The Morbidity of Secondary Vascular Access. A Lifetime of Intervention

A. C. Ruddle, P. A. Lear and D. C. Mitchell

Department of Vascular Surgery, Southmead Hospital, Bristol BS10 5NB, U.K.

Objectives: to examine the outcome and incidence of access-related procedures in patients who dialyse via PTFE secondary access grafts.

Design: retrospective case note study.

Results: recipients of secondary access procedures face a lifetime of haemodialysis access interventions. In total, 639 access-related procedures were performed on the 72 patients studied. At the end of the study five patients were wholly reliant on central venous catheters for dialysis access.

Patients with secondary access grafts have little hope of transplantation; only six of 72 patients received a transplant after a secondary access procedure.

Conclusion: the increasing number of patients coming to synthetic access-graft procedures and the morbidity of such procedures mean that surgeons should adopt strategies to minimise the use of grafts and limit the number of interventions performed. Careful planning will also reduce the number of central line placements and help to reduce the morbidity associated with long-term haemodialysis. Increasing resources will be required to meet the rising demand for secondary access provision.

Key Words: Secondary access; Access intervention.

Introduction

Increasing acceptance of elderly patients onto dialysis programmes and improved dialysis therapy has resulted in more patients receiving treatment for end-stage renal failure (ESRF). World-wide the incidence of treated ESRF is expected to double in the last decade of this century. The continuing shortage of organs for renal transplantation means that many patients accepted for ESRF treatment face life-long haemodialysis. Autologous fistula is the optimal method of haemodialysis access. In patients who do not have suitable veins, or to avoid the need to await fistula maturation, haemodialysis access may require the use of synthetic grafts (secondary access), or central lines. The results of secondary access procedures vary, probably due to the indications for placement and how aggressively graft malfunction is treated.

We examined the morbidity associated with failure to establish a native arteriovenous fistula. Our study focused on the number of access-related procedures performed on patients who ultimately require synthetic access-graft placement. We also examined overall patient outcome in this difficult group of patients.

Patients and Method

We conducted a retrospective case note study of all patients who received a polytetrafluoroethylene (PTFE, Impa) haemodialysis graft, placed between July 1991 and July 1996. Graft placements were identified through the renal unit computerised database and operation records.

Patients underwent access-grafting following failure of native arteriovenous fistula (AVF) or failure of such fistula to mature. It was our policy to exhaust forearm and antecubital fossa veins prior to placement of access grafts. Thigh grafts were used when arm veins were absent or arm-swelling prevented their use. Arm-swelling was seen in some patients who had undergone numerous subclavian-line placements and was presumed to be secondary to central venous stenosis. Duplex scanning and venography were not routinely used during the period under study. All graft placements received prophylactic antibiotics and were not used until at least 10 days had elapsed.
Patency rates were analysed by the Kaplan–Meier life-table methods. Log rank tests were used to compare groups. Graft failure was defined as graft occlusion, or graft removal/part removal for sepsis, whether requiring graft revision or replacement by a new site of access.

**Results**

In total there were 104 grafts placed in 72 patients in the five-year period studied (43 male and 29 female, mean age 52 years, range 19–76 years, including 14 diabetic patients with 19 grafts).

Grafts were placed in the forearm, wherever a suitable artery and vein could be identified. There were 21 straight forearm grafts from radial artery to a vein in the antecubital fossa. A further 21 grafts were placed in a forearm loop configuration between brachial artery and an antecubital vein. The majority of grafts (n = 45) were placed in an upper arm straight configuration between the brachial artery in the antecubital fossa and the basilic or brachial vein at the level of the axillary floor. Seventeen femoral artery to long saphenous vein thigh-loop grafts were also placed (Fig. 1).

**Graft survival complications and interventions**

The overall one-year secondary patency across all graft types was 56% (Fig. 2). Mean graft patency was 20.4 months (Table 1). There was no significant difference in secondary patency rates between graft configurations (log rank test).

**Graft malfunction**

During the study period there were 51 grafts that required intervention for malfunction as shown in Table 2. The commonest cause of graft failure was thrombosis caused by outflow vessel stenosis or thrombosis during low flow states associated with post-
A. C. Ruddle et al.

### Table 3. Overall patient outcome at the end of the study period.

<table>
<thead>
<tr>
<th>Patient outcome</th>
<th>Number of patients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Functioning access graft</td>
<td>48</td>
</tr>
<tr>
<td>Functioning transplant</td>
<td>6</td>
</tr>
<tr>
<td>Patient death</td>
<td>11</td>
</tr>
<tr>
<td>Dialysis via central line</td>
<td>5</td>
</tr>
<tr>
<td>Dialysis via fistula</td>
<td>2</td>
</tr>
</tbody>
</table>

### Table 4. Total procedures to maintain haemodialysis access.

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Central line insertion</td>
<td>310</td>
</tr>
<tr>
<td>Fistula formation</td>
<td>122</td>
</tr>
<tr>
<td>Fistula revision</td>
<td>33</td>
</tr>
<tr>
<td>PTFE graft placement</td>
<td>104</td>
</tr>
<tr>
<td>PTFE intervention</td>
<td>53</td>
</tr>
<tr>
<td>Other secondary access grafts</td>
<td>7</td>
</tr>
</tbody>
</table>

dialysis hypotension. Graft sepsis was the second commonest cause of graft failure (21% of grafts) (Fig. 3).

In total, there were 54 interventions for graft malfunction. Fourteen patients required a total of 22 interventions for graft occlusion. Simple graft thrombectomy was performed in 12 cases, thrombolysis in one, and in nine cases graft thrombectomy was combined with a procedure to treat outflow obstruction (thrombectomy plus skip graft \( n = 7 \), thrombectomy plus angioplasty \( n = 2 \)).

Graft occlusions treated by thrombectomy or lysis alone all rapidly re-occluded (time to re-occlusion median 18 days, interquartile range (IQR) 39, \( n = 13 \)). Where thrombectomy was combined with an outflow procedure there was a trend to better long-term patency, with the median time to re-occlusion being 210 days (IQR 112, \( n = 4 \)). Five grafts were still patent at the end of the study period after a median follow-up of 317 days (IQR 208, \( n = 5 \)).

Fourteen patients underwent 21 operative procedures for graft sepsis, in one case complicated by haemorrhage. In 17 cases the grafts were excised and a new graft sited elsewhere. On four occasions grafts were successfully treated by local debridement combined with excision and replacement of infected sections of graft. Thigh grafts had the highest rate of interventions for graft sepsis. The commonest infecting organisms were *Staphylococci* and *Coliform* sp.

All patients in whom grafts required re-exploration, for thrombosis or re-siting, were anticoagulated.

**Patient outcome**

At the end of the study period, 48 patients were still dialysing via an access graft. Eleven patients had died, two with functioning access grafts. Two patients were dialysing through an autologous fistula. Five patients were wholly dependent on central venous catheters (Table 3).

These 72 patients who underwent synthetic access grafting had been treated for a total of 383 years, since onset of haemodialysis. In this time a total of 639 procedures were performed to maintain haemodialysis access (Table 4).

**Transplant history**

Of the 72 patients in this study, 25 patients had received a total of 34 renal transplants at some time during their treatment for renal failure. In the patients studied, 18 had received one transplant, five had been transplanted twice and two patients had been transplanted three times.

Only six patients received a renal transplant following a secondary access procedure.

**Incidence of secondary access procedures**

During the study period there was an increase in the number of patients treated by haemodialysis by our unit. This has been caused by an increase in demand for dialysis. The number of secondary access placements has risen rapidly during this period. The number
Correction of outflow tract abnormality is essential if revision procedures are to be successful. It has been proposed that it is more effective to replace rather than revise thrombosed access grafts. During the period under study five of our patients had exhausted all potential sites for definitive access procedures and were wholly reliant on central venous catheters. Patient access opportunities are finite and all attempts should be made to prolong the use of an access site before using a new graft site.

Graft sepsis accounted for 21% of graft failures. In particular, thigh grafts had a high incidence of graft sepsis. Attempts to lessen graft sepsis may contribute to improving the results of secondary access procedures. Avoidance of thigh grafts may reduce sepsis rates, but such grafts may be required if arm veins are exhausted or blocked. Vein allografts have demonstrated resistance to infection in both haemodialysis and peripheral vascular surgery. In patients and graft sites susceptible to infection, vein allografts may offer an alternative to PTFE grafts. This area merits further research.

Discussion

The rise in the haemodialysis population is not being accompanied by a commensurate rise in the number of transplants. We have seen that secondary access recipients are a selected population with a low probability of obtaining a functioning renal transplant. Despite a policy of aggressive use of native vessel arteriovenous fistula, our unit is seeing a relentless rise in the need for synthetic access grafts.

Secondary access-graft recipients have a high access-related morbidity with numerous interventions required most commonly to treat graft thrombosis and sepsis. If the substantial numbers of access interventions are to be minimised, it is essential that interventions are effective and do not compromise the results of future access procedures. In the patients studied, a large number of temporary catheters were used, which in turn may cause central vein stenosis, further limiting access options. Internal jugular catheters cause less vein stenosis than subclavian catheters. It is now our practice to avoid the use of subclavian catheters. Our secondary patency rates are lower than many in the literature, and this may relate to the high incidence of central vein stenosis and the high use of thigh loop grafts.

Graft thrombosis treated by simple thrombectomy or lysis alone is followed by rapid reocclusion. Correction of outflow tract abnormality is essential if revision procedures are to be successful. It has been proposed that it is more effective to replace rather than revise thrombosed access grafts. During the period under study five of our patients had exhausted all potential sites for definitive access procedures and were wholly reliant on central venous catheters. Patient access opportunities are finite and all attempts should be made to prolong the use of an access site before using a new graft site.

Graft sepsis accounted for 21% of graft failures. In particular, thigh grafts had a high incidence of graft sepsis. Attempts to lessen graft sepsis may contribute to improving the results of secondary access procedures. Avoidance of thigh grafts may reduce sepsis rates, but such grafts may be required if arm veins are exhausted or blocked. Vein allografts have demonstrated resistance to infection in both haemodialysis and peripheral vascular surgery. In patients and graft sites susceptible to infection, vein allografts may offer an alternative to PTFE grafts. This area merits further research.

Conclusions

The increasing number of patients coming to synthetic access-graft procedures and the morbidity of such procedures mean that surgeons should adopt strategies to minimise the use of grafts. Careful planning will also reduce the number of central line placements and help to reduce the morbidity associated with long-term haemodialysis.

Acknowledgements

A. C. Ruddle is supported by the National Kidney Research Fund grant number R42/2/94 and Southmead Hospital Research Fund. Miss D. Nguyen. Conflicts of interest: none.

References

4. ETHERIDGE E, HAIN SD, MAESER MN, SICARD GA, ANDERSON CB.


Accepted 15 January 1999