Saphenous Vein Ablation

Do different laser wavelengths translate into different patient experiences?

BY EDWARD G. MACKAY, MD; JOSE I. ALMEIDA, MD; AND JEFFREY K. RAINES, PHD

Surgical ligation and stripping has long been the gold standard in the treatment of great saphenous vein (GSV) insufficiency, which leads to varicose veins. During the past several years, endovenous catheters that deliver destructive heat to the vein wall have challenged the surgical alternative. Radiofrequency ablation or endovenous laser ablation (EVL) has become the preferential treatment option for thermal ablation of the refluxing GSV. Lasers designed for the destruction of the vein wall can be classified into hemoglobin-specific laser wavelengths (HSLWs) and water-specific laser wavelengths (WSLWs).

The three HSLWs currently available, in order of increasing hemoglobin affinity, are 810 nm, 940 nm, and 980 nm. One 1,320-nm WSLW is currently available. Multiple clinical studies have documented excellent vein ablation results with all HSLWs. Postoperative discomfort and bruising are often seen with HSLWs, which act by causing boiling blood to injure, and possibly perforate, the vein wall. The 1,320-nm WSLW was developed to directly target the interstitial water in the vein wall, minimizing perforation.[1]

The purpose of the pilot study described in this article is centered on determining whether patients noted differences between the 810-nm (HSLW) and the 1,320-nm laser (WSLW) when undergoing bilateral GSV ablation. The study was limited to patients who underwent the bilateral ablation in an attempt to minimize individual differences in pain tolerance.

METHODS AND MATERIALS

Patients presenting with bilateral varicose veins between June 2005 and January 2006 were evaluated by routine examination and venous ultrasound. The inclusion criteria were limited to bilateral GSV insufficiency and written consent for EVL. It was carefully explained to all subjects that one limb would be treated with the 810-nm laser, and the opposite limb would be treated with the 1,320-nm laser, but they were not told which laser would be treating each leg. A total of 27 patients were identified and comprised the patient population for this study. All assignments were performed on a random basis; however, the order of which wavelength used first was not implemented uniformly for all patients. The protocol defined that the procedures would not be performed on the same day.

The same surgeon performed the treatments and used local anesthesia (0.1% xylocaine with epinephrine). Laser treatment parameters were constant for all procedures. The energy level was 8 W. We employed a 1-mm/s pullback for a linear endovenous energy density (LEED) of 80 J/cm. After the procedure, patients were evaluated postoperatively during a window of 3 to 4 days, and again approximately 6 weeks after the procedure. At the first postoperative visit, patients were asked to grade the pain they were experiencing from 0 to 5, with 5 being the most severe. The surgeon also graded the degree of bruising using the 0 to 5 scale. At the 6-week visit, patients were asked if they noticed any appreciable difference in limb recovery during the entire postoperative period. Ultrasound was performed at each visit to confirm occlusion of the GSV.

RESULTS

Postoperative Pain (First Visit)

At 3 to 4 days after the procedure, patients treated with the 810-nm laser reported an average pain level of 2.3. Patients treated with the 1,320-nm laser reported an average pain level of 0.9.

Bruising (First Visit)

The physician grade for the 810-nm–treated limb was 1.7. The physician grade for the 1,320-nm–treated limb was 0.9.

Difference Between Limbs

When asked approximately 6 weeks after the procedure which limb experienced the least discomfort, 11 patients (41%) selected the 1,320-nm–treated limb, two patients (7%) selected the 810-nm–treated limb, and 14 (52%) reported no difference.

TABLE 1. ENTIRE DATA SET FROM LASER WAVELENGTH STUDY

	810-nm Limb			1,320-nm Limb			
Patient	Diameter (mm)	Pain	Bruise	Diameter (mm)	Pain	Bruise	Pref†
1	8	1	0	13	0	0	ND
2	5	5	3	7	1	4	1,320
3	6	2	1	3	0	0	1,320
4	6	3	2	6	0	0	1,320
5	8	5	0	5	1	0	1,320
6	6	1	0	13	1	0	ND
7	5	3	3	5	1	0	ND
8	8	2	2	7	1	0	1,320
9	6	2	3	6	5	1	ND
10	11	5	3	9	0	2	1,320
11	10	3	3	11	0	0	ND
12	16	1	2	7	0	3	1,320
13	11	2	2	14	1	0	ND
14	9	0	5	10	0	5	ND
15	6	1	0	11	3	0	810
16	6	4	2	6	3	1	ND
17	8	4	3	7	0	1	1,320
18	7	3	3	9	0	1	ND
19	9	3	2	8	1	0	1,320
20	14	0	3	10	1	1	810
21	9	1	0	4	0	2	ND
22	10	2	3	11	2	1	ND
23	7	2	1	6	1	1	1,320
24	6	3	0	6	2	0	1,320
25	3	0	0	4	0	0	ND
26	8	3	1	10	1	1	ND
27	7	0	0	5	0	0	ND
Mean	8.0	2.3	1.7	7.9	0.9	0.9	

*ND (no significant difference noted by patient).

† Laser preferred by the patient.

Average GSV Diameter

The average diameters of the GSV in the two groups were very similar. The GSV average diameter in the 810-nm–treated group was 8 mm. The GSV average diameter in the 1,320-nm–treated group was 7.9 mm. The raw data for this study are listed in Table 1.

DISCUSSION

Endovenous thermal ablation of the GSV was designed to hasten patient recovery. Now that all investigators who use EVL consistently report excellent closure rates, pain reduction and bruising after EVL has been the focus. The data in the literature suggest that delivery of higher energy is needed to effect secure vein closure; however, with increased energy delivery, pain and bruising after treatment is increased. Furthermore, trends in the literature, and in this pilot study, suggest that longer-wavelength lasers produce fewer side effects at comparable linear energy delivery.

For laser wavelengths of 810 nm and 940 nm, recent data indicated a relationship between increased delivered LEED and improved closure rates.[2-4] Furthermore, the literature suggests that between 60 J/cm and 100 J/cm of LEED is required for effective ablation. In contrast, it has been reported that treatment with less energy causes less pain and bruising. Proebstle described that the use of 5 W demonstrated a lower rate of side effects than 8 W for a 1,320-nm endovenous occlusion.[5]

Kabnick[6] compared two HSLWs in a randomized and single-blinded fashion to determine if there were differences between the 810-nm laser and the 980-nm laser. Overall, the results of the study showed that both the 810-nm and 980-nm wavelengths were effective in closing the GSV. Few untoward events resulted with either device; no deep vein thrombosis, pulmonary embolism, skin burns, or paresthesia were reported. Ecchymosis and superficial phlebitis was more often present when the 810-nm laser was used.

Proestle et al,[5] in a restrictive review of endovenous ablative procedures performed at comparable LEED with either the 940-nm laser or the 1,320-nm laser, demonstrated statistically significant less pain in patients treated with the 1,320-nm laser when compared to the 940-nm laser (50% with 1,320 nm/8 W vs 81% with 940 nm/30 W or 940 nm/15 W). Also, significantly reduced ecchymosis was noticed with the 1,320-nm laser (61% with 1,320 nm/8 W vs 81% with 940 nm/30 W and 78% with 940 nm/15 W). The study also noted increased pain and ecchymosis with the higher energy associated with the 940-nm laser (30 W vs 15 W). However, higher energy level correlated with improved occlusion rates.

The difficulty with studies that evaluate pain is the significant variation in pain tolerance between patients. What may seem like soreness to one patient might be considered severe pain to another. Even objective measures such as carefully recording usage of pain medication can vary, because patients have different pain tolerances. Determining the amount of ecchymosis is highly subjective and produces large interobserver and intraobserver differences. Therefore, the reliability of these and other studies to measure pain and ecchymosis between treatments is limited. This pilot study tried to minimize the difference in reported pain by limiting the study to patients with bilateral disease. The most accurate information was gained by asking patients which treatment was best tolerated. Even this simple technique has variables that are difficult to control, such as depth of the vein below the skin, treatment length, and any concomitant procedures or procedures performed during follow-up. Factors such as dressing compression or stockings could additionally skew a patient's viewpoint.

Finally, this pilot study did not follow patients long enough to determine occlusion rates. Most patients would exchange a minimal increase in pain and ecchymosis for a secure closure (ie, minimal risk of recanalization).

CONCLUSIONS

Published studies have documented excellent ablation out to 5 years with HSLW. Long-term occlusion with WSLW is unknown at this time. Among the three most studied HSLWs (810 nm, 940 nm, and 980 nm), higher wavelength has trended toward reduced side effects. The 1,320-nm WSLW laser shows a trend toward fewer side effects than HSLW. Lower linear endovenous energy density results in higher vein recanalization and lower perioperative side effects. Optimum device configuration will be defined with the availability of additional clinical data. ■

Edward G. Mackay, MD, is Medical Director of Mackay Vein Institute, St. Petersburg, Florida. He has disclosed that he is a paid consultant for New Star Lasers, Inc., Vascular Solutions, Inc., and VeinRX, Inc. Dr. Mackay may be reached at drmackay@drmackay.com; (727) 527-2888.

Jose I. Almeida, MD, is Medical Director at Miami Vein Center and Assistant Professor of Surgery at the University of Miami School of Medicine, Miami, Florida. He has disclosed that he holds no financial relationship with any product or manufacturer mentioned herein. Dr. Almeida may be reached at jia@miamiveincenter.com; (305) 854-1555.

Jeffrey K. Raines, PhD, is Director of the Vascular Laboratory at the Miami Vein Center and Professor Emeritus of Surgery at the University of Miami School of Medicine, Miami, Florida. He has disclosed that he holds no financial relationship with any product or manufacturer mentioned herein. Dr. Raines may be reached at drjraines@yahoo.com; (305) 854-1555.

1. Goldman MP, Mauricio M, Rao J. Intravascular 1320-nm laser closure of the great saphenous vein: a 6- to 12-month follow-up study. Dermatol Surg. 2004;30:1380-1385.
2. Proebstle TM, Gül D, Kargl A, et al. Non-occlusion and early reopening of the great saphenous vein after endovenous laser treatment is fluence dependent. Dermatol Surg. 2004;30:174-178.
3. Timperman PE, Sichlau M, Ryu RK. Greater energy delivery improves treatment success of endovenous laser treatment of incompetent saphenous veins. J Vasc Interv Radiol. 2004;15:1061-1063.
4. Timperman PE. Prospective evaluation of higher energy great saphenous vein endovenous laser treatment. J Vasc Interv Radiol. 2005;16:791-794.
5. Proebstle T, Moehler T, Gul D, et al. Endovenous treatment of the great saphenous vein using a 1,320 nm Nd:YAG laser causes fewer side effects than using a 940 nm diode laser. Dermatol Surg. 2005;31:1678-1683.
6. Kabnick L. Outcome of different endovenous laser wavelengths for great saphenous vein ablation. J Vasc Surg. 2006;43:88-93.