Snorkeling and EVAR of Five Aneurysms in a Single Patient

How to perform the snorkel technique to ensure preservation of pelvic flow.

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In the United States, an estimated 46 million people aged 60 years and older are at risk for an abdominal aortic aneurysm (AAA). Due to asymptomatic presentation until rupture, AAA is a silent killer, which ranks as one of the leading causes of death in Western societies. During the past decade, endovascular aneurysm repair (EVAR) with endograft deployment has shown significant promise in treating this pathology. Coexistence of peripheral arterial diseases such as aneurysms of the common iliacs, external iliacs, and internal iliacs, complicates EVAR.[1] In the past, patients with AAAs and associated iliac artery aneurysms have been treated by embolization or jailing of the internal iliac artery with a stent graft extension in the external iliac artery, essentially blocking perfusion to the branches of internal iliac arteries such as gluteal, rectal, vesical, and internal pudendal arteries as illustrated in Figure 1. This can lead to decreased blood flow in the branches of the internal iliac with clinical symptoms.

Bilateral compromise of the internal iliac arteries can thus lead to severe buttock claudication, erectile dysfunction, and spinal and colonic ischemia.[2,3] These symptoms may improve over a period of time, but up to 15% of patients may have persistent symptoms.[3] Preservation of flow to one of the iliac arteries leads to increased bilateral pelvic blood flow perfusion, which has been demonstrated intraoperatively by penile blood flow.[4]

The following is a case presentation of a complex, large AAA associated with multiple aneurysms of both the common iliacs and involving both internal iliacs in a patient with multiple comorbidities. This case report focuses on the preoperative planning of endovascular repair of AAA with endograft and stenting of the bilateral common iliacs, internal iliacs, and external iliacs by the "snorkel" technique, used for preservation of pelvic flow.

CASE REPORT

A 77-year-old man with a history of smoking was found to have a midline pulsatile mass, just superior to the umbilicus on physical exam. Subsequent ultrasound showed an AAA, which was fusiform: 12 cm in length, 8.8 cm in transverse diameter, and 8.1 cm anteroposteriorly. His medical history included coronary artery bypass grafting in 1985, chronic atrial fibrillation, severe chronic kidney disease, and chronic lung disease. After discussion with the patient and a nephrologist, a decision was made to perform noncontrast computed tomography (CT) of the abdominal aorta and the iliacs due to the severe renal failure. The scan showed an an

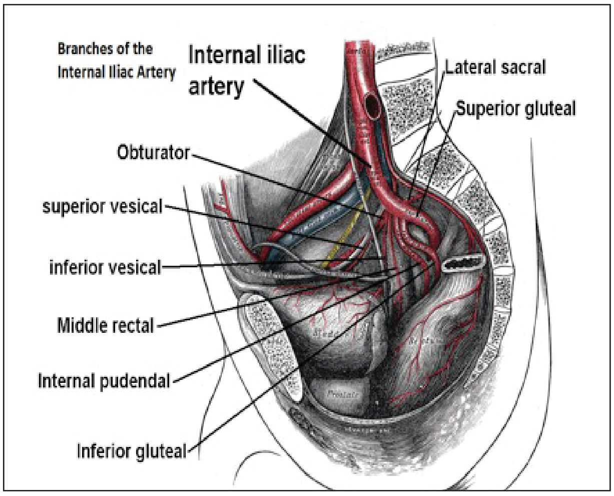

Figure 1. The internal iliac artery and its branches.

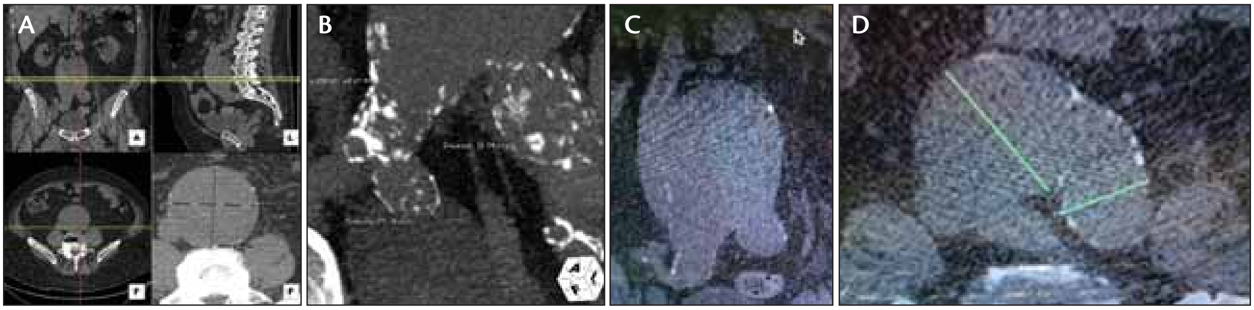

Figure 2. Noncontrast CT image showing a large AAA with a bilateral common and internal iliac aneurysm (A). Noncontrast CT image showing an AAA with right common iliac artery aneurysm measuring 29.24 mm, left common iliac artery aneurysm measuring 36.04 mm, and aneurysm of the right internal iliac measuring 22.15 mm (B). A distal AAA (C). A right common iliac aneurysm and a right internal iliac aneurysm (D).

aneurysm of the abdominal aorta (Figure 2A and 2B), aneurysms of the common iliacs, and aneurysms of the internal iliac (Figure 2C and 2D).

Preprocedure Planning

Preprocedure planning was extensive due to the complexity of the five aneurysms involving the abdominal aorta, the common iliacs, and the internal iliacs, along with multiple comorbid conditions. Due to potential compromise of the bilateral hypogastric arteries (internal iliacs) during treatment with EVAR and stenting of the iliacs after EVAR, a specialized snorkel technique was planned for treatment of the bilateral common iliac and internal iliac artery aneurysms. Preplanning also included measurement of the optimal angle during preoperative CT angiography (CTA) assessed by reviewing three-dimensional images, multiplanar reconstruction, and maximum intensity projection images and planning ahead of time the length and diameter of stents needed for the appropriate sizing of sheaths. It was decided that the endovascular treatment of the AAA and the bilateral iliac artery (Figure 3) aneurysms would be done with a unibody bifurcated endograft, and treatment of the bilateral internal iliac artery aneurysms would be done using our unique snorkel technique with covered stent grafts for the preservation of pelvic flow.

Deployment of Endograft for AAA

Initially, the left femoral artery was accessed with a 6-F sheath, and the right femoral artery was accessed with a 9-F sheath. Preclose of the right and left femoral arteries were performed separately with the Prostar closure device (Abbott, Santa Clara, CA). Suture material was tagged and laid to the side for percutaneous closure of the arteriotomy sites at the end of the procedure. Abdominal and iliac angiography was performed using minimal contrast with a marker pigtail catheter, which showed five aneurysms involving two areas in the abdominal aorta with aneurysms in both common iliacs and both internal iliacs (Figure 3). The Powerlink endograft system (Endologix, Inc., Irvine, CA) was deployed through large, bilateral sheaths using the unibody infrarenal bifurcated stent graft with the standard technique. The dimensions of this device consist of a 28-mm diameter of the main body and 16-mm diameter of the bifurcated limbs, with a total device length of 140 mm. After deployment of this unibody infrarenal bifurcated stent graft, the suprarenal proximal Powerlink extension (34-mm diameter X 100-mm length) was deployed without any evidence of endoleak.

Treatment of Bilateral Common Iliac Artery/Internal Iliac Artery Aneurysms With the Snorkel Technique

Snorkel intervention of the left hypogastric or iliac after EVAR. A 9-F, 70-cm Cook Flexor Check-Flo introducer sheath (Cook Medical, Bloomington, IN) was inserted through an 18-F sheath in the right femoral artery over a 0.035-inch Lunderquist guidewire, which had already been inserted for the initial EVAR procedure. A 5-F Bernstein catheter was inserted through this Cook Flexor Check-Flo introducer sheath. The Bernstein catheter was passed over into the left internal iliac, and with the help of a 0.014-inch Grand Slam wire (Abbott), the catheter was maneuvered into the left internal iliac artery through the deployed Powerlink endograft (Figure 4A). The 9-F Cook sheath was then advanced down into the left internal iliac artery, over the Bernstein catheter and Grand Slam wire. The Bernstein catheter was then removed, and an 8-mm X 10-cm Viabahn endoprosthesis (Gore & Associates, Flagstaff, AZ) was advanced over the wire into the left internal iliac artery (Figure 4B) with the guidance of predetermined angiographic angles from the preoperative CTA for optimal visualization during deployment.

Figure 3. Angiographic image of the infrarenal abdominal aorta before endovascular intervention.

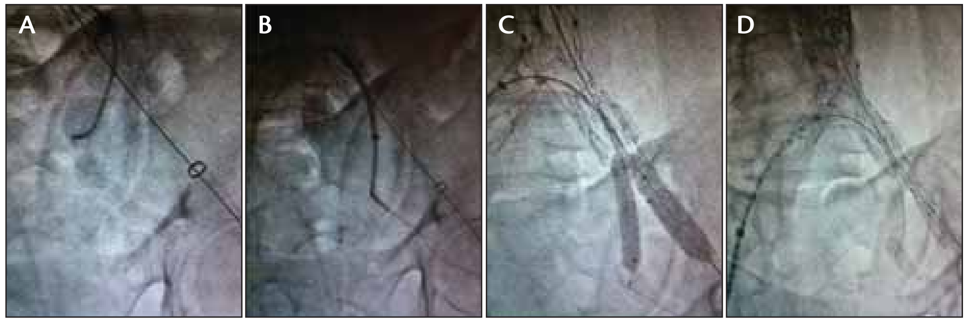

Figure 4. The left internal iliac artery cannulated with a directional catheter from the contralateral side (A). A 9-F, 70-cm Cook Flexor Check-Flo introducer sheath advanced over the bifurcation and a Viabahn stent graft was placed over the wire, into the internal iliac (B). Limb extension and Viabahn deployed and postdilated (C). Completed left internal iliac snorkel procedure (D).

Before deploying the Gore Viabahn endoprosthesis, a 9-F, 11-cm Super Sheath (Boston Scientific Corporation, Natick, MA) was introduced through a 16-F left femoral artery sheath for simultaneous deployment of the Powerlink limb extension into the left common iliac and left external iliac. At this time, the Powerlink limb extension (16-mm diameter X 88-mm length) was placed from the ipsilateral side. Placement of the Viabahn endoprosthesis extending from the ostium of left common iliac (within the endograft) and the placement of the Powerlink limb extension, beginning at the ostium of left common iliac within the endograft, was performed under director fluoroscopy. The Viabahn endoprosthesis and the Powerlink limb extension were simultaneously deployed followed by postdilatation (Figure 4C and 4D).

This created a double-barrel lumen starting from the ostium of the left common iliac (within the iliac limb of the stent graft) to the left internal iliac and the left external iliac, as shown in follow-up CTA (Figure 5), with preservation of pelvic flow via a widely patent left internal iliac artery.

Snorkel intervention of the right iliacs after EVAR. After successful left internal iliac (hypogastric) snorkeling, the 9-F, 11-cm Super Sheath on the left was exchanged with a 9-F, 70-cm Cook Flexor Check-Flo introducer sheath, and the 5-F Bernstein catheter was inserted through this Cook sheath. The Bernstein catheter was passed up and over into the right internal iliac through the deployed Powerlink endograft. The Cook Flexor Check-Flo introducer sheath was then advanced all the way down into the right internal iliac artery over this Bernstein catheter and wire. The Bernstein catheter was removed, and an 8-mm X 10-cm Gore Viabahn endoprosthesis was advanced over the guidewire into the right internal iliac artery with the help of predetermined angiographic angles for optimal visualization during deployment (Figure 6A and 6B).

Before deploying this Viabahn endoprosthesis, a 9-F, 11-cm Super Sheath was introduced through an 18-F right femoral artery sheath for simultaneous deployment of the Powerlink limb extension (16-mm diameter X 88-mm length) into the right common iliac and right external iliac artery. The placement of the Viabahn endoprosthesis, which extended from the ostium of the right common iliac, within the endograft, and the placement of Powerlink limb extension, beginning at the ostium of the right common iliac within the endograft, was performed under direct fluoroscopy. Both the Viabahn endoprosthesis and the Powerlink limb extension were simultaneously deployed. The Viabahn endoprosthesis, from the right common iliac to the right internal iliac, and the Powerlink limb extension, from the right common iliac artery to the right external iliac artery, led to the effective treatment of the aneurysm of the right common iliac and the right internal iliac without compromising the pelvic blood flow.

Figure 5. The double lumen created within the left limb of the endograft after stenting of the left hypogastric by the snorkel technique.

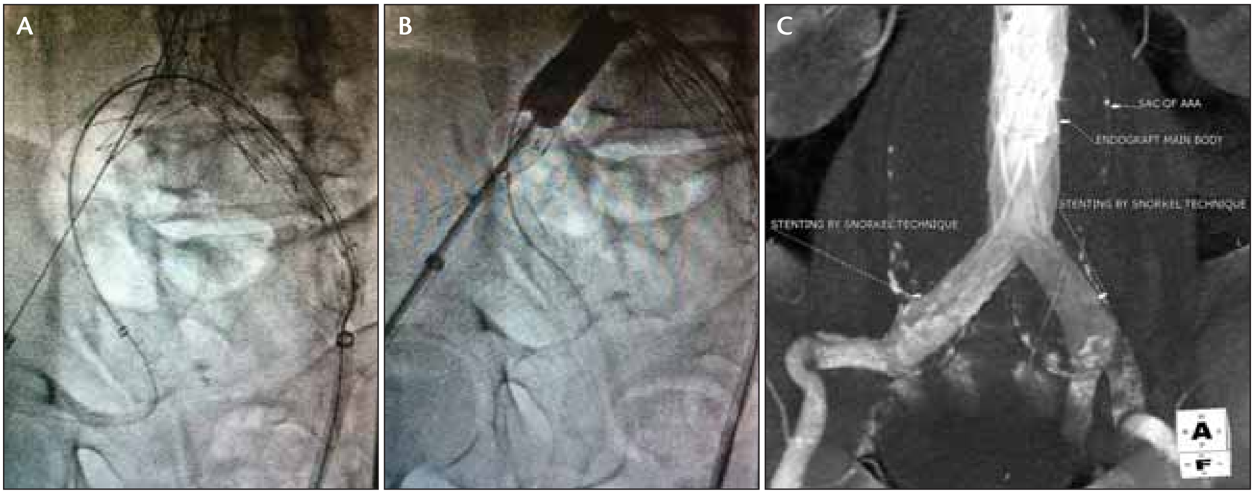

Figure 6. Cannulation of right internal iliac with an 11-F sheath over the bifurcation through the endograft from the contralateral side with deployment of the Viabahn stent graft in the internal iliac and right limb extension simultaneously (A). Postdilation after the snorkel procedure of right internal iliac (B). Angiographic image after deployment of the endograft and bilateral snorkeling of the bilateral iliacs (C).

This unique procedure created a double-barrel lumen starting from the ostium of the right common iliac (within iliac limb of Powerlink endograft) to the right internal iliac and right external iliac. An additional Viabahn endoprosthesis (8 mm X 5 cm) was required for the mid-segment of the right internal iliac, which was passed more deeply into the right internal iliac artery. Angiography was then performed to substantiate excellent deployment (Figure 6C). At the end of procedure, both arteriotomy sites in the right and left femoral arteries were closed with previously placed sutures from the Prostar, and the patient was discharged home the next day.

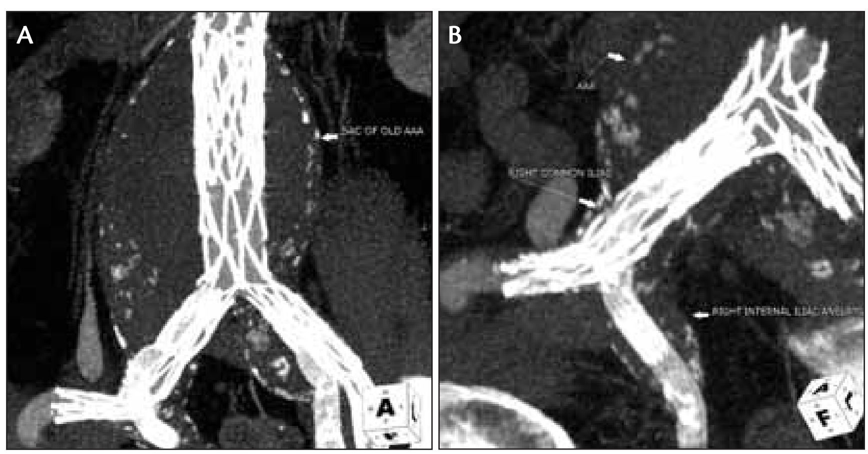

Figure 7. Six-month CT image showing the integrity of the endograft without endoleak and residual aneurysms (A). CT image of the right common iliac and internal iliac with the snorkel technique (B).

CT Imaging Follow-Up

CT imaging is a crucial modality in preplanning and follow-up for EVAR. It is vital in the evaluation of stent graft integrity as illustrated in Figure 7, showing excellent visualization of the Powerlink endograft, Powerlink limb extension, and Viabahn endoprosthesis. Surveillance of AAA and iliac aneurysm sac shrinkage or expansion is critical in follow-up CTA, which is also invaluable in visualization of endoleaks.[5] At 10-month follow-up, the patient was doing remarkably well without any symptoms of claudication, erectile dysfunction, back pain or abdominal pain.

DISCUSSION

The first minimally invasive EVAR procedure was demonstrated as a case report in Russian literature in 1986.[6] Subsequently, several randomized trials comparing EVAR and open repair of AAA have all shown marked 30-day mortality benefit in favor of EVAR.[7-10] During the past 2 decades, EVAR has evolved and now plays a major role in managing AAA.[11] The ultimate goal of EVAR is to prevent rupture and to prolong life.

Therefore, EVAR should be performed in patients whose rupture risk is high as compared to their operative risk and in patients who are going to live long enough to enjoy the benefits. Accurate rupture risk may not be precise, because very few patients with such aneurysms are observed without intervention, and therefore the history of untreated AAA remains poorly defined.[12]

In complex aortoiliac disease, when inadvertent or intentional encroachment of branch vessels such as the internal iliac is expected, a high degree of patency for the iliac bifurcation can be maintained by additional stents via our snorkel procedure as described in this paper. Such snorkel procedures are necessary to prevent compromise of blood flow by the various branches of the internal iliac arteries, for example: internal pudendal, vesical, rectal, gluteal, and sacral arteries (Figure 1).

The stenting of branched vessels, wherein stents are placed within branched vessels and extend parallel to the stent graft, is referred to as *snorkeling*. This has also been referred to as a *double-barrel technique* or *chimney graft*.[13] Although the technical success has been shown to be as high as 91%,[14] it must be noted that these are very complex, demanding, and prolonged procedures. In this small series of branched vessel stent grafts, the average procedure time was 279 minutes, whereas there is much less procedure time in conventional EVAR.[14] Such procedures require extensive preplanning with an in-depth evaluation of clinical and angiographic risk factors. The use of preoperative CTA with three-dimensional imaging helps to prevent overuse of regular or digital subtraction angiography for identification of optimal angiographic views.[14]

CONCLUSION

In complex aortoiliac disease where inadvertent compromise of branch vessels such as the internal iliac is expected, a high degree of patency can be maintained by additional stents via the snorkel technique after the EVAR procedure. Moreover, aneurysms of the common iliac and internal iliac arteries can be treated simultaneously after EVAR safely. Preoperative planning is crucial to minimize contrast use and determine the exact length of the Powerlink endograft, Powerlink limb extension, and Viabahn endoprosthesis, so that they do not extend beyond the ostium of the common iliac artery, thus avoiding difficulty in placing the crossover sheaths. The use of preoperative CTA is also important for identification of optimal angiographic views and helps to avoid frequent use of angiography. ■

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