

# Extra-anatomic bypass can treat renovascular hypertension due to atherosclerotic atypical aortic coarctation

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## ABSTRACT

Atypical aortic coarctation causing high-grade descending thoracic aortic stenosis secondary to calcified atherosclerosis is rare. We have described the case of a 75-year old man with uncontrolled renovascular hypertension secondary to this etiology. His unique anatomy meant he was not a candidate for endovascular management and his multiple comorbidities meant he was high risk for open thoracoabdominal surgery. He successfully underwent extra-anatomic bypass. Postoperatively, his renovascular hypertension improved, and he was weaned off multiple intravenous and oral antihypertensive medications. The findings from the present case suggest that extra-anatomic bypass can be a good option for treating selected patients with renovascular hypertension due to atypical aortic coarctation. (J Vasc Surg Cases Innov Tech 2023;9:1-3.)

**Keywords:** Atypical aortic coarctation; Renovascular hypertension

Atypical aortic coarctation (AAC) has been described as a narrowing beyond the ascending aorta,<sup>1</sup> typically occurring in the descending thoracic aorta (DTA), and has been associated with inflammatory arteritis disease, congenital hypoplasia, and atherosclerosis. Patients can present with upper extremity hypertension and concurrent hypotension in the limbs, causing claudication.<sup>1,2</sup> Surgical management has focused on the inflammatory arteritis pathology,<sup>3</sup> and the best management for atherosclerotic disease has remained unclear.

Few studies have reported on the surgical management of AAC caused by atherosclerotic disease, likely owing to the comorbidities and high surgical risk of these patients.<sup>1</sup> The presentation of patients with uncontrolled (renovascular) hypertension and that of those with claudication is the same; however, imaging studies will reveal high-grade aortic stenosis or calcified atherosclerosis causing AAC.<sup>1,4</sup> The indications for surgery include severe arterial hypertension, severe claudication, and chronic limb-threatening ischemia with or without tissue loss.<sup>3</sup> Most reports have discussed open surgery

with an interposition graft or aorta–aorta bypass. Thoracic endovascular abdominal aortic aneurysm repair (TEVAR) has also been used in certain circumstances.<sup>5</sup> If these direct DTA interventions are not feasible, an alternative could be an extra-anatomic approach such as axillofemoral bypass (AxFB). Although AxFB has mostly been used for occlusion involving the aortoiliac regions in patients with a high surgical risk,<sup>4</sup> in the present study, we have presented a unique case in which AxFB was used to successfully treat renovascular hypertension in a patient with AAC of the DTA due to calcified atherosclerotic disease. The patient provided written informed consent for the report of his case details and imaging studies.

## CASE REPORT

The patient was a 75-year-old man with uncontrolled hypertension, heart failure with a reduced ejection fraction, atrial fibrillation, coronary artery disease, chronic obstructive pulmonary disease, type 2 diabetes, and current tobacco use with a >50 pack-year smoking history. He had had an abdominal aortic aneurysm that had been treated with endovascular aneurysm repair (EVAR) in 2017. Additionally, the patient had had claudication with an ankle brachial index (ABI) of 0.69 (toe, 79 mm Hg) on the right and 0.63 (toe, 77 mm Hg) on the left. He did not report any symptoms of chronic mesenteric ischemia, including postprandial pain, food fear, or unintended weight loss. Computed tomography angiography (CTA) of the chest from 2 years prior showed critical stenosis of his DTA with collateralization and no significant stenosis of the left and right renal arteries. Vascular and cardiac surgery were consulted at that time but did not consider the patient a candidate for open surgical repair given his multiple comorbidities, nor was he an appropriate candidate for TEVAR given the extensive calcification.

The vascular surgery team was consulted again when the patient was admitted to the intensive care unit with a hypertensive

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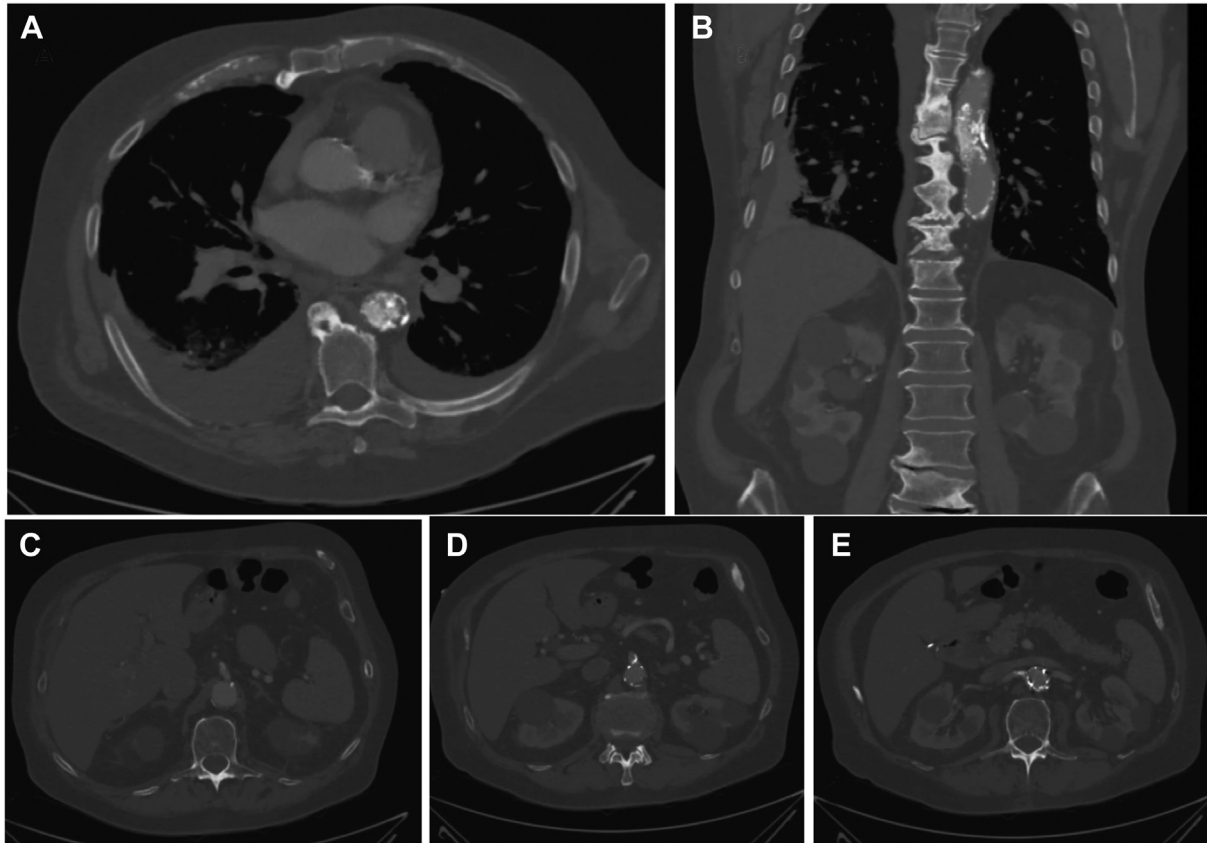
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**Fig.** Axial (**A**) and coronal (**B**) views of computed tomography angiography (CTA) of the chest demonstrating heavily calcified stenosis within the descending thoracic aorta (DTA). CTA of the abdomen and pelvis indicating no significant stenoses in the celiac artery (**C**), superior mesenteric artery (**D**), and bilateral renal arteries (**E**).

emergency characterized by slurred speech and blurry vision, heart failure exacerbation, and flash pulmonary edema. His prior CTA was evaluated owing to the known critical stenosis in the DTA, with a trickle of flow through the lumen identified on the axial and coronal images (Fig. A and B). The pathology was considered to have progressed enough to have caused his renovascular hypertension with recurrent hypertensive emergencies. Blood pressure management at that time included seven oral medications and a nicardipine intravenous infusion. His systolic blood pressure (SBP) remained elevated (>200 mm Hg) despite aggressive medical management. An echocardiogram showed concentric left ventricular hypertrophy with an ejection fraction of 45% to 50%. The results of a cardiology consultation for risk assessment of open DTA reconstruction again indicated he was high risk for surgery (revised cardiac risk index, 4) with a 15% risk of perioperative mortality. On discussion of other surgical options, we did not deem him a candidate for supraceliac aorta-to-renal bypass because his cardiac disease precluded toleration of aortic cross-clamping. The use of iliorenal bypass was also problematic because it would have required an open abdominal incision, placing him at high risk of cardiopulmonary complications. Additionally, his iliac arteries were not suitable inflow vessels. His symptoms of claudication indicated that his AAC was a physiologically significant upstream stenosis that

would cause a low-flow state with iliorenal bypass. He was offered AxFB as an alternative.

Further preoperative evaluation included renal artery and upper extremity duplex ultrasound. He had also undergone his annual follow-up CTA of the abdomen and pelvis after EVAR, which had confirmed the absence of significant stenosis of the celiac artery (Fig. C), superior mesenteric artery (Fig. D), and bilateral renal arteries (Fig. E). We did not perform a repeat CTA of his chest given the increased contrast load. His renal duplex ultrasound demonstrated normal waveforms, normal acceleration times, and normal resistive indexes. On examination, his blood pressure was found to be significantly lower in the left arm. His prior CTA of the chest had not shown stenosis of his proximal upper extremity vasculature; therefore, upper extremity duplex ultrasound was completed to evaluate for flow-limiting lesions. The duplex ultrasound study confirmed monophasic arterial waveforms throughout the left arm vasculature, indicative of proximal stenosis. The right arm arterial system had normal triphasic waveforms and was selected as the inflow source for AxFB.

After he had provided written informed consent, he underwent general anesthesia for right AxFB (axillary-to-bilateral common femoral artery bypass) with an 8-mm polytetrafluoroethylene graft. He tolerated the procedure well, with no

intraoperative complications. By postoperative day 2, he no longer required nicardipine, and, at discharge, he only required four antihypertensive medications with a consistent SBP <160 mm Hg. He was discharged home with instructions to take aspirin and atorvastatin. Additionally, his postoperative ABI had improved to 0.89 (toe, 117 mm Hg) on the right and 0.91 (toe, 124 mm Hg) on the left. At his 1-month follow-up visit, the patient reported feeling well, walking farther, and recording a SBP of <110 mm Hg at home. At the patient's 6-month follow-up visit, axial imaging showed patency of his AxFB. He has been scheduled to continue to follow-up annually with CTA for surveillance of his EVAR and ABIs to evaluate the flow dynamics in his AxFB.

## DISCUSSION

AAC causing high-grade DTA stenosis secondary to calcified atherosclerosis is a rare disease. This condition will most often manifest as uncontrolled renovascular hypertension and/or symptomatic peripheral artery disease.<sup>6</sup> Open aortic reconstruction has classically been used but represents a high-risk surgery for elderly patients presenting with this pathology. The use of TEVAR has expanded for both aneurysmal and nonaneurysmal DTA pathology, with the benefits of reduced perioperative morbidity. However, aortic calcification has been shown to increase the incidence of postoperative complications with TEVAR.<sup>6</sup> Aortic calcification is a factor used to define aortic pathology, and severe disease carries a higher risk of technical failure.<sup>7</sup> Furthermore, although TEVAR has shown benefits for nonaneurysmal pathology, most of these studies have considered acute aortic syndromes as an indication for intervention.<sup>5</sup> Our patient's rare calcific AAC is an outlier compared with these more commonly studied nonaneurysmal pathologies.

Because his renovascular hypertension was not caused by renal artery stenosis, our patient was a candidate for extra-anatomic bypass to provide retrograde aortoiliac blood flow to improve his renal artery perfusion and also address his lifestyle-limiting claudication. Both of these disease manifestations responded to the approach used. Although all surgical decisions must consider patient comorbidities and anatomy, the results from the present case suggest that AxFB can be a good option to treat selected patients with renovascular hypertension due to AAC.

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