

Renofemoral shunt for protection of abdominal allografts during emergency abdominal aortic surgery

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Emergency aortic surgery can be a daunting task in patients with functioning kidney and pancreas allografts because it poses the risk of allograft loss due to prolonged warm ischemia created by aortic cross-clamping. We present a case in which dual allografts, both originating from the right iliac arterial system, were protected from warm ischemia during aortic cross-clamping by creation of a temporary renofemoral shunt between the native left renal artery and right femoral artery. This simple technique maintained pulsatile allograft perfusion during aortic reconstruction for treatment of a ruptured mycotic aortic aneurysm complicated by an aortocolonic fistula. (*J Vasc Surg Cases* 2015;1:113-5.)

Emergency surgery for abdominal aortic aneurysms (AAAs) in patients with functioning kidney and pancreas allografts risks allograft failure. Hypotension, hypovolemia, and warm ischemia (WI) from aortic cross-clamping may contribute to this risk.¹ Studies in canine models have demonstrated that WI times in excess of 30 to 60 minutes predict irreversible kidney and pancreas allograft damage.² Preservation of the transplanted allografts has important long-term implications on patient survival. Kidney graft loss increases mortality by more than threefold,³ and although repeat transplantation is an option, the success rates of repeat transplantation are inferior.⁴

We present a case in which a patient with a prior kidney and pancreas transplantation presented with a ruptured mycotic aneurysm complicated by formation of aortocolonic fistula. Intraoperative perfusion to the pancreas and kidney allografts was maintained by creating a renal-to-femoral shunt. A series of reports describe aortic surgery with and without the use of temporary bypass in kidney transplant recipients,⁵⁻⁸ but there is a dearth of literature about the protection of a pancreas allograft during such surgery. The patient gave consent for the publication of his data.

CASE REPORT

A 61-year-old man with prior endovascular exclusion of a saccular infrarenal AAA presented with blood from the rectum.

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Author conflict of interest: none.

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The editors and reviewers of this article have no relevant financial relationships to disclose per the Journal policy that requires reviewers to decline review of any manuscript for which they may have a conflict of interest.

2352-667X

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<http://dx.doi.org/10.1016/j.jvsc.2015.03.006>

His medical history includes type 1 diabetes mellitus. He underwent living donor kidney transplantation in 2010, originating from the right external iliac artery and vein, and cadaveric pancreas transplantation 9 months later, originating from the right common iliac artery and the inferior vena cava. The pancreas allograft was drained by enteric drainage.

Twenty-two months after the pancreas transplantation, the patient was found to have a traumatic saccular AAA protruding from the medial wall of the infrarenal aorta 4 cm proximal to the aortic bifurcation. This was thought to have resulted as a sequela to a severe road traffic accident with multisystem trauma, which the patient had suffered a year previously.

The AAA was chosen for endovascular repair based on measurements of the aneurysmal neck and landing zones. Endovascular exclusion of the aneurysm was achieved with a AneuRx 18-mm diameter × 55-mm length stent graft (Medtronic, St Paul, Minn) with a 2-cm landing zone in the normal aorta above and below the aneurysm. A completion angiogram demonstrated no endoleak.

The patient presented 3 months later with back pain and blood from the rectum. A computed tomography scan with contrast demonstrated a ruptured AAA at the site of the previous repair, with contrast opacification extending into the right colon (Fig 1). The patient was transferred to our center due to the complexity of care needed going forward. He was and remained hemodynamically stable, with normal kidney and pancreas function, throughout this time.

Description of operation. Retroperitoneal exposure was achieved through a midline laparotomy. The left renal artery was transected. Full systemic heparin anticoagulation was administered. A 6-mm Propaten polytetrafluoroethylene graft (Gore Medical, Flagstaff, Ariz) was sewn end-to-end to the stump of the left renal artery. This graft was then externalized through the laparotomy, and the distal anastomosis was performed end-to-side to the right common femoral artery (Fig 2). Renal femoral flow was initiated before aortic cross-clamping. The abdominal aorta was clamped immediately below the renal arteries. Distal control was achieved by clamping the proximal bilateral common iliac arteries. The right iliac clamp was placed proximal to the origin of the pancreatic allograft. Pulsatile perfusion to the kidney and pancreas was achieved with retrograde flow and was confirmed by Doppler

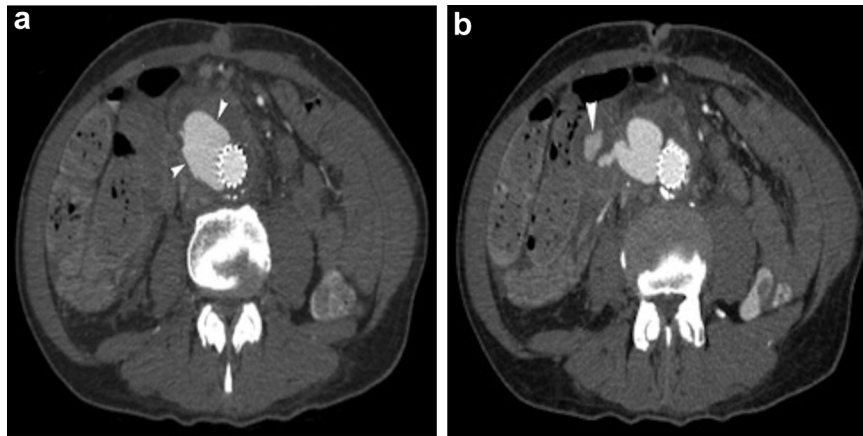


Fig 1. **a**, A contrast-enhanced axial computed tomography image reveals a large pseudoaneurysm (*arrowheads*) arising from right medial wall of previously stented abdominal aorta. **b**, Active contrast extravasation into the bowel (*arrowhead*) on a more inferior image indicates an enteric fistula.

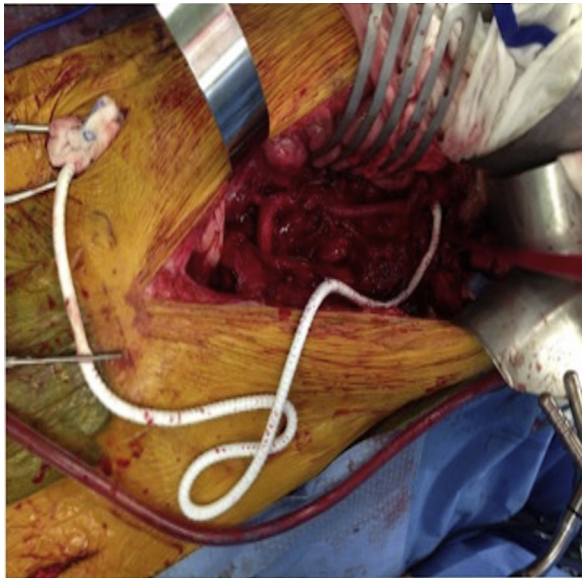


Fig 2. Creation of a renofemoral shunt: A 6-mm Propaten polytetrafluoroethylene graft (Gore Medical, Flagstaff, Ariz) was anastomosed to the left renal artery and the other end was anastomosed to the right femoral artery after a groin incision was made.

interrogation. The longitudinal arteriotomy was extended the length of the infrarenal aorta.

A completely intact but unincorporated stent graft was excised, and the aortic wall was débrided. The left femoral vein was harvested and reversed. The proximal anastomosis was performed end-to-end to the proximal infrarenal aorta. A size mismatch between the 18-mm-diameter native aorta and the 10-mm-diameter proximal femoral vein graft was tapered with a patch angioplasty of the hood of the proximal anastomosis using an ellipse of cadaveric inferior vena cava. The distal anastomosis was performed end-to-end to the right common iliac artery. This construct was selected based on the 8-mm distal vein graft diameter.

Aortoiliac flow was restored. Restoration of axial flow to the left common iliac artery was achieved by transposing the left common iliac artery onto the distal right common iliac artery in an end-to-side fashion. For this, the right common iliac artery clamp was placed beyond the origin of the pancreatic allograft anastomosis. During this portion of the procedure, the pancreas was perfused by antegrade aortoiliac flow and the kidney was perfused by retrograde femoral flow from the shunt. After completion of the arterial reconstruction, the left renal artery was ligated, the renal femoral shunt was excised, and the right femoral arteriotomy was repaired.

Completion of the aortocolonic fistula excision was achieved with a right hemicolectomy. Enteric continuity was maintained with an ileocolonic anastomosis. The aortoiliac clamp time was 52 minutes, during which urine output and glucose levels remained normal. Vascular reconstruction was not covered by omentum or muscle flap.

Postoperative outcome. The patient's postoperative course was unremarkable. Cultures of specimens collected intraoperatively showed methicillin-resistant *Staphylococcus aureus*, which was treated with linezolid according to the infectious disease specialist recommendation. A computed tomography arteriogram on postoperative day 6 demonstrated patency of the aortoiliac reconstruction and normal perfusion to the kidney and pancreas allografts (Fig 3). Function of the grafts has remained stable in the 22 months since the operation.

DISCUSSION

There is a dichotomy in the opinion of whether to use some sort of protective measures in patients with organs implanted on iliac vessels that subsequently require aortic reconstruction.

A "clamp-and-sew" technique relies on the concept that adequate distal aortic pressure is maintained during aortic cross-clamping. Lacombe⁹ reported mean distal perfusion pressures of 35 mm Hg are maintained by retrograde flow through lumbar, inferior mesenteric, and iliac arteries. The mean aortic clamp time in his series was 39 minutes.⁹ However, because the distal aortic pressure

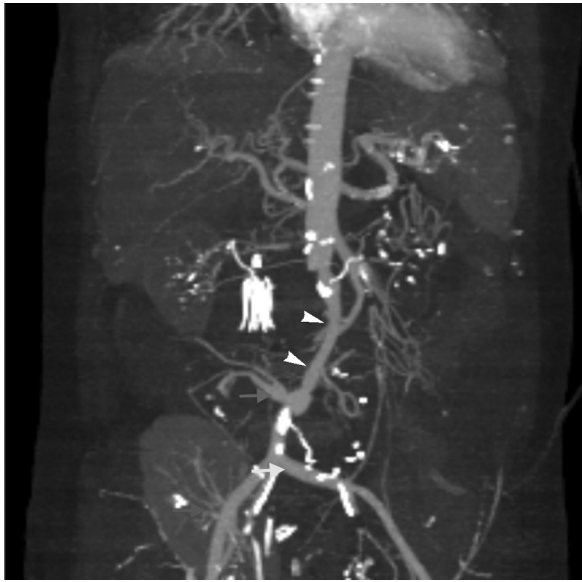


Fig 3. Maximum intensity projection reconstructed contrast-enhanced computed tomography image displays patent femoral vein graft (*arrowheads*) after stent resection and abdominal aortic reconstruction. The *gray arrow* shows the pancreatic Y graft, and the *white arrow* shows transposition of left common iliac artery to the reconstituted right common iliac artery.

dissipates after 30 minutes, reliance on retrograde flow might be inadequate in cases where cross-clamp time is >30 minutes, as it did in this case.⁸ Additional protective measures are warranted in such cases to prevent organs from the deleterious effects of prolonged WI. Furthermore, retrograde flow may not be adequate in all cases because collateral flow varies with branch vessel patency, anatomy, and chronicity of occlusive disease as well as the patient's overall condition. Superimposed hypotension or hypovolemia may further compromise distal allograft perfusion during aortic clamping.

WI can have devastating effects on pancreatic allograft function. Islet cells comprise only 1% of pancreatic cells yet receive 12% of the pancreatic blood flow and are more susceptible to WI.^{10,11} Ischemic insults dramatically affect the energy-generating mechanisms of pancreatic islet cells and may result in significant cell swelling and death. Although exocrine function has the ability to resort to anaerobic glycolysis, lactic acidosis triggers premature intracellular activation of trypsinogen, initiating an autocatalytic process. This leads to self-digestion of the pancreas and also affects the function and morphologic integrity of the islets.¹²

There is a dearth of literature about the salvage and functional outcomes of the pancreas allograft after aortic cross-clamp. Faidutti et al¹³ used femorofemoral

extracorporeal circulation with an oxygenator to protect a transplanted pancreas and kidney during aortobifemoral vascular grafting in a 39-year-old diabetic patient, with good allograft outcome. We believe their technique has the advantage because it can be used during shock, but it is time consuming. We think our technique is expeditious, simple, and efficacious in perfusing the allografts with oxygenated blood, because allograft function stayed completely stable after the surgery. Because our technique relies on arterial blood flow, we believe it may not be efficacious in a state of shock. We believe that any other external shunt, such as a brachiofemoral shunt, could be useful in such a situation, but this would require more time than our technique because of the separate incision required to access the brachial artery.

CONCLUSIONS

We propose creation of renofemoral shunt as a simple and expeditious technique to avoid abdominal allograft WI during aortic cross-clamp. This allows time for unexpected technical difficulties during such a surgery.

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Submitted Nov 19, 2014; accepted Mar 1, 2015.