Expert Insights

Update on Devices for Endovascular Therapy of AAAs

The Miami Cardiac & Vascular Interventional experience with today's AAA devices.

BY BARRY T. KATZEN, MD

Endografts have made a great impact on how we treat vascular disease, especially in aneurysms and traumatic lesions of the large vessels. During the past decade, many lessons have been learned about device design, patient selection, and other factors relating to the efficacy of endografts as a solution for aortic aneurysms. The following is a discussion of the current status and some insight into future directions.

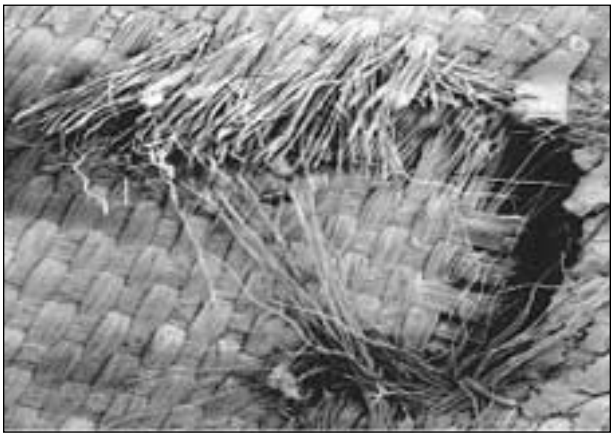

Figure 1. Magnified evaluation of polyester fabric that developed a hole due to wear and tear.

> "When we consider the efficacy of devices, it is overly simplistic to think in terms of a one size or one device fits all."

THE IMPORTANCE OF PATIENT SELECTION

In treating patients with AAAs, it is important to remember that we are treating mostly asymptomatic patients with a defined risk of rupture. Although this is a potentially life-threatening problem, the relative risk of rupture needs to be taken into account when making the first critical decision in aneurysm therapy—does the patient need immediate therapy or not?

In the past couple of years, there have been two important studies—the UK Small Aortic Aneurysm Trial and the ADAM trial in the US—that have directed us toward being a little more conservative in patient selection. Whereas in the past, most would have more readily treated patients in the 4.5-cm to 5-cm range, in our own program, we are now leaning to the 5-cm and 5.5-cm size aneurysm before applying any type of therapy.

The functional attribute of endografts, of course, is to exclude the aneurysm, and therefore, durability has

been a primary issue. The device must perform several important functions, such as attachment and fixation of the device because we are not suturing in place, as we do with traditional surgery. It has to have a sealing function and be flexible to be able to be delivered in a relatively simple and predictable way, and it should be applicable to a diverse group of anatomic applications. For many of us involved in the development of next-generation devices, certainly the profile is important, not only to reduce entry size, but to a range of other functions, including trackability and deliverability.

In planning aneurysm therapy, it is important to understand the physiological demands on the devices resulting from aneurysms coming in a variety of different shapes and sizes. Aneurysms present a diverse group of challenges for devices; we can treat patients with long or short proximal necks, degrees of angulation, small distal necks, the presence of calcification, and extension of the aneurysm sack into the bifurcation of the aorta. We can see pelvic angulation and tortuosity that may challenge us in terms of delivery. When we consider the efficacy of devices, it is overly simplistic to think in terms of a one size or one device fits all, as we do in stents and other technologies.

Figure 2. The AneuRx device.

CURRENT DEVICES

There are four devices currently approved in the US and only three are available for use; a number of others are currently in clinical trials. One additional device has actually failed in its clinical trial, and there is much we can learn from both successful and unsuccessful studies. Figure 1 is a close-up photographic evaluation of a polyester fabric that was taken from a patient who presented with an acute rupture after the implantation of a Vanguard device (Boston Scientific Corporation, Natick, MA) (Figure 1). The fabric has undergone wear and tear to actually produce a fabric hole. In early endovascular experience, it started to become clear that the interaction of fabrics and metals was critical, just as the tissue-healing device is important in stents. In endografts, we are using a device combining both fabric and metal components, which may act differently than than either component independently. A bench study of the impact of a flat, stent-like apex against polyester with 10^6 cycles when there is tortuosity placed on it results in the apex forming a hole in the polyester. This interaction between fabrics and metals is something that no one really appreciated in the early years of endografts, but has become an important issue in subsequent design. It is also important to understand that, although our surgical colleagues and our patients have historically believed that if the patient underwent surgical repair of an aneurysm, the patient was fixed—meaning that it was permanent and no need to worry about it—there are failure rates that occur with traditional surgery.

Figure 3. The Excluder Bifurcated Endograft.

Ancure

As a result of these issues, there are only three devices available in the US. The Ancure device (Guidant Corporation, Indianapolis, IN) was taken off the market as of October 1, 2003. The Ancure endograft was the first device brought into clinical trial and subjected to the scrutiny of a prospective clinical trial. It was a relatively simple device in many ways and had many positive aspects, but it was technically challenging to implant. The Ancure clinical trial was well run and provided an abundant amount of significant data. An analysis of the 5-year Ancure data reveals a number of interesting findings. First, the type II endoleak decreased over time. Second, over time, the rate of increased adverse events, or increased endoleaks, remained relatively stable. The Ancure does protect patients from rupture in the long term, with a 97.4% freedom from rupture. Most of these patients had stable or shrinking aneurysm size. Also, the Ancure stayed in place quite well, and migration was not of significance in terms of device failure, nor were there delayed type I endoleaks or sealing failures in the history of this device.

Nonetheless, in April 2001, the FDA issued a public health notification regarding both of the endografts available on the market at that time—the Ancure and the AneuRx

(Medtronic, Inc., Santa Rosa, CA), for totally different reasons. These notifications raised concerns in the community about the performances of these devices. Subsequently, Ancure had some difficulties, and there was a Department of Justice judgment against Guidant for more than $90 million. Guidant then elected to remove this device from the market, despite the fact that it had if not the best results, certainly outcome and long-term durability results that were equal to or superior to any other device on the market.

This action had several important secondary effects. One was that it created tremendous confusion in the medical community involved in treating AAAs, but more important, among our patients who are becoming increasingly Internet savvy. This was not a problem of the FDA withdrawing the device from the market, but rather the company deciding to get out of the business because it was not profitable anymore. Despite this, if you go do a Google search now for Ancure, you will find that the first 50 to 70 sites are law firms looking for patients because of this event. This is not a problem with the performance of the device, but it has changed the environment for us and our patients.

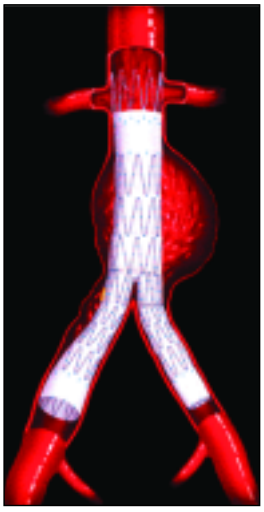

Figure 4. The Zenith graft.

AneuRx

The AneuRx device (Figure 2), which is widely available and has been used for a number of years now in the US, is a totally different type of device. It is a modular device that has an exoskeleton and is essentially constructed inside the abdomen, inside the aorta, and it is 22 F and 16 F on the contralateral limb. It has a very good delivery system now, as opposed to when it was introduced, and the ease of use is greatly improved with the generational iterations and the manufacture of this device (the AneuRx underwent design change during the clinical trial). In the first set of patients, after successful implantation, there was a rupture rate of 3.4%, which was addressed effectively through improvements in design. It is important to understand the learning curve and the fact that we are routinely adding to our understanding of the design of these devices. It is also important to understand that if you look at some studies (ie, the Canadian experience), and look at surgically treated patients, there is a delayed rupture rate in patients who have undergone surgical therapy (1.5% in this particular case) and there is a small delayed rupture rate from endografts for a variety of reasons. Ongoing surveillance is an integral part of this kind of therapy. Recently, the FDA released another Public Health Notice emphasizing the importance of optimizing patient selection for the AneuRx device, a fact that is important for all devices.

Figure 5. The Lifepath device.

Excluder

The Excluder Bifurcated Endograft (W.L. Gore, Flagstaff, AZ) (Figure 3) is also widely used and looks completely different. It is made of PTFE rather than polyester, and it has no sutures in it. The device uses PTFE tape and other technologies to adhere nitinol rings that vary in the size and shape of the sinusoidal curves, which makes the device quite flexible and deliverable in relatively small catheters. It does have proximal fixation using barbs on the proximal portion of the device. The delivery profile is small, with delivery through an 18-F sheath. We have placed many of these percutaneously or with "preclose" techniques quite effectively. Outcomes using this device in the US clinical trial of 235 patients showed there is a significant reduction in length of stay and improvement in return to normal activity. The device-related complications have become extremely low in the next generation of these devices, translating into high levels of safety. When pivotal study results and adverse events are compared to surgical controls, there is dramatic reduction in the morbidity in the study group compared to the surgical control group, similar to other device trials.

Patients in clinical trials were all low risk in terms of medical comorbidity. No statistical difference in acute mortality was noted comparing the surgical to the endovascular group. Previous controlled comparative trials have failed to demonstrate a benefit in mortality. Overall, results are comparable in the Excluder trial. What about endoleaks? The endoleak rate in this trial was 15%, and most were related

to collateral flow rather than any kind of device failure or attachment problems

Zenith

The Zenith graft (Cook, Inc., Bloomington, IN) (Figure 4) was recently launched and is a modular device that has many different anatomic options in terms of sizing. The size matrix allows use in 29-mm-diameter necks, and large-diameter iliac arteries. It utilizes suprarenal attachment, with positive fixation utilizing barbs. At this point, there is no evidence that suprarenal fixation is a risk in the long term, but it is a concern, and it is something that is being monitored. There were 200 patients in the clinical trial, 80 of which were in the standard-risk trial, and there was also a high-risk component that provided data. A review of 30-day morbidity shows that the number of patients who are free from morbidity with endografts is significantly reduced, compared with the surgical cohort. As with all clinical trials, there was a marked reduction in morbidity in the study group compared to the surgical group, but no statistical improvement in mortality.

The treatment success was found to be equivalent in both groups. Some of the important factors that this trial began to look at were some of the most important to our patients, such as time to ambulation and ability to resume normal activities, like eating, drinking, other bodily functions. Statistically significant benefits can be seen in all aspects; similarly, in the quality-of-life parameters that are being increasingly measured in clinical trials, and benefits were observed in all the important things about patients getting back to their normal life and compared favorable to surgical therapy. In terms of aneurysm size, the Zenith device was associated with aneurysm shrinkage during the course of the trial.

Figure 6. The Quantum AAA device.

Our own results (Table 1) at Miami Cardiac and Vascular Institute have shown that we can actually reduce the acute procedural mortality with endografts compared to surgery. The endograft FDA device trials all include low-risk patients, and because the surgical outcomes have been so good, statistical differences with traditional surgery have not been able to be proven. In our cohort of 486 patients, a significant reduction in predicted mortality in high-risk patients has been shown (Table 1).

ONGOING CLINICAL TRIALS

There are several devices in clinical trials of devices that are going to be available for use in the future in the US. One is a modular suprarenal device called the Talent device (Medtronic, Inc.). The Talent device can be custom sized for each patient, and also utilizes suprarenal attachment. Although some in the business community believe this may not be a successful strategy, it has allowed us to extend the number of patients who are candidates for endografts, probably by 20% to 30%.

Other devices in US clinical trials include the Lifepath (Edwards Lifesciences, CA) (Figure 5), the Quantum AAA Device (Cordis Corporation, a Johnson & Johnson company, Miami, FL) (Figure 6), and the Endologix Endograft (Endologix, Irvine, CA) (Figure 7).

FUTURE DEVICES

One of the most challenging aspects of endovascular AAA repair is to be able to treat side branches to avoid having to exclude arteries. In the example of an iliac artery aneurysm, ordinarily we would have to exclude the hypogastric artery by extending the device into the external iliac artery. By using the Quantum branch device, one can exclude the aneurysm and spare the hypogastric artery, reducing the incidence of buttock

Figure 7. The Endologix Endograft.

Figure 8. Next-generation Zenith devices will allow branch and segmented implants.

TABLE 1. MCVI MORTALITY OUTCOMES.

	0 Low	1 Minimal	2 Moderate	3 High	Overall Sample
Overall Number	56	174	175	47	486
30-Day Mortality	1	1	4	1	7
30 Day Mortality (%) this study	1.8%	0.6%	2.3%	2.1%	1.4%
Peri-procedural Mortality	1	2	5	2	10
Peri-Procedural Mortality (%) this Study	1.8%	1.1%	2.9%	4.3%	2.1%
Predicted Mortality of Open AA Repair	0-1%	1-3%	3-8%	8-30%	2.3% - 7.2%

claudication and potentially bowel ischemia. Next-generation Zenith devices will allow us to actually perform branch and segmented implants (Figure 8). With the ability to use fenestrated and branch grafts, we can actually implant a device that has a branch going into the right renal artery and a branch going into the left renal.

The Trivascular Enovus Endograft (Santa Rosa, CA) employs a number of innovative concepts (Figure 9). The device employs suprarenal fixation, is unibody rather than modular, and is extremely low profile, utilizing an injectable polymer that fills sealing rings at multiple levels during deployment. This device is currently in Phase I US clinical trials.

CONCLUSION

Today, there is consensus that endografts are associated with reduced morbidity in the treatment of AAA. At MCVI, we have demonstrated that endografts can certainly reduce mortality in high-risk patients. Patient selection is critical for success, and there are significant areas for improvement in design. There is controversy, however, in terms of the treatment choice of low-risk, younger patients and perhaps whether there is one ideal endograft. Clearly, each device has specific advantages and some disadvantages. Endografts have had an impact on existing AAA therapy, with an estimated 24% in the US and 11% in Europe receiving endovascular therapy. Endografts definitely work in preventing rupture, which is the goal of therapy. I think we are beginning to realize that all implants are not created equal, and we need to optimize each patient's anatomy for specific implants as we have more available. Next-generation devices appear to address some of the concerns of durability and greater ease of use, and perhaps percutaneous introduction. However, some of the concerns of the future still surround endoleak management and optimal matching of specific device design for patients' morphology. ■

Figure 9. The Trivascular Enovus Endograft.

Barry T. Katzen, MD, is the Founder and Medical Director of the Miami Cardiac & Vascular Institute, an affiliate of Baptist Health Systems of South Florida; and Clinical Professor of Radiology at the University of Miami School of Medicine in Miami, Florida. He has disclosed that he is on the advisory board of Trivascular, and that he receives educational grants from Boston Scientific Corporation, Medtronic, and W.L. Gore. Dr. Katzen may be reached at (786) 596-5990; btkatzen@aol.com.