Revista Portuguesa de cirurgia

II Série • N.° 31 • Dezembro 2014

ISSN 1646-6918

Órgão Oficial da Sociedade Portuguesa de Cirurgia

Treatment of Perforating Veins – Review of Techniques

Tratamento de Veias Perfurantes – Revisão de Técnicas

Costa Almeida CE

Assistente Hospitalar de Cirurgia Geral

Serviço de Cirurgia C, Centro Hospitalar e Universitário de Coimbra – Hospital Geral (Covões)

ABSTRACT

Introduction/Objectives: Incompetent perforating veins are implicated in venous ulcers and varicose veins recurrence. Complete closure of all perforating veins is the only predictor of ulcer healing. Review and comparison of techniques to conclude on the best treatment option is the objective of this article. **Methods:** Open surgery, subfascial endoscopic perforator surgery (SEPS), percutaneous ablation of perforating veins (PAP) (chemical and thermal) and embolization were analyzed and compared. **Results:** Open surgery has an ulcer-healing rate of 89% with recurrence of 23%. SEPS has an ulcer-healing rate of 90% and recurrence of 11%. Wound complication rate with SEPS is 5%. Sclerotherapy has an ulcer-healing rate up to 67,6%. PAP has near 100% immediate closure rate, but decreases during follow-up. **Discussion:** SEPS has better ulcer-healing rate, and decreases recurrence. The major disadvantage of PAP is missed perforators, and long-term series are lacking. **Conclusion:** PAP is safe with minimal complications equal to SEPS, has advantages compared to surgery, but there are no studies on ulcer-healing and recurrence rates. Due to that, SEPS continues to be the choice/gold standard for the treatment of incompetent perforating veins. A combination of SEPS and PAP may result in better outcomes.

Key words: *Perforating veins, SEPS, endovenous laser, radiofrequency, sclerotherapy*

RESUMO

Introdução/Objectivos: Veias perfurantes incompetentes estão implicadas na génese de úlceras varicosas e na recidiva de varizes. A laqueação de todas as perfurantes é o único factor preditor de cicatrização da úlcera. O objectivo deste artigo é rever e comparar técnicas para poder concluir sobre a melhor opção de tratamento. **Métodos:** Cirurgia aberta, laqueação subfascial endoscópica de perfurantes (SEPS), ablação percutânea de veias perfurantes (PAP) (quimica e térmica) e embolização, foram analizadas e comparadas. **Resultados:** Cirurgia aberta tem uma taxa de cicatrização de úlcera de 89% com recidiva de 23%. SEPS tem uma taxa de cicatrização de 90% e recidiva de 11%. A taxa de complicação da ferida operatória com a SEPS é de 5%. Escleroterapia tem uma taxa de cicatrização até 67,6%. PAP há quase 100% de encerramento completo imediato, mas este diminui durante o seguimento. **Discussão:** SEPS tem melhor taxa de cicatrização, e diminui a recidiva da úlcera venosa. As principais desvantagens da PAP são as perfurantes esquecidas, e a falta de resultados a longo prazo. **Conclusão:** PAP é segura e com mínimas complicações como a SEPS, tem vantagens em relação à cirurgia, mas não há estudos da cicatrização nem da recidiva de úlcera. Por isso, a SEPS continua a ser a melhor escolha / "gold standard" para o tratamento de perfurantes insuficientes. A combinação da SEPS e PAP poderá ter melhores resultados.

Palavras chave: *perfurantes, SEPS, laser endovascular, radiofrequência, escleroterapia*

INTRODUCTION

Chronic venous insufficiency (CVI) is a frequent pathology in the west with a negative impact in societies worldwide. It affects more women than men (6:1), and has an increasing incidence above the sixth decade of life. Adults tend to be affected during their professional active life[1]. According to Ministério da Previdência Social of Brazil's data, it represents the 14th cause of temporary absence to work, and the 32nd cause of permanent disability[2]. In the US it is the 7th cause of chronic disabling disease, responsible for losing 2 million days of work, costing 3 billion dollars a year[3]. Venous ulcers and post-thrombotic syndrome are the most serious manifestations of CVI, decreasing the patient's QOL (quality of life).

Perforators, or perforating veins, of the lower limbs connect the superficial veins to the deep veins where they drain, and are so called because they perforate the fascia of muscles. They have valves that prevent the backflow of blood (reflux) from deep to superficial veins. Perforating vein incompetence is defined by retrograde (outward) flow lasting longer than 0.3 seconds or with a diameter ≥ 3.5 mm[4]. Because they raise venous hypertension, incompetent perforating veins are implicated in venous ulcers and in varicose veins recurrence[2,5,6]. Today, the objective of perforators' ablation is to reduce venous ambulatory pressure below a level that helps ulcer healing, and because it is not known what that level is, all perforators must be treated so that ambulatory venous pressure is minimal[6]. Incompetent calf perforating veins in conjunction with superficial or deep vein reflux have been reported in 56-73% of lower limbs with venous ulceration. Reflux of perforators in a diseased limb occurs predominantly in the Cockett veins[7], and because these veins connect with Leonardo's vein, which connects to the great saphenous vein (GSV) just below the knee, stripping of GSV will not affect blood flow through Cockett perforating veins[4].

Although hemodynamic significance of perforators is clear, debate continues on the clinical significance of perforating veins – whether they independently contribute to CVI severity or if they are a secondary effect of superficial and/or deep incompetence. ESCHAR study[8] concludes that they may be secondary to superficial reflux, while Edinburgh[9] group has an opposing opinion. The comparison of clinical results and patient's satisfaction after treatment of two different groups, truncal insufficiency versus truncal with perforating vein insufficiency, showed that the former was remarkably superior[10], thus supporting the major role of incompetent perforators in CVI. A recent paper published in 2014 by Kiguchi *et al* concluded that complete closure of all perforating veins is the only predictor of ulcer healing[5].

Between 1992 and 2008, subfascial endoscopic perforator surgery (SEPS) became the technique of choice for perforator ablation[11]. However, the emergence of ultrasound-guided percutaneous ablation techniques (thermal and chemical) has transformed the treatment of perforators. Percutaneous ablation techniques are attractive to doctors and patients, but it has to be asked whether they have the same results of SEPS or if they will be able to overwhelm SEPS. In the presence of several techniques a comparison is needed to help doctors and patients to choose one. In this paper, the author performs a review of indication and techniques and makes some conclusions.

INDICATIONS FOR TREATING PERFORATORS

According to both the Society for Vascular Surgery and the American Venous Forum, there is indication to treat incompetent perforating veins in patients with CEAP class C_3-C_6 (GRADE 2B). They also recommend against the treatment of incompetent perforating veins in patients with CEAP class C_2 (GRADE 1B).[11]

There is only indication to treat perforators in CEAP class C_2 in the presence of varicose veins recurrence[4,12]. Occlusive arterial disease, infected ulcers and medically high-risk patients are contraindications[7].

Incompetent perforators have been implicated in venous ulcer origin and varicose veins recurrence. TenBrook[13] indicated the postoperative presence of persistent incompetent perforators as a risk factor for a non-healing ulcer, along with ulcers > 2 cm and secondary etiology. Additionally, treatment of incompetent perforating veins can effectively prevent varicosity in superficial veins[7]. Therefore, in the opinion of the author, in the era of minimally invasive techniques there is probably no reason in leaving incompetent perforating veins untreated, which can lead to recurrence and/or ulceration, only because it is a CEAP class C_2 disease.

TREATMENT OF INCOMPETENT PERFORATING VEINS

Incompetent perforators are frequently found in venous duplex ultrasound of patients with varicose veins, and venous ulcers are frequently associated to the presence of incompetent perforating veins. The treatment of perforators has been evolving and there are several options available today.

Open surgery

In 1938, Linton suggested for the first time the surgical interruption of perforators to treat and prevent venous ulcers. However, Linton's operation had wound complication rates up to 25%, and it is now obsolete[4]. Edwards in 1976 reported a technique to treat perforators from sites remote to diseased skin. He designed a device, *phlebotome*, which is introduced subfascially through a medial incision below the knee, advanced to the medial malleolus, and without visualization and feeling resistance as perforators are engaged, and perforating veins are disrupted. Stab wounds and hook avulsion is another possibility to treat perforators. However, this technique depends on duplex ultrasound information and operator, and some perforating veins may not be found.

Endoscopic surgery

Wound complication issues were overcome in 1985 when Hauer first described the minimally invasive endoscopic approach to occlude perforating veins. Subfascial endoscopic perforator surgery (SEPS) has a wound complication rate of only 3%-5%, including minor complications[4,6]. The author performs single port technique, which uses a device with a scope and a single working channel. Through a one centimetre--long single incision in the medial face of the upper third of the leg remote from the area of the ulcer and lipodermatosclerosis, the device is introduced subfascially into the superficial posterior compartment, CO_2 insufflation is set to 19 mmHg, and all perforating veins are found and ligated under direct visualization. All Cockett perforators, which are the most affected in CVI[7], are treated. Even perforators under lipodermatosclerosis and ulcers are reached and treated, leaving diseased skin intact. This is the most frequently used technique in Europe[4].

Described by O'Donnell in the US, the two-port technique uses standard laparoscopic instrumentation and two ports, one 10 cm below tibial tuberosity for camera (10 mm) and another half way between first port and ankle (5mm) for instrumentation. Both techniques are valid.

Percutaneous ablation of perforating veins (PAP)

All techniques for PAP involve an ultrasound--guided intraluminal access, instillation of an ablative energy source (chemical or thermal), confirmation of immediate treatment success, and follow-up.

a. *Endovascular techniques*

Radiofrequency (RF) has the capability to measure impedance in the tissues, which helps to confirm the intraluminal presence of the catheter. This is an advantage, because sometimes it seems to be intraluminal in the duplex ultrasound, but impedance

readings with values above 350 ohms confirm the extraluminal presence[6].

For endovenous laser ablation (EVLA) intravascular access is gained with a needle (gauge depends on the fibers used), and intraluminal position is confirmed by ultrasound and aspiration of blood. The fiber is introduced through the needle into the perforating vein with ultrasound guidance.

After correct positioning, local anesthesia is injected around perforator. Trendelenburg position and tumescent anesthesia will exsanguinate the vein and improve catheter/vein wall contact. Energy is applied to the segment. RF has a target temperature of 85ºC in the first minute for all four quadrants of the vein. When using EVLA various methods of energy delivery are possible. Steve Elias[6] uses 15 watts with a 4-second pulse interval and each segment is treated twice, giving 120 joules to each segment. There are reports using 940 nm, 1320 nm and 1470 nm diode laser, delivering 250-290 joules, with similar results[14,15]. The catheter is then withdrawn 1-2 mm and another segment is treated, with a total of two to three segments being treated. Depending on anatomy and access, the longer segment of the vein should be treated. Pressure is applied for 1 minute with an ultrasound probe, and immediately after treatment, a duplex ultrasound should show no flow through treated perforators, and a normal flow in deep vessels.

b. *Ultrasound-guided sclerotherapy (chemical)*

Intraluminal access is confirmed with ultrasound and blood aspiration. Foam is better than liquid, because it helps to exsanguinate the vein and prolongs the contact between sclerosant and vein wall. Many types of sclerosants have been used: sodium tetradecyl sulfate or polidocanol foam[5], sodium tetradecyl sulfate 3% or sodium morrhuate 5% in liquid form, injecting 0,5-1 mL of sclerosant[15]. After infusing the sclerosant, compression is applied with elastic stockings with direct pressure over treated perforator using gauze under the stocking.

Embolization

Garcarek *et al* described in 2012 embolization of perforating veins using Gianturco-Wallace and Tornado (Cook) coils. With this technique 85% of ulcers were completely cured[17]. More studies are needed to compare this endovascular closure with other treatments.

DISCUSSION

Linton procedure is obsolete because of wound complication rates up to 25%, a long recovery period, and an ulcer recurrence rate of up to 55%[4]. To do open surgery with stab incision and hook avulsion, the preoperative exact location and number of perforating veins are needed, which is unusual and ultrasound operator dependent. Additionally, to treat all incompetent perforators in a lower limb, incisions on a skin with ulceration and lipodermatosclerosis are needed, which are extremely dangerous with possible bad outcomes. Using SEPS, the surgeon only needs to know if there is one incompetent perforator to put indication for surgery, because using the endoscope all medial and posterior perforators are visualized and treated. A median of 2 to 3 more perforators are found during SEPS than in the preoperative duplex ultrasound[6]. Common laparoscopic scissors, dissector, and clip applier are all that is needed to perform SEPS. Any surgeon with basic laparoscopic skills will be able to perform it without difficulties. Limited access to perforators due to instruments conflict, or "sword fighting", will not be a problem in the one port technique. Although general or regional anesthesia is the rule, Proebstle and Herdemann performed SEPS with local tumescent anesthesia in 78% of patients. Contrasting to Linton procedure, SEPS can be performed in an ambulatory center, and the patient returns to normal life in one week.

The Piereck *et al* study comparing open surgery with SEPS had to be interrupted due to 53% of complications in open surgery versus 0% in SEPS. In that

study there was no ulcer recurrence in 21 months of follow-up with endoscopic technique[18]. GSV stripping combined with elastic banding when treating venous ulcer has a healing rate of 65%[4], but Ten-Brook reports a healing rate of 88% if SEPS is used in conjunction with stripping[13]. With SEPS, Gloviczki reports an ulcer-healing rate of 88% in 12 months and a recurrence rate at 1-year and 3-years of 16% and 39%[19]. Kalira in a similar study reports a healing rate of 89% and recurrence rate of 4% and 20% at 1-year and 3-years of follow-up[20]. Comparing open surgery with SEPS there is a median healing rate of 89% for open surgery and 90% for SEPS, a median recurrence rate of 23% for open surgery and 11% for SEPS, and wound complication of 25% for open surgery versus 5% with SEPS[4]. It seems clear that SEPS has better results than open surgery. There is a drawback in these studies that do not allow us to take solid conclusions on perforators' role in CVI – SEPS is combined with GSV stripping in most of the cases. However, a study published in 2014 by Kiguchi *et al* on perforators' sclerotherapy in patients without axial reflux support the importance of incompetent perforators in venous ulceration[5]. A paper by Gloviczki reports better results with SEPS combined with GSV stripping than with SEPS alone, but all patients receiving only SEPS had persistent or recurrent ulcer after GSV stripping[19]. Finally Van Gent *et al* concluded in their study published in 2013 that a well-performed SEPS procedure lowers the venous ulcer recurrence rate[21].

Percutaneous ablation of perforating veins (PAP) has advantages that overcome some limitations of surgery. Both SEPS and PAP are performed in an ambulatory center setting, but PAP only requires intravenous sedation and local anesthesia. Wound or infectious complications will be decreased to near zero[6,16], and pain will be minimal. PAP is a good option for high-risk patients. Since recurrent/new perforators will develop in patients over time, PAP offers an easily repeatable and minimally invasive method of management for doctors and patients. Inframalleolar perforating veins can be treated with PAP, and perforators' location is not a problem if they are visualized in duplex ultrasound. However, the major disadvantage of PAP is missed perforating veins, which has a negative impact in the outcome. It is documented that 2 to 3 more perforating veins are seen during SEPS than were identified preoperatively[6,22]. PAP depends on duplex ultrasound information and operator, an important limitation that is overcome by SEPS. Although rare, skin injury, nerve injury, deep vessel injury, recanalization and recurrence of perforating veins are other disadvantages of PAP[6].

With ultrasound-guided sclerotherapy using sodium tetradecyl sulfate or polidocanol foam, Kiguchi[5] reports an ulcer-healing rate of 59% at a mean follow-up of 30,2 months, with an average thrombosis rate of 64%, and calf vein thrombosis occurred after 3% of injections. Warfarin has decreased rates of perforating vein thrombosis with ultrasound-guided sclerotherapy. Masuda *et al.*[16] treated 80 limbs of 68 patients with incompetent perforating veins without axial reflux or previous venous surgery with liquid sodium morrhuate 5%. Immediate occlusion rate was 98%. There were 37 limbs with ulceration and of those, 25 (67,6%) healed at an average time of 35,6 days, with ulcer recurrence rate of 32,4%. They also concluded that perforating veins recurrence is higher in CEAP class C_6. Although there were less wound complications than with surgery, a case of skin necrosis with an ulcer of 5x4 cm occurred after sclerotherapy.

Using RF to treat 20 perforators in 14 limbs, Chang *et al.*[23] reported a 100% immediate success, but 2 (14,3%) perforating veins remained open at the end of 3 weeks. At 6 months and 12 months of follow-up 87% and 91% were reflux free, and 37% and 56% were patent. Meaning that post-treatment patency does not always reveal incompetency. Lumsden *et al.*[24] presented in 2006 the results of 97 perforators treated with RF in 55 limbs. There was an occlusion rate of 91% at 3 weeks, with 1 asymptomatic tibial deep venous thrombosis (DVT).

Proebstle and Herdemann[14] published their results using 940 nm and 1320 nm diode lasers, delivering

an average of 250-290 joules per perforator. They treated 67 perforators in 60 limbs, and 66 (98,5%) were occluded at day 1 after treatment. In an initial study in which only 130 joules were delivered, minimal shrinkage of perforating veins occurred[6]. In 2014 Zerweck *et al.*[15] treated 69 perforators in 55 CEAP class C_3-C_6 patients with 1470 nm diode laser. Immediate success was 100%, with 95,6% perforating veins occluded at 1 month of follow-up. No venous thromboembolism (VTE) occurred, and one patient reported paresthesia distally to puncture site.

Murphy[25] compared 100 perforators treated with RF and 100 perforators treated with EVLA. At 6 months, a 90% closure rate was obtained for RF and 100% closure rate for EVLA. Complications were minimal but included redness, numbness, or blistering in 6 patients. PAP with laser and RF has similar results; however occlusion rates decrease during time of follow-up.

EVLA and concomitant foam sclerotherapy may potentially decrease the recanalization rate[26]. Koroglu *et al.* comparing results of isolated truncal insufficiency versus truncal with perforating veins insufficiency treated with concomitant EVLA and foam sclerotherapy, report superior results and satisfaction of patients in cases with isolated truncal insufficiency[10]. Combination of SEPS and EVLA offer the advantages of microtrauma and rapid cure. Compared to the classic stripping of GSV, the operation time, the number of incisions, and the in-hospital stay decreased on average by 1,5 hours, 4,7 incisions, and 6,8 days[6] respectively.

For the treatment of incompetent perforators, both the Society for Vascular Surgery and the American Venous Forum suggest SEPS or PAP (ultrasonographically guided sclerotherapy, or thermal ablations), however this is a GRADE 2C recommendation.[6,10] According to all data presented above, although PAP showed it is safe and with minimal complications equal to SEPS, there are no studies evaluating ulcer-healing and recurrence rates after RF or EVLA; some studies showed a lower ulcer-healing rate and a higher recurrence after ultrasonographically-guided sclerotherapy as compared to SEPS, and there are no long-term follow-up series on PAP. Because of that, for the author SEPS still is the choice when treating incompetent perforating veins for ulcer healing. PAP techniques are very good and attractive options due to their advantages like less postoperative pain, local anesthesia, and rapid recovery, but more studies are needed to conclude they are similar to SEPS.

CONCLUSION

SEPS increases ulcer-healing rate up to 90%, and decreases recurrence to 11%. Sclerotherapy has an ulcer-healing rate of only 59%-67,6%. RF and EVLA have near 100% immediate occlusion rates, however it decreases during follow-up. PAP is duplex ultrasound dependent, leaving an average of 2-3 perforating veins untreated. PAP techniques are safe and with minimal complications equal to SEPS, but there are no studies evaluating ulcer-healing rate and recurrence rate after RF or EVLA, and there are no long-term follow-up series. Thus, until more studies are available, subfascial endoscopic perforator surgery (SEPS) continues to be the choice/gold standard for the treatment of incompetent perforating veins and all other techniques must be compared to it. Combination of SEPS and PAP may result in better outcomes, and there seems to be a place for each technique.

REFERENCES

1. Costa Almeida CE, Reis L, Carvalho L, Costa Almeida CM. Treatment of venous ulcers with Cronocol implants – analysis of 10 cases. Rev Port Surg 2012; 2(21): 13-20.
2. Siqueira JJP, Siqueira LCD. Úlceras varicosas – Tratamento clinico e curativos. In: Merlo I, Parente JB, Komlós PP. Varizes e telangiectasias: diagnostico e tratamento. São Paulo: Revinter; 2006. 313-324.

3. Lopez AP, Phillips TJ. Venous Ulcers. Wounds 1998; 10(5): 149-157.
4. Rhodes JM, Kalra M, Gloviczki P. The management of incompetent perforating veins with open and endoscopic surgery. In: Gloviczki P. Handbook of venous disorders. Third edition. London: Hodder Arnold; 2009. 523-535.
5. Kiguchi MM, Hager ES, Winger DG, *et al*. Factors that influence perforators thrombosis and predict healing: perforator sclerotherapy for venous ulceration without axial reflux. J Vasc Surg 2014; 59 (5): 1368-76.
6. Steve Elias. Percutaneous ablation of perforating veins. In: Gloviczki P. Handbook of venous disorders. Third edition. London: Hodder Arnold; 2009. 523-535.
7. Gan S, Qian S, Zhang C, Mao J, Li K, Tang J. Combined subfascial endoscopic perforator surgery and endovenous laser treatment without impact on the great saphenous veins or management of lower-extremity varicose veins. Chin Med J 2013; 126 (3): 405-408.
8. Barwell JR, Davies CE, Deacon J, et al. Comparison of surgery and compression with compression alone in chronic venous ulceration (ESCHAR study): randomized controlled study. Lancet 2004; 363: 1854-1859.
9. Evans CJ, Fowkes FG, Ruckley CV, Lee AJ. Prevalence of varicose veins and chronic venous insufficiency in men and women in the general population: Edinburgh Vein Study. J Epidemiol Community Health 1999; 53: 149-153.
10. Koroglu M, Eris HN, Aktas AR, Kayan M, et al. Endovenous laser ablation and foam sclerotherapy for varicose veins: does the presence of perforating vein insufficiency affect the treatment outcome? Act Radiol 2011; 52(3): 278,184.
11. Gloviczki P, Comerota AJ, Dalsing MC, Eklof BG, Gillespie DL, Gloviczki ML, 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. J Vasc Surg 2011; 53:2S-48S.
12. O'Donnell, TF. The role of perforators in chronic venous insufficiency. Phlebology 2010; 25(1): 3-10.
13. TenBrook JA, Lafrati MD, O'Donnell TF, *et al*. Systematic review of outcomes after surgical management of venous disease incorporating subfascial endoscopic perforator surgery. J Vasc Surg 2004; 39:583-589.
14. Proebstle TM, Herdemann S. Early results and feasibility of incompetent perforator vein ablation by endovenous laser treatment. Dermatol Surg 2007; 33(2): 162-168.
15. Zerweck C, Hodenberg E, Knittel M, Zeller T, Schwarz T. Endovenous laser ablation of varicose perforating veins with the 1470-nm diode laser using the radial fibre slim. Phlebology 2014; 29: 30-36.
16. Masuda EM, Kessler DM, Lurie F, Puggioni A, et al. The effect of ultrasound-guided sclerotherapy of incompetent perforator veins on venous clinical severity and disability scores. J Vasc Surg 2006; 43: 551-557.
17. Garcarek J, Janczak D, Kurcz J, et al. Use of Gianturco-Wallace and Tornado coils in perforators embolization in chronic venous ulcers treatment. Polim Med 2012; 42(3-4): 151-158.
18. Pierik EG, van Urk H, Hop WC, Wittens CH. Endoscopic versus open subfascial division of incompetent perforating veins in the treatment of venous leg ulceration: a randomized trial. J Vasc Surg 1997; 26: 1049-1054.
19. Gloviczki P, Bergan JJ, Rhodes JM, *et al*. Mid-term results of endoscopic perforator vein interruption for chronic venous insufficiency: lessons learned from the North American subfascial endoscopic perforator surgery registry. The North American Study Group. J Vasc Surg 1999; 29: 489-502.
20. Kalra M, Gloviczki P, Noel AA, *et al*. Subfascial endoscopic perforator vein surgery in patients with post-thrombotic venous insufficiency: is it justified? Vasc Endovasc Surg 2002; 36: 41-50.
21. Van Gent W, Wittens C. Influence of perforating vein surgery in patients with venous ulceration. Phlebology Online 2013; 0(0): 1-6.
22. Tawes RL, Barron ML, Coello AA, *et al*. Optimal therapy for advanced chronic venous insufficiency. J Vasc Surg 2003; 37: 545-51.
23. Chang DW, Levy D, Hayashi RM, et al. Ultrasound-guided radiofrequency ablation (VNUS) can be used to treat perforator incompetence: 1-year results and how to do it. Vascular 2005; 13: 518.
24. Lumsden A, Chang D, Peden E, Gale S. Ultrasound-guided percutaneous radiofrequency obliteration for treatment of perforating vein incompetence. In: Presented at the Society for Clinical Vascular Surgery Annual Meeting, March 2006.
25. Murphy R. Comparison of radiofrequency and laser for perforator treatment. American College of Phlebology, Poster Session, November 2006.
26. Yilmaz S, Ceken K, Alparslan A, Durmaz S, Sindel T. Endovenous laser ablation and concomitant foam sclerotherapy: experience in 504 patients. Cardiovasc Intervent Radiol 2012; 35(6): 1403-1407.

Correspondência:
COSTA ALMEIDA CE
carloscostaalmeida@yahoo.com

Data de recepção do artigo:
02-10-2014

Data de aceitação do artigo:
26-11-2014