhem and Nijmegen, The Netherlands*

Objective: **Varicose vein recurrence of the great saphenous vein (GSV) is a common, costly, and complex problem. The aim of the study was to assess feasibility of endovenous laser ablation (EVLA) in recurrent varicose veins of the GSV and to compare this technique with conventional surgical reintervention.**

Methods: **Case files of all patients treated for GSV varicosities were evaluated and recurrences selected. Demographics, duplex scan findings, CEAP classification, perioperative data, and follow-up examinations were all registered. A questionnaire focusing on patient satisfaction was administered.**

Results: **Sixty-seven limbs were treated with EVLA and 149 were surgically treated. General and regional anesthesia were used more in the surgery group ($P < .001$). Most complications were minor and self-limiting. Wound infections (8% vs 0%; $P < .05$) and parasthesia (27% vs 13%; $P < .05$) were more abundant in the surgery group, whereas the EVLA-treated patients reported more delayed tightness (17% vs 31%; $P < .05$). Surgically-treated patients suffered less postoperative pain ($P < .05$) but reported a higher use of analgesics ($P < .05$). Hospital stay in the surgery group was longer ($P < .05$) and they reported a longer delay before resuming work (7 vs 2 days; $P < .0001$). Patient satisfaction was equally high in both groups. At 25 weeks of follow-up, re-recurrences occurred in 29% of the surgically-treated patients and in 19% of the EVLA-treated patients ($P = .511$).**

Conclusion: **EVLA is feasible in patients with recurrent varicose veins of the GSV. Complication rates are lower and socioeconomic outcome is better compared to surgical reintervention. (J Vasc Surg 2009;50:1106-13.)**

Varicose veins are a widespread affliction, causing symptoms varying from minor leg discomfort to chronic disabling venous ulceration. About half of the adult population has minor stigmata of venous insufficiency, whereas 15% of men and 35% of women have visible varicose veins.[1] The majority (70%) of varicose veins are the result of an incompetent saphenofemoral junction (SFJ) and/or great saphenous vein (GSV).[2] Approximately one-third of these patients eventually undergo surgical intervention.[3]

Recurrence of varicose veins after conventional surgical treatment is a common, costly, and complex problem, which accounts for over 20% of patients requiring venous surgery.[4-6] Recurrences may be due to residual varicose veins, true recurrences, or progression of disease.[7] Data on recurrence rates are hard to compare because of differences in the initial treatment, the method of measuring recurrence, and duration of follow-up. The rate of recurrences seems to increase with time.[8] Clinical recurrence rates of 26% to 62% have been described after a follow-up period of 3 to 11 years.[9,10] Recurrences on duplex ultrasound scanning, however, may be even higher. Fischer et al[4] described a clinical recurrence rate of 47%, but a 60% recurrence rate was seen in duplex scanning after a follow-up of 34 years.

Conventional treatment of recurrent varicosities of the GSV usually consists of a surgical rediscconnection of the SFJ, frequently combined with multiple phlebectomies. Surgical reintervention is associated with a higher re-recurrence rate than primary treatment of varicose veins.[11] Various randomized controlled trials assessing new surgical techniques have been performed with varying success. A complete resection of the GSV stump and inversion suturing of the common femoral vein did not seem to decrease neovascularization.[12] Results on the use of barrier materials are conflicting and these techniques have also not yet been introduced into common clinical practice.[13,14]

The role of endovenous techniques in the treatment of recurrences has not been studied to date. Results of endovenous laser ablation (EVLA) for the treatment of primary GSV varicosities are at least comparable with conventional surgical treatment, with early success rates of 88% to 100%.[15-18] Endovenous techniques seem to offer advantages over conventional treatment in terms of reduced postoperative pain, shorter sick leaves, faster return to normal activities, and better cosmetic results. It seems to be cost-saving for society, especially among employed patients.[19,20] The aim of the present study was to assess the role of EVLA in the treatment of recurrent varicosities of the GSV and to compare this technique with surgical re-exploration.

From the Department of Surgery, Division of Vascular Surgery,[a] and Clinical Research Department,[b] Alysis Zorggroep, Location Rijnstate; and the Department of Surgery, Division of Vascular Surgery, University Medical Centre Nijmegen.[c]

Competition of interest: none.

Reprint requests: Michel M.P.J. Reijnen, MD, Department of Surgery, Alysis Zorggroep, Location Rijnstate, Wagnerlaan 55, 6815 AD Arnhem, The Netherlands (e-mail: mmpj.reijnen@gmail.com).

0741-5214/$36.00

doi:10.1016/j.jvs.2009.06.057

METHODS AND MATERIALS

Study population. Case files of patients who were treated in the Rijnstate Hospital for varicosities of the GSV from May 2006 until October 2008 were examined. All patients treated for recurrent varicosities of the GSV were included. All patients were sent a letter in advance giving information on the study and asking them to participate. Informed consent was asked and given by all participants.

Recurrence was defined as the existence of a reconnection with the femoral vein on color-flow duplex ultrasound scanning concurrent with GSV insufficiency. Recurrence was defined as insufficiency (>1 second reversed flow)[21] in a part of the GSV and reflux at the SFJ after prior ligation at the SFJ and/or stripping of the GSV on duplex scanning. All patients previously underwent a saphenofemoral disconnection (SFD) with or without stripping of the GSV. Patients with an isolated insufficiency of superficial system, without existence of a reconnection at the SFJ, were excluded. Patients who had only been treated with a phlebectomy were also excluded. Various included patients were initially operated on in other centers. Reliable data on the duplex scan findings of their initial pathology and details on their initial treatments could, therefore, not be provided. The study categories were defined as recurrent GSV varicosities treated with either EVLA or conventional surgery.

Demographics and history of previous treatment for varicose veins were noted, as was the preoperative clinical disease severity using the CEAP classification (Table I). Patients were classified with secondary varicosis if the deep venous system was insufficient at preoperative duplex scanning in combination with a history of deep venous thrombosis. The interval between initial treatment and current treatment was recorded, as was the follow-up time between intervention and interview. Perioperative data for comparison of the two treatment modalities were obtained from the operation report and medical file. For the surgical intervention group, the types of procedure were recorded, and for the EVLA group the treated length, duration of laser application in seconds, and the fluence, defined as J/cm^2, were recorded. Moreover, the occurrence of postoperative complications, pain, the use of analgesics and compression stockings, and physical activities were noted. The delay before resuming work was defined as the period before all regular working activities could be resumed. A prospectively taken questionnaire,[22] focusing on patient satisfaction, was sent to all patients. Two weeks afterwards, patients were interviewed by two of the authors (L.v.G. and L.F.). The interviewers were not involved in the treatment of these patients. Satisfaction and subjective improvement of symptoms were scored on a 1-10 scale. The questionnaire consisted of questions, with a visual analogue scale outcome on a 1-10 scale. Data retrieved from the case files were completed and confirmed and a questionnaire focusing on patient satisfaction was administered.

Table I. The CEAP classification

Mark	*Definition*
C	Clinical signs (grade 0-6), supplemented by (s) for symptomatic and (a) for asymptomatic presentation.
E	Etiologic classification (congenital, primary, secondary).
A	Anatomic distribution (superficial, deep, or perforator, alone or in combination).
P	Pathophysiologic dysfunction (reflux or obstruction, alone or in combination).
Grade	**Description**
C 0	No evidence of venous disease.
C 1	Superficial spider veins (reticular veins) only.
C 2	Simple varicose veins only.
C 3	Ankle edema of venous origin.
C 4	Skin pigmentation in the gaiter area (lipodermatosclerosis).
C 5	A healed venous ulcer.
C 6	An open venous ulcer.

Treatment protocols

Conventional surgery. The preferred technique was a flush division of the new SFJ, whereby the femoral vein was exposed over a prolonged segment and all tributaries were divided through a groin incision of 4-7 cm. If possible, the GSV and/or anterolateral branch were stripped. Additionally, a phlebectomy, according to the Mullerian technique, was performed: using skin incisions as small as 1 mm, veins were extracted with a phlebectomy hook or mosquito clamp. Incisions were closed with tissue glue (Indermil Tissue Adhesive, Covidien Syneture, Mansfield, Mass) or intracutaneous stitches (Monocryl, Ethicon, Johnson & Johnson, Langhorne, Pa). Thigh-high compression stockings (30 to 40 mm Hg) were prescribed for 1 week after surgery. A prolonged use was allowed for reasons of comfort. All patients were scheduled for out-clinic control, without a routine duplex scan investigation.

EVLA. Suitability for EVLA was assessed on the preoperative duplex scan. Contraindications for EVLA included severe tortuosity, thrombus, and a vein diameter of less than 4 mm. The GSV was punctured, ultrasound-guided, and a 0.035-inch J-tipped guidewire was introduced into the GSV and passed to the level of the SFJ. A 5Fr catheter introducer sheath was inserted over the guidewire into the vein. The position of the sheath, 20 mm below the SFJ, was confirmed with ultrasound scan imaging. A sterile, bare-tipped 600-μm diameter laser fiber (Diomed, Andover, Mass) was inserted into the sheath and connected to the 810-nm diode laser (Diomed). Confirmation of the position of the laser tip was accomplished using both duplex ultrasound scan and visualizing the red aiming-beam through the skin. The tissue surrounding the saphenous vein was then infiltrated with tumescent aesthetic. Thermal laser energy was applied from the SFJ to the access site by slowly withdrawing the laser fiber and sheath. During the withdrawal, the vein was compressed manually to oppose the vein walls and aid in the obliteration of the lumen. Thigh-high compression stockings (30 to 40 mm Hg) were

Table II. Previous treatment modalities of patients with recurrent varicose veins of the GSV

Treatment history EVLA n = 67, Surgery n = 149	*Number of procedures*	*EVLA*		*Surgery*		P *value*
Saphenofemoral disconnection	1	n = 56	84%	n = 124	83%	.721
	2	n = 10	15%	n = 20	13%	
	3	n = 1	1%	n = 5	3%	
Strip GSV to knee level	1	n = 23	34%	n = 67	45%	.142
	2	n = 0	0%	n = 3	2%	
Strip GSV to ankle level	1	n = 13	19%	n = 67	45%	.001
	2	n = 2	3%	n = 1	1%	
Phlebectomy thigh	1	n = 11	18%	n = 45	34%	.09
	2	n = 1	2%	n = 1	1%	
Phlebectomy leg	1	n = 15	25%	n = 51	39%	.194
	2	n = 1	2%	n = 1	1%	

GSV, Great saphenous vein; *EVLA,* endovenous laser ablation.
Patients were treated with either surgery or EVLA. Data are presented as *n* and (%) unless otherwise specified.

prescribed for 1 week after treatment. A prolonged use was allowed for reasons of comfort. Routine duplex scanning was performed 6 weeks after treatment and all patients were scheduled for out-clinic control.

Statistics. Data are presented as mean and standard deviation or as median and range, depending on whether the variable was normally distributed. Differences between groups were tested using the Pearson χ^2 test and *t* test. In case of unevenly distributed variables, differences between groups were tested using the Mann-Whitney *U* test. Recurrence-free rates were estimated using the Kaplan-Meier method, and differences were assessed using the log-rank test. A *P* value of $< .05$ was considered to be significant.

RESULTS

Demographic data. In the study period, a total of 1068 limbs were treated for varicose veins of the GSV, of which 216 procedures (20%) were performed for recurrences. Of the 436 surgically-treated legs 34.2% (n = 149) were done for recurrences and of the 632 EVLA-treated legs 11% (n = 67; $P < .0001$). In the EVLA group, 6 patients (9.8%) were treated bilaterally for recurrent varicosities and in the surgical group 32 patients (27.3%). Demographic data were comparable: the surgical group contained 17% males and the EVLA group 18% males, the mean ages were 53.7 ± 12.3 years and 54.1 ± 11.2 years, respectively. The median time between treatment for recurrence and initial treatment was 13.5 (range, 0.3-37) years in the EVLA group and 10 (range, 0.76-39) years in the surgery group ($P = .06$). The median time between treatment of recurrences and last postprocedure contact was 13.5 months (range, 3-31) in the surgery group and 15.0 months (range, 3-31) in the EVLA group ($P = .06$).

The questionnaire was completed by 62 patients (92.5%) in the EVLA group, and 132 patients (88.6%) in the surgical group. Eleven patients, in whom 14 recurrences were treated, were not included due to failure to contact after five or more attempts spread over 1 month. Five patients, with six treated recurrences, were not included because contact information was incorrect and could not be verified by their family physician. One patient, with two treated limbs, refused to cooperate.

History and risk factors. All patients had at least once been treated previously with an SFD (Table II). Of the surgically-treated legs, 87% had previously been stripped, 19 legs (13%) were treated with SFD only, and 8 legs (5%) were treated twice; subsequently with a strip until knee level (short strip), and a strip until ankle level (long strip) of the GSV. In the EVLA group, 57% were previously stripped and 1 patient had been treated twice in the same leg: subsequently with a long strip and a short strip of the GSV. In the surgery group, more patients previously underwent a thigh phlebectomy ($P < .05$), and sclerocompression therapy was significantly more abundant in the EVLA group ($P < .01$).

Risk factors for development of varicosities were similar in both groups. In the surgery and EVLA group, respectively, 87% and 89% had a family history for varicose veins, 92% and 94% of female patients had one or more pregnancies, and 58% and 57% had working activities in a standing profession for more than 3 years, respectively. Thirteen percent of patients in the surgery group and 5% in the EVLA group had a history of deep venous thrombosis ($P = .06$). A history of crural ulceration, not present at time of treatment, was present in 2% in the surgery group and in 10% in the EVLA group ($P < .03$). Factors that may contribute to altered anatomy and disturbance of the venous system were similar in both groups: in the surgery group and EVLA group, respectively, major burns appeared in 2% and 3% ($P = .68$) leg fractures in 4% and 2%, ($P = .41$), prosthesis placement 3% and 2% ($P = .75$), and inguinal hernia repair was performed in 5% and 7% ($P = .75$).

Preoperative duplex, CEAP classification, and symptoms. The preoperative duplex scan observations have been described in Table III. The mean maximum GSV diameter was 6.1 ± 1.9 mm in the EVLA group and 6.4 ± 1.8 mm in the surgery group ($P = .66$). Tortuosity was an exclusion criterion in 55 (37%) of the 149 surgically-treated legs. In 12 patients (8%), the diameter was <4 mm and

Table III. The preoperative duplex examination of patients with recurrent varicose veins of the GSV treated with either surgery or EVLA

Preoperative duplex EVLA n = 67, Surgery n = 149	*Surgery*		*EVLA*		P *value*
SFJ insufficiency					
Groin	131	88%	63	94%	.170
Lower level	18	12%	4	6%	.170
GSV insufficiency					
Thigh	136	91%	66	99%	.106
Leg	126	85%	63	94%	.064
Anterolateral branch insufficiency	50	34%	16	24%	.153
Concurrent SSV insufficiency	32	22%	16	24%	.694
Concurrent SPJ insufficiency	20	13%	10	15%	.768
Deep venous insufficiency					
Iliac vein	0	0%	1	2%	.135
Femoral vein	2	2%	1	1%	.930
Popliteal vein	4	3%	0	0%	.176
Gastrocnemic vein	7	5%	1	2%	.249

EVLA, Endovenous laser ablation; *SFJ,* saphenofemoral junction; *GSV,* great saphenous vein; *SSV,* small saphenous vein; *SPJ,* saphenopopliteal junction.
Data are presented as *n* and (%) unless otherwise specified.

Table IV. CEAP classification of patients with recurrent varicose veins of the GSV treated with either surgery or EVLA

Preoperative CEAP classification EVLA n = 67, Surgery n = 149	*EVLA*		*Surgery*		P *value*
Clinical status					
C2	n = 25	37%	n = 65	44%	.02
C3	n = 12	18%	n = 45	30%	
C4-6	n = 30	45%	n = 39	26%	
Etiology					
Ep	n = 64	97%	n = 144	98%	.806
Es	n = 2	3%	n = 3	2%	
Anatomy					
As	n = 55	83%	n = 127	86%	.526
Ap	n = 8	12%	n = 14	9%	
Ad	n = 3	5%	n = 7	5%	

GSV, Great saphenous vein; *EVLA,* endovenous laser ablation; *Ep,* primary etiology; *Es,* secondary etiology; *As,* anatomy; superficial vein insufficiency; *Ap,* anatomy; perforator vein insufficiency; *Ad,* anatomy; deep vein insufficiency.
Data are presented as *n* and (%) unless otherwise specified.

considered too small for EVLA. Six patients (4%) showed thrombophlebitis on duplex scan. In 76 surgically-treated patients (51%), there were other reasons for surgical treatment; mostly the veins were too branched or superficially positioned. Some veins had too many connections with the DVS and/or the small saphenous vein to be considered treatable with EVLA. No double systems were found at preoperative duplex scanning of the treated legs.

The preoperative CEAP classification is shown in Table IV. The EVLA-treated patients had a significantly worse clinical status. There was no significant difference in aetiology, anatomy, or pathophysiology between groups. Leg discomfort, eg, cramps, restless legs, and tiredness, were present in 89% of the patients in the EVLA group and in 90% of patients in the surgical group ($P = .84$). Pain was present in 53% and 65%, respectively, ($P = .13$), and itching in 42% and 36% ($P = .36$). Cosmetics were expressed to be of importance in 95% of the surgically-treated patients and in 71% of the EVLA-treated patients ($P < 001$).

Procedure

EVLA. Technical success was achieved in 100% of the cases, including the 36 previously stripped legs. The operation was performed using local anesthesia in 95.5%, under regional anesthesia in 3%, and under general anesthesia in 1.5%. Access to the GSV was always accomplished by puncture. A mean length of 35 ± 11 cm was treated with 77 ± 13 J/cm. In 16 cases (24%), the contralateral GSV was treated in the same session. No concomitant phlebectomies or perforantectomies were performed. All patients were discharged on the day of treatment. A postoperative color-flow duplex scan was made in 46 legs (69%) after an average of 8 ± 2.5 weeks. In all patients the GSV remained occluded and no signs of deep venous thrombosis were found on duplex scan. Twelve patients (19.7%) were additionally treated with sclerocompression therapy for residual reticular veins.

Conventional surgery. The procedure was performed successfully in all legs. The operation was significantly more often performed under regional anesthesia (85%; $P < .0001$) and general anesthesia (15%; $P < .001$). In 130 legs (87%), a re-SFD was performed, and in all these procedures the deep venous system was visualized. In 23 legs (15%) a short strip of the GSV was performed and in 2 legs (1%) a long strip was performed. In 14 legs (10%), an anterolateral branch was stripped. In 7 legs (5%), perforating veins were ligated. In 120 legs (81%), phlebectomy on the thigh was performed, and in 99 legs (66%), on the leg. In 99 cases (66%) the contralateral side was treated in the same session. Twelve patients (9%) remained in the hospital overnight, which was significantly more than in the EVLA-treated group ($P < .01$). Thirty-two patients (24%) received additional sclerocompression therapy for residual reticular veins ($P = .48$).

Complications and follow-up. The postoperative pain score was significantly lower in the surgery group; 4.7 ± 2.6 points compared to 5.7 ± 2.5 points in the EVLA group ($P = .02$). The median duration of postoperative pain was also shorter in the surgery group (4.5 days [range, 0-42] vs 7 days [range, 0-49] $P = .03$). In contrast, the use of NSAIDs was significantly higher in the surgical group (0 days [range, 0-28] in the surgery group vs 0 days [range, 0-21] in the EVLA group, $P = .04$). Surgically-treated patients had a significantly longer delay before resuming work (surgery 7 days [range, 0-42] vs EVLA 2 days [range, 0-21] $P < .0001$). The return to a normal level of activity was not significantly different (surgery 21 days [range, 0-170] vs EVLA 17.5 days [range, 0-84]). The median

Table V. Complications after treatment of recurrent varicose veins of the GSV with either surgery or EVLA (P = ns)

EVLA n = 61, Surgery n = 132	*EVLA*		*Surgery*		P *value*
Minor complications					
Ecchymosis	n = 51	84%	n = 114	86%	.613
Hematoma	n = 16	26%	n = 44	33%	.322
Induration	n = 20	33%	n = 48	36%	.629
Phlebitis	n = 4	7%	n = 11	8%	.668
Temporary parasthesia	n = 8	13%	n = 36	27%	.04
Tightness (>7 days)	n = 19	31%	n = 22	17%	.02
Wound infection	n = 0	0%	n = 10	8%	.04
Major complications					
Deep venous thrombosis	n = 0	0%	n = 0	0%	0
Persistent saphenous neuralgia (>1 year)	n = 1	1%	n = 0	0%	.140

GSV, Great saphenous vein; *EVLA,* endovenous laser ablation.
Data are presented as *n* and (%) unless otherwise specified. The number of procedures indicates the amount of procedures that patients had previously undergone.

postoperative use of compression stockings was longer in the surgical group (21 days [range, 0-365 days] in the surgery group and 14 days [0-210 days] in the EVLA group [P = .001]).

Minor, self-limiting complications were common in both groups (Table V). In the surgery group, 1 patient suffered from persistent saphenous nerve neuralgia, and had remaining numbness of the skin after 1 year follow-up after surgery. No deep venous thrombosis was reported. Wound infection was reported in 10 surgically-treated patients (8%; P = .03) and temporary parasthesia in 36 (27%; P = .04) was also significantly more present in the surgery group. A wound infection was defined as a swollen wound with redness and/or heat, or when purulent was discharged from the wound.

Tightness of the leg, defined as the experience of a painful feeling of constriction, lasting longer than 7 days postoperatively, was significantly more present in the EVLA group (n = 19; P = .02). Hematomas, defined as a localized collection of extravasated blood, were equally distributed between groups. All of the minor complications were self-limiting within 3 months.

After a median follow-up period of 13.5 months (range, 3-31) in the surgery group and 15.0 months (range, 3-31) in the EVLA group (P = .06) clinical recurrences occurred in 25.8% of the surgically-treated limbs and in 11.5% of limbs treated with EVLA (P = .024). This observation did not remain significant after correction for length of follow-up by Kaplan-Meier comparison (Fig). The re-recurrence rates after 25 weeks of follow-up were 29% in the surgically-treated patients and 19% in the EVLA-treated patients (P = .51).

Satisfaction. Patients in both groups gave similar grades for their satisfaction with the treatment, 7.6 ± 1.6 points and 7.5 ± 2.0 points (P = .71) in the surgery- and EVLA group, respectively. The preoperative grade given for the subjective severity of symptoms was comparable: 7.0 ± 1.5 points in the surgery group and 7.0 ± 1.4 points in the EVLA group. The experienced improvement of symptoms, measured by deduction of the preoperative grade of the current grade of symptoms, was also not different between the groups (2.5 ± 2.4 in the surgery group, 2.7 ± 2.6 in EVLA group).

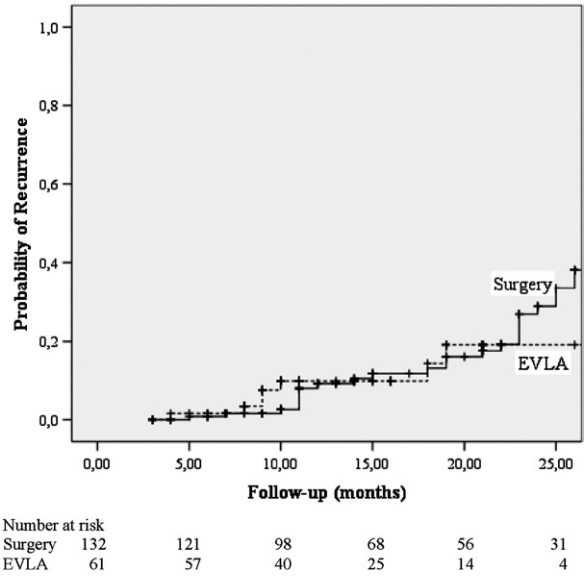

Fig. Kaplan-Meier survival curve showing re-recurrences after endovenous laser ablation (EVLA) and surgical treatment of recurrent varicose veins of the great saphenous vein (GSV). P = .511 after log-rank (Mantell-Cox) comparison.

DISCUSSION

In the present study, we have demonstrated that, if anatomically suitable, EVLA is a good treatment alternative for recurrent varicose veins of the GSV, also after previous stripping. Socioeconomic outcomes are better and the complication rate is lower after EVLA. Patient satisfaction and clinical re-recurrences are equal in both groups. Surgically-treated patients reported less postoperative pain but a higher use of analgesic medication.

The observation that EVLA is feasible after simple SPD could have been expected. It is more surprising that 36 previously stripped legs could also be treated. Anatomic suitability on duplex scan is a prerequisite. In this series, 31% of patients with recurrences were treated with EVLA, suggesting that tortuosity is a common contraindication for endovenous treatment in these patients. Nevertheless, 10 patients having tortuous veins on preoperative duplex scan were effectively treated with EVLA. Both the existence of double system and neovascularization may partly explain the feasibility of EVLA after previous stripping.

As in other series, minor self-limiting complications, such as ecchymosis, hematoma, indurations, temporary paresthesia, and delayed tightness were frequent. All of these were more prevalent in the surgical group except for the delayed tightness. A higher incidence of tightness in the EVLA group could have been expected because the entire length of the vein was ablated, in contrast to the surgical group that underwent an SFD only. As could be expected, wound infections only occurred in the surgical group. The combination of temporary paresthesias and wound infection was 35% in the surgical group, which may be considered a significant price to pay when compared to the 13% incidence after EVLA. Generally, treatment of recurrences is considered to have higher complication rates than treatment for primary varicosities.[11] Our data do not confirm this: only 1 surgically-treated patient had lasting saphenous paralysis and there was no deep venous thrombosis in either group. The occurrence of a temporary parasthesia was significantly more frequent in the surgery group. The high incidence after surgery is in accord with Morrison and Dalsing,[23] who have described that 40% of patients have symptoms consistent with saphenous nerve injury at some time after operation, but that these symptoms affected quality of life in only 6.7%. The incidence of wound infections and hematomas may also be important because they have been correlated with revascularization.[24]

In this study, patients treated with EVLA could return to their working conditions in 2 days, which was significantly shorter than surgically-treated patients, who needed 1 week. The minimally invasive character of EVLA, including the absence of wounds, may have contributed to this finding. This socioeconomic observation may have great impact, considering the large number of patients treated annually. Surprisingly, the increased postoperative pain in EVLA-treated patients, did not refrain them from returning to work. The lower use of analgesic medication in this group might partly explain the increased experience of postoperative pain. Higher pain scores after EVLA and a longer duration of pain, however, have been reported in previous studies.[20,25] The amount of tumescent fluid used during EVLA might have also contributed. Unfortunately, these data were not recorded in the case files. The thermal ablation of long segment of the saphenous vein may also have contributed injury to the increased pain score and the duration of postoperative pain in the EVLA group. Patients who are treated conventionally usually are prescribed analgesics for some days. After EVLA, in contrast, patients are advised to use analgesics only when necessary. The observation of higher pain scores in EVLA-treated patients may be used to better prepare patients preoperatively, informing them on postoperative pain, and prescribing adequate pain medication.

Clinical studies have suggested that the recurrence of varicose veins after EVLA may be lower than after conventional surgery.[19,26] In our study, we found that the re-recurrence rate was not different between groups, although a tendency was observed towards a higher rate in the surgery group. In the present study, we have measured clinical recurrences only. Recurrences on duplex ultrasound scans have been reported to be higher and might differ between groups. Additional prospective trials are indicated to illuminate this subject and the timing of re-recurrences.

In the present study, a remarkably high percentage of the legs that had undergone previous GSV stripping were found to have a GSV insufficiency on duplex scan. This might be partly explained by the existence of a double system, but may also indicate a role of neovascularization in the pathophysiology of re-recurrences. The role of neovascularization in the development of recurrences is still debated. Some declare that it is the main cause for recurrences,[6,27] although others state that other causes, such as persistent tributaries, are more important. Theivacumar et al,[28] however, found that the persistence of nonrefluxing GSV tributaries at the SFJ did not have an adverse impact on clinical outcome 1 year after EVLA. Additionally, Pittaluga et al[29] described good results with regard to hemodynamics and neovascularization on the SFJ, varicose vein recurrence, improvement of symptoms, and aesthetic appearance after preservation of the SFJ during saphenous stripping. The mechanisms of neovascularization are yet to be discovered. In the event of neovascularization of the ablated vein, Labropoulos et al[30] proposed arteriovenous fistulae as the responsible mechanism for recanalization. With laser ablation the incompetent stump is not specifically treated, but the GSV stump shrinks and is reduced 3 months after EVLA.[28,31] Recently, it was shown that although duplex ultrasound scan is a reliable tool to diagnose groin recurrences, its validity in classifying the different types of recurrent groin vessels is limited.[32] Histologic examination should, therefore, be regarded as the gold standard when trying to differentiate between different types of groin recurrences. Further studies focusing on the mechanisms of recurrences after both surgery and endovenous techniques are indicated.

The retrospective design of this study may have induced a selection bias. Patient selection on duplex ultrasound scan was mainly based on the anatomy. Severe tortuosity, thrombus, and possible access difficulties were considered to be exclusion criteria for EVLA. Patients with cosmetic concerns were more abundant in the surgical group. This might have been caused by a larger and more complex vein pattern thus favoring results in the EVLA-treated group. The preoperative clinical status as measured with the CEAP classification, however, was worse in the EVLA-treated group, which might have negatively affected

the results in this group. Kambal et al[33] have suggested that EVLA may be more effective in the treatment of patients with a severe clinical status. In our study, all patients were included after introduction of EVLA in our institution. Thus, these data also reflect the center's initial experiences in treating GSV varicosities with EVLA. A learning curve may be expected that could have negatively affected the results of the EVLA group. During the study period, contraindications for EVLA included severe tortuosity, thrombus, and a vein diameter of less than 4 mm. Currently, the lower limit of diameter in our institution is 3 mm, indicating that some of the surgically-treated patients unrightfully have been denied EVLA.

In conclusion, we have shown that EVLA is feasible in patients with recurrent varicose veins of the GSV, even after previous stripping. Complication rates are lower and socioeconomic outcome is better, compared to surgical reintervention. Patient satisfaction is high for both treatment modalities.

AUTHOR CONTRIBUTIONS

Conception and design: LG, MR, AV
Analysis and interpretation: LG, MR, AV
Data collection: LG, LF
Writing the article: LG, MR
Critical revision of the article: SS, AV, ER
Final approval of the article: MR
Statistical analysis: ER
Obtained funding: MR
Overall responsibility: MR

REFERENCES

1. Callam MJ. Epidemiology of varicose veins. Br J Surg 1994;81:167-73.
2. Labropoulos N, Leon M, Nicolaides AN, Giannoukas AD, Volteas N, Chan P. Superficial venous insufficiency: correlation of anatomic extent of reflux with clinical symptoms and signs. J Vasc Surg 1994;20:953-8.
3. Engelhorn CA, Engelhorn AL, Cassou MF, Salles-Cunha SX. Patterns of saphenous reflux in women with primary varicose veins. J Vasc Surg 2005;41:645-51.
4. Fischer R, Chandler JG, Stenger D, Puhan MA, De Maeseneer MG, Schimmelpfennig L. Patient characteristics and physician-determined variables affecting saphenofemoral reflux recurrence after ligation and stripping of the great saphenous vein. J Vasc Surg 2006;43:81-7.
5. Pavei P, Vecchiato M, Spreafico G, Giraldi E, Ferrini M, Baccaglini U, Ancona E. Natural history of recurrent varices undergoing reintervention: a retrospective study. Dermatol Surg 2008;34:1676-82.
6. van Rij AM, Jiang P, Solomon C, Christie RA, Hill GB. Recurrence after varicose vein surgery: a prospective long-term clinical study with duplex ultrasound scanning and air plethysmography. J Vasc Surg 2003;38:935-43.
7. Blomgren L, Johansson G, Dahlberg-Akerman A, Norén A, Brundin C, Nordström E, Bergqvist D. Recurrent varicose veins: incidence, risk factors and groin anatomy. Eur J Vasc Endovasc Surg 2004;27:269-74.
8. Chiesa R, Marone EM, Limoni C, Volontè M, Petrini O. Chronic venous disorders: correlation between visible signs, symptoms, and presence of functional disease. J Vasc Surg 2007;46:322-30.
9. Campbell WB, Vijay Kumar A, Collin TW, Allington KL, Michaels JA, Randomised and Economic Analysis of Conservative and Therapeutic Interventions for Varicose veins Study. The outcome of varicose vein surgery at 10 years: clinical findings, symptoms and patient satisfaction. Ann R Coll Surg Engl 2003;85:52-7.
10. Winterborn RJ, Foy C, Earnshaw JJ. Causes of varicose vein recurrence: late results of a randomized controlled trial of stripping the long saphenous vein. J Vasc Surg 2004;40:634-9.
11. Gibbs PJ, Foy DM, Darke SG. Reoperation for recurrent saphenofemoral incompetence: a prospective randomised trial using a reflected flap of pectineus fascia. Eur J Vasc Endovasc Surg 1999;18:494-8.
12. Heim D, Negri M, Schlegel U, De Maeseneer M. Resecting the great saphenous stump with endothelial inversion decreases neither neovascularization nor thigh varicosity recurrence. J Vasc Surg 2008;47:1028-32.
13. De Maeseneer MG, Vandenbroeck CP, Van Schil PE. Silicone patch saphenoplasty to prevent repeat recurrence after surgery to treat recurrent saphenofemoral incompetence: long-term follow-up study. J Vasc Surg 2004;40:98-105.
14. Winterborn RJ, Earnshaw JJ. Randomised trial of polytetrafluoroethylene patch insertion for recurrent great saphenous varicose veins. Eur J Vasc Endovasc Surg 2007;34:367-73.
15. Kalteis M, Berger I, Messie-Werndl S, Pistrich R, Schimetta W, Pölz W, Hieller F. High ligation combined with stripping and endovenous laser ablation of the great saphenous vein: early results of a randomized controlled study. J Vasc Surg 2008;47:822-9; discussion 829.
16. Reijnen MM, Disselhoff BC, Zeebregts CJ. Varicose vein surgery and endovenous laser therapy. Surg Technol Int 2007;16:167-74.
17. van den Bos RR, Kockaert MA, Neumann HA, Nijsten T. Technical review of endovenous laser therapy for varicose veins. Eur J Vasc Endovasc Surg 2008;35:88-95.
18. Mundy L, Merlin TL, Fitridge RA, Hiller JE. Systematic review of endovenous laser treatment for varicose veins. Br J Surg 2005;92:1189-94.
19. Darwood RJ, Theivacumar N, Dellagrammaticas D, Mavor AI, Gough MJ. Randomized clinical trial comparing endovenous laser ablation with surgery for the treatment of primary great saphenous varicose veins. Br J Surg 2008;95:294-301.
20. Rasmussen LH, Bjoern L, Lawaetz M, Blemings A, Lawaetz B, Eklof B. Randomized trial comparing endovenous laser ablation of the great saphenous vein with high ligation and stripping in patients with varicose veins: short-term results. J Vasc Surg 2007;46:308-15.
21. Labropoulos N, Tiongson J, Pryor L, Tassiopoulos AK, Kang SS, Ashraf Mansour M, Baker WH. Definition of venous reflux in lower-extremity veins. J Vasc Surg 2003;38:793-8.
22. Trip-Hoving M, Verheul JC, van Sterkenburg SM, de Vries WR, Reijnen MM. Endovenous laser therapy of the small saphenous vein: patient satisfaction and short-term results. Photomed Laser Surg 2009 [Epub ahead of print].
23. Morrison C, Dalsing MC. Signs and symptoms of saphenous nerve injury after greater saphenous vein stripping: prevalence, severity, and relevance for modern practice. J Vasc Surg 2003;38:886-90.
24. Munasinghe A, Smith C, Kianifard B, Price BA, Holdstock JM, Whiteley MS. Strip-track revascularization after stripping of the great saphenous vein. Br J Surg 2007;94:840-3.
25. Rautio T, Ohinmaa A, Perälä J, et al. Endovenous obliteration versus conventional stripping operation in the treatment of primary varicose veins: a randomized controlled trial with comparison of the costs. J Vasc Surg 2002;35:958-65.
26. Theivacumar NS, Dellagrammaticas D, Darwood RJ, Mavor AI, Gough MJ. Fate of the great saphenous vein after endovenous laser ablation: does re-canalisation mean recurrence? Eur J Vasc Endovasc Surg 2008;36:211-5.
27. Blomgren L, Johansson G, Dahlberg-Akerman A, Thermaenius P, Bergqvist D. Changes in superficial and perforating vein reflux after varicose vein surgery. J Vasc Surg 2005;42:315-20.
28. Theivacumar NS, Dellagrammaticas D, Darwood RJ, Mavor AI, Gough MJ. Fate and clinical significance of saphenofemoral junction tributaries following endovenous laser ablation of great saphenous vein. Br J Surg 2007;94:722-5.

29. Pittaluga P, Chastanet S, Guex JJ. Great saphenous vein stripping with preservation of sapheno-femoral confluence: hemodynamic and clinical results. J Vasc Surg 2008;47:1300-4; discussion 1304-5.
30. Labropoulos N, Bhatti A, Leon L, Borge M, Rodriguez H, Kalman P. Neovascularization after great saphenous vein ablation. Eur J Vasc Endovasc Surg 2006;31:219-22.
31. Pleister I, Evans J, Vaccaro PS, Satiani B. Natural history of the great saphenous vein stump following endovenous laser therapy. Vasc Endovascular Surg 2008;42:348-51.
32. Geier B, Mumme A, Hummel T, Marpe B, Stücker M, Asciutto G. Validity of duplex-ultrasound in identifying the cause of groin recurrence after varicose vein surgery. J Vasc Surg 2009;49:968-72.
33. Kambal A, De'ath AD, Albon H, Watson A, Shandall A, Greenstein D. Endovenous laser ablation for persistent and recurrent venous ulcers after varicose vein surgery. Phlebology 2008;23:193-5.

Submitted May 27, 2009; accepted Jun 27, 2009.