Venous Insufficiency of the Lower Limb and Stasis Ulceration

Changing Concepts and Management

SESHADRI RAJU, M.D.

In a group of patients studied for venous insufficiency, the incidence of deep venous insufficiency was much higher than previously suspected. Insufficiency of the superficial system, when present, was associated invariably with deep venous insufficiency, suggesting a leading role for the latter condition. Evidence is presented to show that in many instances, such reflux is probably non-thrombotic. The results of various types of direct venous valve surgery in a group of patients are presented.

From the Department of Surgery, University of Mississippi Medical Center, Jackson, Mississippi

DESPITE A SUBSTANTIAL PREVALENCE, the etiology of varicose veins and stasis ulceration has remained controversial and poorly understood. The traditional view of primary varicosities is that of Trendelenburg, implicating failure of the sapheno-femoral valve as the causative mechanism. This view has been challenged strongly by Linton,[1] Cockett,[2] and others. According to the latter authors, the primary pathology is located in the perforators of the lower leg. Regardless of which view is given primacy, the precise reason for valve failure in an isolated anatomic location such as the perforators or the sapheno-femoral junction has never been explained satisfactorily.

Current perceptions regarding stasis ulceration are even more confusing and replete with contradictory views. While some clinicians infer a causal relationship between varicosities and stasis ulceration, others vehemently deny a relationship between the two entities. Bauer[3,4] considered the failure of the valve in the popliteal vein a crucial factor in the genesis of stasis ulceration; deep vein thrombosis was thought to be the main mechanism.

The recent advent of new diagnostic techniques is yielding newer insights into the pathogenesis of venous insufficiency. As a result, many of the traditional views, cited above, may have to be revised. It now appears that in almost all the patients shown to have venous pathology, incompetence of valves in the deep venous system in widely distributed locations invariably is present. Isolated, superficial varicosities or insufficiency appears to be extremely rare without associated deep venous valve insufficiency. Thus, the classification of varicosities into primary and secondary varieties and the division of venous insufficiency into superficial and deep types may be artificial and have no basis in fact. These findings appeared to offer a basis for direct venous valve surgery. In a substantial number of operated patients, deep venous valve incompetence appeared to be due to valve ectasia of presumed congenital origin, rather than previous phlebitis. This raises the possibility that deep venous thrombosis may be the result (from reflux stasis) rather than the cause of deep venous insufficiency in a substantial number of patients presenting with characteristic symptomatology.

Materials and Methods

One hundred forty-seven patients, clinically suspected of venous insufficiency, were studied. Fourteen "normal" asymptomatic volunteers were also studied for control purposes.

Doppler Venous Examination

Doppler venous examination was carried out as described by Barnes.[5]

Impedance Plethysmography

Impedance plethysmography was performed as described by Wheeler.[6]

Photoplethysmography (PPG).[7]

A modified technique utilizing manual calf compression was used. Recovery times of over 20 seconds were considered to be normal. With reduced recovery times,

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Reprint requests: Seshadri Raju, M.D., 2500 North State Street, Jackson, Mississippi 39216.

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the test was repeated with a tourniquet in place below the knee.

Ambulatory Venous Pressure

Ambulatory venous pressure measurement was a modification of the technique described by Nachbur.[8] Instead of calf exercise, manual calf compression was utilized. Tourniquet application was used selectively to identify superficial venous insufficiency.

Venography

Ascending and descending venograms were performed as described by Kistner.[9]

Surgical Technique

Valvuloplasty

Almost always, a valve was present in the superficial femoral vein at a constant location just below its junction with the profunda-femoral vein. *In situ* incompetence of this valve could be demonstrated easily by digitally emptying the vein segment below the valve to monitor retrograde filling. The valve was approached through a transverse venotomy under systemic heparinization. The incompetent valve was usually supple with no obvious evidence of previous phlebitis. The valve edges, however, appeared markedly elongated, often presenting like lettuce with multiple folds and pleats at the edges.

The technique of valvuloplasty is depicted in Figure 1. If valvuloplasty was properly performed, previously noted *in situ* reflux disappeared. Heparin was reversed before wound closure.

Axillary Vein Transfer

This technique was reserved for the relatively rare instances where a reparable valve could not be located in the superficial femoral vein. A valve-bearing segment of axillary vein was excised, and the ends of the axillary vein were simply ligated. No ill effects have been noted by simply ligating rather than reconstructing the axillary vein. The valve-bearing segment, approximately 2.5 cm long, was oriented properly and transferred to the superficial femoral vein.

Kistner Segment Transfer

In three patients during our initial experience, the superficial femoral vein was divided and anastomosed to the profunda femoral vein below a competent valve, as described by Kistner.[9,10]

Regardless of the type of surgery performed, long-term anticoagulation with Coumadin was started on the third postoperative day.

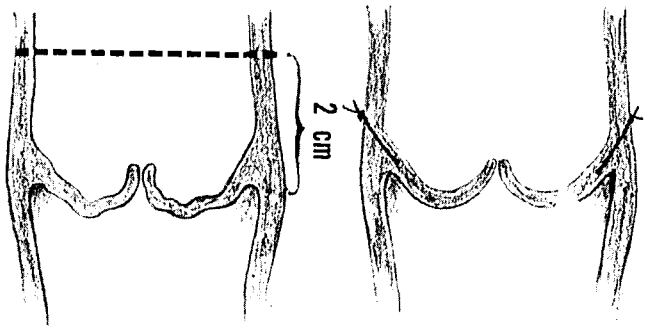


FIG. 1. Technique of valvuloplasty. The transverse venotomy is placed at least 2.5 cm away from the valve bulge.

Results

One hundred forty-seven patients were studied with symptomatology suggestive of venous insufficiency. The primary symptoms which prompted the study are shown in Table 1. In 14% of the patients, the primary indication was the presence of superficial varicosities.

The venous profile was normal in 10% of these patients.

"Normal" Venous Studies

Fourteen asymptomatic "normal" volunteers underwent venous profile examination. Twelve of 14 had normal values. Two among these "normal" volunteers demonstrated deep valve reflux, even though completely asymptomatic.

Predominantly Obstructive Disease

Thirteen of the 147 patients studied had predominantly obstructive (as opposed to reflux) disease, as evidenced by one or more of the following parameters: (a) an obstructive impedance plethysmography result, (b) increased foot/arm pressure differential in the supine position, or (c) the presence of an obstructive lesion with transpelvic collaterals demonstrated by ascending veno-

TABLE 1. *One Hundred Forty-seven Patients Tested for Suspected Venous Insufficiency*

Primary Symptoms	
Pain	10%
Swelling	21%
Ulcer	53%
Discoloration	2%
Varicosities	14%

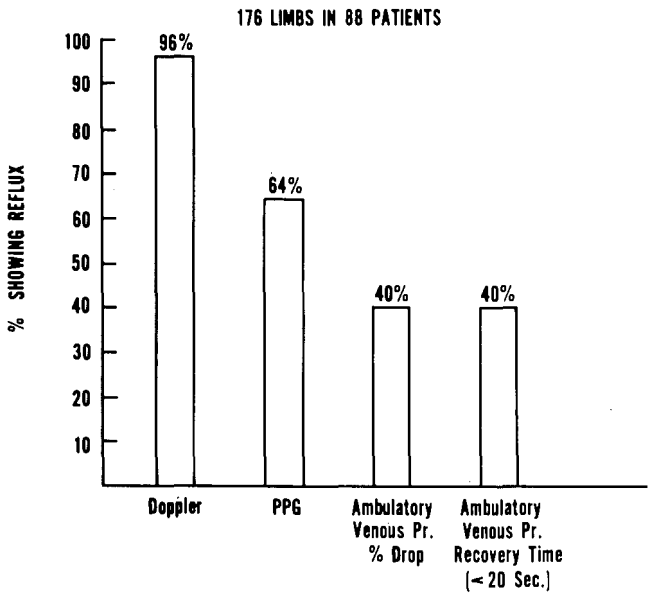


FIG. 2. Sensitivity of different techniques utilized to detect reflux. Doppler was the most sensitive.

gram. The surgical approach to these patients will be reported separately.

Reflux Disease

Among 120 patients determined to have reflux, detailed studies in 88 patients (176 limbs) were available for analysis. The relative sensitivity of the techniques for detecting reflux is depicted in Figure 2. The venous Doppler was the most sensitive technique for determining reflux.

Bilaterality

In 100 patients, both limbs were examined by Doppler for reflux. When reflux was present, it was bilateral (femoral or popliteal level in either limb) in 95% of the patients. Only 5% of the patients had unilateral reflux.

Level of Reflux

The anatomic level of reflux is shown in this group of 100 patients (Table 2). It is clear that valves in the femoral vein region are affected more commonly.

Superficial Versus Deep Venous Insufficiency

Doppler examination of the sapheno-femoral and deep valves, as well as the tourniquet technique with PPG and ambulatory venous pressure, was utilized to categorize superficial and deep venous insufficiency. When superficial venous insufficiency was present, recovery times either with PPG or ambulatory venous pressure significantly improved with tourniquet application. The patient population available for this analysis is shown in Table 3.

TABLE 2. *Anatomical Level of Reflux (100 Patients)*

	Right	Left
Femoral	97%	98%
Popliteal	75%	79%

TABLE 3. *Isolated Superficial Insufficiency is Rare*

	PPG/Doppler (136 Limbs)	Venous Pr./Doppler (51 Limbs)
Isolated superficial venous insufficiency	0%*	0%
Isolated deep venous insufficiency	73%	81%
Combined superficial and deep venous insufficiency	27%	19%

* One patient with Doppler positive, PPG negative.

Of a total of 136 limbs studied in 68 patients,* isolated superficial venous insufficiency was not detected, even in a single patient (Table 3).

In the majority of limbs studied (approximately 70–80%), deep venous insufficiency was identified as an isolated finding. A combination of superficial and deep venous insufficiency was detected in a much smaller number (approximately 25%).

Reconstructive Venous Valve Surgery

Forty-two patients underwent one or the other type of venous valve reconstructive surgery described. The type of procedure performed and the indications for surgery are classified in Table 4 and Table 5. In 40 limbs in 36 patients, a follow-up of over three months (range, 3–40 months) was available. In all but a few patients, preoperative and multiple postoperative studies of the venous system were available for assessment of the results of surgery. The following criteria were used for grading postsurgical studies as showing improvement over preoperative values: (a) restoration of valve competency by Doppler at the site of valve repair, (b) a doubling of photoplethysmography recovery time following surgery, (c) at least a 20% increase in percentage pressure drop following simulated exercise on ambulatory venous pressure measurements, and (d) doubling of recovery time in the ambulatory venous pressure measurements following surgery. The improvements recorded in these parameters after operation are shown in Figure 3.

* Even though 88 patients were available for study of PPG and venous pressure results, only 68 had the test performed with tourniquet application.

TABLE 4. *Reconstructive Venous Valve Surgery (45 Limbs in 40 Patients)*

	No.	Per cent
Valvuloplasty	20	44
Vein valve transfer	22	49
Kistner segment transfer	3	7

TABLE 5. *Reconstructive Venous Valve Surgery (40 Patients)*

Indications	
Ulcer	78%
Pain	15%
Swelling	4%
Recurrent phlebitis	3%

Results of surgery were considered to be excellent if the patient had improvement in pain and complete resolution of the primary complaint which prompted surgery (healing of ulcers or resolution of edema, etc.). Persistence of the primary symptom after operation was counted as a surgical failure. Recurrence of stasis ulceration or dermatitis was counted as surgical failure.

Surgical Results

Overall, of 40 limbs operated on, there was complete amelioration of the primary symptom in 30 limbs for a salvage rate of 75%. Following surgery, it was remarkable that many patients reported complete absence of the vague, nagging pain associated with venous stasis. Equally impressive was the rapid onset of healing in some stasis ulcers that had persisted for years without healing, despite usual conservative measures of bed rest, skin grafting, etc. (Figs. 4A, 4B). Even though immediate postoperative results were excellent regardless of the type of surgical procedure performed, axillary vein transfers tended to fail with passage of time. A similar experience was noted with Kistner segment transfer procedure in a relatively small number of patients. Within the follow-up period cited, the results following valvuloplasty have been the best of the three procedures performed.

Postoperative Complications

Wound Hematoma or Late Serous Collection

Wound hematoma or late serous collection occurred in five patients.

Thrombosis of Valve Repair

Thrombosis of valve repair occurred in one patient who had an unsatisfactory surgical procedure early in our experience. It was remarkable that in 17 other patients who had venographic examination of the repair after operation, there was not a single incidence of thrombosis of the repaired site.

Episodes of Acute Limb Edema

Six patients who had undergone valvuloplasty and nine others with axillary vein segment transfer presented

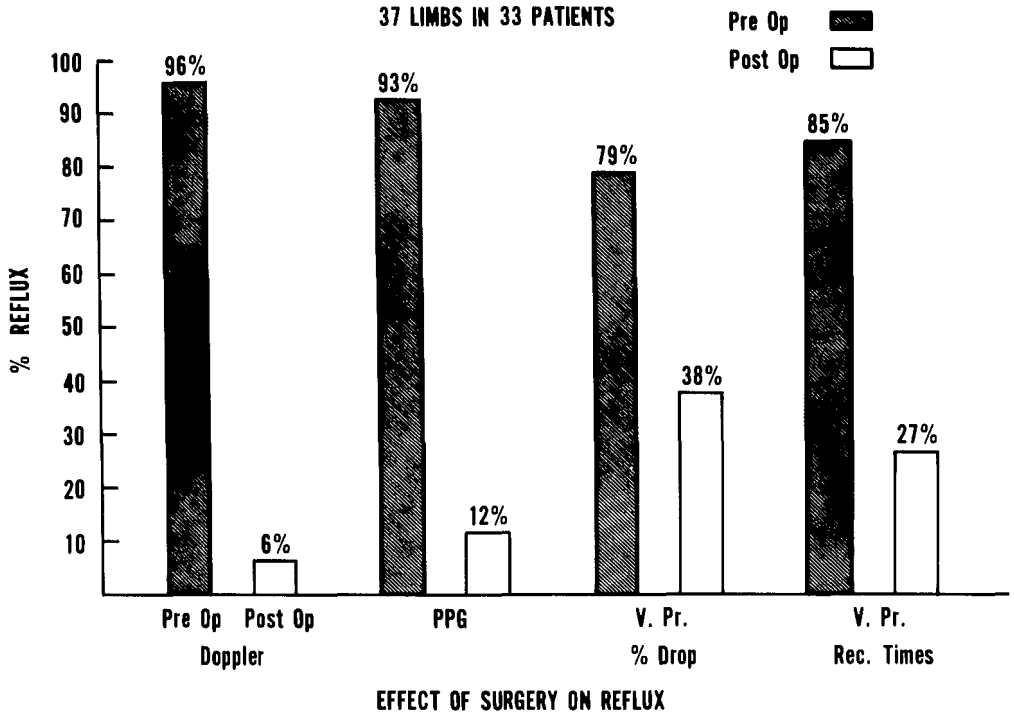


FIG. 3. Effect of valve reconstructive surgery on venous function studies.

FIGS. 4a,b. Large bilateral indolent ulcers of many years' duration. These healed promptly after staged bilateral reconstructive valve surgery.

in the postoperative period with sudden onset of limb edema. In two of the patients, the episodes occurred 2 and 3 years following surgery, respectively. In all others, the episodes occurred in the first few months after surgery. The cause of this edema was determined to be calf vein thrombosis (one patient), repair occlusion (one patient), and staphylococcal infection (one patient). In all others, the reason for acute onset of edema could not be determined positively. Venogram showed a patent repair and the edema resolved rapidly with elevation.

Kistner Segment Transfer Procedure

Of three patients undergoing this procedure, two have had resolution of their primary symptoms following surgery with concomitant improvement in their laboratory venous studies. The third patient had rapid clearing of venous dermatitis immediately following surgery, and this improvement persisted for 2 years. The stasis dermatitis recurred at this time, however, and descending venogram demonstrated reflux through the repair. An axillary vein transfer with a Dacron sleeve, as described in a later part of this paper, was carried out as a secondary procedure in this patient 4 months ago; again, immediate clearing of dermatitis has occurred.

Axillary Vein Transfer

Axillary vein transfer to the femoral segment was carried out in 23 limbs among 21 patients. Two patients have been lost to follow-up. There has been resolution of the primary symptom in 13 limbs (nine ulcers, two edema, two chronic pain). Of this group, ten limbs show improvement in venous laboratory parameters. In three limbs, despite subjective improvement, laboratory parameters have remained unchanged. Eight patients are surgical failures. The cause of failure was technical in one patient (small axillary vein). In all others, failure was due to recurrence of reflux through the transferred axillary vein segment, proven by venography and venous profile testing.

Follow-up Descending Venography

Follow-up descending venography was available in six patients who were counted as surgical successes. In all but one patient, mild to moderate reflux (less than 50% of dye injected) through the axillary vein segment was present despite complete subjective improvement. The descending venogram correlated poorly with other laboratory studies. In three patients. despite mild contrast reflux, laboratory venous studies were improved.

Among ten patients (13 limbs) "cured" by surgery, eight are working full-time and only one is wearing support stockings.

Valvuloplasty

Valvuloplasty was carried out on 16 limbs in 15 patients. One patient is lost to follow-up. In all others, results were excellent with cure of presenting complaint (nine ulcers, four pain, one edema, and one recurrent phlebitis). All but two are at full-time occupations. Only one patient uses support stockings and elevation by habit; all others have abandoned these measures. In this group of surgical "cures", laboratory venous parameters showed postoperative improvement in ten patients, while in the remaining five there was no improvement. However, in all 15 limbs, the repaired valve was competent by Doppler.

Five patients underwent descending venogram after operation. In four patients, reflux was absent or very mild. In one patient, despite complete healing of the ulcer and improved laboratory parameters, contrast reflux was unchanged.

Discussion

In the present study, with possibly one exception (Doppler incompetence of sapheno-femoral valve not confirmed by PPG), there was not a single patient detected with isolated superficial venous insufficiency. This finding is remarkable since the indication for venous profile determination was varicosities in 14% of patients studied. It was our consistent finding that superficial venous insufficiency, when present, always occurred in association with deep venous reflux (approximately 25% incidence). In contrast, in approximately 75% of the patients, deep venous insufficiency occurred as an isolated finding. If confirmed, this finding would seem to indicate a primary or even an initiating role for deep valvular reflux in combined forms of venous insufficiency. According to this view, the concept of primary varicosities, which presumes a normal deep venous system, is questioned. Parenthetically, almost all cases of superficial venous insufficiency will be "secondary" to deep venous insufficiency. Also, this concept provides a framework of understanding as to why the sapheno-femoral valve (Trendelenburg) or the perforator valves (Linton, Cockett) should become incompetent.

Deep venous insufficiency, when it occurs, has been viewed traditionally as almost always due to deep vein thrombosis. Recanalization of the thrombosed deep vein is believed to result in valve destruction and consequent incompetence. Several of our findings would seem to contradict this traditional view: (a) In the overwhelming majority of patients (95%), valve incompetence was bilateral and at multiple levels, being present at both the femoral and popliteal areas. If resolving deep venous thrombosis was the initiating factor, an extensive bilateral process involving the entire femoropopliteal segment would have to be assumed; this seems unlikely. In carefully conducted studies, Kakkar et al.[11] have shown the incidence of bilateral thrombophlebitis to be 18%; (b) Incompetence of the femoral vein area occurred more often than popliteal vein incompetence (Table 2). Since thrombophlebitis is known to extend cephalad from its origin in calf veins, exactly the reverse finding (greater incidence of popliteal incompetence over femoral valve incompetence) should be expected if deep vein thrombosis is the initiating factor of valve reflux; (c) Venographic evidence of previous phlebitis was found only in some patients. Recanalization, multiple channels, wall irregularities, abnormal collaterals, and destroyed venous segments were clear evidence of such a process when present. However, in the great majority of patients, ascending venography was "normal" with no evidence of past or current phlebitis. Nevertheless, descending venography and other laboratory parameters clearly established the presence of extensive reflux; (d)

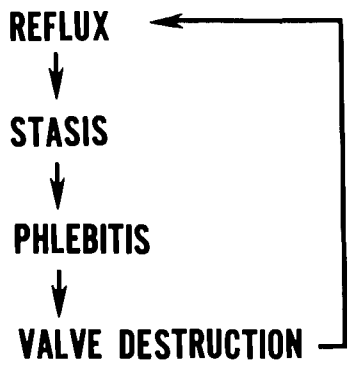


FIG. 5. Primary reflux disease may predispose to thrombosis and valve destruction. This, in turn, may aggravate preexisting reflux.

The above venographic finding was consistent with the surgical findings in many patients in whom there was no periphlebitic reaction to indicate past thrombotic pathology. The vein itself and the tissues around appeared normal and dissected easily. Again, on opening the vein, there was no evidence of recanalization, and the endothelium appeared clean and normal looking. The valve itself bore no evidence of previous inflammation and appeared normal except for incompetence, which appeared to be caused by a redundance of the valve cusp edges, appearing much like the edge of a lettuce leaf, with multiple pleats and folds. The redundancy apparently allows eversion of the valve edge much like a funnel, as clearly described by Kistner.[10] In one instance, a congenitally abnormal tricuspid valve was identified. Despite the frequent absence of any indication of previous thrombotic process that had resolved, the valve could be demonstrated to be incompetent *in situ* by the technique described in the text; (e) In at least three cases of attempted axillary vein transfer, the axillary vein valve was found to be incompetent *in situ*. This is suggestive of a global defect in venous valve tissue rather than a post-thrombotic process; (f) A similar process appears to be responsible for surgical failures following axillary vein transfer and Kistner segment transfer procedures. The failures appear to be due to renewed incompetence of the repaired site, suggestive of an inherent valve defect of the transferred valve segment. Venographic studies of these surgical failures are highly suggestive that the process is non-thrombotic; (g) Finally, it should be noted that numerous other workers (Bauer,[4] Cockett,[2] DeCamp,[12] Luke[13]) noticed an absence of correlation between thrombophlebitis and deep venous incompetence. More recently, Kistner[10] has described a small group of patients with primary deep vein valve incompetence, apparently of non-thrombotic origin. On the basis of our current experience, it is our belief that this entity is more commonly prevalent than hitherto suspected. Based on the fact that valve incompetence is noticed at multiple levels and in widely distributed anatomic areas (femoral, popliteal, bilateral, and axillary veins), one could speculate on a congenital

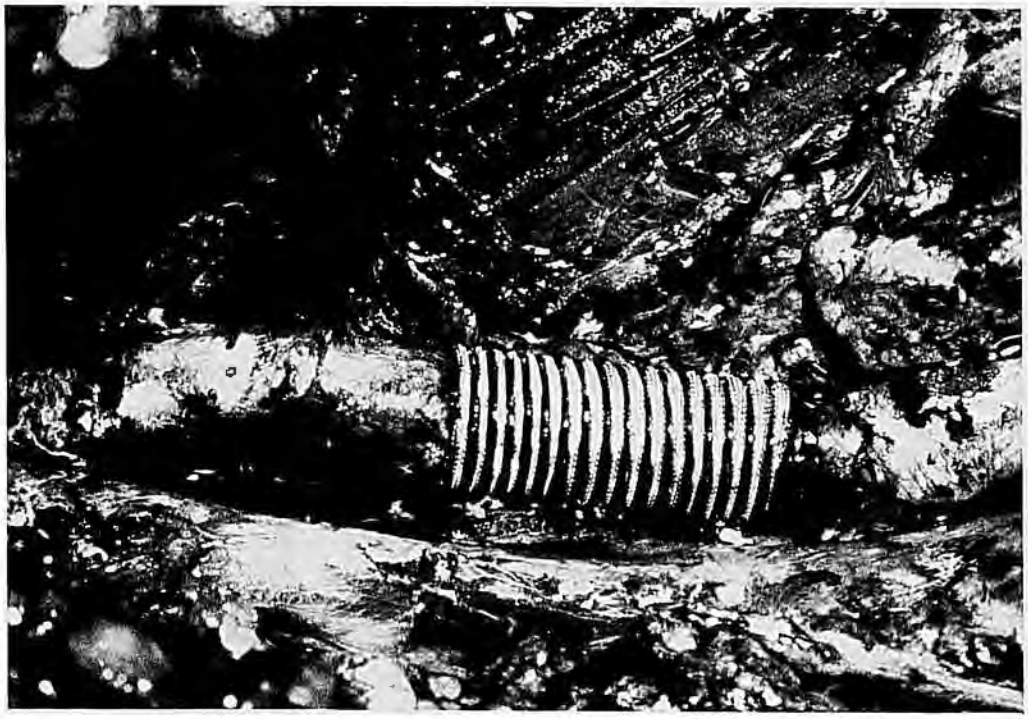


FIG. 6. Dacron sleeve (10 mm) around a transferred axillary vein segment to prevent late dilatation.

defect in the venous valve tissue as the basis for ectasia and reflux. The presence of asymptomatic reflux in two of our "normal" volunteers could lend further credence to this view. Other workers (DeCamp,[12] Yao[14]) have noted similar asymptomatic deep venous reflux in ostensibly normal individuals. It should be pointed out that acceptance of this hypothesis does not preclude the occurrence of venous thrombosis as a result of reflux stasis, as depicted in Figure 5. With the observation that superficial venous insufficiency seldom occurs alone while deep venous insufficiency commonly does, a primary role for the latter is inferred in combined reflux disease. This concept forms the basis for direct deep vein valve surgery in symptomatic venous insufficiency states. With the reduction of reflux in the deep system, it is assumed that any insufficiency of the superficial system would resolve spontaneously. However, the durability of direct valve surgery on long-term follow-up of patients remains to be proven. But our experience indicates that once-feared complications of direct deep vein surgery such as thrombosis, pulmonary embolism, etc., do not occur. In our limited follow-up experience, direct valvuloplasty appears to yield a more durable result, while axillary vein transfers and Kistner segment transfers appear to deteriorate with passage of time. Bergan and Yao[15] have reported a similar experience with Kistner segment transfer procedures. The possible reason for this late failure has been discussed already and is thought to be due to late dilatation of an inherently ectatic valve in the transferred valve segment. Our surgical approach, therefore, has been to do valvuloplasties wherever possible. Fortunately, with experience, this appears possible in the overwhelming majority of cases. An ectatic valve suitable for repair can almost always be located in the uppermost portion of the superficial femoral vein. In the last 18 repairs in our institution, valvuloplasty was possible in all but three instances. In the latter three instances, due to a completely destroyed valvular apparatus, valvuloplasty was precluded and axillary vein segment transfer was resorted to. To prevent late dilatation of the valve segment, the repair was enclosed by a 10-mm Dacron® graft, 2 in long, as a sleeve (Fig. 6). All three patients' stasis ulcers have healed within a few weeks after surgery. In two instances, the ulceration has been long-standing and indolent, and healing had occurred for the first time in many years.

The technique we used for valvuloplasty is somewhat different from the original description by Kistner.[9,10] A transverse venotomy is used, through which the entire valve apparatus can be visualized without disturbing the commissures. More exact commissural sutures can be placed than with the original technique, which utilized a longitudinal incision, traversing one of the commissures. Also, unlike the original pioneering report by Kistner, no concomitant ancillary procedure, such as perforator ligation, etc., was carried out in our group of patients. The concept of direct valve surgery has been criticized strongly by Strandness[16] on substantial theo-

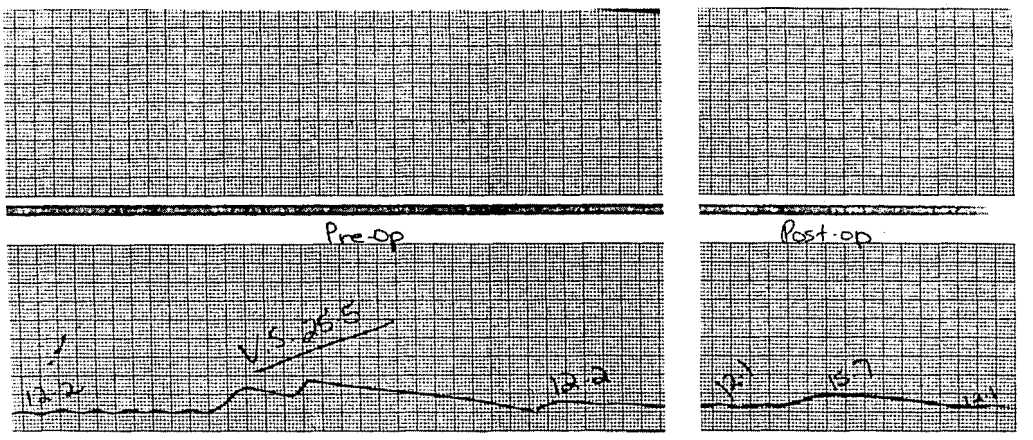
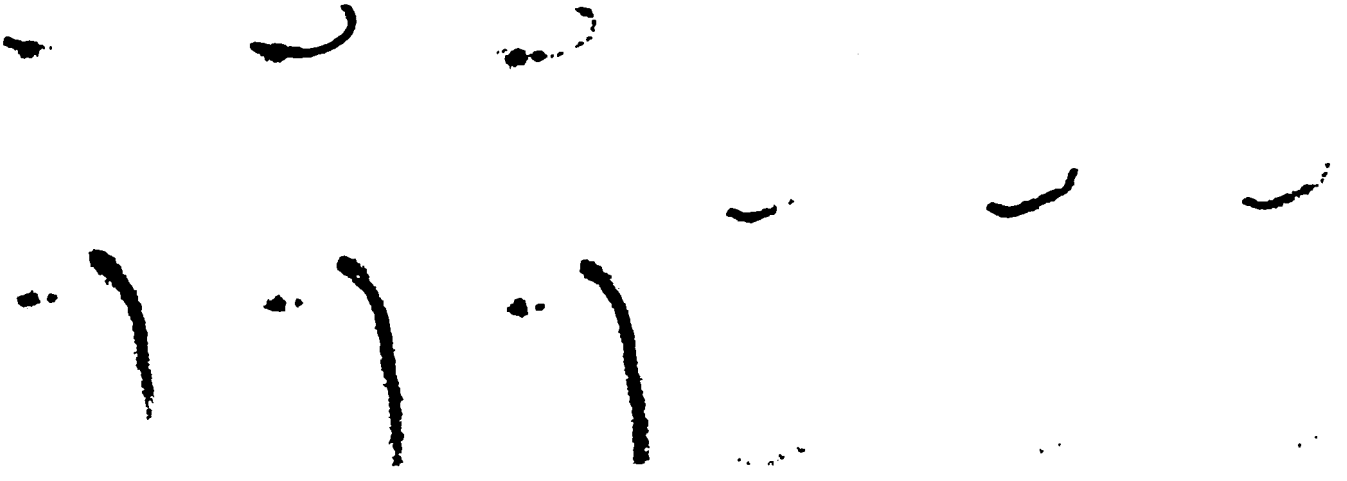


FIG. 7. Effect of valsalva maneuver on dorsal foot vein pressure in a supine patient; notice improvement in valsalva induced reflux after valve repair.

retical grounds. A major point of contention is whether the repair of a single valve in the superficial femoral vein can provide hemodynamic improvement in the presence of multiple leaky valves elsewhere in the entire venous system, including the popliteal vein, etc. Postoperative hemodynamic data in our patient group indicate substantial improvement in the parameters studied (Fig. 4). However, there was poor correlation between the various studies employed to test venous reflux after operation. Competence of the repaired valve was present in a high percentage of cases by Doppler after operation. Improvement in PPG and ambulatory venous pressure studies could be documented much less frequently after surgery. As expected, there was also poor correlation between static studies, such as descending venogram to test postoperative reflux, and dynamic studies, such as PPG and ambulatory venous pressure. In the patients reported here, every patient (with one exception who has refused follow-up and evaluation) in whom hemodynamic improvement by dynamic postoperative studies could be documented has shown marked clinical improvement. The reverse situation, however, was not found to be true. Several patients who had excellent clinical improvement have shown no hemodynamic improvement in the laboratory. This is due perhaps to the lack of an adequately sensitive technique to measure reflux. Only a few patients in our experience have achieved completely "normal" values on postoperative dynamic testing. Many, however, showed substantial improvement as defined. It is assumed that direct valve surgery, while not providing total hemodynamic correction, introduces enough improvement so as to make the patient revert from an uncompensated state to a state of compensated venous insufficiency that is well tolerated and provides clinical improvement. A more sensitive technique than is currently available to evaluate reflux may help to quantitate even subtle changes after surgery. Two approaches currently undergoing trial in our laboratory are shown in Figure 7 and Figure 8. Since the isotope used for nucleotide descending veno-



FIGS. 8A, 8B. Nucleotide descending venogram before (left) and after valve repair (right). Reflux down the femoral vein is no longer present after repair.

gram more closely approaches the specific gravity of blood than conventional angiocontrast, streaming effects associated with contrast venography are expected to be avoided. In addition, "counts" of the refluxing isotope may provide better quantification of static reflux than is currently available with contrast venography.

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Discussion

DR. GEORGE JOHNSON (Chapel Hill, North Carolina): The big message that Dr. Raju has brought to us is the paramount role of the deep venous system in venous problems of the lower extremities. He was unable to identify a single patient with isolated saphenous insufficiency, of the 68 patients that he studied. This is in contrast to a series of 22 patients with venous ulceration and, therefore, venous insufficiency, recently reported by Nicolaides from London, using similar techniques. Forty-one per cent of Nicolaides' patients were found to have isolated superficial venous incompetence.

As I understand Dr. Raju's manuscript, this difference may be due to the difference in the definition of, or, perhaps, in the identification of, venous insufficiency. Perhaps Dr. Raju might expand on this. Although this may seem to be an irrelevant discussion, these findings are important in selecting the proper care for these patients.

One of the more fascinating aspects of Dr. Raju's presentation is his report that venous insufficiency may occur without previous venous thrombosis. In a patient whose ascending venogram showed no venous occlusion nor evidence of past venous thrombosis, the descending venogram was markedly abnormal, with the dye refluxing down to the foot, when compared with this normal descending venogram, in which the dye is stopped by competent valves. This patient had no history of deep venous thrombosis, and yet there was incapacitating swelling of the lower extremities. Although deep venous insufficiency without thrombosis has been noted before, it was thought to be rare. As Dr. Raju reports, perhaps it is not as rare as we had previously thought.

We have no experience with valvular reconstruction; in the meantime, it is our belief that there are four Es in the management of patients with chronic venous insufficiency. These include evaluation, education, elevation, and elastic compression. The most important of these in our experience is the E that belongs to education. We think that great success can be achieved with attempts at educating these patients in the pathophysiology of their disease.

DR. WILEY F. BARKER (Sepulveda, California): I do not fully agree with Dr. Raju. He presented an immense amount of information, and I recommend a detailed study of it. It seems to contradict some of the concepts we have had in the past, but there is some good evidence that he presents which may be right and we may be wrong. But I want to make two other quick comments.

One is to remind you that when Joao Cid dos Santos was in the last months of his life, he was studying a topic which he described as systemic venous devalvulation, as a cause of this syndrome; perhaps he was talking about the same thing that Dr. Raju has demonstrated so nicely here.

Second, in the past few months, I have had the pleasure of working with an Egyptian surgeon, who has the talent of looking at an extremity and saying, "That is an ulcerophilic skin" or "That is a non-ulcerophilic skin." Unfortunately, he went back to Cairo before he taught me how, and I would really like to know more about his criteria.

DR. ANDREW DALE (Nashville, Tennessee): The chief reasons that the rational management of peripheral venous disease has fallen so far behind arterial disease are twofold. The first has been the lack of any laboratory model or animal preparation to allow controlled study of deep venous thrombosis, and the second—failure to develop accurate diagnostic studies for clinical use. This presentation of Dr. Raju emphasizes the latter and shows us what can be done to achieve an accurate functional, as well as anatomic, understanding of the peripheral venous occlusion. The complete paper contains Dr. Raju's discussion of his studies in the light of the older literature, which have led him to believe that some of our previous concepts have been erroneous, and that non-thrombotic phenomena explain the problems of many of these patients.

His reconstructive surgical experiences among 40 patients are excellent, and although his particular operative procedures have been different from mine, they do encourage the belief that many of these patients can be benefited by reconstructive venous surgery. I was particularly interested in the results of his 21 axillary vein transplants and of his report that no particular harm results to the arm from removal of the distal portion of the axillary vein. His finding that 57% of the vein transplant patients had a good result, while 94% of the valvuloplasty patients had the same good result, is surprising.

His observation that the complication of acute postoperative venous thrombosis is not common parallels my own experience, where only four such venous thromboses have occurred in over 70 patients. Three appeared in the contralateral, nonoperated extremity, leading me to believe that deep venous thrombosis may complicate any major sur-

gery, but that this venous reconstruction is not particularly apt to provoke it.

The field of venous reconstructive surgery is now reaching a firm stance and is needed by the many patients who suffer from these problems.

DR. JAMES A. DEWEESE (Rochester, New York): Dr. Raju has clearly demonstrated that there is a group of patients with venous valvular insufficiency who may benefit from venous reconstructive procedures.

I think this group is a little different than I am accustomed to seeing. A few years ago, we did a large number of phlebograms on individuals with venous ulcers and found that the ones who did not have apparent recanalized veins or obstructed veins from their phlebitis did have large, dilated deep veins. These veins were all at least one and one-half times the diameter of a normal group of patients whom we observed, and I suspect that these are the individuals whom he is talking about.

Our experience has been more with patients who have been left with obstruction from their venous thrombosis and attempts to do bypasses, either from the popliteal to the femoral or cross-leg bypasses. We are sometimes disappointed, because we open the veins and not find nice, smooth-lined vessels, but see only webs and fenestrations in material that, clearly, you can not do anything directly to.

I still feel that venous reconstructive surgery is the frontier of vascular surgery. We have come a long way in arterial reconstruction, and I think it is going to take a while, but we should try and catch up on the venous side.

DR. PAUL T. DECAMP (New Orleans, Louisiana): Work on the chronic venous problems should be continued; however, we need to be very cautious in moving into this field and be very critical, because there has been a lot of trouble over the last 50 years from not being sufficiently critical.

I must admit, the type of patients I see do not fall into the same category as the bulk of these that have been reported, and I think there must have been some preselection in the patients reported here. I have the same problem Dr. DeWeese has. Many of the patients we see have primarily venous occlusive problems, and, actually, the number that seem to have primary venous valvular insufficiency is smaller.

I would also remind you that many other conditions that do not involve the venous system at all create conditions in the lower leg that resemble venous stasis ulcers very closely: ankylosis, osseous and non-osseous major trauma to the leg without venous disease, sickle cell disease, and postpoliomyelitic paralysis. There are a host of things that give this sort of picture in which the venous system is not involved.

I am very much interested, too, to notice that in Jackson they found two normal students who had incompetent deep venous systems. We had a few normal controls thirty years ago, when we did our ambulatory venous pressure studies, and we found a normal individual who had an incompetent deep venous system. My interpretation, since I have observed that patient closely for 67 years, is that simple deep venous valvular incompetence may not be very important.

I would be surprised if we studied a hundred normal individuals, and did not find a significant percentage of them to have deep venous valvular incompetence. So I think we need to be very cautious in evaluating correction of valvular incompetence, although I would encourage the authors to continue their study.

I recall thirty years ago when two of the most eminent names in national and international venous disease recommended, performed, and recorded as being helpful the completely illogical ligation of the popliteal vein and ligation of the superficial femoral vein. So we need to be very careful.

DR. SESHADRI RAJU (Closing discussion): The technique of Doppler examination of the venous system is important. Our patients are examined supine with valsalva supplemented by manual abdominal compression by the technician to elicit reflux. The saphenous vein is monitored for reflux separately some distance along its course. With possibly one exception, we have not come across a patient with superficial insufficiency in whom at least mild femoral incompetence was not present. It is possible that our case material was a select group.

Dr. DeCamp, your admonition for caution is appropriate and well taken.

As Dr. Dale pointed out, a serious impediment to further progress in this area is the absence of a reliable quantitative technique to measure venous reflux.