scan

Valvuloplasty and valve transfer

SESHADRI RAJU, *M.D.*
University of Mississippi Medical Center, Jackson, MS, U.S.A.

INTERNATIONAL ANGIOLOGY

Vol. 4 - No. 4 - pp. 419-424 (October-December 1985)

Valvuloplasty and valve transfer

SESHADRI RAJU, *M.D.*
University of Mississippi Medical Center, Jackson, MS, U.S.A.

SUMMARY.—The technique and results of valvuloplasty and valve transfer are presented. The rationale and theoretical background for these procedures are outlined. Results of reconstructive valve surgery have been good and justify continued application of this therapeutic modality in chronic venous insufficiency.

KEY WORDS.—Venous insufficiency - Valvuloplasty - Valve transfer - Venous reflux - Postphlebitic syndrome.

INTRODUCTION

Chronic venous insufficiency may be due to obstruction or, more commonly, to deep valvular reflux.[1] One hundred forty seven patients with suspected chronic venous insufficiency were investigated in the Vascular Laboratory of the University of Mississippi Medical Center, utilizing both invasive and noninvasive techniques. Ten percent of this group had normal venous studies. Nine percent of patients were found to have venous obstruction while 81% had predominantly reflux disease. In the latter group of patients, reflux in the superficial and deep venous systems could be characterized separately by utilizing noninvasive and invasive techniques.[1] It was remarkable that isolated superficial venous insufficiency was virtually nonexistent in the large group of patients studied.[1] In contrast, deep valvular reflux was a common finding (Table 1). Combined deep and superficial venous reflux was present in 31% of the patients. In this analysis, the perforator valve was included as part of the deep system. In later analyses of 64 ascending and descending venograms (unpublished data), isolated perforator incompetence was also found to be a rare entity (less than 5%). When present, it invariably occurred in combination with other deep valvular reflux. The import of these findings offers a significant departure from the conventional view of venous insufficiency. The traditional separation of venous insufficiency into superficial and deep varieties for clinical purposes is perhaps artificial, as the former condition seldom occurs alone. Our findings further challenge the view that primary varicosities often occur with a functionally intact deep venous system. The evidence indicates that patients with primary varicosities suffer from valvular reflux in widely distributed locations in both the deep and the superficial systems. In some of these patients, valve incompetence in the axillary vein has been observed, a surprising finding considering the absence of gravitational load on the venous valves in this location. A global defect in venous valve tissue manifesting as incompetence in a variety of locations is proposed as a basis of chronic venous insufficiency. Traditional theories, such as sapheno-femoral valve incompetence or perforator incompetence[3] as the basis of primary varicosities, are inconsistent with cited findings. Furthermore, development of valve incompetence at isolated locations (i.e., sapheno-femoral, perforator) without adjoining deep valve involvement, as propounded by Cockett[2] and others, is difficult

TABLE 1.—*Incidence of superficial and deep venous insufficiency in 252 examinations.*

Isolated superficial venous insufficiency	0%*
Isolated deep venous insufficiency	69%
Combined superficial and deep venous insufficiency	31%

*One patient had mild Doppler reflux in the saphenous vein only.

to accept when no exclusive anatomical or hemodynamic loads have been demonstrated to be peculiar to these specific valve sites.

The presence of deep valvular reflux appears to be a prerequisite for the development of reflux in the superficial system.[1] The mechanical factors precipitating reflux in the deep system are unknown. Fourteen percent of "normal" individuals appear to have asymptomatic deep valvular reflux.[1] The commonly held view that deep valvular reflux is predominantly due to recanalization and valve destruction following deep venous thrombosis is probably incorrect. Deep valvular reflux is overwhelmingly bilateral,[1] occurring in both lower limbs, while deep venous thrombosis only occasionally has bilateral limb distribution.[4] The femoral valve is more commonly incompetent than the popliteal valve, a situation just the reverse of the distribution of deep venous thrombi, as elucidated by I131 studies.[1] The observed incidence of axillary vein incompetence in many patients with deep venous reflux of the lower limb would also argue against a postthrombotic etiology. In a significant number of patients, valve-bearing axillary vein segments initially competent at the time of transfer tend to dilate and become incompetent with passage of time.[1] This finding, along with others cited above, tends to support the view that deep valvular reflux is due to an inherent weakness of a global nature in venous valve tissue.

A group of patients with congenital deep valvular reflux was identified by Kistner.[5] This condition is probably more ubiquitous than hitherto believed. Certainly, a great many patients operated on in our institution for deep valvular reflux presented little evidence of previous phlebitis on venography or direct inspection of the venous tissue during surgery.

Preoperative investigations

Patients suspected of having chronic venous insufficiency are carefully examined by a complete venous doppler examination, photoplethysmography,[6] and ambulatory venous pressure measurements.[7] The technique of doppler examination is particularly important. While listening to the femoral vein area, manual abdominal compression is carried out by the technician while the patient is executing the Valsalva maneuver. With this modification, even mild femoral valve incompetence can be successfully detected.

Patients considered for surgery on the basis of the above noninvasive tests are further assessed by ascending and descending contrast venography.[8] More recently, supine foot venous pressure measurements with Valsalva and nucleotide descending venograph have been found to be very useful in our laboratory, particularly in assessing the outcome of surgery.

Selection of patients for surgery

Many patients with chronic venous insufficiency develop considerable functional overlay, perhaps due to the chronicity and persistence of symptoms. The pain threshold of many of these patients is low and therapeutic results may be less than satisfactory it functional complaints have become fixed. Careful selection based on clinical judgment and evaluation of emotional stability is therefore essential. Generally, excellent results can be expected in patients with stasis dermatitis or frank ulceration. Prompt healing of the ulcer following surgery provides objective evidence of improvement for the patient as well as for the physician. The duration of chronicity of the stasis ulceration is not at factor in patient selection. In our experience, patients with persistent ulceration of many years' duration have healed their ulcers postoperatively. Patients with predominantly venous type of pain or cosmetic complaints of varicosities are also candidates for venous reconstructive surgery. Symptomatic relief of pain and substantial improvement in the prominence of varicosities can be expected. However, the physician should assure himself that the pain is not functional and the cosmetic improvement expected by the patient is not exaggerated beyond therapeutic possibilities. Patients with the chief complaint of swelling without pain are not good candidates for valve reconstructive surgery. Swelling often becomes worse for several months surgery, but gradually improves and may slowly become better than the preoperative status.

TECHNIQUE-VALVULOPLASTY

Through a longitudinal groin incision, the common femoral, superficial, and profunda femoral veins are exposed. The sapheno-femoral junction is identified and ligated in continuity. About two inches of the superficial femoral vein and an inch of common femoral vein are mobilized by ligating and dividing small sized branches. Larger branches are doubly looped by 0 silk for vascular control. Except when destroyed by previous phlebitis, a large superficial femoral vein valve at or near the opening of the profunda femoral vein is always constant in position. The presence of the valve can be confirmed preoperatively by venography. Characteristic bulge of the valve sinuses by gross inspection of the area is a further indication of the presence of this important valve. After systemic heparinization with 10,000 units, the valve is tested for competence in situ as follows: a bulldog clamp is applied to the distal superficial femoral vein. The vein is then digitally stripped empty of blood. Incompetence of the valve is manifested by prompt retrograde filling of the superficial femoral vein segment caudad to the valve. With vascular control of the profunda and common femoral veins, a transverse venotomy is carried out some 2 cms cephalad to the external bulge of the valve sinuses.[1] In our experience, the valve commissures are frequently higher than one suspects by external inspection of the valve bulge.

Therefore, the venotomy should be placed high in a cephalad direction to avoid injury to the commissures. Six to eight 5-0 prolene stay sutures are placed at the distal circumference of the venotomy and weighted down by rubber-shod mosquito clamps. After a few minutes of persistent traction, the vein will slowly dilate to allow inspection of the first superficial femoral vein valve. Good lighting by a head lamp is extremely helpful. It is our practice to turn off other lighting, which transilluminates the vein and obscures the transparent valve cusp. Irrigation of the upper superficial femoral vein with cold Ringers lactate is useful in identifying the valve cusps. Persistence will often be rewarded by successful detection of valve cusps even when initial inspection had led one to suspect their absence. Once the valve cusps are identified, the valve commissures

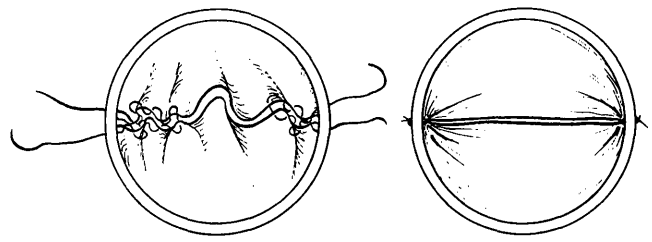

Fig. 1.—Technique of valvuloplasty. Straightening of the valve cusp edges by plicating sutures is shown.

should be individually identified; occasional slight release of the distal bulldog clamp to allow blood to trickle through the valve opening is useful in identifying the valve edges and the commissures. The valve cusps present a picture of redundancy with numerous folds and pleats, as clearly described by Kistner.[5 8] The valve cusps often evert like a funnel on hand irrigation with cold irrigant. The object of valvuloplasty is to gather enough valve tissue at the commissures to reduce the free length of the cusp edges. This is often accomplished by gathering or plicating about 3 mms. of the cusp edge at each commissure with a 6-0 prolene suture mounted on a fine needle.

With a needle at each end, a single suture is used to plicate both cusps at each commissure (Fig. 1). The suture is passed through the vein wall to be tied together outside. After commissuroplasty, the valve edges present as a sharp crescent. Until this appearance is achieved, additional commissural sutures may be necessary. With practice and experience, the end result is usually achieved with one or, at the most, two sutures at each commissural end.

Cold irrigant solution can be squirted on the reconstructed valve to get an idea of their apposition. The final test of competence awaits closure of the transverse venotomy with interrupted 5-0 prolene sutures. The previously placed stay sutures with intact needles are conveniently used for this purpose. The digital test for valve competency is repeated. Restoration of valve competency after successful valvuloplasty is often dramatic. The surgeon should persist until satisfactory competency of the valve is achieved by this test. The author has on several occasions achieved valve competency either by reexploration of the valve cusp and placement of additional sutures, or by resorting to axillary vein transfer when all

efforts at primary valve repair have failed due to irreparable iatrogenic or preexisting valve damage resulting from phlebitis and recanalization.

VARIATIONS

The author once encountered a tricuspid valve which was repaired by successful commissuroplasty at all three commissural locations. In one patient the superficial femoral vein bifurcated immediately caudad to the profunda origin to rejoin into a single lumen some inches below. Two valves were present, one in each bifurcated lumen. Each was successfully repaired individually and provided the patient with dramatic symptom relief. In two patients, the valve cusp edge had become adherent to the periphery, presumably due to a prior inflammatory process. The valve cusp was successfully freed by sharp dissection and satisfactorily repaired by valvuloplasty. Occasionally (3 instances), in situ testing after valvuloplasty revealed a substantial improvement over the preoperative status but very mild reflux persisted.

In these instances, a Dacron sleeve as described below was applied over the valve segment following valvuloplasty. In seven patients, in situ testing revealed a competent valve, even though preoperative noninvasive and invasive investigation had indicated incompetence of the valve in the femoral area.

In these cases, contraction of the femoral vein during surgical manipulation was obvious. This venoconstriction was believed to have restored competency to the valve, which in the normal dilated state of the vein was shown to be refluxive. A Dacron jacket was applied to the vein in the contracted state to provide continued competency in the postoperative period.

Often a large valve in the common femoral vein can be visualized on venography. It is tempting to attempt to repair this valve in preference to the smaller valve at the highest location in the superficial femoral vein .We believe this should not be done. Even when successful repair of this common femoral location is achieved, the considerable profunda flow will provide a rich source of reflux when the superficial femoral valve is incompetent. For this reason, we prefer the superficial femoral vein location for primary valve repair and for axillary vein valve transfer as well (see below).

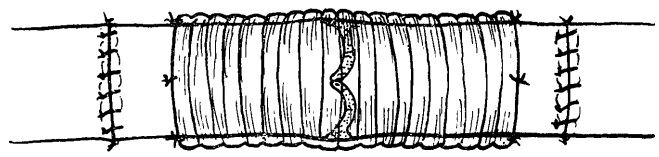

Fig. 2.—Dacron sleeve over transferred axillary valve segment.

AXILLARY VEIN VALVE TRANSFER

The basic technique has been described in detail by us [1] and others.[9]

The technique is useful when superficial femoral valvuloplasty is not feasible.

It should be emphasized that a successful primary valvuloplasty can be achieved in the overwhelming majority of patients suitable for reconstructive venous surgery. In our institution at the present time, only 20% of patients require axillary vein transfer for reflux.

TECHNIQUE

The axillary vein is exposed through a 3-inch long incision at the pectoral fold and a valve-bearing segment approximately 3 cms long is excised. No ill effects have been observed following simple ligation of the cut ends of the axillary vein in preference to repair. Not uncommonly, the valve of the axillary vein will be found to be incompetent, emphasizing the global nature of valve defects. If incompetence is mild by in situ testing, valve transfer is still possible with a Dacron jacket around the transferred segment. If the valve incompetence is severe, the opposite axilla should be searched for a competent valve. Since the axillary vein approximates the superficial femoral vein in caliber, a technically satisfactory anastomosis can almost always be achieved. Interrupted 5-0 prolene sutures are preferred. It is our practice to immerse the transferred segment in cold Ringers lactate for endothelial preservation before beginning the transfer procedure. In the last two years, the transferred axillary vein segment has been provided with a fitting Dacron jacket (Fig. 2), usually 8 mms in diameter,

to prevent late dilation of the transferred segment. When the Dacron sleeve was not provided, recurrent reflux was observed in several patients due to late dilatation of the transferred valve segment.[1]

SECONDARY PROCEDURES

In an occasional patient, valve reconstruction either by valvuloplasty or axillary vein transfer may not be feasible for reasons already discussed. In these patients and in others in whom prior valve reconstruction had failed with passage of time, we have utilized the Linton procedure[3] as a secondary operation (four patients). However, secondary axillary vein transfer was possible in two other patients in whom a prior reconstruction (valvuloplasty and Kistner segment transfer, respectively) had failed. In six patients, saphenous vein stripping alone was employed when the associated deep venous reflux was of a mild nature and the saphenous vein itself was prominently varicose, presenting as the main complaint. One patient in this group has subsequently come to a valvuloplasty due to progression of the deep valvular reflux following vein stripping.

POSTOPERATIVE CARE AND COMPLICATIONS

Patients are treated in the immediate postoperative period with foot elevation. Ambulation is allowed on the second postoperative day. Mild, long-term anticoagulation is practiced with the institution of 5 mg of Coumadin daily for most patients.

Postoperative complications are few. Occasional wound hematoma requiring evacuation and late serous collections do occur. There has been no incidence of infection in the Dacron sleeves applied to transferred valve segments. Thrombosis of repaired valve has occurred occasionally (4%). There has been no incidence of pulmonary embolism. An intriguing complication is acute onset of limb edema, sometimes occurring several months after the procedure. Venograms obtained in several such patients have been within normal limits. Foot elevation and reinstitution of anticoagulation have generally resolved the problem in a few days. Since the regular institution of mild chronic anticoagulation, the incidence of this complication appears to have decreased. Thrombosis of dilated superficial varicosities is often seen in the postoperative period, presumably due to reduction of reflux. Conservative measures result in symptomatic resolution.

TABLE 2.—*Surgical results with a minimum of 2 years follow-up (range 2 years-5 years).*

	Valvuloplasty	Axillary vein transfer*
No. operated	16	21
Good result	82%	57%
Poor result	18%	43%

*These patients represent our initial valve transfer without Dacron sleeve.

RESULTS

Since 1979 over 75 patients have undergone reconstructive venous surgery in our institution. With a minimum follow-up of two years, good results can be expected in approximately 75% of the patients undergoing reconstructive valve surgery (Table 2). With increasing experience in the technique itself, the results should improve further. Over 80% of the patients operated on for stasis dermatitis or ulceration in the last 3 years have complete resolution, providing objective evidence of symptomatic improvement. The great majority of patients operated show at least a doubling of recovery times on photoplethysmography.[1] Two-thirds of the patients operated showed doubling of recovery times on ambulatory venous pressure measurement.[1] The major thrust of criticism[10,11] against reconstructive valve surgery has revolved around the absence of consistent hemodynamic normalization following surgery by currently available testing techniques. As indicated above, hemodynamic improvement rather than normalization can be demonstrated in a majority of patients undergoing reconstructive valve surgery. It is our belief that hemodynamic improvement is sufficient in many patients to convert them from a decompensated state to one of compensated venous insufficiency, resulting in symptomatic relief and forming the basis of successful clinical results. A more sensitive technique to measure gradations of improvement in venous reflux is sorely needed. Supine foot venous

pressure measurement with Valsalva is being currently evaluated in our laboratory and appears promising in this regard.[12]

REFERENCES

1. Raju S. Venous insufficiency of the lower limb and stasis ulceration: Changing concepts and management. Ann Surg 1983; 1976:688-96.
2. Cockett FB, Dodd H. The pathology and surgery of the veins of the lower limb. London: Churchill Livingstone, 1976.
3. Linton RR. Post-thrombotic ulceration of the lower extremity, its etiology and surgical treatment. Ann Surg 1953; 138:415-33.
4. Stamatakis JD, Kakkar VV, Lawrence D, Bentley PG. The origin of thrombi in the deep veins of the lower limb: a venographic study. Br J Surg 1978; 65:499-51.
5. Kistner RL. Transvenous repair of the incompetent femoral vein valve in venous problems. In: Bergan JJ, Yao JST, eds., Chicago: Year Book Medical, 1978: 492-509.
6. Barnes RW. Non-invasive diagnostic techniques in peripheral vascular disease. Am Heart J 1979; 2: 241-58.
7. Nachbur B. Assessment of venous disorders by venous pressure measurements in the treatment of venous disorders. Hobbs JT, ed., Philadelphia: JB Lippincott, 1977:71-82.
8. Kistner R, Sparkuhl MD. Surgery in acute and chronic venous disease. Surgery 1979; 85:31-43.
9. Taheri SA, Lazar L, Elias SM, Marchand P. Vein valve transplant. Surgery 1982; 91:28-33.
10. Strandness DE, Thiele BI. In: Selected topics in venous disorders. New York: Futura, 1981:158-190.
11. Bergan JJ. Venous reconstructive surgery Surg Clin 1982; 62:399-410.
12. Raju S, Fredericks RK. Late hemodynamic sequelae of deep venous thrombosis. J Vasc Surg 1986; in press.

[Author's address:

S. Raju
University of Mississippi Medical Center
2500 North State Street
Jackson, MS 39216 (U.S.A.)]