EVAR Access: Past, Present, and Future

Difficult iliac and femoral access anatomy remains a challenging obstacle in endovascular aneurysm repair.

BY EDWARD Y. WOO, MD

Without question, endovascular aneurysm repair (EVAR) has revolutionized the treatment of infrarenal abdominal aortic aneurysms. Although much of the focus has been on proximal landing zones and graft design to accommodate disadvantaged necks (those that are short, angulated, thrombus-lined, calcified, etc.), attention to graft delivery has also increased. Initial stent graft designs were larger and more cumbersome than they are today. These grafts are now becoming more "access friendly."

Early experience with EVAR was complicated by access limitations. This often led to adjunctive techniques that facilitated deployment.[1] Gender also played a role, because female anatomy is typically smaller.[2] Tortuous, stenotic, or narrow iliac and femoral vessels could be circumvented with retroperitoneal exposures and subsequent conduit placement.[3,4] These exposures, however, could be associated with increased morbidity.[5]

The use of aorto-uni-iliac devices has also assisted in overcoming diseased and difficult iliac anatomy. However, this required a femoral-femoral bypass to restore circulation, a procedure that could lead to additional complications.[6] Device tracking was also sometimes difficult, even through vessels that were not severely tortuous. Novel techniques evolved to work around this. For example, brachiofemoral access was developed to allow device entry and tracking.[7]

With technological advancements, access-related preclusion has decreased over time.[8] Stiffer wires such as the Lunderquist (Cook Medical, Bloomington, IN) allowed for improved trackability without the need for brachiofemoral access. Stent grafts were designed with smaller sizes and improved flexibility and delivery methods. Currently, five FDA-approved devices exist: the Zenith (Cook Medical), the Powerlink (Endologix, Inc., Irvine, CA), the Excluder (W. L. Gore & Associates, Flagstaff, AZ), and the AneuRx and Talent devices (Medtronic, Minneapolis, MN). Crossing profiles for these devices range from approximately 20 to 24 F depending on whether a delivery sheath or catheter is required, as well as the length of the device being implanted.

> "Initial stent graft designs were larger and more cumbersome than they are today. These grafts are now becoming more 'access friendly.' "

Retroperitoneal exposure and conduit placement is now far less common. Most devices can be delivered through the femoral artery and navigated through the external iliac artery. Adjunctive angioplasty and stenting and even the use of endoconduits can facilitate delivery.[9,10] Although most groups favor surgical exposure of the femoral artery, some have gone to percuta-

neous EVAR with excellent results.[11-14] These techniques, however, often require use of multiple closure devices.

Future devices will need to address several issues in order to allow improved accessibility. For instance, current devices either come enclosed within their own sheath or require a sheath for delivery. This certainly adds some material and size, but it is helpful for maintaining hemostasis when needed. Progression to an ultimately "sheathless/nonenclosed" delivery system could potentially offer some reduction in device size.

> "In the future, different metal components may offer stronger support with reduced size. A separate concept altogether would be to deliver the fabric and supportive skeleton sequentially."

In terms of the device itself, current iterations of stent grafts mostly consist of some type of fabric supported by a metal skeleton. Since these designs only exist using the current materials offered, only a certain size reduction is possible. New types of fabric that are much less cumbersome need to be developed. At the same time, the fabric needs to offer low porosity to avoid type IV and V endoleaks. It also needs to provide long-term durability to resist wear and tear from aortic pulsations and potential type III endoleak formation.

Current supportive frames in the form of metallic skeletons provide radial and longitudinal support. This allows for stent graft sealing, as well as resistance to kinking. Maintenance of these principles is critical, which limits the ability to reduce the framework to a thinner size. In the future, different metal components may offer stronger support with reduced size. A separate concept altogether would be to deliver the fabric and supportive skeleton sequentially. Current and future endostaplers and endosutures might allow for step-by-step intravascular/in vivo stent graft construction, thus limiting the size of each component delivered.

In general, several concepts need to be incorporated for optimal EVAR access. Ideally, reduction in size to 12 F or lower would overcome almost any iliofemoral disease, as well as allow for generalized percutaneous delivery. As discussed previously, changes would need to be made not only to the packaging but also to the materials that comprise the graft. Size reduction, however, should not result in the sacrifice of other essential components. Devices would still need to be flexible, yet sturdy enough to allow for proper fixation and sealing. Trackability would need to be preserved or even improved upon, and prevention of graft kinking and long-term patency would need to be maintained. With a small enough device, access site hemostasis could ideally be achieved with manual compression or simple closure devices. Finally, all of these improvements would need to be accomplished while preserving, or even improving upon, long-term durability.

Ultimately, an entirely new concept of EVAR might be the solution. The concept of a metal-supported fabric device may never accomplish all of our goals for access and delivery. Thus, a completely different approach to aneurysm exclusion may be warranted. Regardless of the approach, there is no doubt that technological advancements will continue to optimize not only endovascular aneurysm treatment but also the institution and delivery of that treatment. ■

Edward Y. Woo, MD, is Assistant Professor and Program Director, Division of Vascular Surgery, University of Pennsylvania Medical Center, Philadelphia, Pennsylvania. He has disclosed that he holds no financial interest in any product or manufacturer mentioned herein. Dr. Woo may be reached at (215) 662-7836; wooe@uphs.upenn.edu.

1. Henretta JP, Karch LA, Hodgson KJ, et al. Special iliac artery considerations during aneurysm endografting. Am J Surg. 1999;178:212-218.
2. Sampaio SM, Panneton JM, Mozes GI, et al. Endovascular abdominal aortic aneurysm repair: does gender matter? Ann Vasc Surg. 2004;18:653-660.
3. Chuter TA, Reilly LM. Surgical reconstruction of the iliac arteries prior to endovascular aortic aneurysm repair. J Endovasc Surg. 1997;4:307-311.
4. Abu-Ghaida AM, Clair DG, Greenberg RK, et al. Broadening the applicability of endovascular aneurysm repair: the use of iliac conduits. J Vasc Surg. 2002;36:111-117.
5. Lee WA, Berceli SA, Huber TS, et al. Morbidity with retroperitoneal procedures during endovascular abdominal aortic aneurysm repair. J Vasc Surg. 2003;38:459-463; discussion 64-65.
6. Walker SR, Braithwaite B, Tennant WG, et al. Early complications of femorofemoral crossover bypass grafts after aorta uni-iliac endovascular repair of abdominal aortic aneurysms. J Vasc Surg. 1998;28:647-650.
7. Criado FJ, Wilson EP, Abul-Khoudoud O, et al. Brachial artery catheterization to facilitate endovascular grafting of abdominal aortic aneurysm: safety and rationale. J Vasc Surg. 2000;32:1137-1141.
8. Moise MA, Woo EY, Velazquez OC, et al. Barriers to endovascular aortic aneurysm repair: past experience and implications for future device development. Vasc Endovasc Surg. 2006;40:197-203.
9. Peterson BG, Matsumura JS. Internal endoconduit: an innovative technique to address unfavorable iliac artery anatomy encountered during thoracic endovascular aortic repair. J Vasc Surg. 2008;47:441-445.
10. Peterson BG, Matsumura JS. Creative options for large sheath access during aortic endografting. J Vasc Interv Radiol. 2008;19:S22-26.
11. Lee WA, Brown MP, Nelson PR, et al. Midterm outcomes of femoral arteries after percutaneous endovascular aortic repair using the Preclose technique. J Vasc Surg. 2008;47:919-923.
12. Lee WA, Brown MP, Nelson PR, et al. Total percutaneous access for endovascular aortic aneurysm repair ("Preclose" technique). J Vasc Surg. 2007;45:1095-1101.
13. Dosluoglu HH, Cherr GS, Harris LM, et al. Total percutaneous endovascular repair of abdominal aortic aneurysms using Perclose ProGlide closure devices. J Endovasc Ther. 2007;14:184-188.
14. Smith ST, Timaran CH, Valentine RJ, et al. Percutaneous access for endovascular abdominal aortic aneurysm repair: can selection criteria be expanded? Ann Vasc Surg. 2008. Epub ahead of print.