

Renal artery revascularization using the inferior mesenteric artery as an inflow source with a long-term follow-up

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ABSTRACT

This case describes a 72-year-old woman with a history of chronic kidney disease stage III presented with bilateral renal artery stenosis with a progressively atrophied right kidney. At the time of surgery, the atrophied kidney was nonfunctional. Therefore, the patient underwent unilateral renal artery revascularization via the inferior mesenteric artery as an inflow. A 7-year follow-up revealed improvement in the kidney function and stabilization of blood pressure, which was controlled with less number of antihypertensive medications. In brief, open surgical correction of the renal artery stenosis using the inferior mesenteric artery as an inflow source can retrieve renal function in selected hypertensive patients with ischemic nephropathy. (*J Vasc Surg Cases and Innovative Techniques* 2021;7:223-5.)

Keywords: Renal artery stenosis; Chronic kidney disease; Surgical revascularization; Inferior mesenteric artery; Percutaneous transluminal angioplasty; Case report

Renal artery stenosis (RAS) is the most common cause of secondary hypertension¹ and is present in 1% to 5% of patients with hypertension.² Medical therapy and endovascular revascularization are the preferred treatment options. Open surgical revascularization may be warranted in selected cases after first-line therapies have failed.^{3,4} The aorta and iliac arteries are most commonly used as a source of inflow, though other mesenteric arteries can be used as well.^{5,6} In this case, we describe a patient with a solitary functioning kidney who is successfully treated by surgical revascularization using the inferior mesenteric artery (IMA) as the source of inflow with significant improvement of renal function and well-controlled blood pressure postoperatively. The patient consent was obtained for publication of this case report.

CASE REPORT

A 73-year-old Caucasian woman with a history of stage III chronic kidney disease, renovascular hypertension, and coronary artery disease presented with uncontrolled blood pressure (205/104) and acute kidney injury (serum creatinine: 2.6 mg/dL) with baseline chronic kidney disease and creatinine of 1.0 to 1.5 mg/

dL. The renal duplex ultrasound scan showed increased renal artery peak systolic velocity (PSV) in the right kidney (right: PSV: 350 cm/s, and renal-aortic ratio: 2.4 vs left: PSV: 109 cm/s, and renal-aortic ratio: 1). Furthermore, B-mode ultrasound evaluation revealed asymmetry in kidney length (right: 8.0 cm vs left: 11.7 cm). The resistive index for the right and left kidneys was 0.4 and 0.6, respectively. A computed tomography scan showed diffuse aortic calcifications (Fig 1, A). Also, the renal angiogram demonstrated critical stenosis at the origin of the left and right renal arteries secondary to a bulky calcified atherosclerotic plaque (Fig 1, B). After multiple failed attempts of percutaneous transluminal angioplasty, a surgical left renal artery revascularization was planned. We had one inflow source, and given the relative sizes of the kidneys and the anatomic considerations, we elected to revascularize the left kidney only.

Intraoperative exploration showed "porcelain" abdominal aorta and heavily calcified bilateral common and external iliac arteries. Both the celiac and superior mesenteric arteries (SMA) were critically stenotic at their origins due to significant calcifications. The left renal artery was severely calcified proximally but had a suitable caliber distally for the planned anastomosis. The IMA appeared healthy without significant stenosis at its origin, and it was the only suitable artery to establish an inflow. A 6-mm polytetrafluoroethylene graft was selected to be used as a bypass graft. The graft was sewn in place to the IMA and left renal artery in an end-to-side fashion. Intraoperative Doppler ultrasound scan confirmed the patency of the graft. Then, the colon was examined carefully and found to have adequate color and active peristalsis. Also, we obtained handheld Doppler assessment of the sigmoid and left colon mesentery as well as the antimesenteric border. This ruled out flow competition between the left kidney and the colon.

The hospital course was uneventful with a gradual improvement of her kidney function, as the creatinine and estimated glomerular filtration rate values were 1.6 mg/dL and 31.6 mL/min, respectively, after 2 weeks of discharge. A computed

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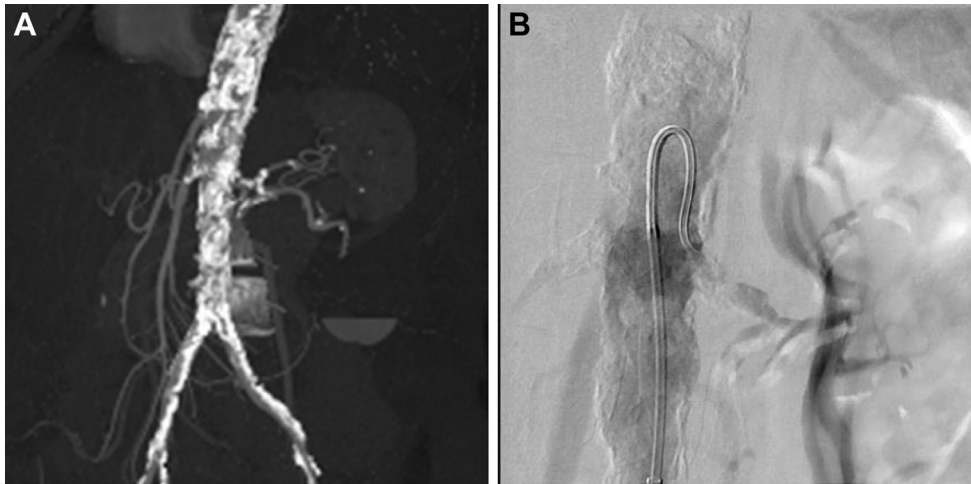


Fig 1. **A,** Noncontrast computed tomography scan showed the diffuse aortic calcifications. **B,** An angiogram demonstrated a significant stenosis in the left renal artery.

tomography angiogram (CTA) 2 and 7 years postoperatively showed a patent bypass graft with normal perfusion of the left kidney (Fig 2).

During the 7-year follow-up, the kidney function remained stable. Congruently, blood pressure remained well controlled on two antihypertension medications as compared with three antihypertension medications (calcium channel blockers, beta blockers, and angiotensin receptor blockers) that she was on preoperatively without adequate control.

DISCUSSION

The current treatment options for atherosclerotic RAS are medical therapy, endovascular, and surgical revascularization.⁷⁻⁹ Medical therapy has been the cornerstone of management of patients with RAS.^{2,7} Several randomized controlled trials including the Cardiovascular Outcomes in Renal Atherosclerotic Lesions (CORAL) and the Angioplasty and Stenting for Renal Artery Lesions (ASTRAL) trials have shown no significant benefit of using endovascular interventions compared with the medical therapy alone.^{10,11} However, other studies have shown that endovascular intervention has a beneficial outcome in select high-risk patients.^{12,13} The declining use of surgical revascularization intervention option is fully understandable due to availability of endovascular alternatives.⁷ Thus, the surgical option is usually reserved for select patients as a last choice.^{3,4}

Weibull et al¹⁴ evaluated 58 patients who were randomly assigned into two groups based on their treatment. Hypertension cured or improved in 90% and 86% and the renal function improved or unchanged in 83% and 72% of the endovascular and operative groups, respectively. Nevertheless, more than half of the patients who have failed endovascular therapy required additional surgical intervention.

A meta-analysis study, by Abela et al,¹⁵ demonstrated that, for suitable patients, the surgical revascularization could be a better option for improving renal function and adequate control of hypertension.

Different surgical techniques have been described in the literature. Silvestro et al¹⁶ describe a case in which surgical revascularization was performed using transposition of the IMA into the left renal artery in an end-to-end fashion.

Jaroszewski et al⁶ mentioned that the normal-caliber SMA can be used as an inflow in contrast to the previous studies that recommended using a large-caliber SMA to avoid flow competition and the risk of developing mesenteric ischemia.^{17,18}

In our case report, we observed that all the vessels that are typically used as the source of bypass inflow for revascularization were heavily calcified to the degree that they were neither suitable for anastomosis reconstruction nor adequate for vascular clamping at the time of bypass creation. Furthermore, although the patient did not present with symptoms for chronic mesenteric ischemia, her preoperative CTA revealed critical stenosis at the origin of the celiac artery and SMA. Therefore, because there was no clinical indication for concomitant mesenteric and renal revascularization, we were concerned of creating significant flow competition and steal phenomenon, between the intestinal tract and the kidney, should we use either of the celiac artery (or its branches) or the SMA distal to their heavily calcified origins. On the other hand, the IMA was found to be large in caliber, widely patent, and with minimal calcification. Hence, it was used as the source of inflow.

Aortic endarterectomy using the trap-door technique was considered preoperatively and was determined not to be applicable at the time of surgery. Therefore, using the IMA as an inflow source was an intraoperative

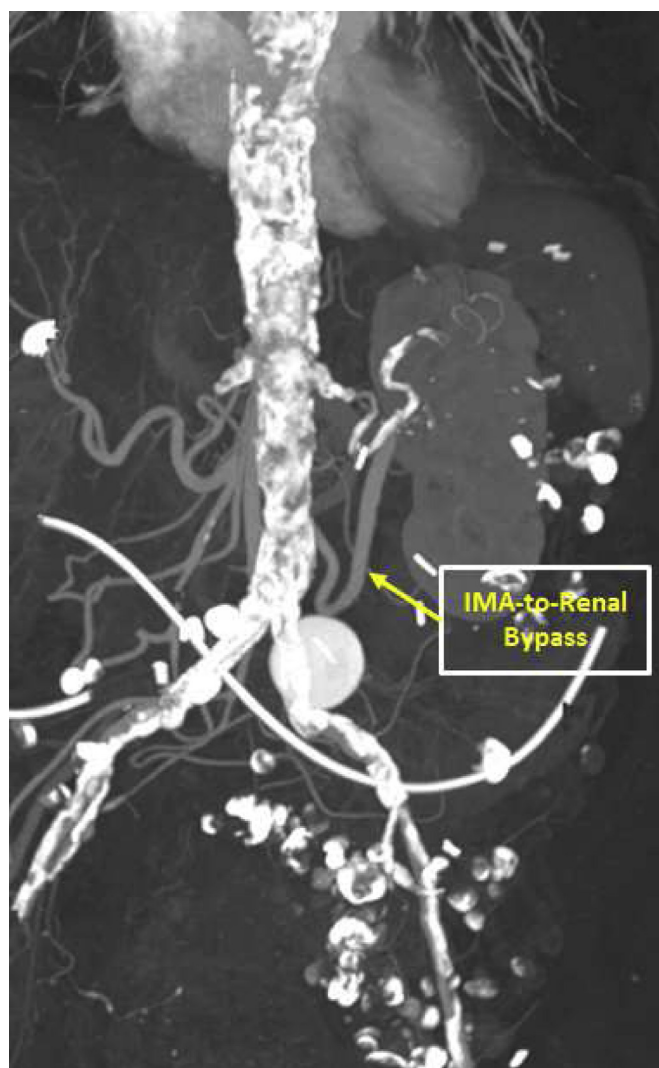


Fig 2. Postoperative computed tomography angiogram demonstrated a patent inferior mesenteric artery (IMA)-left renal artery bypass graft.

decision due to the porcelain nature of the aorta that was underestimated based on the CTA findings. The end-to-side bypass technique was employed instead of the transposition (ie, end-to-end) because the most of the intestinal tract perfusion was dependent on the IMA as there was significant flow-limiting occlusive disease of the celiac and SMA. After the establishment of the IMA-to-left renal bypass, a handheld Doppler was used to assess the bypass flow. Near-infrared spectrophotometry and/or fluorescein were not used.

Should the bowel appeared inadequately perfused after bypass creation, our alternative plan was to look for an alternative inflow such as the left axillary artery.¹⁹ After the procedure, there was a significant improvement in the kidney function and stabilization of the blood pressure over a prolonged period of follow-up. The patient did not require temporary dialysis, and her blood

pressure was adequately controlled on two antihypertensive medications. In conclusion, a significant improvement in kidney function with a return into baseline and adequate control of renovascular hypertension using less number of antihypertensive medications over 7 years of follow-up period denote that in select patients, the IMA can be an acceptable alternative inflow to the arteries that are commonly used in conventional surgical renal revascularization.

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