There is the need to develop a universally accepted standard investigation for recurrent varicose veins. Duplex venous imaging offers a precise, non-invasive technique to make anatomic and hemodynamic diagnoses. A routine protocol of duplex imaging of recurrent varicose veins is described based on the known recurrent sources of reflux from deep to superficial veins. Results from this protocol indicate that incompetent perforating veins are the most common site of reflux from deep to superficial veins in patients with recurrent postsurgical varicose veins. Other important sites of reflux detected by this method are recurrent communications with the common femoral vein, the saphenopopliteal junction, and incompetent pelvic veins. Duplex imaging is recommended as a safe, non-invasive method of evaluating recurrent varicose veins.


Varicose veins that recur after treatment remain one of the greatest challenges facing modern phlebology practice. The 5-year recurrence rate after surgery is around 50% and for compression sclerotherapy around 90%. Despite continuing developments in surgical technique since the stripping operation was first introduced there has been little evidence of improvement in the recurrence rate. There has been optimism that newer methods of assessment will result in reduction in recurrence but it is likely that the 5-year recurrence rate will remain high because of the relentless natural progression of varicose disease.

Early recurrence within 6 months of surgery is generally owing to incomplete surgery or incorrect diagnosis. Prior to the establishment of routine Doppler assessment as an essential preoperative investigation, undiagnosed short saphenous vein incompetence was frequently a cause of early recurrence. Richardson and Beckwith stressed the importance of undiagnosed or untreated residual vulval or buttock varicose veins of pregnancy as a common cause of early recurrence. Undiagnosed deep venous incompetence and soleal arch compression were other causes noted by Juhan et al. Thorough clinical and non-invasive examination prior to treatment will help avoid early recurrences such as these. There are four common sources of reflux associated with late recurrence of varicose veins after 6 months: 1) recurrence of significant reflux at the saphenofemoral or saphenopopliteal junctions because of neovascularization or inadequate ligation; 2) incompetent thigh or calf perforating veins; 3) incompetent gastrocnemius veins; and 4) persistent varicose tributaries or duplication of the long saphenous vein in the thigh. The ideal method of investigation of recurrent varicose veins should be capable of diagnosing all of the above recognized entities.

Current Methods of Investigating Recurrent Varicose Veins

In the investigation of recurrent varicose veins, good correlation has been found between operative findings and continuous-wave Doppler ultrasound, ascending phlebography, and popliteal phlebography or varicography. Limitations of continuous-wave Doppler ultrasound occur in the identification of individual incompetent perforating veins in the presence of large superficial varicosities resulting in many false positives. The other disadvantage of continuous wave Doppler ultrasound is that it does not demonstrate anatomy and therefore can only be complementary to anatomic studies. Ascending phlebography combined with clinical examination has reportedly given a diagnostic accuracy of 87% in localizing incompetent perforating veins, but phlebography has the risks of any other invasive technique including allergic reactions to the contrast material and thrombophlebitis. In addition, ascending phlebography is unable to localize accurately incompetent mid-thigh perforators or incompetent gastrocnemius veins. Varicography will give more accurate information in these areas but has a higher risk of thrombophlebitis. Duplex venous imaging overcomes the disadvantages of continuous-wave Doppler examination by providing detailed anatomic information and accurately localizing the...
site of reflux. Duplex imaging is a non-invasive examination that avoids the inherent risks of phlebography yet provides additional qualitative hemodynamic information. However, duplex imaging can be time consuming and requires a skilled vascular sonographer to obtain reliable information.

The aim of this study was to document the results of duplex imaging of patients with recurrent varicose veins following the stripping operation for long saphenous vein incompetence, using a set protocol of imaging designed to detect all known sources of recurrent varicose veins.

Materials and Methods

Seventy-six patients (122 limbs) with recurrent varicose veins following the stripping operation were evaluated using duplex imaging. There were 74 women and 2 men with a mean age of 49 years (range 26–72). Prior to scanning a history was obtained to ascertain whether the long saphenous vein or short saphenous vein had been stripped. If the patient had a groin incision it was presumed that the saphenofemoral junction had been ligated. Only those limbs with previous long saphenous vein ligation and stripping were entered into the study. Twelve of these limbs had also had previous saphenopopliteal junction ligation with or without stripping of the short saphenous vein. The duplex scanner used was an ATL Ultramark 4 (Advanced Technology Laboratories, Bothell, WA) with a multifrequency sector scanhead. Five megahertz, 7.5, and 10 MHz were available for imaging while the Doppler had a pulsed frequency of 3.75 MHz. The 10-MHz frequency was generally used to visualize superficial and perforating veins (with or without a “stand-off”), although 7.5 MHz was required for obese patients. The 7.5-MHz frequency was generally utilized for imaging deep veins and muscle veins. The protocol for duplex imaging of recurrent varicose veins was similar to that previously described for examining primary varicose veins.

The examination was commenced in the standing position as this resulted in hydrostatic pressure being applied to venous valves, which was necessary to demonstrate significant reverse flow. The standing position also dilated the veins, thereby enhancing ultrasound imaging. With the patient’s weight bearing on the opposite limb, the limb to be examined was abducted at the hip with the knee slightly flexed. The common femoral vein was imaged at the groin. If present, the saphenofemoral junction was located and investigated with Doppler. If the junction had been adequately ligated it was absent or occasionally there was a small “nub” where the long saphenous vein drained to the common femoral vein. If a superficial vein was located at the groin following a previous surgical ligation, imaging determined whether there was a persistent communication with the common femoral vein. Competence of recurrent veins in the groin was determined by imaging the vein in the sagittal plane and investigating with Doppler during calf and/or thigh compression and release. Reflux was designated by reverse flow greater than 10-cm per second for longer than 0.5 seconds on calf release. Frequently small superficial veins which could not be seen to join the common femoral vein were visualized at the groin. These were usually competent if less than 3-mm in diameter but sometimes dilated distal to the groin and became incompetent in the thigh. Incompetent veins draining from the pelvis were noted at this stage of the examination.

The thigh was then imaged for recurrent varicose tributaries, duplication of the long saphenous vein, and thigh perforating veins. A thigh perforating vein was located in two ways.

1. A superficial recurrent vein was visualized in the thigh and followed to determine its origin. If the recurrent vein or a vein communicating with the recurrent vein penetrated the muscle fascia to join the superficial femoral vein or popliteal vein, a perforating vein had been located.

2. In transverse section the superficial femoral vein was imaged in the groin and scanning distally any communicating veins from the superficial femoral vein or popliteal vein which perforated the muscle fascia were designated as perforating veins.

Posterior tibial perforating veins and gastrocnemius perforating veins were usually located by following a superficial varicosity and observing whether there were any tributaries which perforated the muscle fascia.

To assess for competence of perforating veins, the perforating vein was imaged in a sagittal plane and, with the “sample volume” placed in the perforating vein while in Doppler mode (Figure 1), the leg was manually compressed above and below the transducer. If bidirectional flow or flow from deep to superficial was detected, the perforating vein was said to be incompetent (Figure 2). The diameter of incompetent perforating veins as they perforated the muscle fascia as well as the site of the perforating vein in reference to landmarks such as the knee joint, medial malleolus of the ankle, and popliteal crease was then documented.

Finally, the posterior thigh, popliteal fossa, and posterior calf were examined. Occasionally incompetent deep muscular perforating veins from the posterior thigh were found to be the source of posterior leg varicosities. The popliteal fossa was examined to determine the location and competence of the saphenopopliteal junction and gastrocnemius veins were evaluated from the popliteal
Figure 1. The "sample volume" is the discrete region where blood flow is measured. Its position along the line representing the incident Doppler beam is indicated by a small square. IPV = incompetent perforating vein.

fossa to the mid-calf region. At this stage the short saphenous vein was also investigated with Doppler. Incompetence in the short saphenous vein can be secondary to saphenopopliteal incompetence, a communication with an incompetent gastrocnemius vein, or a communication from an incompetent branch of the long saphenous system.12

Results were recorded on an Apple Macintosh SE/30 (Apple Computer, Inc., Cupertino, CA) using Claris Filemaker II data base. For analysis, each limb was treated as an independent observation.

Results

It is useful to classify the pattern of distribution of varicose veins into those belonging to either the long- or short-saphenous systems.13 Although the long saphenous vein had been previously ligated and stripped to knee level or below in this group of patients, a similar classification was used in this study. Eighty-seven (71.3%) of limbs had recurrent incompetent superficial thigh veins in the long saphenous distribution. Forty (32.8%) limbs had incompetence in the short saphenous system. Twenty of these limbs had reflux at the saphenopopliteal junction. Twenty-three (18.9%) had reflux in both superficial systems. In the deep system 13 (10.7%) limbs had incompetence in the gastrocnemius veins and 8 (6.6%) limbs had incompetence in the superficial femoral vein and/or popliteal veins. Seventy-five (61.5%) limbs had incompetent thigh or calf (gastrocnemius/soleus and posterior tibial) perforating veins. The incidences of reflux at the various sites of deep to superficial communications are shown in Figure 3.

Discussion

The results of this study indicate that incompetent perforating veins are the most common source of reflux from the deep system in patients presenting with recurrent varicose veins following the stripping operation. However, there was also a significant incidence of reflux from recurrent communications with the common femoral vein, from the saphenopopliteal junction, and from incompetent pelvic veins, indicating inadequate or incomplete surgery and/or inadequate primary evaluation. Incompetent gastrocnemius perforating veins were the most frequent incompetent perforating veins encountered, although incompetent gastrocnemius veins within the muscle fascia were found in only 10.7% of limbs. In contrast, Juhan et al1 using phlebographic diagnosis found gastrocnemius vein incompetence in 20% of limbs previously treated surgically for long saphenous vein in-
competence. This may indicate that duplex imaging although sensitive to detection of incompetent perforating veins is less sensitive than phlebography in detection of gastrocnemius vein insufficiency. A comparative study is required to verify this.

It is reasonable to suggest that varicose veins recur because the primary etiologic factor has not been addressed by initial treatment. High recurrence rates after the stripping operation may be owing to incorrect assumptions on the etiology of varicose veins or inadequate surgical technique. Burnand et al. have shown that flush ligation of the long saphenous vein at the saphenofemoral junction appears to be more important than perforating vein ligation in reducing foot vein pressure on exercise. It is therefore a simple assumption that, because ligation of the long saphenous vein at the saphenofemoral junction normalizes foot pressure soon after operation, a primary abnormality of the saphenofemoral junction is the cause of the disease. In the situation of short saphenous vein incompetence this reasoning could similarly be applied to the saphenopopliteal junction. However, there is ample evidence to the contrary. In a detailed anatomic study of varicose veins, Cotton was unable to attribute their development to a descending incompetence originating at the saphenofemoral junction. A duplex study of cosmetic veins which was essentially a study of early varicose disease, indicated that an ascending pattern of incompetence was more common with the saphenofemoral junction becoming the ultimate secondary source of reflux. Lofgren et al. observed that with recurrent veins following surgical stripping, recanalization began distally and moved progressively in an upward direction when the ligation at the saphenofemoral junction had been performed satisfactorily. King and Thiery have also expounded the ascending nature of varicose disease albeit through different theories of causation but emphasizing the secondary source of reflux from the saphenofemoral junction precipitating symptom presentation.

The other major assumption of the stripping operation is that it will avulse incompetent perforating veins. This has proved to be an incorrect assumption as only one or two perforating veins (Hunterian and Boyd) communicate directly with the long saphenous vein. In particular, the posterior tibial perforating veins usually communicate directly with the posterior arch complex, which is not removed by the stripping operation. In addition, incompetent gastrocnemius perforating veins will not be removed by the stripping operation. Advocates of the stripping operation often postulate that the operation will result in a lower incidence of recurrence compared with saphenofemoral ligation alone because incompetent
Figure 3. Deep venous anatomy of the lower extremity showing the common recurrent sources of reflux. A) Recurrence at the common femoral vein (CFV) or saphenopopliteal junction (SPJ). B) Incompetent thigh or posterior tibial perforating veins (IPV = incompetent perforation vein). C) Incompetent gastrocnemius and gastrocnemius perforating veins. D) Incompetent pelvic veins refluxing into persistent varicose tributaries in the thigh.
thigh perforating veins will be removed by the procedure of stripping.\textsuperscript{1,2} The relatively high incidence of incompetent thigh perforating veins found in this study does not support this view. Instead, it is possible that the stripping operation may predispose to the development of incompetent thigh perforating veins by causing trauma to the Hunterian perforator during the procedure.

The incidence of incompetent perforating veins found in this study is significantly higher than that found in our previous study of early primary varicose disease.\textsuperscript{10} This finding conflicts with Fegan’s\textsuperscript{22} assumption that because a perforating vein has reflux at the time of patient presentation, the perforating vein has caused the varicosities. If this was the case, one would expect a similar incidence of incompetent perforating veins in both primary and recurrent varicose veins. The possibility that incompetence of perforating veins is a secondary source of reflux cannot be dismissed.\textsuperscript{14,15} It is presumptuous to conclude that because control of the high pressure leak from the incompetent perforating vein has immediate beneficial effects on patient symptoms that the incompetent perforating vein is the primary cause of the varicose disorder. Although there is increasing evidence that the primary mechanism of varicose disease is a defect in the vein wall\textsuperscript{23-25} the primary etiology remains uncertain. It is probable that a number of primary causes exist and it is therefore unlikely that one standard procedure is going to cure the majority of sufferers, and instead best results will be achieved if treatment is individualized for each patient on the basis of combined clinical, anatomic, and functional diagnosis.

There is no doubt that ligation or sclerosis of the long saphenous vein at the saphenofemoral junction is essential as the initial step in the management of many patients with long-standing venous disease. Likewise interruption of any incompetent perforating veins by surgery or sclerotherapy is necessary at this stage. In addition to the above measures eradication of all incompetent superficial veins by the stab avulsion technique or sclerotherapy appears to be important.\textsuperscript{2,27} Recurrences are therefore likely to be less frequent if precise and extensive mapping of incompetent superficial veins is obtained by thorough clinical examination combined with duplex evaluation prior to initiation of surgery and/or sclerotherapy. Through duplex imaging, we have found patterns of incompetence to be extremely variable and often unexpected. Despite this, not all patients with primary varicose veins require duplex imaging evaluation. A patient with cosmetic symptoms where the maximum diameter of the reticular or varicose veins is less than 4 mm is unlikely to have superficial reflux that will affect management. However if there is venous ulceration, pain associated with varicose veins, or if the maximum diameter of the varicose veins is greater than 4 mm and involvement of the long or short saphenous veins cannot be excluded by clinical or continuous-wave Doppler examination, then duplex imaging is advisable if one is to avoid subjecting the patient to multiple secondary treatment procedures with their associated costs, including absence from the workforce. In the management of recurrent varicose veins duplex imaging becomes mandatory.

References