Optimal therapy for advanced chronic venous insufficiency

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Introduction: While definitive therapy awaits level I evidence, controversy persists regarding the optimal operation for treatment of advanced chronic venous insufficiency (CVI). We propose a pragmatic approach to the correction or amelioration of venous hypertension resulting from hydrodynamic and hydrostatic venous reflux. We evaluated a strategy of balloon dissection, subfascial endoscopic perforating vein surgery (SEPS) with routine posterior deep compartment fasciotomy, including ligation and stripping of the superficial system, for use when reflux is documented at duplex ultrasound (US) scanning.

Methods: This is a cooperative, multicenter, retrospective review of 832 patients stratified by CEAP classification. The series consisted of 300 patients with C4 CVI, 119 patients with C5 CVI, and 413 patients with C6 CVI. A subset of 92 patients with C4 disease were prospectively randomized, and ambulatory venous pressure (AVP) was determined preoperatively and postoperatively. All patients underwent duplex US scanning to document reflux in the deep, superficial, and perforating venous systems. Efficacy, safety, and durability were evaluated over follow-up of 1 to 9 years (mean, 31/2 years). Uniformity was attempted by adoption of the senior author’s protocol and technique through on-site preceptorship in each surgeon’s operative theater.

Results: This technique interrupted 3 to 14 (mean, 7) incompetent perforating veins per patient. Of the 832 patients undergoing SEPS, 460 (55%) underwent saphenous vein ligation and stripping at the same operation. In 92% ulcers healed or were significantly improved within 4 to 14 weeks. In 64 (8%) patients, ulcers failed to heal or there was no benefit from the operation. Thirty-two patients (4%) experienced recurrent ulceration or skin deterioration at 6 months-2 years (mean, 15 mo). Repeat SEPS was successful in 28 of these 96 patients, and deep valve repair was successful in 4 patients. In the 92 randomized patients with C4 disease, 41 refused postoperative AVP, leaving 51 compliant patients. The SEPS group (n = 25) had significantly reduced AVP (P < .01) compared with the control group (n = 26). Complications in 825 patients were less than 3% and consisted mostly of transient neurologic disorders (eg, paradysthesia), but deep venous thrombosis occurred in 2 patients, with pulmonary embolus in 1. No operative deaths occurred. Follow-up for 1 to 9 years (mean, 31/2 years) demonstrated durability.

Conclusion: The efficacy, safety, and durability of this operative protocol proved beneficial in our clinical experience with 832 patients during 9 years of follow-up. The SEPS subset of randomized patients with C4 disease experienced significant decrease in AVP, objectively supporting the effectiveness of reflux surgery in advanced CVI. Until definitive level I evidence is available, this operative technique is advocated as optimal therapy for CVI. (J Vasc Surg 2003;37:545-51.)

Controversy persists regarding the best treatment for advanced chronic venous insufficiency (CVI). The relative contribution of reflux in the deep, superficial, and perforating venous systems of the leg, separately or in combination, is unknown. While there is strong inferential and empirical clinical evidence to support correction of hydrostatic and hydrodynamic causes of CVI, the definitive operation awaits level I evidence.

In the interim, our experience supports a pragmatic approach that optimizes correction or amelioration of venous hypertension associated with reflux in the superficial and perforating venous systems. In our method, balloon dissection is used to facilitate subfascial endoscopic perforating vein surgery (SEPS), including routine posterior deep compartment fasciotomy. In addition, ligation and stripping of the saphenous veins is performed when reflux is documented at duplex ultrasound (US) scanning.

The objective of this clinical study was to assess the safety, efficacy, and durability of this approach. While our results suggest the proposed technique may promote optimal therapy, a randomized prospective study is required.

METHODS

In a cooperative, multicenter, retrospective clinical review, 832 patients were stratified by CEAP classification. Advanced CVI was defined as stage C4 to C6, which represented an indication for surgery. The surgery was...
performed in five community hospitals in Germany, Florida (n = 2), Texas, and California by experienced surgeons in private practice, three with university affiliation. Uniformity was achieved by adoption of the senior author's (R.L.T.) protocol and technique with initial on-site preceptorship in each surgeon’s operative theater with his own team. Most patients were under epidural anesthesia and underwent same-day surgery.

Inclusion or selection criteria. Candidates for surgery were limited to patients with C4, C5, or C6 CVI, with reflux documented in either the superficial, deep, or perforating venous system. The number of incompetent perforating veins documented at duplex US scanning was recorded in preoperative mapping. A duplex scan was considered positive if color-flow reversal occurred (pathologic reflux) or valve closing time was greater than 0.5 second, and arbitrarily if the diameter of the perforating vein was greater than 2.5 mm. There were no cases with fewer than three positive reflux points. Doppler scan analysis confirmed borderline or questionable reflux in a few instances involving less experienced US technicians during their diagnostic learning curve. Since there were always three or more positive (unequivocal reflux) that they were observing perforating vein reflux. Eight hundred thirty-two patients met inclusion requirements and were stratified into C4, C5, and C6 groups, along with demographic data. Only patients, not limbs, were counted for evaluation of outcome.

Exclusion criteria. Acute deep venous thrombosis (DVT) and complete deep venous obstruction noted on duplex scans were considered contraindications to surgery. However, partial deep obstruction, recanalization, and deep venous insufficiency (DVI) were not. Accurate data regarding the small number excluded could not be determined.

Objective data. One surgeon’s (R.K.) “Dusseldorf experience” with a subset of 92 patients with C4 CVI was included in the study. This group was prospectively randomized to determine ambulatory venous pressure (AVP) and venous recovery time (VRT) preoperatively and postoperatively. This assessment of venous hemodynamics rendered objective data to evaluate the effect of corrective reflux surgery on venous hypertension.

Reflux was documented in all cases with color-flow duplex scanning and spectral doppler scan analysis with a linear array transducer. Perforating veins were assessed with the patient sitting with the legs hanging freely.

Data included clinical severity score, disability score, and clinical outcome score. Hemodynamic analysis consisted of AVP and VRT measurements obtained the day before surgery and again 1 month later. The needle was fixed in position and connected to an external pressure transducer. The patient then performed 10 dorsiflexions in 10 seconds. Changes in AVP (%) and VRT (sec) were calculated. Postoperative AVP and VRT determinations were available for only 51 compliant patients. The distribution for comparison was comprised of 26 patients in the conventional surgery (control) group and 25 patients in the endoscopic surgery (SEPS) group.

Subset operative groups: AVP cohort (Dusseldorf). The conventional group underwent standard ligation and stripping, with the saphenous vein ligated and divided at the saphenofemoral junction, then stripped distally to just below the knee. Incompetent perforating veins were mapped with duplex scanning and ligated subfascially through multiple calf incisions.

Patients in the SEPS group were operated on while in the Trendelenburg position, without a tourniquet, after administration of epidural or spinal anesthesia in most. The instrumentation and technique have been described in detail. In brief, one of two essentials is balloon dissection (Spacemaker; US Surgical Corp, Norwalk, Conn) in the superficial posterior compartment. With proper positioning and, if necessary, balloon reinfusion with 200 to 400 mL of saline solution, distal dissection is confirmed by palpitation of the balloon tip posterior to the malleolus. The second essential is dissection of the posterior deep compartment, accomplished by taking down the peritibial fascia from 24 cm above the malleolus to the ankle (posterior deep compartment fasciotomy). This may be accomplished with blunt or sharp dissection or with the harmonic scalpel.

Carbon dioxide insufflation maintains the working space with pressure of 15 to 25 mm Hg. Visualization is accomplished with a zero-degree 10 mm rigid scope with a 5 mm low-profile working port. A second 5 mm port may be inserted lower to enable placement of a 5 mm fan retractor to facilitate distal malleolar dissection and perforating vein interruption. The camera and port sites are placed in normal skin just below the knee to avoid having to make incisions in diseased distal tissue. This SEPS operative protocol was used throughout the series, not only in this randomized subset.

Follow-up. Patients were seen 7 to 10 days after surgery. Clinical assessment was carried out, AVP and VRT were measured, and duplex US scanning was performed 4 weeks postoperatively. The hemodynamic measurements were analyzed with mean value comparison with the nonparametric Mann Whitney U test. Mean values and standard deviation of the mean values were noted. P < .05 was considered statistically significant. Life table analysis was feasible for patients with C6 CVI, for whom there were definitive end points.

Interventions. Of the 832 patients undergoing SEPS in this series, 460 (55%) underwent superficial ligation and stripping of saphenous veins at the same operation. All underwent balloon dissection and posterior deep compartment fasciotomy as described above. The number of incompetent perforating veins observed and interrupted was noted for later comparison with mapping with duplex scanning. Perforating veins smaller than 2.5 mm in diameter were not counted as incompetent, although small accessory perforating veins often were divided for exposure.
**RESULTS**

**Demographics.** The 832 patients in this series were stratified into C4, C5, or C6 groups with data on age and sex (Table I).

**Regional and geographic differences.** An unexpected finding was the variability of operative experience due to geographic caseload differences. Compared with the California and Texas experience, C4 cases represented a greater proportion of operative indications in Dusseldorf, Germany, and in Florida (45%). The incidence of documented DVI in C4 cases was also higher in Germany (26%). In California and Texas, the incidence of DVI was 8% when the major operative indication was active ulceration (C6) in 85% of cases. The overall incidence of DVI in this series was 28% (237 patients). This percentage calculation was heavily weighted by the German cohort, which had a high incidence of DVI in all three CEAP classes (C4, 26%; C5, 44%; C6, 35%). Indeed, the Dusseldorf observations accounted for 135 of 237 DVI cases (55%) in this series, skewing the overall incidence of DVI.

**Incidence of DVI.** DVI was documented at duplex scanning in 237 of 832 patients (28%). Phlebography also confirmed DVI in 124, about half of the cases. A history suggesting DVT was elicited in 160 of 237 patients with DVI (70%). There was a large anatomic variance of deep vein involvement with partial obstruction, recanalization, and extent of DVI.

**Superficial venous reflex.** Documented saphenous vein reflex occurred in 460 of the 832 patients (55%) in this clinical study. Valvular incompetence was noted in all cases at the saphenofemoral junction. Popliteal reflux and lesser saphenous incompetence occurred in only 58 patients (12%).

**Perforating vein reflux.** Duplex scanning and doppler assessment documented significant perforating vein reflux in all 832 patients. This reflux was associated with the superficial venous system in 55% of cases and with DVI in 28% of cases. Isolated reflux was observed in 90 patients (10%), half with a history of ligation and stripping, and in combination with DVI and superficial vein reflux in 45 patients (5%). Diagnostic and preoperative mapping studies enabled identification of a wide range of anatomic incompetent perforating vein locations, from the malleolus to 24 cm proximal in the lower paratibial area. The usual locations at Cockett II and III were most frequently involved (n = 817). It was also noted that incompetent perforating veins were observed 15 to 16 cm above the malleolus, just above Cockett III, in more than two thirds of patients (n = 554). Malleolar perforating veins were more difficult to define, especially if induration and inflammatory changes were present. With diligence and skill, most could be identified when ulceration was present at the malleolar level. Scans showed 3 to 8 (mean, 4) documented incompetent perforating veins per patient.

**Pooled data operative results by CEAP classification.** The composite results were analyzed by category (Table II). Results in the C5 and C6 groups were judged by the definitive outcome, ie, ulcer healing, time to healing, and ulcer recurrence. Severity, disability, and outcome scores contributed to evaluation of a satisfactory or good outcome. In the 300 patients with C4 CVI, tabulation of clinical severity, disability, and outcome scores was cumbersome to quantitate. Therefore the ratings were added and mean values are given. In summary, the clinical score improved from 5.7 to 2.2 compared with preoperative values. This decrease was statistically significant (P < .05). Although generally improved, disability scores did not show any significant statistical changes. In contrast, the outcome score was significantly improved, 1.5 ± 1.2 (P < .05) overall. In the C4 group, 93% of patients experienced good results according to these criteria. In the 119 patients with C5 CVI, ulceration occurred in only 2 (1.8%), for a 98.2% satisfactory outcome. In the 413 patients in group C6, 64 (8%) ulcers failed to heal and 32 ulcers (4%) recurred. Overall, 96 patients (12%) in the C6 group experienced poor results; conversely, 317 patients (88%) experienced a good outcome.

**Time to ulcer healing.** In the C6 group, 349 patients (92%) had healing of ulcer or were significantly improved to

**Table I.** CEAP demographics

<table>
<thead>
<tr>
<th>Classification</th>
<th>Number of patients</th>
<th>Male/female</th>
<th>Age (y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C4: Lipodermatosclerosis, eczema</td>
<td>300</td>
<td>140/160</td>
<td>30-88</td>
</tr>
<tr>
<td>C5: Healed ulcers</td>
<td>119</td>
<td>50/69</td>
<td>42-89</td>
</tr>
<tr>
<td>C6: Venous ulcers</td>
<td>413</td>
<td>220/193</td>
<td>40-94</td>
</tr>
<tr>
<td>Total C4-C6</td>
<td>832</td>
<td>410/422</td>
<td>30-94</td>
</tr>
</tbody>
</table>
“pinpoint” granulation tissue within 4 to 14 weeks (mean, 7 weeks). Only 64 (8%) failed to heal or benefit from the procedure.

**Ulcer recurrence.** Two patients in the C5 group had recurrent ulcer 6 months and 14 months, respectively, after surgery. In the C6 group, 32 patients (4%) experienced ulcer recurrence or skin deterioration and recurrent signs and symptoms of CVI. Recurrence occurred between 6 months and 2 years postoperatively (mean, 15 months). After 2 years, no recurrence of ulcer was observed.

**Overall combined results.** Long-term beneficial results in all three groups (C4, C5, C6) were achieved in 715 of 832 patients (86%).

Repeat SEPS was successful (ulcer healed) in 25 of 96 patients (28%) in whom surgery failed. Four others underwent deep venous repair, and two underwent axillary vein transplantation.

**Correlation of surgical failure with DVI.** The 96 surgical failures were analyzed relative to association with DVI. While DVI was documented in 237 patients (28%) in the series, only 29 of 96 poor results (ulcer recurrence or failure to heal) were associated with DVI. This represents 12.3% of the DVI cases in the study and 30% of the surgical failures.

**Correlation of missed or recurrent incompetent perforating veins to surgical failure.** Seventy percent (67 patients) of the surgical failures demonstrated no evidence of DVI, but duplex scans showed missed or recurrent incompetent perforating veins. Early failures were considered due to missed veins; late failures (after 1 year) were probably attributable to “new” perforating veins.

**Analysis of hemodynamic data.** Of the 92 German patients in the Dusseldorf cohort who underwent preoperative AVP determination, 41 either refused or were unable to undergo postoperative AVP testing. Therefore 51 compliant, randomized patients were evaluated in the conventional surgery group (n = 26) or SEPS group (n = 25). All 51 were graded as having C4 SE_p perforating vein reflux, which describes severe skin changes secondary to CVI with reflux. The mean age of this subset was 62.7 years (range, 38 to 84 years).

The number of patients with deep venous reflux was higher in the endoscopic group compared with the control group (P < .06), which may explain the increased preoperative AVP in patients randomized for the SEPS proce-

dure. Postoperative duplex scans showed that in both groups deep venous reflux was diminished after surgery, even though before surgery there were more patients with deep venous reflux in the SEPS group. Only one patient had reflux down to the level of the crural veins, which could not be detected after the endoscopic operation.

Ablation of superficial varicosities, including saphenous vein stripping, in addition to perforating vein surgery was required in all patients. Lesser saphenous vein surgery was performed in 4 patients in the SEPS group and in 6 patients in the conventional surgery group.

Follow-up duplex scanning enabled identification of more residual perforating veins after conventional subfascial ligation compared with the endoscopic procedure (P < .02). The clinical score improved from 5.5 to 2.0 in the endoscopic group, and from 5.2 to 2.4 in the control group, compared with preoperative values. The decrease was statistically significant (P < .05) regardless of the operative procedure chosen. The disability score did not show any significant changes.

The clinical outcome score was improved in both groups: 0.96 ± 1.1 in the conventional group versus 1.6 ± 1.3 in the endoscopic group (P < .06).

In the SEPS group there was a significant improvement in VRT to normal values (P < .02). In patients in the conventional surgery group a slightly prolonged VRT was detected, but no statistically significant changes. Correlation of the hemodynamic data revealed a significant decrease in AVP in patients in the SEPS group, compared with preoperative values (P < .01), but not in patients in the control group (Tables III and IV).

**Number of incompetent perforating veins interrupted.** This operative protocol interrupted 3 to 14 (mean, 7) incompetent perforating veins per patient. More incompetent perforating veins were observed in the C6 group than in the C4 group, in general, but no statistical significance was determined. Duplex scanning enabled diagnosis of 3 to 8 (mean, 4) such veins, lower than the operative findings. Preoperative mapping was used routinely, but additional perforating veins greater than 2.5 mm in diameter found at surgery were considered incompetent and interrupted, perhaps accounting for the higher number, representing perforating veins missed at mapping. Usually, posterior deep compartment fasciotomy yielded 1 to 4 more incompetent perforating veins per patient, in addition to those observed within the superficial posterior compartment. It is noteworthy that some were 4 to 5 mm in diameter, yet were missed at duplex scanning.

**Complications.** The overall 30-day complication rate was 3%, mostly transient neurologic symptoms, eg, paralysis and dysesthesia, and the rest composed of wound dehiscence, cellulitis, infection, and hematoma. DVT occurred in two patients, with nonfatal pulmonary embolus in one. No compartment syndromes were observed. Subcutaneous emphysema was noted in 14 patients. Congestive heart failure requiring hospital treatment complicated 18 cases. No operative deaths occurred.
Cost-effectiveness. In the United States, 95% of the operations were same-day surgery. In Germany, it is customary to hospitalize the patient for 1 or 2 days, which skews cost comparisons, making analysis impractical. Hospital length of stay and readmission are recognized major cost factors associated with surgery. SEPS is a high-benefit, low-cost procedure with few complications and is well suited to the present economic environment. No definitive analysis was directed to this particular aspect of the study, and these statements represent our opinion only.

Patients lost to follow-up. Except for the late 8 deaths, all cardiac related, it was difficult to ascertain the exact attrition rate in this multiple-center study. Up to 2 years postoperatively, compliance was excellent. Life table analysis for the C6 group still at risk is presented in the Figure. After 5 years, 60 patients underwent annual examination to 9 years. Four of the late deaths (3, myocardial infarction; 1, congestive heart failure) occurred in this time period. It was difficult to ascertain the cause of death. None experienced recurrent ulcer. Life table analysis was not feasible for the C4 and C5 groups because of ill-defined end points, according to our statistician.

DISCUSSION

This retrospective clinical study assessed safety, efficacy, and durability with limited hemodynamic data. We evaluated our operative technique in addressing two major factors that contribute to venous hypertension. If our hypothesis—that abnormal hydrostatic forces in the superficial venous system and hydrodynamic reflux in the perforating vein system are significant pathologic forces—is accepted, it is not unreasonable to accept our operative protocol objectively of addressing both factors to optimize results.

In 832 patients with advanced CVI, we noted a complication rate of 3%, establishing an acceptable range of safety. We observed an overall effectiveness of 86% in the C4, C5, and C6 groups, with durability to 9-year follow-up. In addition, 25 of 96 patients (28%) in whom ulceration failed to heal or who had recurrent ulcer underwent repeat SEPS with a successful outcome (healing).

Our study design reflects our bias and contention that correction of perforating vein reflux is pivotal to successful healing of venous stasis ulceration and to prevention of recurrence. This positive outcome occurred in most patients, with only 8% with an healed ulcer and 4% experiencing recurrent ulcer. While a prospective randomized study design addressing superficial venous reflux and perforating vein reflux separately and in combination would be ideal, it was not possible or practical. Lack of funding, government and private reimbursement deficiencies, and disparate clinical research restraints and policies rendered only a clinical study possible.

Since beneficial results were achieved in almost 9 of 10 patients, we offer our operative protocol as an interim strategy until level I evidence becomes available. At that time, a definitive statement regarding what constitutes optimal surgery for advanced CVI will be possible. Meanwhile, the decades old controversy will persist relative to the extent to which source of reflux in each venous system contributes to venous hypertension leading to CVI. A recent review of the literature by Tassiopoulos et al1 noted superficial venous reflux in 88% of patients with venous ulceration (C5, C6), while reflux in the deep system was observed in only 12%. Isolated saphenous vein incompetence with reflux was reported in 45%. Convincing perforating vein reflux data were limited in this review of 13 studies involving 1249 ulcerated limbs. In the 250 cases reported, perforating vein reflux was generally associated with superficial or deep vein incompetence (n = 232, 82%).

In contrast, in all 832 patients in our study perforating vein reflux was documented at duplex scanning, with venous ulceration (C5, C6) in 532 patients (64%). Association of perforating vein reflux with superficial venous reflux was noted in 460 patients (55%), and DVI was found in 237 patients (28%). The combination of both superficial and deep reflux with perforating vein reflux was observed in 45 patients (5%). Isolated perforating vein reflux was present in 90 patients (10%). The striking disparities and wide variance in these clinical observations compared with the recent comprehensive review of the literature4 demonstrates the difficulty of attempting to solve the controversy regarding the relative contribution of each respective venous reflux component, much less answer the question of what constitutes optimal therapy. Significant geographic differences in our study complicated comparisons. Although reasonable uniformity of treatment was attempted by preceptorship and shared operative strategy, our review is subject to flaws of vascular registries. Therefore it is difficult to show a definitive causal relationship between the data we collated and analyzed and the clinical effectiveness of the surgical intervention we advocate.

Table III. Preoperative and postoperative venous recovery time

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<tr>
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<th>VRT (s)</th>
<th>Post-VRT (s)</th>
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<tr>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Conventional</td>
<td>10.8 ± 8.9</td>
<td>19.6 ± 13.8</td>
</tr>
<tr>
<td>Endoscopic surgery (SEPS)</td>
<td>11.8 ± 4.0</td>
<td>34.4 ± 10.3</td>
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Significant improvement of VRT to normal in SEPS group (P < .02).

Table IV. Preoperative and postoperative ambulatory venous pressure

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<tr>
<th></th>
<th>AVP</th>
<th>Decrease (%)</th>
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<tbody>
<tr>
<td></td>
<td>Mean ± SD</td>
<td>Mean ± SD</td>
</tr>
<tr>
<td>Conventional</td>
<td>38.7 ± 16.3</td>
<td>32.5 ± 39.0</td>
</tr>
<tr>
<td>Endoscopic surgery (SEPS)</td>
<td>43.2 ± 15.7</td>
<td>65.2 ± 35.5</td>
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</table>

Significant decrease in AVP postoperatively in SEPS group (P < .01)

AVP, Ambulatory venous pressure; SEPS, subfascial endoscopic perforating vein surgery; SD, standard deviation.
More than a decade ago, Zukowski et al\textsuperscript{10} observed a linear relationship between venous hypertension and severity of venous ulceration with the number of incompetent perforating veins. While there are proponents of the role of perforating vein reflux\textsuperscript{11-13} others question its importance.\textsuperscript{14,15} Our clinical observations put us in the school of thought of Zukowsky et al, suggesting a major role for perforating vein reflux. Our pragmatic operative strategy is directed to this causative factor. This approach appears reasonable. Technologic advances make it feasible.

Duplex US scanning enables assessment of all variables of CVI, allowing the surgeon to specifically target the source of the reflux. In this series all 832 patients had perforating vein reflux. Therefore SEPS was performed in all, and 55\% underwent saphenous vein reflux ablation. The paradigm for treatment in patients with concomitant DVI (28\%) was the same, accepting perhaps a higher failure rate. We noted a significant disparity in incompetent perforating veins mapped (mean, 4) with those found at surgery (mean, 7). This observation emphasizes the importance of the knowledge of surgical anatomy, and a caveat to not rely solely on duplex scan mapping.

Anatomic studies show that approximately a third of perforating veins in the lower leg are located in the posterior deep compartment\textsuperscript{16}. This provides a rationale, if not an imperative, for SEPS to routinely include posterior deep compartment fasciotomy to maximize perforating vein interruption. We observed 1 to 4 incompetent perforating veins per patient in the posterior deep compartment. Failure to take down the paratibial fascia could result in missed incompetent perforating veins and not enhance the likelihood of a satisfactory outcome. Balloon dissection in the superficial posterior compartment facilitates perforating vein identification, especially distal to the malleolus, and is recommended as an atraumatic, time-saving, expedient adjunct to SEPS.\textsuperscript{6} The learning curve is short and may obviate difficult malleolar dissection. The majority of incompetent perforating veins are located in the superficial posterior compartment. The number of perforating veins interrupted in the series (mean, 7), compared with that in the literature (mean, 4), is attributed to attention to these details in technique. Preoperative mapping, while helpful, may miss more than a third (4 vs 7) of incompetent perforating veins, in our experience, and may be omitted by experienced surgeons.

The old adage that experience is the best teacher has some merit, especially if the outcome is positive. Overall, a good result was attained in 86\% of patients. In a subset of randomized patients in the C4 group, venous filling time returned to normal in the SEPS subset, with a statistically significant reduction in AVP. This is a strong objective indication of the effectiveness of reflux surgery. However, additional solid scientific evidence is necessary to evaluate our clinical observations and further assess the effectiveness of our strategy for correcting reflux in both the superficial and perforating venous systems. Our data suggest it optimizes reduction in venous hypertension that contributes to CVI.

While we did not specifically analyze our data for cost effectiveness, most patients underwent same-day surgery, resulting in economic benefits that others have noted, eg, importance of shortened length of stay and reduced reli-
ance on chronic ulcer care. It is intuitive that combining superficial venous ablation, when documented, with SEPS may result in further savings by averting staged operations. Long-term, our strategy has proved durable, obviating hospital readmission and further care. Some may judge this treatment protocol as aggressive, but the positive outcomes reported in this review suggest that this approach may represent optimal surgery.

CONCLUSION

The efficacy, safety, and durability of this operative protocol have proved beneficial in our clinical experience with 832 patients over 9-year follow-up. After surgery, ulcers in 92% of patients in the C6 group healed, with a 4% recurrence rate, for an overall 88% satisfactory result. In the subset of 51 patients randomized to the C4 group, the 26 patients who underwent SEPS experienced a significant decrease in AVP, with return of VRT to normal, objectively supporting the effectiveness of reflux surgery in advanced CVI. Until definitive level I evidence is available, SEPS is advocated as optimal therapy for CVI.

REFERENCES


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