Repair of a type II thoracoabdominal aortic aneurysm with three equal-sized renal arteries and bilateral common iliac aneurysms using a completely percutaneous transfemoral approach

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Over the past two decades, fenestrated/branched endovascular aneurysm repair has been increasingly performed with high technical success rates and low mortality and morbidity for thoracoabdominal aortic aneurysms (TAAAs).[1] This has been shown to have similar outcomes for both post-dissection and degenerative TAAAs.[2]

Postoperative acute kidney injury is associated with decreased postoperative survival.[3] Prior studies using volumetric kidney perfusion have shown that >40% of one kidney and >25% of two kidneys perfused by a renal artery merit consideration of renal artery preservation during fenestrated/branched endovascular aneurysm repair.[4] This would decrease the chance of postoperative acute kidney injury and associated mortality.

A 73-year-old man presented with 6.2 cm type II TAAA secondary to chronic dissection, with three equal-sized renal arteries and bilateral common iliac aneurysms. He had a prior history of ascending aortic replacement for acute dissection. He developed chronic heart failure due to non-ischemic cardiomyopathy. At the time of presentation, he had depressed ejection fraction (35%-40%) with bilateral atrial dilation and dyspnea on exertion, making open thoracoabdominal repair prohibitive. His baseline creatinine was 1.25 mg/dl, and estimated glomular filtration rate 56.5 ml/min/1.73 m^2. He consented to the publication of this case.

Computed tomography angiogram demonstrated an intact prior ascending aortic repair, a three-vessel aortic arch, and a visceral aorta with patent celiac, superior mesenteric artery (SMA), right renal, and two equal-sized left renal arteries, with aneurysmal degeneration from zones 3 to 11. Both left renal arteries measured 6 mm in diameter and appeared to perfuse significant portions of the kidney.

PROCEDURE

We planned for a two-stage, totally percutaneous, transfemoral, endovascular repair. The surgical technique is shown in the Supplementary Video (online only). In the first stage, two commercially available tapered thoracic endovascular aneurysm repair devices were deployed from the left subclavian artery to the celiac artery. In the second stage, a custom fenestrated stent graft was designed with five fenestrations for the celiac, SMA, right renal artery, and both left renal arteries. The upper renal artery fenestration was 97 mm from the proximal edge of the graft and was at 2:15 on the clock face. The lower renal artery fenestration was 103 mm from the proximal edge of the graft and was at the 4 o'clock position. Using these measurements, the fabric distance between these two fenestrations was about 11.7 mm. The fenestrated device was designed to be mated with a bifurcate stent graft with an inverted contralateral limb. This bifurcate was then mated to bilateral iliac branch devices, allowing for seal in the external iliac arteries and perfusion to bilateral internal iliac arteries.

Fusion overlay was utilized throughout the case. Through bilateral percutaneous femoral access, the fenestrated device was oriented and deployed via the left femoral access. The fenestrations and target vessels were sequentially selected with a steerable sheath. The fenestrations were bridged to their target vessels with covered stent grafts.

Bilateral iliac branch devices were then deployed to obtain distal seal. The bifurcate stent graft was then deployed with bridging iliac limbs. Completion angiography demonstrated complete aneurysm exclusion with seven patent target arteries (celiac artery, SMA, three renal arteries, bilateral internal iliac arteries).

At 1 month, the patient was back at baseline health and activity level. His computed tomography angiogram demonstrated an intact endovascular repair with maintained patency of all incorporated target vessels. A type II endoleak from a pair of lumbar arteries was noted, which will be monitored.

DISCUSSION

Alternate approaches include brachial or axillary access for cannulation of the renal arteries, physician-modified endograft, or parallel stenting to ensure continued

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perfusion to the renal arteries. By doing the entire case through transfemoral percutaneous access, we reduce access sites, reduce risk of upper extremity access complications, and reduce operator radiation exposure.[5] We also show that technical factors like down-going renal arteries, often cited as needing arm access, can also be cannulated from femoral access using modern endovascular techniques.[4] We used bilateral iliac branch devices rather than covering one or both of the internal iliac arteries. Given the extensive aortic coverage, preserving the internal iliac arteries optimized the preservation of spinal cord perfusion. Using custom-manufactured devices, nearly all renal anatomy can be accommodated by using fenestrations in close proximity, a combination of a branch and a fenestration, or using two bridging stent grafts through an individual large fenestration. We recommend all endovascular techniques, including physician-modified endograft, to include multiple renal arteries to preserve renal perfusion and the use of iliac branch devices to preserve hypogastric flow.

This case demonstrates a transfemoral, totally percutaneous, staged endovascular repair of a complex extent II TAAA with chronic dissection and degeneration involving the entire aorta and bilateral iliac arteries while preserving anomalous renal artery anatomy.

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DISCLOSURES
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