Cosmetic Leg Veins: Evaluation Using Duplex Venous Imaging

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Abstract. The records of 305 consecutive patients who had presented with cosmetic symptoms related to varicose and/or spider veins over a 12-month period were studied. Following clinical assessment, 250 (82%) patients were referred for duplex venous imaging. A total of 500 lower limbs were evaluated; 236 (47%) were documented to have incompetence in the superficial venous system (long or short saphenous veins). Only 6 (1%) limbs had deep venous incompetence and 45 (9%) limbs were found to have perforator incompetence. Short saphenous vein incompetence was found in 59 (12%) limbs. In the long saphenous vein there was a consistent pattern of an increasing incidence of incompetence from the saphenofemoral junction down to the below-knee segment. The duplex imaging findings were applied to determine the optimal treatment, ie, whether surgery, sclerotherapy, or a combination of both would provide the best short- and long-term results. The possible etiology and pathophysiology of spider and varicose veins are discussed in relation to these results. J Dermatol Surg Oncol 1990; 16:612–618.

INTRODUCTION

Cosmetic leg veins can be classified into two broad groups: spider veins and varicose veins. Clinically the two conditions often occur together. A varicose vein may be defined as an abnormally dilated and tortuous subcutaneous vein. Spider veins are dilated, cosmically unattractive veins, 0.1–1.0 mm in diameter that occur in the dermis. Many patients presenting with spider veins will also have visible varicose veins. The clinical impression that the two conditions are closely related in pathophysiology is supported by morphological evidence showing similar histological disturbances in spider and varicose veins. Typically, irregular thickening of the media with myocytes occurs in both types of vessels. It can be inferred that increased intraluminal pressure causes vein dilatation and subsequent thickening of the vein wall. Venous dilatation also results in valvular incompetence, which in turn leads to flow reversal in the superficial venous system and extension of the venous hypertension to more distal vessels. The primary cause of varicose and spider veins could therefore be any condition that results in increased superficial venous pressure.

This suggests that effective therapy for lower-limb varicose veins requires accurate localization of the areas of reflux, irrespective of whether surgery or sclerotherapy is the preferred mode of treatment. While other methods have been employed, it would appear that duplex venous imaging offers the most accurate and least invasive technique to provide this data. The ability of duplex venous imaging to provide important information about the natural history and pathophysiology of the post-thrombotic syndrome and deep venous incompetence is well recognized. However, several others have suggested that for simple varicose veins, especially in those patients who require treatment for cosmetic reasons, there is no need for noninvasive examination.

Duplex venous imaging involves B-mode ultrasound imaging of the deep and major superficial...
FIGURE 1. Deep venous anatomy of the lower extremity, with Doppler interrogation sites marked (*).

veins combined with directional pulsed Doppler assessment of blood flow. This technique gives a precise localization of the areas of venous reflux and is also capable of quantifying the degree of venous reflux, thereby providing more useful information than continuous wave Doppler examination, photoplethysmography, and venography.

The aim of this study is to determine the value of duplex imaging in the management of cosmetic leg veins.

METHODS

The records of 305 consecutive patients who presented with cosmetic symptoms related to varicose and/or spider veins over a 12-month period were reviewed. Patients were either self-referred or referred by their primary physician and classified according to whether spider veins, varicose veins, or a combination of both were present. Following clinical assessment, 250 (82%) patients were referred for duplex venous imaging. There were only 6 male patients in this group. Patients with minor spider veins (ie, those with localized areas of spider veins that were clinically not directly related to the long or short saphenous veins and that would normally be treated in one sclerotherapy session) were not referred for duplex scanning.

The duplex ultrasound examination was performed by trained vascular technologists using either ATL UM4 (Advanced Technology Laboratories, Bothell, WA) or Ultrasonix 750SD (GE Medical Systems, Milwaukee, WI) duplex scanners. With the patient in a standing position, the examination was commenced in the groin, imaging the common femoral vein (Figs. 1 and 2). Pulsed Doppler recordings were taken from the center of the vein during manual calf compression and release. The common femoral vein was followed down to the saphenofemoral junction. The long saphenous vein was then imaged at the saphenofemoral junction and the calf was compressed in Doppler mode, augmenting forward blood flow in the long saphenous vein. Reverse flow on calf release signified reflux at the saphenofemoral junction. The long saphenous vein was then followed distally to assess competence at the proximal thigh, above-knee, below-knee and mid-calf regions. Significant branches of the long saphenous vein (eg, anterior accessory and posterior accessory) were also assessed for diameter and competence. Veins less than 2 mm in diameter were not interrogated by Doppler.
COSMETIC LEG VEINS

The superficial femoral vein was then evaluated for venous competence at the proximal and distal thigh with calf compression. While scanning the femoral and long saphenous veins, perforating veins connecting the deep and superficial systems in the thigh were located. When located, they were measured for diameter and competence by manual compression above and below the transducer.

At the level of the adductor canal, the superficial femoral vein continues as the popliteal vein. The popliteal vein was assessed in Doppler mode by calf compression and release. The short saphenous vein, usually located in the popliteal fossa, was evaluated by Doppler in proximal, mid- and distal calf by calf compression and release. The sapheno-popliteal junction was imaged and evaluated with Doppler. In a significant number of patients, the short saphenous vein did not communicate with the popliteal vein and instead continued proximally to become a branch of the long saphenous vein. In some patients, the short saphenous vein was found to drain into the gastrocnemius vein, which then drained into the popliteal vein.

While scanning in the medial plane, the posterior tibial veins and peroneal veins were located in the proximal calf. The veins were assessed from the tibioperoneal trunk to the ankle. Routine sites for assessment were the proximal, mid- and distal calf. Significant perforator veins (greater than 2-mm diameter) from the deep venous system to the superficial calf veins were noted. They underwent Doppler evaluation with compression proximal and distal to the transducer. Other significant veins, such as the calf muscle veins, (gastrocnemius and soleal), which drain into the popliteal, posterior tibial, or short saphenous veins, were also imaged and evaluated by Doppler.

During the examination, vein diameters were recorded by the vascular technologist at each level of assessment. Hard copy Doppler tracings were taken at each point of venous reflux. At the end of the examination, the technologist drew a schematic diagram of significant abnormalities found in both anatomy and venous flow (Fig. 3). This enabled the referring clinician to focus on any detected abnormalities.

Results were recorded on an Apple Macintosh II (Apple Computer, Inc., Cupertino, CA) using the Claris Filemaker II database. For analysis, each limb was treated as an independent observation. Comparison of the occurrence of venous incompetence was made by standard contingency table methods.

RESULTS

The ages of female patients ranged from 18 to 75 years (n = 244) with an average age of 42 years. The ages of male patients ranged from 33 to 79 years (n = 6) with an average age of 49 years. Clinically, 83 (17%) limbs were assessed as having spider veins only, 84 (17%) limbs were found to have only varicose veins, and 314 (63%) limbs had a combination of varicose and spider veins. The remaining 19 (4%) limbs studied were clinically normal.

A total of 500 lower limbs were evaluated using duplex venous imaging. Of these 236 (47.2%) limbs were documented to have incompetence in the superficial venous system. This involved reflux in a segment of the long or short saphenous veins or a branch of the long saphenous vein. Only 6 (1.2%) limbs had deep venous incompetence and 45 (9.0%) limbs were found to have perforator incompetence. In the limbs scanned there were no significant differences between the average ages of patients in each clinical classification (Table 1).

Occurrence of Incompetence in Four Clinical Groups

Table 1 shows the proportion of limbs found to have venous incompetence in each of the four clinical classifications. There were significant differences between the four groups in the proportion of patients with superficial vein incompetence ($\chi^2 = 33.7$, df = 3, $p < 0.0001$). Nineteen (22.9%) limbs that had been classified as having spider veins only
were found to have superficial venous incompetence. In contrast, limbs with varicose or a combination of varicose and spider veins, superficial venous incompetence was found in 56 (66.7%) and 154 (49.0%) limbs respectively. Seven (36.8%) of the 19 clinically normal limbs had superficial venous incompetence. In this group, 14 (73.7%) of the opposite limbs (ie, the clinically abnormal limbs) had superficial venous incompetence (Table 2).

Similar significant trends were seen in the proportion of limbs with perforator incompetence in the four clinical groupings. No clinically normal limbs and 1 limb with spider veins only had perforator incompetence while 11 (13.1%) limbs with varicose veins only and 33 (10.5%) limbs classified as mixed spider and varicose veins were found to have perforator incompetence ($\chi^2 = 10.6$, df = 3, $p < 0.01$).

There was no deep venous incompetence found either in the clinically normal limbs or in limbs with spider veins only. Five (1.6%) of the limbs with spider and varicose veins and 1 (1.6%) limb with varicose veins only were found to have deep venous incompetence. The numbers were too small to perform statistical tests.

**Patterns of Superficial Incompetence by Clinical Classification**

| LONG SAPHENOUS VEIN VERSUS SHORT SAPHENOUS VEIN INCOMPETENCE |

Table 3 shows the proportion of limbs found to have long and short saphenous incompetence in each of the four clinical classifications. Again there were significant differences between the clinical groups ($\chi^2 = 12.07$, df = 3, $p = .007$ for the long saphenous vein and $\chi = 12.2$, df = 3, $p = .007$ for the short saphenous vein). There was a relatively high proportion of long saphenous vein incompetence in all four groups and a low proportion of short saphenous vein incompetence. For both veins there were similar patterns across the clinical classifications with the lowest occurrence of incompetence in the normal and spider veins-only groups compared to the varicose groups.

**TABLE 1**
Venous Incompetence According to Clinical Classification

<table>
<thead>
<tr>
<th></th>
<th>Spider Veins Only (n = 83)</th>
<th>Spider and Varicose Veins (n = 314)</th>
<th>Varicose Veins Only (n = 84)</th>
<th>Clinically Normal (n = 19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Average age</td>
<td>39.7 years</td>
<td>41.4 years</td>
<td>42.5 years</td>
<td>43.4 years</td>
</tr>
<tr>
<td>Superficial incompetence</td>
<td>22.9%</td>
<td>49.0%</td>
<td>66.7%</td>
<td>36.8%</td>
</tr>
<tr>
<td>Deep incompetence</td>
<td>0%</td>
<td>1.6%</td>
<td>1.2%</td>
<td>0%</td>
</tr>
<tr>
<td>Perforator incompetence</td>
<td>1.2%</td>
<td>10.6%</td>
<td>13.1%</td>
<td>0%</td>
</tr>
</tbody>
</table>

**TABLE 2**
Venous Incompetence in Patients with One Clinically Normal Limb

<table>
<thead>
<tr>
<th></th>
<th>Clinically Normal Limb (n = 19)</th>
<th>Clinically Abnormal Limb (n = 19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Superficial incompetence</td>
<td>36.8%</td>
<td>73.7%</td>
</tr>
<tr>
<td>Saphenofemoral junction incompetence</td>
<td>10.5%</td>
<td>21.0%</td>
</tr>
<tr>
<td>Long saphenous vein incompetence</td>
<td>36.8%</td>
<td>68.4%</td>
</tr>
<tr>
<td>Short saphenous vein incompetence</td>
<td>0%</td>
<td>15.8%</td>
</tr>
</tbody>
</table>

**TABLE 3**
Localization of Superficial Venous Incompetence

<table>
<thead>
<tr>
<th></th>
<th>Spider Veins Only (n = 83)</th>
<th>Spider and Varicose Veins (n = 314)</th>
<th>Varicose Veins Only (n = 84)</th>
<th>Clinically Normal (n = 19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long saphenous vein incompetence</td>
<td>22.9%</td>
<td>32.2%</td>
<td>47.6%</td>
<td>36.8%</td>
</tr>
<tr>
<td>Short saphenous vein incompetence</td>
<td>4.8%</td>
<td>12.1%</td>
<td>20.2%</td>
<td>0%</td>
</tr>
</tbody>
</table>
COSMETIC LEG VEINS

TABLE 4
Site of Incompetence in Long Saphenous Vein by Clinical Classification

<table>
<thead>
<tr>
<th></th>
<th>Spider Veins Only (n = 79)</th>
<th>Spider and Varicose Veins (n = 257)</th>
<th>Varicose Veins Only (n = 66)</th>
<th>Clinically Normal (n = 19)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saphenofemoral junction</td>
<td>5.1%</td>
<td>7.8%</td>
<td>25.7%</td>
<td>10.5%</td>
</tr>
<tr>
<td>incompetence</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Proximal thigh</td>
<td>8.9%</td>
<td>13.6%</td>
<td>34.8%</td>
<td>10.5%</td>
</tr>
<tr>
<td>Above knee</td>
<td>8.9%</td>
<td>17.5%</td>
<td>40.9%</td>
<td>15.8%</td>
</tr>
<tr>
<td>Below knee</td>
<td>17.7%</td>
<td>29.6%</td>
<td>40.9%</td>
<td>36.8%</td>
</tr>
</tbody>
</table>

SITE OF INCOMPETENCE IN LONG SAPHENOUS VEIN
BY CLINICAL CLASSIFICATION

Table 4 shows the incidence of incompetence in the four segments of the long saphenous vein in each clinical group. The below-knee segment had the highest incidence of incompetence in all clinical groups. In contrast, the saphenofemoral junction had the lowest incidence of incompetence in all clinical groups. The occurrence of incompetence in each segment interrogated by Doppler was lowest in the spider vein-only group and highest in the varicose vein-only group.

PATTERN OF INCOMPETENCE IN THE LONG SAPHENOUS VEIN

There appeared to be two common patterns in limbs that had incompetence in the long saphenous vein (Table 5): 63.3% of limbs had a pattern of incompetence extending upward from the below-knee segment. Only 10% of limbs had a pattern of incompetence extending downward from the saphenofemoral junction. Eight percent of limbs had other patterns where there were 2 noncontiguous incompetent segments. The remaining 18.7% had incompetence in all segments, and therefore a pattern of incompetence could not be determined. Limbs that had previously had surgery to the long saphenous vein were excluded from this analysis because of possible ambiguity in interpretation of residual veins.

TABLE 5
Patterns of Long Saphenous Vein Incompetence

<table>
<thead>
<tr>
<th>Incompetence from below knee extending upward</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incompetence from saphenofemoral junction extending downward</td>
<td>15</td>
<td>10.0</td>
</tr>
<tr>
<td>Other patterns of incompetence</td>
<td>12</td>
<td>8.0</td>
</tr>
<tr>
<td>Incompetent in all segments</td>
<td>28</td>
<td>18.7</td>
</tr>
</tbody>
</table>

DISCUSSION

The important findings of this study were first, the high percentage of superficial venous incompetence and the low percentage of deep venous and perforator incompetence in patients who presented with cosmetic varicose veins (ie, patients whose main complaint was the cosmetic appearance of the veins). Assuming that detailed knowledge of superficial venous reflux is important prior to commencing treatment, it would appear that duplex venous imaging has a role in the evaluation of cosmetic leg veins.

Second, there were significant differences in the occurrence of venous incompetence in the four clinical classifications. When comparing the spider vein-only group with the spider/varicose vein group, the patterns of incompetence in the long saphenous vein were similar, but there was a significantly higher proportion of incompetence in each segment examined in the mixed group. It is possible that the spider vein-only limbs are a chronologically earlier presentation of the mixed spider and varicose vein group.

When comparing the spider/varicose vein group with the varicose vein-only group, the varicose-only group had a significantly higher proportion of saphenofemoral incompetence. This may indicate different etiological factors in the two groups.

Third, the common pattern of an increasing incidence of incompetence in the long saphenous vein from the saphenofemoral junction to below the knee in all four groups supports the view that the most common cause of varicose veins is secondary valvular incompetence from venous dilatation due to venous hypertension secondary to hydrostatic gravitational forces in the superficial venous system. Increased deep venous pressure and perforator incompetence was not a common etiological factor associated with varicose or spider veins in this group of patients. The pattern of incompetence in patients with long saphenous vein incompetence...
conflicts with the hypothesis that the initiating factor in primary varicose veins is incompetence of the valves above or at the saphenofemoral junction. The evidence for this hypothesis has been previously acknowledged as being scientifically weak. Instead, the results support the hypothesis that the most common initiating factor is the hydrostatic pressure in the presence of vein wall weakness and increased venous distensibility in the tributaries and main trunk of the long saphenous vein (Fig. 4).

Finally, in patients with unilateral disease there was a high incidence of superficial venous incompetence in the clinically normal limb. This supports the view that the underlying cause is a generalized defect in vein wall structure rather than an isolated localized defect.

Clinically, the information obtained with duplex venous scanning allowed rational decisions based on precise anatomical and pathophysiological detail so that the optimal choice of therapy for lower limb varicose disorders was made. Despite the many advances of sclerotherapy over recent years, it is still widely accepted that flush ligation of the long saphenous vein at the saphenofemoral junction, with or without stripping of the long saphenous vein, gives the most long-lasting result for varicose veins associated with saphenofemoral incompetence. This may also apply to saphenopopliteal incompetence.

As the main reason for these patients seeking treatment of venous disorders is the hope of cosmetic improvement, it is important that treatment should be relatively free of adverse sequelae, including scarring. This clinic has applied the results of duplex venous imaging to decide patient treatment. If there was incompetence at the saphenofemoral or saphenopopliteal junction, surgery was recommended initially with subsequent postsurgical sclerotherapy to achieve the desired result.

The variations in termination of the short saphenous vein are well-recognized. Duplex venous imaging provided anatomical details as to the presence and level of the saphenopopliteal junction above (or below) the knee crease. The surgeon could then plan the incision to adequately flush ligate the saphenopopliteal junction. By giving details of vein diameter, (particularly at the saphenopopliteal junction) a decision was made as to the likely success of sclerotherapy as an alternative to surgery in the presence of short saphenous incompetence. If the saphenopopliteal junction was incompetent but measured less than 7 mm in diameter, sclerotherapy was considered.

Optimal results from sclerotherapy are achieved through proper selection and concentration of the sclerosing agent, correct injection technique, and adequate postsclerosis compression. If a decision was made to use sclerotherapy in the presence of saphenous vein incompetence, higher concentrations of more potent sclerosants and greater post-sclerotherapy compression for at least 2 weeks were used to achieve a satisfactory sclerosis and reduce adverse sequelae, such as superficial thrombophlebitis and postinjection pigmentation. By identifying the areas of reflux, the duplex scan assisted in determining the optimal sites of injection, the position of compression pads, and the grade of compression stocking required to achieve effective sclerosis. If no major superficial vein incompetence was detected with duplex scanning, lower, safer concentrations of sclerosants were used with minimal compression.

The areas of recurrent veins following surgery were also determined. This was of great value in determining whether the saphenofemoral or saphenopopliteal junctions were properly ligated at the initial procedure and identified any atypical venous anatomy. It indicated whether surgery was required initially to flush ligate recurrent veins or whether sclerotherapy was likely to achieve the desired result.

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REFERENCES