Recurrent Varicose Veins

Part 2: Injection of Incompetent Perforating Veins Using Ultrasound Guidance

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Treatment options following duplex evaluation of recurrent varicose veins are discussed and a method of injecting incompetent perforating veins using ultrasound guidance is described. The results of duplex evaluation 6 months postinjection using this technique are presented. These early results indicate that sclerosant injection employing ultrasound guidance is an effective and safe method of treating incompetent perforating veins. [J Dermatol Surg Oncol 1992;18:895-900.]

Although inadequate evaluation and surgical techniques are common causes of recurrent varicose veins, new varices may develop after technically correct surgery.1 In many areas of surgical practice operative procedures are regarded by the doctor and patient as curative. This certainly does not apply to varicose vein surgery; many patients having experienced one apparently unsuccessful procedure are reluctant to undergo another. These patients often look to sclerotherapy, which offers a less traumatic procedure with minimal, if any interruption to their normal daily activities. If compression sclerotherapy is preferred by patient and clinician, precise functional and anatomic diagnosis of areas or points of reflux is essential. Duplex evaluation of recurrent varicose veins is well accepted as a reliable and safe method of assessment, especially in the detection of sources of reflux from the deep system.2,3

Following duplex evaluation a rational decision can be made concerning optimal management. These management decisions will vary between practicing phlebologists according to their particular expertise. If there is a significant communication greater than 4 mm in diameter with reflux from the common femoral vein re-exploration of the groin may be required. Persistent varicose tributaries without evidence of reflux from the deep veins can be treated with compression sclerotherapy.4 The alternative surgical approach is to remove the varicose tributaries by the stab avulsion or Müller technique.1,5-7 Frequently recurrences are associated with incompetent perforating veins.2,4 If incompetent thigh, posterior tibial, or gastrocnemius perforating veins are found a decision must be made concerning whether further surgery or, alternatively, sclerotherapy should be recommended.

Surgical searches for incompetent perforating veins can be frustrating and futile. Recurrences fed by long narrow perforating veins are difficult to find at operation with the patient lying flat, and sclerotherapy has been recommended in these situations.9 However, often there is not an obvious varicosity lying over the incompetent perforating vein5 and while venography has been used to localize incompetent perforating veins before surgery, ultrasound localization is more practical if sclerotherapy is to be used. Similarly, ultrasound localization can be utilized prior to surgery to accurately determine the site of incompetent perforating veins.

Studies of surgical interruption of incompetent posterior tibial perforating veins have been confined to management of chronic venous ulcers. Reported results have been poor with recurrent ulcers forming in 40-55% of patients within 5 years.10-12 Åkesson13 has been unable to show any improvement in venous function following perforating vein ligation in patients with deep venous insufficiency and the long incisions down the medial aspect of the leg and the stocking-seam line incisions down the back of the leg risk interrupting the cutaneous arterial blood supply, thereby further impairing the cutaneous circulation.5,13,14

The authors are not aware of any studies on the effectiveness of sclerotherapy for lower leg perforator disease. However in his comparative study of surgery and sclerotherapy in the treatment of varicose veins, Hobbs15 concluded that incompetent lower leg perforating veins were best treated with injection-compression. The Fegan16 method of compression sclerotherapy requires localization of incompetent perforating veins by palpation followed by injection of sclerosant into the adjacent superficial vein while the limb is elevated to empty the vein.
The aim of this prospective study was to determine the injection of incompetent perforating veins is attempted. However, the accuracy of clinical examination in locating incompetent perforating veins has been found to be around 50%. Second, Fegan's method of sclerosing incompetent perforating veins depends on a “relatively” uncontrolled spreading phlebitis from the adjacent injected superficial varicosity. It is therefore likely that inadequate sclerosis of incompetent perforating veins by this technique contributes to the high 5-year recurrence rate. B-mode ultrasound localization and subsequent direct injection of the incompetent perforating vein under ultrasound guidance theoretically should improve the long-term success rate of compression sclerotherapy and reduce the incidence of inadvertent intra-arterial injection that can occur when “blind” injection of incompetent perforating veins is attempted. The aim of this prospective study was to determine the effectiveness of sclerosant injection to incompetent perforating veins using ultrasound guidance.

Materials and Methods

Thirty-six patients (38 limbs) with incompetent perforating veins were treated with sclerosant injection of incompetent perforating veins using ultrasound guidance. There were 31 females and 5 males with a mean age of 54 years (range 27 to 78). A total of 43 incompetent perforating veins were injected. There were 12 incompetent thigh perforating veins, 13 incompetent gastrocnemius or soleus perforating veins, and 18 incompetent posterior tibial perforating veins. The duplex scanner used was an ATL Ultramark 4 (Advanced Technology Laboratories, Bothel, NJ) with a multifrequency sector scanhead.

The patients were positioned in the semi-reclining position with the legs extended. For incompetent perforating veins on the medial aspect of the thigh and calf the leg was externally rotated and abducted at the hip. The semi-reclining position dilated the veins slightly thereby assisting ultrasound visualization. For perforating veins on the posterior calf or thigh the patient was positioned in the prone position with the head of the treatment couch slightly raised and the foot supported by a pillow so that the knee was flexed slightly. (This position can also be used for injection of the short saphenous vein.)

The vascular sonographer located and measured the diameter of the incompetent perforating vein and the depth from the skin surface to the segment of incompetent perforating vein immediately beneath the muscle fascia, which was the usual site of injection (Figure 1). The incompetent perforating vein was imaged in a sagittal plane and the transducer held perpendicular to the skin. The 10-MHz imaging frequency was selected for this procedure. The cylindrical multifrequency sector transducer used on the ATL Ultramark 4 has a vertical line down the transducer that aligns with the sagittal plane. This allowed the physician to guide the needle accurately along the axis of the transducer. Twenty-three-gauge Terumo needles (Terumo, Melbourne, Australia) have been found to be suitable for this purpose as their tip is ultrasound reflective. A high quality 2-mL plastic syringe (Becton Dickinson, Singapore) loaded with 1 mL of sodium tetradecyl sulphate 3% (STD; STD Pharmaceuticals, Hereford, England) was attached to the needle. When the skin was pierced along the line of axis of the transducer the needle tip could be visualized.

As the needle was slowly inserted, it appeared as a reflective straight line angling towards the perforating vein (Figure 2). (It is important to verify early in the procedure of needle insertion that the needle is being introduced in the correct sagittal plane, ie, the needle and vein must be imaged simultaneously at all times.) If the needle moved off axis the sonographer localized the needle tip in relation to the perforating vein and informed the clinician in which direction (anterior, posterior, medial, lateral) an adjustment of needle plane insertion was to be made. As the needle tip contacted with the perforating vein an indentation was seen on the vein wall (Figure 3). At this stage a little extra pressure was required to pierce the vein wall and when this occurred the needle tip could be seen within the lumen and a small amount of blood was withdrawn in the needle hub.
Figure 2. B-mode ultrasound image of needle angling towards incompetent perforating vein (IPV). The angle of insertion is determined by measuring the depth of proposed injection site on the ultrasound image prior to needle insertion. The needle and the incompetent perforating vein should be imaged simultaneously throughout the procedure.

A small volume (≈0.1 mL) of sclerosant was then injected and, providing the needle tip was still located in the vein, sclerosant was seen on the ultrasound image to be flowing into the vein (Figure 4). If any of the solution appeared to be collecting outside the vein wall the injection was stopped until the needle tip was again sighted within the vein lumen. During injection the direction of flow of sclerosant could usually be determined and digital pressure was applied proximal or distal to the injection site to ensure that the sclerosant acted on the selected segment of vein. The volume of sclerosant injected was 0.5 to 1.0 mL depending on the incompetent perforating vein length and diameter. Within several minutes of injection the incompetent perforating vein would spasm and become indistinct on the B-mode image, indicating a successful injection (Figure 5).

Immediately following injection a foam pad (C Pad; STD Pharmaceuticals, Hereford, England) was placed over the injection site and firmly held in place by a low-stretch crépe bandage. Additional graduated venous compression with a Class 3 (40 to 50 mm Hg at the ankle) compression stocking (Medi Forte; Medi Strumpf, Bayr-

Figure 3. B-mode ultrasound image of reflective needle tip indenting vein wall immediately prior to vein puncture.

Figure 4. B-mode ultrasound image of needle located in vein with sclerosant flowing towards the right of image.

Figure 5. Postinjection B-mode image of incompetent perforating vein (IPV). There is spasm of the incompetent perforating vein which is now indistinct.
Figure 6. B-mode ultrasound image and pulsed Doppler spectral display of 4-mm diameter thigh incompetent perforating vein prior to injection. SFA = superficial femoral artery; SFV = superficial femoral vein.

Results

Two incompetent thigh perforating veins, three incompetent posterior tibial perforating veins, and one incompetent gastrocnemius perforating vein required repeat injections. Of these, one posterior tibial perforating vein remained incompetent at the 6 month follow-up evaluation. The 6 month follow-up results are shown in Table 1. Sixteen treated incompetent perforating veins classified as successful at 6 months have been followed up over 12 months. The ultrasound results in these patients at 12 months did not differ from the 6 month results and it can therefore be inferred that treatment failure will be detected in the first 6 months when using this protocol. There were no complications reported by the patients or detected on follow-up in this study.

Discussion

Six month follow-up results of injection of incompetent perforating veins under ultrasound guidance indicate that the procedure will become a worthwhile supplementary method in the treatment of varicose veins and especially in the management of recurrent varicose veins. The method eliminates several of the uncertain variables of compression sclerotherapy by accurately localizing the incompetent perforating vein and allowing precise injection of the point of reflux. We have applied the method to injection of incompetent thigh, posterior tibial, and gastrocnemius perforating veins, as well as impalpable, incompetent short saphenous veins and impalpable incompetent recurrent thigh tributaries following the stripping operation. In addition to postsurgical recurrences, this procedure has been used in the treatment of recurrences...
Figure 7. B-mode ultrasound image and pulsed Doppler spectral display of thigh incompetent perforating vein shown in Figure 6, 7 weeks following injection. The incompetent perforating vein is now an incompressible cord measuring 2 mm in diameter with no recordable flow.

following compression sclerotherapy when duplex imaging has revealed inadequate sclerosis of incompetent perforating veins. In most cases the procedure has resulted in rapid subsidence of patient symptoms with absence of thrombophlebitis, which can develop with Fegan's method. The best results have been achieved with injection of incompetent gastrocnemius perforating veins. Treatment failures when injecting incompetent thigh perforating veins could be attributed to technical difficulty in accurately locating small incompetent perforating veins more than 2.5 cm beneath the skin. Treatment failures when injecting incompetent posterior tibial perforating veins were most likely because of the type and concentration of sclerosant used. Theoretically, poliodinated iodine (which is not approved for use in Australia) should give more consistent results when injecting distal calf incompetent perforating veins because of its more localized, potent action on venous endothelium compared with sodium tetradecyl sulphate.

Complications, such as deep vein thrombosis, pulmonary embolus, or inadvertent intra-arterial injection have not occurred when injecting incompetent perforating veins. However, there has been one case of intra-arterial injection when injecting a symptomatic 3-mm diameter incompetent short saphenous vein receiving reflux from an incompetent Giacomini vein. There was no sapheno-popliteal junction in this patient and a cutaneous branch of the popliteal artery was injected in the popliteal fossa. This resulted in a 5 × 5 cm area of skin necrosis that healed in 3 months using hydrocolloid occlusive dressings. Despite this, the Giacomini vein and short saphenous vein were successfully sclerosed by the procedure and the patient was asymptomatic after the ulcer healed. We have since modified the technique to avoid this complication. We now scan with pulsed Doppler for arterial signals along the line of needle approach and around high risk sites such as calf perforating veins and the short saphenous vein in the popliteal fossa. If an arterial signal is detected the needle approach is modified to avoid any risk of intra-arterial injection. This incident highlights the need for extreme diligence in performing each injection and the technique should only be undertaken by a skilled vascular technologist and an experienced sclerotherapist.

There is need for further refinement of the procedure, which is often technically difficult, and development of a needle guide probe attachment to aid precise localization of the needle tip at a depth of 0.5 to 3.0 cm from the skin surface.

Table 1. Injection of Incompetent Perforating Veins, Using Ultrasound Guidance

<table>
<thead>
<tr>
<th>Location</th>
<th>IPV (N)</th>
<th>Mean Age</th>
<th>Successful at 6 Months (N [%])</th>
</tr>
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<tbody>
<tr>
<td>Thigh IPV</td>
<td>12</td>
<td>50</td>
<td>10 (83)</td>
</tr>
<tr>
<td>Gastrocnemius IPV</td>
<td>13</td>
<td>48</td>
<td>13 (100)</td>
</tr>
<tr>
<td>Posterior Tibial IPV</td>
<td>18</td>
<td>61</td>
<td>13 (72)</td>
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</tbody>
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References

1. Bergan JJ. The role of surgery in treatment of varicose veins and venous telangiectasias. In Goldman MP, ed. Sclero-


