Subsartorial Mid-thigh Graft for Hemodialysis Access in Patients with Exhausted Arm Veins
A Novel Strategy

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Abstract:
To study the value of a mid-thigh graft as an alternative in the provision of long-term vascular access in patients requiring hemodialysis 11 patients (9 females, 2 males) aged 27–71 (mean 48 years) with unsuitable arm veins underwent surgery between February 2001 and January 2004 to create an arteriovenous fistula (AVF) between the superficial femoral artery (SFA) and superficial femoral vein (SFV). There were no deaths due to the procedure, no limb losses, no technical failures and all fistulae matured satisfactorily. Complications included two cases of thrombosis (surgically thrombectomised at 15 and 24 months post-operatively), one case of graft infection at three years post-operatively (treated by graft excision), and one graft failure at five years post-operatively (replaced with a second graft at the same site). After three years 10 grafts were functional and being used for dialysis. It was concluded that a mid-thigh graft is a suitable durable procedure in patients where creation of vascular access at the upper limbs is not feasible. Adequate clinical and radiological surveillance is imperative.

Introduction:
A well-functioning vascular access is essential to achieve long-term survival and optimal quality of life for patients requiring hemodialysis. The radio-cephalic fistula fashioned at the non-dominant arm is the first choice, followed by the brachiocephalic fistula at the elbow. In the absence of a suitable cephalic vein at the forearm and arm a fistula can be fashioned using a prosthetic graft or a transposed basilic vein.

When both the non-dominant and dominant arm vessels are exhausted, remaining options for long-term access are groin and thigh arteriovenous fistulas. Infection is a frequent complication in the groin and is associated with anastomotic dehiscence, haemorrhage and death.

A novel strategy that may reduce the risk of graft infection is to position a prosthetic loop graft between the femoral artery and vein in the sub-sartorial canal. This requires only a short incision in the mid-thigh and allows placement of the graft in the cleaner distal thigh region (Figure 1).

Figure 1

Patients and Methods:
Between February 2001 and January 2004 about 1,200 patients were referred to the Department of Vascular Surgery in Queen Alia Military Hospital for creation of primary, secondary or tertiary vascular access in addition to salvage of malfunctioning vascular access and management of vascular access complications.

After clinical and Duplex examinations 14 were found unsuitable for vascular access at the upper limbs; five of these had no suitable arm veins after multiple previous vascular access procedures; five had signs of venous hypertension by central venous occlusion, where angioplasty had failed to recanalize the occluded veins; three underwent removal of the graft at the upper limb due to infection; one patient had an extensive burn scar on both arms and another had bilateral subclavian artery stenosis.
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All patients underwent clinical examination followed by Duplex imaging to evaluate the arterial system for the presence of peripheral arterial occlusive disease, and the venous system to rule out deep vein thrombosis. The long saphenous vein was evaluated for size, course and anatomical variations. Two patients were converted to peritoneal dialysis and the one male with the burn scar decided to continue hemodialysis via subclavian permcatheter.

In the remaining 11 patients surgery was performed under spinal, epidural or local anesthesia to create an arteriovenous fistula using a mid-thigh graft. All patients received pre-operative antibiotic prophylaxis (0.5 gram of mefoxitin or cefatazidim i.v).

The patient was placed in the supine position and the whole leg was prepped and draped. After mild flexion of the knee (about 30 degrees) a folded towel was placed underneath the knee. A longitudinal incision, 7-10 cm, was made at the upper border of the Sartrius muscle at the mid thigh. After dissection of the subcutaneous tissue and fascia, the Sartrius muscle was retracted posteriorly. The superficial femoral artery and vein were dissected in the subsartorial canal taking care to preserve the saphenous nerve. A 35-40 cm long, 6 mm PTFE graft was tunneled subcutaneously, inferio-lateral to the mid-thigh incision, through two small skin incisions at the anterior aspect of the thigh and a third incision at the lateral aspect of the thigh. Both ends of the graft were tunneled proximally, parallel to each other and to the dissected femoral vessels forming a sharp angle less than 45 degrees with these vessels. After both ends were cut in an S-shaped fashion the femoral vein was sacrificed; the graft was examined for the presence of a thrill and distal pulses were palpated to rule out steal. The subcutaneous fascia at the medial incision was approximated with absorbable interrupted stitches and the wounds were closed with interrupted nylon sutures. The patients were admitted for one day. The fistula was allowed to be used five weeks after surgery. The patients were followed up by regular visits in the clinic and in cooperation with the dialysis units.

Results:

There were no deaths associated with the procedures. All of the fistulae matured well and were ready to be used for regular haemodialysis after five weeks.

Two fistula thrombosed 15 and 24 months after surgery. The first graft thrombosed in the presence of severe stenosis at the venous anastomosis due to neo-intimal hyperplasia. Revision of the venous anastomosis and surgical thrombectomy were necessary to restore blood flow. In the second patient thrombosis occurred during an attack of hypotension and was treated with surgical thrombectomy. One patient underwent closure of the graft three years after surgery following successful kidney transplantation. Graft infection occurred in one patient three years after surgery and treated by excision of the graft and repair of the artery and vein. After three years 10 of the 11 mid-thigh grafts were still patent.

The first patient in whom this procedure was applied endured five years of adequate function before the graft needed replacement with a new one at the same site due to graft failure from repeated punctures.

<table>
<thead>
<tr>
<th>Primary Patency</th>
<th>Primary Assisted Patency</th>
<th>Secondary Patency</th>
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<tbody>
<tr>
<td>12 months</td>
<td>100%</td>
<td></td>
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<tr>
<td>24 months</td>
<td>82%</td>
<td>100%</td>
</tr>
<tr>
<td>36 months</td>
<td>73%</td>
<td>91%</td>
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Discussion:

Adequate care of a patient with end-stage renal failure on hemodialysis requires a permanent vascular access that delivers a flow rate adequate for dialysis prescription, has a good functional length of survival (secondary patency) and is associated with a low complication rate.

The recent expansion of renal replacement therapy has been associated with an increase in the number and complexity of patients requiring permanent vascular access. General principles involved in access planning to improve access patency and patient survival are (1) the use of an autogenous vein where possible, (2) construction of distal AVFs in the arms first, preserving more proximal sites for subsequent procedures, (3) preservation of the superficial veins of the arm and central veins of the thorax by avoiding venepuncture, and peripheral and central cannulation, and (4) fistula construction before the onset of renal replacement therapy.

The first choice of AVF is the Brescia Cimino radio-cephalic arteriovenous fistula, first described in 1966. (1) In the absence of suitable vessels at the wrist the next choice of AVF is the brachio-cephalic fistula at the antecubital fossa. These fistulas can be fashioned under local anesthesia and are also resistant to infection compared with constructions using polytetrafluoroethylene (PTFE) grafts. (4,5,7)

In the absence of suitable superficial veins in the arm or forearm the next best type of access is a choice between prosthetic arteriovenous graft insertion and the brachiobasilic AVF using basilic vein transposition. [309x349]the brachiobasilic AVF using basilic vein transposition.
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(4,5,9) Expanded PTFE is the most popular graft material having the advantage that it is easy to handle, is always available, and can be inserted under local anaesthesia in a wide variety of configurations depending on the available vascular anatomy. (4)

The transposed autologous brachio-basilic AVF is fashioned by mobilising the basilic vein from its subfascial bed, transposing it to a subcutaneous tunnel on the anterior surface of the arm and anastomosing it to the brachial artery at the level of the antecubital fossa. The procedure is technically feasible in 95–98% of cases owing to the subfascial location of the vein protecting it from previous venipuncture. It has the advantages of resistance to infection as well as requiring only one anastomosis. (6,7,8,9)

When both arm veins are not suitable, remaining options to create long-term vascular access are groin or mid-thigh prosthetic arteriovenous access. In the groin the choice lies between using the saphenous vein or prosthetic material to form an arteriovenous fistula. A graft in the groin is associated with a number of serious complications including graft infection and ischemia. Graft infection is a particular risk in the distal groin and is associated with anastomotic dehiscence, hemorrhage and death. (10,11) The incidence of infection in groin PTFE grafts ranges from 1.6 to 3.5 percent (other reports describe a leg amputation rate of 22 per cent and a mortality rate of 1.8% attributable to infection. (4,5,10,11,12)

A novel strategy to reduce the incidence of infection is to place a prosthetic loop graft between the femoral artery and vein in the subsartorial canal (Figure 1). This requires only a short incision in the mid thigh and allows placement of the graft in the cleaner distal thigh region. (9)

The exposure of the superficial femoral artery and vein in the subsartorial canal is easier than in the groin for placement of the graft and for excision of the graft if infection occurs. Our series further emphasises the previously reported benefits. Our patients have particularly found the procedure beneficial in the limitation of body exposure during dialysis (Figure 2).

Figure 2

To avoid using synthetic grafts in the thigh, transposition of the superficial femoral vein for creation of vascular access in a configuration similar to a transposed basilic vein is an alternative in selected patients. (12,13,14)

The design of protocols in which clinical variables and measurement of access function are registered is required for effective surveillance. This surveillance protocol should be able to detect stenosis at an early stage where angioplasty can re-establish adequate function of the access before thrombosis occurs. (3,4)

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References: