

Ten conclusions after ten years' experience in radical endovenous laser therapy of lower extremity varicose veins

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OBJECTIVE: Objective. The paper is aimed to show our experience with endovenous surgical treatment of superficial venous insufficiency of the lower limbs.

SUBJECTS AND METHODS: We have been performing the radical endovenous laser therapy in the treatment of the chronic venous insufficiency of the great and the small saphenous veins with the device Cerelas D 15, (Biolitec Inc.) since 2004. The 980 nm wavelength was used until the end 2007, and the 1470 nm wavelength has been used from 2008 to date. All patients underwent the procedure under the conditions of the aseptic operation theatre, the length of their hospitalisation ranged from a few hours to 24 hours. In total, we treated 835 patients, 65.5% of them were females, the great saphenous veins were closed in 724 cases, the small saphenous veins in 103 cases, bilateral procedure was performed in 102 cases and the accessory veins in 77 cases. The power of the laser beam decreased from 12W in the groin to 2W in the ankle. The amount of energy released per unit length oscilated around 80 J/cm. We always sought to treat simultaneously all varices on the extremities during the initial endolaser therapy. All dilated branches of the main veins were closed either by laser, or instrumentally with combined approach, or by sclerotisations.

RESULTS: 448 (53.6%) patients were examined within 1 to 8 years after the procedure. The partial recanalisations in the main veins were observed in 7

(6.5%) patients, with the 980 nm device, and in 29 (8.5%) patients with 1470 nm device, respectively. The complete recanalisation in the main veins was observed in 3 (2.8%) patients with 980 nm device and in 8 (2.3%) patients with 1470 nm device, respectively. All patients with total recanalisation have been reoperated. The recurrence in the groin was found in 3 (2.8%) cases with 980 nm device and in 19 (5.5%) with 1470 nm device, respectively. The recurrence in the popliteal area was found in 1 (0.9%) with 980 nm device and in 5 (1.46%) with 1470 nm device, respectively. The immediate complications after the surgery were: longer lasting paresthesia in 12 (2.67%), skin burn of mild degree in 7 (1.56%), deep venous phlebothrombosis in 1 (22%) patient.

CONCLUSION: A vast majority of our patients was satisfied with the endolaser therapy provided for their varices. The benefit of radical treatment may be summarised as follows: better postoperative comfort and immediate cosmetic effect, significantly shorter work incapacity, faster achievement of full socioeconomic activity. The administration of the cold physiological saline solution close to the laser fiber is a great advantage, in present time. We believe, that if we offer the radical treatment of lower extremity varices via endolaser therapy, the procedures should be performed in conditions of the aseptic operation theatre, with the choice of different types of anesthesia, crosssectomy, instrumental removal of varices, in special cases. We believe, that the more radical treatment is performed initially, the longer lasting effect may be expected, of course in synergy with the complete care of the insufficient venous system.

Key Words: *Varicose veins of lower limbs; Experience in endovenous laser surgery – 10 years.*

The paper is aimed to show our experience with radical endovenous surgical treatment of superficial venous insufficiency of the lower limbs. We started to use endo-laser therapy in 2004 and after 10 years experience, nowadays, this is the method of the first choice of the treatment.

SUBJECTS AND METHODS

A complete pre-surgical vascular examination with a colour ultra sound Doppler examination of the veins the lower extremities and a brief examination of the arteries is performed in every patient. Radical treatment, in this case using endo-laser device is suggested in patients with provable dilatation of the great saphenous vein or the small saphenous vein, with the reflux in the saphenofemoral or saphenopopliteal junctions and with dilatations of the collateral branches. It is necessary to know the detailed informatins about the condition of the deep venous system, their connections to the superficial system, about competency of valves both legs, even if only one leg is planned to be operated.

Hospitalisation ranged from a ten hours to twenty hours. All the patients underwent the procedures in aseptic operation theatre conditions. The surgical procedure is consistently performed either in a total, or nerve-block spinal anesthesia, or local anesthesia in special cases.

We have been performing the radical endovenous laser therapy with the device CERELAS D 15 (BIOLITEC Inc) since 2004. The 980 nm wave length was used until the end 2007, and the 1470 nm wave length has been used from 2008 to date. The laser fibre is always inserted from microincision or veinpuncture in the distal part, above the medial or lateral ankle, depending on impairment of the great or the small saphenous vein. The position is controlled by peroperative ultrasound, especially if crosssectomy

wasn't performed, and always during the closure of the small saphenous vein. If it is not possible to insert the fibre in the proximal direction, we insert it via crosssectomy or via microincision in the popliteal region in the distal direction. We have been performing selective crosssectomy according to a local finding since 2008.

It devised on the diameters in saphenofemoral or saphenopopliteal junctions. In cases, when diameter in femoral junction was approximate 1.0 cm, with reflux in the dilated branches, unclear peroperated findings, reoperations etc.

The power of the laser beam decreased from the maximum of 12 W in the groin, or in the popliteal region (only extremely rarely 14 W), towards the ankle to 2 W. The amount of energy released per unit length oscilated around 80 J/cm. By a slow retrograde move of the fibre, in continual mode, we closed both great and small saphenous veins in their entire lengths.

The administration of the cold physiological saline solution close to the laser fiber is a great advantage in present time. If dilated collateral branches are not too coiled, we try to close them from the point punctures by the laser fiber as well. The succes is conditioned by the ability of the fiber to penetrate intraluminally. If this is not possible, due to a significant coiling of the veins, we always remove a dilated branches instrumentally.

All our patients recieve a standard prevention of thromboembolic disease with LMWH during the procedure and after it. Immediately, after the procedure, at the operation room, a new, high elastic compression stocking with so called class compression II, i.e., 40 mg Hg, is pulled on patients operated leg. Wears the stocking permanently, even after dismissal from the hospital, for a period of one week. During the second week after the surgery,

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the patient pulls the stocking on the operated leg only during a day time. Work capability is mostly reached on the fifth day following the procedure and it depends on the extent of the venous impairment and on the character of the work (Table 1).

TABLE 1
The overview and characteristics of our group

Total number of ELVeS	835, female547
The average age	44 years
ELVeS on the great saphenous vein	724
ELVeS on the small saphenous vein	103
ELVeS on the vena saphena accesoria	77
ELVeS bilaterally	102

TABLE 2
The severity of the venous impairment – CEAP classification

Variables	C-0	C-1	C-2	C-3	C-4	C-5	C-6
Number of patients	26	53	270	215	111	96	64

C-0 no varices, C-1 spider veins, C-2 truncal veins, C-3 venous edema, C-4 lipodermatosclerosis, C-5 healed varicose ulcer, C-6 not completely healed varicose ulcer (Table 2).

Within 1 to 8 years after the procedure we examined 448 (53.6%) our patients. All patients with total recanalizations have been reoperated, the others have been treated ambulatory (Table 3).

TABLE 3
The results of surgeries 448 followed up patients

	Partial recanalisations in the main veins	Total recanalisations in the main veins	Recurrence in the groin	Recurrence in the popliteal area
107 pts. 980 nm	7 (6.5%)	3 (2.8%)	3 (2.8%)	1 (0.9%)
341 pts 1470 nm	29 (8.8%)	8 (2.3%)	19 (5.5%)	5 (1.46%)

TABLE 4
The summary of complications

Variables	Number of patients, (% , (no, nm)
Long-term lasting paresthesias	12, (2.67), (6-980 nm, 6-1470 nm)
Skin burns of a minor degree	7, (1.56), (3-980 nm, 4-1470 nm)
Deep phlebotrombosis	1, (0.3), (980 nm)
Pulmonary embolism	0

DISCUSSION

The color Doppler ultrasound examination is a part of the basic diagnostic vascular testing in a patient with lower limb varices and it should be optimally performed by a physician trained and experienced in endovascular treatment of insufficiency of the superficial venous system of lower limbs. The examination relatively exactly helps determining the current situation of magistral veins in both legs, the extent of their dilatation in different levels and potential existence of reflux, the examination of valves, collateral branches, perforators and the deep venous system as well as the state of the arterial supply of limbs (Table 4).

According to our opinion, the optimal place of treatment in the planned radical procedures should be the aseptic operating room, due to a large variability of venous impairment. The patient may be provided with not only

different methods of anesthesia that are suitable for the given procedure but also with different ways of the extension of the basic procedure, i.e., the removal of magistral veins, so called – crosssectomy, the preparation in the popliteal region, mini-phlebectomy, etc., in such a place. All these conditions are met in the one day surgery departments (1-11).

As for the assesment of used medical devices, the 1470 nm wavelength device was significantly superior to the 980 nm wavelength device (12-15). The optimal power output was 12-2 W with the beam energy around 80 J/cm. This experience is consistent with other authors (6,7,16-20). It is proved that the 1470 nm wavelength of the laser beam is more powerful in destroying the wall of dilated veins; therefore it is more suitable to have the vein partially evacuated. Also, this wavelength is very probably more effective when assessing the postoperative 10years follow up (20). The shaped tip of the laser fibre, that gets in touch with the wall of the vein, is also significant. Peroperatively administered cold normal saline around the laser fiber also acts positively both by the pressure againts the vein and by a local cooling (21). However, it seems, that the additional increase of the wavelength of laser devices not be more effective, according to several studies. The 1950 nm wavelength is more effective only in tiny veins with the inner diameter of approximately 1 mm (19).

Besides the technical equipment of the working place the management of the procedure itself is predominatly important in terms of the therapeutical effect. We believe that the laser closure of the entire length of the dilated great or small vein is necessary. As for the proximal closure of the great saphenous vein together with its branches in the so called crosssectomy, we have been performing it selectively since 2008. In any case we perform it, consistently with other authors, in situations when it is not possible to penetrate the fiber to the saphenofemoral junction retrogradely, in extreme dilatation, or reflux; and in the insufficiency of valves, the magistral vein and its branches in order to prevent the so called – neovascularization – and the recurrence of varices in groin, and in anatomically unclear situations (9). Some authors report that such a neovascularization occurs more often after simple ablation with endo-laser method in groin (3). It must be said that this complication was not observed in our group who passed the crosssectomy. It is reported in the literature that the recurrence of varices in groin occurs also after high ligation and the stripping method, but that it was supposedly caused by another factors (5). We believe that the crosssectomy and /or the high ligation, were not performed lege artis in these cases. The development of the deep phlebotrombosis after the surgery may be promoted by other factors –older age, an increased diameter of the great saphenous vein – around 1.5 cm, obesity, miniphlebectomy, etc. (10,21,22). The local phlebotrombosis spontaneously dissolves according to the follow up ultrasound examinations performed 4 weeks after the procedure. However, it is evident that in the insufficient valve in the saphenofemoral junction and in the increased diameter of the great saphenous vein, crosssectomy is an effective prevention of both the thrombosis reported in up to 3,2%, and of other complications as well. Also, only the peroperative ligation of the saphenous vein may prevent the recently seen complication. The displacing of the broken tip of the laser catheter into the deep venous systém (2,14). The cons of crosssectomy are the future scars in the groin, certain prolongation of the procedure, and predominantly the unsuitability for the out-patient setting. In some cases also the professional orientation of the department may disapprove the crosssectomy. The fact is that the health institutions specialized in surgery and vascular procedures have recently preferred certain form of the high ligation of the saphenous vein – for example with Deschamps needle or with other devices (16,23).

When assessing our five-year outcomes of the endo-laser procedures we evaluated positively the the simultaneous treatment of impaired branches of magistral veins by miniphlebectomy. Other authors have recently joined this opinion (4). We still prefer this procedure together with a simultaneous treatment of dilated collateral branches after our ten years experience and this is accordance with other authors (13). Considering the recent polymorph approach to the treatment of the insufficiency of the superficial venous system of the lower limbs by various experts – phlebologists, invasive radiologists, dermatologists and last but not least surgeons, we consider the primary endo-laser treatment of impaired magistral veins including all dilated branches as the best way. Especially in cases when a patient demands and is consequently proposed the radical treatment of his/her chronic disease. In accordance with other authors we not consider the treatment of

dilated collateral branches before the radical procedure to be the optimal method (18).

Despite the extremely low occurrence of phlebotrombosis in our patients we have recently administered the LMHW heparin as a standard prevention of the thromboembolic disease in the day of the procedure and during the next three days in accordance with other authors (10,19). The wearing of high elastic socks with 40 mmHg compression during 2 weeks (the first week permanently and the second week only during the day) is sufficient for the after treatment according to our experience. Other authors report similar date (8).

CONCLUSIONS

We can draw ten conclusions from the above discussion:

1. The indication for ELVeS of magistral veins and their branches must be established after the clinical and the ultrasound Doppler examination. This examination exactly determines the extent of their impairment, dilatation, reflux in magistral veins and their branches, deep veins patency and arterial system patency. This enables to determine the extent of the surgery for the individual patient.
2. ELVeS should be performed at Surgery, Angiosurgery or Phlebology Departments respectively, where the procedure can be modified or extended, for example with crosssectionomy, ligation, instrumental resection of branches, etc.
3. We believe that the standard approach to the ELVeS procedure is that it should be performed under aseptic conditions in the operating theatre with multiple choices of analgesia, as well as with the possibility of one day hospitalization. The out-patient setting often limits the extent of the radical treatment.
4. The specialization of the physician shouldn't limit the primary procedure. The extent of the procedure should be determined after the basic examination, if and where the crosssectionomy, ligation, modified „pinhole“ crosssectionomy, instrumental removal of too coiled branch, foam sclerotisation. etc., is to be performed – lege artis.
5. The nature of the disease itself predicts, that the chronic venous insufficiency is a long term, sometimes even life long burden for the patients. It is determined genetically, professionally – static load, constitutionally – overweight, hormonally – contraception, and by bad habits – smoking, etc. The primary extent of the procedure is the key factor of the treatment in reducing the recurrence of the disease.
6. Long term prevention of the recurrence of the disease including patients' follow up is also very important. This is the only way to reduce late complications and recurrences, eg. in the extreme static load, sports, travelling, etc.
7. While some authors emphasize also the established role and comeback of stripping and cryostripping surgical procedures, after their long term (10 years and more) experience, it is necessary to keep emphasizing big advantages of endovascular procedures, of course if the complexity of the primary treatment, including combined procedures is respected.
8. Concurrent price evaluation of the individual therapeutical methods is and will be very important, also when compared to the traditional stripping method.
9. Nowadays, no method of the radical treatment of the insufficiency of the superficial venous system can be considered obsolete for the above mentioned reasons. Recently, the combined procedures have been used more and more.
10. We believe, that the future of the radical endo-laser closure of the insufficient superficial venous system of the lower limbs, lies in a further improvement and a wide use of fibers and laser energy with a wavelength around 1500 nm and with possibility of a simultaneous percutaneous treatment of intracutaneous spider veins. Or even higher wavelength may be used. Further technical development is

very likely in this area, as well as the establishment of internationally recommended standards of the treatment. At present time we recommend using 1470 nm wavelength device.

CONFLICT OF INTERESTS

The authors declare that they have not conflict of interest in connection with emergence of and that the article was not published in any other journals.

REFERENCES

1. Aurun O, Duman A, Yildirim S, et al. Endovenous laser ablation under general anesthesia for day surgery: Feasibility and outcomes of the 300 patients. *Ann Thorac Cardiovasc Surg.* 2014;20:55-60.
2. Bozogjan O, Messe B, Inici MF, et al. A rare complication of endovenous laser ablation: Intravascular laser catheter breakage. *BMJ Case.* 2013.
3. Brake M, Lim CS, Shepherd AC, et al. Pathogenesis and etiology of recurrent varicose veins. *J Vasc Surg.* 2013;57:860-8.
4. El-Sheika J, Nadhra S, Carradice D, et al. Clinical outcomes and quality of life 5 years after a randomized trial of concomitant or sequential phlebectomy following endovenous laser ablation for varicose veins. *Br J Surg.* 2014;100:2.
5. Flessenkamper I, Hartman M, Hartman K, et al. Endovenous laser ablation with and without high ligation compared to high ligation and stripping for treatment of great saphenous varicose veins: Results of a multicentre randomized controlled trial with up to 6 years follow-up. *Phlebology.* 2014.
6. Golbasi I, Turkay C, Erbasan O, et al. Endovenous laser with miniphlebectomy for treatment of varicose veins of different levels of laser energy on recanalization. A single center experience. *Laser Med Sci.* 2014.
7. Heger M, Van Golen RF, Broekgaarden M, et al. Endovascular laser-tissue interactions and biological responses in relation to endovenous laser therapy. *Laser Med Sci.* 2013.
8. Huang TW, Chen SL, Bai CH, et al. The optimal duration of compression therapy following varicose vein surgery: A meta-analysis of randomized controlled trials. *Eur J Vasc Endovasc Surg.* 2013;45:397-402.
9. Igari K, Hirokawa M, Uchiyama H, et al. Anatomical variation at the sapheno-femoral junction. *Ann Vasc Dis.* 2013;6(4):702-5.
10. Kane K, Fisher T, Bennett M, et al. The incidence and outcome of EHIT after endovenous laser ablation. *Ann Vasc Surg.* 2014.
11. Kokkosis A, Schanzer H. Anatomical and clinical factors favoring the performance of saphenous ablation and microphlebectomy or sclerotherapy as a single-stage procedure. *Phlebology.* 2014.
12. Lin JC, Peterson EL, Smith JJ, et al. Vein mapping prior to endovenous catheter ablation of the great saphenous vein predicts risk of endovenous heat-induced thrombosis. *Vasc Endovasc Surg.* 2012;46(5):378-83.
13. Liu P, Ren S, Yang Y, et al. Intravenous catheter guided laser ablation: A novel alternative for branch varicose veins. *Int. Surg.* 2011;96:331-6.
14. Lun Y, Shen S, Wu X, et al. Laser fiber migration into the pelvic cavity: A rare complication of endovenous laser ablation. *Phlebology.* 2014.
15. Maiskat WS, Poluetkova AA, Van der Geld CW, et al. Endovenous laser ablation (EVLA): A review of mechanism, modeling, outcomes and issues for debate. *Laser Med Sci.* 2013.
16. Okazaki Y, Orihashi K. Less invasive ultrasonography-guided high ligation of great saphenous vein in endovenous laser ablation. *Ann Vasc Dis.* 2013;6(2):221-5.
17. Park JA, Park SW, Chang IS, et al. The 1470-nm bare-fiber diode laser ablation of the great saphenous vein and the small saphenous vein at 1-year follow-up, using 8-12 W and a mean linear endovenous energy density of 72 J/cm. *J Vasc Interv Radiol.* 2014.
18. Park SW, Yun IJ, Hwang JJ, et al. Fluoroscopy-guided endovenous sclerotherapy using a microcatheter prior to endovenous laser ablation: comparison between liquid and foam sclerotherapy for varicose tributaries. *Korean J Radiol.* 2014;15:481-7.

19. Poluetkova AA, Maiskat WS, van Gemert MJ, et al. Some controversies in endovenous laser ablation of varicose veins addressed by optical-mathematical modeling. *Lasers Med Sci.* 2013.
20. Scarpelli P, Maggpinto A, Leopardi M, et al. An update in varicose vein pathology after ten years of endo-venous laser therapy (EVLT) with a 980 nm diode laser: clinical experience of a single center. *Laser Ther.* 2013;30:269-73.
21. Sutton PA, EL-Duhwaib Y, Dyer J, et al. The incidence of post operative venous thromboembolism in patients undergoing varicose vein surgery recorded in Hospital Epi-sode Statistics. *Ann R Coll Surg Engl.* 2012;94(7):481-3.
22. Vuylsteke ME, Mordon SR. Endovenous laser ablation: A review of mechanism of action. *Ann Vasc Surg.* 2012;26:424-33.
23. Zhu HP, Zhou YL, Zhang X, et al. Combined endovenous laser therapy and pinhole high ligation in the treatment of symptomatic great saphenous varicose veins. *Ann Vasc Surg.* 2013.