Abdominal Aortic Interventions

Device selection and procedural recommendations for precise graft deployment.

BY GEORGES E. AL KHOURY, MD, AND ROBERT Y. RHEE, MD


Georges E. Al Khoury


Robert Y. Rhee

PREOPERATIVE EVALUATION

- Cardiology evaluation, stress test, and medical optimization.
- CT scan of abdomen and pelvis (with and without contrast) with 1- to 3-mm cuts and three-dimensional reconstruction.
- Note the neck anatomy (length, diameter, angulation, calcification, amount of mural thrombus), presence of accessory renal arteries, patent inferior mesenteric artery, and special attention to the access vessels and landing zone.
- Angiography on rare occasions to evaluate difficult anatomy and for staged embolization.
- Measurements and ordering appropriately sized grafts (oversize by 15% to 20%, depending on the endograft type).

SET-UP

- Operating room under general or spinal anesthesia; local anesthesia may be used for percutaneous techniques.
- Supine position on a moveable fluoroscopic table or an operating room table that permits imaging of the abdomen and pelvis.
- Prepping and draping in the same fashion as open AAA repair.
- Foley catheter, radial arterial line, central venous access.

ACCESS SITES

- Transverse oblique incision 3 cm to 4 cm long proximal and parallel to the inguinal ligament to expose the common femoral arteries.
- Percutaneous access is an option using the Prostar XL device (Abbott Vascular, Santa Clara, CA) or two Perclose devices (Abbott Vascular).
- If percutaneous access is chosen, the anatomy of the femoral artery is closely examined for size and calcifications; direct anterior puncture of the vessel wall is crucial for the success of this technique.
- Arteriotomy is an option when the vessels are severely calcified.
- Common iliac artery conduit is considered only in rare situations for large-bore devices and in the presence of severe calcification.
- In the case of severe stenosis of the external iliac artery, angioplasty followed by the use of an endoconduit may be required to facilitate the passage of larger devices.

DIAGNOSTIC DEVICES USED

Needles/Sheaths

- Micropuncture needle if percutaneous access is chosen (1).
- 18-gauge needle single-wall entry for the anterior puncture in the open technique.
- 7- to 8-F introducer sheath placed over an .035-inch wire (2).

Guidewires

- .018-inch when using the micropuncture kit (1).
- .035-inch J-shaped tip as a starter wire (1).
- Hydrophilic-coated wire used with a guiding catheter to negotiate tortuous iliac vessels and aortas (1).

Catheters

- Flushing 5-F pigtail catheter 60- to 90-cm long, with radiopaque markers at 1-cm intervals, placed above the origin of the renal arteries at the level of L1 vertebral body.
- 5-F hydrophilic catheter used as an exchange catheter.
- 5-F selective catheters (Kumpe, Cobra, vertebral, Bernstein) are used when difficult iliac anatomy is encountered and to access the contralateral stump in the modular grafts.

INTERVENTIONAL DEVICES USED

Guidewires

- .035-inch stiff wire (Amplatz Super Stiff [Boston Scientific Corporation, Natick, MA], Lunderquist [Cook Medical, Bloomington, IN]), 180- to 260-cm long (2).
- Angled Glidewire (Terumo Interventional Systems, Somerset, NJ) used to access the contralateral stump and

tortuous iliac arteries (1).
- The stiff wires are always advanced under fluoroscopic guidance and placed in the descending thoracic aorta; it is useful to mark the working length of the wire to avoid misplacing the wires in the carotid arteries or in the heart during graft deployment and ballooning.

Dilators
- 12- to 22-F dilators are used if there is a question of the device being able to traverse a difficult iliac artery.

Sheaths
- 12- to 22-F introducer sheath for the limb.
- 18- to 24-F introducer sheath for the main body, depending on the endograft type; each of the endografts has a different introducer system, some with integrated systems.

Coils/Snares
- Platinum coils 8- to 12-cm long and 4 to 6 mm in diameter.
- Tornado embolization coils (Cook Medical) for tapered vessel diameter.
- Amplatzer Vascular Plug (AGA Medical, Plymouth, MN) for larger hypogastric vessels.
- Multiple-loop snares are preferred in cannulating the gate from the ipsilateral limb.
- Coils are used for staged embolization of the hypogastric vessels, the inferior mesenteric artery, and sometimes the accessory renal arteries if their origin is within the aneurysm sac.

DEPLOYMENT OF ENDOGRAFTS
- The main trunk is introduced over the stiff wire to the level of the lowest renal artery and then angiography with the optimal angle (90° to the aneurysm neck) is performed before final deployment, as instructed by the manufacturer of each endograft.
- Sometimes, cannulating the gate of the contralateral limb can be challenging. Depending on the anatomy, the C-arm should be manipulated freely to obtain three-dimensional visualization of the gate location. If the access is difficult or delayed for more than 10 minutes after trying the appropriate angulated catheters, consider the crossover technique by snaring the wire via the ipsilateral approach.

BALLOONS
- A compliant balloon is generally used at the attachment sites proximal and distal bilaterally and at the junction of the limbs and main trunk.
- Occasionally, the noncompliant systems are used for difficult proximal anatomy.
- Gentle pressure is used and is limited to the inside of the graft only.
- It is advised to balloon the proximal attachment for stability before deploying the contralateral limb. This is particularly important when using the snare technique.

IMAGING NOTES
- Hold ventilation when under general anesthesia to obtain the initial angiogram using the power injector 20 mL X 15 mL/s.
- Mark the origin of the renal arteries, aortic bifurcation, and origin of the internal iliac arteries, and finalize the main body/trunk endograft selection.
- The image intensifier should be perpendicular to the aneurysm neck for optimal visualization of the renal arteries. Depending on the angulation, the C-arm is positioned craniocaudally for most of the anterior angulation, and it is adjusted to the lateral angulation left anterior oblique or right anterior oblique for precise deployment of the endograft.
- An oblique view is required to identify the exact origin of the internal iliac artery before deployment of the contralateral limb.

PHARMACEUTICALS
- Intravenous heparin (100 U/kg) is administered after obtaining bilateral access and placement of the sheaths.
- Another dose is given after 1 hour to maintain an activated clotting time above 250.
- A prophylactic antibiotic is given 30 minutes before skin incision and continued for 24 hours afterward.
- Acetylcysteine for patients with renal dysfunction.
- Nonionic contrast is recommended.

Tips & Tricks

Management of Angulated Proximal Necks During EVAR

Deploy the aortic cuff more exactly and predictably below the renal arteries.

Neck angulation is a common cause of failure of endovascular AAA repair (EVAR). Angulated necks contribute to a higher incidence of proximal type 1 endoleaks, graft migration (early and late), and complications related to inadvertent renal artery coverage. There are various mechanical forces that can cause unnatural bending of the endograft in this zone; however, each type of system is different. This bending can lead to a compromised sealing zone and may

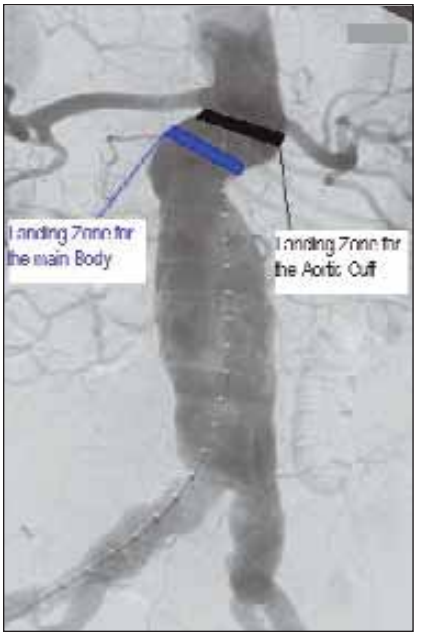

Figure 1. Landing zones for the planned, deliberate aortic cuff extension.

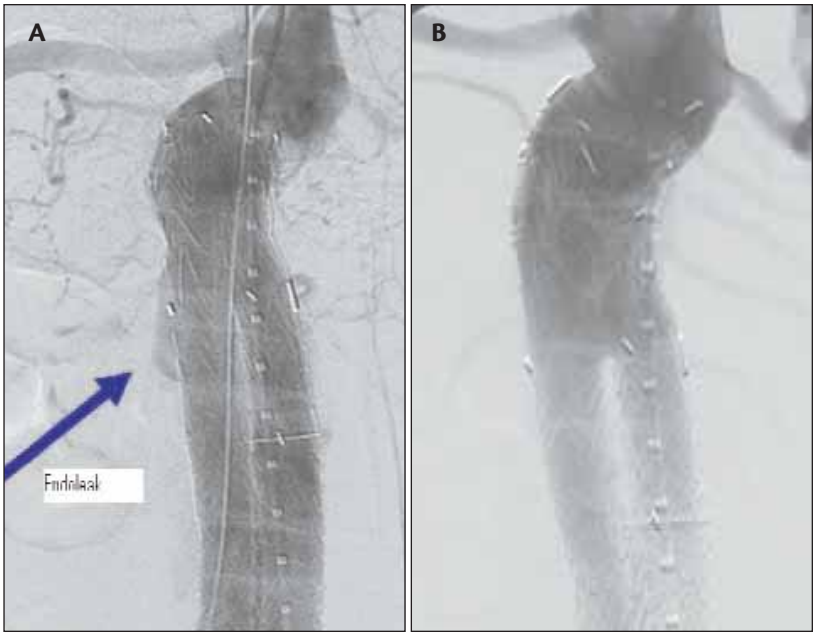

Figure 2. Type I endoleak after deployment of the main body endograft (A). Complete seal after the aortic cuff extension (B).

ultimately lead to unpredictable deployment of the device. Some interventionists have advocated that devices with suprarenal attachment may be beneficial in the management of this anatomical challenge but, in our experience, the actual suprarenal attachment system may contribute to inadequate sealing in this critical zone because of the stiffness of the struts. Flexible infrarenal endografts are more able to conform to difficult anatomy situations with proper technique. We describe a technique of using an infrarenal endograft system with intentional aortic extension in the presence of an angulated neck.

IMAGING

The aortogram is obtained with the C-arm in optimal position relative to the direction of angulation (calculated from the computed tomography scan). This allows for maximal use of the infrarenal neck, even in compromised situations. The renal arteries are identified, and the length of the neck is measured using the marking catheter.

We plan the placement of an aortic extension cuff at the level of the lowest renal artery and target a lower, slightly straighter anchoring zone, at least 1 cm in length, for the main trunk deployment (Figure 1).

PROCEDURE

The main body is introduced over a stiff guidewire, and it is oriented with the contralateral gate in the anterior position (or in a position to allow the endograft to flex perpendicular to the limb orientation). Occasionally, the stiff guidewire may need to be pre-bent to allow the endograft system to conform to the anatomy. Using a slow, controlled deployment technique, the graft is precisely landed at the targeted zone (Figure 1). Ballooning is performed with a compliant system before the subsequent deployment of the contralateral limb and subsequent aortic cuff extension (Figure 2).

CONCLUSION

The advantage of this technique is a more exact and predictable deployment of the aortic cuff just below the level of renal arteries. We believe that graft migration and kinking are less likely to occur when deploying the endograft within the relatively straight segment of the angulated infrarenal neck. The aortic cuff allows the graft to hinge at the critical angulation point. In addition, this technique reduces the risk of inadvertent renal artery coverage by not forcing the endograft into a configuration with unnatural stress forces. It is hoped that a more flexible, third-generation endograft should be able to traverse angulated necks without deliberate use of this technique. ■

Georges E. Al Khoury, MD, is a vascular surgery fellow at the University of Pittsburgh Medical Center. He has disclosed that he holds no financial interest in any product or manufacturer mentioned herein. Dr. Al Khoury may be reached at (412) 802-3333; alkhouryge@upmc.edu.

Robert Y. Rhee, MD, is Clinical Director, Division of Vascular Surgery at the University of Pittsburgh Medical Center. He has disclosed that he holds no financial interest in any product or manufacturer mentioned herein. Dr. Rhee may be reached at (412) 623-3333; rheery@upmc.edu.