Resecting the great saphenous stump with endothelial inversion decreases neither neovascularization nor thigh varicosity recurrence

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Background: Neovascularization at the saphenofemoral junction is one of the principal causes of recurrent varicose veins after great saphenous vein surgery. Because angiogenic stimulation from the exposed endothelium of the great saphenous vein stump is considered an important trigger for this process, we hypothesized that complete resection of the stump with endothelial inversion might lessen grade 2 groin neovascularization and thereby decrease recurrence of thigh varicosities.

Methods: Two groups of consecutive patients with primary varicose veins of the great saphenous vein were studied. Group A was a historical control group of 70 limbs (48 patients) in which conventional flush ligation was performed at the level of the saphenofemoral junction. Group B was a prospectively studied clinical trial cohort of 65 limbs (45 patients), wherein the great saphenous vein stump was completely resected using a side-biting clamp to isolate the saphenofemoral junction, and the resulting common femoral vein venotomy was closed with a running inverting suture. Early postoperative follow-up was performed at 6 weeks. Clinical examinations and duplex ultrasound scans were performed after 2 years of follow-up. Grade 2 groin neovascularization was defined by the presence of >3 mm tortuous new refluxing veins, typically communicating with recurrent varicosities in the thigh.

Results: After 2 years, recurrent varicose veins were present in the thighs of 13 of 65 limbs (20%) in group A and in 22 of 61 limbs (36%) of group B (P = .049). Grade 2 neovascularization was present at the saphenofemoral junction in six of 65 limbs (9%) of group A and in 12 of 61 limbs (20%) of group B (P = .127).

Conclusion: Complete resection of the great saphenous vein stump and inversion suturing of the common femoral vein venotomy, instead of simple flush ligation at the level of the saphenofemoral junction, do not appear to decrease grade 2 neovascularization and related thigh varicosity recurrence after great saphenous vein stripping for primary varicose veins. (J Vasc Surg 2008;47:1028-32.)

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Recurrence of varicose veins after surgery is a common problem that occurs in 20% to 50% of cases, with increasing prevalence attending additional years of follow-up. For a long time, recurrence was attributed to incomplete surgery in the groin or popliteal fossa and progressive development of incompetence in residual collaterals. The common use of duplex Doppler scanning in the 1990s, led to gradual acceptance of the conviction that recurrence after surgery is mainly caused by a phenomenon called neovascularization. One effective way of addressing this problem has been the development of endovenous treatment methods that do not have the same proclivity as open surgical procedures to invoke groin neovascularization.

Several alternative surgical techniques have also been proposed to reduce the likelihood of postoperative neovascularization. The construction of an anatomic or prosthetic barrier, using a patch to cover the ligated saphenofemoral junction (SFJ), has been tested in primary varicose vein recanalization. The principle of “no stump, no stump-related neovascularization” suggests moving beyond flush ligation to actual resection of the SFJ and an inverting closure of the resultant common femoral vein venotomy. This completely eliminates the proximal remnant of the great saphenous vein (GSV) and all exposed stump endothelium. Jaeschok et al reported promising 3-month results with this technique, without any further follow-up. This study examines the same hypothesis with 2-year clinical evaluations and duplex ultrasound (DUS) scanning.

METHODS

Patients. A prospective study of 65 limbs (45 patients) with primary varicose veins was conducted between October 2002 and December 2003, wherein the GSV stump was completely resected using a side-biting clamp to isolate the SFJ. The resulting common femoral vein (CFV) venotomy was closed with an inverting suture. The 6-week follow-up and 2-year clinical and DUS findings in the groin and thigh in these limbs were then compared with those of a historical control group of 70 limbs in 48 patients who had attended routine follow-up at the District Hospital (Frutigen, Switzerland) after having undergone GSV stripping with flush SFJ ligation between January 2001 and May 2002.
Both groups included only limbs with primary GSV varicosities, in which DUS scan revealed an at least above the knee refluxing main trunk and DUS-demonstrable incompetence of the terminal valve. Limbs with substantive, concomitant small saphenous vein varicosities, congenital vascular malformations, and recurrent varicose veins were excluded. Informed consent was obtained during the preoperative interview at the surgeon’s clinic.

All operations were performed by the same experienced vascular surgeon (D. H.). If both limbs were to be operated on, a bilateral procedure was done at the same intervention, and both limbs were entered into the study. Patients stayed overnight and were discharged the next day. Low-molecular-weight heparin was administered once during the evening after surgery. The protocol of the study was approved by the local ethics committee (District Hospital, Frutigen, Switzerland), including use of the historical data as well as the prospective trial.

Surgical procedures. The groin incision was made ≤2 cm above the skin crease and parallel to it. All tributaries of the proximal GSV were carefully dissected and ligated. Dissection was continued to the ventral surface of the CFV to expose the complete circumference of the SFJ and to ligate additional tributaries entering directly into the CFV 1 cm above and below the junction. Stripping of the GSV was performed without invagination to just below the knee. Incompetent perforators and varicosities were treated with mini-phlebectomies by means of Varady phlebectomy hooks.

In the historical group A controls, a conventional flush SFJ ligation was performed with a double tie using resorbable polyglactin. The length of the stump was approximately 0.5 cm. In the group B trial limbs, the CFV was partially excluded using a pediatric Satinsky clamp (Fig 1, A), without heparin coverage. The SFJ was divided flush with the CFV surface using a Potts scissors. The venotomy was closed with a single-layer, running monofilament 5-0 polypropylene suture, while taking care to invert the intima into the vein lumen (Fig 1, B).

Clinical and duplex ultrasound evaluation. Clinical examination mainly consisted of the evaluation of the presence or absence of recurrent varicose veins, defined as palpable dilated subcutaneous veins with a diameter larger ≥3 mm.19 After 2 years, DUS scans were performed by the same physician (M. N.) for both the historical control and the clinical trial limbs. An Acuson Sequoia (Siemens, Malvern, Pa) DUS machine (8-5-MHz linear transducer) was used to study the limb or limbs with the patient supine and then standing. The deep vein system was assessed for patency and pathologic reflux, defined by a ≥1 second duration.

The site of the previous SFJ was identified, and then, with the color DUS scan preset at low-scale with high persistence, a combination of augmentation and Valsalva maneuvers were used to detect groin tributaries. Each groin was accorded a neovascularization grade from grade 0 to grades 1 and 2, as previously described.3,5,20 If no new vessel was seen connecting with the ventral aspect of the CFV, the groin was grade 0. If a new connecting venous vessel was found at this site, its diameter and duration of reflux were measured. A tiny ≤3-mm, tortuous vein without reflux received a grade 1. Grade 2 was reserved for refluxing veins >3 mm in diameter that had traceable communications with a superficial varicosity in the thigh. In limbs with clinically obvious recurrent varicose veins, the sonographer not only examined the groin but also looked carefully for other escape points, such as incompetent perforating veins or veins descending from the pelvic region.

Statistical analysis. Prevalences of clinically evident thigh varicosities and DUS-defined neovascularization were compared using contingency table analysis. A P < .05 indicated statistical significance.

RESULTS

The characteristics of patients and limbs in both groups were similar (Table). No postoperative infection or symp-
communicated with the latter limbs had clinically evident thigh varicosities that were grade 1, and six limbs were grade 2 (Fig 2). The six at the site of the previous SFJ in 28 control limbs (43%): 22 previous SFJ. DUS-defined neovascularization was present of CFV stenosis or deep vein thrombosis at the site of the trial nor control group had evidence on DUS scanning trol limbs (92%) and 61 group B trial limbs (93%). Neither wound infection below the knee.

A control limbs, but one group B trial limb had a superficial symptomatic deep vein thrombosis was noted among the group A control limbs, but one group B trial limb had a superficial wound infection below the knee.

Two-year follow up was available for 65 group A control limbs (92%) and 61 group B trial limbs (93%). Neither the trial nor control group had evidence on DUS scanning of CFV stenosis or deep vein thrombosis at the site of the previous SFJ. DUS-defined neovascularization was present at the site of the previous SFJ in 28 control limbs (43%): 22 were grade 1, and six limbs were grade 2 (Fig 2). The six latter limbs had clinically evident thigh varicosities that communicated with >3-mm SFJ-site neovascular tributaries. Grade 1 neovascularization was not associated with clinically evident thigh varicosities. Seven other control limbs had clinical varicosities, but each had demonstrable reflux sourced from either a perforating vein or pelvic vein incompetence. Saphenofemoral junction neovascularization was visualized in 30 trial limbs (49%): 18 were grade 1 and 12 were grade 2 (Fig 2). The 12 limbs all bore above knee clinical varicosities communicating with newly formed SFJ-site tributaries. Ten other trial limbs had thigh varicosities, and just as was observed in the control limbs, these had feeding sources unrelated to lesser grade groin neovascularization.

The 2-year between-group differences all had a nonsignificant α level, although the prevalence of thigh varicosities of varying extent—22% in the historical controls and 36% for the trial limbs—was indeed a narrow miss at \( P = .049 \) and \( P = .592 \) for the 43% prevalence of SFJ neovascularization, irrespective of grade, in the control limbs vs 49% for the trial limbs. The prevalence of varicosity-linked, grade 2 neovascularization—9% in the control limbs and 20% for trial limbs—had a key value of \( P = .127 \).

**DISCUSSION**

The results of the present study suggest that modifying the technique of managing the SFJ by resecting the GSV stump completely, instead of simpler flush ligation, does not decrease postoperative neovascularization or improve 2-year clinical results. After 2 years, in fact, the prevalence of clinically evident recurrent varicose veins was almost significantly higher among the trial limbs. Yet, the prevalence of recurrent varicose veins above the knee in communication with >3 mm, grade 2, neovascular SFJ tributaries was not statistically different between the two groups. Hence, the promising 3-month results reported by Jae-schok et al could not be confirmed in this study. Interpretation of our results needs to be conditioned by its several limitations. Prospectively studied trial limbs were compared with a recent historical control group, precluding randomization. Although one senior surgeon performed all operations and one experienced physician conducted all DUS scans at identical time periods, with >90% follow-up on demographically similar groups, different ligature and suture materials were used and selective and unintentional bias cannot be excluded. The sample size is constraining for a negative result. No power determination was made before the study, which might have been based on a contemplated 50% differential in the 2-year prevalence of grade 2 neovascularization. As they are, the results must be regarded as observational and suggestive that the trial technique will not best patching or emulate the neovascularization avoidance that characterizes endovenous elimination of a refluxing GSV.

The pathophysiology of SFJ recurrent reflux remains poorly understood. Postoperative DUS scans show a remarkable proclivity of the former SFJ site to re-establish venous connections after an apparently correct surgical ligation. Several explanations about how, when, and why new veins develop at the former SFJ have been proposed, including angiogenic stimulation by the exposed GSV stump endothelium or the wound healing process, transnodal lymphovenous connections, dilation of CFV vasa vasmorum, and disturbed venous drainage of ligated suprainguinal tributaries. In particular, hypoxic intima beyond the GSV ligature has been postulated as an important neovascularization initiator.

It is known that the responses of endothelial cells to hypoxia initiate a signalling cascade of intracellular and molecular events that may explain several vascular pathologic situations. A recent immunohistochemical study demonstrated that the expression of vascular endothelial growth factor (VEGF) and VEGF-receptors were up-regulated in neovascular veins compared with both varicose and normal
veins. In view of the crucial role of the endothelium, some authors have attempted to mitigate neovascularization by inverting the free endothelial border of the ligated GSV stump with a running suture. Frings et al reported a reduction of DUS-diagnosed recurrence after 2 years, from 11% to 3% in 152 limbs. Haas et al , however, could not reproduce these results. They observed 9% neovascularization between 4 and 54 months after inverting suture of the GSV and no difference between the group with the inversion of the stump and two other groups without it among 490 groins.

Complete resection of the stump, as used in our trial group, is a more radical approach than just hiding or destroying the stump endothelium, because the CFV venotomy eliminates all GSV endothelium, and its inverting closure insulates the cut edge of the CFV from other groin contents. Our negative result may just reflect sample-size vitiating or be an indication that eliminating one factor among several is insufficient to make a meaningful difference. Angiogenesis is not limited to the exposed endothelium of the stump or to the site on the CFV and may begin in surrounding supporting tissue, neighboring lymph nodes, and in tissue reaction to surgical sutures. Neo-vascular veins have even been recognized around a prosthetic patch implanted to function as a barrier against neovascularization. Endovascular approaches may hold the best promise. Wound healing is minimized, and normal prograde venous flow from the pudendum and lower abdomen is generally preserved, but 5-year follow-up is the longest available, and recurrent SFJ reflux can occur considerably later.

CONCLUSION

Complete resection of the proximal GSV stump in the groin and inverting suture of the resulting CFV venotomy, instead of simple flush ligation at the level of the SFJ, does not appear to decrease grade 2 neovascularization and its associated recurrent thigh varicosities at 2 years after surgical stripping of the GSV for primary varicose veins.

AUTHOR CONTRIBUTIONS

Conception and design: DH, MN Analysis and interpretation: DH, MM Data collection: DH, MN Writing the article: DH, MM Critical revision of the article: MM Final approval of the article: DH, MM, MN, US Statistical analysis: US, MM Obtained funding: Not applicable Overall responsibility: DH

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