

The first 1000 cases of Italian Endovenous-laser Working Group (IEWG). Rationale, and long-term outcomes for the 1999-2003 period

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Aim. The innovations for disease management need to be thoroughly evaluated so that their benefits and potential downsides can be compared with the already existing approaches. Endovascular laser (EVL) treatment for varicose veins offers today several advantages over surgical standard stripping. The Italian Endovenous-laser Working Group (IEWG) is a homogeneous group of surgeons and phlebologists who have been using EVL since 1999 and has undertaken to examine EVL in a multicenter study starting from a well defined rationale, with the benefit of a single protocol to use.

Methods. In a cooperative, multicenter, clinical study, 1076 limbs in 1050 patients, mean age of 54.5 years, 241 males and 809 females affected by chronic venous insufficiency (CVI) were considered eligible for surgery and stratified by CEAP classification in a four-year period (January 1999 – December 2003). Inclusion criteria were insufficiency of the great and/or small saphenous vein at various levels, beyond those accessory saphenous trunks with incompetence in the saphenofemoral junction. In all cases truncular reflux appeared up on duplex scan examination, with or without associated varicosities. All the patients underwent a surgery on the basis of the clinical assessment. All the centres involved performed treatment in conformity with the Food and Drug Administration (FDA) validated procedure, using an endo-laser venous system kit with a

810-980 nm diode. Duplex scan was performed in all patients after 36 months with very few lost to follow-up cases.

Results. In the immediate postoperative period the results have been impressive, with a very effective closure of incompetent great saphenous vein and the other treated varicose veins (the early occlusion rate has been 99%). Major complications have not been detected: in particular, no deep venous thrombosis (DVT) evaluated duplex ultrasound. The patients' acceptability and satisfaction regarding the procedure, have been measured by means of a questionnaire on the quality of life, and the result was 96.7%. After 36 months, the total occlusion rate of saphenous trunks has been 97%.

Conclusion. The first important Italian experience with EVL based on preoperative, perioperative and postoperative duplex control and which is also based on the patients' satisfaction at mid/long-term has indicated some advantages over the standard treatment with the stripping method. In terms of reduced postoperative pain, shorter sick leave, a faster resumption of the normal activities, and, in particular, the total absence of DVT, we can conclude that EVL is a good solution for all patients with anatomic and hemodynamic patterns for saphenous vein surgery.

[Int Angiol 2006;25:209-215]

Key words: Endovascular surgical procedures - Laser - Varicose veins - Veins, surgery.

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Received December 21, 2005; accepted for publication May 25, 2006.

The early Italian experience of endovascular laser (EVL) treatment for varicose veins dates back to the late 1980s.^{1,2} Nevertheless, the first attempts were conditioned by a poor and undedicated technical support, little know-how regarding treatments of truncular reflux without saphenofemoral junction (SFJ) ligation. In contrast, starting from 1999, one member of our group (G. M.) started the clinical practice with diode laser following a standard procedure³ that later on, in 2001 and 2002, received the approval by Food and Drug Administration (FDA) in the USA.

Endovascular treatment for varicose veins offers today several advantages over surgical standard stripping. It is less invasive and it is associated with minimal discomfort and complications, with a quick recovery after treatment. However, the durability of endovascular options, EVL, radiofrequency (RF) or sclerofoam, in the saphenous segment are not the same as the ones shown in the results of the long-term follow-up of stripping. Recurrent recanalization rates have been reported as low as 2-12% after 1-3 years from the endovascular treatment^{4,6} while the rates for recurrent varicose vein that have been reported 35 years after the stripping procedure, can vary widely from 10% to 60%.^{7,8} This wide range made more uncertain the generalized recommendations for the stripping method. It is more likely that differences in the results of varicose vein surgery are related to differences in the patterns of lesions of the chronic venous insufficiency (CVI) that are treated. Few studies have considered the role of extensive dissection of SFJ in association with stripping.^{9,10} It is obvious that the new methods need to be thoroughly evaluated so that their benefits and potential downsides can be compared with the existing approaches.

EVL has been criticized for its applying several different laser types and equipment with multiple devices, but without having a single well-defined protocol. This is in contrast to RF that uses one single type of device and technique.⁶ As matter of fact only a single technique, that uses the endolaser vein system (ELVeS™) with a single type of device manufactured and which is distributed by a single company with a unique procedure FDA-approved.

The Italian Endovenous-laser Working Group (IEWG) which is a group of surgeons and phlebologists who use the ELVeS¹¹ investigated the value of EVL in a multicenter study based on a well defined rationale (www.IEWG.org). Duplex ultrasound scanning was used to determine the hemodynamic patterns, which served as the primary outcome measure together with the patient's satisfaction.

Materials and methods

In a multicenter study 1 050 patients with mean age of 54.5 years (range: 21-80), among which

241 were males and 809 females affected by CVI were considered eligible for surgery and stratified by CEAP classification, in a four-year period (January 1999 – December 2003). Inclusion criteria were the insufficiency of the greater and/or shorter saphenous vein at various levels, beyond the accessory saphenous trunks with SFJ incompetence: in all cases there was a truncular reflux visible upon colour-flow duplex scan examination, with or without associated varicosities. All the patients underwent surgery on the basis of clinical assessments and duplex scan control. The same venous diagnostic protocol was preoperatively used in all centers until 7 days after the surgical procedure according the step-by-step shared procedure (Table I), with standard method previously described.

The study design was a retrospective review of a prospectively maintained database in Milan.

Advanced CVI defined as stage C4 to C6 was present in only 8% of the patients, for a total of 84 patients. The largest class of patients was stratified in C2 to C3 with 861 patients (82%) in C2, and 105 (10%) in C4 respectively. In 36% (378 patients) we observed simultaneous clinical stages of CVI, with association C2-C3 in 270 patients (25.7%), C2-C4 in 25 (2.3%) and C2-C6 in 73 (6.9%). Eleven patients (1.04%) showed venous ulcers without significant varicosities.

To assess the symptoms and the generic quality of life a Italian version of MOS SF-36 has been administered before the clinical and duplex examination. Patients completed alone the questionnaire, often helped by nurses when required.

Exclusion criteria were deep venous thrombosis (DVT), superficial venous thrombosis (SVT) and complete obstruction of deep veins. Deep venous insufficiency was not part of the exclusion criteria.

Treatment was performed in 12 centres in the whole Italian territory, north, centre and south, as shown in Table II. All the patients underwent an EVL treatment, instead of standard ligation and stripping.

All the centres involved performed the treatment in conformity with the FDA validated procedure, using endolaser venous system kit with 810-980 nm diode laser (ELVeS, Biolitec AG, Germany). The kit is composed by the following material:

- 1) "J" Guide-wire 0.035".

TABLE I.—*Step by step of endovascular laser procedure.*

- 1) Patient's company of the informed consent
- 2) Preoperative hemodynamic mapping by colour-flow duplex scan, with orthostatic study for any reflux; of saphenous course and its collateral trunks (in clinostatic position); complete cartography with indelible skin marker. Mapping of transcutaneous point of insertion, of saphenofemoral junction (SFJ) and significant sites of emerging collaterals
- 3) Survey in clinostatic position of the diameters of the great saphenous vein, of the presumed point of percutaneous access and particular expansions of the saphenous axis. Survey of anatomical anomalies and tortuosity of the saphenous axis along its total length. Survey of venous collaterals junctions in the saphenous territory.
- 4) Supply of medication preanaesthesia if necessary or if requested by the patient
- 5) Preparation of the sterile operating field in a dedicated surgical atmosphere, complete disinfection of the limb and preparation of the surgeons
- 6) Watertight covering of colour-flow duplex scan probe without folds and with a layer of gel carried out by the ultrasonographer
- 7) Opening of Endovenous laser Kit with verification of the catheter 5 F patency of and spillage of the laser-probe tip from the same one for 2 cm, after the complete coupling to the ELVeS-Lok TM -device
- 8) Introduction and implantation of the conical dilatator (blue) inside catheter 5F (white), until reaching a spillage of the dilatator terminal part on the catheter of approximately 2 cm
- 9) Extemporaneous measurement of the distance between the point of insertion and the SFJ on the complex dilatator-catheter, along the saphenous course, and mapping of the length with sterile-strip, easily removable
- 10) Local intradermic anesthesia by means of infiltration with 27 G needle at the point of percutaneous insertion (or surgical, for preference or necessity)
- 11) Incision by means of tip of blade N° 11
- 12) Puncture of the great saphenous vein under duplex control, by means of a 19 G needle included in the Endovenous laser Kit. Reflux verification by aspiration with a sterile syringe
- 13) Introduction of the guide terminal "J" by means of the appropriate introducer
- 14) Sliding of "J" guide until the SFJ, aided by the duplex monitoring, and positioning of the terminal J exactly at the SFJ
- 15) Externally, extraction of the "J" guide from its circular support and extraction of the needle for percutaneous site of introduction, along the same one
- 16) Introduction of the complex dilatator-catheter on successive guide gone back "J" and until the saphenofemoral splice. During this operation, duplex scan control of the terminal "J" passing, since it is hidden from the tip of the conical dilatator (blue)
- 17) Complete extraction of the conical dilator (blue) and guide-wire "J". The 5 F catheter's extremity (white man) exactly to 2 cm from the saphenofemoral splice
- 18) Introduction of the laser probe inside the catheter, until the sign of the removable marker on the fibre, that is placed 2 cm from the lock on the same probe
- 19) Retraction and removal of the removable marker of the catheter's extremity from 5 F until the lock, so to expose the 2 cm terminal of the laser probe. In this way, the tip of the fibre will be found to be exactly at 2 cm from the SFJ
- 20) Connection of the probe to the opening of the laser equipment, setting in action the light guides of the laser (red) to 3 intensities and control of the position of the red light on the point of the SFJ mapping
- 21) Infiltration of anesthesia to the saphenic course, from the SFJ (using local anesthetic dilution to 0.5% in physiological to 60 cc, 3 syringes from 20 cc with 27 G needle)
- 22) While pressing the pedal, slowly extract the entirety fibre-catheter from the vein (approximately 3-5 impulses per cm): every impulse is indicated by the sound of an acoustic beacon
- 23) On the display of the laser equipment, verify that 50 to 80 J of energy was distributed, in function of the diameter, for every centimetre of worked vein
- 24) Application of a concentric inelastic hand wrap from the foot until the root of the thigh, to be left in place for 24-48 h. Later on, change with 18 mmHg elastic stockings
- 25) The patient can walk after 20-30 min. Discharge after 2-6 h
- 26) First postoperative, clinical and duplex scan control, up to 7 days from the surgical procedure

2) Needle for percutaneous introduction mode 19 G.

3) Dilatators and catheter complex 5 Fr 55 cm.

4) Laser probe (600 µm).

5) Label of conformity (EC, FDA).

The instrumentation that was employed consisted of a diode laser, with an operative frequency

between 810 and 980 nm in 31% and 69% procedures respectively. It should be emphasized that only 4 centres made use of the 810 nm diode laser, and only in the early phase of their experience, until October 2002. However, 1 centre used exclusively the aforesaid equipment. On average, the laser-power used was at 12.5 W. For the sake of

TABLE II.—Teams performing endovascular laser treatment.

City	Institution
Milan	Institute of Vascular Surgery and Angiology, University of Milan
Siena	Surgical Department, Phlebo-Lymphological Centre, University of Siena
L'Aquila	Chair of Vascular Surgery, University of L'Aquila
Arezzo	Angiological Unit, S. Giuseppe Clinic
Padova	Surgical Department, University of Padua
Verona	Vascular Surgery School, University of Verona
Padua	Multidisciplinary Day Surgery Centre, Busonera Hospital, University of Padua
Nuoro	General Surgery, S. Francesco Hospital
Catania	Vascular Surgery, Ferrarotto Hospital
Macerata	General Surgery, Civil Hospital
Naples	Vascular Surgery, S. Giovanni Bosco Hospital
Caserta	Vascular Surgery, S. Sebastiano Hospital

uniformity a step-by-step protocol has been adopted and was followed by every centre as shown in Table I.

All the patients underwent a preoperative colour-flow duplex and have been grouped in 4 surgically oriented and, hemodynamic patterns, as shown in Figure 1. All 4 models were considered suitable for EVL treatment.

Results

The hemodynamic patterns determined by duplex scanning have been subdivided in the following groups:

1) Patterns 1 and 2 (incompetence of great saphenous vein, GSV): 1 052 (97.7%).

2) Pattern 3 (incompetence of small saphenous vein, SSV): 16 (1.6%).

3) Pattern 4 (incompetence of an accessory saphenous trunk): 8 (0.7%).

In addition, duplex scanning demonstrated that the lumen diameter of the GSV bore was less than 10 mm in 719 (66.8%) and greater than 10 mm in the remaining 357 patients (33.2%) with an average diameter of 10 mm. The distance of the vein from the skin was less than 5 mm in 463 (50%) and more than 5 mm in the remaining 50% of the patients.

During the study, a total of 1 076 procedures were performed with an average follow-up time of 36 months. In 526 cases the procedure involved

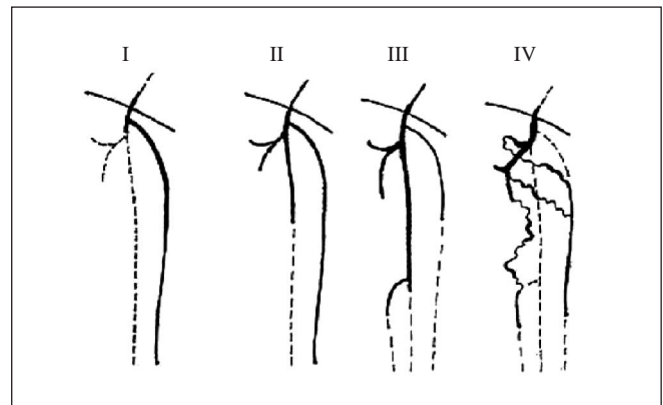


Figure 1.—Refluxes: haemodynamic patterns in surgery (according to Camilli ¹²).

the right lower limb (48.8%), 543 the left one (50.4%), while the remaining 5 were bilateral (0.8%). Mean surgical time of the entire procedure, including those during the learning curve (5 procedures) was 35 min. In all cases, colour-flow duplex was used during the operation and we can firmly assert that the use of this instrument is essential for the correct execution of the procedure.

Percutaneous access was possible in 422 cases (39.2%), while a surgical exposure of the saphenous trunk became necessary in 654 (60.8%) patients. In the majority of these (74.5%) it was adopted a local anesthesia, while epidural anaesthesia, or sometimes other as propofol in the rest (25.5%).

In 875 cases, complementary surgery was performed such as ablation of varicose tributaries (794 cases) or ligation of incompetent perforators (81 cases). An elastic bandage was applied for the first 24-48 h, while in 463 (43%) patients LMWH prophylaxis against venous thromboembolism was administered for 3-7 days in accordance with each team's customs because of risk factors such as age, obesity and previous thrombosis. Subsequently, elastic stockings (18 mmHg) had to be worn in the day-time for a period of 4 weeks.

All the patients were fully ambulant within an average time of 2 h: in fact, the greater part of the procedures has been carried out as Day Surgery (Table III).

The small number of necessary patient hospitalization was principally due to the distance between the treatment site and patient's home.

In the immediate postoperative period the

TABLE III.—Ankle:arm index: post-therapy variations measured by color wave Doppler.

Modality	N.	%
Day surgery (0 nights)	991	92.2
One day surgery (1 night)	76	7
Ordinary shelter (2 nights and over)	9	0.8

results were impressive, with effective closure of incompetent GSV and other treated varicose veins (the early occlusion rate has been of 99%). Major complications have not been detected: in particular, no DVT was detected by the duplex ultrasound, specially if considering the elevated average age of the patients. However, 11 SVT have been observed (1%), more properly to be defined “periphlebitic events”, due to laser-induced heat transmission from the inner vein to the perivenium. Minor complications characterized by rapid clinical resolution are shown in Figure 2.

The patients’ acceptability and satisfaction measured with appropriate forms regarding the quality of life, was 96.7%. Ten patients expressed an insufficient satisfaction probably due to pain suffered during operation (Figure 3).

Currently, we possess over 6 year results in terms of long-term follow-up, but in this study we have decided to consider a 36 months period for all the centres using duplex scanning.

Controls have been carried out by duplex scan, in a total average according to the number of treatments carried out in every centre. The total occlusion rate has been of 97% and only 6% patients required complementary sclerotherapy or phlebectomy of remaining distal varicosities.

Discussion

The IEWG has decided to work for an investigation and widespread use of a new treatment for CVI by introducing a Registry. This is the most suitable tool for collecting data as far as such a technologically innovative procedure is concerned. Although Registries produce a lower level of clinical evidence than the randomised clinical trials, they became the most advantageous way to illustrate the reality of the clinical practice. They generate immediate feedback and professional discussion, improve the self-assessment and develop a better decision-making, without long delays

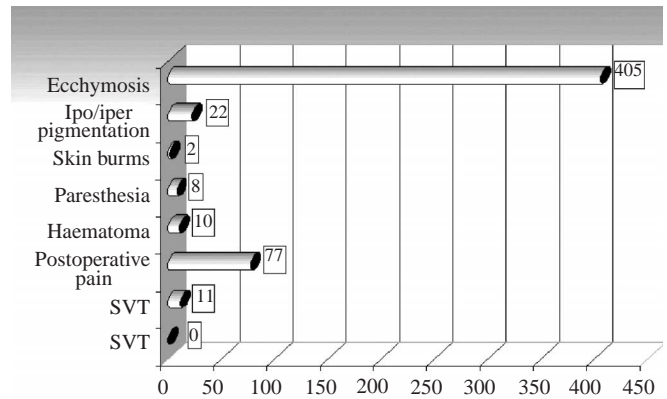


Figure 2.—Collateral events and complications.

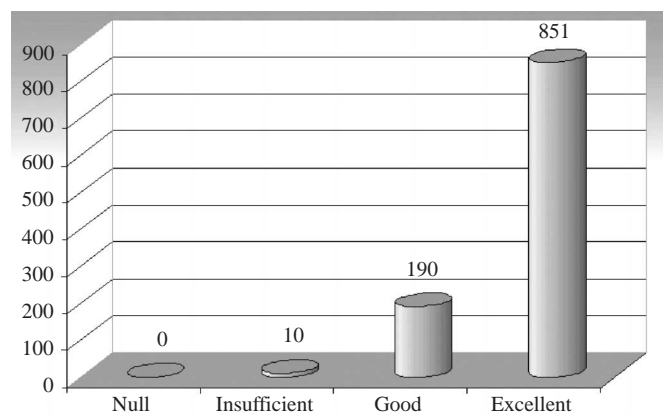


Figure 3.—Patient’s compliance and satisfaction for signs and symptoms.

or waits for final results. They furthermore enable a larger quantity of data to be collected. Unlike studies on of new drugs and their introduction, which are, furthermore, covered by adequate European legislation, randomised controlled studies are not particularly suitable tools to analyze new surgical practices and biomedical technology. The reasons for this include the learning curve, the rapid evolution of technology even while a study is in progress, the difficult ethics involved in proposing alternative surgical procedures etc. Registries, on the other hand, have proved their worth as valid tools in the field of vascular medicine, starting as far back as 1979, with the first experience of the Cleveland Vascular Society for collecting computerised data on a large scale. Other useful references supporting the decision to introduce the Registry can be found in the EVAR Registry and in the TASC Registry.^{13, 14}

Perrin and Bergan claim the absence of phenomena of neovascularisation, and in particular

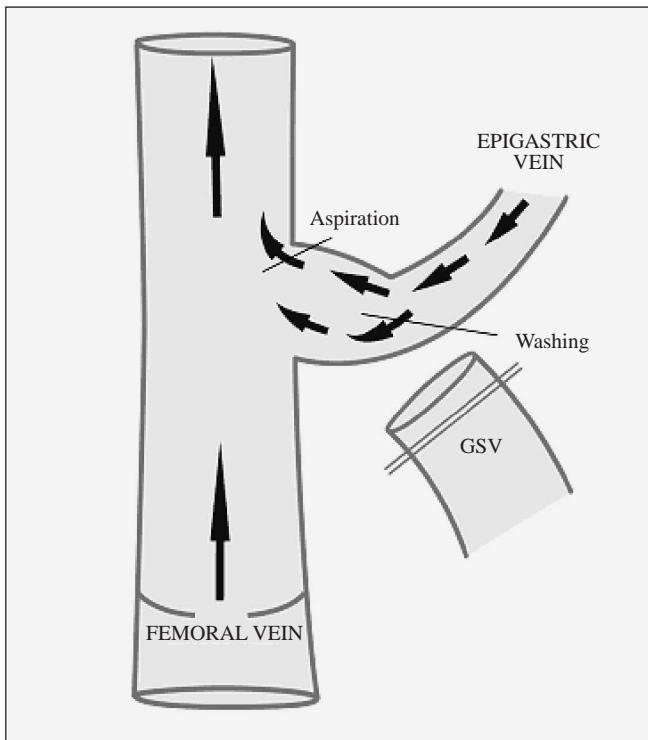


Figure 4.—The scheme of the great saphenous vein (GSV) occluded with the flux preserved in the saphenofemoral junction.

at the SFJ following the endoluminal surgery. It is known that this phenomenon, which occurs rather frequently (20-40% at 5 years) after standard surgery plays an important role in the incidence of recurrence. Maintaining the patency of the saphenous termination tributaries can probably play a favourable role, since these tributaries drain physiologically (Figure 4), as shown by the duplex ultrasound investigation performed after the GSV endovenous obliteration.^{6, 9, 10}

The mid/long-term results after 3 years were particularly favourable after EVL both in term of vein obliteration and in terms of symptomatological absence and few minor residual varicosities.

Under the economical point of view, the varicose vein surgery involves a cost estimation of the EVL which is definitively cheap for the catheter and favourable in the global cost, as well as for the generator (with respect of the Italian DRG reimbursement).

Finally, possible conflicts of interests are presently a highly topical problem at the international level, aggravated by the development of an increasingly technology-dependent medicine. This, there-

fore, is unquestionably connected to relations between medical personnel and industry.¹⁵ In this context, and mainly for reasons of accountability, the members of the IEWG Board feel that it is extremely important to pursue a working programme in which we are not only investigators but also developers of the technologies and procedure in question. This occurred with our development of a step-by-step protocol for a new treatment possibility of saphenous insufficiency which is less invasive than stripping. Greater and/or shorter saphenous vein stripping has proven to be a standard method for treatment of CVI but it is also associated with a significant incidence of recurrence in the groin and of complications and it can result in delayed resumption of normal activity.

Conclusions

Several reports have confirmed the efficacy and safety of EVL. The IEWG presented a large number of scientific contributions in the 15th World Congress of Union International de Phlébologie.¹⁶

The first large Italian experience with EVL based on preoperative, perioperative and postoperative duplex control and patients satisfaction at mid/long-term indicated some advantages over standard treatment with stripping method. In terms of reduced postoperative pain, shorter sick leave, faster resumption of the normal activities, and, in particular, the total absence of DVT, we conclude that EVL is a good solution for the patients with standard saphenous vein stripping indication to treat.

Nevertheless, the IEWG would like to recall that innovative Laser treatment of CVI should not let us forget the mainstay of CVI therapy, which for the majority of the patients is not surgery. In these cases, pharmacological and compression therapy must be considered. Similarly, when the indications are appropriate, the IEWG suggests that other options such as ablative surgery and hemodynamic treatment or sclerotherapy should be preferred (www.IEWG.org).¹⁷ Patients should be closely followed after the procedure so to ensure a long-term benefit and care.^{17, 18}

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