The Effect of a Surveillance Programme on the Patency of Synthetic Infrainguinal Bypass Grafts


Department of Surgery, Clinical Sciences Building, Leicester Royal Infirmary, Leicester, LE2 7LX, U.K.

Objectives: Vein graft surveillance is widely acknowledged to be of benefit in improving graft patency at least in the first year after arterial bypass surgery. The aim of this study was to examine the effect of a surveillance programme on the patency of synthetic infrainguinal bypass grafts.

Design: A prospective study of 69 consecutive prosthetic bypass grafts was undertaken over a 3 year period.

Methods: Patients were seen at 3 monthly intervals after surgery and underwent measurement of ankle brachial pressure indices and a colour Duplex scan of the graft.

Results: The surveillance programme was able to detect treatable lesions in five grafts and in the run-off vessels of two other grafts prior to occlusion. However, 14 grafts failed after the first 30 days, 12 of which were not predicted by the surveillance programme.

Conclusions: Surveillance appears to be of limited benefit in the maintenance of patency of synthetic infrainguinal bypass grafts.

Key Words: Surveillance; PTFE; Infrainguinal bypass.

Introduction

Autologous saphenous vein is the conduit of choice for infrainguinal arterial bypass surgery.1 When there is no ipsilateral long saphenous vein available, alternative vein such as the short saphenous vein, the contralateral long saphenous vein or arm vein all give acceptable patency rates.2-4 It is only when these sources of vein are exhausted that many surgeons turn to the use of prosthetic alternatives such as polytetrafluoroethylene (PTFE), polyurethane, dacron, bovine vein or human umbilical vein. The reported patency rates for synthetic materials vary considerably with figures of 40–90% being quoted at 1 year,5-9 whilst at 5 years the values range from 18–60%.1,10-13 Even the best reported patency rates for prosthetic grafts do not match those of vein grafts. The most common reasons for failure of synthetic grafts are progression of atherosclerotic disease7,10-13 and anastomotic intimal hyperplasia.14 This contrasts with vein grafts where intrinsic stenoses due to intimal hyperplasia represent the commonest cause of graft failure between 1 month and 1 year after surgery.15-18 Few centres enter prosthetic grafts into surveillance programmes as the benefits of a surveillance programme for synthetic grafts have yet to be proven whilst surveillance for vein grafts is widely accepted to improve graft patency.

In order to assess the efficacy of synthetic graft surveillance, all prosthetic infrainguinal bypass grafts performed at the Leicester Royal Infirmary from January 1992 onwards were prospectively entered into a surveillance programme. Patients were seen postoperatively at 1 month then at 3 monthly intervals. The surveillance consisted of a clinical history, measurement of resting ankle brachial pressure index (ABPI), and a colour Duplex scan of the graft inflow, outflow and anastomoses. This paper describes the results of the programme.

Patients and Methods

All patients undergoing an infrainguinal bypass procedure between January 1st 1992 and December 31st 1994 using prosthetic material were prospectively entered into a surveillance programme. Surveillance of these grafts took place at one month then at 3 month intervals after the initial operation, providing the graft...
was still patent. The results described include those grafts which failed before they could attend the surveillance clinic.

All patients attending the surveillance clinic had a colour-coded Duplex scan (Diasonics Spectra, Diasonics Sonotron, Bedford, U.K.) of the graft inflow, outflow and the proximal and distal anastomoses. This took place in our Vascular Studies Unit where the patient was seen at each visit by an experienced technician. A peak systolic velocity ratio of > 2.0 at the anastomosis was taken to represent a significant anastomotic stenosis. A segmental peak velocity ratio > 2.0 in the native inflow or run-off vessel was taken as representing a significant native vessel stenosis. Initial treatment of anastomotic or native artery stenoses was by Percutaneous Transluminal Angioplasty (PTA).

### Data analysis

Graft patency was assessed using the recommendations of Rutherford based on the suggestions of the Ad Hoc Committee on Reporting Standards of the Society for Vascular Surgery. 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 such as thrombolysis or thrombectomy 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.).

### Results

There were a total of 69 synthetic grafts in 65 patients. The median (range) patient age was 69 (48–92) years. Forty-five of these patients were male and 20 were female. Twenty (29%) of the patients admitted to being smokers at the time of their operation, 18 (26%) were diabetic and 28 (41%) were hypertensive. Nineteen of the operations were performed for intermittent claudication, 42 for chronic critical limb ischaemia and eight for acute lower limb ischaemia.

In total, 49 above-knee popliteal, six below-knee popliteal, 12 femorodistal and two iliopopliteal grafts were performed using either PTFE (56 grafts), polyurethane ("Corvita") (10 grafts) or tanned bovine vein ("Procol") (3 grafts). The type of graft used at each position is shown in Table 1. A "Miller collar" of vein was used at the distal anastomosis in 30 (44%) cases. The median (range) follow up was 9 (1–34) months.

Sixteen grafts failed within the first 30 days postoperatively giving a 1 month patency rate of 77%. Seven patients died perioperatively producing a perioperative mortality rate of 10%. Six of these deaths were in patients having surgery for limb-threatening chronic critical ischaemia, the other patient had surgery for an acutely ischaemic limb. Five of the patients who died in the perioperative period did so after their grafts failed. Fifty-one patients remained alive with a functioning graft to enter the surveillance programme at 1 month.

After the initial 30 day period, 14 grafts subsequently occluded, 12 in the interval between surveillance clinic attendances. The median (range) time to occlusion in these grafts was 6.5 (3–32) months. Five grafts were found to have a treatable lesion at the distal anastomosis by the surveillance programme at a median (range) interval of 6 (3–30) months after surgery. Two of these grafts occluded prior to PTA. A further two grafts had treatable lesions detected in the popliteal artery distal to the anastomosis which were successfully treated by PTA.

The seven grafts with abnormal findings at surveillance are shown in Table 2. The primary, primary assisted and secondary patencies at 12 months were 54%, 55% and 55%. At 24 months the figures were 39%, 46% and 46%. The patency rates are demonstrated in the survival curve in Fig. 1. There is little difference between the primary assisted and secondary patency rates.

Whilst there is a preponderance of 'corvita' grafts among those found to have treatable lesions, there was no significant difference between the graft materials in the number of unexpected graft occlusions (p = 0.44, Log Rank test).

A Cox multivariate analysis of the following risk factors; diabetes mellitus, hypertension, ischaemic heart disease, continued smoking (as admitted by the patient), the site of the distal anastomosis, the use of a
Table 2. Abnormalities detected by surveillance

<table>
<thead>
<tr>
<th>Patient</th>
<th>Graft</th>
<th>Details</th>
</tr>
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<tbody>
<tr>
<td>66yr Male</td>
<td>Corvita, AK fempop</td>
<td>2.5x velocity increase in distal popliteal artery at 22 months post-op. Had successful PTA.</td>
</tr>
<tr>
<td>78yr Female</td>
<td>Corvita, AK fempop</td>
<td>4x velocity increase in popliteal artery at 12 months post-op. Had successful PTA.</td>
</tr>
<tr>
<td>63yr Male</td>
<td>Corvita, AK fempop</td>
<td>3x velocity increase at distal anastomosis at 5 months post-op. Graft occluded before angioplasty.</td>
</tr>
<tr>
<td>79yr Male</td>
<td>PTFE, AK fempop</td>
<td>2.5x velocity increase at distal anastomosis at 6 months post-op. Graft occluded before angioplasty.</td>
</tr>
<tr>
<td>66yr Female</td>
<td>Corvita, AK fempop</td>
<td>2.5x velocity increase at distal anastomosis at 3 months post-op. Had successful PTA.</td>
</tr>
<tr>
<td>65yr Female</td>
<td>PTFE, AK fempop</td>
<td>2.5x velocity increase at 29 months post-op. Had PTA of distal anastomosis and popliteal artery.</td>
</tr>
<tr>
<td>72yr Female</td>
<td>Corvita, AK fempop</td>
<td>3x velocity increase at distal anastomosis and 2x velocity increase inflow at 12 months post-op. Had successful PTA.</td>
</tr>
</tbody>
</table>

Miller cuff, the material used and the indication for the operation showed no significant differences in occlusion or stenosis rates between the groups. However, the numbers of grafts in each subgroup are small and it is difficult to draw any firm conclusions.

**Discussion**

Graft surveillance for vein grafts is of proven benefit in maintaining graft patency.4,17,18,23-32 However, the benefits from surveillance of PTFE grafts are not so clear. The main causes of PTFE graft failure are progression of atherosclerosis and anastomotic intimal hyperplasia and any surveillance programme would have to detect and allow treatment of these problems before graft occlusion occurred.33 As the results of treating a failed graft are worse than treating a failing graft, a surveillance programme would be of benefit in improving graft patency if it was cost effective and detected enough treatable lesions prior to graft occlusion.34 Stenoses can be treated by open operation or by PTA. Inflow and run-off disease can also be treated by PTA or by further arterial bypass surgery. If the graft has already occluded, then it may be treated by thrombolysis or thrombectomy prior to treating the underlying cause for the occlusion10 but the results are not as good.

There are few reports of surveillance programmes of synthetic grafts in the literature. Sanchez et al. retrospectively reviewed the results of their treatment of 91 ‘failing’ PTFE grafts performed over a 12 year period.34 These were grafts found to have a problem during routine follow up. They found 43 inflow and 83 outflow lesions in addition to 10 lesions within the graft itself and eight anastomotic lesions. These grafts had all been followed up in an outpatient setting at 1–2 monthly intervals for the first year, 3 monthly intervals for the second year and at 3–6 monthly intervals thereafter. Duplex scanning was available during the last 6 years of their study and ‘most’
patients were said to have had a Duplex scan during this time. However, the study is retrospective and the follow up protocol was not standardised. In addition, no mention is made of the number of unexpected graft failures during this time so we can not tell how successful their programme was at picking up problems. They conclude that a surveillance programme may allow detection and treatment of graft-threatening lesions but that a prospective study is needed.

Lalak et al. reported a prospective surveillance programme of 69 PTFE grafts over a 44 year period.33 Their report included only those patients who left hospital with a functioning graft and patients were seen at 1 month, 3 months then at 6 monthly intervals. There were no inflow or runoff problems found in this series but there were three proximal and one distal anastomotic stenoses requiring treatment. Twenty-seven grafts occluded during the 3 year follow up despite having been seen in the surveillance clinic during the preceding 6 months. They concluded that surveillance was of little benefit in improving overall synthetic graft patency.

A prospective randomised study of graft surveillance by Lundell et al.34 included 43 PTFE or composite grafts. Twenty-three of these grafts were allocated to intensive surveillance with ABPI measurements and Duplex scans at 1 month, 3 months then 3 monthly intervals. The remaining 23 grafts underwent ‘routine surveillance’ at 1 month then 12 monthly intervals. These grafts had ABPI measurements but did not have a Duplex scan. Two of their PTFE grafts in the intensive surveillance group developed anastomotic stenoses that were treated and one other PTFE graft with a stenosis occluded before it could be treated. Ten of their PTFE grafts and three of their composite grafts in the intensive surveillance group occluded without warning. There was no statistical difference between intensive and routine surveillance at 1 year but the numbers of PTFE grafts in the study were too small to make statistical comments beyond this time.

Before deciding whether or not a screening programme is useful, we have to determine how effective the screening method is and how expensive the screening process is. In our study, we were able to detect haemodynamic abnormalities in five grafts and in two run-off vessels which we believed were indicative of threatening graft occlusion. Two of the grafts with anastomotic stenoses occluded before the patient returned to have a remedial procedure. Whilst surveillance was certainly useful in these seven patients, we also had 12 grafts fail unexpectedly during follow up. Haemodynamic abnormalities were not detected despite the patients being in our surveillance programme. Assuming the Duplex scanning was carried out effectively, and we believe it was, we can only conclude that surveillance at 3 monthly intervals is of limited use in improving the patency of synthetic infravascular bypass grafts.

There are several possibilities why our grafts occluded between surveillance appointments and why we were unable to substantially alter our overall graft patency. Synthetic grafts are more thrombogenic than vein grafts and small haemodynamically insignificant stenoses causing minimal flow disturbance, which would not jeopardise vein graft patency, may lead to occlusion of synthetic grafts. Alternatively, the intimal hyperplasia at the anastomoses of synthetic grafts may progress more rapidly than that in vein grafts. Thus an insignificant stenosis seen on duplex may advance to cause a graft occlusion within the 3 month interval between surveillance appointments. The surveillance interval in Lalak’s study was even longer — 6 monthly after the first 3 months and there was a higher rate of unexpected graft occlusion. It would appear that the detection of treatable lesions in synthetic grafts before occlusion occurs is fraught with difficulties. A surveillance programme with a shorter interval between visits, perhaps monthly, may detect more treatable lesions but the costs of the programme would rise considerably. We conclude that a prosthetic graft surveillance programme can not be justified.

Acknowledgements

The authors are grateful for the help of Ms Hayley Handford, Mr Tim Hartshorne, Ms Abigail Thrush, Mrs Anne Reid and Mrs Sarah Nicholson in the follow up and assessment of these patients.

References

Synthetic Infrainguinal Bypass Grafts


Accepted 29 September 1995