The Long-term Outcome of Infrainguinal Vein Graft Surveillance

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Objectives: Vein graft surveillance is of proven benefit in improving graft patency at least in the first year after arterial bypass surgery. The aim of this study was to look at the longer term outcome of a vein graft surveillance programme on graft patency.

Methods: One hundred and twelve consecutive vein grafts in 106 patients were prospectively entered into a vein graft surveillance programme. The median (range) follow up was 34 (1-76) months.

Results: There were 23 (21%) early (less than 1 month) failures and a further 15 grafts occluded during follow up. The primary, primary assisted and secondary patencies at 4 years were 27%, 59% and 67% respectively. Thirty-eight grafts (34%) developed at least one stenosis at a median interval of 5 months after the operation. Eight (21%) of these stenoses occurred more than 12 months after surgery and would have been missed had surveillance been curtailed after 1 year.

Conclusions: The benefits of graft surveillance extend beyond one year and surveillance should therefore continue indefinitely.

Key Words: Vein graft; Surveillance; Intimal hyperplasia.

Introduction

Infrainguinal vein graft surveillance has been shown to be of benefit in several studies in the maintenance of patency of bypass grafts.¹⁻¹² In a previous publication from our department¹ we reviewed 112 consecutive vein grafts which were followed up in our vein graft surveillance programme for a median period of 14 months. These vein grafts achieved a primary patency of 40% at 42 months with primary assisted and secondary patencies of 65% and 69% respectively. Those patients who remain alive with patent grafts continue to be followed up in our graft surveillance programme. This paper describes the longer term outcome of these grafts.

Patients and Methods

All infrainguinal vein bypass grafts performed between July 1988 and March 1992 were entered into our vein graft surveillance programme.³ There were 112 vein grafts in 106 patients. The median (range) age of the patients was 75 (32-97). The male:female ratio was 68:38, there were 37 (35%) diabetics, 25 (24%) patients had a previous history of ischaemic heart disease, 33 (31%) patients admitted to continued smoking postoperatively and 43 (41%) patients were on aspirin postoperatively.

The patients were examined in the vascular studies unit at intervals of 1, 3, 6, 9 and 12 months after their surgery then at 6 monthly intervals. A clinical assessment, measurement of resting and post-exercise ankle brachial pressure indices (ABPI), and Duplex scan of the graft took place at each visit. Since November 1991, the graft and tibial vessels have also been routinely insonated with a colour-coded Duplex scanner (Diasonics Spectra, Diasonics Sonotron, Bedford, U.K.). Arteriography was performed if there was a serial fall in the resting ABPI > 0.1 or a post-exercise fall in ABPI > 0.1 or a segmental peak velocity ratio increase > 3 on Duplex.

The initial treatment for any vein graft stenoses detected by surveillance was percutaneous transluminal angioplasty (PTA). Only one stenosis was treated primarily with open revision. This was for a long diffuse narrowing in the distal part of a below-knee popliteal in situ graft in a 70-year-old lady occurring 5 months after surgery. The graft details are shown in Table 1.
### Table 1. Graft details

<table>
<thead>
<tr>
<th>Indication</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Claudication</td>
<td>15</td>
<td>13%</td>
</tr>
<tr>
<td>Rest pain</td>
<td>38</td>
<td>34%</td>
</tr>
<tr>
<td>Tissue necrosis</td>
<td>59</td>
<td>53%</td>
</tr>
<tr>
<td>Graft type</td>
<td></td>
<td></td>
</tr>
<tr>
<td>In situ</td>
<td>79</td>
<td>71%</td>
</tr>
<tr>
<td>Reversed</td>
<td>33</td>
<td>29%</td>
</tr>
<tr>
<td>Graft position</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Above-knee popliteal</td>
<td>6</td>
<td>5%</td>
</tr>
<tr>
<td>Below-knee popliteal</td>
<td>30</td>
<td>27%</td>
</tr>
<tr>
<td>Distal</td>
<td>76</td>
<td>68%</td>
</tr>
</tbody>
</table>

### Data analysis

Graft patency was assessed using the recommendations of Rutherford\textsuperscript{13} based on the suggestions of the Ad Hoc Committee on Reporting Standards of the Society for Vascular Surgery.\textsuperscript{14} Primary patency was defined as uninterrupted patency after the initial surgery with no further procedure performed on the graft. Primary assisted patency requires that the graft remains patent but procedures such as PTA can be performed to prevent subsequent graft failure. Secondary patency allows procedures to be performed to salvage an occluded graft. Patients who died during follow-up were censored to their last clinic attendance. Statistical analysis was performed using the statistical package SPSS for Windows (SPSS, Chertsey, U.K.). Risk factors were compared using a Log Rank test\textsuperscript{15} for univariate analysis and a Cox proportional hazards model was used for multivariate analysis.\textsuperscript{16}

### Results

The 30 day mortality rate among the 106 patients undergoing surgery was 7%. Twenty-three (20%) of the grafts occluded during this period, four of these within the first 24 h. The median (range) follow up for all patients was 34 (1-76) months. Twenty-eight limbs (20%) were lost with a 4 year limb salvage rate of 79%. Thirty-eight grafts (34%) developed at least one stenosis during follow up. The median (range) interval to development of a stenosis was 5 (2-46) months. Eight primary stenoses occurred over 1 year after the initial operation. These stenoses had not been present at earlier attendances at the surveillance clinic.

Eight (7%) grafts required an inflow procedure at a median (range) interval of 15 (1-38) months after surgery, and 12 (11%) grafts required PTA of a run-off vessel at a median (range) interval of 31 (2-61) months after surgery. The presence of significant inflow or run-off disease was detected by the surveillance programme.

The primary, primary assisted and secondary patency curves are shown in Fig. 1. The primary assisted patency was significantly better than the primary patency ($p=0.0001$ Log Rank test).

Smoking, diabetes mellitus, critical ischaemia, single vessel run-off and the ingestion of aspirin were not found to significantly affect primary, primary assisted or secondary patency using either a univariate Log Rank test or a Cox multivariate regression analysis. There was an increased mortality associated with diabetes ($p=0.006$), those not taking aspirin ($p=0.006$), female gender ($p=0.03$), and patients with single vessel run-off ($p=0.0001$) using a Log Rank test. However, multivariate analysis showed diabetes not to be a significant factor but single vessel run-off ($p=0.04$), female gender ($p=0.04$) and not taking aspirin ($p=0.004$) were all still significant.

Limb salvage was adversely affected in a univariate Log Rank analysis by diabetes ($p=0.02$) but not in a multivariate analysis ($p=0.72$).

### Discussion

There are no controlled trials of vein graft surveillance but there are several reports in the literature strongly suggesting a benefit of surveillance in maintaining vein graft patency.\textsuperscript{1,2,4,5,6,8,9,17,18} The recommended duration of a surveillance programme is uncertain. The time course of vein graft intimal hyperplasia in humans is not as well worked out as it is in animals. Angelini et al. showed that in experimental vein grafts in pigs, there was an initial rapid increase in medial and intimal smooth muscle cells in the first week, followed by a rapid increase in matrix production up to 4 weeks after surgery.\textsuperscript{19} After this time, there was a slow but gradual increase in smooth muscle cell numbers. Intimal hyperplasia in human vein grafts is thought to be maximal in the first 12–18 months after surgery. Some authors have reported very few remediable problems after the first year\textsuperscript{9,20} and Taylor et al. reported no problems after the first year,\textsuperscript{21} recommending that surveillance should be curtailed...
after one year on the basis of cost. However, whilst intimal hyperplasia is relatively uncommon over 12–18 months after bypass surgery, atherosclerosis is quite common. Atherosclerotic plaques can develop within the vein graft or in the native arteries of the patient. If there is significant disease in an inflow or run-off vessel, this can be picked up by vein graft surveillance. In our study, we have found eight first-time stenoses occurring over 1 year after bypass surgery. As these stenoses were not excised, we can not be sure of their histology but they may well have been atherosclerotic. In addition, we have also found eight inflow and 12 run-off problems requiring treatment. These problems in the native vessels were due to the progression of atherosclerosis. Five of the inflow and eight of the outflow problems were found over 12 months after the initial operation. These problems would not have been found or treated had the patients not attended our graft surveillance clinic. Most stenoses will go on to cause graft occlusion and as the result of salvage procedures on occluded grafts are so poor, we feel an aggressive policy on management of graft stenoses is justified. Vein graft patency and limb salvage can be improved by an effective surveillance programme. This is beneficial to the patient and gratifying to the surgeon. Also in these cost-conscious times, it is important to prevent unnecessary amputations, as the estimated cost to the community of an amputation in 1992 was over £25 000. Therefore, despite the relatively low number of stenoses found after 1 year, we currently continue graft surveillance for life at 6 monthly intervals after the first year. As the surveillance programme is already in place, the cost of seeing another patient at 6 monthly intervals is relatively inexpensive (the cost for a private patient is currently £124 for a single limb and £155 for a bilateral scan) compared to the cost of an amputation.

It was disappointing to find that none of the risk factors associated with atherosclerosis seemed to have an effect on primary, primary assisted or secondary patencies in this cohort of patients. However, mortality was significantly affected by the presence of single vessel run-off preoperatively, female gender and the use of aspirin. The presence of a single run-off vessel is an indication of severe lower limb atherosclerotic disease and is a reflection of atherosclerotic disease elsewhere, particularly the coronary arteries. Female gender appears to adversely affect mortality but this is related to the fact that women develop atherosclerotic disease at a greater age than men. The median (range) age for women in this group was 76 (37–85) whilst the median (range) age for men was 67 (37–97). Aspirin has been shown to be beneficial in preventing cardiovascular morbidity and mortality and even if it does not improve graft patency, it may allow the patient to live longer with his patent graft. This in itself should be reason enough to recommend its routine use.

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References


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