IV. POST-THROMBOTIC DISEASE: DEEP AND SUPERFICIAL

CASE OF SECONDARY DEEP VENOUS DISEASE-SOMETHING CAN ALWAYS BE DONE

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Compression therapy of deep venous insufficiency is associated with high recurrence.[1] In a carefully conducted study from Sweden, Nelzen, et al reported a 56% recurrence, the majority occurring in the first year. Apart from the high recurrence and primary non-healing (30%), noncompliance is a major factor in many compression regimens.[2,3] Noncompliance is associated with nearly 100% recurrence.[2] The reasons for noncompliance are many, including lack of self discipline, poor fit, a sensation of "binding" or "cutting off the circulation", cosmetic considerations, warm weather, high recurrent cost, and other more compelling reasons such as contact dermatitis, infirmity or arthritis that prevents the patient from applying the device without daily help. In addition to these drawbacks it is our impression that many patients under chronic compression regimens seldom get *complete* relief of symptoms particularly pain and swelling. A surgical approach provides a more definitive therapy with superior symptom relief. The majority of patients after successful valve repair discard their stockings,[4] and the remainder who continue to use them after surgery have a greater latitude and freedom in utilizing the device compared to patients on primary compression therapy. The surgical option should, therefore, be considered in patients in whom compression therapy had failed or cannot be applied.

Relatively minor improvement in hemodynamics can lead to remission with healing of stasis ulceration, even though substantial improvement in reflux parameters (see below re. obstruction) appears to be required for total relief of pain and swelling. This argues for an aggressive surgical approach in patients with secondary or post-thrombotic disease. This is the basis of the premise that a comprehensive correction of obstructive and refluxive pathologies as is practically feasible offers the best chance of symptom relief for the post-thrombotic patient. Hard data to support this philosophy is however not yet available and the approach is strictly empirical at the present time. However there have been technical advances in venous surgery, allowing a greater number of patients, many with pathologies previously considered inoperable to benefit from a surgical approach. Several different techniques[5] of valve repair are now available, allowing repair of even small caliber veins or multiple repairs if desired. There is little difference in the clinical result between the various techniques.

Similar ulcer healing is obtained as long as valve competency was restored irregardless of the individual technique used. Valve reconstruction techniques can now be applied to even post-thrombotic trabeculated veins[6] and axially transformed profunda femoris veins.[7] Cryovalves have become available for salvage cases. Secondary saphenous varicosities can be safely stripped[8] providing improvement in the overall reflux without affecting outflow. The advent of endovenous stenting has provided a means of a simple percutaneous technique in nearly an outpatient setting to afford significant symptom relief in the large subset of patients with stenosis or obstruction of the iliac veins. Relief of pain and swelling with this simple procedure has been impressive.[9] Approximately 30% of ulcers appear to heal with the stenting procedure alone.

In the last five years, >85% operability was achieved in post-thrombotic patients, even though no preselection was made based on severity of venographic appearance, size, extent or duration of the ulcer, or presence of procoagulant abnormalities. Employing this aggressive approach, actuarial ulcer healing of >60% at 10 yrs was achieved even in those with severely mangled and trabeculated post-thrombotic veins.[5]

References

1. Nelzen O, Bergqvist D, Lindhagen A. Long term prognosis for patients with chronic leg ulcers: a prospective cohort study, *Eur J Vasc Endovasc Surg.* 1997;13:500-08.
2. Mayberry JC Moneta GL, Taylor LM Jr., Porter JM. Fifteen year results of ambulatory compression therapy for chronic venous ulcers, *Surgery.* 1991;109:575-81.
3. Franks PJ, Oldroyd MI, Dickson D, Sharp EJ, Moffatt CJ. Risk factors for leg recurrence: randomized trial; of two types of compression stocking, *Age and Aging.* l995; 24:490-4.
4. Raju S, Fredericks R. Valve reconstruction procedures for non-obstructive venous insufficiency, *J Vasc Surg.* l988;7:301-10.
5. Raju S, Hardy JD. Technical options in venous valve reconstruction, *Am J Surg.* l997;173:301-07.
6. Raju S, Neglen PN, Doolittle J, Meydrech EF. Axillary vein transfer in trabeculated post-thrombotic veins, *J Vasc Surg.* 1999;29:1050-64.
7. Raju S, Fountain T, Neglen PN, Devidas M. Axial transformation of the profunda femoris vein, *J Vasc Surg.* l998;27:651-9.
8. Raju S, Easterwood L, Fountain T, Fredericks R, Neglen PN. Saphenectomy in the presence of chronic venous obstruction, *Surgery.* l998;123:637-44.
9. Neglen PN, Raju S. Endovenous stents for iliac venous obstruction, *J Endovasc Surg.* In press.

CASE OF SECONDARY DEEP VENOUS DISEASE – VALVE TRANSPLANTATION

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Introduction

It has been estimated that 2.7% of the U.S. population (~ 6 million people) have advanced chronic venous disease with approximately 800,000 new cases recognized per year.[1,2] These symptomatic patients often have deep venous disease (~ 70% isolated or 80-100% combined with superficial disease).[2] Approximately 85% are due to insufficiency and possibly 50% have an etiology classified as secondary (eg. post-phlebitic).[3,4] A rough estimation would suggest therefore, that of these six million patients about two million would have deep venous insufficiency due to a secondary cause and may require venous valve transplantation to free them from a life of disabling symptoms.

Indications/Preoperative Evaluation

Patient selection for venous valve transplantation is based upon symptoms, anatomy/physiology and the failure of other more conservative medical and surgical options designed to alleviate the patient's disability.

Patient symptoms coincide with a CEAP classification of 4 or higher.[5] The patients typically have severe lower extremity edema, lipodermatosclerosis and recurrent venous ulceration. Recurrent

ulceration unresponsive to medical management afflicting a motivated compliant patient constitutes a prime candidate for this surgical approach.

Anatomy/physiologic considerations are defined by the preoperative work-up. The initial history and physical examination can eliminate patients with insignificant venous disease while arterial disease (lower extremity arterial doppler examination) and a preexisting hypercoagulable state (Antithrombin III, Protein C, Protein S, Factor V leiden deficiencies, etc.) can also be investigated. The latter does not necessarily eliminate the patient as a candidate for venous surgery but does stress the need for stringent anticoagulant therapy if a surgical procedure is undertaken. The next step is a venous duplex study to define the precise location of disease throughout the leg (obstruction or insufficiency). In addition, a plethysmographic evaluation, usually air plethysmography, provides an overall hemodynamic estimate of calf pump function, venous obstruction or valvular insufficiency. Confirming insufficiency as the major problem, an ascending venogram with intravenous pressure measurements confirms the noninvasive findings and provides a roadmap of the venous anatomy. If obstruction is a significant problem, it would be addressed at this time. Lastly, a descending venogram performed by the method of Kistner[6] determines the presence and location of venous valves as well as the degree of reflux. Grade 3 and 4 reflux are considered abnormal.

Prior to considering a valve transplantation to alleviate the patient's complaints, all superficial and perforator disease should be addressed. I tend not to perform simultaneous major superficial and deep venous surgery due to the bleeding which may occur at the time of heparinization for the valve transplantation. Certainly, the less invasive nature and long-term results of valvuloplasty[7] make it a surgical approach which should be attempted prior to transplantation if applicable. The post-phlebitic patients considered for valve transplantation generally do not have the proper anatomy to allow this option. Valve transposition is also a viable first approach but is possible in less than 3% of patients evaluated.[8] Valve transplantation, due to its need for multiple incisions and more extensive operative repair, is the final option offered to patients who have exhausted all other avenues. For those 30-40% of patients who have no appropriate autogenous valve for transplantation,[9] cryopreserved venous valve transplantation is considered.

Technique

The goal of therapy is, of course, to prevent grade 3 or 4 venous reflux. When considering venous reflux, it is critical to evaluate the profunda femoral vein. Profunda reflux can allow grade 3 plus reflux and recurrent symptoms following the correction of superficial femoral vein incompe-tence.[7,9,10] Often, only one autogenous venous valve is available for transplantation. In this situation, the valve must be positioned below all thigh reflux. The superficial femoral vein will suffice if the profunda is competent,[7,9-11] but others have championed the popliteal location for most cases.[12-15] The popliteal location must be chosen if the profunda is incompetent. If two or more valves are available, correction of reflux in both the superficial femoral and profunda femoral veins may be appropriate.[16] The duplex scan and ascending venogram may help one decide which area of the vein is most normal in caliber allowing optimal flow and ease of surgical implantation.

The operation is routinely performed under general anesthesia to allow dissection in the leg and axillary region. A valve containing vein segment demonstrated to be competent by preoperative duplex scanning is harvested through an infra-clavicular incision positioned over the neurovascular bundle. Sometimes the only available vein is in the upper arm venous system but the size discrepancy makes this less desirable. Harvest is not performed until the standard groin or medial leg incision has allowed dissection of the appropriate superficial femoral or popliteal vein segment. In addition, systemic heparinization is provided prior to any venous interruption. At harvest, the axillary vein is simply ligated and divided to provide a 4-6 cm length of vein with the valve lying safely within. The lower leg venous segment is transected after applying vessel loop or vascular clamp control. The vein edges spring apart and residual vein is then removed to accommodate the length of upper extremity vein available. The anastomosis is performed with interrupted 6-0 or 7-0 prolene sutures in an end-to-end fashion. It is often useful to perform the cephalad anastomosis first, release the proximal clamp, and allow retrograde flow. The valve, if competent, will prevent reflux of the blood and the caudal anastomosis can be completed with proximal clamps removed. This confirms valve competence and allows more native femoral or popliteal vein to be removed if required for proper matching of length. The distal anastomosis is flushed, irrigated with heparinized saline, the last sutures tied and the distal clamp is removed. The "strip-test" confirms valvular competence. If incompetent, the valve is made competent by the closed technique of Kistner.[17] Careful hemostasis is mandatory. Suction drainage of the subcutaneous tissue is optional but often used because postoperative anticoagulation will be utilized. Incisions are closed in standard fashion. Intermittent lower limb pneumatic compression is begun in the operating room and continued until the patient is ambulating well. Postoperative anticoagulation may be with fractionated or unfractionated heparin followed by Coumadin therapy for 3-6 months or for life if the patient has a hypercoagulable state. Elastic compressive support is encouraged to control any residual edema.

For those patients with no autogenous venous valve available for transplantation, the use of cryopreserved tissue has been studied. The technique is essentially the same as for an autogenous transplant without the need for an axillary incision. The cryopreserved valve containing vein segment is ordered by blood type, diameter and length. It was originally procured from qualified donors with an acceptable superficial femoral vein valve. The allograft is shipped at –70°C and must be thawed for surgical use within 72 hours. The thawing process is a 4 step protocol generally requiring 30 minutes and, therefore, should be started significantly early during the groin or medial leg incision. Once thawed, the valve is checked for competence by injecting heparinized saline retrograde in the vein. Valvuloplasty may be used if required, but the company is willing to send more than one valve to ensure an immediately competent valve. I personally tend to add a distal arteriovenous fistula if the valve is placed low in the popliteal fossa. Anticoagulation is continued for the life of the valve. All other technical considerations are similar to those used for an autogenous valve transplant.

Results

The competence of upper extremity donor valves, when defined as

absent or only mild reflux and substantiated by duplex scanning or descending venography, range from 75-100% at six months.[7,10,13,14] With follow-up of 6-48 months, the reported competency rate was 34-100%.[7,10-14] Although not always in a direct one to one relationship, a competent valve translates into a symptomatically improved limb. Restricting the patients to those with prior or concurrent recalcitrant ulcers, ulcer healing occurred in 95% and recurrence was prevented in 60% up to 10 years post-transplant.[11]

Cryopreserved tissue has only recently been used for this clinical scenario, the single published paper suggests a 6 month valve competency rate of approximately 60% with ulcer healing/prevention of recurrence of approximately 67%.[18] Issues of rejection and the need for long-term anticoagulation make this a secondary choice for most patients.

Summary

The number of patients suffering from disabling chronic venous insufficiency is not insignificant and is generally treated with conservative medical maneuvers. There are alternatives including surgical procedures to prevent massive venous reflux. Proper patient classification and a regimented diagnostic evaluation including non-invasive and invasive imaging can define the patient who may benefit from a specific surgical approach. The transplantation of valves from the upper to lower extremity is generally reserved for patients with secondary causes of deep venous insufficiency who have no other options. The environment into which the valve is placed is a damaged, scarred conduit which probably explains the less impressive long-term function of these valves when compared to primary valvuloplasty. Nevertheless, one can expect a clinical benefit defined as ulcer prevention in approximately 60% of patients. For those lacking an autogenous valve, a cryopreserved valve may substitute with encouraging early results.

References

1. Coon WW, Willis PW, Keller JB. Venous thromboembolism and other venous disease in the Tecumseh community health study, *Circulation.* 1973;XLVIII:839-846.
2. O'Donnell TF. Chronic venous insufficiency: An overview of epidemiology, classification, and anatomic considerations, *Sem in Vasc Surg.* 1988;1:60-65.
3. Kistner, RL. Primary venous valve incompetence of the leg, *Am J Surg.* 1980;140:218-224.
4. Kistner RL. Surgical repair of the incompetent femoral vein valve, *Arch Surg.* 1975;110:1336-1342.
5. Prepared by an ad hoc committee of the American Venous Forum chaired by A.N. Nicolaides. Classification and grading of chronic venous disease in the lower limbs. A consensus statement. In: Gloviczki P, Yao JST, eds. *Handbook of Venous Disorders.* New York, NY: Chapman & Hall Medical; 1996:652-660.
6. Kistner RL, Ferris EB, Randhawa MD. A method of performing descending venography, *J Vasc Surg.* 1986;4:464-468.
7. Masuda EM, Kistner RL. Long-term results of venous valve reconstruction: A four- to twenty-one year follow-up, *J Vasc Surg.* 1994;19: 391-403.
8. Raju S. Venous insufficiency of the lower limb and stasis ulceration. Changing concepts and management, *Ann Surg.* 1983;197: 688-697.
9. Raju S, Fredericks R. Valve reconstruction procedures for nonobstructive venous insufficiency: Rationale, techniques, and results in 107 procedures with two- to eight-year follow-up, *J Vasc Surg.* 1988; 7:301-310.
10. Eriksson I, Almgren B. Influence of the profunda femoris vein on venous hemodynamics of the limb, *J Vasc Surg.* 1986;4:390-395.
11. Raju S. Fredericks RK, Neglen PN, et al. Durability of venous valve reconstruction techniques for 'primary' and post-thrombotic reflux, *J Vasc Surg.* 1996;23:357-367.
12. Taheri SA, Heffner R, Budd T. Five years' experience with vein valve transplant, *World J Surg.* 1986;10: 935-937.
13. O'Donnell TF, Mackey WC, Shepard AD. Clinical, hemodynamic, and anatomic follow-up of direct venous reconstruction, *Arch Surg.* 1987;122:474-482.
14. Rai DB, Lerner R. Chronic venous insufficiency disease. Its etiology. A new technique for vein valve transplantation, *Int Surg.* 1991;76: 174-178.
15. Nash T. Long term results of vein valve transplants placed in the popliteal vein for intractable postphlebitic venous ulcers and pre-ulcer skin changes, *J Cardiovasc Surg.* 1988;29:712-716.
16. Raju, S. Multiple-valve reconstruction for venous insufficiency: Indications, optimal technique, and results. In: Veith, FJ, ed. *Current Critical Problems in Vascular Surgery, Volume 4.* St. Louis, MO: 1992:122-125.
17. Kistner RL. Valve repair and segment transposition in primary valvular insufficiency. In: Bergan JJ, Yao JST, eds. *Venous Disorders.* Philadelphia, PA: 1991:261.
18. Dalsing MC, Raju S, Wakefield TW, Taheri S. A multi-center, phase I evaluation of cryopreserved venous valve allografts for the treatment of chronic deep venous insufficiency, *J Vasc Surg.* In press.

ANGIOPLASTY AND STENTING OF THE OBSTRUCTED ILIAC VEIN

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Chronic venous insufficiency of the lower extremity is a complex disease with several etiological factors. In approximately one-third of the limbs with postthombotic disease an obstructive component is predominant. The treatment of the outflow obstruction has been hampered by difficulty in identifying hemodynamically significant obstruction and by a rather extensive surgery to correct it. Available surgical procedures like the crossover femoro-femoral bypass or axial iliocaval bypass graft constitute major surgery, always followed by long-term anticoagulation. The interest in venous obstruction is now rising owing to the development of the new technology to diagnose and treat stenosis and occlusion by percutaneous dilatation and insertion of stent. This study presents the technical aspects of this procedure and the results when applied in limbs with postthombotic disease.

Material

A prospective study of 78 limbs with post-thrombotic disease had balloon dilatation and insertion of stent to correct iliac vein obstruction (median age 47 [range 18-77], male/female ratio 1/1, left/right lower extremity 2.3/1). All patients had a thorough history taken and clinical examination performed. A visual analogue pain severity scale from 1-10, in which 10 is the most severe pain, was used to assess pain intensity. The clinical score as per the guidelines of the SVS/ISCVS was also used to assess swelling and pain.

The presenting limb complaint was active (24%, 24/79) or healed ulcer (8%, 6/79); lipodermatosclerosis, pigmentation and/or dermatitis (12%, 9/78); and swelling (50%, 39/78). Concomitantly, 35% of the patients had severe pain (> 5/10 as assessed by the analogue pain severity scale) and required analgesics. Only 16% of patients denied any pain. In addition, 97% of the patients complained of swelling. A comprehensive work up was performed prior to the intervention.

The following preoperative indicators of obstruction were used: occlusion or obvious stenosis on ascending or antegrade transfemoral venography, increased arm/foot pressure differential and/or abnormal hyperemia-induced pressure rise, and presence of pelvic collaterals on venogram. Positive preoperative pressure measurement was present in 38% of the limbs, radiological obstruction in 81%, and collaterals were visualized in 63%.

Intervention

All interventions were performed in a dedicated interventional room with ceiling mounted ISS equipment in the surgical suite with complete sterile precautions. The procedures were done under general anesthesia or local infiltration analgesia in combination with