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Case Report

The Upside-Down Gore Excluder Limb and Double-Barrel Sandwich Technique for Penetrating Aortic Ulcer and Iliac Aneurysm Exclusion

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Endovascular aneurysm repair has become the first-line treatment for abdominal aortic aneurysms and iliac artery aneurysms in recent years. However, the diameter of the infrarenal aorta is larger than that of the aortic bifurcation, especially with small aortic diameters, for which a reversed tapered device is necessary. We describe the off-label use of the upside-down Gore Excluder limb and double-barrel sandwich technique for the treatment of a penetrating abdominal aortic ulcer with a large common iliac artery aneurysm. These techniques offer an easy endovascular approach for excluding an aneurysm in selected patients. However, this technique is outside the standard instructions for use, therefore careful planning and long-term follow-up are mandatory.

Key Words: Aneurysm, Abdominal aorta, Iliac artery, Stent graft

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INTRODUCTION

Endovascular aneurysm repair (EVAR) has become the first-line treatment for abdominal aortic aneurysms (AAAs) and iliac artery aneurysms in recent years. However, in up to 40% of cases, anatomic barriers such as problematic access vessels and the aortic neck may exclude the use of EVAR in AAA or iliac artery aneurysms [1]. Another anatomical constraint is size incompatibility in some patients. For example, in AAAs with a small aortic diameter combined with proximal and distal size discrepancy, conventional EVAR with a tubular stent graft will induce limb competition because of the small aortic diameter. To overcome this anatomic constraint, an upside-down technique using an Excluder limb (W. L. Gore and Associates Inc., Flagstaff, AZ, USA), Zenith leg (Cook Medical Inc., Bloomington, IN, USA), or Endurant limb (Medtronic Cardiovascular, Santa Rosa, CA, USA) has been used successfully in selected cases of AAA and iliac artery aneurysm [2-5]. In addition, the most appropriate endovascular approach for treatment of isolated common iliac artery (CIA) aneurysms without adequate sealing zone is currently a standard EVAR with a bifurcated endograft. However, in some patients with narrow distal aorta, traditional bifurcated repair poses an anatomical challenge due to limited space. In this study, we describe our experience using this technique and double-barrel sandwich grafts for the treatment of a patient with a penetrating abdominal aortic ulcer and a large CIA aneurysm.

CASE

A 77-year-old woman presented to our emergency department with abdominal pain and tenderness. Her medical history was significant and included hypertension, asthma, and chronic obstructive lung disease. Computed

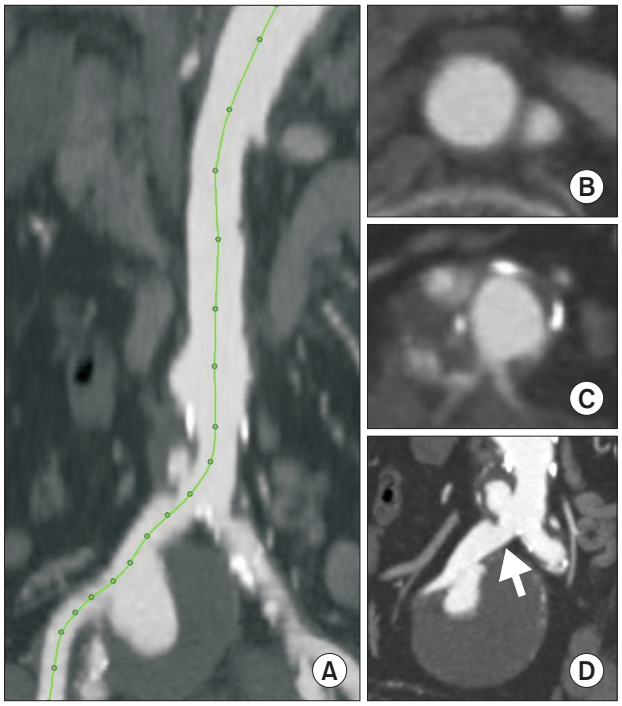

Fig. 1. Preoperative computed tomography images. (A) The centerline image shows a penetrating aortic ulcer in the distal abdominal aorta and a right common iliac artery (CIA) aneurysm measuring 46 mm in diameter. (B) Axial image of the proximal landing zone of the infrarenal aorta measuring 14.6 mm in diameter. (C) Axial image of the most stenotic segments of the infrarenal aorta near the penetrating aortic ulcer measuring 13 mm in diameter. (D) Coronal image of the right CIA aneurysm showed a short neck between the aortic bifurcation and the aneurysm (arrow, 8 mm in length).

tomography (CT) revealed a small AAA with a penetrating aortic ulcer. The right CIA also showed aneurysmal dilatation with a diameter of 46 mm (Fig. 1). The diameter of the infrarenal abdominal aorta measured 14.6 mm cranially and 13 mm caudally. The distance between the aortic bifurcation and the right CIA aneurysm was 8 mm in length (Fig. 1). The patient's comorbidity was considered to be significant, and we decided to perform an EVAR. The placement of an isolated stent graft in the right CIA aneurysm without EVAR from the aortic bifurcation to the iliac arteries was not considered possible due to the short proximal landing zone (8 mm). EVAR with an inverted Y stent graft was also not feasible due to the small diameter of the infrarenal aorta, especially just above the aortic bifurcation (13 mm in diameter), and also due to the discrepancy in the proximal and distal diameters. Therefore, we decided to use an upside-down Excluder limb for infrarenal aortic sealing and a double-barrel sandwich technique within the upside-down Excluder limb for iliac aneurysm exclusion.

The technique used for stent graft preparation of the Excluder contralateral leg was the same as the method previously described by van der Steenhoven et al. [2]. After cutting off the olive tip of the delivery catheter and the deployment suture line at the nearest position to the deployment knob, the leg was removed from the delivery catheter together with the deployment suture line. After embolization of the right internal iliac artery (IIA) with a vascular plug (Amplatzer vascular plugs; St. Jude Medical Inc., Saint Paul, MN, USA) (Fig. 2A), the upside-down procedure for the aortic lesion was performed using a

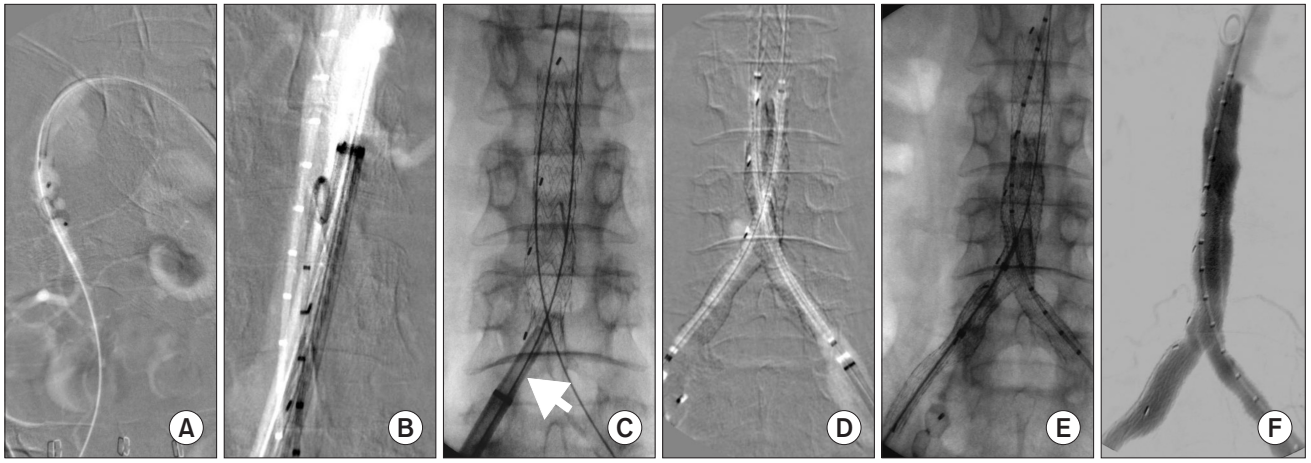

Fig. 2. Intraoperative images. (A) Embolization of the right internal iliac artery with a vascular plug. (B) Introduced upside-down Excluder limb within the 18 Fr sheath just distal to the left renal artery. (C) Deployment of the upside-down Excluder limb at the infrarenal aorta supported by a cut dilator (arrow). (D) Deployment of two parallel Viabahn stent grafts within the deployed Excluder limb. (E) Deployment of the additional iliac extender to the external iliac artery on the right side. (F) Successfully excluded aneurysms shown on completion angiography.

9.5-cm long Excluder contralateral leg component (PLC 201000), which, once implanted, has a proximal diameter of 20 mm and a distal diameter of 16 mm. The device was introduced into an 18 Fr sheath (St. Jude Medical Inc.) placed in the landing zone beforehand and was advanced to the planned position (Fig. 2B). Once the entire device was inside the sheath, it was deployed by pulling back the deployment suture line while the distal end of the device was supported by a cut dilator (Fig. 2C). The device was then deployed across the landing zone by pulling the sheath while holding the pusher firmly. A double-barrel sandwich stent graft to both iliac arteries was performed using 13-mm diameter and 10-cm long Viabahn stent grafts (W. L. Gore and Associates Inc.) with a 5-cm length of overlapping zone within the proximal stent graft (Fig. 2D). On the right side, an additional iliac extender was deployed to the external iliac artery (EIA) (Fig. 2E) and final angiography demonstrated no contrast filling in the right CIA aneurysm (Fig. 2F). The procedure was uncomplicated, and the patient left the hospital 3 days after the procedure.

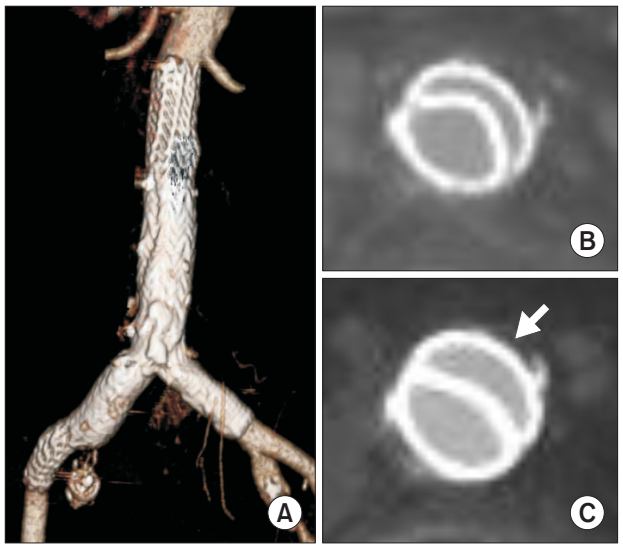

Fig. 3. Postoperative computed tomography (CT) scan and follow-up CT 18 months after the procedure. (A) Postoperative three-dimensional reconstructed image demonstrated no endoleak from the right common iliac artery aneurysm. (B) Postoperative axial image of distal abdominal aorta demonstrated compression of one Viabahn stent graft within the upside-down Excluder limb caused by competition of the two parallel stent grafts. The distal segment of the upside-down stent graft was not fully expanded (14 mm in diameter) because of the small aortic diameter. (C) Axial image of the same area 18 months after the procedure. The stenosis was improved after remodeling of the aortic wall (arrow) and the diameter was enlarged to 16 mm.

On postoperative follow-up CT, there was no endoleak (Fig. 3A). However, the parallel stent graft to the right leg exhibited signs of compression because of competition of the two stent grafts within the upside-down Excluder leg (Fig. 3B). Her ankle–brachial index was 0.91 on the right side and 1.11 on left side, but the patient did not complain of right leg claudication, and we observed the patient closely. The follow-up CT 18 months after the procedure showed no endoleak and the diameter of right CIA aneurysm had decreased to 29 mm. The luminal stenosis of the Viabahn stent graft in the right leg was much improved compared with that shown on the postoperative CT scan (Fig. 3C).

DISCUSSION

The main pathology of our patient was a right CIA aneurysm measuring 46 mm in diameter. In addition, the distal abdominal aorta had a small aortic diameter with a penetrating aortic ulcer. If the disease is confined to the CIA with adequate proximal and distal sealing zones, treatment with a covered stent or endograft limb for aneurysm exclusion is considered an appropriate approach. In our case, the neck from the aortic bifurcation to the right CIA aneurysm was 8 mm and was considered inappropriate for stent grafting within the isolated iliac arteries. Currently, the preferred and most commonly used endovascular approach for isolated CIA aneurysm without adequate sealing zone is a standard EVAR with a bifurcated endograft. However, in some patients with narrow distal aorta such as our case, traditional bifurcated repair poses an anatomical challenge due to limited space. The limited space within the tight distal aorta may result in limb competition. Also, this limb competition can result in compression and/or kinking of one or both iliac limbs, and can lead to a higher rate of limb occlusion [6]. To overcome this problem in narrow distal aortas, some adjunctive maneuvers to maintain limb patency such as kissing balloon angioplasty, selective or routine bilateral stent reinforcement, and "cracking" of a narrow distal aorta with high-pressure kissing-balloon angioplasty may be performed. Another possible option in the presence of a narrow distal aorta can be an aorto-uni-iliac (AUI) graft. Although AUI implantation is an attractive option without concerns for limb competition, the limitation of an AUI device is the necessity of a femorofemoral bypass which has the drawback of adding procedural time and further risk of morbidity such as graft thrombosis. In our case, the luminal diameter of the infrarenal aorta was small; the diameter of the proximal infrarenal aorta was 14.6 mm and the distal abdominal aorta was 13 mm. The diameter of the smallest

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commercial bifurcated EVAR device is 23 mm. Therefore, the concern after deployment of a standard bifurcated device in our patient was that in theory it could induce infolding or wrinkling of the device, which could lead to stenosis or occlusion of the limb from competition. Also, contralateral gate cannulation can be significantly impeded once the ipsilateral limb is deployed through the narrow aorta. Therefore, we decided to perform an upside-down technique combined with double-barrel sandwich grafting within the upside-down graft.

There are some reports on the upside-down technique using commercially available devices in patients with unsuitable anatomy [2-5]. For example, this technique has been used for saccular aneurysms of the abdominal aorta with a small reverse-tapered aortic diameter, as in our patient [2,4]. This technique has also been used for iliac artery aneurysms [3-5]. Endovascular repair by coverage of the iliac artery from the CIA to the EIA after the IIA embolization has been proven to be safe and effective for treatment of isolated iliac artery aneurysms. The proximal diameter of a Zenith leg is 12 mm and that of an Excluder leg is 16 mm. Therefore, when the proximal neck diameter is smaller than 10 mm or larger than 14 mm, no available commercial devices can be used as intended. In cases in which the diameter of the proximal sealing zone is larger than that of the distal sealing zone, or in isolated IIAs with a history of Y-graft replacement, a tapered or reverse-tapered device is needed besides the commercially available stent grafts.

In contrast to the upside-down technique for other devices using deployment outside the body and a remounting process to the delivery device, the advantage of the Excluder device is that it can be removed from the catheter in a constrained manner within the sleeve and can be reintroduced into the delivery catheter [5]. This reduces the operating time and the theoretical risk of damaging the stent, fabric, or sheath, which could cause accelerated stent fatigue and fracture.

The sandwich technique, which involves placement of two parallel stent grafts into two outflow arteries from a more proximal graft, was originally introduced as a bailout technique and is an acceptable and viable method for preservation of arterial flow to at least a single internal iliac artery, albeit in an off-label manner [7]. However, with this approach, there is an inherent risk of a type III endoleak because of the "gutters" created by the two sandwich graft components. To minimize this risk of endoleak, sufficient overlap of the two sandwich grafts and the proximal stent graft is required, and an oversizing of the two parallel sandwich grafts within the more proximal graft is necessary. The length of the overlapping zone is recommended to be at least 5 cm [8]. The suggested method for oversizing the two parallel grafts is that the summed areas of the two stent grafts should be 10%-30% more than the area of the more proximal graft [9,10]. In our patient, the area of the upside-down graft was about 201 cm^2 because we used the Excluder leg 16-mm proximal end in the upside-down configuration. Therefore, we can use two parallel stent grafts with a diameter of 12 mm or 13 mm for sufficient oversizing. In our case, we used 13 mm-sized stent grafts because 12 mm-sized stent grafts are not manufactured. The area of one parallel graft with 13 mm diameter was 133 cm^2, and the summed area was 266 cm^2. Therefore, about 30% oversizing was used in our patient.

In postoperative follow-up CT, one parallel graft to the right leg showed stenosis because of compression by the other parallel graft. This may have occurred because the proximal graft was not fully expanded to 16 mm due to the small aorta. The diameter was measured as 14 mm on follow-up CT (Fig. 3B). Therefore, the actual diameter should be considered when performing the sandwich graft for a small arterial diameter. Fortunately, the stenosis had resolved at the time of the next follow-up CT 18 months after the procedure possibly because of remodeling of the aortic wall.

In summary, the upside-down technique with double-barrel sandwich grafts offers an easy endovascular approach for excluding an aneurysm in selected patients. However, this technique is outside the standard instructions for use, therefore careful planning and long-term follow-up are mandatory.

REFERENCES

1) Arko FR 3rd, Murphy EH, Boyes C, Nussbaum T, Lalka SG, Holleman J, et al. Current status of endovascular aneurysm repair: 20 years of learning. Semin Vasc Surg 2012;25:131-135.

2) van der Steenhoven TJ, Heyligers JM, Tielliu IF, Zeebregts CJ. The upside down Gore Excluder contralateral leg without extracorporeal predeployment for aortic or iliac aneurysm exclusion. J Vasc Surg 2011;53:1738-1741.

3) Koike Y, Nishimura J, Hase S, Yamasaki M. The upside down Endurant iliac limb stent graft for treatment of a common iliac artery aneurysm. Vasc

Endovascular Surg 2014;48:58-60.
4) Higashigawa T, Kato N, Hashimoto T, Inouchi M, Chino S, Yamamoto N, et al. Upside down use of Gore Excluder or Cook Zenith legs. Cardiovasc Intervent Radiol 2014;37:1068-1072.
5) Song KS, Lee H, Nam DH, Park KH, Yun SS, Lee BY, et al. Use of reversed iliac leg stent-graft for the treatment of isolated aneurysm of internal iliac artery. Vasc Specialist Int 2014;30:38-42.
6) Gabrielli L, Baudo A, Molinari A, Domanin M. Early complications in endovascular treatment of abdominal aortic aneurysm. Acta Chir Belg 2004; 104:519-526.
7) Lobato AC. Sandwich technique for aortoiliac aneurysms extending to the internal iliac artery or isolated common/internal iliac artery aneurysms: a new endovascular approach to preserve pelvic circulation. J Endovasc Ther 2011;18:106-111.
8) Lobato AC, Camacho-Lobato L. The sandwich technique to treat complex aortoiliac or isolated iliac aneurysms: results of midterm follow-up. J Vasc Surg 2013;57(2 Suppl):26S-34S.
9) Smith MT, Gupta R, Jazaeri O, Rochon PJ, Ray CE Jr. Preservation of internal iliac arterial flow during endovascular aortic aneurysm repair using the "Sandwich" technique. Semin Intervent Radiol 2013;30:82-86.
10) Ricci C, Ceccherini C, Cini M, Vigni F, Leonini S, Tommasino G, et al. Single-center experience and 1-year follow-up results of "sandwich technique" in the management of common iliac artery aneurysms during EVAR. Cardiovasc Intervent Radiol 2012;35: 1195-1200.

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