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Bilateral Infrainguinal Vein Grafts and the Incidence of Vein Graft Stenosis

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Objectives: *To elucidate the incidence of significant vein graft stenosis in patients who have undergone bilateral infrainguinal vein grafts.*
Materials: *Between 1987 and 1996, 22 patients were identified from our vascular studies database as having undergone bilateral infrainguinal vein bypass grafting.*
Methods: *Data was obtained from the vascular studies database and by case note review. All patients had been part of a vein graft surveillance programme.*
Results: *Of the 22 patients with bilateral vein grafts, eight were excluded from further analysis because one or more of their grafts failed within 30 postoperative days. In the remaining 14 patients (28 vein grafts) there were 15 primary vein graft stenoses. Six patients (43%) had bilateral vein graft stenoses, which is significantly higher ($p=0.0008$) than the predicted value of 9%, for developing bilateral vein graft stenoses. For those patients who developed a vein graft stenosis in their first grafted limb (9/14), 67% (6/14) subsequently developed a vein graft stenosis in their second grafted limb.*
Conclusion: *Patients who develop vein graft stenosis in one limb are at a greater risk of developing a contralateral vein graft stenosis if that limb is grafted. This may well be due to individual vein morphology or unidentified systemic factors that play a role in the aetiology of vein graft stenosis.*

Key Words: Infrainguinal vein graft; Vein graft stenosis; Intimal hyperplasia.

Introduction

For infrainguinal bypass grafts the conduit of choice is autologous vein.[1,2] Vein graft failure occurring within the first 30 postoperative days can be attributed to technical errors incurred at the time of operation. However, up to 30% of grafts will develop a significant vein graft stenosis between the first and twelfth months, the aetiology of which is intimal hyperplasia in the majority of cases.[3–5] The cause of intimal hyperplasia appears to be multifactorial, with both local and systemic factors playing a role. Vein morphology has been suggested by some authors as being an important predetermining factor in the development of vein graft stenosis,[6–8] whilst other groups have disputed this claim[9] and several studies have shown that elevated systemic factors such as fibrinogen,[10–12] homocysteine,[13,14] increased lipoprotein(a)[15] and continued smoking[10,15] are associated with an increased risk of developing vein graft stenosis.

If systemic factors and vein morphology play a role in the development of vein graft stenosis, then it can be hypothesised that patients who develop a vein graft stenosis in one grafted limb would be at a higher risk of developing a vein graft stenosis in the contralateral limb if it was subsequently vein-grafted. In other words, there would be a higher than expected number of patients who develop bilateral vein graft stenoses than one would predict if the development of vein graft stenosis in either limb was completely independent. As far as we can tell there have been no previously reported series, in the medical literature, on the incidence of vein graft stenosis in patients who have undergone bilateral infrainguinal vein grafts.

To test this hypothesis we undertook a retrospective study of all patients who had undergone bilateral infrainguinal vein grafts, for lower limb ischaemia, in our unit, over a 9-year period.

Materials and Methods

Between 1987 and 1996 there were a total of 326 infrainguinal vein grafts performed at our unit and,

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of these, bilateral infrainguinal vein grafts were performed on 22 patients. A review was undertaken on all patients to study graft outcome and to identify the development of significant vein graft stenoses that required intervention during a period of routine postoperative vein graft surveillance. All patients whose graft had failed within the first 30 postoperative days were excluded from any further analysis with regard to the development of significant graft stenoses, as it is recognised that graft failure during this time period is either due to technical errors incurred at the time of grafting or poor vein quality.

Colour-coded duplex scans of the grafts took place at 1 month after the initial operation and thereafter at 3-monthly intervals. All scans looked at graft inflow, outflow and the proximal and distal anastomoses. A peak systolic velocity ratio of >2 was taken to represent a significant stenosis and the initial treatment of stenoses was percutaneous transluminal angioplasty (PTA). Each patient was assessed for independent risk factors, e.g. diabetes mellitus, smoking, hypertension and ischaemic heart disease.

During the same study period, of the 326 infrainguinal vein grafts performed, 98 (30%) developed significant primary vein graft stenoses. The incidence of vein graft stenosis in our total patient population corresponds with previously published data on the incidence of vein graft stenosis in infrainguinal vein grafts.[4]

Statistical analysis

For vein graft stenoses, the differences between the observed and expected findings were analysed using the binomial probability test.

Results

Twenty-two patients with 44 infrainguinal vein grafts were identified. There were 15 males and seven females, with a median age of 63 years (51–74) and 67 years (51–81), respectively. Thirty per cent (13) of lower limb vein grafts were for life-limiting intermittent claudication of less than 50 m and 70% (31) were for critical lower limb ischaemia (which was comprised of rest pain, ulceration and/or gangrene). The mean follow-up time for each grafted limb was 57 months and the median time interval between both limbs being grafted was 18 months (2 weeks–108 months). The type of procedures performed are shown in Table 1. All proximal anastomoses were to the femoral or superficial femoral artery. Eight patients occluded either one or both of their grafts within 30 postoperative days and were excluded from further analysis. In the remaining 28 vein grafts (14 patients), primary graft stenoses requiring PTA occurred in 15 (54%) of the grafts, with three at the proximal anastomosis, three mid-graft and nine at either the distal graft or anastomosis. Mean time to developing a vein graft stenosis for this group of patients was 9.6 months (4–34 months).

Table 1. Site of distal anastomosis and type of conduit used for the 44 infrainguinal vein grafts studied (22 patients) including the 16 grafts (eight patients) that were excluded from further analysis due to one or more failed grafts within 30 post operative days.

Site of distal anastomosis	Conduit used	Grafts included in study	Grafts excluded from study
Tibial vessels	ISLSV	9	5
	Composite Reverse pain	1	1
	Reverse LSV	4	0
Above knee popliteal artery	ISLSV	2	2
	Reverse LSV	0	2
Below knee popliteal artery	ISLSV	9	5
	Reverse LSV	3	1

ISLSV = *In situ* long saphenous vein, LSV = long saphenous vein.

Table 2. Number of vein graft stenoses occurring in both limbs of 14 patients.

		First grafted limb		
		Vein graft stenosis	No stenosis	Total
Second Grafted limb	Vein graft stenosis	6	0	6
	No stenosis	3	5	8
Total		9	5	14

The outcome of both vein-grafted limbs, with regard to developing a vein graft stenosis, for the 14 patients studied is shown in Table 2. For the first grafted limb of each patient, nine (64%) developed a significant stenosis, and for the second grafted limb, six (43%) developed a significant stenosis. So for this group of 14 patients, six patients (43%) developed significant bilateral vein graft stenoses, requiring PTA, in both of their grafted limbs. In other words, of the nine patients who developed a vein graft stenosis in their first limb, six (67%) went on to develop a vein graft stenosis in their contralateral grafted limb.

For this select group of 14 patients there were five

diabetics, four patients with hypertension, seven patients with a history of ischaemic heart disease and 12 patients who were either current smokers or apparent ex-smokers. No further analysis was performed due to the small numbers involved.

Discussion

For the total number of patients who have undergone infrainguinal vein bypass in our unit ($n=326$) during 1987 to 1996, the chance of developing a vein graft stenosis in that graft is 0.3 (30%). Patients who have undergone bilateral infrainguinal bypass grafts are a very select group and in this published series 54% of vein grafts (15 vein grafted limbs) developed a significant stenosis, which is significantly higher ($p=0.005$) than the incidence in the total patient population. If we believe the hypothesis that the cause of intimal hyperplasia is the direct result of local factors alone, i.e. intra-operative vein trauma, then the chance of developing bilateral vein graft stenoses in bilateral grafted limbs should be independent of one another. Therefore, the chance of developing independent bilateral vein graft stenoses in bilateral infrainguinal vein grafts is the probability of developing a stenosis in one grafted limb $\{0.3\} \times$ the probability of developing a stenosis in a contralateral grafted limb $\{0.3\}=0.09$ (9%). Therefore, if this hypothesis is correct, only 9% of those patients undergoing bilateral infrainguinal vein grafts should develop bilateral vein graft stenoses. However, in this selected group of patients 43% developed bilateral vein graft stenoses. This occurrence is obviously higher than one would expect and the difference between the expected findings and the actual findings was analysed using the binomial probability test ($p=0.0008$), which demonstrates that this finding did not occur by chance alone. Furthermore, if a patient developed a significant vein graft stenosis in the first grafted limb, the chance of developing a significant graft stenosis in a subsequently vein-grafted contralateral limb was 67%.

What is the significance of these observations?

Moody *et al.*[16] investigated the effect of local intra-operative vein factors such as valve sites, tributaries, clamp-site trauma and residual valve cusps and demonstrated that there was no correlation between these factors and the development of vein graft stenosis. Several studies have shown that systemic factors play a role in the development of intimal hyperplasia,[10–15] but intimal hyperplasia probably develops due to a combination of these systemic risk factors and intrinsic vein morphology, which may well be identical for both long saphenous veins in each individual patient. The present study supports these findings because it appears that the incidence of bilateral vein graft stenoses, in this select group of patients, is much higher than one would predict if the development of vein graft stenosis was due to independent variables alone, i.e. local factors. The present study was retrospective, and so specific serum markers such as fibrinogen, lipids, homocysteine and carboxyhaemoglobin were unable to be measured.

In conclusion, it appears that patients who have developed a vein graft stenosis in one grafted limb have a greater chance than one would predict of developing a vein graft stenosis in the contralateral limb if it is subsequently vein-grafted. This further supports the theory that the development of vein graft stenosis is the result of a systemic pathological process and/or vein morphology intrinsic to each individual patient. These observations should be taken into account when assessing patients for possible infrainguinal vein grafting in the second ischaemic lower limb. Vascular surgeons should also be more aware of this increased risk during the postoperative vein graft surveillance of this very select group of patients.

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