CONTENTS

PHLEBOLYMPHOLOGY

EDITORIAL

Several problems of considerable clinical importance are discussed in this issue of Phlebolymphology.

A paper from Hawaii, written by ***Alessandra Puggioni and Fedor Lurie****, gives an update on surgical options for the treatment of obstruction and reflux in the deep venous system that cause postthrombotic syndrome. The discrepancy between the high incidence of the disease (3/1000 per year in the adult population) and the low number of surgical procedures reported in the literature raises the suspicion that there is still no ideal and standardized method that can be performed in a wide range of settings. However, superficial reflux may additionally contribute to the severity of signs and symptoms of postthrombotic syndrome. The authors underline that removal of a refluxing great saphenous vein is indicated in symptomatic patients if the deep system is not significantly obstructed. The potential damage caused by destroying important collaterals seems to be less relevant than the benefit derived from improving the reflux.*

Abolishment of superficial reflux by "exo-stent repair" is the subject of the paper by ***Rodney J. Lane and Joseph A. Graiche*** *from Australia. The Australian group speculates that neovascularization is a result of blocking the orthograde flow at the level of the junction, in a way similar to what occurs when the caval vein is blocked and collateral veins develop in the abdominal wall. External valvuloplasty would not impede flow and would therefore not cause neovascularization. During the last few years other theories have also emerged, one suggesting that the groin incision alone is the triggering factor. It would be interesting to compare the latest results of Rodney Lanes' method with those after conventional flush ligature of the saphenofemoral junction, regarding both success and the occurrence of neovacularization.*

The report of ***Charles E. Stonerock*** *from the United States on his experiences as a visitor to several vein centers in France convincingly demonstrates the merits of the Servier Traveling Fellowship. It is refreshing to read that our young colleague learned a lot (not just French), and was able to make new friends as well.*

Erysipelas, or cellulitis as it is also called in the English-speaking world, is not an infectious disease beyond the spectrum of vascular medicine, but is in fact associated with lymphatic disorders. This is one of the clear messages of the article by ***Loic Vaillant****, Tours, France. Skin changes on the lower leg are frequently seen in phlebological practice and occasionally misdiagnosed as erysipelas.*

Another frequent clinical condition is the symptom of heavy and swollen legs in premenstrual women. In his short presentation ***Jerry G. Nina*** *reports an enlargement of the great saphenous vein at mid-thigh level in the premenstrual phase in comparison with the follicular phase in women suffering from these symptoms measured by Duplex ultrasonography. Unfortunately, no clinical classification (CEAP) of the 12 investigated legs is given. However, reflux of ≥0.5 seconds was found in 6/11 legs in the follicular phase, while all investigated legs showed a reflux duration of more than 2.5 seconds in the premenstrual luteal phase. One practical implication of these findings is that reflux duration depends not only on room temperature and the time of day of the investigation, but also on the menstrual cycle in females. As the author states, more work will be needed to establish the existence and the pathophysiology of a "premenstrual vasodilation syndrome."*

Interesting data are presented by ***C. E. Virgini-Magalhães and coworkers*** *of* ***Professor Bouskela****'s group in Rio de Janeiro, Brazil. The orthogonal polarization spectral imaging technique was used to visualize skin capillaries in the ankle region in a cohort of different stages of chronic venous disorders C0-C6 according to the CEAP, and the results were compared with those of completely healthy individuals.*

It is amazing to see that even individuals with a C1-pathology (small reticular veins and teleangiectasias) already showed abnormal changes in the microcirculation in the distal lower leg. Could this be related to local spider veins or even corona phlebectatica, perhaps not yet visible to the naked eye?

Happy reading!

Hugo Partsch, MD

Advances in the surgical treatment of postthrombotic syndrome

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ABSTRACT

Postthrombotic syndrome (PTS) is the late complication of lower extremitiy deep venous thrombosis (DVT). Its incidence is approximately 3/1000 per year in the adult population. A combination of reflux and obstruction is often seen in limbs with more advanced clinical disease than obstruction alone. A thorough workup of the patient with disabling PTS is necessary to identify patients amenable to open surgical or endovascular intervention. Duplex scanning is the gold standard for diagnosis of chronic venous disease. The superficial system should be addressed first, followed by or in conjunction with the perforator and deep systems. Chronically obstructed veins are amenable to endovascular interventions, sometimes in combination with disobliteration of the veins ("endophlebectomy"), bypasses or valvular repair. A novel autologous valve reconstruction (the Italian neo-valve) that involves the construction of a valve in postthrombotic veins by using an intimal flap has been performed with satisfactory results. A percutaneously-implantable, non-immunogenic venous valve that remains patent and competent is an attractive alternative to deep venous reconstructions. Results from animal studies with a bioprosthetic valve (the Portland valve) are encouraging.

INTRODUCTION

Postthrombotic syndrome (PTS) is the late complication of lower extremitiy deep venous thrombosis (DVT). Its manifestations are lower extremity edema, pain, eczema, hyperpigmentation, lipodermatosclerosis, and stasis ulcers. The estimated incidence of DVT is approximately 3/1000 per year in the adult population, and the cumulative incidence of PTS after DVT is 22.8% after 2 years, 28% after 5 years, 29% after 8 years,[1] and 40% (10% with, 30% without ulcer) after 13 years.[2] There are no validated measures to predict which patients will develop PTS. Therefore, a patient with acute DVT can expect an approximate global risk of 30% to 40% of developing significant postthrombotic sequelae, most likely within the first 2 years.

Keywords:
venous thrombosis, postthrombotic, venous disease, venous disorders, surgery.

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Venous thrombi originate from the valve sinus. As the thrombus resolves, damage to the venous valves and walls occurs, leading to outflow obstruction and valvular insufficiency. Re-canalization of old organized thrombus results in formation of synechiae and septae. In addition to increased resistance, these structures restrict the movements of venous wall, significantly limiting the ability of the affected vein to adjust to outflow changes. These two processes are cumulatively known as "venous obstruction." Valves eventually become incompetent in both the deep and perforating veins, aggravating ambulatory venous hypertension. The combination of reflux and obstruction is seen more frequently in limbs with more advanced clinical disease than obstruction alone.[3]

The CEAP (Clinical, Etiologic, Anatomic, and Pathophysiologic) classification discriminates patients with secondary chronic venous disease (or postthrombotic syndrome) who may have obstruction, reflux, or a combination of reflux and obstruction in deep veins (Es, Ad, Pr; Es, Ad, Eo; Es, Ad, E r+o), from patients with primary chronic venous disease (Ep) who always have superficial reflux, and do not have deep vein obstruction. The third group includes patients with a combination of primary and secondary diseases, who have postthrombotic changes in deep veins, and reflux in superficial veins.

Duplex scanning is the gold standard for diagnosis of chronic venous disease and constitutes level 2 investigation of the CEAP. It is sufficient for identification and anatomical classification of reflux. Venous obstruction, however, is not as clearly identifiable and quantifiable as reflux, and to-date there is no set of duplex criteria for venous obstruction. Therefore, thickened walls and valves as well as luminal narrowing with poor flow and reduced augmentation after manual compression are often considered as signs of venous obstruction on duplex scans. Plethysmography is another noninvasive tool commonly used for the diagnosis of chronic venous insufficiency, as it may provide an overall assessment of the physiological function of the lower extremity venous system, but is not able to determine the anatomical level of the disease precisely. Ascending and descending venography are invasive methods, performed when vascular or endovascular options are being considered, in order to evaluate the site and extent of both reflux and obstruction. These invasive techniques should be combined with and considered as complementary to duplex studies. Magnetic resonance and computed tomography are evolving techniques that provide a 3D view of the lower extremity venous systems.

In general, conservative management aimed at decreasing ambulatory venous pressure is attempted first. Graduated compression stockings, Unna Boots, leg elevation and local wound care are effective, if ulcers are present. When these noninvasive therapies are unsuccessful (failed ulcer healing or recurrence), due either to poor patient compliance or significant reflux and/or venous obstruction, then surgical therapy should be considered.

SURGERY FOR PTS

Planning for surgical treatment of patients with postthrombotic syndrome requires a thorough and thoughtful diagnostic workup. All sites of reflux and obstruction should be identified and evaluated. Ideally, a "hemodynamic map" should be created for each patient outlining major and minor outflow tracks and reflux sites. This may require a sequence of noninvasive and invasive techniques including dynamic ascending and descending venography.

In general, the more accessible superficial system should be treated first, followed by, or at the same time as the perforator system. However, in the presence of significant proximal deep vein stenosis or occlusion associated with severe obstructive symptoms such as venous claudication, deep venous recanalization by means of angioplasty and stenting may be considered early in the management algorithm (*Figure 1*).

If the deep system is not significantly obstructed, removal of a refluxing great saphenous vein (GSV) is indicated in symptomatic patients. The procedure is generally well tolerated and is associated with improvement in reflux parameters without significant worsening of objective measures of obstruction.[4,5] Thromboprophylaxis with subcutaneous low-molecular-weight heparin should be instituted in this group of patients even during superficial vein surgery. More recent endovenous techniques like endovenous laser therapy (EVLT) and radiofrequency ablation (RFA) have been successfully employed by some authors, even in postthrombotic limbs,[5,6] while others have considered this as a contraindication.[7,8] Therefore, given the paucity of data and the serious concern of recurrent DVT, use of endovenous techniques should be carefully considered in this group of patients.

Leg ulcers are often due to localized venous hypertension originating in an incompetent perforator, which can be treated by minimally invasive surgery (subfascial endoscopic perforator vein surgery - SEPS) or percutaneous

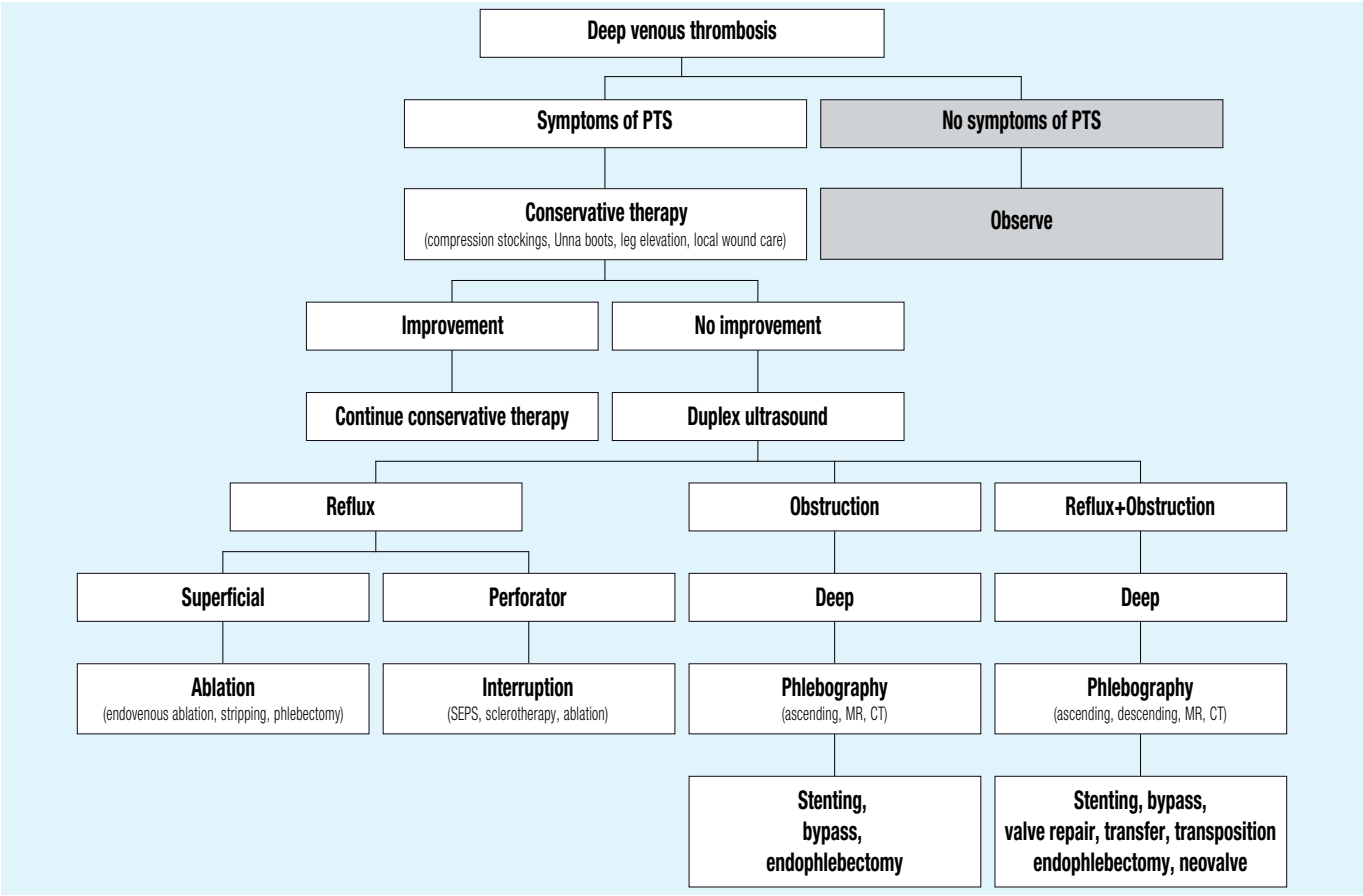

Figure 1. Management algorithm of postthrombotic syndrome (PTS).

procedures (sclerotherapy, avulsion, RFA). Interruption of incompetent perforators with SEPS in limbs with PTS is followed by good early outcomes (72-86% ulcer healing rate),[9,10] but long-term follow-up data have shown that over 50% of healed ulcers recur within 5 years in this group of patients.[9,11] We have used duplex-guided sclerotherapy to treat incompetent perforating veins with good short-term results, also in patients with PTS.[12] RFA[13] has also been recently described as a means of ablating incompetent perforating veins, but its role in PTS has yet to be defined. Moreover, while the advantages of SEPS over conservative treatment have been demonstrated by at least one prospective randomized trial that included 60 limbs with PTS,[10] such comparisons are not available for percutaneous techniques of perforator ablation.

The mainstay of treatment for iliocaval obstruction nowadays is percutaneous angioplasty and stenting. If endovascular recanalization of unilateral iliac vein obstruction has failed, use can be made of a crossover saphenous vein transposition (Palma-Dale procedure), which utilizes the GSV of the contralateral limb to be anastomosed distal to the iliac obstruction. When this type of reconstruction is not feasible or not indicated (ie, GSV not available, bilateral iliac vein or caval obstruction not amenable to stenting), an iliocaval or femorocaval expanded polytetrafluoroethylene bypass graft with the adjunct of a distal arteriovenous fistula is a viable option. Primarily incompetent valves without significant structural changes are sometimes found in limbs affected by PTS. Competence can be restored by internal or external valvuloplasty, both of which were introduced by R. Kistner[14,15] (*Figure 2*). However, it should be pointed out that the durability of such repairs and symptom-free interval are shorter in limbs with PTS than in those with primary valvular incompetence.[16] In the absence of a reconstructable valve, a very select group of patients can be treated by transposition of an incompetent femoral vein to a competent saphenous or profunda vein,[17] or by autotransplantation of upper extremity valved vein segments (axillary, brachial or basilic) to postthrombotic veins of the lower extremity.[18]

Reflux in postthrombotic veins is a challenging problem. Because the valves are frequently destroyed, deep venous

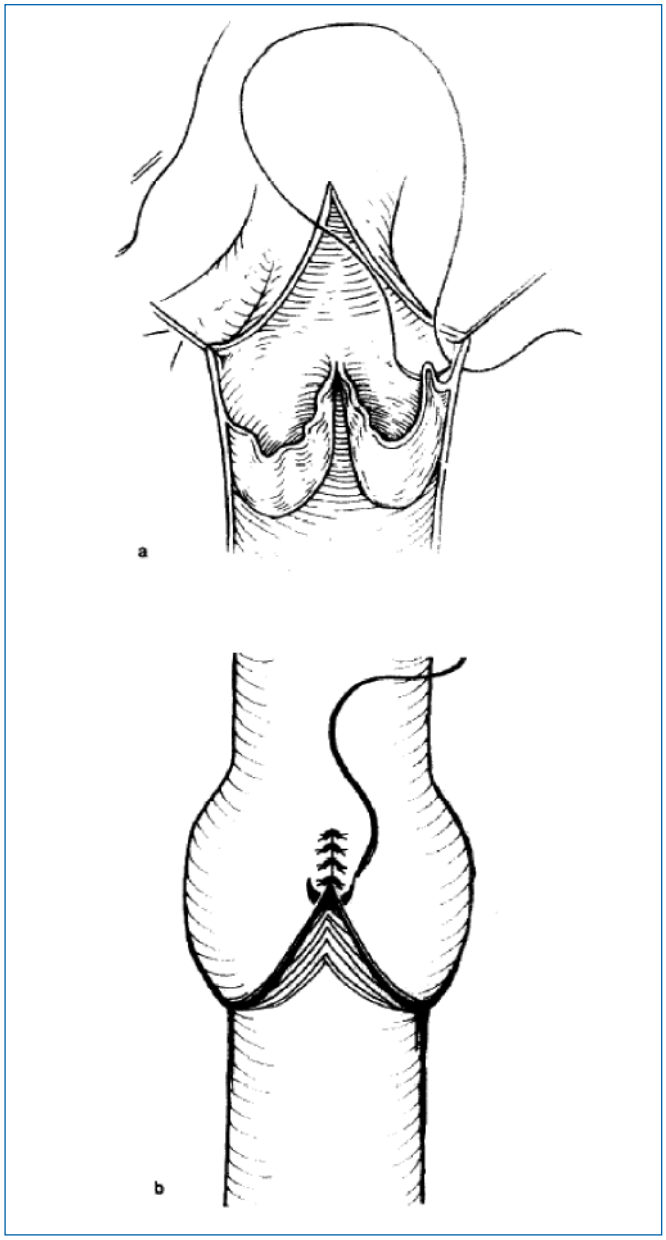

Figure 2. Kistner valvuloplasties.
a) Internal valvuloplasty (transvalvular approach) and
b) External valvuloplasty.

"Reprinted from *Cardiovascular Surgery*, Vol. 3, No. 2, RL. Kistner, B. Eklof and EM. Masuda, Deep venous valve reconstruction, pp 129-140, Copyright (1995), with permission from Paula Mucci, BC Decker Inc."

reconstruction requires valve substitution rather than repair. Surgical options include transplantation of a venous segment containing an intact valve,[19] or transposition of an adjacent segment containing a competent valve.[20] The long-term success rate of these procedures has been consistently reported as close to 50%.[21]

RECENT ADVANCES

Endophlebectomy

In 2003 we described how surgical disobliteration, or "endophlebectomy", of chronically obstructed venous segments can be performed to increase the flow through previously obstructed veins during various kinds of procedures, including deep venous reconstructions and iliocaval stenting.[22,24] The main indications were: to allow valve repair, increase inflow for iliac vein stenting, increase outflow for vein valve transposition or transfer, and increase calf outflow. With this technique, postthrombotic veins and their major branches are surgically exposed and longitudinal venotomy is carried out at a variable length. The synechiae and masses attached to the intimal layer are carefully excised (*Figure 3*).

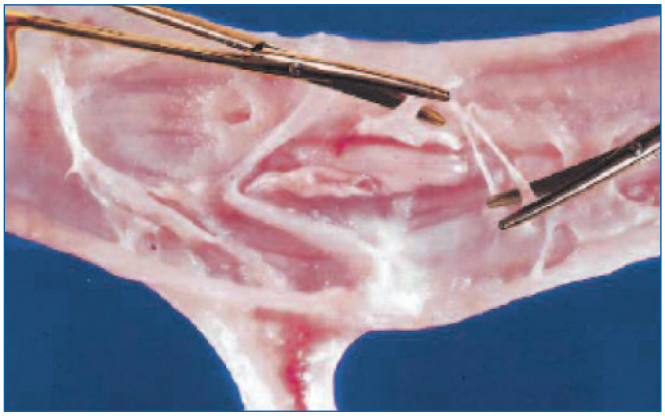

Figure 3. Endophlebectomy. The postthrombotic vein is open longitudinally and the synechiae attached to the intimal layer are carefully removed with scissors.

"Reprinted from *J Vasc Surg*, Vol. 39, No. 5, Puggioni A, Kistner RL, Eklof B, Lurie F, Surgical disobliteration of postthrombotic deep veins – endophlebectomy –is feasible, pp 1048-1052, Copyright (2004), with permission from Elsevier Science Ltd."

After removal of the synechiae, an increase in vein diameter is observed as a result of the release of constricting bands, and this contributes to improved vessel compliance. The venotomy is then repaired primarily with a longitudinal running suture. In our series of 13 patients, surgical disobstruction of 23 deep venous segments was performed in association with 14 deep venous reconstructions. In 10 patients (77%) the treated segments remained primarily patent at mean follow-up of 11 months, while overall secondary patency rate was 93%. Synechiae were removed at the base of their tenuous attachments. In order to minimize the risk of thrombosis, we tried to preserve as much endothelium

as possible. Recently, a case-series of 8 patients who underwent endophlebectomy in conjunction with iliocaval vein stenting has been reported from the Mayo Clinic.[23]

The authors used venoplasty with a bovine pericardial patch to increase vein diameter at the venotomy site. At a mean follow-up of 10 months, 3 occlusions and 2 restenoses were identified, all successfully treated with endovascular interventions.

The Italian neovalve

A novel autologous valve reconstruction that involves the construction of a neovalve in postthrombotic veins by using vein wall dissection and an intimal flap has been performed on 16 limbs and described by an Italian group of vascular surgeons.[25] The technique consists of surgical exposure of the vein, followed by longitudinal or T-shaped venotomy. The thickened intima is carefully dissected and a bi- or monocuspid valve obtained by creating an intimal flap with an ophthalmic blade or microscissors (*Figure 4*). The flaps have to be accurately sized in order to prevent valve prolapse, and therefore incompetence. At the end of reconstruction, valve function is assessed by using the strip test.

At a median follow-up of 22 months, clinical improvement was observed in 89% of cases, overall patency was 83.3%. All patent valves remained competent at follow-up.

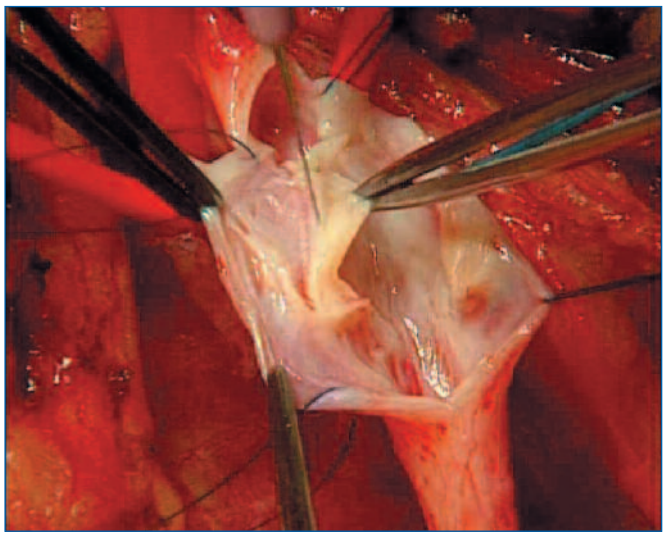

Figure 4. The Italian neovalve. The thickened intima is carefully dissected and a bi- or monocuspid valve obtained by creating an intimal flap with an ophthalmic blade or microscissors.

"Reprinted with verbal consent from the authors (Maleti and Lugli) – Unpublished."

Cryopreserved venous valves

Short-term results of cryopreserved vein valves in humans have not been favorable. Neglen and Raju[26] described a high morbidity of 48% after the procedure was performed in 25 patients due to seroma formation, with wound infection and poor patency/competency rates at 2 years (41% and 27%, respectively). Clinical results paralleled poor technical results as pain and swelling did not ameliorate significantly. At this point in time, it seems that improved cryopreservation techniques, immunologic modifications, or better matching are required before cryovalves can be reconsidered as an alternative to deep venous reconstruction.

Experimental artificial venous valves

Percutaneously implanted artificial venous valves were frist attempted in animal models, with various degrees of success. The small-intestinal submucosa square-stent bicuspid venous valve—the Portland valve—has given very promising results.[27]

Long-term results of the valve implanted in the sheep's internal jugular resulted in 88% success as the valves maintained good function after 6 months.[28] Malfunction of the remaining valves (12%) was due to valve tilting; 4% had thrombi in the tilted valve. A second-generation valve consisting of a square stent submucosa attached to a second square stent (DS BVV) or Z-stent was then developed (*Figure 5*). No tilting was seen at 6 weeks and angiographic competency was over 90%.

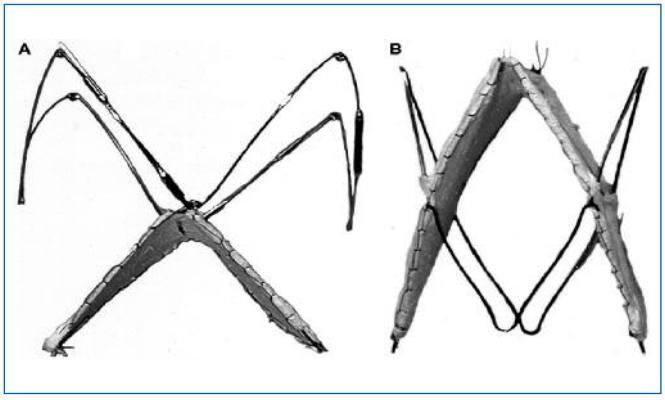

Figure 5. Second-generation bioprosthetic venous valves. A stainless steel Z-stent with barbs is attached to the apex of the square stent valve. B, A nitinol double-stent bioprosthetic venous valve with 4 barbs.

"Reprinted from *J Vasc Surg*, Vol. 40, No. 6, Pavcnik D, Kaufman J, Uchida BT, et al, Second-generation percutaneous bioprosthetic valve: a short-term study in sheep, pp 1223-1227, Copyright (2004), with permission from The Society for Vascular Surgery."

CONCLUSION

A thorough workup of patients with disabling PTS is necessary to identify which patients are amenable to open surgical or endovascular intervention. The superficial system should be addressed first, followed by or in conjunction with the perforator and deep systems.

In those who have mainly deep valvular incompetence, valvuloplasty can be expected to yield good long-term results in a high percentage of patients. Chronically obstructed veins are amenable to endovascular interventions, sometimes in combination with open disobliteration of the veins, bypasses or valvular repair.A percutaneously implantable, nonimmunogenic venous valve that remains patent and competent is an attractive alternative to deep venous reconstructions. The results of current studies are encouraging and warrant an experimental trial in humans.

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REFERENCES

1 Prandoni P, Lensing AW, Cogo A, et al. The long-term clinical course of acute deep venous thrombosis. *Ann Intern Med*. 1996; 125:1-7.

2 Eichlisberger R, Widmer MT, Frauchiger B, et al. The incidence of post-thrombotic syndrome. *Wien Med Wochenschr*. 1994;144:192-195.

3 Neglén P, Thrasher TL, Raju S. Venous outflow obstruction: an underestimated contributor to chronic venous disease. *J Vasc Surg*. 2003;38:879-885.

4 Raju S, Easterwood L, Fountain T, et al. Saphenectomy in the presence of chronic venous obstruction. *Surgery*. 1998;123:637-644.

5 Neglen P, Hollis KC, Raju S. Combined saphenous ablation and iliac stent placement for complex severe chronic venous disease. *J Vasc Surg*. 2006;44:828-833.

6 Puggioni A, Kalra M, Carmo M, et al. Endovenous laser therapy and radiofrequency ablation of the great saphenous vein: analysis of early efficacy and complications. *J Vasc Surg*. 2005;42:488-493.

7 Lurie F, Creton D, Eklof B, et al. Prospective randomized study of endovenous radiofrequency obliteration (closure procedure) versus ligation and stripping in a selected patient population (EVOLVeS Study). *J Vasc Surg*. 2003;38:207-214.

8 Huang Y, Jiang M, Li W, et al. Endovenous laser treatment combined with a surgical strategy for treatment of venous insufficiency in lower extremity: a report of 208 cases. *J Vasc Surg*. 2005;42:494-501.

9 Kalra M, Gloviczki P. Surgical treatment of venous ulcers: role of subfascial endoscopic perforator vein ligation. *Surg Clin North Am*. 2003;83:671-705.

10 Van Gent WB, Hop WC, Van Praag MC, et al. Conservative versus surgical treatment of venous leg ulcers: a prospective, randomized, multicenter trial. *J Vasc Surg*. 2006;44:563-571.

11 Puggioni A, Kalra M, Noel A, et al. Ulcer healing and recurrence after subfascial endoscopic perforator surgery (SEPS). Paper presented at the 17th American Venous Forum Meeting; March 9-13, 2005; San Diego-CA.

12 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;43:551-556.

13 Whiteley, MS, Holstock JM, Price BA, et al. Radiofrequency ablation of refluxing great saphenous systems, Giacomini veins and incompetent perforating veins using VNUS Closure and TRLOP Technique. *J Endovasc Ther*. 2003;10:1-46.

14 Kistner RL. Valve reconstruction for primary valve insufficiency. In: Bergan JJ, Kistner RL, eds. Atlas of Venous Surgery Philadelphia: WB Saunders, 1992:125-130.

15 Kistner RL. Surgical technique of external venous valve repair. *The Straub Foundation Proceedings*. 1990;55:15-16.

16 Raju S, Fredericks RK, Neglen PN, Bass JD. Durability of venous valve reconstruction techniques for "primary" and postthrombotic reflux. *J Vasc Surg*. 1996;23:357-366.

17 Kistner RL, Sparkuhl. Surgery in acute and chronic venous disease. *Surgery*. 1979;85:31-43.

18 Raju S, Neglen P, Doolittle J, et al. Axillary vein transfer in trabeculated postthrombotic veins. *J Vasc Surg*. 1999;29:1050-1062.

19 Taheri SA, Pendergast DR, Lazar E, et al. Vein valve transplantation. *Am J Surg*. 1985;150:210-212.

20 Ferris EB, Kistner RL. Femoral vein reconstruction in the management of chronic venous insufficiency. *Arch Surg*. 1982;117:1571-1579.

21 Lurie F, Kistner RL, Eklof B. Surgical management of deep venous reflux. *Seminars in Vascular Surgery*. 2002;15:50-56.

22 Kistner RL, Lurie F, Puggioni A, Eklof B. Seven cases illustrating the feasibility of surgical disobliteration of deep veins ("Endophlebectomy") in postthrombotic disease. Paper presented at the 15th American Venous Forum Meeting; February 20-3, 2003; Cancun-Mexico.

23 Oderich GS, Noel AA, Bjarnasson H, et al. Open endophlebectomy and endovenous stenting for chronic thrombosis of the inferior vena cava and the iliofemoral veins. Presented at the 18th annual American Venous Forum meeting, Feb 22-26, 2006 Miami, FL.

24 Puggioni A, Kistner RL, Eklof B, Lurie F. Surgical disobliteration of postthrombotic deep veins –endophlebectomy - is feasible. *J Vasc Surg*. 2004;39:1048-1052.

25 Maleti O, Lugli M. Neovalve construction in postthrombotic syndrome. *J Vasc Surg*. 2006;43:794-799.

26 Neglen P, Raju S. Venous reflux repair with cryopreserved vein valves. *J Vasc Surg*. 2003;37:552-557.

27 Pavcnik D, Uchida BT, Timmermans HA, et al. Percutaneous bioprosthetic venous valve: a long-term study in sheep. *J Vasc Surg*. 2002;35:598-602.

28 Pavcnik D, Kaufman J, Uchida BT, et al. Second-generation percutaneous bioprosthetic valve: a short-term study in sheep. *J Vasc Surg*. 2004;40:1223-1227.

Incompetent venous valves: ultrasound imaging and exo-stent repair

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Keywords:
incompetent, venous valve, ultrasound, B-flow, external stenting.

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SUMMARY

Background: Lower limb venous disease remains a significant problem in our community today. The condition has been treated mainly with ablative procedures such as stripping and/or sclerotherapy. The aim of this study was to assess external valvular stenting (EVS) of incompetent venous valves as a reparative alternative to the management of patients with varicose veins. In addition, ultrasound examination of the superficial venous valves prior to surgery was also assessed for its ability to predict success with EVS.

Methods: Valves considered for EVS were assessed with brightness-mode (B-mode), spectral pulsed Doppler (PD), color Doppler imaging (CDI) and brightness-flow (B-flow).
The ultrasonic features of the great saphenous vein (GSV), terminal valve (TV) and sub-terminal valves (STV) were considered. Inclusion criteria were valvular ring dilation <12 mm in diameter, internal diameter (ID) <12 mm along the entire length of the trunk, symmetry of the valve sinuses, positive identification of two valve cusps, and symmetrical reflux flow patterns through the incompetent valve. There were 69 limbs included in the study. All repaired TVs were tested intraoperatively for competence after application of the EVS. If there was evidence of residual reflux, the STV was also repaired. The operated limbs were assessed clinically 3 months after the procedure at which time ultrasound was also used to test the repaired valves.

Results: Of the 69 TVs that were examined preoperatively, a total of 50 were considered repairable by ultrasonic features. At operation, 44 of these valves were successfully repaired. In the 6 limbs that had residual TV reflux, the STV was repaired. All 6 had competence in the GSV trunk following the STV EVS. Of the 19 TVs that were considered by ultrasonic features to be unrepairable, 18 had gross reflux following EVS with 1 only being repaired successful. All limbs that were successfully repaired at operation were followed up 3 months later, and re-examined with diagnostic ultrasound. Of this group, 3 GSVs had residual reflux at the TV and STV, 1 GSV had major reflux and 1 GSV developed thrombophlebitis. The overall figures for the predictability of successful EVS based on ultrasonic features of the valve were sensitivity 97.8% (95% CI, 88.2 – 99.6), specificity 75% (95% CI 53.3 – 90.2) and accuracy 90.4%.

Conclusions: In the treatment of varicose veins, a combination of ultrasound modalities accurately predicts EVS outcomes at the TV and STV of the GSV.

INTRODUCTION

The consensus among vascular surgeons is that high ligation of the great saphenous vein (GSV) without stripping makes it available for use as a bypass conduit, produces greater patient postoperative satisfaction, and minimies postoperative neuralgia.[1] Unfortunately, this procedure results in a high long-term recurrence rate.[2,3] Similarly, the use of ultrasound-guided sclerotherapy (UGS) to treat reflux in the GSV while cost effective and less invasive, at present has a high incidence of residual saphenofemoral junction (SFJ) and GSV reflux with subsequent recurrences.[4-6] For treatment to be successfully reflux must be significantly abolished. Most available treatment options have achieved this however; all obstruct the normal upward flow of blood in the GSV. This results in neovascularization, usually at the groin, and the development of haphazard collateralization that presents as recurrent varicose veins. The most spectacular example of venous neovascularization is seen in obstruction of the inferior vena cava. Collateral pathways will always develop with obstruction to any part of the vascular system, arterial or venous. In the venous system, these collateral veins have no valves and therefore reflux returns.

The ideal surgical solution is a minor procedure, like high ligation, which abolishes the source of reflux without stimulating collateral development. External valvular stenting (EVS) has been performed in a large number of animals and man with encouraging results.[7-10] The premise of this treatment is based upon the initial pathology being venous valve ring dilation with normal cusps that progressively become atrophied, avulsed, and resorbed.[11-13] The physiology of the GSV is restored by repairing the terminal valve (TV) and/or subterminal valve (STV) at the SFJ because repair inhibits reflux without producing obstruction. The key to success in EVS lies in the identification of valves that are suitable for repair. The original criteria for determining valve suitability for EVS were based upon the preoperative brightness-mode ultrasound (B-mode) measurements of the internal diameter (ID) of the GSV at the SFJ and STV.[8-10] Over time, imaging of the valve cusps has become more consistent as ultrasound technology has improved. In recent times, there has been significant improvement in the axial and lateral B-mode resolution, the development of color doppler imaging (CDI) and more recently the addition of brightness- flow (B-flow) technology.[14-18]

METHODS

Patients

Forty-two patients or 69 limbs were included in this study. A standard history was taken and clinical examination performed on all patients with the management options in mind being both to repair the SFJ and preserve the GSV or, conversely, ablation of the GSV. Patients with a history of above-knee thrombophlebitis or obvious advanced disease (gross dilatation of the GSV trunk itself or ID.12 mm) were excluded from the study. Good indicators of a successful restorative procedure were mild to moderate varicose veins in a young patient, particularly with an incompetent anterior or lateral accessory system with minimal involvement of the GSV trunk.[8] Males with a strong personal or family history of degenerative arterial disease or patients with underlying primary or secondary deep venous disease were a further relative inclusive category. Future pregnancy aspirations were also considered, as EVS at the SFJ should be performed prior to the next conception if possible. This is in stark comparison to conventional management practice where it is recommended that surgery is delayed until after the final pregnancy.

Ultrasound equipment

A General Electric, Logic 700 Expert Series (General Electric, Milwaukee, Wisconsin, USA) with 5-10 MHz and 6-13 MHz carrier frequency probes were utilized in this study. This system also includes a B-flow module that allows simultaneous imaging of tissue and blood flow.

Scanning technique

a. B-mode

In a sagittal plane, the valve mechanism is usually identified as a pear-shaped dilatation extending over approximately 1-1.5 cm. This is accentuated with a Valsalva maneuver. The cusps of a normal venous valve are semilunar in shape and directly opposed (*Figure 1*). The most common location of any valve is immediately distal to the point of entry of a major tributary. The valve cusps themselves project directly into the lumen and, being

specular reflectors, produce brighter or stronger echoes than the surrounding blood. The curvature of the cusps can often be seen and normal cusps may be seen to move or flutter with respiration. During the Valsalva maneuver, with normal competent valves the cusps can be seen to move towards each other. If the cusps are diseased, movement may be decreased and occasionally the cusps themselves move discernibly slower. In the diseased vein, dilatation of the valve ring may also be evident. The cusps may look normal in the early stages with progressive thickening, atrophy and eventually resorption with advanced disease. Movement is decreased and there may be asymmetry of the valve sinus. Indeed it is important to scan the whole system to make sure there is no thrombophlebitis or that the remainder of the GSV trunk is too diseased to consider repair even if the valves appear suitable. In advanced disease the GSV is >10 mm ID in females and >11.0 mm ID in males.[7,8] It is interesting to note, however, that occasionally competence may be found in systems that are quite dilated and in these cases, the valve cusps themselves are usually quite long. Therefore, the measurements are a rough guide only. It is important that perforating systems, particularly the reentry perforating systems, are detected and removed at surgery. Also, an understanding of pathology involving the short saphenous vein and the underlying deep system is critical.

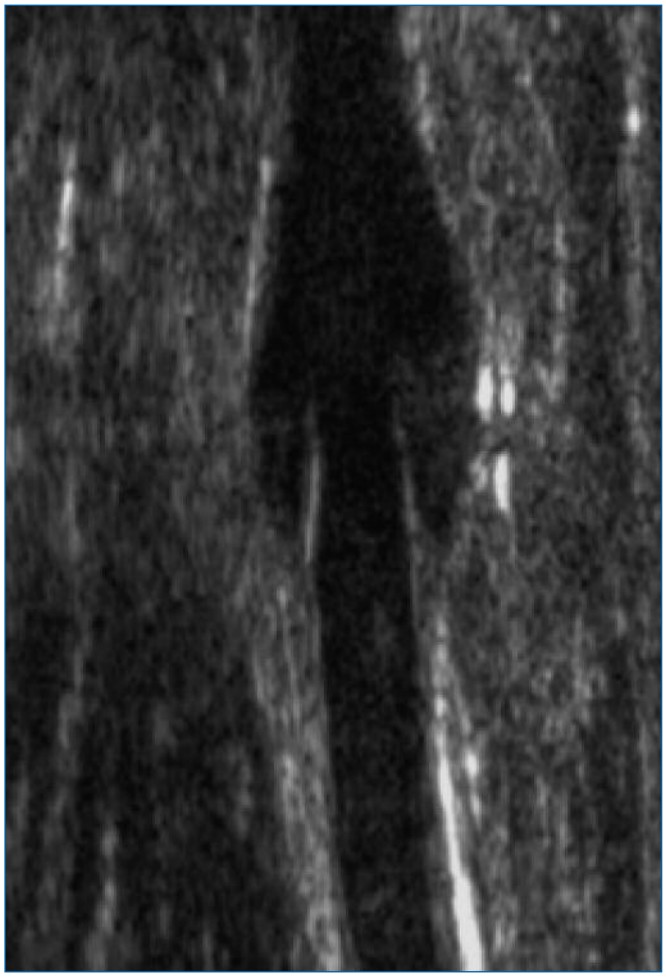

Figure 1. Open venous valve (B-mode). Sagittal image of an open STV at the SFJ. Following flow augmentation, separation of the two cusps is clearly demonstrated as flow.

b. Color duplex imaging

This is extremely helpful when applied to venous valve localization assessment, particularly in the deep veins of the thigh where the resolution of the B-mode may be inadequate. When reflux is present, retrograde flow produces a change in the color flow above the level of the valve sinus, turbulence is readily seen immediately superior to the valve cusp indicated by multidirectional flow and frequency aliasing in some cases. This usually occurs in the angle between the valve leaf and the venous wall. Depending on the valve dilatation and subsequent valve cusp misalignment, a high flow is seen originating from the center of the vessel between the valve cusps. The use of this technique needs to be combined with the other two as confusion can arise when there are incompetent tributaries and varicosities near the valve under investigation.

c. B-flow

This technique uses the unique ultrasonic reflectivity of aggregates of moving red cells. The higher the velocity of the red cells the greater the return signal and the brighter the real-time echo. Streaming of red cells is demonstrated and, the laminae between relatively high and low flows can often be discerned. Turbulence can be detected as an interruption of the laminae. In other words, B-flow looks and acts like a radiological contrast agent.

Optimally, B-flow images should be assessed using cine-loop video so that the playback speed can be adjusted. This allows more detailed examination of the various blood flow patterns that develop in and around the valve cusps. A normal open valve is demonstrated in *Figure 2*. The location of the valve cusps is implied by the hypoechoic areas on either side of the vein lumen where the streaming red cells produce an "hour-glass" appearance. As the valve opens with flow augmentation via compression of the distal muscle groups, the intrusions decrease in size and may completely disappear *(Figure 3)*. With a

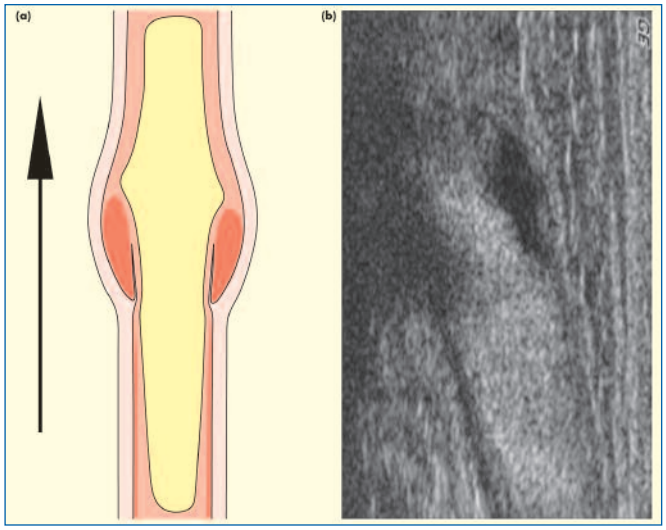

Figure 2. Competent venous valve (open). Sagittal section of a normal venous valve demonstrated on B-flow. There is central streaming, with a decrease in the "hourglass" appearance following flow augmentation with distal limb compression: (a) schematic and (b) B-flow ultrasound images.

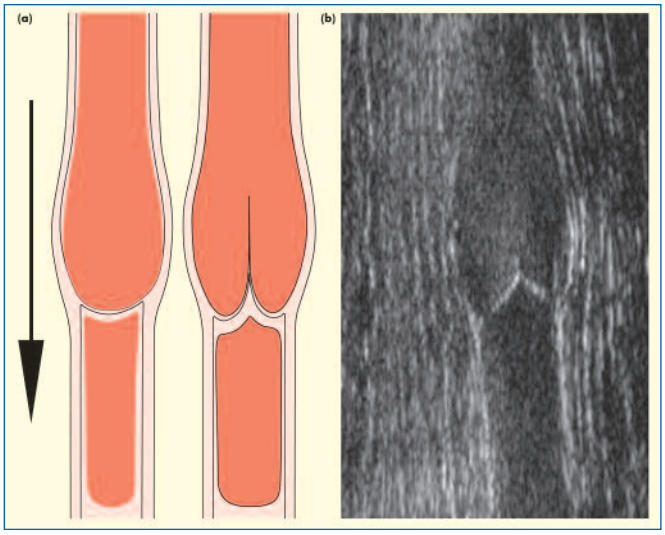

Figure 4. Competent venous valve (closed). The valve sinus is symmetrical, the flow defect is seen either side of the flow stream and the valve cusps approximate following a Valsalva maneuver. No B-flow is seen as blood flow has ceased: (a) schematic and (b) B-flow ultrasound images.

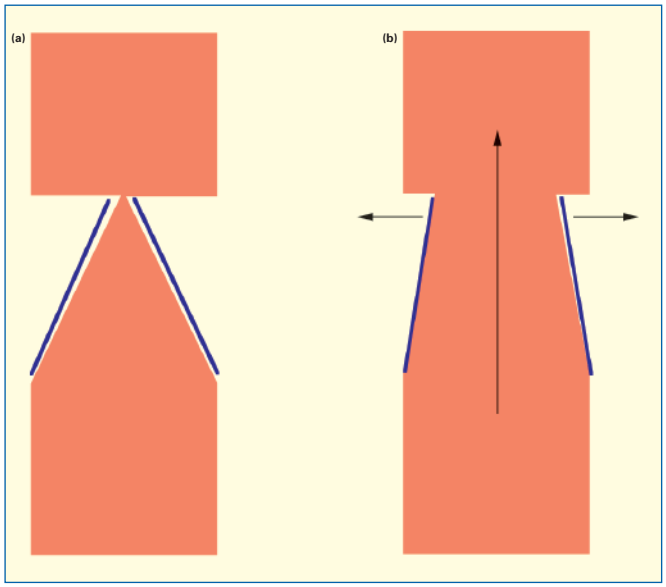

Figure 3. When the valve is closed (a), the B-flow image is comparable to that given by descending phlebography during the Valsalva maneuver. When the valve is open (b), the lumen widens because of the passage of blood.

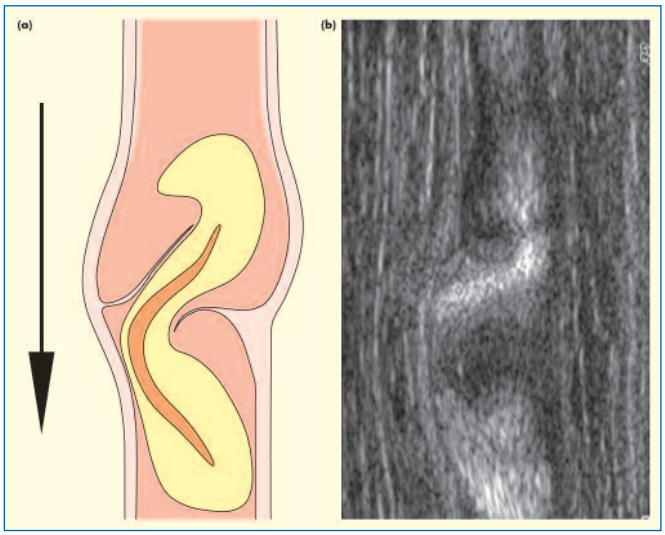

Figure 5. Incompetent abnormal venous valve. The valve sinus is distorted. The cusp above the dilatation is frozen and the adjacent cusp is prolapsed. The high-velocity retrograde streaming deviates laterally above a prolapsing cusp: (a) schematic and (b) B-flow ultrasound images.

cross-section image, the central streaming and subsequently an increase in velocity of red blood cell rouleaux density produces an increased ultrasonic return echo as it passes through the valve. In assessing retrograde flow, either a Valsalva maneuver or digital compression produces no streaming beyond the valve. *Figure 4* is a typical representation of a closed or competent valve following a Valsalva maneuver. The valve sinus is symmetrical, the valve cusps come together and as flow has ceased there is no B-flow information.

An abnormal finding is shown in *Figure 5*. In the longitudinal plane, the "hourglass" appearance is asymmetrical. When the valve cusp is fixed and immobile, the central streaming does not move out to the vein wall and there may be a high-velocity flow as shown by increasing

density of the returning echoes. On cross-section, irregular streaming and asymmetrical vortices associated with asymmetrical areas of low echoes indicate low flow.

A repairable valve is demonstrated in *Figure 6*. There is symmetrical streaming but retrograde flow indicating incompetence. There are symmetrical hypoechoic areas in the valve sinus and inferior to the cusps themselves. The central streaming broadens, however, with digital pressure inferior to the valve. *Figure 7* demonstrates prolapsing valve cusps, which have been christened the "Dagger Sign" by the sonographer and co-author. Two valve cusps are implied by the symmetrical flow defect and appear to be flattened against the wall with upward flow. This valve also repairs well. *Figure 8* is of a SFJ with no demonstrable valve where there is clear retrograde flow, ie, reflux and no apparent eddies with a uniform return of echoes across the entire lumen.

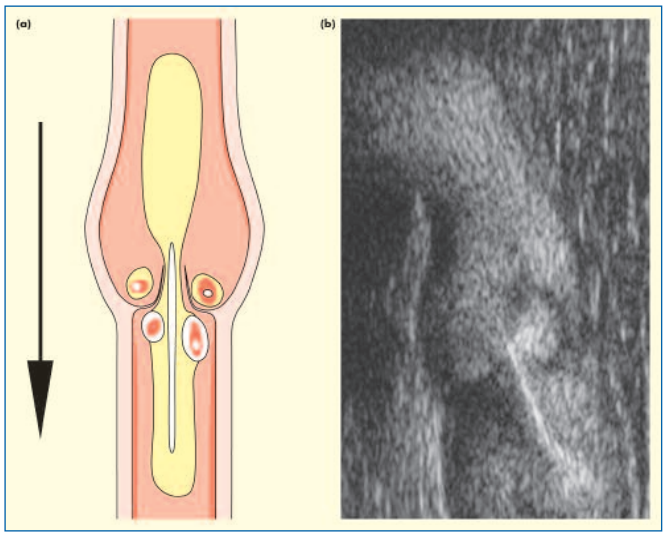

Figure 6. Incompetent repairable venous valve. Retrograde high velocity central streaming is seen with turbulence above the upturned valve cusps and decrease flow below. Flow distribution is symmetrical: (a) schematic and (b) B-flow ultrasound images.

d. Ultrasound data collation

All examinations were performed by the same sonographer with many years of extensive experience in the diagnosis of venous disease. Ultrasound findings were documented on a "Venous Map", a worksheet with a schematic representation of the deep and superficial veins of the lower limb (*Figure 9*). This provided graphic information on the size and condition of the GSV and any associated tributaries or perforators. Particular emphasis was placed on determining the effects of previous surgical intervention, the maximum ID of the GSV and any significant tortuosity, and any evidence of superficial thrombophlebitis. Abnormalities within the deep venous system and/or the short saphenous vein were also recorded. For clarity, an enlarged section representing the terminal segment of the GSV was incorporated into the worksheet to detail the condition of the TV and STV and their relationship to the common femoral vein (*Figure 10*).

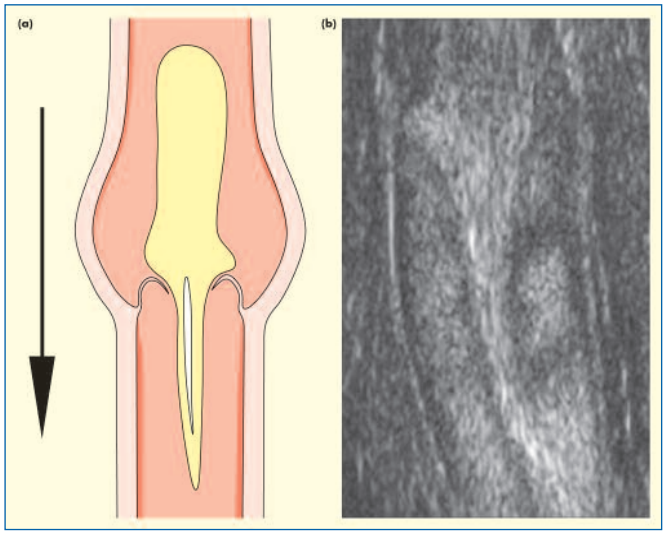

Figure 7. The "Dagger Sign." Retrograde flow is seen through and over the downward-facing, prolapsed valve cusps with a curved tapering stream as flow velocity decreases distally: (a) schematic and (b) B-flow ultrasound images.

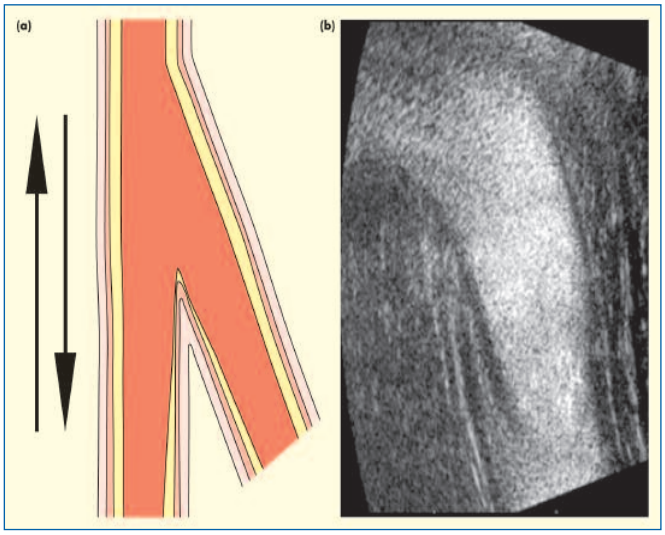

Figure 8. Avalvular vein. No cusps were visible on B-mode. As the lumen is empty, no laminar flow separation is seen on B-flow: (a) schematic and (b) B-flow ultrasound images of the terminal and subterminal valves sites, respectively.

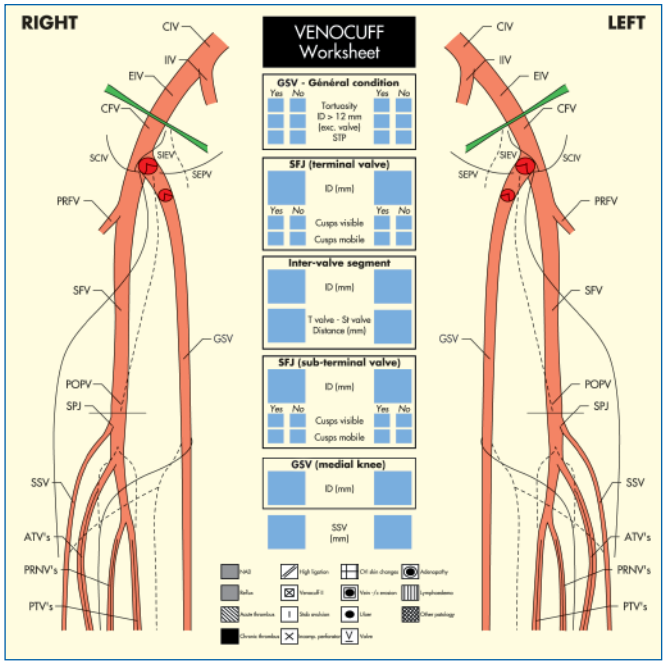

Figure 9. Venous ultrasound examination worksheet, used to record findings including the anatomy of the deep and superficial veins, previous surgical intervention, and any evidence of deep vein thrombosis or superficial thrombophlebitis. An enlarged schematic representation of the terminal segment of the great saphenous vein allows for more precise documentation of the terminal and subterminal valves.

CIV = common iliac vein
IIV = internal iliac vein
EIV = external iliac vein
CFV = common femoral vein
PRFV = profunda femoris vein
SCIV = superficial circumflex iliac vein
SIEV = superficial inferior epigastric vein
SEPV = superficial external pudendal vein
SFV = superficial femoral vein
SFJ = saphenofemoral junction
GSV = great saphenous vein
POPV = popliteal vein
SPJ = saphenopopliteal vein
SSV = small saphenous vein
ATV's = anterior tibial veins
PRNV's = peroneal veins
PTV's = posterior tibial veins
ID = internal diameter
T valve = terminal valve
ST valve = subterminal valve
NAD = no abnormality detected

MATERIALS

The usual configuration of the materials supplied in a Venocuff II' Kit, (Imthage, Sydney, New South Wales, Australia) include a designated "L" stent, which is for repairing the left SFJ, a designated "R" for the right SFJ, and an un-notched stent, "D". The "D" is used for deep venous valve reconstruction, but can also be used to repair to the ST valve of the left or right GSV. Holes have been placed in the belt of the Venocuff II' act as a guide indicating the stent ID. The first hole in the belt indicates a stent ID of 5.5 mm equating to an GSV ID of 4.5 mm when the wall thickness of the GSV is considered. From experience this is the most appropriate size of the TV ring for a small woman. The next hole on the belt indicates a stent ID of 6.5 or GSV ID of 5.5 mm. The third hole indicates a stent ID of 7.5 mm or GSV ID of 6.5 mm, which is most appropriate for a larger male. The shape of the notch has also been modified to improve the symmetrical reduction of the diameter of the valve ring of the SFJ. Also, the belt buckle has been widened to allow the device to take on an elliptical shape as the diameter is decreased.

Operative management

In patients taking hormonal medication, medication was stopped and treatment was suspended for a minimum of 3 weeks prior to operative intervention. Infected lower limb lacerations were assessed, documented and the procedure was postponed if there appeared to be any chance of an infective complication occurring. The patients were instructed not to shave their legs or the groin region as the chance of developing an infection in the severed hair follicles is high. Shaving was performed at the time of induction. Immediately before operative intervention 5,000 units of heparin were given subcutaneously and 2,000 units intravenously. At this stage intravenous antibiotics were also given.

A standard groin incision was used dissect to and expose the SFJ. Tributaries were clipped for access only and the common femoral vein was exposed with at least 1/2 cm clearly visible in the operative field. A Vessiloop™ was placed around the terminal portion of the GSV 3 cm below to the SFJ and was used to control inflow while testing the competence of the SFJ after EVS. The exact location of the TV was identified based on preoperative ultrasound measurements and with a right-angle forceps; the stent was introduced around the valve. The end of the stent was inserted into the buckle and tightened. By determining the ID of the SFJ preoperatively, it was often possible to predict the ID required at operation to achieve competence as previously described. A mosquito clip was used to temporarily fix the diameter of the stent and then to position the device as high as possible onto the common femoral vein by using the notch in the belt to cover the valve ring.

The valve repair was then tested. The head of the bed was elevated maximally in order to increase the venous pressure, and if the patient was under general anesthesia,

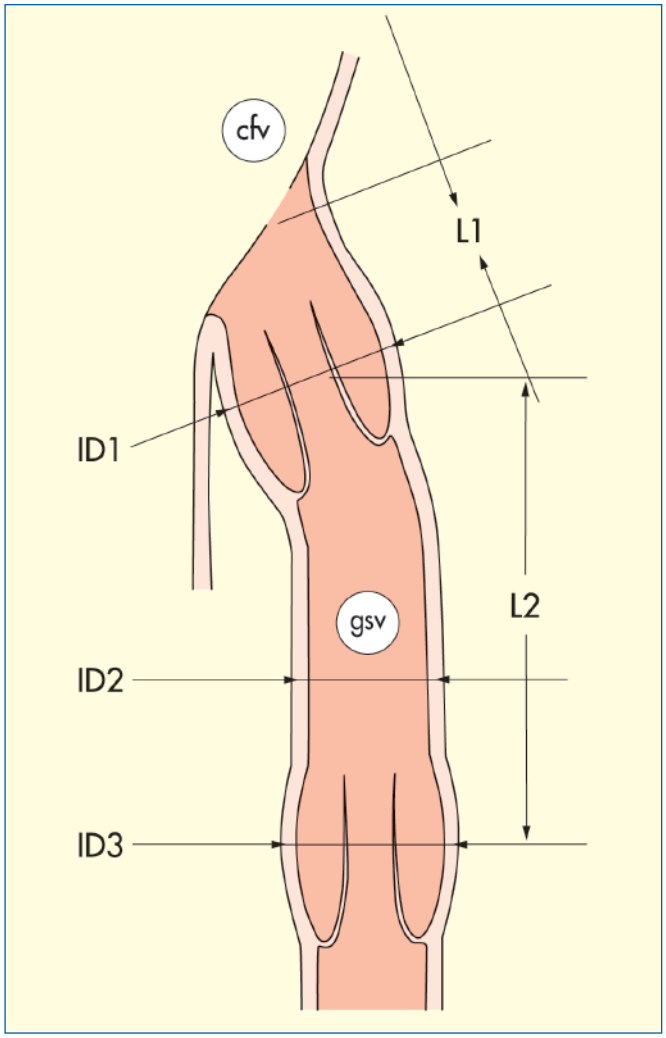

Figure 10. Venous mapping after ultrasound examination: schematic representation of the terminal and subterminal valves.

ID1 = internal diameter of the great saphenous vein at the level of the terminal valve (ostial valve)
ID2 = internal diameter of the great saphenous vein between the terminal and subterminal valves
ID3 = internal diameter of the great saphenous vein at the level of the subterminal valve
L1 = distance between the saphenofemoral junction and the terminal valve
L2 = distance between the terminal and subterminal valves
cfv = common femoral vein
gsv = great saphenous vein

the anesthetist assisted the patient to perform an operative Valsalva maneuver. If the operation is performed under local anesthetic, the patient may perform the manoeuver. If no reflux was seen, the diameter of the stent was fixed by using a 5.0 Prolene suture through the buckle, the belt, and the common femoral vein. A further suture was also used distally in order to maintain the diameter of the stent. If required, the stent could be made conical by reducing the lower diameter of the stent. Operative management is summarized in *Figure 10*.

Testing maneuvers

The most reliable and reproducible test to determine competence was to leave an untied tributary distal to the valve repair. It was important to ensure that the inflow was blocked by using a Vessiloop™ and, after the anesthetist assists the patient to perform the Valsalva maneuver, there should be no bleeding. However, there should free bleeding from the tributary if the Vessiloop™ is loosened and upward flow is reestablished.

- The "Milking Test": When the inflow was blocked, the segment of SFJ between the Vessiloop™ and stent was milked free of blood. The segment remained empty if the valve was competent.

- Intraoperative duplex ultrasound and continuous wave Doppler were also reliable modalities for testing and recording incompetence.

Immediate postoperative strategy

The patients were mobilized as soon as possible. Compression of the limb was achieved by applying rolled wool and simple crepe bandages in the operating room. Prior to discharge from hospital, compression bandages were used to encompass the whole lower limb. All patients were given antiplatelet agent for 2 to 3 weeks postoperatively, eg, salicylic acid or an equivalent. Surgical clips used to close stab avulsions were removed approximately 3 days postoperatively and replaced with "Steri-Strips" or a similar adhesive material. At that time, the underlying compressive bandages were discarded and only the overlying self-elasticized bandages were used. Compression was continued for a further 4 days. The patients were then reviewed at 3 months and a duplex scan was performed to assess the competence and size of the GSV.

Data management

All data were evaluated using receiver operator characteristics (ROC) curve analysis (Metz, 1978; Zwieg & Campbell, 1993).

RESULTS

The results of intraoperative competence testing following EVS are summarized in *Table Ia*. Of the 69 TV's that were examined preoperatively, 50 (50/69, 72%) were considered repairable in view of their ultrasonic features. At operation, 44 (44/50, 88%) of these valves were successfully repaired. In the 6 limbs that had an unrepairable TV,

Ultrasound prediction	Competent	n	Incompetent	n	Total	
Repairable						
(Positive)	44	(a)	6	(c)	50	(a + c)
Unrepairable						
(Negative)	1	(b)	18	(d)	19	(b + d)
Total	45	(a + b)	24	(c + d)	69	

Table Ia. Results at operation following EVS.

repair of the STV was attempted at operation. All 6 (100%) STV's were successfully repaired with EVS and competence of the corresponding SFJ's was restored intraoperatively. Of the 19 (19/69, 28%) TVs whose ultrasonic features indicated they were unrepairable, 18 (18/19, 95%) had gross reflux but 1 (1/19, 6%) was repaired successfully. All STV deemed unrepairable remained incompetent following EVS (18/18, 100%). At 3 months after the procedure, only 3 (3/44, 7%) GSV's demonstrated residual reflux at the TV and STV, 1 (1/44, 2.3%) GSV demonstrated major reflux and 1 (1/44, 2.3%) LSV developed thrombophlebitis.

Intraoperative data and the findings are summarized in *Table Ib*. The predictability of successful EVS based on ultrasonic features of the valve were sensitivity 97.8% (95% CI, 88.2 – 99.6), specificity 75% (95% CI 53.3 – 90.2), and accuracy 90.4%. Of the 24 (24/69, 35%) limbs where competence was not restored at operation by the EVS procedure, the GSV was tied and stripped in the usual manner.

Sensitivity	97.8% (95% CI, 88.2-99.6)
Specificity	75.0% (95% CI, 53.3-90.2)
Positive Predictive Value (+PV)	88.0%
Negative Predictive Value (-PV)	94.7%
Positive Likelihood Ratio (+LR)	3.91
Negative Likelihood Ratio (-LR)	0.03
Accuracy	90.4%

Table Ib. Ultrasound EVS prediction test statistical analysis.

DISCUSSION

The advantages of GSV preservation with valvular stenting relate to correcting reflux and subsequent physiological normalization. With little stimulus for the development of collateralization, the incidence of recurrent varicose veins following EVS is approximately nine times less than stripping in a long-term, prospective, controlled, multi-center trial.[8] The initial results with external valvular stenting were based upon the size of the GSV as a predictor of early varicose veins and minimal disruption of venous valve function.[7] However, minor dilatation of the GSV can occasionally be associated with severe valve atrophy. Corcos has shown that atrophy of the cusps is important, confirming previous work by Cotton and Edwards & Edward.[11-13] All of these pathological findings have usually been associated with advanced disease while in earlier cases the cusps appeared intact.[13] External stenting can only produce competence and patency where the valve cusps are essentially nondiseased. The method of EVS to the TV and/or STV often produces descending competence so that the entire GSV functions normally. The GSV resumes its normal size and, in many cases of associated incompetent lateral accessory disease, the GSV remains normal.[7,8]

Better preoperative understanding of the architecture of the TV and STV at the SFJ should produce better results. The ability of ultrasound to predict a successful valvular stent repair of the TV or SFJ valve was emphasized by a sensitivity of 97.8% and specificity of 75%. However, in many cases, it is possible to repair the STV as well, due to the fact that, if present, the valve cusps were almost always readily identifiable on ultrasound. The more reliable imaging of the STV relates to the angle of incidence of the ultrasound beam. At the SFJ one or both of the cusps may be parallel to the axis of ultrasound beam producing poor return echoes. This is in contrast to the return echoes produced by the STV, which lies closer to the skin and the cusps are usually perpendicular to the beam. In the case of advanced disease, the STV should be repaired also. The tests for competence commonly used at operation are the

"Milking-Test" and the test involving blocking of the inflow while leaving a tributary untied so that free egress blood can be seen with increasing central venous pressure. The hydrostatic pressures produced do not completely equate to those produced when tested at 3 months using ultrasound, which explains the difference between operative findings and postoperative ultrasound results. In this series, 4 (4/45, 8.8%) cases of residual reflux were identified 3 months postoperatively. Previous experience has shown that minor reflux rarely progresses when the valve ring diameter is fixed by the external stent and recurrences in this situation are distinctly uncommon. [8] The single case of major reflux identified at 3 months postoperation represented a technical failure. Though the stent was placed at the terminal segment of the GSV, the TV was, in fact, another 1 cm distal to the stent and junction. This anatomical variation is not uncommon.

In every case there was a dramatic reduction in ID of the GSV.[7-9] In addition, incompetent tributaries are removed by stab avulsion. Therefore, the postoperative ultrasound usually indicates that the GSV is "normal".
One complication of venous valve repairs using external stenting is thrombophlebitis. This often occurs when the diseased valve ring is quite dilated (ID>12). Although the ultrasonic appearance of the TV cusps may suggest the valve is repairable, stenting produces folding within the valve ring, which subsequently renders the valve and vein susceptible to thrombosis. It is worth noting that this is a not an uncommon outcome in UGS and may also occur following simple high-ligation of the GSV.[4-6] Reflux is obviously abolished but stimulation of collateral veins may occur. Occasionally a localized plug of thrombus occurs immediately distal to the stent and in the short term this will usually recanalize and, in most cases, the SFJ remains competent.

The imaging quality of the valve cusps depends upon the axial and lateral resolution of the B-mode image. Although this has improved dramatically over the past decade, the fine details of the valve cusps and their motion, even in the superficial venous valves, can be challenging in obese patients. To obtain better penetration, a lower frequency probe is required, but this is associated with a dramatic decrease in resolution. Color duplex images are a combination of color-coded Doppler information superimposed over a B-mode image. Although it proves to be highly accurate in locating the site of valves and the presence of reflux, it is usually impossible to completely discern streaming, localized turbulence, laminar flow characteristics, and the relationship of the venous valve structure to venous flow. In comparison, B-flow imaging can demonstrate all of these flow characteristics. Further, B-flow images and the resultant flow patterns can be used to infer morphological detail. For example in *Figure 6*, the actual cusps can't be seen directly but prolapsing cusps are strongly suggested. Turbulence, which does not change with the forward and backward flow, strongly suggests thickening and nonmovement of the valve cusps. These cusps themselves may be very difficult to discern with B-mode alone. A similar finding occurs when forward flow is used to assess valve movement. Flattening of the cusps against the wall is a very good sign for EVS success. Conversely asymmetrical funneling or irregular vortices are a reliable predictor for a poor outcome following EVS. These findings have been confirmed by examining the valves of veins that were removed at operation by high ligation and stripping.

The mechanism and action of "B-flow" relates to the reflectivity of red cells at low venous flow. Large numbers of red cells aggregate and rouleaux which produce back scattering proportional to the fourth power of the carrier frequency of the transducer (Rayleigh scattering).[19] With increasing velocity, the number of pixels activated per unit time by the same group of red cells is increased which intensifies a return signal. Pre- and postsignal processing can magnify the effects. In other words, "B-flow" acts and looks like a radiographic contrast agent.

Valve ring		Sinus		Subvalvular		Cusps		
Ultrasound prediction	**ID**	**ID**	**Symmetry**	**ID**	**Symmetry**	**Number**	**Mobility**	**Shortened**
Repairable	<12	<12	Yes	<12	Yes	2	Yes	No
Unrepairable	>12	>12	No	>12	No	0 – 1	No	Yes
n=19	4	4	1	4	2	3	5	4

Table II. Preoperative diagnostic ultrasound criteria for EVS.

B-mode imaging alone may be used to reliably predict repairability.[7] The basic requirement is the presence of two discernible cusps which move and are not thickened in the presence of reflux. The valves sinus should be symmetrical and the vein below not aneurysmal. Good signs are symmetrical widening with prolapse, long thin cusps, and valve ring dilatation of up to 10 mm in females and 12 mm in males (*Table II*). Also, having both the TV and STV deemed suitable for EVS is a good indication for success as the STV valve acts as a backup. The best outcomes were seen in patients presenting with TV incompetence and an associated large incompetent anterior or lateral accessory system and the STV had minimal reflux or none at all.[7]

CONCLUSION

High quality ultrasound with B-flow provides new and valuable preoperative information on the status of the venous valve mechanism at the SFJ, negating the need for invasive diagnostic procedures. The combination of advances in ultrasound technology and improvements to the stent device itself can produce very favorable results when repairing venous valves using EVS in the treatment of varicose veins. The results of this series indicate that venous valves can be repaired provided that two cusps are present and have not been significantly damaged. Compared with conventional stripping operations, EVS is a less invasive procedure, more physiologically acceptable, and more often preferred by patients.[8] *Table III* summarizes the differences between EVS and stripping.[20] It is recommended that high-resolution ultrasound and, if available, B-flow, be used to assess venous valve function as an essential preliminary investigation for patients being considered for EVS of the GSV in the treatment of varicose veins.

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Features	EVS	Ablative
Operation complexity	Simple	More difficult
Removal of SFJ tributaries	No	Yes
Preoperative imaging of valves	Yes	No
Preoperative imaging of perforators	Yes	Yes
Resumption to normal distal GSV ID	Yes	N/A
Decreased distal GSV tortuosity	Yes	N/A
Pain associated with procedure	Low	High
Lower limb edema	Absent	↗ With multiple procedures
Inadvertent superficial nerve damage	Rare	Not uncommon
Competence during pregnancy	Good	Poor
Neovascularization and angiogenesis stimulus	Low	High
Preservation of GSV for homograft	Excellent	Nil
Physiological	Yes	No
Abolishes reflux	Yes	Yes
Destruction of nondiseased tributaries	No	Yes
Performed under local anesthetic	Yes	No
Ambulatory phlebectomy	Yes	No
Patient acceptability[7]	High	Low
Suitable for treatment of minimal disease	Yes	No
Postoperative thigh hematoma	Nil	Common

Table III. Summary of comparisons between EVS and stripping of the GSV.

REFERENCES

1 McMullin GM, Coleridge Smith PD, Scurr JH. Objective assessment of high ligation without stripping the long saphenous vein. *Br J Surg.* 1991;78:1139-1142.

2 Stonebridge PA, Chalmers N, Beggs I, Bradbury AW, Ruckley CV. Recurrent varicose veins: a varicographic analysis leading to a new practical classification. *Br J Surg.* 1995;82:60-62.

3 Quigley FG, Raptis S, Cashman M. Duplex ultrasonography of recurrent varicose veins. *Cardiovasc Surg.* 1994;2775-2777.

4 Pichot O, Sessa C, Chandler JG, et al. Role of duplex imaging in endovenous obliteration for primary venous insufficiency. *J Endovasc Ther.* 2000;7:451-459.

5 Bishop CC, Fronek HS, Fronek A, et al. Real-time colour duplex scanning after sclerotherapy of the greater saphenous vein. *J Vasc Surg.* 1991;14:505-508.

6 Myers KA, Wood SR, Lee V. Early results for objective follow-up by duplex ultrasound scanning after echosclerotherapy or surgery for varicose veins. *ANZ J Phleb.* 2000;4:71-74.

7 Lane RJ, McMahon C, Cuzzilla M. The treatment of varicose veins using the venous valve cuff. *Phlebology.* 1994;9:3-11.

8 Lane RJ, Cuzzilla ML, Coroneos JC. The treatment of varicose veins with external stenting to the saphenofemoral junction. *Vasc Surg.* 2002;36:179-192.

9 Corcos L, De Anna D, Zamboni P, et al. Reparative surgery of valves in the treatment of superficial venous insufficiency. External banding valvuloplasty versus high ligation or disconnection. A prospective multi centric trial. *J Mal Vasc.* 1997;22: 128-136.

10 Donini I, Corcos L, De Anna D. Preliminary results of external sapheno-femoral valvuloplasty: a trial by the Italian Society of Phlebolymphology. *Phlebology.* 1991;6: 167-179.

11 Corcos L, Procacci T, Peruzzi G, et al. Sapheno-femoral valves. Histopathological observations and diagnostic approach before surgery. *Dermatol Surg.* 1996;22: 873-880.

12 Akesson H, Risberg B, Bjorgell O. External support valvuloplasty in the treatment of chronic deep vein incompetence of the legs. *Int. Angiol.* 1998;18:233-238.

13 Edwards JE, Edwards EA. The saphenous valves in varicose veins. *AM Heart J.* 1940; 19:338-351.

14 Pellerito JS. Current approach to peripheral arterial sonography. *Radiol Clin North Am.* 2001;39:553-567.

15 Furuse J, Maru Y, Mera K, et al. Visualisation of blood flow in hepatic vessels and hepatocellular carcinoma using B-flow sonography. *J Clin Ultrasound.* 2001;29:1-6.

16 Henri P, Tranquart F. B-flow ultrasonographic imaging of circulating blood. *J Radiol.* 2000;81:465-467.

17 Pooh RK. New application of B-flow sonoangiography in perinatology. *Ultrasound Obstet Gynecol.* 2000;15:163.

18 Deane C. Extended field-of-view and B-flow ultrasound: fashion or future? *Ultrasound Obstet Gynecol.* 2000;15:96-97.

19 Sigel B, Machi J, Beitler JC, et al. Variable ultrasound echogenicity in flowing blood. *Science.* 1982;218:1321-1323.

20 Lane RJ, Graiche JA, Coroneos JC, Cuzzilla ML. Long-term comparison of external valvular stenting and stripping of varicose veins. *Aust NZ J Surg.* 2003;73: 605-609.

Exchanges between European and American physicians: the first American Venous Forum, Servier Traveling Fellowship

Report from Charles E. Stonerock (Indianapolis, USA), winner of the 2006 AVF/Servier Fellowship

Charles E. STONEROCK

South Carolina, USA

BONJOUR MESDAMES ET MESSIEURS,

My name is Charles Stonerock and I have recently completed a Peripheral Vascular Surgery Fellowship at Indiana University, Indianapolis, IN. I have been fortunate enough to have been awarded the Servier Traveling Fellowship for my work in *Deep Venous Thrombosis Diagnosis* last year and would like to give an update of my experiences, and how they have changed my current practice of medicine.

The Servier Traveling Fellowship was established to promote better communication and understanding on the treatment of venous diseases between European and American physicians. The first leg of my journey was to attend and present at the European Venous Forum in London. After that

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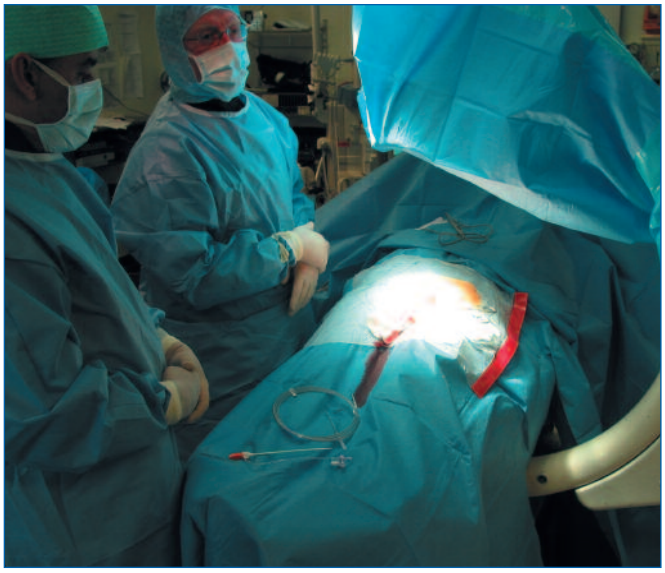
insightful meeting, I traveled to Paris where I spent the day at Servier on Neuilly/sur/Seine. There, I spent time with Director Françoise Pitsch and her colleagues

concerning the mission statement and overall goals of Servier in the treatment of patients afflicted with venous diseases. In addition, I was able to visit their research lab and see the future advances they are striving to achieve (though I can't be more specific as I am "sworn to secrecy").

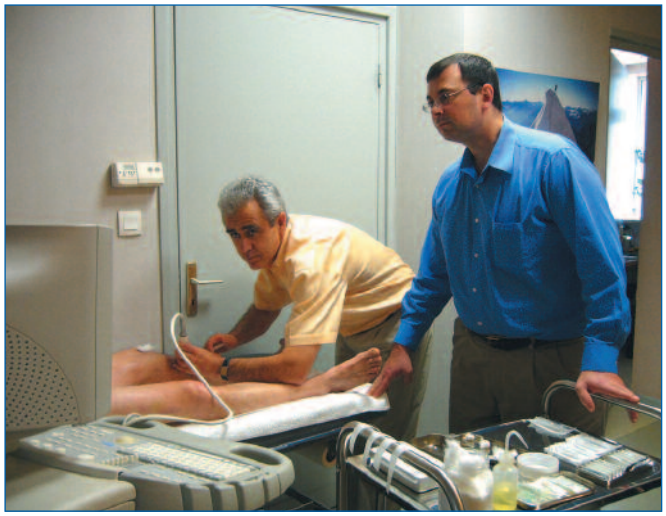
The next leg of my journey was to Lyon, where I spent two days with Dr Philippe Nicolini at his clinic. We focused

on an array of endovascular techniques, including recanalization techniques, coil embolization, and alcohol ablation, the use of intraoperative ultrasound, as well as radiofrequency ablation. I also had the pleasure of



participating in open techniques such as valvuloplasty, which is not a common procedure in the United States. Fortunately for me, I also learned why Lyon is the "heart" of French gastronomy; however, it was unfortunate for my waistline but well worth the experience.

From there, I traveled to Bourgoin-Jallieu, where I spent several days with Dr Jean-Luc Gillet at his office. Dr Gillet is well known for his work in foam sclerotherapy and I was able to learn first-hand the basic techniques and principles in the use of ultrasound in diagnosing venous insufficiency. In addition, I was able to improve my skills in injection sclerotherapy for venous varicosities, perforator veins, as well as the greater and lesser



saphenous veins. I was also able to see the differences, as well as the similarities, in the difficulties in running an office-based practice in France compared with the US. While the main focus of education was on medicine, there was a substantial amount of cultural education as well. I do speak French; however, not nearly as was well as I did several years ago. My hosts were gracious enough to speak "en français" as much as possible to help me regain some of my abilities. Even more so, they were more than polite with me even when I knew that I had committed a "grammatical atrocity." I am also very grateful to Dr Gillet and his wife for allowing me to stay at their house and immersing me in French culture. I must admit, the view of the Rhone-Alps is much more pleasant than the flat plains of the Midwestern US. As a reflection, I do find my experiences in France to be less hectic and chaotic than my experiences in the US. As an American, I feel that we have a more "hustle and bustle" lifestyle in which we are more likely to neglect to take time and enjoy some of the simple pleasures in life.

After this trip, I have taken what I have learned and assimilated it into my own surgical practice. One main difference between our practices is the way we run ultrasonography. In France, most of the physicians that I encountered perform their own ultrasounds. While I am required to understand the principles and perform ultrasounds myself, American physicians have a more

"hands-off" approach and have the majority of the work performed by technicians. I feel that I have developed a better understanding of venous ultrasonography and, as such, have done more work to communicate and work more closely with my vascular technicians. In addition, I am starting a vein clinic and trying to educate the surrounding community more about venous diseases and the forms of treatment available. I am also becoming more involved with a wound care center.

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I feel very fortunate for this experience. Not only do I feel that it has made me a better diagnostician and physician, but I feel that it has enriched me as a person. I have not only met fellow colleagues, but I have gained good friends. As such, I feel that the communication between our cultures is improving, which is required, as we are becoming more of a global community. I am deeply indebted to Servier for this once in a lifetime experience. I would like to specifically thank Director Françoise Pitsch for her integral role and I look forward to the future. In addition, I am grateful to Drs Nicolini and Gillet as well as their families for their gracious hospitality. I would also like to thank Dr Michel Perrin for all of his hard work and assistance during this experience. And finally, I would like to thank the American Venous Forum and its sister organization, the European Venous Forum, which have been striving to promote interest, research, and communication in venous disorders.

Merci beaucoup!

THE ANNUAL AMERICAN VENOUS FORUM (AVF) SERVIER TRAVELING FELLOWSHIP

The Servier Traveling Fellowship offers two (2) **American fellows*** an opportunity to travel first to the AVF Annual Meeting (usually in February), then to France and to the European Venous Forum (EVF) meeting to present their scientific research. The grant for Fellow/Resident research is awarded following competitive peer review selection:

Submission of an abstract for consideration to the AVF indicating the wish to be considered for this exciting Servier Traveling Fellowship.

The AVF Program Committee, which comprises distinguished vascular physicians/surgeons appointed by the AVF, reviews the proposals and selects four finalists, who are then invited to become Candidate AVF Members **and to present their winning science reports** at the Annual Meeting of the AVF (travel to and accommodation at the meeting for the four (4) finalists are provided by the AVF).

3. The four (4) presenting finalists are judged by an AVF-appointed committee. **Two winners are chosen** and announced at the end of the meeting.
4. A Servier-appointed Training Master in France coordinates the program for the two (2) winners and the experts in France. The training program lasts approximately ten (10) days, and includes **travel to the European Venous Forum (EVF)** Meeting and **a tour of hospital wards and private clinics in France** (according to topic of interest of each winner).
5. The two (2) winners, the AVF/Servier Traveling Fellowship, are expected to present their scientific research at the EVF meeting (the cost of travel, registration, and accommodation at the EVF meeting is borne by Servier).
6. The two (2) winners are expected to attend the AVF's next meeting and to present the highlights of their Fellowship Experience to attendees.

*The competition is open to US citizens in Accreditation Council for Graduate Medical Education (ACGME) programs who have a specific interest in the diagnosis and treatment of venous disease. Abstracts submitted must represent original, basic or clinical research in venous or lymphatic disease. For CVD projects only, funded projects shall not be related to specific pharmaceutical products. The outcome of the research must be documented in manuscript form intended for peer review by the *Journal of Vascular Surgery.*

Erysipelas and lymphedema

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SUMMARY

Erysipelas is a nonnecrotizing bacterial hypodermal cellulitis usually associated with streptococcal infection. It may be a mainly secondary complication of chronic lymphedema, and occurs in 20% to 30% of cases.
The first presenting signs are sudden fever and shivering. The clinical feature is inflammatory plaque, which is often chronic and accompanied by fever. Inflammatory plaque is promoted by lymph stasis, and is marked by inflammatory episodes that often regress spontaneously.
Erysipelas per se is mainly treated with antibiotics, and adjuvant therapies are not justified. The prevention of recurrence is primary. Since lymphedema is the first risk factor for recurrence, its treatment and risk of occurrence must be considered. This includes physiotherapy, well-adapted compression therapy, and avoidance of wounds.

INTRODUCTION

The lymphatic system has a role in antigen presentation and defense against infection. Infection is the most common type of complication observed in lymphedema, and is promoted by lymphatic system dysfunction, which causes locoregional immune disorders. Infectious complications are primarily bacterial, and most commonly are erysipelas (cellulitis) and sometimes lymphangitis. ß-hemolytic streptococcus (groups A, C, G) is the organism usually (and even almost exclusively) observed in everyday practice. Bacterial complications are promoted by the abundance of proteins characteristic of edema in lymphatic insufficiency related to obstructed lymphatic vessels. This high protein content of the interstitial fluid is an ideal culture medium for the growth of bacteria.[1]

Keywords:
erysipelas, lymphedema, lymphangitis, infectious complications.

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ERYSIPELAS: DIAGNOSIS

Erysipelas is a nonnecrotizing dermo-hypodermal bacterial infection without involvement of the superficial aponeurosis.[1] Erysipelas (also known as cellulitis

in English-speaking countries) is the clinical presentation most often observed in lymphedema, which it complicates in 20% to 30% of cases.[1] It occurs slightly more frequently in secondary lymphedema than in primary lymphedema.

The diagnosis of erysipelas is clinical[2]

Erysipelas is often of sudden onset, marked by frank systemic signs—fever ≥38°5, chills—and general malaise. Patients with lymphedema, who present with recurrent episodes of erysipelas, often recognize these inaugural signs. Local signs develop within a few hours: a red, warm, painful, inflammatory spreading lesion, with centrifugal extension within a few days. Erysipelas can start at any point of lymphedema and can extend to all or part of the lymphedematous cutaneous tissue, in an anterograde or retrograde pattern. Inflammatory, satellite adenopathy and lymphangitis are associated with erysipelas in 25% to 50% of cases.[3]

In the case of erysipelas complicating lymphedema, the clinical presentation is more serious. Statistically significant differences ($P<0.05$) were seen between 20 controls with erysipelas but without lymphedema and 10 age- and sex-matched patients with lymphedema hospitalized for erysipelas: prolonged persistence of fever, more frequent tachycardia, delayed recovery, and positive blood cultures (30% vs 0%).[4]

The diagnosis of erysipelas is clinical: sudden occurrence of an inflammatory lesion that spreads within a few days, preceded by or concomitant with fever and chills, and general malaise. No bacterium other than ß-hemolytic streptococcus has been demonstrated as responsible for erysipelas.[2] Streptococcus was isolated 15 times more often in lymphedema with an infectious complication than outside any acute inflammatory episode, and serology testing for streptococcus (ASLO) was more often positive in patients with lymphedema (78%) than in a healthy control population (46%).[1] Bacteriological samples are positive in erysipelas in only 4% to 35% of cases with standard methods. Using the most sophisticated methods (immunofluorescence, polymerase chain reaction), streptococcus is isolated at a frequency of 70% to 80%.[5] Other bacteria (*Staphylococcus aureus*, *Enterobacteriaceae*, *Pseudomonas*) have been isolated alone or in combination with streptococcus. But to date a causal relationship has never been demonstrated.

Furthermore, these bacteria are commonly found on skin and colonize wounds, and their isolation from samples collected from the skin is difficult to interpret. Laboratory tests are not helpful in establishing the diagnosis: the complete blood count shows leukocytosis in one-half of cases, and a nonspecific inflammatory syndrome is indicated by laboratory findings in two-thirds of cases.[3]

Causes of febrile inflammatory spreading lesions other than erysipelas

Erysipelas should be differentiated from other infections sometimes observed in lymphedema, such as lymphangitis, most often streptococcus-related (rarely staphylococcal), or necrotizing fasciitis (most often streptococcal).

Lymphangitis is characterized by the occurrence of an inflammatory streak (red, warm, and painful) whose topography is that of the superficial lymphatic vessels (which themselves are satellites of the superficial venous system). It is accompanied by fever. There is no inflammatory spreading lesion.

Necrotizing dermo-hypodermal bacterial infection or necrotizing fasciitis is characterized by necrosis of the aponeurosis and myositis, resulting in a presentation of infectious gangrene. Diffuse, indurated edema extends beyond the margins of the erythematous and sometimes slightly inflammatory spreading lesion. Deep necrosis may be manifest in the initial stage solely as a cyanotic, grayish-blue, poorly demarcated swelling, with a geographical map-like presentation. Fever is a usual finding but can be mild or absent. A septic syndrome (with hemodynamic signs, hypoxia, and thrombocytopenia) develops subsequently. In lymphedema, subacute forms of necrotizing dermo-hypodermal bacterial infection with superficial necrosis are observed; these are absent in typical erysipelas. This should prompt emergency hospitalization of the patient. In a patient with lymphedema, it is important to differentiate necrotizing fasciitis, which is rarely observed, from erysipelas, since systematic surgery should be avoided in all cases of atypical erysipelas whose course is not immediately favorable because healing is difficult to obtain. Necrotizing fasciitis is a life-threatening medical-surgical emergency and must be treated in a specialized hospital department.

In lymphedema, chronic, inflammatory spreading lesions with little or no fever are often seen. They correspond to skin inflammation mediated by macrophages, lymphocytes, and cytokines,[6] without bacterial infection. Such inflammatory spreading lesions are favored by lymph

stasis and are similar to findings in stasis dermatitis observed in chronic edema. Their course is marked by inflammatory episodes that often regress spontaneously. In spite of their chronic nature and the absence of a frank infectious syndrome, it is usually difficult to eliminate the role of streptococcus in the case of such inflammatory spreading lesions. Their assumed pathophysiology in lymphedema (major secretion of cytokines subsequent to lymph stasis) has been the rationale for trials of oral steroid therapy. This treatment produces a prompt decrease in signs of inflammation. But such an approach cannot be recommended in practice because it is potentially hazardous. Cases of necrotizing fasciitis induced or exacerbated by anti-inflammatory drugs have been reported.

Febrile dermo-hypodermal lesions of a surgical scar (in particular breast scars or after breast implant surgery) have been reported,[2] and may be infectious (erysipelas) or allergic (justifying steroid therapy).

Other acute forms of dermo-hypodermal bacterial infection are caused by *Erysipelotrix rhusiopathiae* (Rouget's swine erysipelas), *Haemophilus influenzae*, *Pasteurella multocida*, and *Borrelia borgdorferi*. They have a different medical history or a less inflammatory, less febrile clinical presentation without the typical chronology (systemic syndrome followed by an inflammatory spreading lesion a few hours later), or both.

In summary, the diagnosis of erysipelas is solely clinical, and does not require any laboratory tests, in particular, bacteriological.

LYMPHEDEMA AND ERYSIPELAS: MANAGEMENT

Lymphedema is by far the most important risk factor for erysipelas (relative risk: 71.2) (*Table I*).[7] The risk of recurrence of erysipelas after a first episode in patients with lymphedema is very high (greater than 50% within a year of the first episode), and increases as recurrences occur.

Treatment of erysipelas

The reference treatment of erysipelas is pristinamycin at a dosage of 3 g/d for two weeks.[8] In a randomized, controlled study of 289 adults with erysipelas, the cure rate was 81% vs 67% for treatment with intravenous penicillin followed by a switch to oral penicillin (per protocol analysis, a statistically significant difference).[8] In the absence of pristinamycin, treatment with oral amoxicillin (3-4.5 g/d, in 3 daily doses) for two weeks has been proposed.[9]

Oral therapy allows outpatient treatment, but hospitalization is necessary if:

1. there is doubt regarding the diagnosis, or there are serious systemic signs, comorbid conditions, or a social context which makes home treatment of the patient impossible, in which case admission should be immediate;
2. fever persists after more than 72 hours of treatment or new local or locoregional signs recur or both.[10] In such cases, treatment with intravenous penicillin G (10-20 million units in 4-6 infusions a day) is the reference treatment.

	ODDS RATIO	95% CI
Lymphedema	71.2	5.6-91
Portal of entry	23.8	10.7-52.5
Venous insufficiency	2.9	1.0-8.7
Edema of the lower limbs	2.5	1.2-5.1
Obesity	2	1.1-3.7

95% CI: 95% confidence interval of the odds-ratio

Table I. Erysipelas: risk factors.[7]

The value of adjuvant therapies was analyzed at a consensus conference organized by the French Society of Dermatology, the French Society of Lymphatic Disease, and the French Society of Infectious Diseases.[9] Local, antiseptic, or antibiotic therapy is not necessary. Systematic anticoagulant prophylaxis is not justified if lymphedema is complicated by erysipelas alone. In fact, the risk of deep vein thrombosis (DVT) is only 0.7%-4.5%.[11] There is no rationale for systematic screening for DVT with duplex scanning.

Treatment of lymphedema

No study has demonstrated that physiotherapy or compression promotes bacterial infection in lymphedema. In a few isolated cases, pressure therapy has been implicated as having induced episodes of lymphangitis or erysipelas. This assertion has not been confirmed by a large retrospective study.[12] In practice, it may be advisable to avoid manual exercises to promote lymphatic drainage and pressure therapy in the case of erysipelas, and to resume such measures only two to four weeks after the start of antibiotic therapy. Compression therapy is not contraindicated in erysipelas.[11] A consensus conference has recommended the evaluation of compression therapy in reducing edema and the risk of venous thrombosis.[9] From a pragmatic standpoint, considering the events in inflammation, it is advisable to avoid vigorous compression therapy during the first two weeks of treatment.

Physical therapy, even intensive (decongestive complex physiotherapy), does not justify the use of streptococcal prophylaxis. On the other hand, in the case of surgery (venous lymphatic anastomosis, etc) antibiotic prophylaxis should be considered in patients with a history of lymphedema complicated by infection.

Treatment of factors that promote erysipelas

Treatment should minimize local risk factors for lymphedema (*Tables I and II*). The main portals of entry of erysipelas are intertrigo and wounds.[7]

Wound disinfection with an antiseptic (chlorhexidine or Betadine®) is recommended, although it has not been validated and the efficacy of antiseptics on abraded skin has recently been called into question.[13] If a wound is infected (locoregional signs of inflammation), the best treatment is a topical antibiotic such as Fucidin®.[14] If systemic signs of infection are present, oral antibiotic therapy with pristinamycin as in erysipelas is the best validated treatment. Screening and treatment of a fungal infection, in particular, between the toes, is the most effective measure in terms of prevention of infectious complications, considering the incidence of this disorder.[6] Treatment of such fungal infection is based on use of an imidazole cream in a single application (Fonx®, Amycor®), and the use of imidazole powder (Daktarin®, Pevaryl®) in the patient's shoes and socks. If recurrence is frequent, long-term prophylaxis can be recommended. Use of an antifungal cream and appropriate skin care decrease the recurrence of erysipelas.[15]

Physiotherapy for lymphedema decreases the recurrence rate.[16,17] In a study of 20 patients, the wearing of elastic compression stockings after a first episode of erysipelas reduced the risk of recurrence 5-fold (results at 5 years:

	ODDS RATIO	
	IPSILATERAL (same side as the erysipelas)	CONTRALATERAL (side opposite the erysipelas)
Lymphedema	69	-
Leg ulcers	25	(0.6-16)
Eschars	12	(0.2-57)
Wound	10	0.2
Interdigital intertrigo	10	0.7
Excoriated dermatosis	4	(0.7-7.4)

Table II. Erysipelas: risk factors (local or systemic).[7]

5% recurrence vs 25% in the absence of treatment).[16] Identical results have been reported with physiotherapy combined with decongestive therapy.[17]

Prophylaxis of recurrence of erysipelas

When factors that promote erysipelas are difficult to control, and erysipelas or lymphangitis has recurred in spite of good management of lymphedema, streptococcal prophylaxis is necessary.[18] It should be of long duration or even permanent since the effect of treatment is only temporary.[9] It requires use of penicillin: intramuscular benzathine penicillin 1.2-2.4 million units every 2-3 weeks, or oral penicillin V 2-4 million units in 2-3 doses a day. The intramuscular route, which is painful, ensures better compliance and has proven effective.[19] In this study, treatment with benzathine penicillin for 1 year reduced acute episodes of erysipelas (results at 1 year: 0.5 vs 4.6 before treatment), and at 2 years, ie, 1 year after discontinuation of treatment, the reduction was still significant (results at 2 years: 1.9 vs 4.6 before treatment).[19] In the case of ß-lactam allergy, it is advisable to prescribe a macrolide; roxithromycin (Rulid®) has been validated in erysipelas.[18]

CONCLUSION

Erysipelas is a frequent complication of lymphedema. It is caused by a ß-hemolytic streptococcus, which can destroy lymph vessels. Thus, secondary and tertiary prevention of lymphedema absolutely requires early management and prophylaxis of bacterial and fungal infections.

Conversely, proper management of lymphedema, with reduction of the extent of lymphedema and daily care of the skin and integument, decreases the risk of bacterial and fungal infections.

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REFERENCES

1 Vaillant L, Gironet N. Complications infectieuses des lymphoedèmes. *Rev Med Interne*. 2002;23(Suppl):403s-407s.

2 Vaillant L. Critères diagnostiques de l'érysipèle. *Ann Dermatol Venereol*. 2001;128:326-333.

3 Lorette G, Py F, Machet L, Vaillant L. Erysipèle : étude rétrospective de 100 cas. *Med Hyg*. 1990;48:764-768.

4 Woo PC, Lum PN, Wong SS, et al. Cellulitis complicating lymphedema. *Eur J Clin Microbiol Infect Dis*. 2000;4:294-297.

5 Bernard P, Bedane C, Mounier M, et al. Streptococcal cause of erysipelas and cellulitis in adults study using a direct immunofluorescence technique. *Arch Dermatol*. 1989;125:779-782.

6 Olszewski WL. Episodic dermatolymphangioadenitis (DLA) in patients with lymphedema of lower extremities before and after administration of benzathine penicillin preliminary study. *Lymphology*. 1996;29:126-131.

7 Dupuy A, Benchikhi H, Roujeau JC, et al. Risk factors for erysipelas of the leg (cellulitis): case-control study. *BMJ*. 1999;318:1591-1954.

8 Bernard P, Chosidow O, Vaillant L. French Erysipelas Study Group. Oral pristinamycin versus standard penicillin regimen to treat erysipelas in adults: randomised, non-inferiority, open trial. *BMJ*. 2002;325:864-868.

9 Prise en charge des érysipèles et fasciites nécrosantes. Conférence de consensus. *Ann Dermatol Venereol*. 2000;127:336-340.

10 Bernard P. Critères d'hospitalisation primaire et secondaire. *Ann Dermatol Venereol*. 2001;128:363-367.

11 Perrot JL, Perrot S, Laporte Simitsidis S. Un traitement anticoagulant est-il utile dans le traitement des érysipèles ? *Ann Dermatol Venereol*. 2001;128:352-357.

12 Vaillant L, Titon JP, Gaisne E, Barsotti J. Compression for lymphedema and cellulitis. *J Am Acad Dermatol*. 1990;23:952-953.

13 Wolkenstein P, Vaillant L. Antiseptiques en peau lésée. *Ann Dermatol Venereol*. 1996;123:343-348.

14 Machet L, Wolkenstein P, Vaillant L. Antibiotiques topiques en dermatologie : efficacité, indications et effets secondaires. *Ann Dermatol Venereol*. 2000;127:425-431.

15 Shenoy RK, Kumaraswani V, Suma TK, et al. A double-blind, placebo-controlled study of the efficacy of oral penicillin, diethylcarbamazine or local treatment of the affected limb in preventing acute adenolymphangitis in lymphedema caused by bugian filariasis. *Ann Trop Med Parasitol*. 1999;1933:367-377.

16 Yasuhara H, Shigematsu H, Muto T. A study of the advantages of elastic stockings for leg lymphedema. *Int Angiol*. 1996;15:272-277.

17 Foldi E. Prevention of dermatolymphangioadenitis by combined physiotherapy of the swollen arm after treatment for breast cancer. *Lymphology*. 1996;29:48-49.

18 Bernard P. Dermo-hypodermal bacterial infections. Current concepts. *Eur J Med*. 1992;1:97-104.

19 Badger C, Seers K, Preston N, Mortimer P. Antibiotics/anti-inflammatories for reducing acute inflammatory episodes in lymphedema of the limbs. *Cochrane Database Syst Rev*. 2004;2:CD003143.

Premenstrual symptoms in lower limbs and Duplex scan investigations

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ABSTRACT

Objectives: Approximately 40% of menstruating women experience luteal phase symptoms that are bothersome. Although the distinguishing characteristic is irritability, symptoms typically are a mix of cognitive and physical disturbances. Leg swelling and discomfort are one such physical symptom. The goal of the study is to define the clinical entity of a late luteal phase vasodilation syndrome in symptomatic patients.

Methods: Duplex venous scans were performed in the standing position on 12 premenopausal women (age range 19-46 years) who described premenstrual symptoms of bilateral leg swelling, pressure, or pain. One scan was performed during the follicular phase (days 3-6) and one during the luteal phase (days 20-24). Great saphenous vein (GSV) diameter and reflux (with calf augmentation) were measured mid-thigh.

Results: Seventeen limbs in 12 patients were studied. An increase in GSV diameter and reflux was appreciated in 100% (12/12) of symptomatic patients and (17/17) limbs when scanned in the follicular and luteal phases of the menstrual cycle. Follicular phase GSV diameters ranged from 2.0 to 7.2 mm. Luteal phase GSV diameters ranged from 2.5 to 8.0 mm. Follicular phase reflux ranged from 0 to 2.5 seconds. Luteal phase reflux ranged from 1.5 to 5.0 seconds.

Conclusions: Lower extremity swelling, pain, and discomfort are common complaints of menstruating women in the luteal phase of the menstrual cycle. Symptoms seem to be related to vasodilation and reflux—perhaps mediated by the effects of progesterone, which serves as a smooth muscle relaxant and the dominant hormone of the luteal phase. Further studies can employ the use of a control group, measurement of serum progesterone levels ,and evaluation of the use of graduated compression therapy as a treatment option.

Keywords:
PMS, Duplex ultrasound, lower extremities.

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INTRODUCTION

The clinical management of unpleasant premenstrual symptoms is difficult. Although recognized in the medical literature for over a century, it is only over the past 20 years that there has been a consensus regarding the diagnosis of premenstrual syndrome (PMS). Early literature described this condition as "premenstrual tension,"[1] referring to a constellation of symptoms occurring during the week prior to menstruation and ending with the onset of menstrual flow. Strict diagnostic criteria have been used to study pathophysiology and therapy.[2] In general, approximately 40% of menstruating women experience bothersome luteal phase symptoms. For 25%, these symptoms are annoying but do not impair daily functioning. In about 15% symptoms are severe, with 3% of these women experiencing significant impairment in daily functioning.[3,4]

Characteristic symptoms include a mixture of cognitive and physical disturbances. The hallmark feature is irritability separate and distinct from depression or anxiety disorders.[5] Physical disturbances include migraine headaches, mastalgia, gastrointestinal disturbances, and leg pain among others. Leg pain may be described as "dull" and "aching." These are typical of the symptoms associated with patients with chronic venous insufficiency and varicose veins. This study is designed to define the clinical entity of a late luteal phase vasodilation syndrome in symptomatic patients. Comparison is made of GSV diameter and reflux in both the follicular as well as the luteal phases of the menstrual cycle.

METHODS

Duplex venous scans (Sonosite 180 plus; Bothell, WA) were performed in the standing position on 12 premenopausal women (age range 19-46 years) who described premenstrual symptoms of bilateral or unilateral leg swelling, pressure, or pain. These symptoms were present premenstrually and resolved with the onset of menstrual flow. One scan was performed during the follicular phase (days 3-6) and one during the luteal phase (days 20-24) of the menstrual cycle. GSV diameter and reflux were measured mid-thigh. B-mode was used to measure GSV diameter (*Figure 1*).

Reflux was appreciated with calf augmentation (*Figure 2*). Doppler mode was used to assess reflux. Temperature of the examination room was controlled at 22 degrees centigrade.

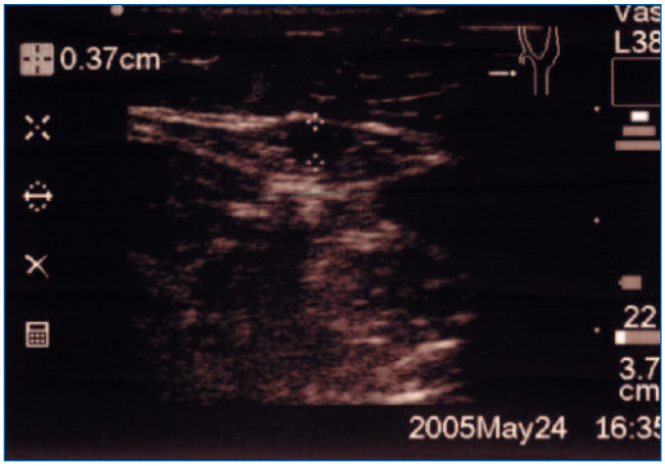

Figure 1. Transverse measurement of great saphenous vein in saphenous sheath.

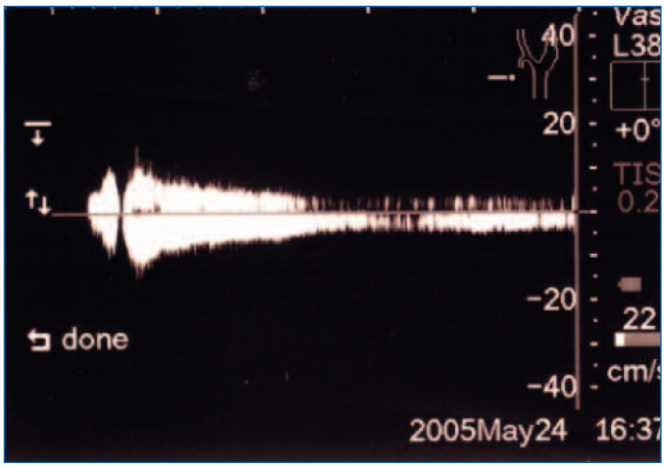

Figure 2. Assessment of reflux in great saphenous vein.

RESULTS

Seventeen limbs in 12 patients were examined. An increase in GSV diameter and reflux was appreciated in 100% (12/12) of symptomatic patients and (17/17) limbs when scanned in the standing position during the follicular and luteal phases of the menstrual cycle. Follicular phase GSV diameters ranged from 2.0 to 7.2 mm (mean 4.46 mm). Luteal phase GSV diameters ranged from 2.5 to 8.0 mm (mean 5.11 mm). This is equivalent to a 15% increase in GSV diameter (*Table I*).

Limb/Vein	Follicular phase	Luteal phase
1.	2.2	3.0
2.	2.4	3.2
3.	2.6	3.5
4.	3.2	3.7
5.	3.5	3.9
6.	3.5	4.0
7.	4.0	4.5
8.	4.2	4.8
9.	4.3	5.0
10.	4.6	5.2
11.	4.8	5.6
12.	4.8	5.6
13.	5.8	6.4
14.	5.8	6.5
15.	6.4	7.0
16.	6.5	7.2
17.	7.2	8.0

Table I. Great saphenous vein diameter in millimeters.

Follicular phase reflux ranged from 0 to 2.5 seconds (mean 1.03 seconds). Luteal phase reflux ranged from 1.5 to 5.0 seconds (mean 2.76 seconds). This is equivalent to a 168% increase in GSV reflux (*Table II*).

Limb/Vein	Follicular phase	Luteal phase
1.	0	1.5
2.	0	1.5
3.	0	1.5
4.	0	1.5
5.	0	2.0
6.	.5	2.5
7.	.5	2.5
8.	1.0	2.5
9.	1.0	3.0
10.	1.0	3.0
11.	1.5	3.0
12.	1.5	3.0
13.	1.5	3.0
14.	2.0	3.5
15.	2.0	4.0
16.	2.5	4.0
17.	2.5	5.0

Table II. Great saphenous vein reflux in seconds.

CONCLUSIONS

Lower extremity swelling, pain, and discomfort are common complaints of menstruating women in the luteal phase of the menstrual cycle. Symptoms seem to be related to vasodilation and reflux—perhaps mediated by the effects of progesterone, which serves as a smooth muscle relaxant and is the dominant hormone of the luteal phase. Menses, along with a resolution of symptoms, coincides with a decrease in progesterone levels, a phenomenon known as "progesterone withdrawal."

This preliminary study can serve as a template for further investigation into the venous changes associated with hormonal changes unique to the premenopausal female patient. This condition may aptly be termed "premenstrual vasodilation syndrome," consisting of symptoms of lower extremity swelling, pressure, and pain characteristic of the luteal phase of the menstrual cycle. A control group consisting of asymptomatic patients would be helpful. Measurement of serum progesterone levels may also be of interest. Additionally, assessing the qualitative and quantitative therapeutic effects of graduated compression and hormonal therapy may be of value. Well-designed, placebo-controlled clinical trials have been conducted for some pharmacologic agents. However, use of these agents may help some aspects of PMS while aggravating others.[6] For patients in whom these more conservative therapies fail, exploration of endoluminal therapy such as ultrasound-guided sclerotherapy, radiofrequency, and laser would be indicated.

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REFERENCES

1 Greene R, Dalton K. The premenstrual syndrome. *Br Med J*. 1953;1:1007-1014.

2 Endicott J. History, evolution and diagnosis of premenstrual dysphoric disorder. *J Clin Psychiatry*. 2000;61(suppl 12):5-8.

3 Johnson SR. The epidemiology and social impact of premenstrual symptoms. *Clin Obstet Gynecol*. 1987;30:367-376.

4 Sternfeld B, Swindle R, Chawla A, et al. Severity of premenstrual symptoms in a health maintenance organization population. *Obstet Gynecol*. 2002;99:1014-1024.

5 Endicott J, Amsterdam J, Eriksson E, et al. Is premenstrual disorder a distinct clinical entity? *J Womens Health Geno Based Med*. 1999;8:663-679.

6 Barnhart KT, Freeman EW, Sondheimer SJ. A clinician's guide to the premenstrual syndrome. *Med Clin North Am*. 1995;79:1457-1472.

Quantification of microangiopathy in chronic venous disease

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ABSTRACT

Analysis of microcirculatory changes in chronic venous disease (CVD) is challenging because we lack practical tools. The orthogonal polarization spectral (OPS) imaging technique used in the Cytoscan is less than ten years old and seems to be suitable for studying patients suffering from CVD. The Cytoscan has a small handheld probe which can be noninvasively applied to all body surfaces.

CVD was studied using the OPS technique for the first time in the Laboratory for Research in Microcirculation at State University of Rio de Janeiro, Brazil. Five microcirculatory parameters were correlated with the clinical-etiologic-anatomic-pathophysiologic (CEAP) classification (C0 to C5). A new microcirculatory index (MI) with stages I, II and III (mild, moderate and severe microangiopathy, respectively) based on previously cited variables was used to investigate the severity of the microcirculatory damage. Movies of the internal perimalleolar region were analyzed using the CapImage software.

The following five microcirculatory parameters were evaluated: functional capillary density (FCD, capillaries/mm^2), diameter of dermal papilla (DDP, µm) to quantify edema, the largest diameter of the capillary bulk (DCB, µm) to assess its degree of change, capillary limb diameter (CD, µm) to describe diameter changes, and capillary morphology (CM, % of abnormal capillaries per field). It was demonstrated that FCD, DDP, DCB, CD and CM values were significantly different from control values (P<0.05) in different CEAP classes. C2 to C5: DC and CM; C3 to C5: DDP and DCB and C4 to C5: FCD.

The MI showed that 27 out of 30 patients classified as CO and C1 had mild microangiopathy, and 28 out of 36 of C3 to C5 had severe impairment of the microcirculation. Moderate microangiopathy was almost homogeneously distributed among all CEAP classes, with the exception of C0.

Keywords:
chronic venous disease, orthogonal polarization spectral imaging, CEAP classification.

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In conclusion, CM and CD measurements detected microcirculatory alterations as early as CEAP class C2. The suggested MI could be used in future clinical trials to quantify microcirculatory impairment associated with the various CEAP classes and to evaluate drug therapy.

INTRODUCTION

Chronic venous disease (CVD) of the lower limbs is a common public health problem worldwide. Its many clinical presentations indicate its complexity. CVD is multifactorial and over the years has a highly negative impact on quality of life because of leg ulceration, pain, and sick leave.

Epidemiological studies demonstrate growth in CVD worldwide. In the Edinburgh Vein Study, varicose veins were noted in 40% of men and 32% of women in the United Kingdom.[1] Scuderi et al used the CEAP classification to study the incidence of venous disease in Brazil.[2] The percentage of symptomatic patients suffering from CVD varies between 25% to 84% depending on the population studied, age range, and severity of the disease.[3] Population studies such as Framingham[4] and San Valentino[5,6] have reported a CVD prevalence of 5% to 15% in men, 3% to 29% in women, and an incidence of leg ulcer of 0.03% to 2% of the population per year.[7] The concept of venous microangiopathy as one of the first signals, resulting from venous hypertension, enables quantification of microcirculatory parameters in monitoring of the severity of CVD.[8,9] High venous pressure is transmitted to the capillary bed and results in chronic damage and microcirculatory dysfunction. Cutaneous nutritive capillaries progressively become enlarged and tortuous and form masses or skeins described in the literature as "glomerulus-like" capillaries.[10,11] Capillaries of patients with CVD have an increased permeability to large molecules as a result of stretched interendothelial pores leading to an irregular capillary lumen.[12] The persistence of venous stasis and hypertension results in chronic inflammation of the capillary bed and surrounding tissues[13] and edema.[14] The reduction in the number of capillaries leads to trophic disorders and leg ulceration.[15,16]

Several methods have been used to visualize the microcirculation directly or indirectly, like laser Doppler fluxometry,[17] videocapillaroscopy,[18] plethysmography,[19] and fluorescence videomicroscopy.[20]

Some CVD classification methods have been developed in order to compare the outcomes of various treatment attempts. Examples include the CEAP classification, the Venous Clinical Severity Score (VCSS) and Venous Segmental Disease Score (VSDS). These three methods base their findings mainly on venous imaging by duplex scanning and phlebography.[21] Although the CEAP classification was revised in 2004,[22] with enhancement of the pathophysiologic analysis, we still lack a larger microcirculatory study.

Orthogonal polarization spectral (OPS) imaging is the latest technique used to visualize the microcirculation. It is based on intravital microscopy with incident polarized light that produces reflected depolarized light from hemoglobin. Cytoscan implements the OPS technique and was described for the first time in 1999.[23]

The Cytoscan can be used for noninvasive studies of all tissue surfaces without the use of fluorescent dyes, and OPS imaging has been validated in comparison with conventional videocapillaroscopy and intravital microscopy.[24,25] Nowadays it is possible to quantify microangiopathic changes related to CVD with Cytoscan. It is important to evaluate the perimalleolar area in CVD patients as it is a gaiter zone where stasis ulcers usually appear.[14]

Our laboratory was the first to use OPS imaging to assess the cutaneous microcirculation of the perimalleolar area in female patients at different CEAP stages of the disease, compared with healthy subjects (control group). We described a new microcirculatory index (MI) to quantify and grade microangiopathy.[26] The following sections summarize the main findings of our study.

Patients and methods

Forty-four women (87 lower limbs) aged 48±8 years (range 28 to 60 years) were selected and divided into six groups based on the CEAP classification:[22,27,28] C1 (n=21), C2 (n=20), C3 (n=17), C4 (n=18), C5 (n=11). Thirteen healthy subjects (n=25) were chosen as controls. All individuals signed a written consent form and were evaluated through a research protocol in the Venous Disease Outpatient Unit of the Medical School and Laboratory for Research in Microcirculation. The research project was approved by the Ethics Committee of the State University of Rio de Janeiro (UERJ).

Exclusion criteria included arterial ischemic disease with a supramalleolar Doppler index lower than 0.8 and all diseases that could influence the results. Cytoscan cannot visualize the microcirculation of patients with phototypes 5 (dark brown) and 6 (black) according to Fitzpatrick,[29] and such patients were therefore excluded from the study. Patients were assigned to groups on the basis of Doppler ultrasonography and clinical examination of the lower limbs. Deep venous thrombosis and venous valve incompetence were mapped by duplex scanning.

Analysis of the microcirculation

We prepared a 7.5 cm² (width 3.0 cm, height 2.5 cm) plastic rectangular mask pierced by 10 small windows of the size of the Cytoscan probe (Cytometrics Inc, Philadelphia, PA, USA). This probe was placed above the internal malleolus using an X-Y positioning system built into the platform. A robot was created to hold the Cytoscan probe in the same position without excessive pressure on the skin to avoid interruption of blood flow (*Figure 1*).

Each field was recorded for 30 seconds in S-VHS format with a Philips VR999 video recorder (São Paulo, SP, Brazil), and the microcirculation images were analyzed using CapImage software.[30]

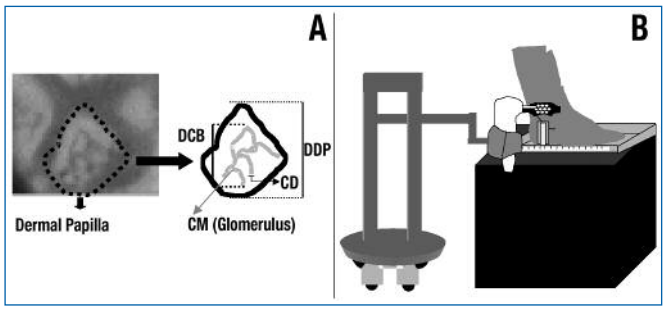

Figure 1. A: Microcirculatory parameters. Dermal papilla (DDP, µm), diameter of capillary bulk (DCB, µm), capillary limb diameter (CD, µm), and capillary morphology (CM). B: Robotic positioning of the Cytoscan video microscope at the perimalleolar region. Note the foot is placed on a platform for repeatable measurement of microscopic fields.

Five microcirculatory parameters were chosen to investigate CVD: functional capillary density (FCD, number of capillaries with red blood cell flow per mm²), diameter of dermal papilla (DDP, µm) to quantify edema, the largest diameter of the capillary bulk (DCB, µm) to assess its degree of change, capillary limb diameter (CD, µm) to evaluate diameter changes, and capillary morphology (CM, % of abnormal capillaries in the total number of capillaries in each field) (*Figure 2*). In CM, a hairpin pattern with more than two crossings was deemed pathological.[31]

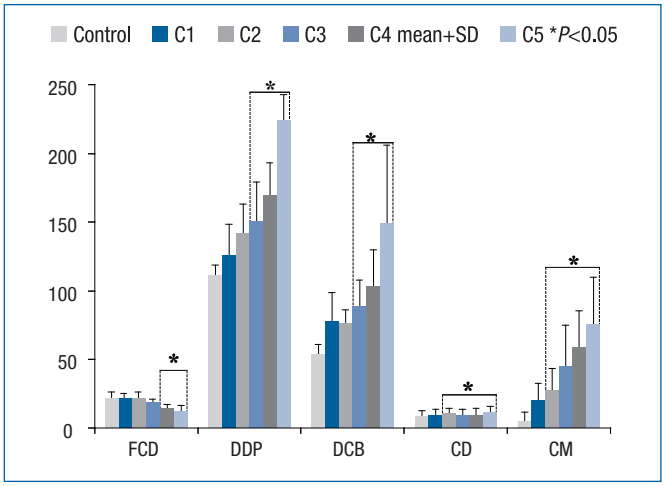

Figure 2. Distribution of CVD patients through CEAP classification classes. Duplex scanning was performed in all patients. Functional capillary density (number of capillaries/mm²), dermal papilla (DDP, µm), diameter of capillary bulk (DCB, µm), capillary limb diameter (CD, µm), and capillary morphology (CM, % of abnormal capillaries per field).

Microcirculation index

Virgini-Magalhães and co-workers created a microcirculatory index (MI) that is the sum of weighted microcirculatory parameters (FCD, CM, DDP, DCB and DC). There were three classes of MI: I (<8), II (≥8 and ≤12) and III (>12). Before being used in the study, MI was validated using known microcirculatory parameters of ten patients and controls.

Software Statistica (Statsoft Inc., Tulsa, OK, USA) was used for ANOVA and Tukey tests. All results are expressed as mean±SD.

RESULTS

Many patients with CVD have a family history of the disease.[26] *Figure 2* shows the microcirculatory parameters associated with the CEAP classification. The worsening of these parameters followed the severity of CVD (C1 to C5). CM and CD differed significantly from those of healthy subjects from class C2 onwards. DCB and DDP also increased with disease progression and were significantly different from those of healthy subjects from C3 to C5. FCD decreased significantly compared with healthy subjects from C4 to C5.

Figure 3 shows MI from CEAP-classified patients. There were 105 valid values analyzed. MI grades I, II, and III were denominated mild, moderate, and severe microangiopathy, respectively. There were some discrepancies: 6 lower limbs of C2 patients severe microangiopathy, and one limb of a C4 patient had mild microangiopathy.
A good correlation was found between clinical data and

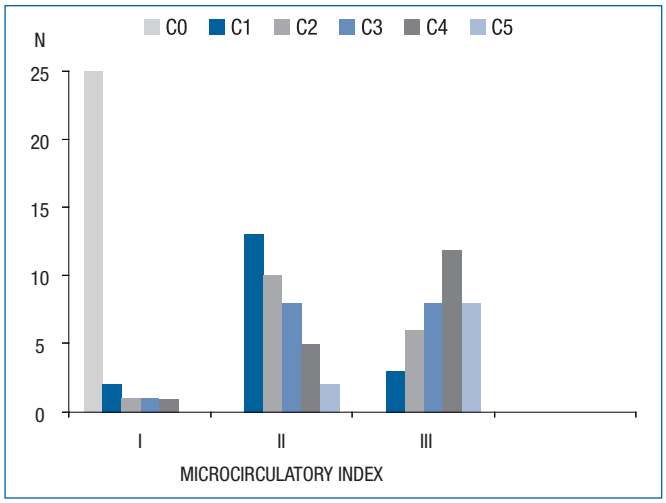

Figure 3. Microcirculatory index (MI) and CEAP classification (C0 to C5).

microcirculatory index: 93.3% of class I patients had no symptoms; 65.8% of class II patients had symptoms, but only 18.4% of them were classified as C4 or C5, and 90.3% of class III patients had symptoms, and 55.6% of them were classified as C4 or C5.

DISCUSSION

Virgini-Magalhães and co-workers found in patients with CVD that microcirculatory parameters (FCD, DDP, DCB, CD and CM) could be correlated with the CEAP classification. Also, these parameters showed different levels of statistical significance compared with healthy controls. For example, CM was statistically significant ($P<0.05$) from C2 to C5 (*Figure 2*). Finally, a microcirculation index was created to reorganize patients from C1 to C5 into three new categories according to microcirculatory impairment (mild, moderate, and severe microangiopathy).

The complexity of CVD prompted attempts to classify its severity, and the CEAP classification, and VCSS and VSDS scores are frequently used to produce an instantaneous picture of venous pathology. So far, very few attempts have been made to quantify microangiopathy, so a noninvasive test to achieve this would be useful to stage the disease and perhaps establish the prognosis. This quantification was possible with OPS imaging.

Cytoscan (OPS) is a small easy-to-use handheld device for noninvasive recording of very stable and artifact-free images of the microcirculation. The microcirculatory approach in CVD is not new. Howlader and Coleridge-Smith used capillary videomicroscopy to assess lipodermatosclerosis[32] in C4a patients. Also, fluorescence videomicroscopy is an additional diagnostic form of capillaroscopy where sodium fluorescein is injected into the brachial vein to study microvascular permeability. However, this method is invasive and there is a real risk of anaphylactic shock.[33] Until now, the best ambulatory methods to examine the microcirculation in patients have been nail fold videocapillaroscopy[34,35] and laser Doppler flowmetry.[36] Cytoscan therefore shows great promise in microcirculatory studies. OPS imaging has already been tested and validated by many authors.[25,37,38]

We have developed in our lab, the Laboratory for Research in Microcirculation at State University of Rio de Janeiro, an OPS imaging method to observe the cutaneous microcirculation in patients with CVD. We developed a motorized robot to hold the Cytoscan probe and a platform on which the foot is placed to reproduce the same perimalleolar region during measurements (*Figure 1*).

Microcirculatory parameters (FCD, DDP, DCB, CD and CM) were statistically significant within different CEAP classes. Lower significant FCD values started at C4. Decreased FCD leads to tissue ischemia and consequent ulceration.[15] The methodology used (room temperature, time to rest, etc) explains differences between our FCD values and those of Hasselbach et al.[39] The diameter of the dermal papilla and the largest diameter of the capillary bulk (DDP and DCB) changed from C3, but capillary limb diameter and capillary morphology (CD, CM) were already altered from C2, and so are the best parameters for evaluation of CVD from its early stages.

The proposed MI combines five microcirculatory parameters. Functional capillary density allows the functional analysis of the microcirculation, while the remaining four parameters (DDP, DCB, CD, CM) are used for morphological evaluation of the microcirculation. Another interesting functional variable not chosen in this

study to define MI is red blood cell velocity. As the dermal papilla shows only the top of the capillaries, it is almost impossible to determine the velocity precisely. Greater magnification is needed, but a suitable microscope is not commercially available. An MI defined as I (mild microangiopathy) covered most patients in classes C0 and C1, and an MI of III (severe microangiopathy) was applicable to 28 of 36 patients in classes C3 to C5. However, an MI of II applied to patients in all classes except C0. Therefore, MI may be used differentiate patients with mild and severe CVD according to the CEAP classification, but further investigation is needed to clarify its utility in class II.

It was demonstrated that 9 patients classified as C1 and C2 already had severe microangiopathy and it would be very interesting to see, in a prospective study, if microcirculatory alterations of these patients lead to greater disease progression (*Figure 3*). Cytoscan can be used to compare microcirculatory parameters, in association with the CEAP classification, and so drug efficacy can be assessed. Laser Doppler flowmetry has already been used to measure the effects of drugs on skin flow in the internal perimalleolar region.[9,40]

In conclusion, the Cytoscan device can be used for OPS imaging of the microcirculation. We propose a new microcirculatory index for use in defining the prognosis of chronic venous disease.

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REFERENCES

1 Greene R, Dalton K. The premenstrual syndrome. *Br Med J*. 1953;1:1007-1014.

2 Bradbury A, Evans CJ, Allan P, et al. The relationship between lower limb symptoms and superficial and deep venous reflux on duplex ultrasonography: the Edinburgh Vein Study. *J Vasc Surg*. 2000;32:921-931.

3 Scuderi A, Raskin B, Al AF, et al. The incidence of venous disease in Brazil based on the CEAP classification. *Int Angiol*. 2002;21:316-321.

4 Nicolaides AN. Chronic venous disease and the leukocyte-endothelium interaction: from symptoms to ulceration. *Angiology*. 2005;56(Suppl 1):S11-S19.

5 Brand FN, Dannenberg AL, Abbott RD, et al. The epidemiology of varicose veins: the Framingham Study. *Am J Prev Med*. 1988;4:96-101.

6 Cesarone MR, Belcaro G, Nicolaides AN, et al. 'Real' epidemiology of varicose veins and chronic venous diseases: the San Valentino Vascular Screening Project. *Angiology*. 2002;53:119-130.

7 Cesarone MR, Belcaro G, Nicolaides AN, et al. Epidemiology and costs of venous diseases in central Italy. The San Valentino Venous Disease Project. *Angiology*. 1997;48:583-593.

8 Valencia IC, Falabella A, Kirsner RS, et al. Chronic venous insufficiency and venous leg ulceration. *J Am Acad Dermatol*. 2001;44:401-421.

9 Katsenis K. Micronized purified flavonoid fraction (MPFF): a review of its pharmacological effects, therapeutic efficacy and benefits in the management of chronic venous insufficiency. *Curr Vasc Pharmacol*. 2005;3:1-9.

10 Cesarone MR, Belcaro G, Rohdewald P, et al. Rapid relief of signs/symptoms in chronic venous microangiopathy with pycnogenol: a prospective, controlled study. *Angiology*. 2006;57:569-76.

11 Fagrell B. Structural changes of human capillaries in chronic arterial and venous insufficiency (CVI). *Bibliotheca anatomica*. 1981;20:645-648.

12 Jünger M, Steins A, Hahn M, et al. Microcirculatory dysfunction in chronic venous insufficiency (CVI). *Microcirculation*. 2000;7(6 Pt 2):S3-S12.

13 Gschwandtner ME, Ehringer H. Microcirculation in chronic venous insufficiency. *Vasc Med*. 2001;6:169-179.

14 Schmid-Schonbein GW, Takase S, Bergan JJ. New advances in the understanding of the pathophysiology of chronic venous insufficiency. *Angiology*. 2001;52(Suppl 1):S27-S34.

15 Agren MS, Eaglstein WH, Ferguson MW, et al. Causes and effects of the chronic inflammation in venous leg ulcers. *Acta Derm Venereol Suppl (Stockh)*. 2000;210:3-17.

16 Gschwandtner ME, Ambrozy E, Maric S, et al. Microcirculation is similar in ischemic and venous ulcers. *Microvasc Res*. 2001;62:226-235.

17 Nicolaides AN. Investigation of chronic venous insufficiency: a consensus statement (France, March 5-9, 1997). *Circulation*. 2000;102:E126-E163.

18 Mayrovitz HN, Larsen PB. Periwound skin microcirculation of venous leg ulcers. *Microvasc Res*. 1994;48:114-123.

19 Fagrell B, Intaglietta M. Microcirculation: its significance in clinical and molecular medicine. *J Intern Med*. 1997;241:349-362.

20 Owens LV, Farber MA, Young ML, et al. The value of air plethysmography in predicting clinical outcome after surgical treatment of chronic venous insufficiency. *J Vasc Surg*. 2000;32:961-968.

21 Leu AJ, Leu HJ, Franzeck UK, et al. Microvascular changes in chronic venous insufficiency-a review. *Cardiovasc Surg*. 1995;3:237-245.

22 Rutherford RB, Padberg FT Jr., Comerota AJ, et al. Venous severity scoring: an adjunct to venous outcome assessment. *J Vasc Surg*. 2000;31:1307-1312.

23 Eklof B, Rutherford RB, Bergan JJ, et al. Revision of the CEAP classification for chronic venous disorders: consensus statement. *J Vasc Surg*. 2004;40:1248-1252.

24 Groner W, Winkelman JW, Harris AG, et al. Orthogonal polarization spectral imaging: a new method for study of the microcirculation. *Nat Med*. 1999;5:1209-1212.

25 Langer S, Born F, Hatz R, et al. Orthogonal polarization spectral imaging versus intravital fluorescent microscopy for microvascular studies in wounds. *Ann Plast Surg*. 2002;48:646-653.

26 Mathura KR, Vollebregt KC, Boer K, et al. Comparison of OPS imaging and conventional capillary microscopy to study the human microcirculation. *J Appl Physiol*. 2001;91:74-78.

27 Virgini-Magalhaes CE, Porto CL, Fernandes FF, et al. Use of microcirculatory parameters to evaluate chronic venous insufficiency. *J Vasc Surg*. 2006;43:1037-1044.

28 Beebe HG, Bergan JJ, Bergqvist D, et al. Classification and grading of chronic venous disease in the lower limbs. A consensus statement. *Eur J Vasc Endovasc Surg*. 1996;12:487-491.

29 Porter JM, Moneta GL. Reporting standards in venous disease: an update. International Consensus Committee on Chronic Venous Disease. *J Vasc Surg*. 1995;21:635-645.

30 Fitzpatrick TB. The validity and practicality of sun-reactive skin types I through VI. *Arch Dermatol*. 1988;124:869-871.

31 Klyscz T, Junger M, Jung F, et al. Cap image-a new kind of computer-assisted video image analysis system for dynamic capillary microscopy. *Biomed Tech (Berl)*. 1997;42:168-175.

32 Bosley PG, Gibson WC, Griffiths RS. Photomicrographic studies on the nail bed capillary networks in human control subjects. *J Nerv Ment Dis*. 1956;123:219-231.

33 Howlader MH, Smith PD. Microangiopathy in chronic venous insufficiency: quantitative assessment by capillary microscopy. *Eur J Vasc Endovasc Surg*. 2003;26:325-331.

34 Jünger M, Braun S. Microvascular Mechanisms Controlling CVI. In: GW Schmid-Schönbein, D Neil Granger, eds. *Molecular Basis for Microcirculatory Disorders*. Paris, France: Springer-Verlag; 2003:501-513.

35 Vaz JL, Dancour MA, Bottino DA, et al. Nail fold videocapillaroscopy in primary antiphospholipid syndrome (PAPS). *Rheumatology (Oxford)*. 2004;43:1025-1027.

36 Aguiar T, Furtado E, Dorigo D, et al. Nail fold videocapillaroscopy in primary Sjogren's syndrome. *Angiology*. 2006;57:593-599.

37 Pryce DW, Friedmann PS. Hemodynamics of leg ulceration assessed by laser Doppler flowmetry. *J Am Acad Dermatol*. 1993;29(5 Pt 1):708-714.

38 Harris AG, Sinitsina I, Messmer K. The Cytoscan Model E-II, a new reflectance microscope for intravital microscopy: comparison with the standard fluorescence method. *J Vasc Res*. 2000;37:469-476.

39 Pahernik S, Harris AG, Schmitt-Sody M, et al. Orthogonal polarization spectral imaging as a new tool for the assessment of antivascular tumor treatment in vivo: a validation study. *Br J Cancer*. 2002;86:1622-1627.

40 Hasselbach P, Vollenweider U, Moneta G, et al. Microangiopathy in severe chronic venous insufficiency evaluated by fluorescence videomicroscopy. *Phlebology*. 1986;1:159-169.

Congress and conference calendar

XXXVIITH BRAZILIAN CONGRESS OF ANGIOLOGY

This congress will be held in Goiânia (Brazil) from September 4 to 8, 2007.

• *For further information, please contact:*

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IST CONGRESS OF THE COLOMBIAN COLLEGE OF PHLEBOLOGY

This congress will be held in Bogota (Colombia) from September 13 to 15, 2007.

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Organizing secretariat:
Jorge Hernando Ulloa
Auditorio de la sede Salitre de la Cámara de Comercio de Bogotá, Colombia

Tel: +57 1 523 26 70

E-mail: cirugiavascular@yahoo.com

FRENCH SOCIETY OF VASCULAR MEDICINE

This congress will be held in Brest (France) from September 20 to 22, 2007.

• *For further information, please contact:*

President: Dr Jean-Pierre Laroche

Organizing secretariat:
Alexandra Leclerc – Elizabeth Negre
Palais des Congrès
10, rue de la Chancellerie
78 000 Versailles, France

Tel: +33 1 46 43 33 00

E-mail: congres@nex-com.com
Web site: www.palaisdescongres-versailles.com

XXIST ANNUAL MEETING, THE EUROPEAN SOCIETY FOR VASCULAR SURGERY

This congress will be held in Madrid (Spain) from September 20 to 23, 2007.

• *For further information, please contact:*

E-mail (scientific): contact@esvs.org
E-mail (congress): m.velazquez@torrespardo.com
Web site: www.esvs.org

IIIRD INTERNATIONAL EDUCATIONAL COURSE OF THE CENTRAL EUROPEAN VASCULAR FORUM

This congress will be held in Portorož (Slovenia) from September 27 to 29, 2007.

• *For further information, please contact:*

President: Prof Matija Kozak

Organizing secretariat:
Slovenian Association for Vascular Disease
Zaloska 7 / VI
1000 Ljubljana, Slovenia

Tel: +386 1 522 80 32
Fax: +386 1 522 80 70

E-mail: scientific@cevf2007.org /
infodesk@cevf2007.org
Web site: www.cevf2007.org

THE ARTIC FIORDS CONFERENCE AND WORKSHOPS ON CHRONIC VENOUS DISEASE (UNDER THE AUSPICES OF THE EUROPEAN VENOUS FORUM)

This congress will be held in Hurtigruten (Norway) from October 2 to 6, 2007.

• *For further information, please contact:*

Organizing committee: Bo Eklöf, Olle Nelzén, Andrew Nicolaides, Dag Sörlie

Organizing secretariat:
Anne Taft
Beaumont Associates
PO Box 172
Greenford
Middx, UB6 9ZN, UK

Tel/Fax: +44 20 8575 7044

E-mail: evenousforum@aol.com /
Taftbeaumont@aol.com
Web site: www.europeanvenousforum.org

XVITH ARGENTINA CONGRESS OF CARDIOVASCULAR SURGERY

This congress will be held in Buenos Aires (Argentina) from October 3 to 5, 2007.

• *For further information, please contact:*

President: Carlos Goldenstien

Organizing secretariat:
Tinogasta 4151 (C1417EIQ)
Ciudad de Buenos Aires, Argentina

Tel: +54 11 4639 4820 / 4567 4481
Fax: +33 496 15 33 08

E-mail: congreso@caccv.org /
publica.estudiomaril@gmail.com
Web site: www.congreso.caccv.org

XITH CIF NATIONAL CONGRESS

This congress will be held in Chia Laguna (Sardinia) from October 10 to 12, 2007.

• *For further information, please contact:*

Scientific President: Prof G. Brotzu

Organizing secretariat:
GC Congressi Srl
Via P. Borsieri n.12
00195 Roma, Italy

Tel: +39 06 37 29 466
Fax: + 39 06 37 35 2337

E-mail: segreteria@gccongressi.it /
segreteria2@gccongressi.it
Web site: www.sifcs.it

HUNGARIAN ANGIOLOGY CONGRESS

This congress will be held in Nyíregyháza (Hungary) from October 10 to 12, 2007.

• *For further information, please contact:*

Scientific President: Prof György Acsády

Organizing secretariat:
Pf. 143
1300 Budapest, Hungary

Tel: +36 6 202 4424 73
Fax: + 36 1 368 3645

E-mail: z.szabo@rodin.hu
Web site: www.rodin.hu / www.korona-hotel.hu

GIUV NATIONAL CONGRESS

This congress will be held in Rome (Italy) from October 18 to 20, 2007.

• *For further information, please contact:*

Scientific President: Prof F. Benedetti-Valentini

Organizing secretariat:
GC Congressi Srl
Via P. Borsieri n.12
00195 Rome, Italy

Tel: +39 06 37 29 466
Fax: + 39 06 37 35 2337

E-mail: segreteria@gccongressi.it /
segreteria2@gccongressi.it
Web site: www.sifcs.it

XIVTH ANNUAL NATIONAL CONFERENCE OF THE VASCULAR SOCIETY OF INDIA (VSICON) 2007

This congress will be held in Baroda (India) from October 26 to 29, 2007.

• *For further information, please contact:*

President: Dr Ashwin Bhammer

Organizing secretariat:
Dr Vijay Thakore
Angio Care Hospital
Vinraj Plaza
Opp. Govt. Press, Kothi
Baroda –1, India

Tel: +91 265 242 8181 / 8383
Fax: +91 265 242 8282

E-mail: info@vsicon2007baroda.com
Web site: www.vsicon2007baroda.com

IIIRD NATIONAL PHLEBOLOGY CONGRESS

This congress will be held in Antioquia (Colombia) from November 2 to 5, 2007.

• *For further information, please contact:*

President: Dr Norman Pizano

Organizing secretariat:
Dr Julieta Duque
Recinto Quirama
Rionegro – Antioquia, Colombia

Tel/Fax: +57 4 512 38 63

E-mail: juldubo@gmail.com /
vasculab@une.net.co

IVTH CONGRESS OF NORTH AFRICAN & MIDDLE EAST CHAPTER OF INTERNATIONAL UNION OF ANGIOLOGY (IUA) – IIIRD ANNUAL CONGRESS OF THE VASCULAR SOCIETY OF EGYPT

This congress will be held in Cairo (Egypt) from November 8 to 11, 2007.

• *For further information, please contact:*

President: Prof Salvatore Novo

Organizing secretariat:
Misr 2000 Conferences and exhibitions
2, El Gabal el Akhdar Bldgs
Nasr Road
Nasr City
11471 Cairo, Egypt

Tel: +202 458 17 57 / +202 674 50 13 /
+2010 163 4354
Fax: +202 685 25 49

E-mail: misr_2000@hotmail.com
Web site: www.misr2000online.com

XXIST ANNUAL CONGRESS OF ACP

This congress will be held in Tucson (USA) from November 8 to 11, 2007.

• *For further information, please contact:*

Organizing secretariat:
Starr Pass Marriott Resort
Tucson
Arizona, USA

Tel: +1 510 834 6500
Fax: +1 510 832 7300

E-mail: ACP@amsinc.org
Web site: www.phlebology.org

MEETING OF THE SOCIETY OF PHLEBOLOGY

This congress will be held in Vienna (Austria) from November 9 to 11, 2007.

• *For further information, please contact:*

President: Prof. Sanja Schuller-Petrovic

Organizing secretariat:
IFC - Ilona Fuchs Congress
Postfach 6
1106 Vienna, Austria

Tel/Fax: +43 1 602 2548

E-mail: schuller@vienna.at / congress@chello.at
Web site: www.phlebologie-gesellschaft.at

XIXTH SIAPAV NATIONAL CONGRESS

This congress will be held in Palermo (Sicily) from November 15 to 18, 2007.

• *For further information, please contact:*

Scientific President: Prof S. Novo

Organizing secretariat:
GC Congressi Srl
Via P. Borsieri n.12
00195 Roma, Italy

Tel: +39 06 37 29 466
Fax: + 39 06 37 35 2337

E-mail: segreteria@gccongressi.it /
segreteria2@gccongressi.it
Web site: www.sifcs.it

MEETING OF THE SOCIETY OF DERMATOLOGY

This congress will be held in Vienna (Austria) from November 30 to December 2, 2007.

• *For further information, please contact:*

President: Prof H. Pehamberger

Organizing secretariat:
Alser Str. 4
1090 Vienna, Austria

Tel: +43 1 405 138320
Fax: +43 1 405 138323

E-mail: kk@medacad.org
Web site: www.oegdv.at

XVITH WORLD MEETING OF THE UNION INTERNATIONALE DE PHLEBOLOGIE (UIP)

This congress will be held in the principality of Monaco from August 31 to September 4, 2009.

• *For further information, please contact:*

Chairman of scientific committee:
Prof Eberhardt Rabe
Chairman of organizing committee:
Dr Jean-Jérôme Guex

Organizing secretariat:
Publi Créations – Partner of AIM
27, boulevard d'Italie
98000 Monaco

Tel: +377 9797 3555
Fax: +377 9797 3550

E-mail: uip2009@publicreations.com
Web site:
www.aim-internationalgroup.com/2009/uip

INTER-ANGIO 2007 – IIIRD INTERDISCIPLINARY VASCULAR SYMPOSIUM WITH INTERNATIONAL PARTICIPATION

This congress will be held in Liberec (Czech Republic) from October 11 to 13, 2007.

• *For further information, please contact:*

President: Dr Jan Marusiak

Organizing secretariat:
AMCA – Eva Uhrova
Academic and Medical Conference Agency
Ujezd 40
118 01 Praha 1, Czech Republic

Tel: +420 257 007 629 / 731 496 060
Fax: +420 257 007 622

E-mail: amca@amca.cz
Web site: www.interangio.cz

XXXII ANGIOLOGICAL DAYS 2008

This congress will be held in Praha (Czech Republic) from February 21 to 23, 2008.

• *For further information, please contact:*

President: Dr Karel Roztocil

Organizing secretariat:
AMCA – Eva Uhrova
Academic and Medical Conference Agency
Ujezd 40
118 01 Praha 1, Czech Republic

Tel: +420 257 007 629 / 731 496 060
Fax: +420 257 007 622

E-mail: amca@amca.cz
Web site: www.angiologie.cz

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