

THE ROLE OF ANGIOSCOPIC VALVE REPAIR FOR PRIMARY VALVE INCOMPETENCE (PVI)

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The treatment of deep venous valvular reflux for advanced chronic venous insufficiency (CVI) has been cyclical in nature. During the late 1960s and early 1970s there was enthusiasm for ablation of the superficial venous system – saphenous and its branches as well as perforating veins, as the sole management for venous ulcer with deep venous reflux.¹ Both the ulcer recurrence rate and wound morbidity associated with this approach dampened interest in the treatment of venous ulcer by superficial venous system ablation alone.² Direct deep venous reconstruction pioneered by Kistner³ sparked interest in the later approach. Recently, minimally invasive surgery for treatment of incompetent perforating veins (SEPS) however, has refocused the treatment strategy for grade IV through VI CVI back on superficial ablation rather than deep venous reconstruction due to the low wound morbidity rate of the former. The important work of Gloviczki and his North American SEPS Registry has shown that superficial venous ablation works better in patients with primary valvular incompetence than those with a post-thrombotic etiology for their deep venous reflux.⁴ This data suggests that a staged approach to deep venous reflux due to primary valvular incompetence is the appropriate strategy. Although primary valvular incompetence has traditionally been related to a fibro-elastic degeneration of the valve with resultant valvular insufficiency,³ there is increasing evidence that volume overload from a capacious varicose superficial system can cause dilation of the deep venous system and secondary deep venous valvular incompetence.⁵ The valves in this situation are intact, but the dilation of the venous annulus prevents them from appropriately coapting. Superficial system surgery which removes the volume overload has shown to restore both normal venous diameter and valve competence. It has been our approach to treat the incompetent superficial venous system first in patients with primary valvular incompetence and restrict direct deep venous reconstruction to those patients who fail this therapy.

One of the hosts of this conference, Dr. Robert Kistner, was the first surgeon to describe a direct approach to rendering a valve competent rather than replacing the incompetent segment with competent valve “borrowed” from either a local or distant venous segment.³ His initial report in 1968 stimulated interest in the surgical repair of primary valvular incompetence.⁶ Our case report will detail the diagnosis, surgical technique and postoperative results of surgery for primary valvular incompetence.

Diagnostic Methods

Clinical Examination: Patients with deep venous valvular reflux characteristically have pain, which is described as a heaviness rather than the intense bursting pain experienced by patients with deep venous obstruction.⁷ The pain or heaviness develops upon rising from bed and worsens after prolonged standing. Calf heaviness

occurs irrespective of whether the patient is walking which is in distinct contrast to the situation with obstructive venous disease and venous claudication. Edema is a constant finding in patients with deep venous reflux and is of a mild to moderate degree. Cutaneous sequelae, lipodermatosclerosis and pigmentary changes occur frequently in these patients in association with incompetent perforating veins. In our experience, the skin changes may not be as severe as those encountered in patients with post-thrombotic syndrome.

Noninvasive Assessment of Venous Reflux: Duplex scanning is our preferred diagnostic study, because it answers several questions: 1) What is the pathologic process in the deep venous system, 2) what levels are involved, and 3) who are surgical candidates based on the degree of reflux? Quantitative evaluation of venous valvular reflux is performed by the technique described by van Bemmelen. While color flow analysis provides qualitative determination of deep venous valvular reflux, spectral analysis is recorded to quantify the degree of reflux by duration.

Air plethysmography provides hemodynamic information on deep venous valvular incompetence. The venous filling index (VFI) relates directly to the degree of venous reflux and is independent of the venous volume reservoir. Christopolous⁸ as well as our vascular laboratory⁹ have shown that patients with popliteal vein reflux in stage IV – CVI have VFIs in the range from 7 – 28 ml/seconds versus the normal 2 ml/seconds. We perform both of these noninvasive studies prior to consideration for valve reconstruction as well as employing it as a method for documenting hemodynamic results postoperatively. In a prospective trial comparing quantitative duplex scanning and air plethysmography to the gold standard of descending phlebography in patients with stage V/VI chronic venous insufficiency, we demonstrated that the combination of valve closure times at the superficial femoral and popliteal vein levels accurately discriminated mild from severe reflux with a sensitivity of 90% and a specificity of 94%.⁹

Phlebography: In all surgical candidates, ascending phlebography is performed with multiple tourniquets to maximize visualization of the deep system.⁷ With the superficial system occluded the contrast material is injected by hand forcefully into a foot vein. In addition to indicating the presence and level of incompetent perforating vein, valve sites may be seen in the superficial femoral vein. The diameter of the veins helps distinguish relative deep venous valvular insufficiency from true PVI.

Descending phlebography is then performed under fluoroscopy with the patient on a 75 degree tilt table. The contrast material is hand injected while the patient performs a Valsalva maneuver. Reflux of contrast material is followed by fluoroscopy and cut films are taken. As it slips past, the contrast material usually will outline the valve structure much as frost on a windowpane.

Surgical Procedure: The common femoral, superficial femoral, profunda femoris, and greater saphenous veins (if the latter is present) are approached through a longitudinal incision placed over the common femoral vein. Raju and Fredericks¹⁰ prefer to perform the dissection with a scalpel rather than with scissors in order to avoid venospasm. As opposed to veins that have been involved by a previous episode of thrombophlebitis, the veins of a patient with

PVI usually do not have the intense perivenous scarring unique to post-thrombotic veins. The various branches of the major veins are ligated so that approximately 4 cm of superficial femoral vein is isolated. The proximal valve is identified by its characteristic bulge in the upper superficial femoral vein. The vein is then milked of blood to test its competence. An incompetent valve will permit blood flow down to the clamp placed distal to the valve. Following heparinization, soft, noncrushing clamps are placed on the common femoral, profunda femoris, and superficial femoral veins below the valve.

There are three open approaches to exposure of the valve commissure. Kistner originally described a longitudinal venotomy,³ while Raju advocated a transverse venotomy placed above the valve.¹⁰ Finally, Sottiurai used a combination of a transverse and longitudinal venotomy.¹¹ We, however, prefer the closed angioscopic technique first described by Gloviczki.¹²

Angioscopic Technique: Fourteen patients have undergone angioscopic evaluation of the valve before and after repair. The scope is inserted through a large tributary of the proximal greater saphenous vein which was invariably absent or via a branch of the femoral vein down into the superficial femoral vein.¹³ Saline solution is infused through the angioscope, and the valve leaflets are observed for incompetence, which, when present, is both obvious and dramatic. The pathology of PVI usually demonstrates a wispy gossamer-like valve with redundant valve margins.

The Closed Angioscopic Valve Repair Technique: After placing two or three 7-0 monofilament sutures on each side of the valve from outside the vein under angioscopic guidance, the repair was tested for competence by infusing saline solution through the scope. Common to the patients who have undergone angioscopy is the use of the angioscope to judge the competence of the repair rather than the strip test. If the valves are incompetent, additional sutures are added. By contrast, if the repair is narrowed sutures may be removed.

Results: Table I demonstrates the preoperative demographics for seven series in the literature which total 254 limbs. All series except ours were carried out by the open technique. The indication for surgery varied but averaged 75% for stage V/VI disease. Kistner's¹⁴ series has the longest follow-up period. In general patients do quite well regarding ulcer recurrence with rates varying from 35% to 19%. Several series such as Kistner's and the recent one of Perrin¹⁵ show that valvular incompetence is related to the duration of ulcer-free survival. The value of angioscopic repair of primary valvular incompetence lies in the determination while in the operating room that the repair is competent. In the absence of further valvular degeneration in the postoperative period, this finding should be correlated with a good outcome.

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Table 1.- Summary of Preoperative Demographics for the Surgical Treatment of Primary Valvular Incompetence by Valvuloplasty

Preoperative Demographics						
Series	Country	Institution	Year	#Limbs	Indicat (% ulcers)	Technique
Kistner ⁽¹⁴⁾	USA	Straub Clinic	1992	51 (48 pts)	57%	Open ± Perfs
Raju ⁽¹⁰⁾	USA	Mississippi	1987	107 (42 pts)	71%	Open ± SFJ lig
Perrin ⁽¹⁵⁾	France	Clinique Grand Large	1999	52 33 (28 pts)	100%	Open ± Perfs
Eriksson ⁽¹⁶⁾	Sweden	Uppsala Univ Hosp	1989	22 (20 pts)	?? %	Open ± Perfs
Sottiurai ⁽¹¹⁾	USA	L.S.U.	1987	20 (12 pts)	100%	Open
Simkin ⁽¹⁷⁾	Argentina	Clinica Quintana	1988	7 (7 pts)	100%	Open (3) Plication (4)
O'Donnell	USA	NEMC	1992	14 (14 pts)	100%	14 open

Table 2.— Summary of Postoperative Results for the Surgical Treatment of Primary Valvular Incompetence by Valvuloplasty

Postoperative Results

Series	Follow-up(mos)		Imaging	Hemodynam	Clinical Results
Kistner	48-252 (108)	86%	67% (PVI)	60%	35% ulcer
Raju	24-96			85% 1 year 75% 2 years 63% 3 years	7% DVT 5% bleed 5% infec
Perrin	24-96 (58 months)	85%	68%		19.2% ulcer recurrence 77.8% ulcer free survival
Eriksson	6-84		100%	64% 6 mos 62% 84 mos	30% ulcer
Sottiurai	10-73			80%	?
Simkin	??			50%	
O'Donnell	12-62			100%	85% remain healed

Range of follow, as well as (mean follow-up). Imaging refers to the percent of patients who were free of reflux on phlebography or duplex.

Hemodynamics refers to the percent of patients who had normalization of their APG or VRT#.

*Angioscopically guided valvuloplasty

INTERNAL VALVULOPLASTY

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In case of primary deep venous reflux and when deep venous reconstructive surgery is planned internal valvuloplasty looks to be in our experience the recommended surgical procedure.

The rationale for recommending Internal Valvuloplasty (IV):

First of all because other techniques have not yet provided long term results as good as IV.

-Valve transfer (transposition, transplantation) has been mostly used to treat secondary deep vein reflux and generally their results are not as satisfactory as those obtained by IV (Perrin, Raju, Sottiurai).

-Psathakis operation II had given excellent results to his promoter but disappointing in small series reported by others (Perrin, Scurr).

-Several authors (Belcaro, Lane, Raju, and Schanzer) had performed external wrapping (Veno-cuff, banding with Gore-Tex or Dacron sleeve). Results are difficult to assess as various materials and techniques had been used, indications were different according to authors and long-term results are not available. Furthermore, I cannot clearly understand how shrinking of the vein diameter may work to correct reflux when the free borders of the valve are elongated and already in contact.

-Plagnol and Raju had used neovalve. The former had reported only

mid-term results (average 18 month) in 44 extremities including 32-graded C6. Ulcer had recurred in 3/32(9.4%) and hemodynamic failure in 6 /44(13.6%).

-Hoshino, Kistner, Gloviczki, O'Donnell and Raju had used external valve repair, but again we have only short- or mid-term results. The advantages of the external valvuloplasty (EV) compared to IV are: EV is quicker than IV, allowing multivalve repair and avoids phlebotomy. In our unit we have only performed EV in addition to IV at the popliteal level without using angioscopy. Angioscopy is certainly very helpful as recommended by Gloviczki, Hoshino, and O'Donnell. I would add that in EV, the vein needs to be peeled off, and that might be detrimental to the vein wall vascularization.

-Internal Valvuloplasty: Kistner, Raju, and Sottiurai have described three techniques. We used the latter with minor modifications because it seems easier to perform valve repair through the T-shaped phlebotomy.

The ideal site for performing valvuloplasty is still under discussion: Sottiurai recommends popliteal level and Raju termination of the superficial femoral vein. In our series the latter has been chosen.

One of the potential hazards in IV is postoperative thrombosis. All our patients have had a postoperative ascending phlebography (24 to 36 hr. after surgery) to assess this complication. In IV (#65) for primary vein reflux we have recorded 5 (7.6%) limited thrombosis in situ or distal to the valve repair. Our results are summarized in Tables I, II, III, and IV. Table V displays results gathered through the published literature. Until updated data on others' techniques with long follow-up results assessment will be presented, IV seems the more reliable surgical technique to correct deep venous reflux.