An innovative vascular access option for haemodialysis

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Abstract

Traditionally an upper limb arteriovenous fistula (AVF) or arteriovenous graft (AVG) is the first choice for vascular access for haemodialysis. For the group of patients unable to maintain a functioning access the use of a long term central venous dialysis catheter (CVDC) has been necessary. This case study describes an innovative Polytetrafluoroethylene (PTFE) graft from the subclavian artery to the inferior vena cava for the first time in a regional haemodialysis unit. This unit's experience with the graft has been very positive. It has been easy to cannulate and has not presented any difficulties when used three times per week for haemodialysis treatment. The patient reports being comfortable with the placement of the graft and is relieved to have been offered this option on a background of multiple failed upper arm AVF/AVG and three episodes of line sepsis. Long term CVDC can be a poor choice in relation to infection and those patients with no potential for successful access in the upper limbs can be considered for alternative access procedures. Itis likely that renal nurses will become increasingly involved in caring for haemodialysis patients that have dialysis access placed other than in the limbs.

Key Words

vascular access, haemodialysis, PTFE (polytetrafluoroethylene), subclavian artery, inferior vena cava

Introduction

One of the challenges facing haemodialysis treatment is maintaining a well functioning vascular access. Vascular access complications account for 20% of hospital admissions for this group of patients (Suckling et al 2007). The first choice for most patients receiving dialysis will be an upper limb arteriovenous fistula (AVF) that utilises native vessel (James et al 2009) or a Polytetrafluoroethylene graft (PTFE). Whilst the longevity of a native vessel AVF is good, more often patients are presenting for dialysis with poor vasculature and an arteriovenous graft (AVG) is the only alternative. The PTFE graft is usually reserved for patients that have no suitable arm or leg veins. PTFE grafts have lower rates of patency and require more frequent intervention to maintain patency (James et al 2009). For patients on dialysis for a number of years this may mean that the vascular access will fail and require replacing a number of times.

Whilst the AVF/AVG can be upper or lower arm repeated graft failure and revision may render the limb unsuitable for new access placement due to vein stenosis and occlusion and it is not uncommon for all the usual AVF sites to fail (Chemla et al 2006). When PTFE grafts are placed in the femoral triangle, infection and graft failure rates are usually high (Chemla et al 2005). This leaves patients with limited options for access placement and the emergence of a group of patients with a long term CVDC as their only access for haemodialysis. These catheters carry a higher risk of infection in the haemodialysis population (Finelli et al 2005). CVDCs also contribute to vessel stenosis including the superior vena cava making a future successful vascular access less likely (Rabetoy 2005).

Emerging advances in vascular surgery have seen the placement of some innovative and unusual PTFE grafts that are referred to as 'exotic' (Hazinedaroglu 2004). Some examples of this type of vascular access are necklace grafts (Morsy et al 2008) and femoral artery to superior vena cava (Suckling et al 2007). The following case study showcases a innovative graft from the subclavian artery to the inferior vena cava.

Background

A 48 year old male presented with septicaemia and a history of long term access complications. Renal failure is secondary to Spina Bifida with reflux nephropathy. Haemodialysis was commenced in September 2002 via a left arm AVF using a Saphenous vein loop. This AVF required revision due to stenosis and thrombosis and subsequently a PTFE graft was created in the same arm. Revision of vascular access occurred on 5 occasions between 2002 and 2007. The final upper limb graft occluded in 2007 and a thrombectomy was performed. The graft became infected and underwent debridement in April 2007 and a wound break down left the graft exposed and requiring antibiotic treatment and daily dressings for several weeks. During this time the patient dialysed via a CVDC. This CVDC subsequently became infected and was removed in June 2007.

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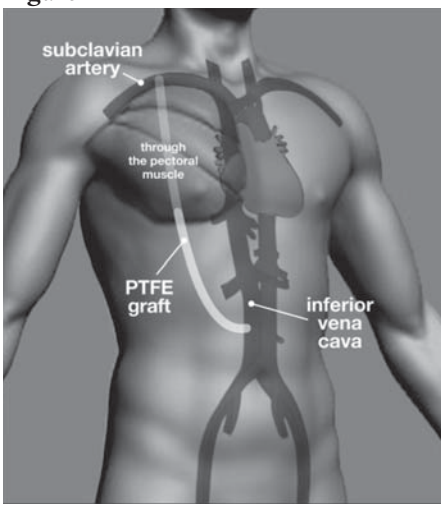
Following failure of this graft a native brachiocephalic AVF was created in the right upper arm. This AVF failed to develop due to a subclavian vein stenosis which had been unsuccessfully surgically treated in February 2008 with a stent placement. Anticoagulation therapy was contraindicated due to mennorhagia. Gross oedema of the right arm occurred as a complication of the occlusion. The patient during this time dialysed via a CVDC placed in the femoral vein. The AVF was again unsuccessfully revised in May 2008. In the year that the patient had dialysis via a CVDC, the line was removed and replaced on three occasions and the patient required admission for septicaemia. Including the line sepsis in 2007, the patient had a CVDC replaced due to infection on three occasions and on one occasion due to thrombosis. During the final admission prior to graft placement, the patient was receiving dialysis via a poorly functioning femoral CVDC and required admission to intensive care for management of life threatening septicaemia.

Method

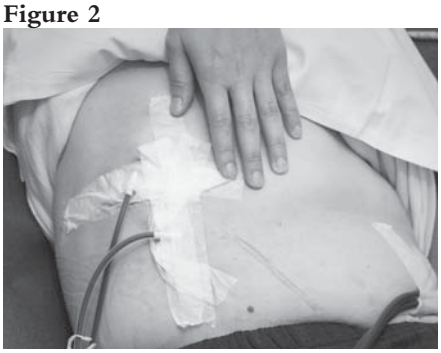
Figure 1



In January 2009 a PTFE graft was joined to the patient's right subclavian artery via an end (graft) to side (SCA) anastomosis, and the inferior vena cava via an end (graft) to side (IVC) anastomosis.

The inferior vena cava was chosen due to occlusion of the superior vena cava and bilateral iliac vein stenoses. The graft is tunnelled and easily visible, palpable and accessible from below the right breast to mid abdomen, a length of some 20cm *(see Figure 2)*. The patient's post-operative course was uneventful. Immediately post-procedure a strong bruit could be heard in the graft. The wound was stapled and followed an uneventful standard healing process. The patient continued haemodialysis as an outpatient via a CVDC whilst awaiting wound healing and resolution of swelling. It is standard practice in this unit to avoid using a new PTFE graft for six to eight weeks.

Figure 2



The photograph (*Figure 2*) shows needles in place for haemodialysis, the patient is lying on their left side and the nurse's hand is resting on the rib cage.

Results

The graft was successfully cannulated eight weeks post insertion. Size 16g needles were used initially with a blood flow rate of 200ml per minute increasing to size 15g needles and a desired optimum of 350ml per minute. The direction of flow needs to be assessed in any new vascular access and in this case the flow is head to pelvis (subclavian artery to inferior vena cava). The arterial needle is placed pointing up towards the patients head, and the venous needle is placed below this pointing downwards. Bleeding is observed to stop promptly following the use of haemostatic gauze and pressure for 10 minutes. The needle sites are dressed with gauze and tape which remains in place until the following morning. This process is considered by this unit to be standard treatment for all PTFE grafts. There has been no evidence of excessive bruising or inflammation. The puncture sites follow the usual healing process seen in the more traditional types of AVG. The patient is now stable and independent at home and the graft has been cannulated successfully three times per week for maintenance haemodialysis for over one year.

The patient reports that the graft feels no different to other PTFE grafts used in the past and has not noted any adverse effects. All temporary lines have been removed and the oedema in the right arm has significantly decreased. Some initial nervousness from nursing staff about excessive bleeding once the needles were removed have been overcome and most staff now approach this graft in the same way as other grafts.

Two recirculation studies performed using thermodilution and blood temperature monitoring (Schneditz et al 1999) reveal a recirculation rate of 6- 8% when used with correct needle orientation and 11-16% when the orientation is reversed. This result indicates that the flow within the graft is likely to be greater than two litres. High-output cardiac failure is a rare complication of high flow AVF/AVG and the flow for this access is similar to some brachiocephalic AVF (MacRae et al 2004).

Banding and surgical closure of AVF has occurred for patients developing frank symptoms of congestive heart failure (MacRae et al 2004). Consideration of this would be on an individual case basis taking into account the difficulty of establishing a new vascular access.

The significance of this high flow access for nursing practice is to treat any bleeding from this graft as if it were haemorrhage from a major artery. This unit's policy is to record access flows every 2 months and report any sudden decrease or a trend of lower readings for further investigation and that a graft should have a flow of at least 1000ml per minute or above to be considered functional and without need of intervention to a graft should have a flow of approximately 1000ml per minute to be considered functional and without need of intervention.

Conclusion

Innovations in vascular access have presented new opportunities to improve outcomes for those patients facing the challenge of maintaining a functioning vascular access for haemodialysis. No longer is a long term CVDC seen as the only option. Even patients with advanced vascular disease and multiple failed AVF could be candidates for the placement of a graft in previously unconsidered locations. Our unit's experience has shown us that this PTFE graft is easy to use and has not presented the staff or the patient with any difficulties. We now find ourselves actively referring patients with a long term CVDC to the vascular team for consideration of alternative placement of access for haemodialysis.

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