Flow-Arrest Interventional Repair of Renal Allograft Arteriovenous Fistula and Pseudoaneurysms

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ABSTRACT: As core biopsies of transplanted kidneys remain the “gold standard” for diagnosis of rejection, the risk of iatrogenic complications such as arteriovenous fistula (AVF) and pseudoaneurysms remains quite real. This case report describes a case of a 59-year-old female with a suspected occult post-biopsy AVF and pseudoaneurysm which over 6 years became enlarged and multilobulated, discovered on routine follow-up imaging. As the patient was symptomatic with flash pulmonary edema, intervention was planned. Angiography demonstrated a complex network of pseudoaneurysms with high flow drainage to the renal venous system. As initial attempts at coil embolization failed due to high flow velocities, a proximal and distal balloon occlusion technique was implemented along with a combination of coils (Axium; Covidien) and glue (Trufil; DePuy) to obtain lasting resolution of the patient’s pathology with minimal risk of embolization material flowing distally. The authors theorize that this technique will facilitate similar results in various high-flow situations, as with transplant AV fistulas.

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Several complications occur after renal transplantation, such as graft dysfunction, recurrence of primary disease, and systemic complications such as infection, hypertension, and malignancy. The complication that clinicians are most wary of is transplant rejection. Percutaneous needle biopsy is the primary modality to assess for rejection; however, with this procedure numerous complications such as arteriovenous fistula (AVF), pseudoaneurysms, arteriocalyceal fistula, and arterial thrombosis can occur. The reported incidence of AVF is 5% to 10% with a majority being treated successfully using interventional therapy. Several case reports have been published regarding this complication, however none use this specific technique, which works effectively and efficiently. This report describes a case of an iatrogenic trilobed pseudoaneurysm with a communicating AVF that developed several years after a post-transplant biopsy treated using a novel interventional approach to cure the lesion.
CASE REPORT

A 59-year-old female had a past medical history of autosomal dominant polycystic kidney disease diagnosed in 1994 after recurrent kidney infection. Four years later she needed hemodialysis and later peritoneal dialysis due to end-stage renal disease. Her symptoms of abdominal and lumbar pain along with recurrent urinary tract infections increased incrementally, and thus, she was ultimately scheduled for elective bilateral nephrectomy in July 2000 with a deceased donor kidney transplant in August 2000. Over the course of the next seven years, the patient was lost to follow-up.

After moving to another state, our patient returned with a high creatinine level of 1.9 mg/dL and disclosed her noncompliance with immunosuppression medication due to financial constraints. Because her creatinine level did not decrease in the following 3 weeks, the diagnosis of rejection was considered and a biopsy was performed. In November 2007, ultrasound was used to localize and obtain two core biopsies, and ultrasound was again used after the procedure to visualize the transplanted kidney. There were no obvious signs of hematoma or fistula at that time. The pathology report showed acute T-cell mediated rejection, chronic allograft arteriopathy, mild interstitial fibrosis, and tubular atrophy. The patient’s immunosuppression dosage was adjusted and she was discharged. In August 2009, the patient had a renal ultrasound showing a possible lower pole AVF and right external iliac vein aneurysmal dilatation that could be due to the AVF. The patient was asymptomatic and intervention was not performed. The patient was again lost to follow-up.

In March 2013, the patient had a multiplanar multi-sequential MRI/MRA of the pelvis that showed a 3.1 cm x 3.7 cm pseudoaneurysm in the lower pole of the transplanted kidney that is likely due to the AVF mentioned in the ultrasound report from 2009. Also there was dilatation of the proximal right external iliac vein up to 2.1 cm x 3.4 cm, which may represent a second aneurysm. The possibility of a third aneurysm from the renal artery could not be ruled out. An ultrasound revealed a large AVF in the lower pole of the transplanted kidney with peak systolic velocities up to 546 cm/sec. The right external iliac vein dilatation was also noted on ultrasound. As the patient became symptomatic with flash pulmonary edema (by presumed high-flow shunting) we decided to intervene, and the patient was admitted for the interventional radiology procedure.

Upon consent, sedation, and sterile preparation, the right common femoral artery was accessed using a micropuncture needle, and following a series of exchanges, a 5 Fr vascular sheath was placed. Using an Omniflush catheter (AngioDynamics), a right external

Figure 1. Digital subtracted angiogram demonstrates a multilobed renal transplant pseudoaneurysm with a communicating AV fistula.
iliac arteriogram was obtained and showed moderate focal stenosis of the right renal artery anastomosis. Next, the right renal artery was catheterized with a 4 Fr Glidecath Cobra catheter (Terumo) and an angiogram was obtained that showed a solitary inferior pole artery supplying a series of pseudoaneurysms that communicated with a downstream AVF to the renal vein (Figure 1). This was followed with subselective catheterization of a supplying artery with a Progreat (Terumo) microcatheter coaxially advanced. The microcatheter was further advanced via the pseudoaneurysms into the AVF and into the right common iliac vein. Sequential pull-back angiograms demonstrated the outflow via the renal vein and also demonstrated three dominant pseudoaneurysms along the course of the AVF.

Based on these findings, initial attempts were made to perform coil embolization with a detachable Ruby coil (Penumbra) using various techniques. The coils could not securely be anchored into the supplying artery due to the high flow velocity so the access device was exchanged for a 6 Fr Ansel sheath (Cook Medical). However, the sheath could not make the final turn of the inferior pole renal artery and the mechanical effects of the sheath placement caused vasospasm and non-flow-limiting dissection.

Subsequently, a flow-arrest approach was utilized. From the left groin, femoral access was achieved with a 21-gauge micropuncture needle under ultrasound guidance. A 12 Fr sheath was then advanced superiorly and across into the right external iliac vein. Over the guidewire, a 30 mm Coda occlusion balloon (Cook Medical) was placed into the right external iliac vein. Then, from the arterial access, the 6 Fr Ansel sheath was replaced with a 7 Fr Terumo destination sheath. The hemostatic hub was replaced allowing for parallel placement of 2 microcatheters. A 7 mm x 15 mm Hyperform balloon catheter (Covidien) was placed into the inferior pole renal artery at the neck of the pseudoaneurysm, and the Coda balloon in the right external iliac vein was inflated. Contrast injection demonstrated significantly decreased flow.

During this time, 10 Axium detachable coils (Covidien) ranging from 12 mm to 18 mm in diameter were placed along with Trufil glue, n-butyl cyanoacrylate liquid agent with 1:1 nca:lipiodol (Cordis Endovascular). The initial attempt at coil placement was suboptimal (Figure 2), though a well-formed, tightly packed coil mass was able to be formed within the pseudoaneurysm (Figure 3). A repeat angiogram

![Figure 2. Digital subtracted angiogram demonstrates suboptimal positioning of initial Axium coil (Covidien), which was not detached and subsequently removed. The Coda balloon (Cook Medical) is located in the right external iliac vein.]
demonstrated slow persistent flow via the coil mass. The Hyperform balloon catheter and the Coda balloon catheter were removed, demonstrating stability of the coil mass (Figure 4). The angiogram demonstrated no further flow to the aneurysm or fistula and decreased flow to the adjacent inferior pole arterial branch (Figure 5). Based on these findings, all access devices were removed and hemostasis was achieved with manual compression. We recommended a 6-week course of systemic anticoagulation to prevent venous thrombus, and the patient was discharged with subcutaneous dalteparin. Ultrasound evaluation 1 month following the procedure demonstrated no flow consistent with embolized trilobed pseudoaneurysm and AVF.

**DISCUSSION**

Acute or chronic rejection occurs in 30% to 40% of patients after renal transplant. When suspected, conservative measures such as evaluation of blood chemistries and radiologic imaging are used, however core needle biopsy remains the “gold standard.” Core needle biopsy carries about a 12% risk of vascular complication, the most common being AVF. An AVF is caused by concurrent destruction and repair of arterial and venous walls. The clinical presentation of AVF varies from asymptomatic to hypertension, hematuria, flash pulmonary edema, and a pulsatile painful mass which can accurately be identified on Doppler-ultrasound imaging.

Another more rare complication of core needle biopsy is pseudoaneurysm, which forms due to destruction of the arterial wall during the biopsy procedure.
The perivascular tissue liquefies during the repair process, leaving a sac continuous with arterial flow. Progressive enlargement of an AVF and pseudoaneurysm can occur, risking rupture and severe hemorrhage. Thus, some clinicians prefer to treat despite 70% of AVF resolving spontaneously. A study by Perini et al showed that the clinical success of microcatheter and microcoils in persistent or symptomatic AVF can be effectively utilized with improvement, but conservative management with ultrasound surveillance is recommended if asymptomatic.

Interventional transcatheter embolization is performed as treatment for AVF and pseudoaneurysms when there is persistent hematuria, high-flow shunts, deterioration of kidney function, or high risk of rupture. Nakatani et al described a technique similar to ours with balloon occlusions in the feeding AVF artery and exiting vein, but the intrapseudoaneurysmal space was instead filled with 50% glucose solution and ethanol in order to form a thrombus. Twenty-four hours later, this form of thrombus was insufficient to close the AVF, so intervention was performed a second time using a balloon catheter in the exiting renal vein and additionally embolizing the AVF using 2 microcoils. Although this method succeeded, we found it to be more efficient to use balloon occlusions in both afferent and efferent vessels to slow flow and insert detachable coils and n-butyl cyanoacrylate liquid agent (glue) simultaneously rather than separately. A case series by Lorenzen et al discussed the use of interlocking detachable coils placed in the feeding vessels to anchor and prevent coil migration within the AVF. We attempted this technique at first, but because of the high flow velocity, the coils would not stay in place. Therefore, we believe a flow-arrest method with balloon catheters in both afferent and efferent vessels while placing detachable coils and glue is most effective, especially for advanced cases such as a high-velocity AVF with 3 pseudoaneurysms.

Our case is rare in that the AVF and pseudoaneurysms were treated 6 years after renal biopsy, allowing for ample time for enlargement and exacerbation of these vascular complications. Most other cases involved a time period of less than 5 years. In summary, post-renal allograft biopsies should be carefully evaluated for vascular complications with echo Doppler imaging, and for high-flow fistulous lesions where embolization carries the risk of inadvertent distal migration of the coil mass, use of a proximal

**Figure 5.** A final renal angiogram after deployment of coils and glue embolization of the lower pole pseudoaneurysm/AVF. Preservation of normal renal vessels and parenchyma was demonstrated.
balloon to induce flow arrest is an elegant technique to safely obliterate these challenging lesions. This technique could facilitate the interventional approach to AVF and pseudoaneurysm repair.

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