

Subfascial Endoscopic Perforator Surgery: New Life for an Old Procedure?

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ABSTRACT

Background: Division of incompetent perforating veins has long been regarded as an appropriate approach for treatment of venous stasis ulcers. The development of endoscopic techniques using standard laparoscopic instrumentation has permitted the application of this therapy without the need for long open incisions, fraught with complications.

Methods: We report our experience with 20 cases of subfascial endoscopic perforator surgery (SEPS) in 19 patients. Seventeen limbs had active ulceration at the time of operation. A gas insufflation technique with two 10 mm ports was used in most cases.

Results: An average of four perforating veins were divided in each case. Mean operating time was 1.5 hours. At a mean follow-up of eight months, initial complete healing occurred in 14 of 17 ulcers, three ulcers improved, and three healed ulcers at the time of SEPS have remained healed. One patient developed a small area of recurrent ulceration after initial healing. There were no thromboembolic complications. One procedure was technically unsuccessful because of morbid obesity. One patient developed a wound infection, and one patient required re-exploration for a subfascial hematoma.

Conclusion: SEPS is a safe, minimally invasive procedure which should become an important part of the surgical armamentarium in treating patients with venous ulcers.

Key Words: Subfascial endoscopic perforator surgery, Venous ulcer, Minimally invasive.

INTRODUCTION

The prevalence of venous ulceration due to chronic venous insufficiency has been estimated to be approximately 0.1 to 0.3%.¹ In addition, for each patient with frank ulceration, there are up to 30 patients with lipodermatosclerosis.² The management of ulceration associated with chronic venous insufficiency remains difficult, frustrating and associated with high failure rates. Cutaneous venous hypertension which occurs as a consequence of primary valvular incompetence in up to 60% of patients,³ deep venous obstruction, or a combination of both, results in a series of cutaneous manifestations which, in their most severe forms, results in skin breakdown over the medial malleolus.

Although superficial stripping, deep venous valve repair and valve transfer all have their advocates, the mainstay of therapy has remained mechanical compression. External elastic stockings, worn by compliant patients, contributes to ulcer healing in 85% of cases.⁴ However, compliance is difficult to obtain in the elderly and infirm, due to difficulty in applying the stockings as well as poor compliance in hot climates.

Therefore, there is clearly a role for a procedure which can promote ulcer healing and minimize recurrence. Subfascial endoscopic perforator surgery (SEPS) may represent such a procedure. In this manuscript we report our initial experience with 20 cases at the Emory University Hospital and the Atlanta Veterans Administration Hospital.

PATIENTS AND METHODS

Patients were selected for this procedure because of their history of chronic venous insufficiency. Their basic demographics are described in **(Table 1)**. Operations were performed on 20 limbs in 19 patients. Seventeen patients had an active ulcer, which had been refractory to conventional therapy attempts such as compression and superficial stripping alone. Relevant previous medical history is given in **(Table 2)**. Three patients had recently healed ulcers, but had been treated for periods in excess of four months. Thirteen patients were evaluated using ascending and descending venography **(Figure 1)**. Fifteen patients had color flow duplex scanning performed. There was reflux

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Table 1.
Patient Statistics

N=19 (17 Males, 2 Females)
❖ Mean Age = 44
❖ Limbs Treated = 20
❖ Indication
- Active Ulceration = 17
- Healed Ulcer = 3

Table 2.
Relevant Medical History

❖ History Deep Vein Thrombosis N=16
❖ Prior Venous Interventions
- Greater Saphenous Vein Stripping N=2
- Axillary Valve Transfer N=1
- Stab Avulsions N=5
- Split Thickness Skin Graft N=4

alone identified in the superficial and deep system in four patients, while 15 patients had a combination of reflux and deep venous obstruction.

SURGICAL TECHNIQUE

The patients are placed supine on the operating table and their pulses are marked. After prepping and draping the entire affected extremity, an Esmarch bandage is tightly applied and a sterile tourniquet is inflated high up on the thigh. The Esmarch bandage is then removed. During draping, the ulcer-bearing skin is covered with an Ioband, followed by an extremity drape.

The first four patients in the series were treated using a mechanical retractor system (Snowden Pencer; Marietta, GA) (**Table 3**). Because of the better visualization and easier access afforded by the use of an insufflation technique, the latter is now exclusively used and will be described below.

A 10 mm diameter forward-looking endoscope is laid on the leg, ensuring that the proposed level of port placement allows the scope to reach below the ulcer level. A 13 mm skin incision is then made 3 cms from the medial margin of the tibia. The 10 mm Optiview port (Ethicon Endosurgery; Cincinnati, OH), with the scope inserted, is then placed through the skin incision and the monitor continuously observed. The Optiview port is then rotated until the subcutaneous fat is observed to give way to the white fascia. The fascia is then divided by rotating the Optiview back and forward. The white fascia can be clearly seen to part, exposing the underlying muscle. At this point the subfascial space has been entered. The Optiview is angled toward the patient's foot and advanced into this space. The Optiview allows a very small fascial opening to be created, maintaining the gas seal and permitting rapid instrument exchanges, without displacing the cannula. The scope and inner cannula are removed, and CO₂ insufflated to 30

mm/Hg pressure. The scope is then re-inserted through the port. Movement of the scope from side to side will open the space sufficiently to allow placement of a second port under direct vision, 5-10 cms posterior to the first port (**Figure 2**).

Endoscissors are inserted through the second port and the subfascial space is easily opened by sharp dissection of all the bridging fascial bands. Large perforating veins can be readily identified, clipped and divided (**Figure 3**) within the superficial posterior compartment. Dividing the perforating veins further opens the space, permitting more distal visualization and dissection.

The space is opened from the medial tibial border to the midline posteriorly and from the level of the port, to as far distally as dissection can comfortably proceed (generally 2-3 cms above the medial malleolus).



Figure 1. Ascending venogram, demonstrating filling of the greater saphenous vein (larger arrow) via incompetent perforating veins (small arrows).

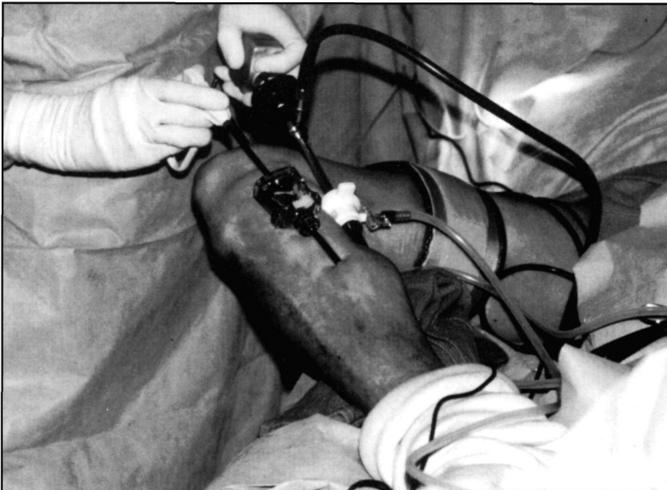


Figure 2. Port location for performing SEPS. The first is placed 3 cms from the medial border of the tibia. The second is placed 5-10 cms from the first at approximately the same level.

An extension of fascia frequently extends from the tibia to the deeper fascia which can conceal perforating veins. For this reason, the paratibial fossa should be opened sharply so that additional perforating veins can be divided in the deep posterior compartment. Caution must be observed so that the posterior tibial artery and veins and the tibial nerve are not damaged during this part of the procedure.

At the completion of the procedure, the ports are removed, the fascial defects are left opened and the skin incision closed using absorbable suture. An elastic bandage is applied to the leg from the foot, prior to deflating the tourniquet.

RESULTS

Mean operating time was 1.5 hours. The average number of perforators divided was 4.2. Mean hospital stay was 1.5 days and adjunctive procedures included stripping of the saphenous vein (N=4), and split thickness skin graft (N=4).

Table 4 summarizes short-term outcome. With a mean follow-up of eight months, there was complete healing in 14 of 17 ulcers and partial healing in 3 of 17 ulcers. One ulcer which was initially healed has had subsequent partial breakdown. Three patients with healed ulcers at the time of SEPS have remained healed. All patients were encouraged to wear 35-45 mm/Hg compression stockings.

No thromboembolic complications occurred. There were two complications noted: one wound infection consisting of cellulitis around a port site and one subfascial hematoma. The latter required return to the operating room for evacuation of the hematoma. Bleeding was controlled



Figure 3. After creating the optical cavity, a larger perforating vein bridging from the underlying gastrocnemius muscle (arrow) to the fascia above has been clipped and is about to be divided.

with balloon tamponade. In one patient with an obese thigh, inflow occlusion could not be achieved using the tourniquet; therefore, the endoscopic procedure could not be completed. Perforator interruption was performed, using a malleable retractor inserted through the port sites into the subfascial space.

DISCUSSION

Despite the rapid advance of endoscopic-based techniques in most surgical specialties, vascular surgery has remained relatively apart in the application of this technology. Recently, however, with the description by our group of endoscopic saphenous vein harvest,^{5,6} of endoscopic aorto-bifemoral bypass⁷ and now with the advent of subfascial endoscopic perforator surgery, video-endoscopic procedures are becoming increasingly popular in vascular surgery. SEPS represents a safe, easily mastered technique for the vascular practitioner to enter the endoscopic world.

Table 3.
Methods

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| <p>❖ Mechanical retractor system N=4</p> <ul style="list-style-type: none"> - Snowden Pencer (Marietta GA) - single incision - short reach |
| <p>❖ Insufflation Technique N=16</p> <ul style="list-style-type: none"> - 2 ports - thigh tourniquet |

Table 4.

Results

N=20

(mean follow-up=8 months)

- ❖ Initial complete ulcer healing = 14
 - maintained healing = 13
 - recurrent skin ulceration = 1
- ❖ Improved ulceration = 3
- ❖ Maintained preoperative healed ulcer = 3

Perforating veins connect the posterior arch vein to the posterior tibial vein. They usually have unidirectional valves, which during calf muscle diastole promote flow of blood from the superficial to the deep venous system. In patients with deep venous obstruction or incompetence of the deep venous valves, flow reversal may occur, leading to venous hypertension. A second mechanism of venous hypertension is simple superficial reflux. This may be easily corrected by stripping the greater saphenous vein and should always be sought. Regardless of the cause, venous hypertension is thought to create increased capillary pressure that leads to edema, fibrosis, hypoxia, and ultimately skin breakdown.^{8,9} Stagnant capillary blood has also been hypothesized to cause white blood cell trapping and activation which adds to the inflammation.¹⁰

Linton proposed that those patients with perforator incompetence could be treated by directly dividing the offending perforators.¹¹ Unfortunately, in order to achieve this goal, a long incision through the medial skin from knee to the medial malleolus was necessary. Perforators could then be identified below the fascia and divided. In concept, the procedure was sound. On average, 85% of patients enjoyed ulcer-free recurrence in the long term.⁴ However, wound-related complications such as infection, flap necrosis, and delayed healing occurred in 17% of patients and caused the procedure to fall into disfavor.⁴ Although several modifications of the Linton procedure have been developed to minimize wound morbidity such as the posterior stocking seam incision¹² and parallel oblique incisions,¹³ it was not until the development of minimally invasive procedures, which permitted small remote incisions to be created, that the procedure began to be re-evaluated.

Hauer in Germany used a mechanical system for endoscopic subfascial surgery and, to date, has the greatest experience.¹⁴ O'Donnell, in the United States, employed saline infusion (due to concerns of CO₂ embolization) in the subfascial space to create an adequate optical space.¹⁵ More recently, Gloviczki, in the United States, employed CO₂ insufflation.¹⁶ Renewed enthusiasm was heralded due

to the increasing technical ease, associated with CO₂ insufflation, and this was the technique used for most cases in our series.

The patients most appropriately treated with SEPS include those with active ulcers, recurrent ulcers, or healed ulcers which were present for greater than four months. The underlying pathophysiologic process can be best defined using color flow duplex scanning. This procedure will document the presence of deep venous obstruction and superficial and deep venous reflux as well as localize perforating veins and determine their competency. Of note, perforator vein incompetence can be demonstrated in 15% of patients without lipodermatosclerosis.¹⁷ Thus, the exact relationship between venous ulceration and incompetent perforating veins requires further study.

The authors would synchronously treat superficial reflux by stripping while also performing SEPS, if perforator competence was also documented. Venography is an uncomfortable procedure which is not strictly required to plan subfascial perforating vein surgery if incompetent perforators can be documented with duplex examination. If desired, the surgeon may perform an ascending venogram with a C-arm in the operating room to mark the perforating veins just prior to the procedure.

Port position for SEPS is determined by laying the scope on the leg and ensuring adequate "reach" to the ulcer bed. We use either an Optiview (Ethicon Endosurgery; Cincinnati, OH) or a Visiport (Auto Suture Company, Norwalk, CT). By virtue of their cutting ability, these ports permit a very tight fascial seal, minimizing air leaks which can develop with the high insufflation pressures (25-30 mm/Hg) employed.

We created the optical space by a combination of blunt dissection with the scope and sharp dissection with scissors, alternately a linear extrusion balloon (General Surgical Innovations, Inc., Palo Alto, CA) can be employed. Having dissected the subfascial space, it is important to open the paratibial fascia in order to identify those veins passing superficially from the deep posterior compartment.

A potential Achilles heel of the procedure may be the limited distal access which is due to the tight confines of the subfascial space as one approaches the ankle. In our experience, the distal limit of the dissection is approximately 2-3 cms above the medial malleolus. Infra-malleolar access (an occasional perforator site) requires a separate incision.

Our series included one patient who developed a large, painful subfascial hematoma and required return to the operating room. This complication was managed by evac-

uating the hematoma through the fascial port sites and inserting two 18 Fr. Foley balloons into the subfascial space with stylettes for temporary balloon tamponade. Although we think that the hemorrhage may have been due to an unclipped perforator vein, SEPS involves opening the paratibial space to expose perforating veins originating from the deep posterior compartment. Thus, the posterior tibial artery and vein as well as the tibial nerve have the potential for injury.

Recently, the North American Subfascial Endoscopic Perforator Study (NASEPS) was conducted.¹⁸ This multicenter study on endoscopic perforator interruption reviewed complications and early efficacy in 158 cases. The overall incidence of wound infection was 6%. Neuralgia following SEPS and saphenous vein stripping occurred in ten patients. The concern of creating further thrombotic or embolic complications by performing procedures in patients with a history of deep venous thrombosis was also addressed. There was no evidence of deep venous thrombosis or pulmonary emboli within the first 30 days of the procedure. Of patients with active ulceration at the time of surgery, 79% achieved ulcer healing at 180 days.

CONCLUSION

In conclusion, SEPS represents a promising new approach to ulcer management in patients with perforator incompetence. This procedure is associated with minimum morbidity and can be performed on an outpatient basis. Continued evaluation within the NASEPS committee is warranted, particularly focusing on the incidence of recurrent ulceration and determining the ultimate standard evaluation of ulcer therapy.

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