Causes of varicose vein recurrence: Late results of a randomized controlled trial of stripping the long saphenous vein

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Background: The purpose of this study was to investigate the long-term outcomes following stripping of the long saphenous vein during primary varicose vein surgery and to identify factors which may predict recurrence and the need for reoperation.

Methods: The original study was designed as a randomized trial of 100 patients (133 legs) who underwent saphenofemoral ligation with or without long saphenous vein stripping. After invitation 11 years later, 51 patients (74 legs) underwent clinical review and duplex imaging and completed an Aberdeen Varicose Vein Symptom Severity Score (AVVSSS). The hospital notes of the original cohort of patients were used to compile cumulative data and assess predictive factors.

Results: A cumulative total of 83 legs had developed clinically recurrent varicose veins by 11 years (62%). There was no statistically significant difference between the ligation-only and the stripping groups. Reoperation was required for 20 of 69 legs that underwent ligation alone compared with 7 of 64 legs that had additional long saphenous vein stripping (relative risk [RR], 2.65; 95% confidence interval, 1.20 to 5.84; \( P = .012 \)). By life table analysis, freedom from reoperation at 11 years was 70% after ligation, compared with 86% after stripping (\( P = .01 \)). The presence of neovascularization (RR, 2.88; \( P = .15 \)), an incompetent superficial vessel in the thigh (RR, 3.24; \( P = .03 \)) or an incompetent saphenofemoral junction on duplex imaging at 2 years postoperatively (RR, 4.89; \( P = .0001 \)) increased the risk of a patient’s developing clinically recurrent veins. Patients with visible recurrent varicose veins had a significantly worse AVVSSS (\( P = .001 \)).

Conclusion: Stripping the long saphenous vein is recommended as part of routine varicose vein surgery as it reduced the risk of reoperation by 60% after 11 years, although it did not reduce the rate of visible recurrent veins. (J Vasc Surg 2004; 40:634-9.)

Varicose vein surgery is the most common elective general surgical operation done in the United Kingdom, with almost 90,000 operations performed per year.1 Approximately 20% of procedures are done for recurrent veins.2 Despite published recurrence rates ranging from 7% to 70%,3-9 little research has been done into the long-term outcomes of varicose vein surgery. This study was originally designed as a randomized controlled trial to compare saphenofemoral ligation with and without stripping of the long saphenous vein. The early results at 2 years postoperatively suggested that stripping the long saphenous vein significantly decreased recurrence rates, but by 5 years postoperatively this was no longer the case. Neovascularization (growth of new vessels at the saphenofemoral junction) was thought to account for the majority of recurrences. Reoperation rates, however, remained significantly lower up to 5 years in the group who had undergone long saphenous vein stripping.10,11

The present study aimed to review findings after 11 years of follow-up. Possible predictive factors for the development of recurrent veins were examined in relation to outcome.

METHODS

Original study. One hundred consecutive patients (133 legs) participated in the original randomized controlled trial. All patients had primary uncomplicated long saphenous varicose veins (CEAP classification C2/3, Ep, As 2/3) with saphenofemoral incompetence diagnosed by handheld Doppler (HHD) scanning. Duplex imaging was not available until the 2-year review. This cohort of patients all had their surgery in a 4-month interval in 1991 and 1992. All patients had flush saphenofemoral ligation with an absorbable polyglycolic acid suture, with diathermy avulsion of all visible tributaries. Patients (rather than individual legs) were randomized to either long saphenous vein stripping to the knee or saphenofemoral ligation alone. Sixty-four legs were randomized to long saphenous vein stripping to knee level, and this was achieved in all cases; 69 legs were randomized to saphenofemoral ligation alone. Patients were followed-up at 6 weeks with clinical assessment, 1 year with clinical and HHD assessment, and 2 and 5 years postoperatively with clinical assessment and venous duplex imaging (Fig 1). The results have been reported previously.10,11
Eleven-year review. In order to determine the long-term outcomes for each group, all patients from the original study were contacted by letter 11 years postoperatively and invited to complete and return an Aberdeen Varicose Vein Symptom Severity Score (AVVSSS)\textsuperscript{12,13} and attend for clinical examination and venous duplex imaging. Patients who agreed to attend completed a brief questionnaire asking whether they remained satisfied with the results of the initial surgery and whether they were smokers at the time of the original surgery.

Duplex imaging was done in the hospital vascular laboratory using an ATL HDI 5000 colour duplex scanner with a 4-7 MHz linear array transducer. Patients underwent scanning in a sitting position with their legs dependent. Venous reflux of greater than 1 second after manual calf compression was taken to be significant. Valsava’s maneuver was performed if no reflux was detected with calf compression. A whole-leg duplex scan was undertaken with documentation of the presence or absence of reflux in the deep and superficial systems. All named vessels and their variants were assessed and varicosities mapped. Neovascularization was defined as the presence of serpentine venous tributaries entering the common femoral vein at the site of the old saphenofemoral junction after calf compression or Valsava’s maneuver. No comment was consistently made on the size of the tributaries. Incompetent perforating veins were defined as those with bidirectional flow on calf compression.

Analysis. In an attempt to increase the completeness of data on late reoperation and recurrence rates, in addition to the present investigation, the hospital health records of the original cohort of patients were reviewed. The information collected at 1, 2, and 5 years postoperatively was used to generate cumulative data. Cumulative reoperation (redo saphenofemoral disconnection, long saphenous vein stripping, and phlebectomies), recurrence rates (visible recurrent varicose veins), and rates of neovascularization (small tortuous tributaries) at the saphenofemoral junction were calculated. Kaplan-Meier survival analysis was performed on times to reoperation, with censoring at May 31, 2004, or at the date of death, if earlier. Times to further treatment were compared between the 2 surgical groups using the log-rank test (data were available for all patients). Standard error for the proportion free from reoperation was $\pm 0.10$ at all times studied in both legs. Possible risk factors, including smoking, age at time of surgery, and long saphenous vein stripping, were assessed. Univariate analysis of the early HHD and duplex findings was performed in order to look for possible predictive factors. Statistical analysis was done with the $\chi^2$ test, and relative risk (RR) assessment with 95% confidence intervals. Early duplex imaging variables, identified as significant by univariate analysis, were subsequently entered into a logistic regression model. The AVVSSS scores were compared using the Mann-Whitney U test. The SPSS software package Version 12.0 was used for statistical analysis.

RESULTS

Eleven-year follow-up: reoperation rates. A total of 51 patients (74 legs) attended for follow-up 11 years postoperatively and completed the AVVSSS. Five patients from the original cohort had died, 10 were unable or did not wish to attend, 7 had moved away, and the remainder were lost to follow-up. Forty-four of the 51 patients who at-
tended follow-up (86%) remained satisfied with the results of their initial surgery. According to all available data, 27 legs had undergone repeat surgery for recurrent varicose veins at various intervals following primary surgery (Fig 2). Seventeen had redo saphenofemoral disconnection with long saphenous vein stripping (where present) and phlebectomies; 10 had multiple phlebectomies alone. A further 2 patients underwent sclerotherapy, 1 from each group. After 11 years, patients who had undergone flush saphenofemoral ligation alone were more likely to have required further surgery: 20 of 69 legs compared with 7 of 64 legs that had additional long saphenous vein stripping (RR, 2.65; 95% confidence interval [CI], 1.20 to 5.84; \( P = .012 \)). Life table analysis showed that freedom from operation or sclerotherapy after 11 years was 70% (SE, 5.8%) after ligation and 86% (4.5%) after stripping (log-rank \( \chi^2 = 6.60; \) df = 1; \( P = .010 \)) (Fig 3).

Univariate analysis revealed several factors which increased the risk of reoperation. Patients who had evidence of reflux in the groin shown by HHD examination 1 year postoperatively were more likely to require reoperation for recurrent veins (RR, 4.13; CI, 2.23 to 7.66, \( P = .001 \)) (analysis based on 77 legs). Patients who had the following findings on duplex imaging 2 years post-

Fig 2. Reoperation rates for (A) patients who underwent long saphenous vein stripping and (B) patients who underwent saphenofemoral ligation alone.

Fig 3. Life table for reoperation or sclerotherapy.
operatively also had a significantly greater rate of reoperation: the presence of neovascularization (RR, 2.88; CI, 1.17 to 7.09; \( P = .015 \)), an incompetent superficial vessel in the thigh (RR, 3.24; CI, 1.41 to 7.45; \( P = .03 \)) and an incompetent saphenofemoral junction (RR, 4.89; CI, 2.14 to 11.17; \( P = .0001 \)) (analysis based on 90 legs). The 3 duplex findings that were identified as significant by univariate analysis were then entered into a logistic regression model. None was independently significant for the need for reoperation. Other factors associated with a higher rate of reoperation were the development of visible recurrent varicosities (17 legs) by 2 years postoperatively (RR, 3.40; CI, 1.51 to 7.69; \( P = .002 \)) and younger age at the time of the original surgery. Twenty-one patients, mean age (SD) 42.3 (11.07), needed reoperation compared with 67 patients who did not, mean age 51 (12.57) (\( P = .006 \)). Data were missing for the remaining 12 patients. Smoking habit had no effect on reoperation rates in this study. The only operative factor that significantly decreased the risk of requiring further surgery was stripping the long saphenous vein (RR, 2.65; CI, 1.20 to 5.84; \( P = .012 \)).

**Recurrent varicose veins.** Cumulative recurrence rates, including data collected from hospital health records and previous studies, reached at least 62% of legs by 11 years (Fig 4). This figure may have been even higher due to missing patient data. There was no statistically significant difference between the ligation-only and the stripping groups. Life table analysis was not possible as exact dates of recurrence were not known.

A number of factors increased the chance of developing visible recurrent varicose veins during the study. Patients with reflux at the saphenofemoral junction on HHD examination 1 year postoperatively had a higher chance of developing recurrent veins by 2 years (RR, 2.17; CI, 1.36 to 3.45; \( P = .016 \)) (based on analysis of 56 legs). Patients who had the following findings on duplex imaging 2 years postoperatively had a significantly greater chance of developing recurrent varicose veins within 11 years: the presence of neovascularization (RR, 1.52; CI, 1.10 to 2.10; \( P = \)
.012), an incompetent superficial vessel in the thigh (RR, 1.41; CI, 1.04 to 1.90; \( P = .029 \)), and an incompetent saphenofemoral junction (RR, 1.42; CI, 1.09 to 1.85; \( P = .036 \)) (based on analysis of 65 legs). The 3 duplex findings that were identified as significant by univariate analysis were then entered into a logistic regression model. None was independently significant for the development of recurrence by 11 years. The presence of deep venous reflux or incompetent perforators did not correlate with the development of recurrent varicose veins. Smoking appeared to have no relation to the development of recurrent varicose veins.

**Neovascularization.** Neovascularization (the presence of visible serpentine venous tributaries entering the site of the ligated saphenofemoral junction on duplex imaging) was present in 86 legs by 11 years postoperatively. The cumulative neovascularization rates based on all available data are shown in Fig 5. Life table analysis was not possible, as exact dates of neovascularization development were not known. Despite the theory that neovascularization is related to the healing process, 14 groins developed tributaries visible on duplex imaging between 5 and 11 years postoperatively (Fig 6). As shown previously, the presence of neovascularization was a significant factor in both the development of visible recurrent varicose veins and the need for reoperation.

**Quality of life.** In the 59 patients who completed quality of life questionnaires 11 years after their surgery, there was no statistically significant difference in AVVSS between patients who had flush ligation alone (29 patients, mean [SD] AVVSS 10.37 [10.04]) and those who had long saphenous vein stripping (30 patients, 11.49 [9.58]; \( P = .866 \)). Of the 51 patients who agreed to attend for 11-year review, there was, however, a significant difference in AVVSSSS between patients who had visible recurrent varicose veins (37 patients, mean [SD] AVVSSS 13.35 [9.87]) and those with no visible recurrent veins (14 patients, 3.97 [3.01]); \( P = .0001 \)).

**DISCUSSION**

This study confirms that the reduced reoperation rate that follows routine stripping, which was shown after 5 years in this randomized trial, was still evident after 11 years of follow-up. Stripping should be a routine part of all long saphenous varicose vein surgery. The strengths of this study are that it is a randomized controlled trial with prolonged follow-up and detailed duplex imaging. Unfortunately, there was a relatively poor attendance of patients after 11 years (just over 50%), so the data were supplemented by case note review and previous trial details. For example, patients who had recurrent veins after 5 years were still classified in this category even if they did not attend for review at 11 years.

Recurrent varicose veins remain a significant problem, as approximately 20% of varicose vein surgery is reoperative; these operations are more difficult and more complicated. This study shows that recurrent veins that needed reoperation tended to occur in younger patients and those who developed visible recurrent veins soon after the initial operation. Other findings that predisposed to reoperation included groin reflux on HHD after 1 year and abnormal duplex findings after 2 years. The implication is that early groin reflux is a marker for early recurrent incompetence, possibly due to neovascularization. The earlier groin recurrence is detected, the more likely reoperation will be needed. Stripping the long saphenous vein was the only factor associated with a reduction in the rate of reoperation.

One possible study limitation is the fact that these patients were under regular investigation and therefore may have been encouraged to seek reoperation. However, there is no evidence that the patients were more likely to have their surgery at the time of review (Fig 2); most had reoperative surgery after a new referral from their family doctor. A significant number of patients in both groups, even those who had their long saphenous veins stripped, still had an incompetent superficial vessel in the thigh on duplex follow-up (34/39 legs in ligation-only group, 27/35 legs in long saphenous vein stripping group). The patients with previous stripping must either have had a bifid venous system or dilatation of other thigh tributaries. Because the duplex machine was not available until the 2-year follow-up, it was not possible to compare findings with preoperative information. The question arises whether the presence of an intact long saphenous vein is itself an encouragement to early recurrence, even after adequate saphenofemoral ligation.

The causes of recurrent varicose veins still remain a mystery. If poor surgical technique is excepted, most recurrent veins are still a result of incompetence in the groin. Whether this is due to dilatation of existing collaterals or angiogenic formation of new vessels (neovascularization) remains uncertain; duplex findings would be similar.
is histologic evidence that neovascularization is caused by angiogenesis as a result of operative surgery. One novel finding in the present study was that neovascularization was a dynamic and continuous process. Several patients who had a clean saphenofemoral junction at 5 years after operation had developed neovascularization by 11 years (Fig 5). Despite the hypothesis that neovascularization might originate from hypoxia-induced activation of endothelial cells distal to the stump ligature, there was no relationship between smoking and the development of neovascularization or recurrent varicose veins.

Little research has been done into the long-term recurrence rates following varicose vein surgery. Indeed, surgeons have found it difficult to agree on a definition for recurrent veins. In this study, the presence of visible recurrent veins was used as the definition, but in many patients these veins were trivial and not all patients had symptoms or requested further treatment. Even after 11 years, 44 of 51 patients remained satisfied with the results of their original surgery, similar to other reports. In a cohort of 100 patients, Campbell et al demonstrated a clinical recurrence rate of 70% at 10 years postoperatively. The rate of visible recurrent varicose veins in this study was comparably high in both groups (at least 62%); it is possible that if followed for long enough, all patients will develop visible recurrent veins. This has significant implications for preoperative informed consent. Not surprisingly, the presence of visible recurrent varicose veins leads to a significantly worse AVVSSS, suggesting impaired disease-specific quality of life.

If there was no difference in clinical recurrence rates between patients who had their long saphenous varicose veins stripped and those who did not, the question remains why the patients in the ligation-only group had a higher rate of reoperation. It is possible that an incompetent long saphenous vein can cause symptoms that make a patient request further surgery. Alternatively, a surgeon might be encouraged to offer reoperation to a patient with a residual long saphenous vein that could be stripped. The reason patients request reoperative varicose vein surgery remains obscure; however, this study provides compelling evidence that stripping the long saphenous vein decreases the need for further surgery and should remain a part of routine primary varicose vein surgery.

In conclusion, the late results from this randomized trial have shown that there was a high rate of visible recurrent veins in both groups 11 years after operation. Both recurrence and the need for reoperation were predicted by early failure of the operation at the groin; in this study the commonest cause was neovascularization. The presence of a residual long saphenous vein may have been contributory to this process. The reasons that patients requested reoperation for recurrent veins remains obscure, but routine stripping is the only known way to reduce the need for surgery for recurrent varicose veins.

REFERENCES