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The place of endovenous laser Ablation in the management of venous disorders.

La place du laser endoveineux dans la gestion de la maladie veineuse.

Grondin L.

Summary

Since the turn of the century, innovations in the field of Phlebology have succeeded each other, revolutionizing the playing field for managing of venous disorders.

The decade leading to the 21st century saw the establishment of duplex color-flow ultrasound, as the gold standard for evaluating patients before, during, and after venous interventions.

Little did anyone realize at the time, how much this would reset our understanding of the limitations of previous treatments, and create new treatment approaches altogether.

This brief paper, presented to the French Society of Phlebology in November 2011, describes this transformation.

Keywords: *foam sclerotherapy, radiofrequency, endovenous laser ablation.*

Résumé

Depuis le tournant du millénaire, les progrès technologiques se sont succédé en phlébologie, transformant radicalement le traitement des désordres veineux.

La dernière décennie du XXe siècle a vu l'établissement de l'ultrasonographie veineuse comme méthode standard d'évaluation des conditions phlébologiques.

Cette simple adoption technologique, a transformé nos concepts des traitements antérieurs, et devint partie intégrale des traitements nouveaux, tels les mousses sclérosantes, la sclérose par radiofréquence, et le laser endoveineux.

Ce document, présenté à la réunion de la SFP en novembre 2011, discute cette transformation de la pratique quotidienne de phlébologie.

Mots-clés : mousses sclérosantes, radiofréquence, ablation par laser endoveineux.

Introduction: The burden of venous disease

For the longest time, varicose veins were considered as "*common, affecting women more than men, and causing only an unsightly appearance to the legs*" [1].

Some authors asked: "*Do varicose veins require treatment at all?*" [2]

In time, however, some saw the benefit of treating primary varices as a prophylaxis to the development of chronic venous insufficiency (CVI) [3], as well as a method of reducing leg symptoms [4, 5].

It is not until the development of vein-specific questionnaires that the extent of the symptoms caused by varicose veins, and their impact on the quality of life came to light [6, 7, 8].

Today, the prevalence of varicose veins is reported to range from 25–32% in women and from 7–40% in men, the value increasing with age [9]. Treatment of varices prior to the development of CVI is largely believed to be preventive of CVI.

In the words of Vaughan Ruckley: "*advanced skin changes and chronic leg ulceration could be prevented in selected patients by means of intervention in the prodromal stages of CVI, which can initially be recognized by clinical examination and further defined by duplex scan*" [10].

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Foam Sclerotherapy and the limitations of traditional vein surgery

Despite having its advocates [3, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21], liquid sclerotherapy has long been considered to have an inferior outcome to surgery [22, 23]; however, "*foam sclerotherapy, in the words of John Bergan, must be looked upon as an entirely new method of treatment*" [24].

It was popularized at the turn of the millennium by Juan Cabrera, a Spanish vascular surgeon who reported on 415 patients with incompetent long saphenous veins of a diameter greater than 9 mm [25].

Of these, 265 patients suffered from post-surgical recurrence of the saphenous veins; 72 patients had venous ulcers; and 31 had venous malformations.

The reported results were astounding: "*After 4-6 years of follow-up, 80% of the long saphenous veins were obliterated and all superficial branches had disappeared in 95% of legs. In the post-surgical recurrence group, 81% of recurrent veins were obliterated and 90% of the branches had disappeared.*

Among the patients with ulcers, the latter remain closed after a mean of 2.5 years treatment in 77% of the cases; recurrence in the remainder was due to re-canalization of perforating veins. All venous malformations were reduced in size and 9 of them had disappeared completely" [25].

The technique was elegant, simple and reproducible. It impacted the vascular community like a storm, and nothing was the same afterwards [26, 27, 28, 29].

With quality of life studies showing worse outcomes "*in recurrent post-surgical varicose vein disease than in primary varicose disease*" [8], and "*significant improvements following ultrasound guided foam sclerotherapy sustained to at least 12 months*" [30], foam sclerotherapy appeared a more desirable therapeutic approach to surgical stripping in the management of saphenous trunk incompetence.

Varicose vein surgery was already under critical scrutiny because of a higher than reported complication rate, namely deep venous thrombosis, which was reported in one study of 377 patients to be 5.3% despite liberal thromboprophylaxis [31], and higher than expected rate of recurrence [32, 33, 34].

The incidence of post-surgical recurrence lies somewhere between 20% and 80% depending on the definition of recurrence and the time of the recurrence [35].

The most significant development in the management of venous disorders in the past two decades has unquestionably been the routine use of duplex color-flow ultrasound before, during and after venous interventions [17, 36 , 37].

Today, post operative varicose recurrences possess a characteristic ultrasound appearance [38], thus allowing us a more precise understanding of treatment outcomes.

Foam sclerotherapy has a clearly superior outcome compared to liquid sclerotherapy but not to the extent that it was initially reported [28, 39, 40, 41]; foam-sclerotherapy failure has been linked to increasing saphenous junction diameter [42].

Foam sclerotherapy appears to have a definite weaker outcome to endovascular ablative techniques [43]. *Foam sclerotherapy is also not without risks.*

Of late, **gas embolization** following foam sclerotherapy has been increasingly reported [44, 45, 46, 47, 48, 49]. Gas embolization to the heart seems to occur every time foam is injected in a superficial vein, regardless of the volume or method of injection [44, 50].

The clinical significance of sclerosant gas-bubbles in the heart and cerebral circulation is unknown.

Scotomas, migraines, and transient neurological deficits have been reported with liquid sclerosants [51], but less frequently than with foam-agents [40, 52].

Lately, stroke is reported increasingly following foam sclerotherapy [53, 54, 55].

Side effects following foam sclerotherapy, namely: chest tightness, dry cough, visual defects and dizziness are less common when carbon dioxide is used instead of room air [56].

To minimize embolization-related complications the European consensus [57] recommends a maximum total dosage of 10 cc of foam per session.

Endovenous Laser Ablation (EVLA)

EVLA was also introduced near the turn of the millennium by yet another Spanish vascular surgeon: Carlos Bonè.

The technique was popularized in the United States by Luis Navarro [58] and Robert Min [59]. Initially, an 810 nm laser-beam and a bare-tip fiber were utilized.

The simplicity, safety and efficacy of the technique out-popularized, and out-performed the traditional surgical stripping procedure [60]. Parallel to the introduction of EVLA, endovenous radiofrequency (EVRF) made its appearance [61].

Initially some felt that EVLA was likely to induce superficial thrombophlebitis and subsequent recanalization [62], and openly favored EVRF claiming that "*vein perforations, extremely high intravascular temperatures, failure to cause significant collagen shrinkage, and intact endothelium* (in animal studies) *justified a closer look at the endovenous laser technique*" [63].

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Indeed, early-on superficial burns, paresthesias and vein rupture were observed [64], as well as rare heat-induced arterial-venous fistulas [65], and lately ischemic stroke has been reported [66].

The success and burn-complications of earlier lower-wave-length-lasers are proportional to the energy delivered [67], upon its principal chromophore: hemoglobin [68].

In an attempt to bypass the problems associated with laser absorption by hemoglobin, longer wave length lasers were introduced [69], which predictably carry fewer complications.

Today, laser systems with higher wavelengths such as 1320, 1470 and 1540 nm with a higher absorption for water, have become the preferred systems showing less discomfort and bruising following the procedure [70, 71, 72].

The use of radial-tip fibers has further reduced the energy requirements and adverse effects compared with the original bare-tip laser fibers [73].

After much debate, both long wavelength lasers and modern RF devices seem to occupy the podium as the first-line treatment for incompetent saphenous trunks.

Speaking for the Society of Vascular Surgery and the American Venous Forum, Peter Gloviczki stated:

"*For treatment of the incompetent great saphenous vein (GSV), we recommend endovenous thermal ablation (radiofrequency or laser) rather than high ligation and inversion stripping of the saphenous vein to the level of the knee (GRADE 1B).*

We recommend phlebectomy or sclerotherapy to treat varicose tributaries (GRADE 1B) and suggest foam sclerotherapy as an option for the treatment of the incompetent saphenous vein (GRADE 2C)" [74].

Mechanism of action

The exact mechanism of action of EVLA and EVRF still eludes us.

Based upon a study of 31 limbs on twenty-six patients, and measuring D-dimers post-operatively :

- ***Proebstle*** concluded that EVLT inducing thrombotic vessel occlusion, and heat injury of the inner vein wall by steam bubbles formation originating from boiling blood is the likely mechanism of action of EVLT [75],
- ***Van der Geld*** and ***Van den Bos*** proposed that the boiling bubbles during EVLA behave according to a heat-pipe mechanism maintaining an even temperature of 100° Celsius over a distance of 20 mm causing irreversible vein wall injury [76].
- EVRF works in the same manner [77].

Fan and ***Rox-Anderson*** argued against the steam bubble theory, and claimed that the likely mechanism of action of EVLA involves initial energy absorption by residual blood in the vein, leading to carbonization of the fiber tip, which in turn creates a secondary intensely light-absorbing interface delivering high temperatures (in excess of 1000°C) leading to fibrotic vein occlusion [78].

However recent reports, using radial fibers show similar results without carbonized fiber tip [79, 80], negate the necessity of carbonization and high heat in obtaining fibrosis.

It is likely that an **energized liquid-gas** (plasma) acts as the heat-carrying medium during the EVLT process [76].

Outcomes

Short- and mid-term studies of EVLA, regardless of wavelength used, seem remarkably consistent, typically reporting ablation of refluxing saphenous veins in 90% or more of cases [81, 82] .

Currently available evidence suggests that EVRFA and EVLT are at least as effective as surgery; however there is insufficient data to comment on USGFS [83].

Labropoulos et al reported that in 5% of ablated GSV, multiple small vessels are found directly adjacent to the involved vein segments forming arterial-venous fistulas within the obliterated vein, and postulated that this process may be responsible for recanalization or recurrence after endovenous ablation procedures [84].

Long-term outcome studies are still pending.

Conclusion

Thermal ablation has unquestionably made a powerful impact in Phlebology.

At present it occupies the podium as the treatment of choice for saphenous vein incompetence, pushing traditional stripping to a far lesser status and relinquishing ambulatory phlebectomy, foam and liquid sclerotherapy to the management of non-saphenous branches.

Whether EVLA or EVRF will ultimately be crowned the overall best treatment remains to be seen.

At present technological developments such as "Closure Fast" and "Radial fibers," narrow the margin of distinction between the two technologies to insignificance.

We are presently conducting a comparative trial between the bare tip 980 nm laser technique and the radial fiber 1470 nm laser technique.

We expect to complete the trial in the next 3 years. Unfortunately with the racing pace of innovation in thermal ablations, newer and more effective techniques are likely to appear within this time frame.

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References

1. Ameli F.M. Current concepts in the management of varicose veins. Can. J. Surg. 1986 Jan; 29(1): 21-3.
2. Mansfield A.O. Varicose veins. Br. J. Hosp. Med. 1986 Aug; 36(2): 124-7.
3. de Groot W.P. Treatment of varicose veins: modern concepts and methods. J. Dermatol. Surg. Oncol. 1989 Feb; 15(2): 191-8.
4. Weiss R.A., Weiss M.A. Resolution of pain associated with varicose and telangiectatic leg veins after compression sclerotherapy. J. Dermatol. Surg. Oncol. 1990 Apr; 16(4): 333-6.
5. Kanter A.H. The effect of sclerotherapy on restless legs syndrome. Dermatologic surgery: official publication for American Society for Dermatologic Surgery [et al]. 1995 Apr; 21(4): 328-32.
6. Garratt A.M., Macdonald L.M., Ruta D.A., Russell I.T., Buckingham J.K., Krukowski Z.H. Towards measurement of outcome for patients with varicose veins. Qual. Health Care 1993; 2(1): 5-10.
7. Bradbury A., Evans C., Allan P., Lee A., Vaughan Ruckley C.V., Fowkes F.G.R. What are the symptoms of varicose veins? Br. Med. J. 1999; 318: 353-6.
8. Beresford T.S., Brown J.J., Greenhalgh L., Davies R.M. A comparison of health-related quality of life of patients and recurrent varicose veins. Phlebology 2003; 18(1): 35-7.
9. Robertson L, Evans C., Fowkes F.G.R. Epidemiology of chronic venous disease. Phlebology 2008; 23(3): 103-11.
10. Ruckley C.V., Evans C., Allan P.L., Lee A.J., Fowkes F.G.R. Chronic venous insufficiency clinical and duplex correlations. The Edinburgh Vein Study of venous disorders in the general population. J. Vasc. Surg. 2002; 36(3): 520-5.
11. Cornu-Thenard A., de Cottreau H., Weiss R.A. Sclerotherapy. Continuous wave Doppler-guided injections. Dermatologic surgery: official publication for American Society for Dermatologic Surgery [et al]. 1995 Oct; 21(10): 867-70.
12. de Groot W.P. Practical phlebology. Sclerotherapy of large veins. J. Dermatol. Surg. Oncol. 1991 Jul; 17(7): 589-95.
13. Griton P. The limits of effective sclerotherapy in the obese. Phlebologie 1988 Jul-Oct; 41(3): 563-72.
14. Grondin L. Echosclerotherapy, or the quest for the safe technique. Phlebologie 92 Proceedings of the XI world congress of the Union internationale de Phlebologie 1992; 2: 824.
15. Kern P. Sclerotherapy of varicose leg veins. Technique, indications and complications. International angiology: a journal of the International Union of Angiology 2002 Jun; 21(2 Suppl 1): 40-5.
16. Zummo M.G. Cloutier's sclerotherapy of varices. Phlebologie 1991 Jan-Mar; 44(1): 37-43.
17. Schadeck M. Echographic sclerotherapy of the great saphenous vein. Phlebologie 1993 Oct-Dec; 46(4): 673-82.
18. Raymond-Martimbeau P. Sclerotherapy of the internal saphenous vein in the standing and sitting position. A comparative study. Phlebologie 1991 Jan-Mar; 44(1): 97-107; discussion 10.
19. Vin F. Echo-sclerotherapy of the external saphenous vein. Phlebologie 1991 Jan-Mar; 44(1): 79-84, discussion 90-6.
20. Baccaglini U. Consensus Conference on Sclerotherapy. Padua, 24 September 1994. Int. Angiol. 1995 Sep; 14(3): 239-40.
21. Baccaglini U., Spreafico G., Castoro C., Sorrentino P. Sclerotherapy of varicose veins of the lower limbs. Consensus paper. North American Society of Phlebology. Dermatol. Surg. 1996 Oct; 22(10): 883-9.
22. Hobbs J. Surgery and Sclerotherapy in the treatment of varicose veins. A random trial. Arch. Surg. 1974; 109: : 793-6.
23. Einarsson E.E., Eklof B., Neglen P. Sclerotherapy or surgery as treatment for varicose veins: a prospective randomized study. Phlebology 1993; 8: 22-6.
24. Bergan J., Cheng V. Foam sclerotherapy for the treatment of varicose veins. Vascular 2007 Sep-Oct; 15(5): 269-72.
25. Cabrera J., Cabrera J., Jr., Garcia-Olmedo M.A. Sclerosants in microfoam. A new approach in angiology. International angiology : a journal of the International Union of Angiology 2001 Dec; 20(4): 322-9.
26. Coleridge Smith P. Sclerotherapy and foam sclerotherapy for varicose veins. Phlebology 2009; 24(6): 260-9.
27. Creton D., Uhl J. Foam Sclerotherapy Combined with Surgical Treatment for Recurrent Varicose Veins: Short Term Results. European Journal of Vascular and Endovascular Surgery 2007; 33(5): 619-24.
28. Hamel-Desnos C., Allaert F.A. Liquid versus foam sclerotherapy. Phlebology 2009; 24(6): 240-6.
29. Nael R., Rathbun S. Effectiveness of foam sclerotherapy for the treatment of varicose veins. Vasc. Med. 2010 Feb; 15(1): 27-32.
30. Darvall K.A.L., Sam R.C., Bate G.R., Silverman S.H., Adam D.J., Bradbury A.W. Changes in health-related quality of life after ultrasound-guided foam sclerotherapy for great and small saphenous varicose veins. J. Vasc. Surg. 2010; 51(4): 913-20.
31. Vanrij A., Chai J., Hill G., Christie R. Incidence of deep vein thrombosis after varicose vein surgery. J. Vasc. Surg. 2005; 41(4): 732-.
32. Vanrij A., Hill G., Gray C., Christie R., Macfarlane J., Thomson I. A prospective study of the fate of venous leg perforators after varicose vein surgery. J. Vasc. Surg. 2005; 42(6): 1156-62.
33. Vanrij AM., Jiang P., Solomon C., Christie RA., Hill GB. Recurrence after varicose vein surgery: a prospective long-term clinical study with duplex ultrasound scanning and air plethysmography. J. Vasc. Surg. 2003; 38(5): 935-43.
34. Perrin M., Gobin J.P., Nicolini P. Recurrent varicose veins in the groin after surgery. J. Mal. Vasc. 1997 Dec; 22(5): 303-12.

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35. Perrin M., Allaert F. Intra- and Inter-observer Reproducibility of the Recurrent Varicose Veins after Surgery (REVAS) Classification. Eur. J. Vasc. Endovasc. Surg. 2006; 32(3): 326-32.

36. Grondin L. Clinical examination & non-invasive evaluation of the patient prior to sclerotherapy Fourth Annual Congress of the North American Society of Phlebology; February 17-19 1991; Lake Buena Vista Florida USA; 1991.

37. Schadeck M., Allaert F. Ultrasonography during sclerotherapy. Phlebologie 1991 Jan-Mar; 44(1): 111-29; discussion 30.

38. Perrin M., Labropoulos N., Leonjr L. Presentation of the patient with recurrent varices after surgery (REVAS). J. Vasc. Surg. 2006; 43(2): 327-34.

39. Goren G. Real-time color duplex scanning after sclerotherapy of the greater saphenous vein. J. Vasc. Surg. 1992 Sep; 16(3): 497-8.

40. Echosclerotherapy of Saphenous axis with Micro-foam Agents; Scottsdale Arizona. 1999.

41. Hamel-Desnos C.M., Guias B.J., Desnos P.R., Mesgard A. Foam Sclerotherapy of the Saphenous Veins: Randomised Controlled Trial with or without Compression. Eur. J. Vasc. Endovasc. Surg. 2010; 39(4): 500-7.

42. Barrett J.M., Allen B., Ockelford A., Goldman M.P. Microfoam ultrasound-guided sclerotherapy treatment for varicose veins in a subgroup with diameters at the junction of 10 mm or greater compared with a subgroup of less than 10 mm. Dermatologic surgery: official publication for American Society for Dermatologic Surgery [et al] 2004 Nov; 30(11): 1386-90.

43. Gonzalez-Zeh R., Armisen R., Barahona S. Endovenous laser and echo-guided foam ablation in great saphenous vein reflux: one-year follow-up results. J. Vasc. Surg. 2008; 48(4): 940-6.

44. Parsi K. Venous gas embolism during foam sclerotherapy of saphenous veins despite recommended treatment modifications. Phlebology 2011; 26(4): 140-7.

45. Ceulen R.P.M., Vernooy K. Reply to letter regarding article titled 'Microembolism during foam sclerotherapy of varicose veins' in the New England Journal of Medicine. Phlebology 2008; 23(5): 250-.

46. Guex J.J., Raymond-Martimbeau P., Simka M., Passariello F. Letter regarding article titled 'Microembolism during foam sclerotherapy of varicose veins' in the New England Journal of Medicine. Phlebology 2008; 23(5): 249-.

47. Rush J.E, Wright D.D. More on Microembolism and Foam Sclerotherapy. N. Engl. J. Med. 2008 August 7 208; 359(6): 656.

48. Ceulen R.P.M.S., Vernooy K. Microembolism during Foam Sclerotherapy of Varicose Veins. N. Engl. J. Med. 2008; 358(14): 1525-26.

49. Hartmann K., Harms L., Simon M. Reversible Neurological Deficit after Foam Sclerotherapy. Eur. J. Vasc. Endovasc. Surg. 2009; 38(5): 648-9.

50. Morrison N., Neuhardt D.L. Foam sclerotherapy: cardiac and cerebral monitoring. Phlebology 2009; 24(6): 252-9.

51. Guex J.J. Complications of Sclerotherapy: An Update. Dermatol. Surg. 2010; 36: 1056-63.

52. Grondin L. Echosclerotherapy of Saphenous Axis with Microfoam Agents. Int. Angiol. 2001; 20(2 (supplement 1)): 144.

53. Forlee M.V., Grouden M., Moore D.J., Shanik G. Stroke after varicose vein foam injection sclerotherapy. J. Vasc. Surg. 2006; 43(1): 162-4.

54. Gillet J.L, Guedes J.M., Guex J.J., Hamel-Desnos C., Schadeck M., Lauseker M., et al. Side-effects and complications of foam sclerotherapy of the great and small saphenous veins: a controlled multicentre prospective study including 1,025 patients. Phlebology / Venous Forum of the Royal Society of Medicine 2009 Jun; 24(3): 131-8.

55. Ma R.W., Pilotelle A., Paraskevas P., Parsi K. Three cases of stroke following peripheral venous interventions. Phlebology / Venous Forum of the Royal Society of Medicine 2011 Mar 21.

56. Morrison N., Neuhardt D., Rogers C., McEown J., Morrison T., Johnson E., et al. Comparisons of side effects using air and carbon dioxide foam for endovenous chemical ablation. J. Vasc. Surg. 2008; 47(4): 830-6.

57. Breu F.X., Guggenbichler S. European Consensus Meeting on Foam Sclerotherapy, April, 4-6, 2003, Tegernsee, Germany. Dermatologic surgery: official publication for American Society for Dermatologic Surgery [et al]. 2004 May; 30(5): 709-17; discussion 17.

58. Navarro L., Min R.J., Bone C. Endovenous laser: a new minimally invasive method of treatment for varicose veins – preliminary observations using an 810 nm diode laser. Dermatologic surgery: official publication for American Society for Dermatologic Surgery [et al] 2001 Feb; 27(2): 117-22.

59. Min R.J., Zimmet S.E., Isaacs M.N., Forrestal M.D. Endovenous laser treatment of the incompetent greater saphenous vein. J. Vasc. Int. Radiol. 2001 Oct; 12(10): 1167-71.

60. Bergan J.J. Phlebology has arrived at last. Phlebology 2008; 23(1): 1-.

61. Zan S., Contessa L., Varetto G., Barra C., Conforti M., Casella F., et al. Radiofrequency minimally invasive endovascular treatment of lower limbs varicose veins: clinical experience and literature review. Minerva Cardioangiol. 2007 Aug; 55(4): 443-58.

62. Weiss R. Commentary on endovenous laser. Dermatologic surgery: official publication for American Society for Dermatologic Surgery [et al] 2001 Mar; 27(3): 326-7.

63. Weiss R.A. Comparison of endovenous radiofrequency versus 810 nm diode laser occlusion of large veins in an animal model. Dermatologic surgery: official publication for American Society for Dermatologic Surgery [et al] 2002 Jan; 28(1): 56-61.

64. Chang C.J., Chua J.J. Endovenous laser photocoagulation (EVLP) for varicose veins. Lasers in surgery and medicine 2002; 31(4): 257-62.

65. Timperman P.E. Arteriovenous fistula after endovenous laser treatment of the short saphenous vein. J. Vasc. Int. Radiol. 2004 Jun; 15(6): 625-7.

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66. Caggiati A., Franceschini M. Stroke following endovenous laser treatment of varicose veins. Journal of vascular surgery: official publication, the Society for Vascular Surgery [and] International Society for Cardiovascular Surgery, North American Chapter. 2010 Jan; 51(1): 218-20.

67. Timperman P.E., Sichlau M., Ryu R.K. Greater energy delivery improves treatment success of endovenous laser treatment of incompetent saphenous veins. J. Vasc. Int. Radiol. 2004 Oct; 15(10): 1061-3.

68. Proebstle T.M., Sandhofer M., Kargl A., Gul D., Rother W., Knop J., et al. Thermal damage of the inner vein wall during endovenous laser treatment: key role of energy absorption by intravascular blood. Dermatologic surgery: official publication for American Society for Dermatologic Surgery [et al]. 2002 Jul; 28(7): 596-600.

69. Weiss R., Munavalli G. Endovenous Ablation of Truncal Veins. Sem. Cut. Med. Surg. 2005; 24(4): 193-9.

70. Pannier F., Rabe E., Rits J., Kadiss A., Maurins U. Endovenous laser ablation of great saphenous veins using a 1470 nm diode laser and the radial fibre – follow-up after six months. Phlebology 2011; 26(1): 35-9.

71. Weiss R.A., Munavalli G. Endovenous ablation of truncal veins. Sem. Cut. Med. Surg. 2005 Dec; 24(4): 193-9.

72. Teruya T.H., Ballard J.L. New approaches for the treatment of varicose veins. Surg. Clin. North Am. 2004 Oct; 84(5): 1397-417, viii-ix.

73. Schwarz T., von Hodenberg E., Furtwangler C., Rastan A., Zeller T., Neumann F.J. Endovenous laser ablation of varicose veins with the 1470-nm diode laser. Journal of vascular surgery: official publication, the Society for Vascular Surgery [and] International Society for Cardiovascular Surgery, North American Chapter 2010 Jun; 51(6): 1474-8.

74. Gloviczki P., Comerota A.J., Dalsing M.C., Eklof B.G., Gillespie D.L., Gloviczki M.L., et al. The care of patients with varicose veins and associated chronic venous diseases: clinical practice guidelines of the Society for Vascular Surgery and the American Venous Forum. Journal of vascular surgery: official publication, the Society for Vascular Surgery [and] International Society for Cardiovascular Surgery, North American Chapter. 2011 May; 53(5 Suppl): 2S-48S.

75. Proebstle T.M., Lehr H.A., Kargl A., Espinola-Klein C., Rother W., Bethge S., et al. Endovenous treatment of the greater saphenous vein with a 940-nm diode laser: thrombotic occlusion after endoluminal thermal damage by laser-generated steam bubbles. J. Vasc. Surg. 2002 Apr; 35(4): 729-36.

76. van der Geld C.W., van den Bos R.R., van Ruijven P.W., Nijsten T., Neumann H.A., van Gemert M.J. The heat-pipe resembling action of boiling bubbles in endovenous laser ablation. Lasers Med. Sci. 2010 Nov; 25(6): 907-9.

77. Frasier K., Giangola G., Rosen R., Ginat D.T. Endovascular radiofrequency ablation: A novel treatment of venous insufficiency in Klippel-Trenaunay patients. J. Vasc. Surg. 2008; 47(6): 1339-45.

78. Fan C.M., Rox-Anderson R. Endovenous laser ablation: mechanism of action. Phlebology 2008; 23(5): 206-13.

79. Schwarz T., von Hodenberg E., Furtwängler C., Rastan A., Zeller T., Neumann F-J. Endovenous laser ablation of varicose veins with the 1470-nm diode laser. J. Vasc. Surg. 2010; 51(6): 1474-8.

80. Pannier F., Rabe E., Rits J., Kadiss A., Maurins U. Endovenous laser ablation of great saphenous veins using a 1470 nm diode laser and the radial fibre – follow-up after six months. Phlebology 2010; 26(1): 35-9.

81. Luebke T., Brunkwall J. Systematic review and meta-analysis of endovenous radiofrequency obliteration, endovenous laser therapy, and foam sclerotherapy for primary varicosis. J. Cardiovasc. Surg. 2008 Apr; 49(2): 213-33.

82. Luebke T., Brunkwall J. Meta-analysis of transilluminated powered phlebectomy for superficial varicosities. J. Cardiovasc. Surg. 2008 Dec; 49(6): 757-64.

83. Nesbitt C., Eifell R.K., Coyne P., Badri H., Bhattacharya V., Stansby G. Endovenous ablation (radiofrequency and laser) and foam sclerotherapy versus conventional surgery for great saphenous vein varices. Cochrane Database Syst. Rev. 2011(10): CD005624.

84. Labropoulos N., Bhatti A., Leon L., Borge M., Rodriguez H., Kalman P. Neovascularization after great saphenous vein ablation. European journal of vascular and endovascular surgery: the official journal of the European Society for Vascular Surgery 2006 Feb; 31(2): 219-22.