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Treatment of large renal allograft arterial pseudoaneurysm with *in situ* cold perfusion, *ex vivo* vascular reconstruction and re-implantation

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ABSTRACT

Background: Pseudoaneurysm after renal transplantation is a rare but serious complication.

Case Presentation: We report a case of a 76-year-old man who presented six weeks after kidney transplant with a large pseudoaneurysm arising from the renal artery anastomosis, causing renal vein compression and renal allograft dysfunction. Prior to the removal of the transplanted kidney, an *in situ* cold perfusion of the allograft was performed. The pseudoaneurysm was repaired *ex vivo* and the renal artery was reconstructed. External iliac vein was reconstructed with deceased donor interposition allograft, and the kidney was then re-implanted. The patient recovered with immediate allograft function.

Conclusions: Successful surgical management of a large renal allograft arterial pseudoaneurysm involves avoidance of dissection of the pseudoaneurysm, utilization of *in situ* cold perfusion and en-bloc removal of the kidney together with pseudoaneurysm, and pseudoaneurysm incision and vascular bypass reconstruction *ex vivo*.

Implication for health policy/practice/research/medical education:

Following renal transplant, the development of arterial pseudoaneurysm may result in significant morbidity and mortality. In this case report of a patient who developed a large allograft arterial pseudoaneurysm six weeks after transplant that resulted in allograft dysfunction, we demonstrate successful surgical management, resulting in patient recovery and allograft function. Physicians and surgeons should be aware of this rare complication as a differential to the presentation of allograft dysfunction, and the important principles and techniques used in repairing this challenging scenario.

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1. Background

Development of pseudoaneurysm following renal transplantation is a rare and serious complication. The most common etiologies for this vascular insult include technical error due to improper anastomotic technique and infection (1). We report a case of a transplant renal artery pseudoaneurysm that was diagnosed and treated six weeks after renal transplant. The surgical approach employed included *in situ* cold perfusion, *ex vivo* renal artery bypass with deceased donor iliac artery, and re-implantation.

2. Case Presentation

A 76-year-old man with a history of end stage renal disease secondary to type 2 diabetes mellitus and hypertension, previously treated with nightly peritoneal dialysis, underwent a deceased donor kidney transplant. His pre-transplant serum creatinine was 8.9 mg/dL. He received a left kidney from a 41-year-old brain dead donor, which was placed in the right iliac fossa (cold ischemic time 19 hours, warm ischemic time 37 minutes). His post-operative course was unremarkable and he was discharged on post-operative day (POD) 5

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with a serum creatinine of 1.0 mg/dL. Six weeks after renal transplantation, patient's serum creatinine increased to 2.6 mg/dL, and he was admitted for evaluation of renal dysfunction. He was asymptomatic, and his physical exam was unremarkable. A renal transplant Doppler ultrasound demonstrated a large 4.5 cm vascular structure with elevated flow velocity, located near the external iliac and renal artery, suspicious for pseudoaneurysm (Figure 1A). Patient underwent an arterial angiogram, which confirmed the presence of a pseudoaneurysm at or near the level transplanted renal artery anastomosis (Figure 1B).

Given the size of the pseudoaneurysm and concerns for rupture, the decision was made to proceed with surgical correction. A computed tomography (CT) angiography with 3D reconstruction was performed for pre-operative planning, which revealed a 3.7 × 2.8 × 6.8 cm pseudoaneurysm compressing the renal vein (Figure 1C). This also revealed that the pseudoaneurysm extended deeply into the hilum of the renal allograft, thereby indicating that surgical excision would be associated with high risk of vascular and collecting system injury.

The size and extensive hilum involvement of the pseudoaneurysm precluded a direct dissection of the pseudoaneurysm as noted above. Our preoperative intent therefore was to remove the allograft and perform *ex vivo* bench repair. In addition, we expected that the *ex vivo* bench repair would be best performed via opening the pseudoaneurysm, identifying the renal artery above the pseudoaneurysm, with reconstruction via a direct end-to-end anastomosis of the distal renal artery to a deceased donor iliac artery interposition graft. Cryopreserved cadaveric iliac artery, blood type O, was requested prior to the operation.

Intraoperatively, patient underwent a midline laparotomy. After complete mobilization of the renal allograft and division of the transplant ureter at the level of the ureter neocystostomy, the external and internal iliac arteries and veins were identified (Figure 1D), and proximal and distal vascular control were obtained. Dissection of the external iliac artery and vein was then carried to the point where both renal arterial and venous anastomoses were seen. Complete dissection of the renal artery and vein with isolation of the iliac artery and vein anastomotic sites was judged to be too difficult and dangerous due to the very large pseudoaneurysm.

At that point, a decision was made to perform *in situ* cooling and preservation with University of Wisconsin preservative solution, followed by completion of the vascular dissection under total vascular occlusion.

This was accomplished by clamping of the proximal and

distal external iliac artery and vein, with distal transverse incision of the iliac artery to allow for cold perfusion and transverse incision of the external iliac vein to vent preservation solution and blood from the transplant kidney. The external iliac artery and vein were dissected after cold perfusion of the allograft with renal artery and vein sharply transected at the level of the iliac artery and vein anastomoses.

The allograft and pseudoaneurysm were removed en-bloc. The pseudoaneurysm was excised *ex vivo* (Figure 1E), and the renal artery was reconstructed on the back table with an interposed cadaveric iliac artery of 7 cm (Figure 1F). The defect in the native external iliac artery was repaired with an end-to-end anastomosis, while the defect in the external iliac vein was repaired with cadaveric

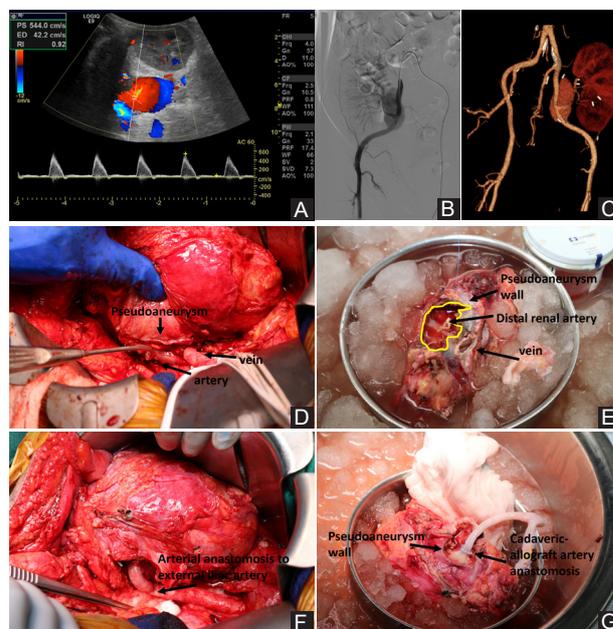


Figure 1. (A) Renal transplant ultrasound demonstrating a large 4.5 cm arterial structure with elevated flow velocity and resistive index of 0.92 near the external iliac and renal arteries. (B) Arterial angiogram of the right external iliac artery demonstrating a pseudoaneurysm originating from the renal artery-external iliac artery anastomosis along with perfusion of the allograft. (C) Computed tomography of the pelvis with angiography and 3-D reconstruction of the pseudoaneurysm in relationship to the external iliac artery and allograft. (D) The allograft was dissected free from its lateral attachments and posterior attachments to the retroperitoneum. The surgeon's thumb overlies the wall of the pseudoaneurysm, and the allograft artery and veins are exposed. (E) The wall of the pseudoaneurysm (highlighted in yellow) was excised on the back bench and noted to surround the artery and compress the adjacent renal vein. (F) To facilitate re-transplantation, donor cadaveric artery was anastomosed end-to-end (arrow) to the allograft renal artery. (G) The allograft was re-transplanted in the right iliac fossa and re-perfused.

common iliac vein interposition graft. The allograft was re-transplanted in the right iliac fossa (Figure 1G). Uretero-ureterostomy was performed using the native ureter and over a ureteral stent. An allograft biopsy was performed prior to the completion of the operation. The total operative time was 9.5 hours. Estimated blood loss was 2.9 L, and the patient was transfused with eight units of packed red blood cells and two units of fresh frozen plasma.

Postoperatively, there were no complications. Foley catheter was removed on POD 7, and patient was discharged on POD 8 with a serum creatinine of 0.8 mg/dL. Surgical pathology demonstrated acute and chronic inflammation of the excised pseudoaneurysm without evidence of bacterial or fungal organisms. The allograft biopsy demonstrated acute tubular injury without evidence of acute cellular rejection or antibody mediated rejection. Six weeks after the operation, the patient was doing well with a serum creatinine of 0.7 mg/dL.

3. Discussion

The incidence of transplant renal artery pseudoaneurysm, due to infectious or technical etiology, is <1% following renal transplantation (2,3). Patients may present without symptoms, or have local tenderness and a pulsatile mass on exam. If the pseudoaneurysm ruptures, the patient may manifest with hypotension and sudden abdominal pain. Diagnostic modalities include duplex sonography, CT and the gold standard angiography (4).

In our case, duplex sonography was the initial test that revealed the unexpected pseudoaneurysm during routine workup for renal allograft dysfunction, which then prompted further evaluation with traditional catheter angiography. After a decision was made about surgical intervention, a CT angiography with 3D reconstruction was done for preoperative planning, particularly to evaluate the relation of pseudoaneurysm to iliac and renal veins. A CT-angiogram showed an extrinsic compression of the renal vein by pseudoaneurysm, which could explain the patient's renal dysfunction and elevated serum creatinine.

Treatment indications for pseudoaneurysms include size greater than 2.5 cm, increasing in size, presence of symptoms, and rupture (1,5). Treatment options include percutaneous thrombin injection for smaller pseudoaneurysms, endovascular approach with stenting to exclude the pseudoaneurysm, and surgical excision (5-9). We favored a surgical intervention based on the size of the pseudoaneurysm, proximity to the renal artery anastomosis, impending rupture, and compression of the renal vein. In selected patients, endovascular treatment

is associated with higher rates of graft salvage compared to surgery (9). This was not an option for our patient because of the compression of the renal vein due to the large size of the pseudoaneurysm.

We chose a midline laparotomy incision to maximize surgical exposure. A lateral incision through an old surgical scar as well as direct dissection of the pseudoaneurysm were considered too unsafe due to an increased risk of damage to the pseudoaneurysm. *In situ* cold perfusion with en-bloc removal of the graft, following by repair of the pseudoaneurysm and vascular reconstruction on the back table allowed us to minimize damage to the kidney and to avoid life-threatening hemorrhage.

4. Conclusions

We present a unique and challenging case of a large pseudoaneurysm after renal transplantation. The important principles in this case were avoidance of dissection of the pseudoaneurysm, utilization of *in situ* cold perfusion and en-bloc removal of the kidney together with pseudoaneurysm, and pseudoaneurysm incision and vascular bypass reconstruction *ex vivo*.

Authors' contribution

BTX and AAR drafted the manuscript. MCC and ESW provided clinical consultation and critical revisions to the manuscript. All authors approved the manuscript.

Conflicts of interest

Authors declare no conflicts of interest.

Ethical considerations

Ethical issues (including plagiarism, data fabrication, double publication) have been completely observed by the authors. The patient has given his informed consent regarding publication of this case report.

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