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Endovenous Laser: A New Minimally Invasive Method of Treatment for Varicose Veins - Preliminary Observations Using an 810 nm Diode Laser

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BACKGROUND: Long-term success in the treatment of truncal and significant branch leg varicosities, when the saphenotransverse junction (STJ) and the greater saphenous vein (GSV) are involved, depends on the elimination of the highest point of reflux and the incompetent venous segment, and is best achieved by surgical ligation and stripping. Minimally invasive alternatives in the treatment of varicose veins with STJ and GSV incompetence have been tried over the years to increase patient comfort, reduce cost and risk, and allow implementation by a wide variety of practitioners resulting in varying degrees of success depending on the skillfulness of the above two processes and the effectiveness of the method used.

OBJECTIVE: To demonstrate a novel way to use laser energy through an endovenous laser fiber for the minimally invasive treatment of truncal varicosities that eliminate the highest point of reflux and the incompetent segment.

METHODS: Patients were treated with 810 nm diode laser energy administered endovenously through a laser-tipped laser fiber (400–700 µm). Vein access for endovenous placement of

the fiber through a catheter was achieved by means of percutaneous or subcutaneous incision under ultrasonographic guidance and local anesthesia. Exact placement of the fiber was determined by direct observation of the aiming beam through the skin and by ultrasonographic confirmation.

RESULTS: Preliminary short-term postprocedure results up to 1 year, 2 months after treatment, in the endovenous laser treatment of 40 greater saphenous veins in 37 patients indicate a 100% rate of closure with no significant complications. In addition, a 2-year experience of 30 cases of isolated branch varicosities (iliolumbar, anteroiliacal/iliacal, etc.) also shows a 100% rate of closure.

CONCLUSION: Early results of our endovenous laser methodology indicate a very effective and safe way to eliminate STJ incompetence and close the GSV. With proper patient selection, the use of methodology and the reduced cost and cost associated with endovenous laser treatment may make it a successful minimally invasive alternative for a wide group of patients that previously would have required ligation and stripping.

SUCCESSFUL LONG-TERM results in the treatment of primary leg varicose veins of truncal origin depend on two basic treatment processes: the elimination of the highest point of reflux, and the elimination of the incompetent venous segment.^{1–7} Surgical ligation and stripping has proved to be the most successful treatment method for truncal varicosities when the saphenotransverse junction (STJ) and the greater saphenous vein (GSV) are incompetent.^{8–10} Treatment of choice for varicose veins of truncal origin, such as perforator, pubofemoral, etc., are sclerotherapy and subcutaneous phlebectomy.

The drawbacks of traditional surgery include increased risk associated with anesthesia, increased cost of hospitalization, and possible complications from surgery (including postthrombotic). These

have been addressed by today's ligation and stripping performed on an ambulatory basis with goals to lower postoperative swelling and discomfort, hence subcutaneous phlebectomy under a minor form of anesthesia.^{11–13} There is, safe and complete eradication of the STJ requires a qualified surgeon, an equipped operating theater in a hospital, ambulatory surgical unit, or office, and some form of anesthesia beyond merely local.

Given the above requirements and the typical patient reaction to surgery, minimally invasive alternatives, such as sclerotherapy, mini-phlebectomy, ultrasound- and radiofrequency-guided sclerotherapy, and minimally and bipolar radio frequency, are being utilized in the treatment of truncal varicosities in an effort to improve patient comfort, reduce cost and risk, and allow implementation by a variety of practitioners in different specialties. However, these procedures have had varied results, depending on the skillfulness of the above two treatment processes, and the effectiveness of the method used to do this.

Simple traditional sclerotherapy and mini-phlebectomy are best used for reagent branch varicosities, and

Endovenous treatment of the greater saphenous vein with a 940-nm diode laser: Thrombotic occlusion after endoluminal thermal damage by laser-generated steam bubbles

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Purpose: Despite a rapid spread of the technique, very little is known about the laser-tissue interaction in endovenous laser treatment (EVLT). We evaluated EVLT of the incompetent greater saphenous vein (GSV) for efficacy, evasione-related adverse effects, and possible mechanisms of action.

Methods: Twenty-six patients with 31 limbs of clinical stage C₂, C₃, E₂, A₂, P₂ with incompetent GSV proven by means of duplex scanning were selected for EVLT in an outpatient setting. A 600-µm fiber was inserted into the GSV via an 18-gauge needle below the knee and precluded by the saphenotransverse junction (STJ). After infiltration of ultrasound local anesthesia, multiple laser pulses of 15 J energy and a wavelength of 940 nm were administered along the vein in a standardized fashion. D-dimers were determined in peripheral blood samples 30 minutes after completion of EVLT in 16 patients and on postoperative day 1 in 20 patients. One GSV that was surgically removed after EVLT was examined by means of histopathology. Additionally, an experimental in vivo set-up was constructed as a means of investigating the mechanism of laser action within a blood-filled tube.

Results: A median of 80 laser pulses (range, 22–116 laser pulses) were applied along the treated vein. On days 1, 7, and 28, all limbs except one (97%) showed a thrombotically occluded GSV. In one patient, the vessel showed incomplete occlusion. The distance of the proximal end of the thrombus to the STJ was a median 1.1 cm (range, 0.2–5.9 cm) in the remaining patients. Adverse effects in all 26 patients were erythema and palpable induration along the thrombotically occluded GSV that lasted for 2 to 3 weeks. In two limbs (8%), thrombophlebitis of a varicose tributary required oral treatment with diclofenac. D-dimers in peripheral blood were tested with normal results in 14 of 16 patients 30 minutes after completion of the procedure and elevated results in 7 of 20 patients on day 1 after EVLT. However, an increase of D-dimers from day 0 to day 1 was observed in 15 of the 16 patients undergoing vein 30 minutes after EVLT and on day 1. The 940-nm laser was demonstrated by means of in vitro experiments and the histopathological examination of one explanted GSV to act by means of indirect heat damage of the inner vein wall.

Conclusion: EVLT of the GSV with a 940-nm diode laser is effective in inducing thrombotic vessel occlusion and is associated with only minor adverse effects. Laser-induced indirect heat injury of the inner vein wall by means of bubbles originating from boiling blood is proposed as the pathophysiological mechanism of action of EVLT. (J Vasc Med Biol 2002; 15:729–36.)

Endovenous Laser Surgery of the Incompetent Greater Saphenous Vein With a 980-nm Diode Laser

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BACKGROUND: In recent years, the minimal endoluminal invasive alternatives against surgical ligation and stripping for the treatment of incompetent greater saphenous vein (GSV) have been explored. Endovenous laser surgery is one of these endoluminal alternatives, and its clinical results are being reported at up to 3 years.

OBJECTIVE: To evaluate the safety and efficacy of a 980-nm diode laser for the elimination of the incompetent GSV.

METHOD: Fifteen limbs in 12 patients with incompetent GSV were treated via an endovenous route with a 980-nm laser under local anesthesia in an outpatient setting. The effects were

evaluated clinically along with duplex ultrasound at 1, 4, and 12 weeks after the treatment to determine efficacy and possible complications.

RESULTS: Complete occlusion and retraction of treated GSV in all patients were observed during the 12 weeks of the postoperative period. There have been no significant complications to be concerned.

CONCLUSION: The endovenous 980-nm diode laser surgery is a relatively simple, safe, office-based procedure that is expected to promise favorable results while a long-term follow-up is awaited.

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