The Crossover Femoropopliteal Bypass: A Useful Option for Unilateral Iliofemoral Occlusive Disease

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Objective: To study the outcome of treating critical limb ischaemia due to concurrent, unilateral iliac and femoral arterial occlusive disease by the placement of a crossover femoropopliteal bypass graft.

Design: Retrospective study of 10 patients unfit for aortic reconstruction whose disease was not amenable to endovascular therapy who were treated with this graft.

Materials: Seven grafts originated from the common femoral artery, two from aortobifemoral graft limbs and one from the common iliac artery. There was no direct revascularisation of the profunda femoris artery. The distal anastomosis was to the above-knee popliteal artery in nine cases and to the below-knee popliteal artery in one.

Outcome measures: Follow-up after discharge from hospital consisted of regular ankle-brachial index measurement and Duplex ultrasound scan assessment to record graft patency and limb salvage.

Results: The median duration of secondary patency was 52.5 months (range 14--84). During follow-up, there were four occlusive events. One graft had its patency restored, but in the other three patients, graft occlusion was associated with limb loss (at 18, 51 and 83 months respectively). In one of this latter group, surveillance had identified a failing graft and a jump graft prolonged patency for a further 34 months.

Conclusion: This experience demonstrates that the crossover femoropopliteal bypass achieves satisfactory limb salvage in patients with extensive iliofemoral occlusive disease who are not suitable for major aortic reconstruction.

Introduction

The traditional surgical treatment of patients with concurrent iliac and femoral arterial occlusive disease has been with the placement of an aortobifemoral bypass.¹ In some such cases, where inadequate distal revascularisation has been achieved via the profunda femoris artery, an additional “outflow” procedure, in the form of a femoropopliteal bypass has been advocated.²³ As far as unilateral iliac artery occlusive disease is concerned, the surgical options lie between an ipsilateral iliofemoral bypass,⁴⁻⁵ femorofemoral crossover,⁶⁻⁷ or axillofemoral grafting.⁸ More recently, the advent of endovascular intervention has meant that a large proportion of these patients can be managed satisfactorily by percutaneous transluminal balloon angioplasty with or without stenting, thereby obviating the need for major surgery altogether.

There is a sub-group of patients with unilateral iliofemoral occlusive disease, however, who are medically unfit for aortic surgery and whose pattern of disease is not amenable to either endovascular recanalisation or to the traditional bypass graft options. In such circumstances it has been our practice to place an extra-anatomic, crossover graft from the contralateral femoral artery to the popliteal artery on the symptomatic side and this paper reports our experience with this operative technique.

Patients and Methods

Between 1985 and 1994, ten patients (7 men, 3 women) of median age 64 years (range 53–81) were treated for critical limb ischaemia with a crossover femoropopliteal bypass graft in the Vascular Surgery Unit of the Royal Infirmary of Edinburgh. In the same time period, there were 636 surgical reconstructions performed for aortoiliac occlusive disease.

Nine of the patients in this series presented with either pain at rest or non-healing ulceration and in one instance, a patient had an infected iliofemoral bypass graft. As can be seen from Table 1, several of the patients studied had undergone previous vascular intervention. In more detail, two patients presented...
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Table 1. Details of the 10 patients treated with the crossover femoropopliteal graft

<table>
<thead>
<tr>
<th>Patient</th>
<th>Previous vascular intervention</th>
<th>Angiogram appearances</th>
<th>Inflow/outflow</th>
<th>Graft material</th>
<th>Primary patency (months)</th>
<th>Secondary intervention</th>
<th>Secondary patency (months)</th>
<th>Limb salvage</th>
<th>Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rest pain</td>
<td>CFA endart 23 and 8 yrs prev</td>
<td>CFA, EIA, CFA, PFA, SFA occl. 3 vessel run-off</td>
<td>CFA/AKP</td>
<td>6mm</td>
<td>PTFE</td>
<td>64</td>
<td>No</td>
<td>—</td>
</tr>
<tr>
<td>2</td>
<td>Rest pain</td>
<td>Nil</td>
<td>CFA, EIA, CFA, SFA occl. 2 vessel run-off</td>
<td>CFA/AKP</td>
<td>8mm</td>
<td>PTFE</td>
<td>84</td>
<td>No</td>
<td>—</td>
</tr>
<tr>
<td>3</td>
<td>Rest pain</td>
<td>ABF 18/12 prev (rest pain)</td>
<td>Graft limb, PFA, SFA occl. Peroneal run-off</td>
<td>Graft limb/AKP</td>
<td>8mm</td>
<td>PTFE</td>
<td>29</td>
<td>No</td>
<td>—</td>
</tr>
<tr>
<td>4</td>
<td>Rest pain</td>
<td>Nil</td>
<td>EIA, CFA, PFA, SFA occl. 2 vessel run-off</td>
<td>CFA/BKP</td>
<td>8mm</td>
<td>PTFE</td>
<td>54</td>
<td>No</td>
<td>—</td>
</tr>
<tr>
<td>5</td>
<td>Rest pain</td>
<td>ABF 24/12 prev (aortic occlusion)</td>
<td>CFA, SFA occl. 3 vessel run-off</td>
<td>Graft limb/AKP</td>
<td>8mm</td>
<td>PTFE</td>
<td>50</td>
<td>Yes</td>
<td>—</td>
</tr>
<tr>
<td>6</td>
<td>Gangrene</td>
<td>CFA balloon angioplasty</td>
<td>CFA, PFA, SFA occl. Peroneal run-off</td>
<td>CFA/AKP</td>
<td>8mm</td>
<td>PTFE</td>
<td>18</td>
<td>Yes</td>
<td>—</td>
</tr>
<tr>
<td>7*</td>
<td>Rest pain</td>
<td>Nil</td>
<td>CFA, bilat SFA occl. 2 vessel run-off</td>
<td>CFA/AKP</td>
<td>8mm</td>
<td>PTFE</td>
<td>49</td>
<td>Yes</td>
<td>—</td>
</tr>
<tr>
<td>8</td>
<td>Infected iliofemoral bypass 2/12 prev</td>
<td>CFA, EIA, SFA occl. 2 vessel run-off</td>
<td>CFA/AKP</td>
<td>6mm</td>
<td>PTFE</td>
<td>14</td>
<td>Yes</td>
<td>—</td>
<td>Yes</td>
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<tr>
<td>9</td>
<td>Rest pain</td>
<td>Lumbar phenol sympathectomy</td>
<td>CFA, EIA, CFA, PFA, SFA occl. 2 vessel run-off</td>
<td>CFA/AKP</td>
<td>8mm</td>
<td>PTFE</td>
<td>51</td>
<td>Yes</td>
<td>—</td>
</tr>
<tr>
<td>10</td>
<td>Ulceration and rest pain</td>
<td>Preop stenting Donor CIA</td>
<td>CFA, EIA, CFA, PFA, SFA occl. PT run-off</td>
<td>CFA/AKP</td>
<td>8mm</td>
<td>PTFE</td>
<td>20</td>
<td>Yes</td>
<td>—</td>
</tr>
</tbody>
</table>

CIA: Common iliac artery; EIA: External iliac artery; CFA: Common femoral artery; PFA: Profunda femoral artery; SFA: Superficial femoral artery; AKP: Above-knee popliteal artery; BKp: Below-knee popliteal artery; PT: Posterior tibial artery; ABF: Aortobifemoral bypass; PTFE: Polytetrafluoroethylene; MI: Myocardial infarction; CVA: Cerebrovascular accident; PE: Pulmonary embolism; *: See Figure 1.

with occlusion of one limb of an aortobifemoral graft, one had undergone common femoral endarterectomy and vein patch on two occasions, one had been treated with common iliac artery percutaneous balloon angioplasty and in one case, a lumbar phenol sympathectomy had been performed prior to surgical intervention. In only one patient (Patient Number 10) was the "donor" artery treated (with balloon angioplasty and stenting) prior to bypass placement. Preoperative angiography demonstrated extensive occlusive disease affecting the iliac and femoral arteries in all cases.

Surgical exposure of the donor vessel (or graft limb) was via a standard groin incision in nine cases and in one patient, the common iliac artery was exposed retroperitoneally through an iliac fossa incision. The popliteal artery was exposed above or below the knee joint via a standard medial approach. In all cases, a small relieving incision was necessary in the groin on the recipient side, to allow for tunnelling of the graft. Grafts were placed in a subcutaneous supra-pubic tunnel and were then led subsartorially to the popliteal artery. Details of the inflow and outflow vessels are shown in Table 1. The profunda femoris artery was not revascularised directly because it was either seen to be severely diseased on preoperative angiograms, or the extent of profunda disease was thought to be responsible for the failure of the two aortobifemoral graft limbs, or there was an infected iliofemoral graft present.

Externally-reinforced polytetrafluoroethylene was the conduit utilised in this series, the graft diameter being 8mm in eight patients and 6mm in two. Details of postoperative morbidity and duration of hospital stay were noted.

After discharge, all patients were monitored at regular vascular out-patient clinic visits using a combination of clinical assessment, ankle-brachial
index measurement and more recently, annual Duplex ultrasound scans of the grafts. Thus graft patency, limb salvage and patient survival were recorded.

Results

There was no perioperative or postoperative (30 day) mortality. Three patients developed a minor, short-lived wound complication (two lymph leaks and one minor infection) and two suffered chest infections that required treatment with antibiotics. One patient (patient number 8) suffered a postoperative cerebrovascular accident from which he made a good recovery. The median postoperative hospital stay was 16 days (range 5–47 days) and in all but one case (patient number 8), patients were discharged directly home.

The median duration of primary graft patency was 49.5 months (range 14–84). During the follow-up period (median 52 months, range 14–84), one patient (number 7) complained of recurrent rest pain. Duplex scanning showed the crossover femoropopliteal graft to be patent and subsequent angiography (Fig. 1) demonstrated progression of occlusive disease in the popliteal artery to be the cause of the recurrence of symptoms. A jump graft was performed to the peroneal artery and the patient remained asymptomatic for a further 34 months, at which time the graft thrombosed and ultimately an above-knee amputation was necessary. There were three other occlusive events during follow-up. One graft was treated successfully by a balloon catheter thrombectomy and this conduit is still patent 74 months after the initial bypass procedure. In the other two cases of graft occlusion, patency could not be restored and major limb amputation was required. Thus the median duration of secondary patency was 52.5 months (range 14–84). As can be seen from Table 1, long-term graft patency did not appear to be related to the number of calf run-off vessels that were patent at the time of the original bypass procedure. Long-term limb salvage was achieved in seven of the 10 patients in this series.

During the follow-up period, three patients died, two from myocardial disease and one from a pulmonary embolism sustained whilst recovering from a limb amputation.

Discussion

The use of extra-anatomic bypass grafting for limb salvage in patients not fit for major arterial reconstruction is not a new concept. The femorofemoral crossover graft was first described in the 1950s by Freeman and Leeds9 and its popularity was increased after the reports of such authors as Vetto in the early 1960s.10 There is now extensive literature on the use of femorofemoral grafting to treat unilateral iliac artery

Fig. 1. Angiogram taken after crossover femoropopliteal graft had been in place for 49 months. The patient complained of recurrent rest pain in the left foot and angiography showed a patent graft in spite of disease progression with occlusion of the popliteal artery (arrow). A jump graft was performed to the peroneal artery, which alleviated symptoms and maintained graft patency for a further 34 months.
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being quoted. 6'-11'-14 The advent of catheter-guided endovascular therapy has meant that in many cases, operative intervention is no longer the primary treatment advocated by many for iliac occlusive disease, although the long-term patency rates of iliac artery balloon angioplasty and stenting have yet to be evaluated and so formal comparisons to extra-anatomic grafting cannot be made at this stage. There is a sub-group of patients that present with critical limb ischaemia and are found to have unilateral atheromatous occlusive disease involving both the iliac and the femoral arteries. In such patients, if the profunda femoris artery is also involved, there is no guarantee that revascularisation of the femoral segment will be adequate to alleviate symptoms. It was when faced with such a problem in the late 1950s, that McCaughan and Kahn suggested taking a graft from the asymptomatic side's external iliac artery to the above-knee popliteal artery on the contralateral, symptomatic side. 15 This graft was tunneled extraperitoneally above the bladder and was also anastomosed side-to-side to the profunda femoris artery. These authors achieved limb salvage in both of the patients they reported in which this operative approach was used.

Since then, this configuration of extra-anatomic bypass has been described in the vascular surgical textbooks. 19 However, the only other significant reports in the vascular surgical literature of the crossover femoropopliteal bypass have come from Schuler et al. In 1984, they reported a series of 13 such grafts, 10 of which consisted of a single length of prosthetic graft taken from the donor side common femoral artery to the contralateral popliteal artery, with a side-to-side anastomosis to the profunda femoris, and three grafts in which a prosthetic femorofemoral bypass was augmented by an autogenous vein femoropopliteal graft, taken from the hood of the crossover graft's distal anastomosis to the popliteal artery of the affected limb. 16 They quoted a 42 month patency rate of 91% for the femorofemoral portion of such grafts and 63% for the distal segment. The limb salvage rate was 88%. In a subsequent publication from the same group, 17 in which their experience over 9 years utilising this technique in 21 patients was reviewed, they reported a 5 year primary patency rate of 57% for the femorofemoral segment and a 40% for the femoropopliteal segment, in association with a limb salvage rate of 77%. The interesting differences between the present series and these two reports are two-fold. First, it has not been our practice to revascularise directly the profunda femoris artery on the symptomatic side. In all of the patients reported here, this vessel was either seen to be severely diseased angiographically, or had been associated with the failure of an aortobifemoral graft limb or was involved in an infected field and it was felt that the thigh would be perfused satisfactorily through collaterals via retrograde flow from the distal anastomosis. Second, all of our patients required bypass for limb salvage whereas, Schuler's group placed a number of these grafts to treat patients with intermittent claudication.

In 1978, Veith et al. described a variety of interesting extra-anatomic grafts placed for limb salvage. 18 Included in their series were five grafts taken from one femoral artery to the opposite popliteal or even to the tibial vessels. The mean patency of this sub-group of grafts was 12 months, with the longest duration of patency being 17 months. Limb salvage was achieved in four of these patients.

We believe that for this sub-group of patients with multi-level, unilateral, atheromatous occlusive disease, the crossover femoropopliteal graft is a useful therapeutic option. In our experience, this technique was associated with minimal intra- and postoperative morbidity and all but one of the patients studied were discharged directly home. Long-term graft patency was satisfactory and correlated with limb salvage. Follow-up surveillance identified one threatened graft which was revised successfully by means of a distal jump graft thereby extending patency (and limb salvage) by a further 34 months. Graft occlusion occurred in a total of four bypasses, only one of which was reopened successfully. The fact that the other three occlusive events were associated ultimately with limb amputation confirmed the degree of limb threat that existed in these patients and suggested that progression of occlusive disease may have been a significant factor in late graft failure. However, there did not seem to be a correlation between the number of patent infrapopliteal vessels seen on preoperative angiography and the long-term patency of the graft.

In conclusion, the femoropopliteal crossover graft offers a practicable solution to the problem of limb salvage in the small sub-group of patients who have concomitant, unilateral iliac and femoral occlusive disease in whom major aortic surgery is not possible due to intercurrent cardiorespiratory disease and in whom the extent of disease precludes conventional operative or endovascular intervention.

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References


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