A retrospective study comparing endovenous laser ablation and microwave ablation for great saphenous varicose veins

JIEQI MAO, CI ZHANG, ZHANSHAN WANG, SHUJIE GAN, KE LI

Department of General Surgery, First People's Hospital affiliated to Shanghai Jiaotong University, Shanghai (China)

Abstract. – BACKGROUND, Endo-venous laser or microwave ablation is a minimally invasive surgery for treating varicose veins of lower limbs.

AIM, The aim of our study was to determine whether endovenous microwave ablation of the greater saphenous vein was associated with better effectiveness and less complications than the endovenous laser ablation.

MATERIALS AND METHODS, From July 2008 to June 2011, 259 cases (306 limbs) of varicose veins were assigned to endovenous laser ablation (n=138, 163 limbs) or endovenous microwave ablation (n=121, 143 limbs).

RESULTS, Through analysis there was no significant difference of the operating time, length of hospital stay and Aberdeen score in the two groups. The recanalization rate was statistically higher in the laser group than that in the microwave group. The ecchymosis complication was significantly lower in microwave ablation than that of laser ablation group. However, the skin burn and paralysis complications were significantly lower in the laser ablation than that of microwave ablation group.

CONCLUSIONS, Endo-venous microwave ablation is an effective alternative to laser ablation for treatment of varicose veins, associated with higher occlusion rate and without serious complications.

Key Words: Saphenous vein, Varicose vein, Laser ablation, Microwave ablation.
Preoperatively, patients were asked to complete the Aberdeen Varicose Vein Questionnaire (AVVQ), which has been shown to be a valid measure of quality of life for patients with varicose veins14. There was no significant difference at baseline between the two groups (Table I).

All cases were diagnosed as varicose vein by the clinical pathway containing detail inquiry of history, Trendelenburg’s test, Pether’s test, Doppler’s inspection and high speed spiral CT venography. The clinical severity of the varicose disease was graded according to the clinical, etiological, anatomical and pathophysiological (CEAP) scoring system15. CEAP classes C0-C6 varicose veins were included in this study (Table II). Patients who had a history of deep vein thrombosis, peripheral artery diseases, serious systemic diseases, or pregnancy were excluded. In addition, the patients who refused to participate in this study were also excluded.

**Endovenous Procedures**

The microwave probe was inserted into the GSV through a small incision of 5 mm in diameter, just in front of the malleolus. The procedure was performed under duplex ultrasonography guidance, using a continuous epidural anesthesia. With the help of duplex scanning and the flush at the tip of the microwave probe, the catheter tip was localized 2 cm below the SFJ. The microwave energy was adjusted to 50 W, which was proved to be effective and safe by previous experiments in vitro and in vivo13. The catheter was withdrawn at the average speed of 3 cm/min until the whole target vessel had been treated. The tumescence anesthesia was not routinely performed unless in case of the distance between the vein and skin less than 7 mm by duplex scanning. Immediate duplex scanning was repeated to reveal whether the GSV had been ablated successfully. The skin incision was closed by a medical adhesive. The ipsilateral limb was wrapped with elastic bandage for continuous compression. Three days later, a compression stocking (30 mmHg) was applied to replace of bandage for one month. The patients were asked to mobilize as soon as they had resumed from the state of anesthesia. A prophylactic dosage of low-molecular weight heparin was given to all patients for three days to avoid the deep vein thrombosis (DVT). In addition, the extract from horse chestnut at a dosage of 600 mg per day was prescribed for all patients for one month postoperatively.

All EVLA procedures were also performed under continuous epidural anesthesia. The GSV was cannulated percutaneously using the Seldinger technique in front of the malleolus. First, a guide wire was introduced into the vein through the needle. Then a 5-Fr catheter was guided into the lumen through the wire, and its tip accurately positioned 2 cm below the SFJ under ultrasound guidance. A sterile laser fiber was introduced via the catheter until the flush could be seen through the skin. Endovenous laser energy was delivered using a 980 nm diode laser generator which was set at a continuous power delivery of 20W for GSV ablation above the knee and 15W below the knee. The fibre was withdrawn at the constant speed of 10 mm per second until the entire GSV had been treated. A mini-incision should be made to introduce the catheter until the flush could be seen through the skin. Endovenous laser energy was delivered using a 980 nm diode laser generator which was set at a continuous power delivery of 20W for GSV ablation above the knee and 15W below the knee. The fibre was withdrawn at the constant speed of 10 mm per second until the entire GSV had been treated. A mini-incision should be made to introduce the catheter in case of failure of percutaneous puncture. The same postoperative compression was performed, and the anticoagulation process as well as horse chestnut extract taking was also adopted.

All patients were asked to visit the Department 1 week and 6 months after the operation. The Doppler Ultrasound examination was repeated to identify whether the treated veins were recanalized.

**Statistical Analysis**

Statistical analysis was performed using the SPSS15.0 software (SPSS Inc., Chicago, IL, USA). $p < 0.05$ was considered statistically significant. Continuous data were first tested for normality. Normally distributed data were presented as mean (s.d.) and significance testing was per-

---

**Table I.** Baseline characteristics of the treatment groups.

<table>
<thead>
<tr>
<th></th>
<th>EVMWA group</th>
<th>EVLA Group</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>56.3 (22-79)</td>
<td>56.8 (25-88)</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>Sex ratio (M:F)</td>
<td>59/62</td>
<td>65/73</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>Left/Right limbs</td>
<td>75/68</td>
<td>86/77</td>
<td>&gt; 0.05</td>
</tr>
<tr>
<td>Aberdeen score</td>
<td>13.76 ± 1.32</td>
<td>13.44 ± 1.29</td>
<td>&gt; 0.05</td>
</tr>
</tbody>
</table>
formed using the Student’s $t$ tests. If the data were not normally distributed, median (interquartile range) values were presented, with analysis using the Mann-Whitney $U$ test for unrelated samples and Wilcoxon signed rank test for paired data. Friedman test was used to analyze multiple related samples across the study interval. Categorical data were analyzed by means of $\chi^2$ test. $p < 0.05$ was considered statistically significant.

## Results

Totally two hundred and fifty nine cases (306 limbs) were included in our study, of them, 138 cases (163 limbs) underwent EVLA and 121 cases (143 limbs) underwent EVMWA. All operations were performed successfully. The operating time and length of hospital stay were similar in both groups and no statistical difference was found in the improvement of Aberdeen score (Table III). Our study revealed a little higher occlusion rate in EVMWA group than that of EVLA group (Table IV). The main postoperative complications were ecchymosis, skin burns, paresthesia and scleroma. No deep vein thrombosis or pulmonary embolism (PE) was observed in our study (Table V). All patients were submissive for the first follow-up examination. However, in the second follow up, the lost rate was up to 18.8% (24 cases lost) and 19.6% (37 cases lost) in EVMWA group and EVLA group, respectively.

## Discussion

Since more than one hundred years, the standard treatment of varicose veins has historically been high ligation and stripping of the GSV. However, it is associated with significant pain, prolonged postoperative recovery in some patients, risks of infection, hematoma, and nerve injury. In recent years, minimally invasive endovenous ablation techniques have been developed as...
alternatives to conventional surgery. Currently literatures have mainly concerned the endovenous thermal treatment, EVLA\textsuperscript{10}. Min et al\textsuperscript{17} reported 97% of GSVs were closed 1 week after initial treatment with endovenous laser ablation\textsuperscript{12} and 93.4% of GSVs have remained closed followed for 2 years\textsuperscript{18}. In fact, the efficacy of EVLA in our center is similar to that of being reported, with the occlusion rate of 98% one week postoperatively and 90.1% six months after the treatment. However, the mechanisms of this technique remain obscure. It is suggested to involve protein denaturation and destruction of cell structure, which was confirmed by histological studies\textsuperscript{19,20}. In addition, it is also deduced that EVLA causes permanent vein closure through a high-temperature photothermal process at the point of contact between the vein and the laser\textsuperscript{11,22}. In 2009, Subwongcharoen et al\textsuperscript{13} found that EVMWA appeared to be another extremely safe and effective technique for treatment of varicose veins and the best ablation effect could be obtained while microwave generator with 50-W power setting\textsuperscript{13}. EVMWA uses dielectric hysteresis to produce direct volume heating of tissue. Our EVMWA treatment also indicated a high occlusion rate could be achieved one week (99.24%) and six months (94.8%) after the procedure.

Furthermore, a significant higher occlusion rate could be observed in EVMWA group than EVLA group regardless of one week or six months follow up (p < 0.01). This may result from the following reasons. The laser fiber is very brittle and easily broken so that we have to use the Seldinger technique to change in the fiber. The microwave probe is more flexible than laser fiber, and it can be smoothly inserted into vessel and reach the SFJ without the help of a catheter and guide wire. In addition, the microwave generator can produce much higher energy than that of laser generator. According to the reference concerning the EVMWA, the microwave power was set to 50W when the saphenous trunk was being ablated, which was much higher than that of EVLA. The occlusion rate of target veins depends on the thoroughness of endothelial damage, which correlates positively to the thermal energy received by the vein wall. Due to more energy provided by the microwave, the occlusion rate after operation was significantly higher in the EVMWA group than that in the EVLA group.

The major complications secondary to the endovenous thermal ablation were ecchymosis, skin burns, paresthesia and scleroma. The extreme temperature of laser fiber tip can reach more than 800°C and the direct contact of fiber tip with the vessel wall can easily cause the perforation of vein wall. The temperature at the tip of microwave probe is usually around 80°C, which seldom creates an ulceration, and even perforation. The perforation of vessel wall leads to intraoperative bleeding subcutaneously, with the manifestation of ecchymosis. Thus, the ecchymosis was shown more severe in EVLA than that of EVMWA group. The energy of laser concentrates on the tip of fiber while a considerable part of energy was distributed in the full fiber of microwave. We could not accurately control the energy at the tip of the microwave fiber, and the released heat from the remaining part of fiber may cause thermal damage to the tissues around the vessel. The main adverse effects of thermal injury contain skin burn and paresthesia. The saphenous nerve is just close to the vein, resulting in more thermal damage to the saphenous nerve in the EVMWA group.

Conclusions

EVMWA is an effective alternative to EVLA for treatment of varicose veins, related with higher occlusion rate and without serious complications.

References


