Neovascularisation is the Principal Cause of Varicose Vein Recurrence: Results of a Randomised Trial of Stripping the Long Saphenous Vein

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Objectives: To determine whether routine stripping of the long saphenous vein reduces recurrence after varicose vein surgery.

Design: Randomised controlled trial. All operations done by a consultant vascular surgeon. Two year follow-up.

Materials and methods: One hundred patients with primary long saphenous varicose veins (133 legs) were randomised. Two year follow-up in 81 patients (113 legs) with questionnaire, clinical examination and Duplex scanning.

Results: Some 89% remained satisfied with the results of their surgery, though 35% had recurrent veins on clinical examination. Recurrence was reduced from 43 to 25% in patients who had their long saphenous vein stripped ($p = 0.04$, $\chi^2$). Neovascularisation (serpentine tributaries arising from the ligated saphenofemoral junction) was detected in 52% of limbs and was the commonest cause of recurrence. Most tributaries were less than 3 mm in diameter and only caused recurrence if the long saphenous vein or a major thigh vein was intact. Twelve patients had tributaries greater than 3 mm diameter and all had recurrent varicose veins.

Conclusions: Recurrence is common after varicose vein surgery and in this study was caused principally by neovascularisation at the ligated saphenofemoral junction. Clinical recurrence is reduced by routine stripping of the long saphenous vein.

Key Words: Varicose veins; Surgery; Recurrence.

Introduction

Varicose veins are common, affecting 20–40% of some populations. In the U.K. the number of operations carried out for this condition has been increasing and is currently in excess of 60,000 per annum. There has been long-standing controversy about whether to strip the long saphenous vein after flush saphenofemoral ligation. Stripping is thought to reduce recurrence rates by ablating contact with thigh perforating veins which may be, or become, incompetent. However, stripping is associated with local bruising and discomfort and may damage the saphenous nerve resulting in paraesthesia. Proponents point out that retaining the long saphenous vein may be advantageous for future peripheral arterial or coronary revascularisation. In the earliest randomised trial, stripping the long saphenous vein to the ankle appeared to increase the morbidity of the operation without improving results. It is probably not necessary to strip to the ankle, the long saphenous vein in the calf is seldom varicose. Present recommendations are that stripping to knee level is adequate.

There is a high recurrence rate after varicose vein surgery, ranging from 7 to 65% after prolonged follow-up. The aetiology of recurrence remains obscure, though in many cases it follows inadequate dissection of the saphenofemoral junction. Modern non-invasive investigation with colour-flow Duplex scanning has enabled a more detailed evaluation of recurrent veins. This study is a prospective, randomised, controlled trial of stripping the long saphenous vein to the knee with results after 2 years assessed both objectively and subjectively.

Patients and Methods

One hundred consecutive patients with primary long
saphenous varicose veins assessed clinically from a waiting list initiative were entered into the study (total 133 limbs). The diagnosis was made using a hand held Doppler alone as the study was initiated prior to routine availability of Duplex scanning. There were 67 women and 33 men, mean age 49 years (range 25–73 years). Each patient was randomised immediately prior to surgery and those with bilateral veins had the same procedure on both sides. All patients had a flush ligation of the saphenofemoral junction and multiple avulsions, 64 legs were randomised to stripping the long saphenous vein to knee level. Flush ligation involved dissection of the saphenofemoral junction visualising 2 cm of common femoral vein and included disconnection of all small lateral tributaries. It was possible to strip the vein in all cases so randomised. All the operations were performed by a single consultant vascular surgeon using standard operative techniques and postoperative compression. The patient was blinded to the procedure performed. There were no early postoperative complications.

Follow-up was done after 6 weeks (clinical examination and patient satisfaction questionnaire), 1 year (clinical and hand-held Doppler examination) and after a minimum of 2 years (clinical examination, patient satisfaction questionnaire and colour-coded image directed Doppler sonography (Duplex U/S)). Duplex ultrasonography was performed using an ATL Ultramark 9 scanner with colour-flow Doppler, using a 5 MHz linear array transducer. Imaging was undertaken with the patient sitting and the legs dependent, but in all other respects the technique was identical to that described by Sarin et al. Statistical analysis was done using the Chi-squared test.

**Results**

**Six week assessment**

Ninety-nine patients attended and 89 (90%) were pleased with the initial results of their surgery. Residual veins were evident in 18 legs — 14% (5 stripped, 13 ligated), and numbness was reported in 10 legs — 8% (3 stripped, 7 ligated). At this stage, there were no statistically significant differences between the two groups.

**One year assessment**

Despite two offered appointments, 11 patients failed to attend. One hundred and twenty-one legs (91%) were therefore reviewed. Recurrent varicose veins were visible in 17 (14%) patients, but no significant difference was observed between the groups (8/55 strip; 9/66 ligated). Reflux of venous blood at the groin was detected by hand-held Doppler in 23 legs (19%) though significantly less often in patients after stripping (5 legs, 9%) than ligation alone (18 legs, 27%), \( p = 0.01 \).

**Two year assessment**

Eighty-one patients (113 legs: 53 strip, 60 ligated) attended, a mean of 31 months (range 28–33 months) after surgery. A total of 89% of patients remained satisfied with the result of their operation after 2 years, (48/53 (91%) strip, 52/60 (87%) ligated; \( p = 0.52 \)). Recurrent varicosities, as detected by an independent observer (LJ), were significantly more common in patients who had ligation alone (26/60; 43%) compared with those who had their long saphenous vein stripped (13/53; 25%), \( p = 0.04 \). When calf vein recurrences alone were considered, the difference was more evident (7/53 strip (13%) vs. 19/60 ligated (32%), \( p = 0.02 \)). All patients were checked for a neurosensory deficit in the distribution of the saphenous nerve. This was detected in 8% of legs, but there was no difference between the groups (4 strip vs. 5 ligated).

**Duplex results after 2 years**

In no patient was an intact saphenofemoral junction identified. However, serpentine tributaries were detected entering the common femoral vein at a position corresponding to the saphenofemoral junction in 52% of limbs (24/53 stripped, 35/60 ligated). Most of these tributaries were less than 3 mm in diameter, but in 12 cases (11%) a connection greater than 3 mm in diameter was identified (Tables 1 and 2).

| Table 1. Duplex results in patients with no recurrent varicose veins after 2 years (n=74). |
|----------------------------------|-----------------|-----------------|-----------|
|                                 | Strip (n=40)    | Tie (n=34)      |           |
| >3mm connection to LSV or thigh vein | 0               | 0               |           |
| <3mm connection to LSV or thigh vein | 0               | 8               |           |
| <3mm not connected to LSV or thigh vein | 14              | 7               |           |
| Perforating vein                | 1               | 3               |           |

*All had <3mm connection in addition.

LSV = long saphenous vein.
Of these, 31 (27% of limbs) connected with a patent and refluxing long saphenous vein, or other thigh vein (7/53 stripped, 25/60 ligated; \( p = 0.0008 \)). All patients with tributaries greater than 3 mm had clinically recurrent veins, as did 11/20 (55%) of those with smaller than 3 mm tributaries connecting with the long saphenous vein or other thigh vein. Twenty-seven percent of limbs had deep venous incompetence in either the thigh, calf or both (14/53 stripped, 17/60 ligated).

Of the 23 limbs with reflux detected at the groin using hand-held Doppler at 1 year, 16 (70%) had a less than 3 mm communication between the saphenofemoral junction and long saphenous vein identified on the 2 year Duplex scan.

**Discussion**

There are several theoretical mechanisms of varicose vein recurrence after surgery including inadequate dissection of the saphenofemoral junction and incompetence of mid thigh perforating veins if the long saphenous vein is not stripped. Glass proposed an alternative mechanism, namely neovascularisation and confirmed in a clinical study that new veins grow from the end of the ligated saphenofemoral junction.\(^{14}\) Previously venography had been used to suggest the possibility of neovascularisation.\(^{15}\) Theoretically new veins could develop through growth of newly formed vessels (true neovascularisation) or through widening of tiny pre-existing collaterals. So far the precise aetiology of these veins is unclear but several authors have described their importance in the aetiology of recurrent varicose veins.\(^{15,16}\) The advent of Duplex scanning has enabled a more detailed analysis of venous anatomy and more accurate diagnosis of the cause of recurrent veins.\(^{13}\)

In the present study, Neovascularisation was the commonest cause of recurrence. If the long saphenous vein remained intact, serpentine new veins could be seen arising from the common femoral vein and the result was early recurrence, especially in the calf. In no patient was an intact saphenofemoral junction identified on Duplex. Even veins more than 3 mm in diameter were serpentine and typical of neovascularisation. All patients with new veins greater than 3 mm had clinical recurrence. Eleven of 20 patients with new veins less than 3 mm had recurrence. It is interesting to speculate whether future recurrence is inevitable in the seven patients with new veins less than 3 mm and an intact long saphenous vein. Neovascularisation may have been evident after as little as 1 year as suggested by the positive Doppler signal in 19% of groins at the second follow-up. Some 70% of these patients were shown to have neovascularisation at the 2 year Duplex scan. Clearly the hand-held Doppler alone is inadequate to assess recurrent saphenofemoral incompetence.

Stripping the long saphenous vein reduced recurrence at 2 years from 43 to 25%. This figure still leaves no cause for complacency, despite the fact that most patients remained satisfied with the results of their surgery. Others have reported similar findings and emphasised the importance of neovascularisation.\(^{11,15}\) Inadequate dissection by junior surgeons is often implicated in recurrent varicose veins but this was obviated in the present study where all operations were done by a consultant vascular surgeon: inadequate surgery was not identified as a cause of vein recurrence. The importance of training and technique even in such a commonplace operation has been emphasised.\(^{5}\) The role of residual mid thigh perforating veins causing long saphenous incompetence has been reported. In a similar randomised trial with almost identical clinical results, this accounted for one-third of recurrences.\(^{11}\) In the present study a mid thigh perforator was only responsible for three cases of recurrence. Despite successful stripping in all randomised cases, a vein was often identified in the thigh in stripped cases presumably as a result of branched or Duplex systems. A further study using varicography to investigate recurrent veins identified a number of different patterns, some of which might have been caused by neovascularisation.\(^{16}\)

The present study has demonstrated that waiting list initiatives can be used to advance medical practice! As a result of the low incidence of postoperative complications noted at the first outpatient appointment, routine outpatient follow up is no longer offered to patients after varicose vein surgery, but has been replaced by a patient information sheet. Hand-held Doppler alone is no longer used to evaluate recurrent long saphenous varicose veins but is supplemented by Duplex scanning.\(^{17}\) Routine stripping of the long saphenous vein from the thigh has been confirmed to

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**Table 2. Duplex results in patients with recurrent varicose veins after 2 years (n=39).**

<table>
<thead>
<tr>
<th>Strip (n=13)</th>
<th>Tie (n=26)</th>
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<tbody>
<tr>
<td>&gt;3 mm connection to LSV or thigh vein</td>
<td>3</td>
</tr>
<tr>
<td>&lt;3 mm connection to LSV or thigh vein</td>
<td>7</td>
</tr>
<tr>
<td>&lt;3 mm not connected to LSV or thigh vein</td>
<td>0</td>
</tr>
<tr>
<td>Perforating vein</td>
<td>3</td>
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LSV = long saphenous vein.
neovascularisation and recurrent varicose veins
give improved results as early as 2 years post-
operatively without increasing the incidence of saphe-
nous nerve injury. In this study neovascularisation
was the most important cause of early recurrent
varicose veins. Neovascularisation may be a normal
response to disconnection and further research into
this phenomenon is warranted. Attempts to create a
barrier at the saphenous opening in the cribriform
fascia might be a way of reducing the very high
recurrence rate after varicose vein surgery.18

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