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Significance of the Early Postoperative Duplex Result in Infrainguinal Vein Bypass Surveillance☆

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Background. *Duplex surveillance of infrainguinal vein grafts may not be efficient.*
Methods. *Consecutive patients who had received infrainguinal vein grafts were enrolled in a duplex surveillance program. A first scan at 6 weeks after surgery categorized grafts into four groups: (a) low risk grafts, (b) mild flow disturbance, (c) intermediate stenosis and (d) critical stenosis. Disease progression was assessed over time.*
Results. *Of 364 grafts followed-up for a median of 23 months, 236 (65%) had no flow abnormality at 6-weeks, and had a 40-month cumulative patency rate of 82%. The remaining 128 (35%) grafts had a flow disturbance. Of 29 critical stenoses, 15 were repaired, 11 occluded and three did not change. Of 57 intermediate lesions, 32 progressed to critical, nine occluded, two were repaired and 14 did not change or improved. Of 42 mild lesions, 16 progressed to a higher grade, four occluded and 22 did not change or improved. There was no significant difference in graft patency between grafts with repaired stenoses and those without stenoses, but grafts with untreated critical stenoses were associated with lower patency* ($p < 0.001$).
Conclusions. *A duplex scan 6 weeks after operation can predict those patients who require continuing duplex surveillance.*

Keywords: Infrainguinal bypass; Vein Graft; Duplex; Surveillance.

Introduction

Infrainguinal bypass using autogenous vein is an established treatment for critical ischaemia of the leg.[1] Vein grafts are prone to develop stenoses, which may precipitate failure of the bypass.[2–5] Stenosis may develop from technical error, vein valve leaflets, pre-existing vein abnormality and myointimal hyperplasia. Evidence of most of these problems may be recognisable by duplex ultrasound scanning, a technique acknowledged for its accuracy in identifying and grading stenotic lesions that threaten graft patency.[6] Duplex scanning has been widely used for graft surveillance, the rationale being that correction of stenotic lesions is likely to improve graft patency and limb salvage rates.[7–9]

The wisdom of duplex vein graft surveillance has been recently questioned. The Vein Graft Surveillance (VGST) trial has revealed no significant difference in graft patency or limb salvage in the medium term between patients who were followed up clinically and those who underwent vein graft surveillance.[8] This study, however, recruited patients at 6 weeks after operation, following the first postoperative surveillance scan. It is possible that some grafts with significant early stenosis may have been treated early, effectively excluding them from further follow-up in the trial.[9] Most duplex surveillance protocols are not initiated until 3 months after surgery and, as a consequence, relatively little is known about the incidence and nature of early vein graft stenosis. However, a significant number of bypasses contain stenotic lesions by 6 weeks after operation.[10]

This study assesses the nature of early flow disturbance and stenosis after infrainguinal bypass using autologous vein.

Patients and Methods

Consecutive patients, who had an infrainguinal bypass procedure using autologous vein between 1st January 2000 and 31st December 2005, were enrolled

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in a graft surveillance program. This involved duplex scanning at 6 weeks, 3 months, 6 months and 1 year after operation, after which surveillance continued by clinical examination and measurement of ankle-brachial pressure index at intervals of 6 months. Extra duplex scanning outside the surveillance program was performed on clinical grounds.

Ultrasound examination used angle of insonation as close to 60° as possible and began within the inflow artery, progressing down the graft and continuing into the outflow artery. The inflow and outflow vessels were assessed for quality of flow based on velocity, waveforms and colour flow characteristics. Peak systolic velocity was measured at sites of stenosis, at multiple sites within the graft and within the outflow vessel. The velocity ratio at the site of stenotic lesions was calculated. Grafts were categorized into four groups based on duplex findings at the first scan: (a) low risk grafts, (b) mild flow disturbances, (c) intermediate stenosis and (d) critical stenosis. Table 1 shows the duplex parameters used to define these groups.

Patient demographics, type of operation, conduit and follow-up information were recorded prospectively in a computerized database (Microsoft™ Access® and Excel®, Redmond, Washington, USA). Data analysis was performed retrospectively. Statistical analysis was performed using *Statistical Package for Social Sciences* version 12 SPSS® (SPSS, Chicago, Illinois, USA) statistical software. The groups were compared in terms of stenosis, need for intervention, graft patency and amputation. Patency and limb salvage were determined using Kaplan–Meier analysis. Difference between groups was assessed using the log rank test. $P < 0.05$ was considered significant.

Results

The initial patient group of 371 comprised 238 men and 133 women who had 385 bypass procedures in total. During the first 6 weeks after operation 21 grafts occluded and were excluded from further study, leaving 364 vein grafts in 352 patients (225 men and 127 women). The median (range) age of the patients was 71 (37–88) years; 148 (41%) were current smokers, 158 (43%) had diabetes and 32 (9%) had chronic renal failure. The indications for surgery are shown in Table 2. Three hundred and fifty eight bypasses were reversed vein grafts and six were in-situ bypasses. Three hundred and forty one bypasses had their origin at the femoral artery in the groin (93.7%), nine from the external iliac artery (2.5%) and 14 bypasses (3.8%) had their proximal anastomosis from the superficial femoral artery. The distal anastomoses were to the above knee popliteal (139, 38%), the below knee popliteal (154, 42%), and the tibial arteries (71, 20%). Overall 40-month primary patency, primary assisted patency and secondary patency rates were 73, 79 and 80 per cent, respectively.

The 364 bypasses underwent surveillance and the median (range) follow-up was 23 (2–60) months. The first postoperative vein graft surveillance scan was performed at a median of 6 weeks (range 4–9 weeks). At the time of the first duplex scan, 236 grafts (65%) had no significant stenosis; these grafts ran a benign course with a 40-month cumulative patency rate of 82 per cent and a limb salvage rate of 93 per cent.

The first postoperative scan identified 128 grafts with a significant flow abnormality (Table 3). The distribution of these flow disturbances along the length of the vein graft is shown in Fig. 1. Of the 29 grafts with a critical stenoses, 15 (52%) were repaired. A further 11 (38%) grafts with critical stenoses were not repaired and occluded during subsequent follow-up; in six a clinical decision was made not to intervene, three had been scheduled for repair but occlusion supervened, and two patients refused surgery. A final three (10%) grafts with critical stenosis were not repaired but did not change during follow-up.

Of 57 grafts with an intermediate stenosis at 6 weeks, 32 (56%) had lesions that progressed to a critical stenosis; nine (16%) lesions did not progress but the graft occluded during follow-up. Two grafts were repaired and 14 (25%) did not change or

Table 1. The velocity criteria identifying different categories of vein graft stenosis identified through duplex surveillance (PSV: Peak Systolic Velocity (cm/s), ABPI: Ankle: Brachial Pressure Index)

	PSV at the site of stenosis		Post stenotic PSV	Drop in ABPI
	Absolute value	PSV ratio		
Critical stenosis	>350	3.5	<40	>0.15
Intermediate stenosis	250–350	3	40–45	<0.15
Mild flow disturbance	200–250	2	>45	<0.15
Low risk grafts	<200	<2	>45	<0.15

Table 2. Indication for infrainguinal vein graft bypass in the study population

Indication	Number	(%)
Intermittent claudication	64	17.6
Critical ischaemia	279	76.6
Popliteal artery aneurysm (asymptomatic)	7	2
Popliteal artery aneurysm (symptomatic)	12	3.3
Popliteal artery aneurysm (ruptured)	2	0.5
Total	364	100