Crossing the Challenging Aortic Bifurcation

A stepwise approach to getting "up and over" for the diagnosis and treatment of peripheral vascular disease and how to choose the right guidewire, catheter, sheath, and technique.

BY KEVIN "CHAIM" HERMAN, MD

Successful endovascular treatment of peripheral vascular disease requires choosing an access that will allow the operator to reach the lesion. Initially described in 1979,[1] the contralateral retrograde femoral approach is currently the most common route to gain access to most infrainguinal lesions.[2,3] Using this approach, the interventionist must first "get around the corner" and cross the aortic bifurcation to gain access to the lesion in the opposite leg. With the advent of stiffened torqueable guidewires, angled and hydrophilic-coated catheters, braided sheaths, and low-profile systems, crossing the aortic bifurcation or "getting up and over" can generally be achieved easily. However, anatomic constraints at the aortic bifurcation, as well as at the iliac vessels, can make getting up and over a very time-consuming and challenging endeavor.

This article reviews the basic techniques and equipment used for crossing the nonhostile, as well as the hostile, aortic bifurcation and pelvic vasculature. Emphasis is placed on tips, techniques, and equipment that can be used for crossing the challenging aortic bifurcation, enabling successful endovascular treatment. For the purpose of this article, *contralateral* means the affected side or side opposite to the puncture.

BASIC TIPS AND TECHNIQUES

Arterial access via the common femoral artery (CFA) is achieved either with a micropuncture needle or an 18-gauge needle. The CFA puncture may be performed using palpation, anatomic landmarks, and imaging for guidance. As soon as vascular access is achieved, a 5-F, 10-cm vascular sheath is inserted (Terumo Interventional Systems, Somerset, NJ) using the standard Seldinger technique.

There are several basic techniques for getting around the corner. In order to go up and over, the aortic bifurcation must first be localized by using bony landmarks and vascular calcifications (Figure 1), as well as by obtaining an angiogram.

Although not always necessary, angiography of the distal aorta and pelvis will help identify the aortic bifurcation and the course of the iliac vessels that will require negotiating. It is often the case that aortoiliac vascular disease that is unknown to the operator will be uncovered based on initial pelvic angiography. Additional localizing techniques include creating a roadmap of the vascular anatomy using digital subtraction angiography (DSA) or by using a third-party commercially available device, such as the TIMS Fluoro-Trace (Foresight Imaging, Chelmsford, MA), to electronically and sterilely trace the vascular anatomy on a touch screen monitor after opacification of the distal aorta and iliac vessels. This tracing can then be used as an overlay or electronic roadmap during live unsubtracted fluoroscopy to successfully get up and over (Figure 2A and 2B).

Once the aortic bifurcation is localized, the tip of a 5-F Omni Flush catheter (AngioDynamics, Queensbury, NY), pigtail catheter, or equivalent diagnostic sidehole catheter is positioned just cranial to the bifurcation, and the reverse curve of the catheter is opened up by initially advancing a Bentson wire (Cook Medical, Bloomington, IN) (Figure 1A). Once the wire engages the common iliac artery oppo-

site the site of puncture, the catheter is pulled down gently and seated at the bifurcation (Figure 1B). The Bentson wire is then advanced as distally as possible into the external iliac artery (EIA) or CFA, and the flush catheter is then tracked distally to the EIA. Alternatively, for obtusely angulated bifurcations, primary access to the contralateral leg may be achieved using a Cobra-shaped catheter.

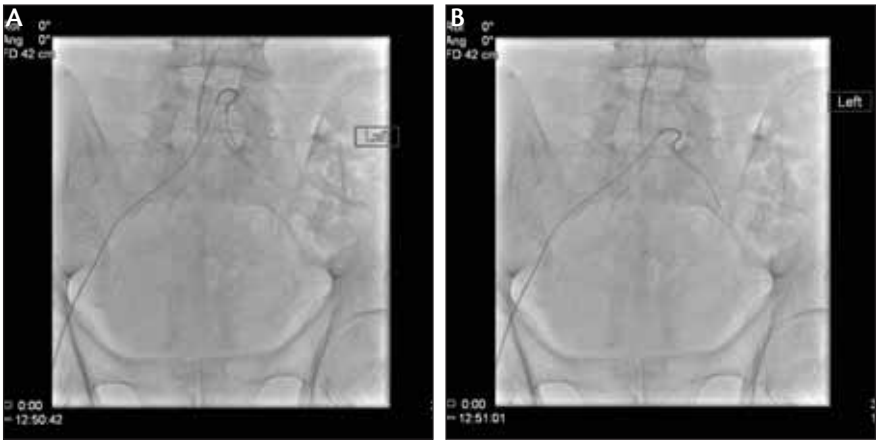

Figure 1. Localizing the aortic bifurcation using vascular calcifications. Note the positioning of the Omni Flush catheter cranial to the bifurcation with successful engagement of the contralateral iliac artery with a Bentson wire (A). Successful catheter engagement of the aortic bifurcation with distal advancement of the Bentson wire (B).

BASIC TROUBLESHOOTING

If difficulty is encountered while advancing the Bentson wire through the flush catheter distally to the EIA opposite the site of the puncture, it should be exchanged for a 0.035-inch floppy or stiff-angled Glidewire (Terumo Interventional Systems) to engage and negotiate the iliac vessels. The angled floppy or stiff Glidewire provides extra support, torque response, and pushability to achieve deeper vessel purchase. If the interventionist continues to have trouble advancing the curved catheter across the bifurcation, a 4- or 5-F Cobra C2 Glidecath (Terumo Interventional Systems) can be used as previously noted.

Once a catheter is secured across the bifurcation, diagnostic angiography of the affected side can be performed. If an intervention is deemed necessary, a longer and generally larger French size sheath is required.

BASIC TECHNIQUE FOR SHEATH ADVANCEMENT ACROSS THE BIFURCATION

For a nonhostile aortic bifurcation, upsizing to a different sheath is generally a smooth process. A 180- or 260-cm stiff wire, such as a 0.035-inch Rosen wire (Cook Medical) or Amplatz wire (Boston Scientific Corporation, Natick, MA), is used as the exchange wire. The diagnostic catheter and 5-F sheath are removed over the stiff wire, and a 55-cm, 6- to 7-F Flexor Raabe sheath (Cook Medical) or similar crossover sheath is advanced as distally as possible to the CFA opposite the site of the puncture. Once the working sheath is inserted, 5,000 units of heparin may be administered intravenously. Other sheath options for going up and

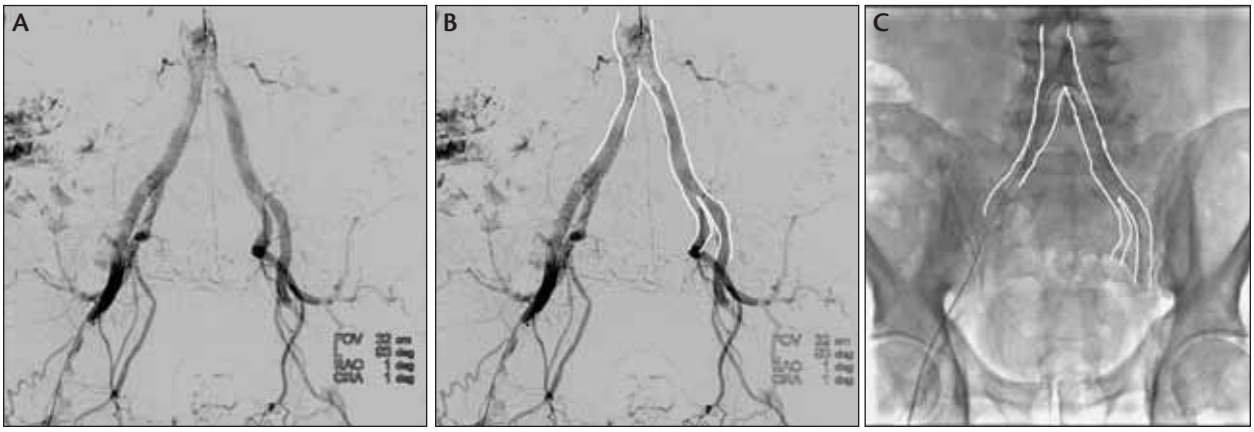

Figure 2. Localization of the bifurcation using the TIMS Fluoro-Trace. A selected image from pelvic DSA. This image is used as a template for the creation of the electronic roadmap/overlay. The overlay can be created on a touch screen monitor under sterile conditions using a sterile stylus (A). DSA image of pelvic angiography with electronic roadmap/overlay. The aortic bifurcation and iliac vasculature are well localized (B). Nonsubtracted image with digital overlay and successful engagement and crossing of the aortic bifurcation with advancement of the guidewire into the left EIA (C).

TABLE 1. SUMMARY OF TIPS AND TECHNIQUES TO CROSS THE BIFURCATION	
Scenario	**Solution/Technique**
Access side iliac vessel tortuosity	• Use a Kumpe or Berenstein catheter • Use a longer sheath for more stability
Difficulty catheterizing the aortic bifurcation	• Change to Glidewire • Change to Glidecath • Use a Morph catheter (BioCardia, San Carlos, CA)
Difficulty tracking the catheter	• Change to Glidecath • Use a stiffer wire • Use groin compression to provide support
Difficulty tracking the sheath	• Use groin compression to provide support • Exchange for a stiffer wire (Rosen or Amplatz) • "Walking" the sheath (advance sheath over dilator) • Balloon stabilization • Snare

over include the Flexor Ansel 1 sheath (Cook Medical) or Flexor Balkin sheath (Cook Medical). In our practice, we generally use a 7-F sheath so as not to limit options during the case for certain devices requiring larger sheath sizes because it is more time consuming to change a sheath during the intervention phase of the procedure.

TIPS AND TECHNIQUES FOR THE COMPLEX AORTIC BIFURCATION

There are several points along the aortoiliac vascular tree that may lead to difficulty in getting up and over. Troubleshooting of each scenario will follow; however, no matter where the problem arises, the technical challenge usually boils down to lack of wire support for advancement of catheters or sheaths. This is most often due to a fixed and narrow aortic bifurcation as a result of heavy calcification of the native aortoiliac vessels.[2] Additional problems may be encountered when there is iliac stenosis or ectasia on the side impeding initial wire crossing, aneurysm of the distal aorta with or without involvement of the iliac vessels, previous iliac stenting, previous endovascular aneurysm repair, and previous aortofemoral/aortoiliac bypass grafting (Table 1).

Tortuous or Stenotic Iliac Vessels on the Access Side

Catheterization of the iliac vessels on the access side is generally not a problem; however, in the event of difficulty negotiating the iliac vessels either due to tortuosity or stenosis, the physician may use the following techniques. To negotiate a tortuous or stenotic iliac vessel, either a 5-F Berenstein catheter (AngioDynamics) or a 4-F Kumpe catheter (Cook Medical) may be used with either a Bentson wire or a Glidewire to gain access to the aorta. This catheter is then exchanged for a reverse-curve or Cobra catheter, and the aortic bifurcation may be negotiated, as described previously.

Frequently, predilation of contralateral iliac stenosis can be performed with hydrophilic-coated balloons, which may cross the lesion more readily than a larger sheath. Once the stenosis is dilated, the sheath may advance more freely, or the balloon may be used to provide countertraction for sheath crossing. This latter technique is described in the Balloon Stabilization and Rendezvous Methods section.

Difficulty may still be encountered in a tortuous iliac vessel on the side of puncture whereby there is not enough support for the curved catheter to advance a wire distally to the opposite side. In that case, the interventionist may exchange the 5-F, 10-cm vascular sheath for a 5-F, 25-cm sheath. This maneuver will straighten the iliac vessel, providing support for successful engagement of the aortic bifurcation and crossover to the opposite side.

THE COMPLEX AORTIC BIFURCATION

Troubleshooting a Difficult Catheterization

Initial engagement and catheterization of the contralateral iliac vessels may be difficult with the Omni Flush catheter. Before exchanging for a different catheter, as mentioned previously, an Omni Flush catheter initially with a floppy 0.035-inch Glidewire followed by a stiff-angled 0.035-inch Glidewire for engagement and catheterization of the contralateral iliofemoral arteries should be tried. If that technique fails, a 4- or 5-F Cobra C2 Glidecath with a floppy or stiff-angled Glidewire to catheterize the contralateral iliac vessels should be used. Rarely, a Morph catheter is needed for successful initial engagement and crossing of the aortic bifurcation.

Troubleshooting Difficulty in Tracking the Catheter

If there is difficulty in tracking the curved Omni Flush catheter over the Bentson wire across the bifurcation, one may exchange the flush catheter for a Cobra C2 or

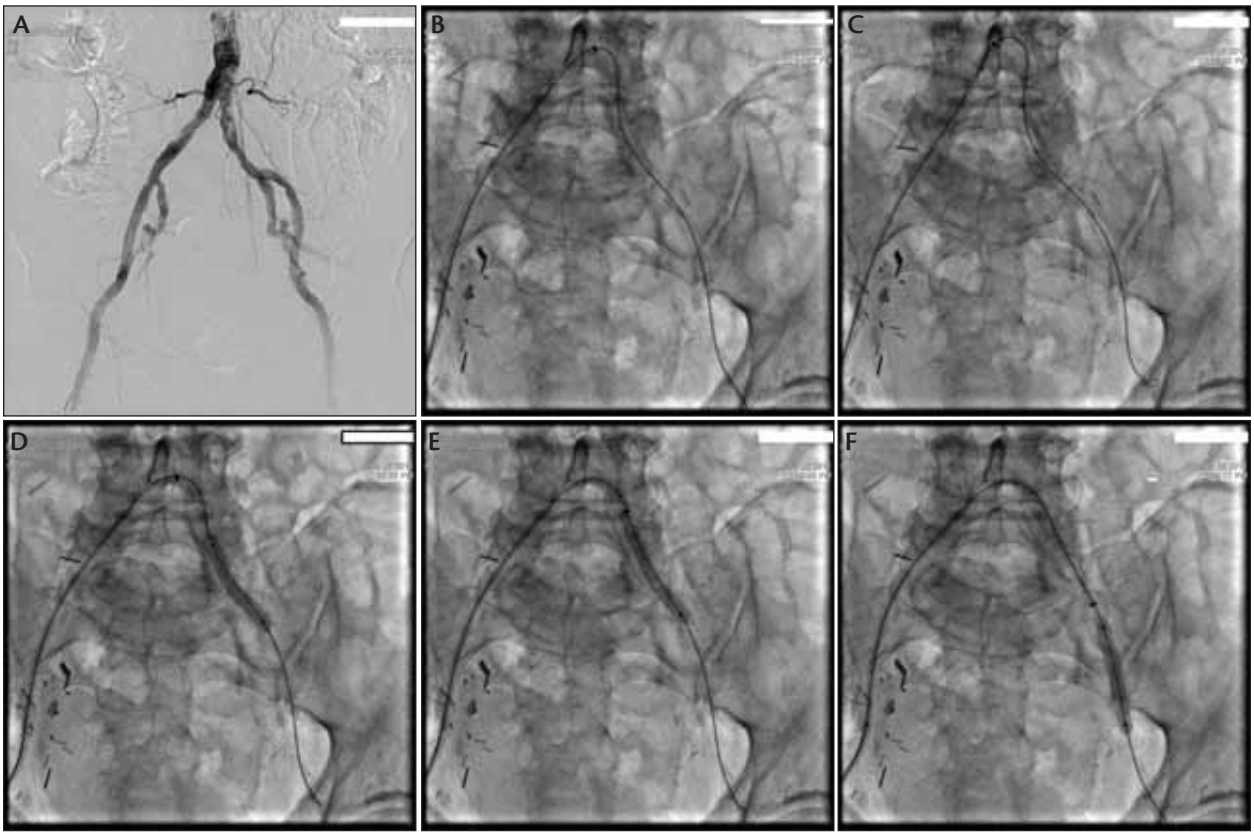

Figure 3. Balloon stabilization technique for sheath advancement across the hostile aortic bifurcation. DSA from a right CFA approach demonstrating a steep bifurcation. Left-sided common iliac disease was suspected as well (A). FluoroSpot image demonstrating a 7-F sheath at the bifurcation with a 0.035-inch Rosen wire in position across the bifurcation distally in the contralateral femoral artery (B). FluoroSpot image showing retraction of the sheath and buckling of the wire into the aorta upon attempts at advancing the sheath across the bifurcation (C). FluoroSpot image demonstrating an inflated balloon in the left common iliac artery with the 7-F sheath engaged at the bifurcation (D). FluoroSpot image demonstrating successful advancement of the sheath across the bifurcation while the balloon remains inflated in the left common iliac artery (E). FluoroSpot image showing the balloon catheter inflated distally in the left EIA with successful advancement of the 7-F sheath into position, enabling successful treatment in this case (F).

different Glidecath, as described previously. If that does not work, a 0.035-inch floppy or stiff-angled Glidewire is used and should provide the extra support needed to track the catheter distally. If further difficulty in tracking the Glidecath is encountered, one technique that may be used is to advance the wire distally to the contralateral CFA and having an assistant apply manual compression at the opposite groin to provide an additional level of stability to track the catheter.

Difficulty in Tracking the Sheath

There are several tips, techniques, and tools the interventionist may use to advance the sheath up and over even the most hostile aortic bifurcation. If there is difficulty in advancing the sheath over the Rosen wire, the first step is to have an assistant apply manual compression at the opposite groin to provide an additional level of stability to track the catheter. If that fails, it may be switched out for an Amplatz Super Stiff wire (Boston Scientific Corporation) to splay the bifurcation, reducing resistance and optimizing pushing forces as the catheter curves over the bifurcation, which should allow for sheath advancement.

If that fails, a third option involves stepwise advancement of the sheath over the dilator. In this technique, the interventionist can "walk" the sheath over the dilator by unlocking the sheath from the dilator and advancing the sheath in small increments.[2]

Balloon Stabilization and Rendezvous Methods

When these techniques fail, there are two final advanced options, such as the balloon stabilization technique and snare technique, to successfully treat a lesion across the aortic bifurcation. In the balloon stabilization technique, the operator advances the sheath across the

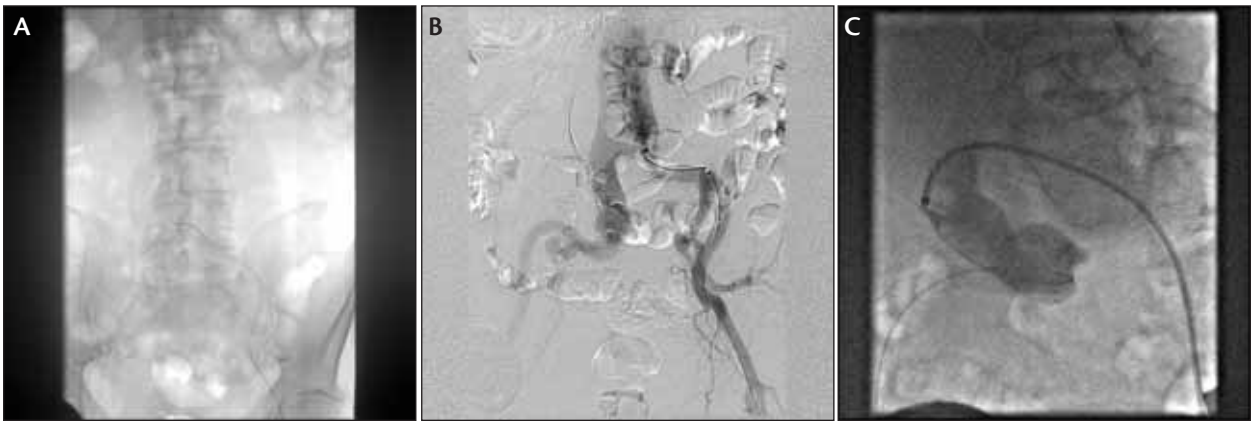

Figure 4. Stepwise approach to crossing the aortic bifurcation in a patient with an abdominal aortic aneurysm and tortuous iliac vessels. FluoroSpot image during attempts to cross the aortic bifurcation using an Omni Flush catheter and Bentson wire. Note the calcified contour of the abdominal aortic aneurysm. Due to the tortuosity of the iliac vessels, we were unable to achieve a stable wire position to advance the catheter across the bifurcation (A). DSA of the distal aorta. At this point, a longer 6-F vascular sheath was advanced to provide additional support. Note the Cobra C2 Glidecath has already been employed to try and cross the bifurcation. Despite these attempts and straightening of the access side iliac vessels, a stable wire position was unattainable given the opposite side or contralateral iliac tortuosity. Therefore, it was decided to use the snare technique. A 5-F vascular sheath was introduced into the right CFA (B). Successful advancement of the left 6-F sheath across the aortic bifurcation (snare not shown). Note the severe right iliac tortuosity. A stiff wire is seen distally in the iliac vasculature (C).

bifurcation while a balloon is inflated in the iliac artery opposite the puncture side (Figure 3A through 3F). With this technique, a balloon catheter (eg, 6-mm X 4-cm Mustang balloon [Boston Scientific Corporation] or 7-mm-diameter Fox balloon [Abbott Vascular, Santa Clara, CA]) is advanced over the bifurcation. The inflated balloon creates the support needed to now easily advance the sheath across the bifurcation.

An interventionist must take caution when inflating the balloon in the iliac vessels and to size the balloon with caution. In addition, there is a small risk of causing dissection or embolization when advancing the sheath without a dilator across markedly atherosclerotic iliac vessels. As a precaution to prevent downstream embolization, aspiration of the sheath before and during deflation of the balloon used for traction is recommended.

One final technique before abandoning the femoral access that is opposite the lesion and choosing a different approach involves the use of a snare from a contralateral femoral arterial access.[4] This technique may be especially helpful in an aneurysmal aorta with tortuous iliac vessels or in the presence of previous bypass grafts or stents. In the snare technique, also referred to as the *rendezvous technique,* a second, retrograde puncture into the opposite CFA is performed. A 5-F, 10- or 25-cm sheath is advanced, and the iliac vasculature on the puncture side is negotiated using standard techniques (Figure 4A through 4C).

Once a catheter is advanced to the aortic bifurcation, a snare, such as the En Snare (Merit Medical Systems, South Jordan, UT), is advanced from the new access site, and a wire placed from the initial puncture side is snared. The wire is then pulled across the aortic bifurcation out of the sheath on the side of the lesion. After replacing the sheath dilator, tension is placed on the wire from the contralateral groin, allowing for catheter or sheath advancement across the aortic bifurcation.

CONCLUSION

The contralateral retrograde femoral approach or femoral approach opposite the side of disease offers the endovascular interventionist a safe and effective means of reaching the targeted area. Although this approach is generally accomplished without significant difficulty, anatomic constraints at the iliac vessel and aortic bifurcation can make getting up and over a challenge. These techniques should be readily available in the armamentarium of all interventional physicians. ■

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