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ORIGINAL ARTICLE

Targeted endovenous treatment of Giacomini vein insufficiency-associated varicose disease: considering the reflux patterns

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PURPOSE
We aimed to assess the technical feasibility of targeted endovenous treatment of Giacomini vein insufficiency (GVI)-associated varicose disease and report our early results.

METHODS
We retrospectively screened 335 patients with varicose disease who underwent endovenous laser ablation from September 2011 to January 2013, and determined 17 patients who underwent Giacomini vein ablation. Using a targeted endovenous treatment approach considering the reflux pattern, all healthy great saphenous veins (GSV) or vein segments were preserved while all insufficient veins (Giacomini vein, perforator veins, small saphenous vein, anterior accessory GSV, major tributary veins, or incompetent segments of the GSV) were ablated. Treatment success was analysed using Doppler findings and clinical assessment scores before and after treatment.

RESULTS
Targeted endovenous treatment was technically successful in all cases. Seven GSVs were preserved totally and three GSVs were preserved partially (10/17, 58%), with no major complications. Clinical assessment scores and Doppler findings were improved in all cases.

CONCLUSION
Targeted endovenous treatment of GVI-associated varicose disease is safe and effective. In majority of GVI cases saphenous vein can be preserved using this approach.

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The Giacomini vein (GV) is defined as a branch of cranial extension of the small saphenous vein (SSV) that connects the SSV with the posterior thigh circumflex vein (PTCV) (1). In 14% of the population, SSV continues directly as the GV (2). Although most varices are caused by reflux originating from the great saphenous vein (GSV), SSV, or accessory saphenous branches, varicose disease caused by a Giacomini vein insufficiency (GVI) is not a rare condition (3, 4). GVI is commonly seen with varices that arise on the posterior thigh or calf and accounts for 4%–6% of cases treated by endovenous laser ablation (ELA) (5–8). There is no defined standard treatment for GVI-associated varicose disease. Performing a phlebectomy as the only treatment may result in recurrent varicose disease for some patients. Classical saphenous vein-focused surgical therapies may result in overtreatment or undertreatment. Targeted endovenous treatment (TET) differs from surgical treatments by focusing on the reflux sources and preserving healthy GSV, either totally or partially, while ablating insufficient segments of the vein. The ablation may be applied to any vein including the GV, perforator vein, SSV, and anterior accessory GSV, except the deep veins.

ELA has recently evolved into an accepted option for eliminating truncal reflux for an incompetent GSV or SSV, with successful saphenous vein ablation rates ranging from 88% to 100% (9–12). However, reports of ELA treatment of the GVI are rare (3, 4, 7, 13). Some authors recommend only GSV ablation (4), while others ablate the insufficient GV (3). To the best of our knowledge, there is only one study on treatment of GVI considering the reflux pattern, which used both ELA and sclerotherapy (13). The present study focuses on the saphenous vein sparing effect of TET while treating the GVI by ELA and sclerotherapy.

Today, reflux sources other than the saphenous veins, such as the perforator veins or GVs, are also accessible and can be treated selectively with the help of new endovenous techniques. TET considering the various reflux patterns is a minimally invasive and selective treatment method for GVI that may prevent unnecessary saphenous ablations in some cases. The purpose of this study was to evaluate the technical feasibility of TET and report early treatment results of 17 patients who had GVI with various reflux sources.

Methods

Patients

Between September 2011 and January 2013, 674 consecutive adult patients presenting with varicose veins were retrospectively evaluated using clinical and Doppler ultrasonography (US) data by a vascular interventional radiologist. Of these, 335 patients underwent ELA treatment.

Seventeen patients (median age, 36 years; range, 28–54 years) had GVI, and all underwent TET (17/335) (Fig. 1). Patients with severe peripheral arterial disease, active thrombophlebitis, deep vein insufficiency, pregnancy, known thrombophilia or coagulation disorders, or a history of deep vein thrombosis were not treated and were not included in the study. The study was approved by the local ethics committee (reference no: 8951337/1009/128). The treatment procedure was explained and written informed consent was obtained from all patients.

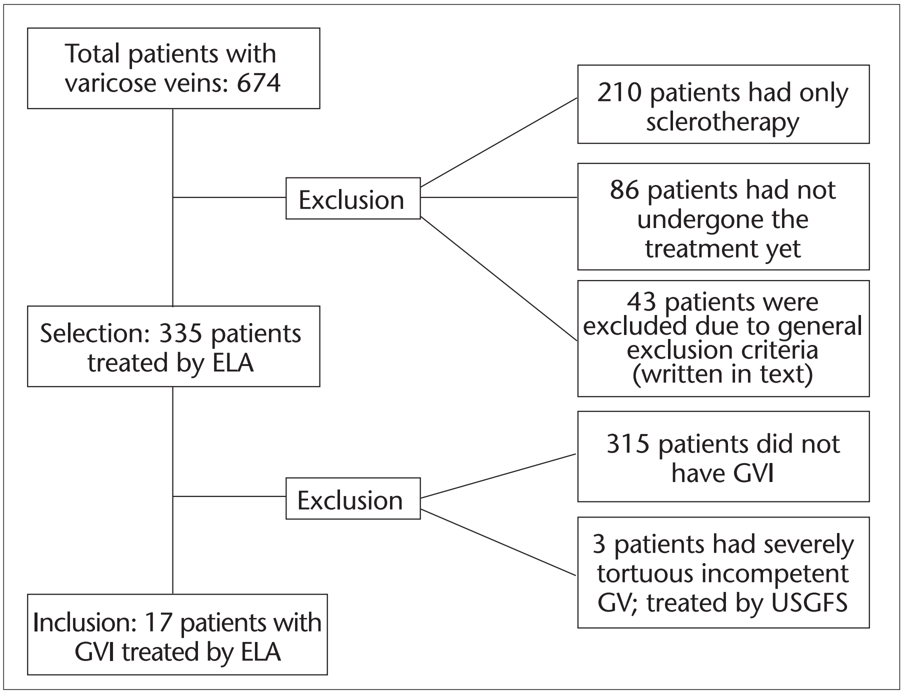

Figure 1. Flow chart of patients screened retrospectively for inclusion in the analysis. ELA, endovenous laser ablation; GVI, Giacomini vein insufficiency; USGFS, ultrasound-guided foam sclerotherapy.

Patient's demographic information and medical histories were recorded. The varicose disease was categorized using the clinical, etiological, anatomical, and pathophysiological (CEAP) classification, and the clinical severity was graded using the revised venous clinical severity score (rVCSS) as recommended by the Society of Interventional Radiology (14).

Each patient underwent a physical examination and a Doppler US examination of both lower extremities, while standing, before and after the treatment by the same physician who performed the ELA procedures. A venous reflux lasting longer than 0.5 s in the superficial veins or the GV and longer than 1 s in the deep veins with compression and release or the Valsalva maneuver was diagnostic for venous insufficiency (15). A preoperative reflux map was obtained to allow flow-mapping for planning the treatment strategy. The same US device with a linear transducer (LA523 [6–13 MHz], Esaote SpA, Genova, Italy) was used for diagnosis, treatment, and postprocedural follow-up. The maximum diameter of the GV was measured in all patients.

All GVIs with a straight course were treated with ELA. Insufficient segments of the saphenous veins were also treated with ELA in the same session. We excluded three patients with significantly tortuous GVs, for whom ELA could not be used and US-guided foam sclerotherapy had to be performed. Patients, who underwent US-guided foam sclerotherapy as a complementary treatment to ELA for residual varicosities in large varicose veins, were included. Polidocanol (Aethoxysklerol 3%; Chemisce Fabrik Kreussler, Wiesbaden, Germany) was used as the sclerosing solution with a modified Tessari technique (sclerosant to air ratio of 1:3).

Targeted endovascular treatment procedure

In the TET approach, we aimed to detect and ablate all the reflux sources and insufficient venous segments. The second aim was to preserve the healthy GSV totally or partially (only the GSV segment proximal to the GSV-PTCV junction).

The procedure was performed under local anesthesia in an outpatient treatment facility. The incompetent GV was punctured at its most caudal level under US guidance for the ELA procedure. The laser fiber tip was placed through a catheter/sheath at the saphenofemoral junction (SFJ) in patients who also had GSV insufficiency or at the PTCV-GSV junction in patients without GSV insufficiency. The tip of the laser was placed at a depth of at least 1 cm below the fascia in the perforator vein when there was a perforator vein reflux. If there was no saphenous reflux accompanying the GVI, isolated GV ablation from the PTCV-GSV junction to the SSV-GV junction was performed while preserving both saphenous veins. If any additional incompetent truncal veins or a tributary vein were present, these were also ablated at the same session. A tumescent anesthetic was injected around the vein under US guidance with a power pump (Klein pump, HK Surgical, San Clemente, California, USA). A 600 μm bare-tip laser fiber was used in continuous mode at 1470 nm (Vari-Lase, Vascular solutions, Minneapolis, Minnesota, USA) for ELA. The energy delivered was 60 J/cm for GVs that were 5 mm or less in diameter and 80 J/cm for the larger veins. Technical success in the ELA procedure was defined as successful access, delivery of laser energy to the incompetent GV, and obliteration of the GV confirmed at the first month of follow-up.

Clinical assessment

The patients were evaluated clinically and by Doppler US one, six, and 12 months after treatment and annually thereafter. Clinical improvement was assessed by the clinical aspect of the CEAP score and by rVCSS score at six months versus pretreatment, which were available for all patients. Improvement in varicosities was assessed by comparing pretreatment photographs with post-treatment six-month photographs. These photographs were categorized as follows: deterioration, no change, improvement, and full resolution. Any adverse effects, such as hyperpigmentation, skin necrosis, allergic reaction, deep vein thrombosis, or paresthesia, were also recorded.

The Wilcoxon test using SPSS version 11.0 (SPSS Inc., Chicago, Illinois, USA) was used for statistical analysis to evaluate the clinical improvement after treatment. Null hypothesis of no difference was rejected if *P* value was less than 0.05.

Table 1. The distribution of ablated veins and vein segments according to the reflux patterns

Ablated vein/vein segments	Reflux type	Preserved saphenous vein	n (%)
GSV_{total}, GV, and SSV	Descending and ascending	none	2 (11.7)
GSV_{total} and GV	Descending	SSV	5 (29.4)
$GSV_{proximal}$ and GV	Descending	SSV and distal GSV	3 (17.6)
SSV and GV	Ascending	GSV	1 (5.8)
GV and perforator vein	Deep to superficial	GSV	3 (17.6)
Only GV	None (isolated GVI)	GSV	3 (17.6)

GSV_{total}, great saphenous vein (GSV) segment from the saphenofemoral junction to the level at which insufficiency was extended; GV, Giacomini vein; SSV, small saphenous vein; $GSV_{proximal}$, GSV segment proximal to the GSV- posterior thigh circumflex vein junction; GVI, Giacomini vein insufficiency.

Table 2. Clinical outcomes of targeted endovenous treatment of Giacomini vein insufficiency after six months (n=17)

	Preoperative median (range)	Postoperative median (range)	*P*
CEAP clinical score	3 (2–5)	1 (0–4)	<0.001
rVCSS	7 (2–12)	1 (0–7)	<0.001

CEAP, clinical etiological anatomical and pathophysiological classification; rVCSS, revised venous clinical severity score.

Results

There were eight patients with descending reflux, one patient with ascending reflux, two patients with both ascending and descending reflux, three patients with deep-to-superficial reflux via the perforator veins, and three patients with isolated GVI without any obvious reflux origin (Table 1). GVI was observed to exhibit three different reflux patterns, which have been described in previous studies (4, 8). Incompetent valves at the SFJ were the major determinants for the descending reflux type. In the descending type, reflux occurred from the GSV to the PTCV-GV and the varicose veins.

The second reflux type, which was rare, was ascending reflux, in which a particular antigravitational upward diastolic flow from the saphenopopliteal junction (SPJ) was a major determinant of the “paradoxical” reflux pattern. Nevertheless, diastolic flow was too slow to be detected by Doppler US examination. For this reason, we also determined whether the proximal SSV and distal GV segments had increased diameter. Additionally, detection of incompetent valves at the SPJ was also used as a determinant of ascending reflux. In the ascending type, reflux occurred from SPJ to the GV and the varicose veins.

The third reflux type was characterized by deep-to-superficial reflux and was easily identified as a perforator vein reflux. The latter was considered when there was an obvious (larger than 4 mm in diameter) incompetent perforator associated with the GVI, resulting in varicose veins. The critical finding for this pattern was the visualization of competent saphenous veins in all segments, particularly at the point of connection with the GV.

The fourth and last group of patients had isolated GVI without any obvious reflux origin. If the varicose veins were related to a large GV with findings of insufficiency on Doppler US and none of the other reflux types were observed, then it was considered as GVI without any obvious reflux origin.

Ablation of GVI was performed in 17 limbs in 17 patients (11 females, 64%; mean age, 42 years; age range, 21–68 years). The distribution of the various patterns of refluxes is shown in Fig. 2, and the distribution of the ablated veins and vein segments according to the reflux patterns is summarized in Table 1. In two cases, the proximal GSV, SSV, and GV were ablated with the same fiber during the same session with only a single distal puncture. This long ablation segment was achieved by US guidance and turning the patient from a prone position to an oblique position for the visualization of the laser fiber at the SFJ. Two patients who had total GSV ablation required a second puncture for the distal GSV ablation during the same session. One patient had anterior accessory saphenous vein ablation and one patient had a major tributary vein ablation during the same treatment session as the patients with total GSV. In six patients, GVI was diagnosed without any truncal reflux. For these patients, only the GV ablation was performed, and the GSV was totally preserved. In three patients, the GSV distal to the PTCV-GSV junction was preserved. In one patient with ascending reflux, SSV and GV ablation was performed and the GSV was totally preserved. None of these patients had recurrent varicose veins at the first-year follow-up.

The mean diameter of the GV was 5.2 mm (range, 3.7–7.1 mm) before the ablations. Continued closure of the ablated GV was observed in all 17 limbs (100%) at one- and six-month follow-ups. Four patients did not return for 12-month follow-up; however, none of the 13 limbs evaluated at 12-month follow-up showed recanalization (100%). The large varicose veins treated by US-guided foam sclerotherapy demonstrated no visible vascularity and no compressibility along their entire course in 17/17 available limbs (100%) at the six-month follow-up. The volume of injected foam ranged from 2 to 10 mL (mean, 4.4 mL). An additional US-guided foam sclerother-

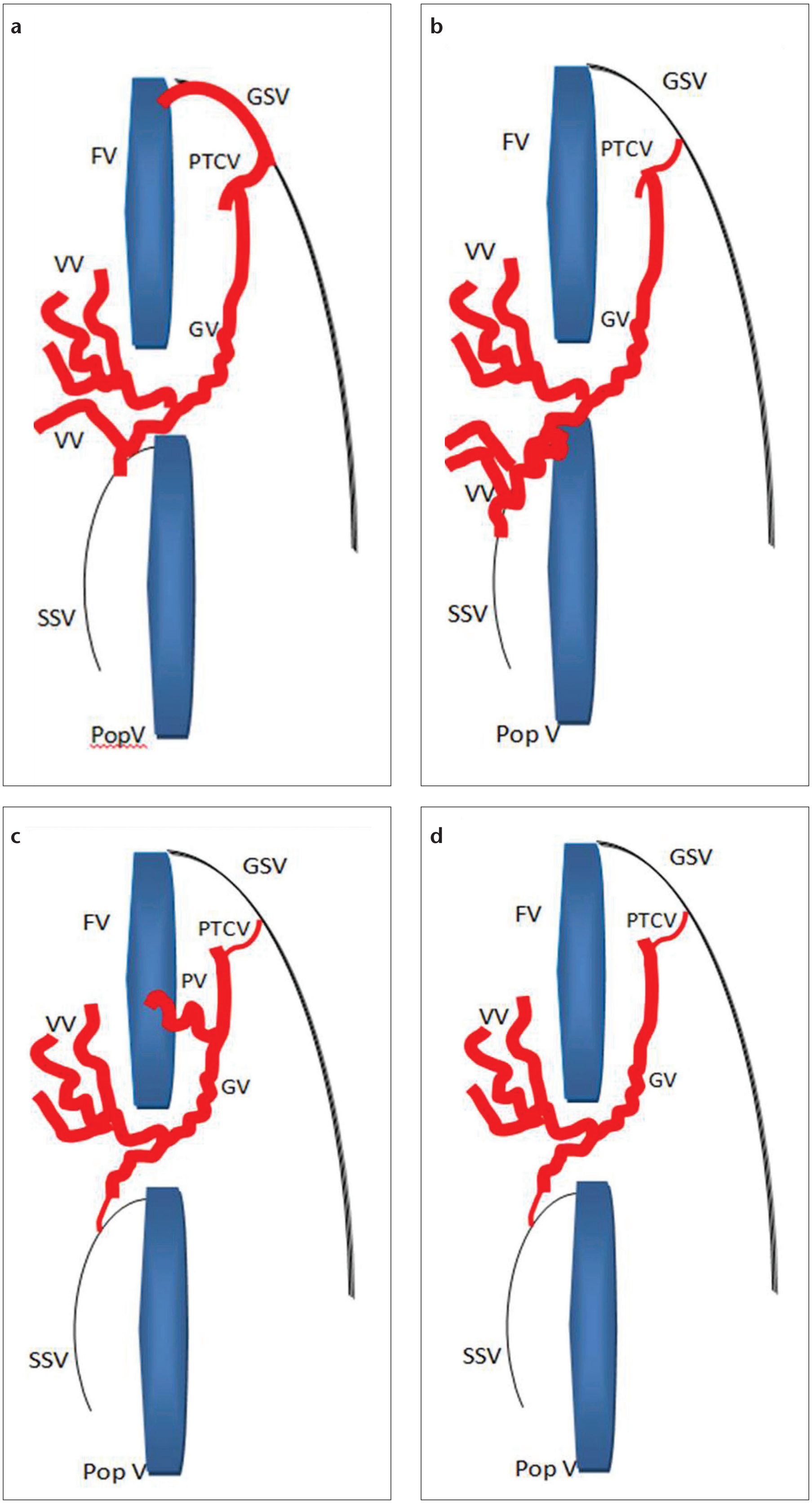

Figure 2. a–d. Reflux patterns of incompetent vein/vein segments and their relation to the GV: **(a)**, descending reflux pattern with incompetent proximal GSV-PTCV-GV; **(b)**, ascending reflux pattern with incompetent GV and SSV; **(c)**, deep-to-superficial reflux pattern with incompetent thigh perforator vein and GV; **(d)**, isolated GVI and related varicose veins with no other reflux sources. GSV, great saphenous vein; FV, femoral vein; PTCV, posterior thigh circumflex vein; VV, varicose veins; GV, Giacomini vein; SSV, small saphenous vein; Pop V, popliteal vein; PV, perforator vein.

apy session for varicose veins was required in only one limb, at one-month follow-up visit. All patients were CEAP class two or greater and symptomatic before the treatment. At six months, the median CEAP classification score decreased from 3 (range, 2–5) before the procedure to 1 (0–4), while median rVCSS decreased from 7 (range, 2–12) before the procedure to 1 (range, 0–7) (Table 2). Clinical outcomes measured by CEAP and rVCSS showed significant improvement compared with the pretreatment scores ($P < 0.001$).

There were no complications other than the expected postprocedural complaints of pain, bruising, and cord-like tightening along the course of the treated vein. Hyperpigmentation was noted in 10 limbs (58%) at one-month follow-up (Fig. 3). Pigmentation either improved significantly or disappeared completely in all limbs at six-month follow-up (Fig. 4). Photographs taken before and after the procedure showed full resolution of varicose veins in 15 patients and improvement in two patients. Symptoms resolved completely or improved greatly, by the six-month follow-up in all patients. There were no significant complications such as skin burns, necrosis, paresthesia, deep vein thrombosis, or allergic reaction.

Discussion

In the present study, GVI-associated varicose disease patients with different reflux patterns (ascending reflux, descending reflux, deep-to-superficial reflux via perforator veins) and patients without an obvious reflux source were treated using the TET approach, aiming to preserve GSVs totally or partially. We preserved seven GSVs totally and three GSVs partially (10/17, 58%) using the TET approach for the treatment of GVI-associated varicose disease.

Truncal reflux is usually associated with GSV and SSV as a cause of varicose veins. Reflux in other incompetent veins leading to varicose disease is less common (17), but it has prompted increasing clinical interest as advanced endovenous techniques have become available. Varicose disease due to a GVI can be observed in clinical practice and is not very rare (3, 4, 18). The prevalence of reflux in the GV ranges from 2% to 19% (16, 18–20). However, primary var-

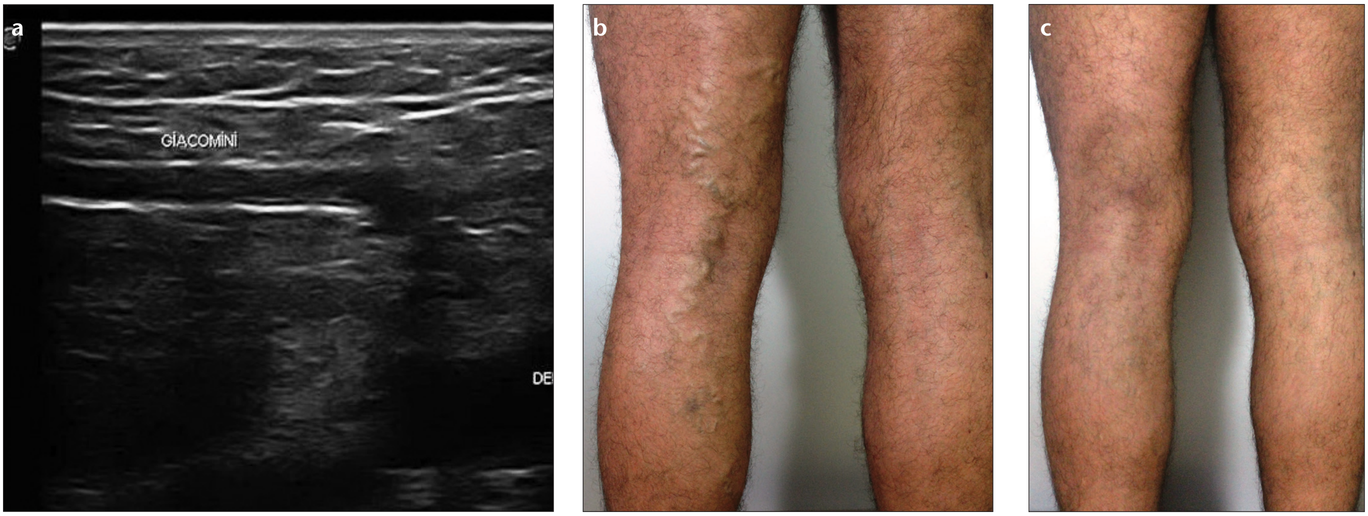

Figure 3. a–c. Endovenous laser ablation of Giacomini vein insufficiency-associated varicose veins. Doppler US image **(a)** shows the relation of perforator vein and GV. A 38-year-old man with varicose veins in the left lower extremity with a deep-to-superficial reflux pattern due to a perforator vein **(b)**. The appearance of the varicose veins was markedly improved at one-month follow-up after targeted endovenous treatment, with mild hyperpigmentation **(c)**.

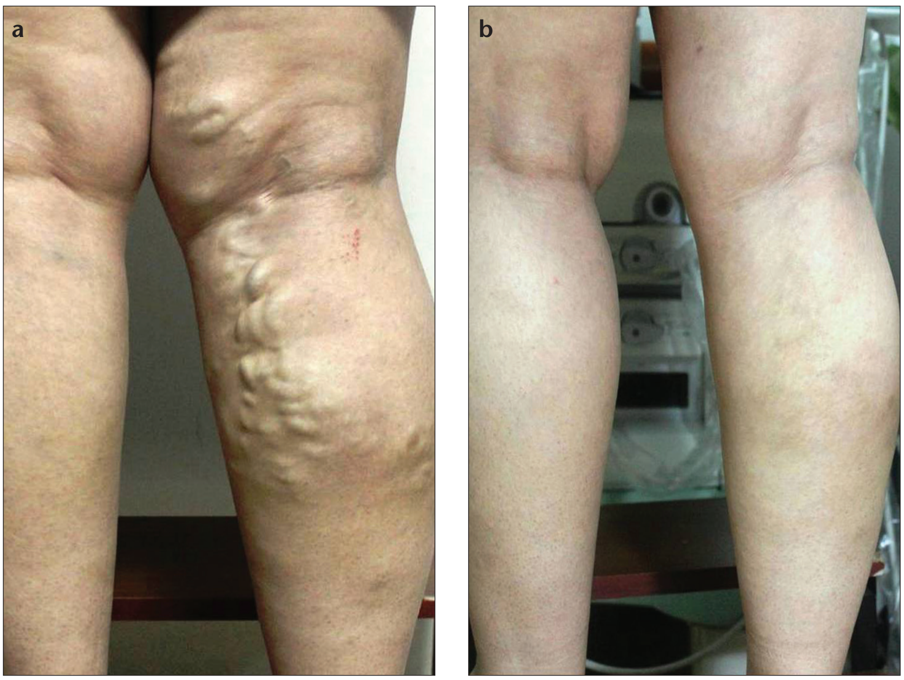

Figure 4. a, b. Endovenous laser ablation of Giacomini vein insufficiency-associated varicose veins. A 41-year-old woman with varicose veins in the right lower extremity with a descending (retrograde) reflux pattern **(a)**. The appearance of varicose veins was markedly improved at six-month follow-up after targeted endovenous treatment of GV and SSV **(b)**. There is no skin pigmentation at the varicose vein trace.

icose veins due to SPJ insufficiency with anterograde diastolic flow are fairly rare, and they accounted for 1% of the patients in a previous study (8). Comparable to previous reports, the present study showed that the GV was affected in 5% of the limbs with varicose veins treated with ELA. Less than 1% of the patients had ascending reflux. GVI without truncal reflux was observed in 1.7%.

Since ELA of the saphenous vein was initially reported in 2001 (21, 22), several studies have been conducted using ELA as a minimally invasive modality for the treatment of different incompetent veins (4, 13, 23–25). Escribano et al. (8) reported a hemodynamic strategy for the surgical treatment of diastolic anterograde reflux of GV. In that study, 16 limbs had retrograde flow from the GSV to the incompetent GV, and two limbs had paradoxical reflux. All patients were treated using surgery, such as phlebectomy and division of the GV and collaterals, but GSV was preserved in all procedures.

There are only a few studies describing ELA treatment for GVI in the literature (3, 7, 13). Theivacumar et al. (4) reported two patients who had GVI with competent proximal GSV and incompetent GSV distal to the draining point of the GV. They treated the distal GSV with ELA and left the GV without treatment. Bush and Hammond (2) reported ELA treatment of 14 patients with GVI with successful outcomes. In their study, the thigh extension branch anatomy was grouped into three categories according to the anatomy of the GV and a subgroup was described in which the GV ended in the femoral vein via a perforator. Park et al. (7) reported the treatment of 18 limbs by ablating both the GV and the proximal GSV.

Ideally, the source of the refluxes in GVI, such as the insufficiency of the GSV, SPJ, or a related thigh perforator vein, should be treated by a specific, minimally invasive method. Saphenous vein-focused surgical therapies may result in overtreatment or undertreatment. TET seems to be an effective alternative to these therapies. Using this approach, we were able to spare the GSV in 58% of the patients, whereas it would normally need to be removed using the standard surgical approach. By preserving the GSV, the natural hemodynamics of the superficial venous network were preserved, and the loss of potential arterial bypass grafts was prevented. In addition, less effective therapies, such as performing a GSV ablation and leaving an untreated perforator reflux source, can be avoided by this approach.

Our study has some limitations and shortcomings. First, the patient follow-up data collection over the 12-month follow-up was not complete. Second, endovenous treatment is not yet accepted as a common treatment technique for the GV. However, we believe that the incidence and outcome of complications in our study were similar or better compared to other ELA studies that reported the incidence of complications.

In conclusion, TET considering all reflux sources, including incompetent GSV segments, SPJ, and the perforator veins, is an effective and safe procedure with good technical success rates for treating GVI-associated varicose disease. Using this technique, saphenous veins can be preserved in the majority of GVI cases. Long-term studies with larger series are required to confirm the advantages of TET for the GVI.

Conflict of interest disclosure

The authors declared no conflicts of interest.

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