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# 신동맥에 접한 복부대동맥류에서 굴뚝형 이식편을 이용한 혈관내 치료

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# Endovascular Repair of a Juxtarenal Abdominal Aortic Aneurysm Using a Chimney Graft

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An endovascular repair of an abdominal aortic aneurysm (AAA) is technically less invasive than open surgery, but gives results as effective as open surgery if the anatomy is adequate. Unfortunately, 20-30% of AAA patients are not suitable for endovascular repair because they lack a sufficient proximal landing zone. In an effort to broaden the applicability of endovascular repair, the chimney technique has been introduced. This refers to deployment of a covered or bare-metal stent parallel to the main aortic endograft within the aneurysm, creating a conduit that runs outside the main aortic endograft into the aortic branches. We report the case of a 75-year-old male with a juxtarenal abdominal aortic aneurysm and multiple comorbidities who was treated successfully with an endovascular aneurysm repair using a chimney graft. (Korean J Med 2014;86:213-217)

**Keywords:** Abdominal aortic aneurysm; Endovascular techniques

## INTRODUCTION

The endovascular aneurysm repair (EVAR) of an abdominal aortic aneurysm (AAA) is a less invasive technique that is as effective as open surgery, but has lower mortality and morbidity rates than surgical repair [1]. Unfortunately, the endovascular treatment of AAAs with an infrarenal proximal neck length < 15 mm and angulation > 60° is associated with a significantly higher risk of short- and midterm proximal endoleaks after EVAR. Due to the hostile anatomy of the proximal aortic neck, 20-30% patients are ineligible for EVAR using stent grafts [2]. Fenestrated or branched endografts have been introduced to overcome such anatomical

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difficulties [3]. However, they are customized individually, requiring months for their production. Moreover, they are not available commercially in Korea. The chimney technique, also known as the double-barrel or snorkel technique, is an alternative technique that involves placing stents into side braches parallel to the stent grafts to preserve blood flow into the side branches and to extend the proximal aortic neck for the landing zone. There are no large-scale data supporting the long-term efficacy of the chimney graft technique. However, it can serve as an alternative to the complex surgical repair of an AAA in high-risk patients. We report the case of a 75-year-old male with a juxtarenal abdominal aortic aneurysm and multiple comorbidities who was treated successfully with endovascular aneurysm repair using a chimney graft.

## CASE REPORT

A 75-year-old male ex-smoker was admitted for a palpable mass in the abdomen that had recently increased in size. He had a history of hypertension, diabetes mellitus, tuberculosis arthritis of both knee joints, and chronic renal failure with an estimated glomerular filtration rate of 53 mL/min/1.73 $m^2$. Four years earlier, he had been diagnosed with stable angina and two-vessel disease and treated with coronary stenting at the proximal left anterior descending artery and distal left circumflex artery. Two years earlier, he presented with pain at rest and gangrenous changes to the toes of both lower limbs. At that time, he had been treated with percutaneous transluminal angioplasty due to total occlusion of the superficial femoral artery and multiple tibial arteries in both legs. Computed tomography angiography (CTA) performed to evaluate peripheral artery disease incidentally found an AAA with a maximum diameter of 55 mm and an angulated (-90°) proximal aortic neck of 15 mm. The left renal artery ostium was located -5 mm below the right one. The patient refused surgical or endovascular repair of the AAA because of his poor general condition. Even when follow-up CTA 1 year later showed that the maximum diameter of the AAA had increased to 65 mm, he remained reluctant to have the aneurysm repaired. However, when the maximum diameter of the AAA increased to76 mm with an angulated (-90°) proximal aortic neck of -19 mm in diameter (Fig. 1), he finally agreed to undergo EVAR using the chimney graft technique, a less invasive procedure than open surgical repair.

Before the EVAR procedure, we performed balloon angio-

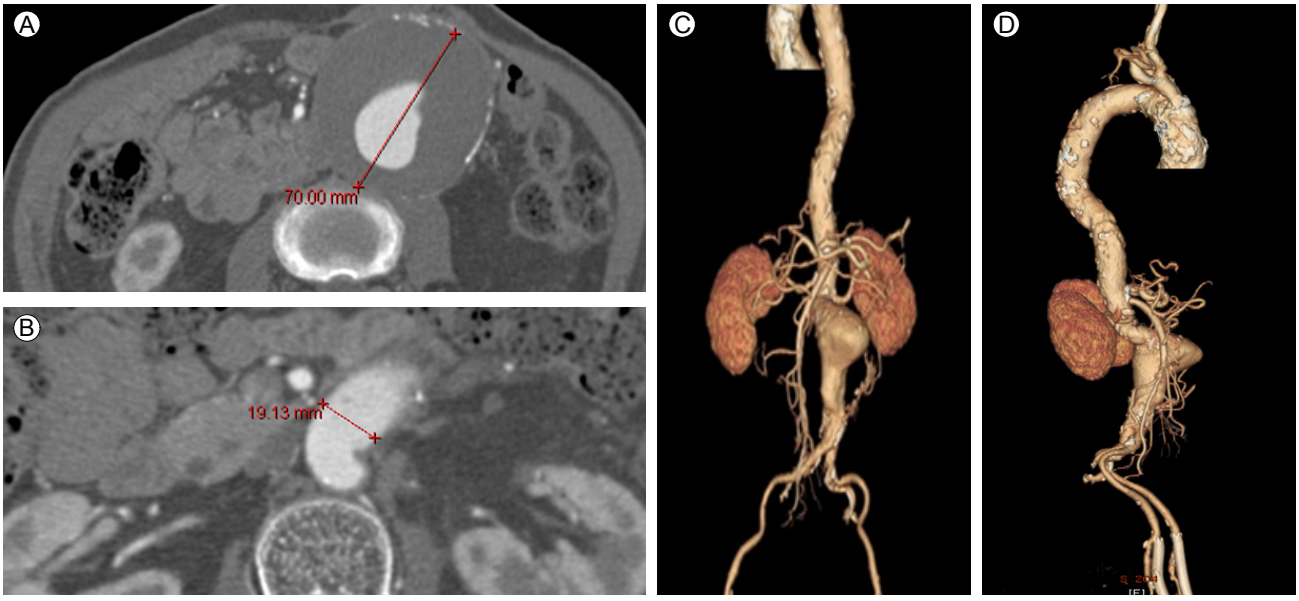


**Figure 1.** Baseline CT images of the abdominal aortic aneurysm. (A) CT showed the increased size of the partially thrombosed abdominal aortic aneurysm with a maximum diameter of 76 mm, with (B) an angulated (ca. 90°) proximal aortic neck of -19 mm in diameter. (C) The left renal artery ostium was located -5 mm below the right ostium and the aneurysm extends down to the distal abdominal aorta, immediately proximal to the iliac bifurcation. (D) Three-dimensional CT angiography showing the angulated proximal aortic neck.

plasty of the reoccluded stents in the bilateral superficial femoral arteries to avoid stent graft occlusion due to poor distal blood flow. After careful hydration for 4 days, the EVAR was performed. An 8-Fr shuttle sheath (Cook Medical; Bloomington, IN, USA) was inserted through the left brachial artery into the suprarenal aorta. Subsequently, a stent graft (Viabahn 6 × 50 mm, Gore; Flagstaff, AZ, USA) was inserted through the shuttle sheath into the left renal artery along a 0.035-inch stiff wire. The main body of the bifurcated stent graft (Endurant 28-16-170 mm, Medtronic; Santa Rosa, CA, USA) was inserted through the right common femoral artery and positioned so that the proximal graft edge was located immediately below the right renal artery ostium. The self-expanding Viabahn stent graft was deployed in the left renal artery. The proximal end of the Viabahn stent graft protruded 10 mm above the main body aorta stent graft. Subsequently, the main body was also deployed (Fig. 2A). The contralateral limb stent graft (Endurant 16-16-120 mm, Medtronic) was inserted through the left common femoral artery (Fig. 2B). An additional self-expanding bare-metal stent (Smart 7 × 40 mm, Cordis; Miami Lakes, FL, USA) was inserted with the Viabahn stent to prevent collapse of the stent graft caused by the main body aorta stent graft. Synchronous ballooning of the main body stent graft (46 mm Reliant, Medtronic; Minneapolis, MN, USA) and the Viabahn stent graft (POWERFLEX balloon 6 × 40 mm, Cordis, Miami Lakes, FL, USA) was performed (Fig. 3A). A final aortogram showed no endoleak and good blow flow to the left renal artery (Fig. 3B).

Aortic computed tomography (CT) performed before discharge revealed patent aorta and renal artery stent grafts without endoleaks (Fig. 4).

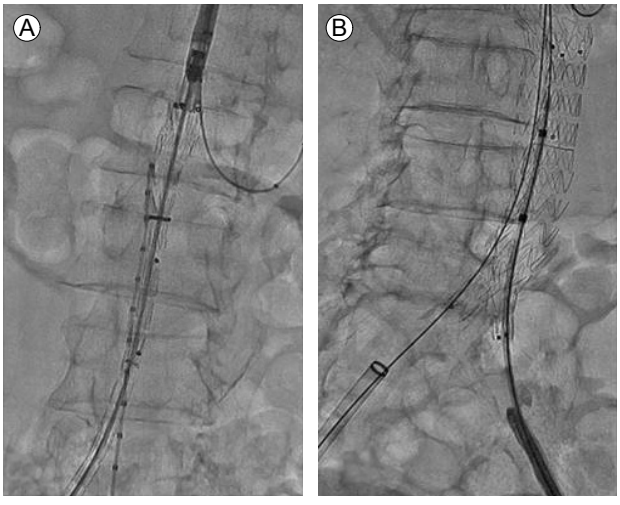


**Figure 2.** (A) A self-expanding Viabahn stent graft (6 × 50 mm Viabahn, Gore; Flagstaff, AZ, USA) was deployed in the left renal artery through the shuttle sheath and the main body of the bifurcated stent graft (Endurant 28-16-170 mm, Medtronic; Santa Rosa, CA, USA) was inserted through the right common femoral artery. (B) The contralateral limb stent graft (Endurant 16-16-120 mm) was inserted through the left common femoral artery.

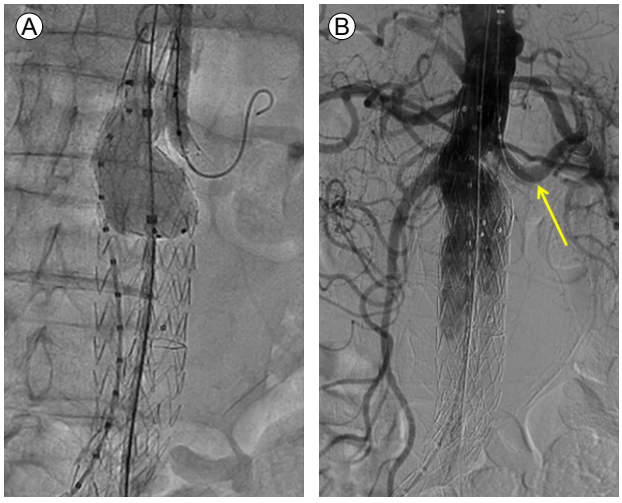


**Figure 3.** (A) Synchronous ballooning of the main body stent graft (46 mm Reliant, Medtronic; Minneapolis, MN, USA) and the Viabahn stent graft (POWERFLEX balloon 6 × 40 mm, Cordis; Miami Lakes, FL, USA) was inserted. (B) A final aortogram showed no endoleak and good blow flow to the left renal artery (arrow).

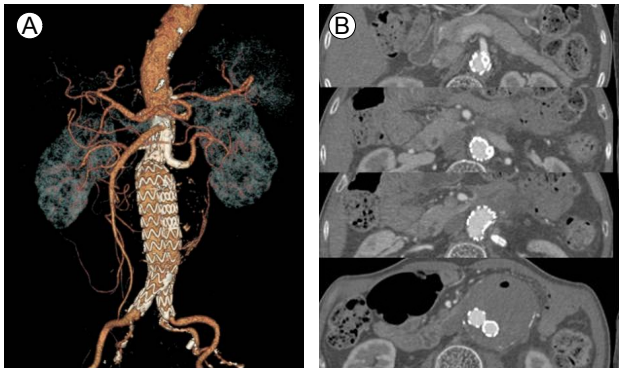


**Figure 4.** CT taken 3 days after the procedure showing complete exclusion of the abdominal aortic aneurysm sac without an endoleak and a patent Viabahn stent graft deployed in the left renal artery.

## DISCUSSION

Endovascular aneurysm repair of AAAs with a hostile neck anatomy is associated with an increased risk of proximal type I endoleak. Alternatively, the surgical treatment of pararenal aortic aneurysms is demanding technically because it requires more extensive mobilization of the viscera and more proximal aortic clamping causing renal and visceral ischemia or atheroembolization and is generally associated with high mortality and morbidity rates [1].

The chimney technique was first developed as a rescue for misplaced endografts. Greenberg et al. [4] suggested a method of treating a short proximal neck, which included using a longer neck covering the ostium of the lowest renal artery, and then deploying renal stents to maintain branch patency. Subsequently, this technique has been used to restore the flow in aortic branches accidentally or intentionally covered during thoracic EVAR in the aortic arch, for patients with juxtarenal AAAs, and in urgent cases when off-the-shelf devices need to be used [5]. Tolenaar et al. reviewed the short- and long-term results of the chimney technique, with follow-ups ranging from 30 days to 54 months [6]. Regarding immediate results, three patients died perioperatively due to a myocardial infarction, lethal stroke, and mesenteric ischemia, respectively [7,8]. Early (within 30 days) complications were type I endoleaks, which were either coil embolized or observed [5]. Late complications (after 30 days) were type II endoleaks and type I endoleaks that resolved spontaneously. Three chimney grafts occluded during follow-up, of which two required reintervention. None of the patients died of device- or aneurysm-related complications. Bruen et al. [7] compared chimney EVAR with open surgical repair in a small case-control study (n = 21) and reported that the chimney EVAR had similar mortality (4%) to open repair with less morbidity. Lee et al. [9] reported the outcomes of 56 chimney grafts in 28 patients with AAA. The technical success rate was 98.2% and the 30-day mortality was 7.1%. During a follow-up duration of 10.7 months, there was no aneurysm-related death. The patency rate of the chimney grafts was 98.2% [9]. There were seven endoleaks (25%) in the early phase, of which two were type I endoleaks. Recently, Donas et al. [10] reviewed the clinical studies on chimney EVAR and EVAR with fenestrated stent grafts and reported that there was no significant difference between the two endovascular approaches in terms of the 30-day mortality, renal impairment, or endoleaks. Therefore, EVAR with the chimney technique is a valuable alternative in patients at high surgical risk with a juxtarenal AAA. However, large-scale long-term data are needed to prove the efficacy and safety of the chimney technique.

Our case demonstrates that EVAR with the chimney technique can be performed as an alternative treatment modality in patients with a juxtarenal AAA at high risk for complex open surgery. The success rate of the technique seems to be high. The early outcomes are favorable and promising. The accumulation of long-term data is required to prove the efficacy and safety of the chimney technique.

**중심 단어:** 복부대동맥; 혈관내 치료

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