

Use of arterial transposition for vascular reconstruction within contaminated or infected abdominal fields

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ABSTRACT

Intra-abdominal arterial reconstructions in the setting of reoperative, contaminated, or frankly infected fields can be a challenging undertaking for even the most experienced vascular surgeons. Open surgical arterial transpositions have been less commonly performed than other methods of reconstruction in the current era of vascular surgery despite many historical reports of successful outcomes. Autologous artery transpositions represent a viable option in the case of an infected or a contaminated operative field. We have described the cases of three patients treated at our institution who had required intra-abdominal revascularization in a contaminated or frankly infected surgical field. All three patients were successfully treated using open native visceral artery transposition procedures. These cases presented multiple challenges secondary to the ongoing infections, infected operative field, and, sometimes, a history of multiple vascular bypasses involving the aorta and visceral arteries. In such circumstances, we have demonstrated the effectiveness of native visceral arterial transposition as a feasible technique. (J Vasc Surg Cases Innov Tech 2024;10:101570.)

Keywords: Complication; Postoperative infection; Transposition; Vascular infection

In an era in which experience with open visceral reconstruction has been decreasing, the ability to perform complex arterial transpositions in the case of gross contamination or hostile surgical fields remains an important skill in the vascular surgeon's armamentarium. It has been widely acknowledged that in the presence of gross purulence or contamination, the risk of reconstruction complications will be increased, especially with in situ prosthetic graft placement.¹ In addition to graft failure, other series have reported that the presence of an infected prosthetic graft can lead to life-threatening sepsis, even from an early graft infection.² Several methods of managing complex prosthetic bypass infections have been proposed. Graft conservation has been attempted using systemic antibiotics, serial debridement, and the placement of antibiotic beads with various results.³ Alternatively, excision with in situ prosthetic graft replacement with either an antibiotic-impregnated Dacron graft, an autogenous vein, or a cryopreserved artery has been shown to result in graft reinfection with rates as great as 10% of the patients in some series.^{4,5}

Albeit challenging, arterial transposition for reconstruction of visceral, renal, or lower extremity arteries can serve to mitigate the occurrence of complications in select cases.

In the present report, we have described three patients from our recent institutional experience who benefited from native arterial transposition. The patients provided consent for the publication of this case report.

CASE REPORT

Patient 1. A 55-year-old woman had been admitted with a 1-week history of abdominal pain, fever, nausea, and vomiting. Imaging studies 10 months prior had demonstrated type B aortic dissection, multiple pancreatic pseudoaneurysms, celiac stenosis, chronic nonocclusive dissection of the superior mesenteric artery with associated aneurysmal dilation to 1.1 cm, and an occluded common hepatic artery at the level of the celiac trunk. At that time, the etiology of these vascular derangements had been thought to be vasculitic, inflammatory, or infectious or due to a hypercoagulable state. She had undergone open ligation of the right gastric artery, common hepatic artery, and pancreaticoduodenal arteries, with infrarenal aorta to proper hepatic artery bypass and a Dacron graft placed to treat the ruptured gastroduodenal and pancreaticoduodenal aneurysms at another facility. She was subsequently diagnosed with a chronic type B aortic dissection aneurysm with celiac artery stenosis and had undergone celiac artery stent placement and thoracic endovascular aortic repair extending to the celiac axis with carotid–subclavian artery bypass to treat the thoracic aortic aneurysm at another outside facility. At 10 months after her initial presentation, and after these prior interventions, the initial computed tomography (CT) imaging study at our facility demonstrated a large fluid- and gas-containing collection with peripheral enhancement adjacent to the infrarenal aorta–proper hepatic artery Dacron bypass, with findings

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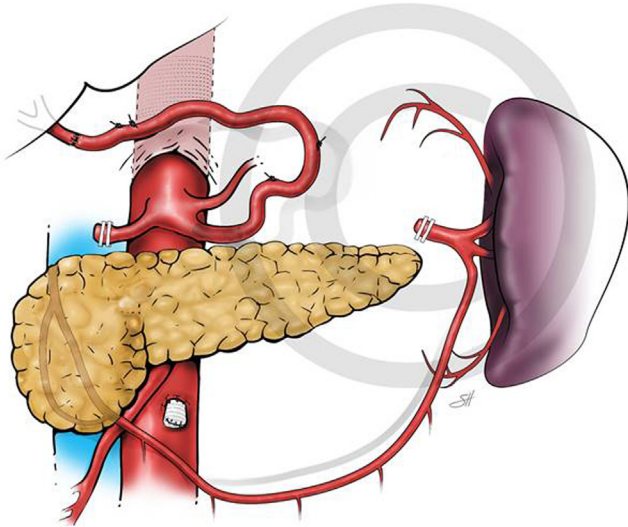


Fig 1. Splenic artery transposition used in patient 1.

concerning for necrotizing pancreatitis. Broad-spectrum antibiotics were started for the intra-abdominal abscess, and percutaneous drains were placed in the collection. However, she had failed to improve with the medical treatment and continued to have recurrent abdominal fluid collections. Endoscopic retrograde cholangiopancreatography was performed, and the findings did not demonstrate the presence of a leak from the pancreatic duct or biliary system. Given her recurrent symptoms, fluid collections, and ongoing necrotizing pancreatitis with failure of nonoperative management, we decided to proceed with operative treatment.

On exploration, extensive lysis of adhesions was required, and a Cattell-Braasch maneuver was performed to access the chronic abscess cavity. The abscess was explored, and the contents were sent for culture. The prior bypass was encountered within the abscess cavity and was dissected from the hepatic artery anastomosis to as close to the aorta as safely possible. Partial pancreatic necrosectomy was also performed. The splenic artery was skeletonized along its course with careful ligation of all pancreatic branches. The left gastric vein was ligated to allow for transposition of the splenic artery. The splenic artery was divided distally and transposed without tension to the bifurcation of the proper hepatic artery. The hepatic artery was controlled, and the distal graft was excised from the artery. The proximal portion of the graft was reasonably incorporated and, therefore, was excised near the takeoff from the aorta and oversewn with polypropylene suture. The splenic artery to proper hepatic artery anastomosis was performed using an end-to-end configuration (Fig 1). A drain was placed in the retroperitoneum and area of necrosectomy, and a pedicled omental flap was placed in the residual chronic abscess cavity. Her postoperative course was complicated by ileus and a recurrent fluid collection in the right lower quadrant, which was treated with percutaneous drainage. Cultures of the graft were positive for both *Klebsiella* and methicillin-resistant *Staphylococcus aureus* for which she received a prolonged course of intravenous (IV) antibiotics

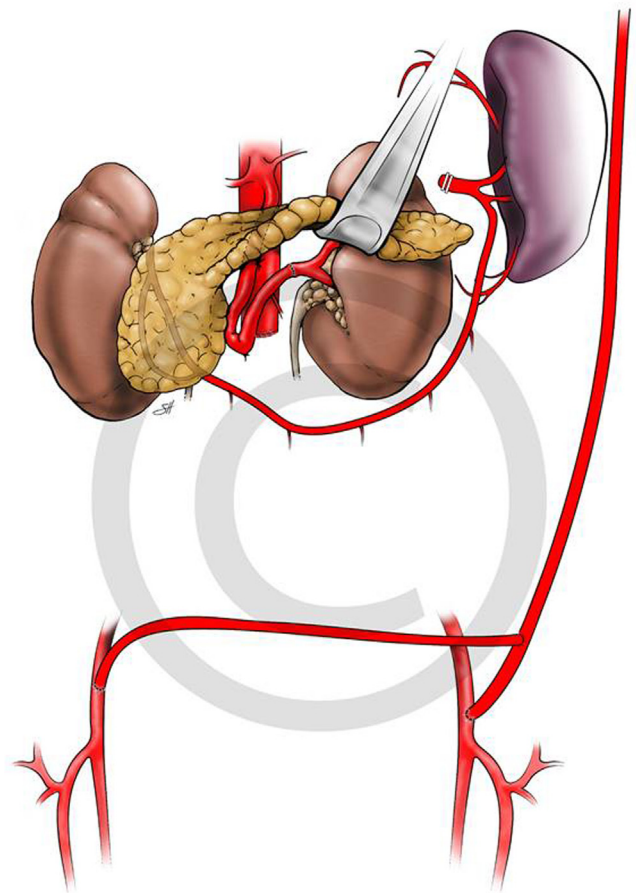


Fig 2. Splenic artery transposition used in patient 2.

selected according to the culture sensitivities. Postoperative surveillance CT angiography indicated patent flow through the splenic artery transposition and resolution of her symptoms. She was discharged home on postoperative day 35. She followed up in our surgery clinic on postoperative day 55 after completion of the IV antibiotics and reported continued resolution of her abdominal pain symptoms and a lack of fever and indicated her plans to continue follow-up in her home state.

Patient 2. A 53-year-old woman had presented with abdominal pain and melena. She had a history of aortoiliac occlusive disease treated with Dacron aortobifemoral bypass and concurrent aorta to left renal artery bypass (also Dacron) originating from the proximal body of the aortobifemoral graft 13 years earlier. At 8 months before her transfer to our facility, she had developed melena and an aortoenteric fistula was diagnosed for which she had undergone subtotal excision of the aortobifemoral graft just distal to the left renal artery bypass (the Dacron aortic cuff with the renal artery bypass was left in place) and simultaneous axillary bifemoral artery extra-anatomic bypass. On arrival to our facility, CT imaging demonstrated intraluminal air within the residual aortic graft and surrounding fluid, with patent axillary bifemoral and left renal artery bypasses. The right kidney was atrophic, and the left renal artery Dacron bypass was patent to a normal-size, functional kidney. It

was decided to perform completion excision of the remnant body of the Dacron aortic graft body and aortorenal Dacron graft, with left renal artery revascularization and autologous splenic artery transposition (Fig 2).

Exploration with left medial visceral rotation was performed. The abscess cavity was explored, and a recurrent aortoenteric fistula was encountered between the duodenum and remnant aortic graft. The left renal vein and aortorenal artery Dacron bypass were also fully exposed. The splenic artery was meticulously skeletonized and then ligated distally toward the spleen and tunneled inferiorly behind the tail of the pancreas. The renal Dacron graft was controlled proximally and distally, and the graft was completely excised. The distal splenic artery was transposed to the left renal artery, and an end-to-end anastomosis was performed with 6-0 polypropylene suture. The remnant aortic graft was dissected back to its anastomosis with the native aorta and excised, including the aorta and renal bypass segments en bloc. The native aorta was then closed, and the involved bowel was excised and reconstructed with duodenojejunostomy. Omentum was placed over the aortic stump.

Postoperatively, the patient continued to receive antibiotics, given her long history of erosion and subtotal graft excision. By postoperative day 3, her renal function had improved compared with preoperatively. She was discharged to home on postoperative day 20. During the 4-year follow-up, her creatinine and renal function had continued to improve, and surveillance demonstrated patency of the splenic artery to left renal artery bypass. She had not experienced recurrent infection or gastrointestinal bleeding.

Patient 3. A 67-year-old man had presented with a T2 rectal adenocarcinoma 12 cm from the anal verge. The patient had a history of a myocardial infarction 20 years before presentation, ischemic cardiomyopathy with an ejection fraction of 45% to 49%, coronary artery bypass grafting 4 years before presentation, chronic obstructive pulmonary disease, hypertension, hyperlipidemia, and former smoker status but reported no history of claudication or aortoiliac disease symptoms. Preoperative CT demonstrated the presence of severe bilateral aortoiliac occlusive and aneurysm disease in retrospect but these had not been identified by the surgical oncology team. He was taken to the operating room for planned resection. Intraoperatively, after division of the descending colon, it was noted that the patient's inferior mesenteric artery (IMA) was exceedingly large and tortuous, with a diameter >1 cm, and had been incorrectly identified as the right common iliac artery. Vascular surgery was consulted intraoperatively to address this anomaly. In addition, concurrent calcific occlusive disease of the aorta with extension into the right common iliac artery was noted. Furthermore, a loss of pulse and signal in the right external iliac artery had occurred with IMA clamping, although the left iliac system had maintained an appreciable signal. The standard low anterior resection was aborted, because ligation of the IMA was thought to have a high probability of creating significant right lower extremity ischemia. The use of a prosthetic graft bypass was believed to be suboptimal given the

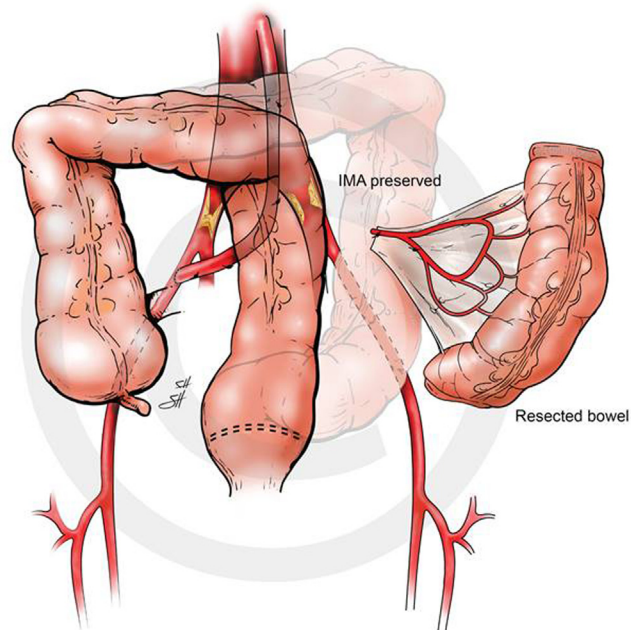


Fig 3. Inferior mesenteric artery (IMA) transposition used in patient 3.

setting of a colorectal surgical field and high likelihood of graft infection. Femoral–femoral arterial bypass was also considered but was thought to be not possible owing to the low extension of the mid-line laparotomy incision and concern for a contaminated field. Intraoperatively, we decided to stage the resection by first performing an IMA-to-right external iliac artery bypass to prevent right lower extremity ischemia (Fig 3). Endovascular therapy was not possible because the patient had not been situated in an operating room with that capability.

The right external iliac artery was identified, and the length of the IMA was already more than adequate from the prior dissection. The IMA was dissected free within the mesorectum, divided distally, and transposed to the right external iliac artery. An end-to-side configuration anastomosis was performed. After ensuring adequate flow through the anastomosis, Hartmann's operation with end colostomy was performed without event. The patient had returned to the operating room 1 week later and had undergone definitive oncologic resection.

The postoperative course was complicated by a colonic anastomotic leak on postoperative day 12 requiring reoperation for washout and creation of an ostomy. At that time, his vascular anastomosis was noted to be functional and intact. The remainder of his hospital course was complicated by multiple intra-abdominal fluid collections requiring percutaneous drainage and IV antibiotics, with eventual resolution. Postoperative surveillance imaging showed a patent extra-anatomic bypass with a palpable femoral pulse after discharge with no signs or symptoms of claudication or right lower extremity ischemia.

DISCUSSION

Creating safe and durable solutions for patients with aortoiliac and visceral artery pathology with concurrent intra-abdominal contamination or infection can be challenging. Because the incidence of open mesenteric bypass has become less frequent, reported studies have rarely contained a sufficiently large number of patients to properly address the questions and concerns regarding appropriate bypass conduit selection for revascularization of the splanchnic and renal circulation. A number of series have supported the use of prosthetic grafts in such cases of visceral bypass. However, in cases with concomitant infection, autologous bypasses have generally been preferred.⁶⁻⁸ Among the reported series, no conduit for bypass has emerged with a clear and superior advantage.⁹ Our center has routinely performed bypass with a harvested native vein (saphenous and femoral) for areas concerning for infectious complications. Although autologous tissue might be preferred in a contaminated field, an autologous vein might have inadequate quality for a mesenteric bypass and be prone to catastrophic blowout within infected fields. Additionally, such bypasses might be more prone to kinking and architectural distortion secondary to decreased muscularity and rigidity compared with an artery or a prosthetic graft. Native arterial transposition could provide a solution in such cases. Inherently, arterial transposition in this context will not require proximal anastomosis, which for all three presented patients would have posed challenges owing to the calcific occlusive disease, dissection, endograft, and resection.

Splenic artery transposition has been sparingly reported for use in rare cases of vascular reconstruction during pancreatic surgery, to treat hepatic artery aneurysms, and during adult liver transplantation.¹⁰⁻¹² The point of splenic artery ligation to allow for adequate mobilization with possible configurations for splenic artery transposition is shown in Fig 1. Several studies have shown splenic artery ligation will be well tolerated, with good rates of splenic survival owing to the short gastric and left gastroepiploic artery collateral vessels.¹³ Also, the spleen can survive in most circumstances even if most of the short gastric branches have been ligated. The primary reported use of splenic artery transposition for infection has been in reconstruction for infected mycotic aortic aneurysms requiring resection of the suprarenal aorta with debranching of the visceral vessels.¹⁴ Our own tertiary center's experience has demonstrated that splenic artery transposition of various configurations can be used in the case of hostile or contaminated surgical fields with durable outcomes. Additional arterial transposition options using the IMA are also available, as demonstrated by our third patient, for whom it had been used as a source of inflow when colonic resection was required in the presence of aortoiliac–mesenteric steal syndrome.¹⁵

CONCLUSIONS

These techniques of arterial transposition can be considered for cases of intra-abdominal contamination requiring maintained inflow to the viscera or iliac systems. Our small case series has demonstrated the ingenuity and effectiveness of such bypass options. The ability to perform these operations safely should remain a part of the skill set of vascular surgeons in the modern era.

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