Reversal of abnormal lymphoscintigraphy after placement of venous stents for correction of associated venous obstruction

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Purpose: **The purpose of this study was to report improvement or normalization of abnormal lymphoscintigraphy in swollen lower limbs after correction of associated venous stenosis by balloon dilatation and placement of venous stent of the iliac veins.**

Material: **Twenty-six patients with lower-limb swelling underwent balloon dilatation and placement of venous stent of the iliac veins for correction of venous stenosis. Technetium 99M-sulfur colloid lymphoscintigraphy was also abnormal (8 absent, 18 reduced) before stent placement in all 26 limbs, suggesting combined venous/lymphatic etiology for the limb swelling. Median age was 53 years. Male-to-female ratio was 1:8 and left-to-right ratio, 3:1. Fifteen patients had limb pain associated with the swelling. Severity of venous stenosis was generally underestimated by preoperative transfemoral venography as compared with intravascular ultrasound, (mean, 50% versus 77%); in five limbs (19%), transfemoral venography altogether failed to identify the venous lesion evident on intravascular ultrasound. The etiology of venous obstruction was post-thrombotic in nine limbs and nonthrombotic (web, stricture, or May-Thurner syndrome) in 17 limbs.**

Results: **Poststent lymphoscintigraphy completely normalized in 10 limbs, improved but remained abnormal in 9, and remained unchanged in 7. Clinical follow-up (mean, 1 year) showed improvement in swelling in 16 of 26 limbs ($P < .022$), with complete resolution of swelling in six; degree of pain also improved ($P < .02$), with total relief of pain in 9 of 15 patients. There was also significant improvement in all categories of a quality of life questionnaire.**

Conclusion: **These findings suggest that patients with a diagnosis of lymphedema made on the basis of lymphoscintigraphy alone and consigned to conservative therapy on that basis may benefit from additional venous investigations regardless of clinical presentation suggestive of lymphedema. This report supports the practice of aggressively searching for a venous basis of edema in these patients. Correction of the venous lesion may result in normalization or improvement of the lymphoscintigraphic abnormality and in any case may yield significant symptom relief, even in some limbs where the lymphoscintigraphic abnormality failed to improve after placement of venous stent. (J Vasc Surg 2001;34:779-84.)**

Nucleotide lymphoscintigraphy has replaced contrast lymphangiography for the diagnosis of lymphedema. Absent or delayed nucleotide activity in femoral and pelvic nodes in the presence of leg swelling is commonly interpreted as indicative of lymphedema. It was therefore of interest to find that in several cases, nucleotide lymphoscintigraphy repeated after correction of a coexisting iliac venous stenosis by stent deployment improved or normalized. This suggests that abnormal lymphoscintigraphic appearance may, in some cases, represent an easily correctable condition rather than refractory lymphedema.

MATERIAL AND METHODS

Three hundred sixty-seven limbs underwent stent deployment for correction of iliac venous stenosis at River Oaks Hospital between March 1997 and January 2001. Nucleotide scintigraphy was a routine part of work up of these patients because the majority (>90%) presented with swelling alone or in combination with other symptoms. Sixty limbs among this group had abnormal nucleotide scintigraphic appearance before stent placement, and the rest were normal. Poststent nucleotide scintigraphy has been completed after placement of venous stent in 28 of these 60 limbs, 17 are scheduled to be tested at their 6-month follow-up visit, 8 have declined for a variety of reasons, 2 have moved, and 5 have been lost to follow-up. Two of these 28 limbs had occluded stents; lymphoscintigraphy normalized in one after successful salvage with a veno-venous bypass, and in the other patient, lymphoscintigraphy remains abnormal with an occluded stent. Both of these patients were omitted from further analysis, leaving 26 limbs for this study.

Clinical presentation. All 26 patients presented with leg swelling, and 15 had associated pain. Swelling was graded by physical examination as follows: grade 0, none; grade 1, pitting, not obvious; grade 2, ankledema; grade 3, obvious swelling involving the limb (Table I). The level of pain was measured by the visual analogue scale method.[1] A commonly available opaque tape measure or ruler scale trimmed to 10-cm length is conveniently used for this purpose. The patient was asked to indicate his pain level on the unmarked or blank side of the device, with one end representing no pain and the other, extreme pain.

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Competition of interest: nil.

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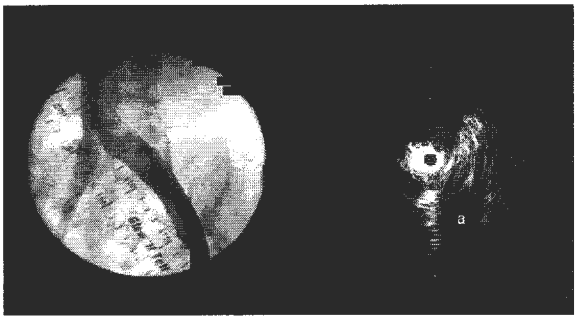

Fig 1. Normal-appearing preoperative transfemoral venogram (*left*) in a patient who had a web stricture detected by IVUS (*right*). The residual lumen at the stricture site is barely larger than the IVUS catheter (8 French). Adjoining luminal structure indicated by *a* is artery.

The indicated pain level was then translated into numeric grade (0-10) by the examiner by referring to the scale markings on the other side hidden to the patient. Patients were asked to fill out a quality of life questionnaire validated for assessment of chronic venous insufficiency[2] prospectively before stent placement and again about 1 year (median) after the stent. Numerical grades (1-5) were provided for each question, allowing the patient to assign a numeric value to the answers.

Preoperative work up. All patients underwent nucleotide lymphoscintigraphy, complete duplex venous scan, venous functional studies (Table II), and transfemoral venography.

Nucleotide lymphoscintigraphy. Technetium 99M-sulfur colloid was injected intradermally and subcutaneously into the first web space and images of the lower limb and pelvis acquired with a gamma camera at 5, 10, 20, 30, and 60 minutes. Patients were asked to walk before the injection and between the images. The temporal progression of activity up the limb and the appearance of isotope activity in the inguinal and pelvic nodes at these time intervals[3] were the basis for interpreting abnormal lymph activity. Other abnormalities of local lymph flow, such as pooling, were also recorded. The images were interpreted as normal when rapid flow progressed up the limb symmetrically with the opposite limb and nodes were rapidly visualized. When normal, nodal activity was visible as early as 10 minutes and well developed by 20 minutes. When nodal visualization was faint or delayed beyond 30 minutes, lymphatic activity was considered abnormal and reduced. When nodal visualization failed to occur at 60 minutes, lymphatic activity was interpreted as being absent. The lymphoscintigraphic data were collected from contemporaneous reports by the interpreting radiologist not involved in the study.

Placement of venous stent. Placement of the venous stent was performed for clinical symptoms in patients refractory or intolerant to conservative therapy. Details of patient selection and stent placement technique have been described in full elsewhere.[4,5] Because the sensitivity of transfemoral venography to identify significant iliac vein stenoses was poor,[4,5] intravascular ultrasound (IVUS) was used liberally to identify treatable lesions. After balloon dilatation, placement of venous stent was mandatory because recoil of the dilated stenosis otherwise occurred.[4,5] The procedure was carried out percutaneously on a 23-hour admission basis. Patients in this series were placed on once-a-day aspirin (81 mg) after the procedure. New generation antiplatelet agents were not used.

Follow up. Patients were seen 6 weeks after placement of the stent for clinical evaluation and transfemoral venography to assess patency of the stent. Thereafter patients were seen at 4 to 6 monthly intervals for follow-up clinical examination. Postoperative nucleotide lymphangiography was performed at about 6 months (median) after the placement of venous stent.

Data collection and statistics. All clinical (including severity scores), venographic, and lymphoscintigraphic data were contemporaneously entered at each patient visit into a time-stamped electronic medical record database and analyzed later for this manuscript. The nonparametric Wilcoxon signed rank test was used to compare preoperative and postoperative values.

RESULTS

The mean follow-up period was 1 year (median, 9 months; range, 2-35 months).

The median age of the 26 patients was 53 years (range, 15-75 years), the male-to-female ratio was 1:8 and the left-to-right ratio was 3:1. The venous stenosis involved the inferior vena cava and the common iliac vein in 2 patients, the common iliac vein alone in 16, both the common and external iliac veins in 6, and the iliac veins and the common femoral vein in 2. The venous lesion was considered nonthrombotic (web, stricture, or May-Thurner syndrome) in 17; a post-thrombotic etiology was apparent on venography and/or IVUS examination in nine limbs. The percentage stenosis of the lesion estimated on venography was much less than direct intraoperative measurement by IVUS (median stenosis, 50% versus 77%); in five limbs there was no venographic stenosis at all (occult venographic stenosis); the stenotic lesion was solely detected by IVUS (Fig 1). Collaterals were identified by the authors prospectively in 24 out of 26 cases on examining prestent transfemoral venograms; in many instances, the observed collaterals were small, faint (presacral), or only partially visualized (ascending lumbar or axial) precluding easy detection. The presence of collaterals was reported quite infrequently by the radiologist interpreting the same films and only when they were large and prominent. This difference is probably a result of observer bias.

Clinical outcome. The degree of swelling decreased significantly after placement of venous stent from a median preoperative grade of 3 (range, 1-3) to grade 2 (range, 0-3) ($P < .022$). In 6 out of 26 limbs, swelling

Table I. Limb swelling before and after placement of venous stent

*Prestent swelling grade**	*Poststent swelling grade*	*n (limbs)*	*Poststent lymphoscintigraphy†*
3 (n = 17 limbs)	3	7‡	3 improved,§ 4 unchanged
	2	4	2 normalized, 2 improved
	1	5	3 improved, 2 unchanged‖
	0	1	1 normalized
2 (n = 6 limbs)	2	3‡	2 normalized,§ 1 unchanged
	1	1	1 normalized
	0	2	1 normalized, 1 improved
1 (n = 3 limbs)	0	3	3 normalized

*Grade 0 = none; grade 1 = pitting; grade 2 = ankledema; grade 3 = gross.
†*Normalized*, normal poststent lymphoscintigram compared with subnormal or absent activity prestent; *improved*, poststent lymphatic activity was subnormal but considered improved because none existed before or there was less delay and better visualization compared to lymphatic activity prestent; unchanged, poststent lymphatic activity was either subnormal or altogether absent, identical to the prestent status.
‡Swelling unchanged after placement of venous stent. There is a total of 10 limbs (7 with grade 3 and 3 with grade 2) in this category.
§Lymohoscintigraphic improvement without clinical improvement in limb swelling. There is a total of 5 limbs (3 with grade-3 and 2 with grade-2 swelling prestent) in this category.
‖Improvement in limb swelling without lymphoscintigraphic improvement. There is a total of 2 limbs in this category (both with grade-3 swelling prestent improving to grade 1 poststent).

Table II. Venous functional studies[4,5,10] before and after stent placement*

Test	*n*	*Prestent (mean ± SD)*	*Poststent (mean ± SD)*	P
Arm/foot pressure differential	15	1.9 ± 1.6	1.3 ± 1.8	NS
Reactive hyperemia pressure increase	15	6.5 ± 5.6	4.1 ± 3.0	NS
Obstruction grade	15	1.5 ± 1	1.2 ± 0.7	NS
Ambulatory pressure drop (%)	14	45 ± 11	40 ± 9	<.05
Ambulatory pressure recovery time (s)	14	38 ± 30	21 ± 11	NS
APG venous volume (mL)	18	58 ± 28	52 ± 26	NS
APG ejection fraction (%)	18	58 ± 21	67 ± 19	NS
APG residual volume fraction (%)	18	38 ± 23	30 ± 17	NS

*Three patients had significant(>100 mL/min) deep reflux at one or more valve sites before stent placement; swelling improved in two and remains unchanged in one after stent placement.
NS, Not significant; *APG*, airplethysmography.

totally disappeared after placement of venous stent (Table I). Notably, 6 out of 26 limbs with massive preoperative swelling had total (grade 0) or near total (grade 1) disappearance of swelling after placement of venous stent. Improvement in swelling by one grade or more over the prestent level occurred in 16 out of 26 (62%) limbs, with 10 limbs showing no objective change in limb swelling. In no patient did the swelling get worse after the placement of venous stent. Two patients who had recurrent episodes of cellulitis prestent have remained free of this complication during the follow-up period.

The degree of pain also significantly decreased from a median prestent level of 5 (range, 1 to 8) to <1 (range, 0 to 6) poststent ($P < .02$). In 9 out of 15 patients with preoperative pain, there was total relief of pain after placement of venous stent.

Quality of life. After stent placement, patients had improved quality of life in all major categories addressed in the questionnaire (subjective pain, sleep disturbance, morale and social activities, and routine and strenuous physical activities) ($P < .048$ or better for each category). No improvement in any of the quality of life criteria occurred among the patients (n-10) without clinical improvement.

Nucleotide lymphoscintigraphy. All of the 26 limbs obviously had either absent or reduced activity before stent placement (Table III). After placement of the stent, retesting showed either normalization (10 limbs) or improvement (nine limbs) in 19 out of 26 limbs (73%); no change was noted in seven limbs.

Clinical correlation. Clinical improvement in swelling was accompanied by either normalization or improvement in lymphoscintigraphic appearance in most cases (14/16, 88%); in two (12%) limbs with clinical improvement in swelling, lymphoscintigraphy was subnormal before the stent procedure and unchanged afterwards. Curiously, in 5 out of 10 limbs with no improvement in limb swelling after the stent procedure, lymphoscintigraphy either normalized (2 limbs) or improved (3 limbs). Fig 2 shows transfemoral venograms and nucleotide lymphoscintigraphy before and after placement of stent in a case included in this series.

Venous function studies.[4,5] Prestent and poststent data for arm and foot venous pressure differential, ambulatory venous pressure, and air-plethysmography are shown in Table II. Ambulatory venous pressure percentage drop improved significantly ($P < .05$); most other

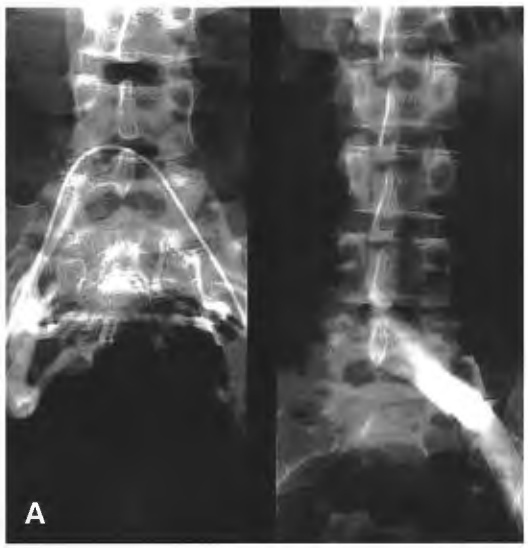

Fig 2. Preoperative and postoperative transfemoral venograms. **A,** correction of iliac venous stenosis by a long 16-mm stent. **B,** normalization (*right panel*) of previously absent (*left panel*) lymphoscintigraphic nodal activity after stent placement.

parameters improved, although not significantly in this small sample size.

Data were separately analyzed for three subsets of patients with clinical features of limb swelling considered highly suggestive of lymphedema (bilaterality, preadolescent onset, swelling of >10-year duration). Both clinical and lymphoscintigraphic improvement occurred in all three subsets (Table III).

DISCUSSION

Lymphedema is generally classified as "primary" because of a congenital or developmental abnormality in the lymphatic system or "secondary" because of destruction of lymph nodes and conduits through disease, surgical ablation, or other causes. Kinmonth[6] classified primary lymphedema into several categories on the basis of lymphangiographic studies with contrast. The advent of isotope lymphoscintigraphy has effectively displaced this cumbersome and technically demanding open technique. Witte[7] has recently reviewed the development of nucleotide lymphoscintigraphy, its clinical use, and current "state of the art," along with his considerable experience with this diagnostic modality. Technetium 99M-sulfur colloid is widely used as in this study and emphasizes nodal activity. Technetium 99m–labeled human serum albumin injected intradermally tends to emphasize lymph channels, but nodal activity may be less.[7] Villavicencio[3] has detailed the various lymphoscintigraphic abnormalities found in lymphedema and in venous pathology.[3,8] Twenty to thirty percent of patients with confirmed venous stasis have been reported to show an abnormal nucleotide lymphoscintigraphy as well in several series.[9,10] One theory ascribes this association to abnormal lymph transport resulting from destruction of local lymphatics by edema and other tissue changes induced by venous stasis. We speculate that the edema of venous origin and the resulting increased load on the lymphatics in some fashion leads to a spurious lymphoscintigraphic appearance even when no inherent abnormality of the lymphatic system exists. In some patients, true overload decompensation of the lymphatic system may occur with onset of venous obstruction. Any pre-existing subclinical lymphatic abnormality will likely be predisposed to overload induced failure. Relief of venous obstruction may allow recovery of the lymph transport mechanism. Lymphatic function appears to improve also after venous valve reconstruction for correction of reflux (6 limbs, unpublished data). Regardless of the precise mechanism, it is clear that the nucleotide lymphoscintigraphic test may improve and even revert to normal after the venous stenosis is relieved. The reason for the absence of clinical improvement in swelling in 5 out of 10 limbs that showed improvement in lymphoscintigraphy is unclear. This may be because of a time factor, coexisting significant reflux (1/5) (Table II), or the dominance of lymphatic pathology over the venous obstruction. No preoperative predictors of poor clinical outcome were found in the 10 patients who did not improve their swelling.

Based on this report and our previous experience,[4,5] some recommendations can be made on the work-up of patients presenting with symptomatic limb swelling in whom systemic causes have been excluded. Lymphoscintigraphy and venous studies are a routine part of work-up in most such patients, particularly in those under consideration for intervention or surgery at our institution. In our practice, the etiology of limb swelling on complete work-up is found to be venous alone in about 75% of limbs, venous and lymphatic in about 20%, and lymphatic alone in about 5%. During the period covered by this study, a total of 74 symptomatic limbs were found to have abnormal lymphoscintigraphy; 60 limbs were

Table III. Lymphoscintigraphic status before and after placement of venous stent

Clinical group	*Prestent lymphoscintigraphic activity*	*Poststent lymphoscintigraphic activity**
All (n = 26)	Absent in 8 limbs Reduced in 18 limbs	Normalized in 3 limbs, improved in 5 limbs Normalized in 7 limbs, improved in 4 limbs, unchanged in 7 limbs
Preadolescent onset (n = 5)	Absent in 2 limbs, reduced in 3 limbs	Normalized in 1 limb, improved in 3 limbs, unchanged in 1 limb
Bilateral leg swelling (n = 10)	Absent in 2 limbs, reduced in 8 limbs	Normalized in 4 limbs, improved in 3 limbs, unchanged in 3 limbs
Swelling >10-y duration (n = 13)	Absent in 4 limbs, reduced in 9 limbs	Normalized in 3 limbs, improved in 6 limbs, unchanged in 4 limbs

*See Table I for definitions of "normalized" and "improved" poststent lymphoscintigraphic activity.

found to have associated venous stenosis and are included in this series. In the remaining 14 limbs, venous outflow obstruction was ruled out and the pathology is presumed to be purely lymphatic. Among limbs that underwent venous stent placement, swelling was the primary complaint in 53%, and it was present in association with other symptoms in 96%.[5] Despite assertions to the contrary in many clinical texts, it has been our experience that there is no clinical feature or sign that can reliably differentiate lymphedema from swelling of venous or combined venous and lymphatic origin (Table III). When a venous lesion has been definitively excluded, an abnormal lymphoscintigram provides confirmation of the diagnosis of lymphedema and assigns prognosis. An abnormal lymphoscintigram obtained preoperatively, before an associated venous lesion is corrected, allows cautionary counseling to the patient regarding outcome possibilities. A normal lymphoscintigram obtained before the correction of a venous lesion provides reassurance to the patient (and the surgeon) that postoperative exacerbation of limb swelling that occurs in some patients is likely to be transient. Ascending venography is inadequate for investigation of the iliac venous segment because of poor contrast visualization. Transfemoral venography is the mainstay in most institutions for this purpose. A venous stenosis will be suspected in about half of the cases based on this investigation. It is recommended that the vascular surgeon personally examine the films. Because of the lack of general awareness of the significance of these lesions, radiologists often limit their report to patency ("the iliac veins are patent") without reference to diffuse or focal lesions that may be present. Noncollateralizing diffuse stenoses occur in the iliac veins and are easily missed.[4] Besides these interpretational problems, transfemoral venography is technically limited in identifying iliac vein stenoses because the luminal compromise is disproportionately in the anterior posterior plane[11] appearing as thinning out of contrast and even broadening of the lumen at the lesion site rather than the familiar constriction; webs, membranes, and strictures of short length are common in this location and are easily masked by the density of contrast leading to a spuriously normal venographic appearance (Fig 1). There were five (19%) such venographically occult stenoses in this series, which parallels our previous experience.[4,5,11] IVUS does not have these shortcomings[11]; it is a percutaneous procedure and is easily followed by stent placement if indicated at the same sitting. We have increasingly come to rely on IVUS to investigate and treat iliac vein stenoses.[11] However, transfemoral venography is adequate for assessing gross patency of venous stents.[5]

Most often, lymphoscintigraphy is the only investigation, if any is performed, that is obtained in suspected cases of lymphedema because of its ease and ready availability. Unfortunately, if the lymphoscintigram is abnormal, a confirmed diagnosis of lymphedema is made and the patient is assigned to lifelong conservative measures with little prospect of definitive therapy. This report supports the practice of aggressively searching for a venous basis of edema in these patients. If it is found and corrected, significant clinical improvement in limb swelling and pain occurs in many patients, even in some patients in whom postoperative nucleotide lymphoscintigram fails to improve or normalize. Many patients reported relief of pain as contributing significantly to an improved quality of life, even when swelling was not completely relieved. Most patients presenting with pain in this series had significant pain relief after placement of stent. Traditional teaching states that true lymphedema is often painless. The presence of pain is perhaps an indication of an underlying venous stenosis despite an abnormal lymphoscintigram. The relative safety and ease with which iliac venous stenoses can be corrected by placement of a venous stent only emphasizes the fact that venous stenoses should be looked for aggressively in this group of patients regardless of an abnormal lymphoscintigram. We have similar experience in two patients (not included in this series) who carried the diagnosis of postmastectomy lymphedema, only to have the edema relieved when coincident venous stenoses were corrected; the etiology of the lesions were probably surgical trauma and/or radiation.

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DISCUSSION

Dr Thomas W. Rooke (Rochester, Minn). This is a topic that has intrigued me for over a decade. In 1991, I attended a conference at Mayo Clinic involving a patient who had chronic thrombosis in the iliac vein, severe swelling and ulceration of the leg, and an abnormal lymphoscintigram. The patient underwent an operation to restore venous flow, and his leg swelling and symptoms subsequently improved. I remember wondering to myself whether the lymphatic abnormalities changed as the result of surgery.

Unfortunately, a follow-up lymphoscintigram was not obtained, so I never knew whether the lymphatic drainage had also improved.

Since that time, practitioners on both sides of the Atlantic have described a relationship between abnormal lymphoscintigraphy and chronic venous disease. Even our own Dr Gloviczki—who has his fingers in just about everything—has reported an association between venous obstruction and lymphatic obstruction, but until now no one has shown that lymph flow can improve if the venous obstruction is relieved.

I will ask three questions about this presentation.

I am bothered by the discrepancy between venography and IVUS. In particular, it is unsettling that 5 patients out of 26 had completely normal findings on venography, and that one patient with a normal venogram actually had a 90% narrowing by IVUS. That does not jibe with my clinical experience. Perhaps IVUS overestimates the degree of stenosis—do we have any information on the pressure gradients (across the stenosis) in these patients? Or is it possible that IVUS causes catheter-associated vasospasm which simulates severe stenosis?

My second question involves adjunctive therapy for venous disease and limb swelling. After venous stents were placed, I assume that some other treatment for swelling was provided—perhaps elastic compression was applied, or perhaps drug therapy with diuretics was initiated? If so, these treatments—rather than venous revascularization—may have produced some (or all) of the improvement in lymph flow? Perhaps the authors have seen patients who presented with symptomatic venous obstruction associated with abnormal lymphoscintigraphy, but who did not undergo venous revascularization; that is, patients who were simply treated with conservative measures for their venous obstruction and edema? If so, did conservative treatment alone eventually lead to clinical improvement? Do we know what happens to their lymphoscintigrams? Do they also improve? It seems possible that the improvement in lymph flow observed in this study following venous revascularization may have been due to the associated treatments (such as elastic compression or drugs) rather than the venous revascularization?

Finally, I was intrigued that no lymphoscintigrams worsened after stenting. That is surprising, because I assume that stenting will relieve the venous hypertension in these patients; in the face of "fixed" lymphatic obstruction, the drop in venous pressure should decrease Starling forces and lead to an immediate decrease in lymphatic flow. We did not see this, perhaps because the lymphoscintigrams were so abnormal to begin with. Eight of them had absent flow; they really could not worsen after venous revascularization. I wonder if the authors could just comment on this?

I enjoyed the paper very much. Thank you.

Dr Seshadri Raju. Thank you, Dr Rooke, for those comments.

I do not think venous spasm is a factor in the discrepancy between venography and IVUS. We routinely perform a venogram either before or after IVUS on the table in the endovascular room. There is no spasm on the intraoperative venogram which pretty much looks like the preoperative venogram. I think there are three factors why the venogram can be deceptively normal. First, the stenosis is often in the anterior posterior plane as already mentioned in the previous paper by Dr Neglen, and it does not show up well on single-plane films. Second, there is considerable dilution of the contrast, even on transfemoral venograms, by the large hypogastric flow, and the iliac vena caval junction often becomes fuzzy because of this dilution. And most importantly, many of the lesions in this area are truly web-like or membranous-like and are easily masked by contrast (or lack of it).

In a handful of cases, even IVUS failed to pick up a membranous short stenosis and we knew the stenosis was there only because tight waisting was observed on balloon dilatation.

We do not know why the lymphoscintigram improves after stenting. We do have similar experience with six cases of valve reconstructions.

We are not big fans of lifelong compression therapy. We do surgery so that patients may discard the stocking. We recommend that they wear them as they please. About half of them will discard it. The other half will use it intermittently.

We think a minority of these cases are true lymphedema and the venous stenosis is incidental. These are the cases that do not improve after stenting. In the majority of the cases, the pathology is primarily venous and the abnormal lymphogram is a secondary phenomenon and reversible in our opinion. We speculate there are probably several reasons why the lymphogram becomes abnormal in the presence of a significant venous stenosis. We think the main reason is technical. Because of the Starling forces, there is a large interstitial fluid compartment that simply dilutes the isotope beyond visibility. It would be interesting to give these patients double or triple the usual dose of isotope and see if the lymphatics visualize. Another possibility is that the lymphatics lose their tone and become paralyzed because of overload. I heard Dr Moneta suggest in one of the meetings earlier this year that local lymphatics may become damaged by the tissue edema of venous stasis. We know from organ transplant experience that lymphatics have a tremendous capacity to regenerate. Once the venous cause is removed, they may regenerate again. We do not know.

Thank you.