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"Chimney" Graft Technique for Juxtarenal AAA Using Unibody Bifurcated Stent Graft

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ABSTRACT: Juxtarenal abdominal aortic aneurysms in patients who are poor candidates for open repair present a challenge for the treating surgeon. With fenestrated aortic endografts currently not readily accessible, the alternative option would be aortic endograft using a "chimney" technique. We present a case report of an 84-year-old female who is a poor surgical candidate, presenting with symptomatic juxtarenal abdominal aortic aneurysm involving the left renal artery. Satisfactory repair was performed using an Endologix Powerlink endograft with chimney technique for the left renal artery. To our knowledge this is the second report of chimney graft using the Endologix Powerlink system.

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Key words: abdominal aortic aneurysm, EVAR, chimney graft, pararenal abdominal aortic aneurysm, juxtarenal abdominal aortic aneurysm

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Endovascular aneurysm repair (EVAR) has become an established treatment modality in the management of abdominal aortic aneurysm (AAA) with decreased short-term postoperative mortality compared to open AAA repair.[1-4] Despite being an appealing minimally invasive option, EVAR is not suitable for patients with challenging anatomy, such as inadequate landing zones or juxtarenal abdominal aneurysms. An endovascular repair for juxtarenal aneurysms currently can be approached in three ways: with a fenestrated endograft, a side branch graft, or a "chimney" graft.[5] The advantage of the latter is that it is more readily available in current clinical settings. The chimney graft was first described by Greenberg et al as an endovascular technique for AAA with a short proximal neck.[6] We hereby present a unique case of chimney endovascular repair for juxtarenal AAA using a Powerlink endograft (Endologix). To our knowledge this is the second reported case of use of Powerlink endograft in this clinical scenario.[7]

Case Report

An 84-year-old female presented to the emergency department with acute onset of severe abdominal and back pain of 2 days duration. Her past medical history was significant for hyperlipidemia, coronary artery disease with coronary artery bypass graft 20 years prior, renal artery stenosis treated with left renal artery stenting, first-degree atrioventricular heart block, gastroesophageal reflux disease, and hypothyroidism. Her social history was significant for 50 pack years of smoking. Her vital signs were within normal limits and her physical exam was significant for lower abdominal tenderness and a pulsatile abdominal mass. Her computed tomography angiogram revealed a 5.4 cm by 5.1 cm pararenal AAA involving the origin of the [4]previously stented left renal artery (Figure 1). Given the patient's comorbid conditions, including coronary artery disease, atrioventricular block, and possibly poor pulmonary reserve function due to her chronic history of smoking (pulmonary function tests were not obtained), the decision was made to proceed with endovascular aortic aneurysm repair using a chimney graft with a snorkel in the left renal artery.

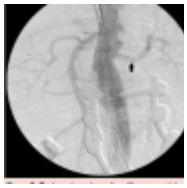
Technique

The patient was placed supine and endotracheal intubation was induced. Under ultrasound guidance, both common femoral arteries were cannulated. An 8 Fr sheath was used in the right common femoral artery and an 11 Fr sheath used in the left common femoral artery. The left brachial artery was then cannulated with a 6 Fr Destination sheath (Terumo) under ultrasound guidance. A Glidewire was then carried down the descending thoracic aorta with a vertebral catheter. A sheath was then introduced and positioned above the level of the renal arteries and an aortogram was obtained, noting the origins of the renal arteries and confirming the takeoff of the left renal artery from the AAA situated about 13 mm below the level of the right renal artery.

[5]Subsequently, the Endologix endograft, with a main body diameter of 22 mm, a length of 70 mm, and an iliac limb length of 30 mm, was advanced from the left groin. The contralateral limb was snared and pulled down proximal to the right iliac bifurcation (Figure 2). The aorta at the level of the right renal artery was normal. The left renal artery was then selectively cannulated and a 6 mm x 59 mm ICAST covered stent (Atrium) was deployed with the proximal end at the level of the right renal artery. The ICAST stent was used because it provides a superior radial force as compared to

VIABAHN (Gore) but is potentially less rigid than the FLUENCY stent (C.R. Bard). The decision to utilize ICAST was based on favorable experience with the stent in previous similar situations. Two additional aortic cuffs that were 25 mm in diameter and 95 mm in length with generous overlap were additionally used to extend the graft up to the level of the right renal artery. The goal of this was to minimize the risk of type I endoleak, covering the origin of the left renal artery which had the "chimney" stent in place.

Next, simultaneous balloon inflation of the graft and the "chimney" stent was done. After this, an angiogram revealed a filling of the aortic sac consistent with type I proximal endoleak. A Palmaz stent was deployed proximally partially into the aortic cuff and partially into the native aorta to eliminate any infolding of the graft that may have been responsible for the endoleak. In order to avoid crushing the ICAST stent, a simultaneous balloon was inflated in the ICAST stent while the Palmaz stent was being deployed. The final angiogram revealed adequate seal with no [6]evidence of endoleak and good perfusion of bilateral renal arteries (Figure 3).



The patient had a noneventful postoperative course and was discharged home on postoperative day 2. Serum creatinine was 1.0 postoperatively compared to 0.8 preoperatively. Upon 90-day follow-up, the patient continued to do well, and her abdominal pain had resolved. Ultrasound studies done at 30 day follow up interval revealed minimal type 2 endoleak. A computed tomography angiogram was obtained at 90 days post procedure and revealed no endoleak. The patient will continue to be seen by vascular surgery as an outpatient for routine follow-up visits for physical exams and follow-up imaging.

Discussion

Management of juxtarenal or pararenal abdominal aortic aneurysms in the elderly remains a major surgical challenge in patients who are not good candidates for open repair in the absence of easily accessible custom-made endografts. The endovascular "chimney" or "snorkel" repair is a promising option in this category of patients who are at high risk for open surgical repair. The technique of endovascular chimney repair revolves around exclusion of the aneurysm while maintaining visceral blood flow. This can be accomplished by deploying a stent graft that extends proximally or distally along the main aortic endograft. In a literature review of 15 reports of chimney graft technique, Moulakakis et al report 100% technical success rate in 93 patients with 14% type I endoleak rate and a 30-day mortality rate of 4.3%. The relatively elevated type I endoleak rate occurring with the technique is related to the blood flow in the gutter between the visceral stent graft and the main body stent graft. For that reason, choosing the proper diameters for the main body graft and chimney graft is of paramount importance.[8]

One other reported case using Powerlink stent graft in chimney EVAR was found in the literature. In the Powelink graft, the graft is located outside the endoskeleton and attached at the proximal and distal ends.[9] This allows blood to expand the graft and eliminates friction between graft and stent. The design of the Powerlink design is useful in the chimney graft repair as it allows the graft to expand beyond the endoskeleton, thereby theoretically minimizing or obliterating the gap between the main graft and chimney stent, therefore reducing the risk of "gutter leak." Another advantage of the Powerlink design is that the endograft flow divider sits on the abdominal aortic bifurcation, which almost eliminates the risk of endograft migration, especially in angulated or short necks.[9]

Finally, a chimney graft provides an alternative to open repair or fenestrated endografts with promising short term results. Larger studies and long term follow up is required to ascertain the

efficacy of this technique. Meanwhile the technique can still be used as an alternative to fenestrated grafts which are not readily available especially in emergency situations in patients with challenging anatomy who are poor candidates for open repair.

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