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A renowned expert in endovascular therapy and aortic stent grafts stresses the importance of CAS patient selection and what new interventionists should know.



In our September 2002 inaugural issue, you predicted the state of carotid artery stenting (CAS) and carotid endarterectomy (CEA) in 2007. How have the events of the past 5 years met or not met your expectations? Time flies; it is already 2007! In that 2002 article, I said, "I am sure we will still be performing CEA in 2007, but probably not frequently. To quote vascular surgeon Bruce Brener, MD, in a recent presidential address, 'Carotid endarterectomy is a great operation; I will miss it.'" Although my bottom-line prediction was not exactly right, many of the concepts and ideas expressed in the article have proved foretelling. The last 5 years have been most eventful, with new CAS technologies, FDA and CMS approvals, registries, randomized clinical trials, and the enormous noise that has surrounded it all. In an editorial, I described carotid developments as the perfect vascular storm, and I sure was right about that one!

Mark Wholey, MD, a good friend and noted interventional expert, described CAS woes best and most succinctly in a recent lecture: "The biggest mistake was to think we could stent everyone!" There is no doubt CAS is a great tool and an elegant intervention with technologies that will continue to improve, perhaps dramatically—particularly embolic protection. However, we have all come to recognize that, unlike CEA, CAS has serious limitations. Anatomy (mainly, the aortic arch), symptomatic status, and certain lesions and patients are obstacles. But, I would also like to remind everyone that carefully selected patients tend to do very well with CAS when performed by highly experienced operators. The issue here is how many of these CAS-favor-

able cases, asymptomatic patients especially, would do just as well with optimal present-day medical treatment and no intervention at all. In the end, when considering treatment of all comers, there is no beating CEA. This surgical procedure has proven more resilient and better than even the strongest advocates have anticipated. It is not going away anytime soon.

CEA remains the standard of care. CAS has proven its value in the treatment of (mostly) anatomic high-risk-for-surgery patients. However, these are not in abundance—10% perhaps. CAS enthusiasts, myself included, need to learn that exclusion of unfavorable cases is the best pathway to achieve safety and success with CAS. Most patients over the age of 80 should have CEA if indicated, as well as all patients with unfavorable arch and/or carotid artery anatomy. In the end, outside the confines of well-controlled clinical trials, I agree with the view that only a minority of carotid stenosis patients should undergo CAS today.

How have recent CAS trial results affected interventionists' willingness to perform these procedures?

Developments during the past several months have had a major impact and have hardened the view that CAS is currently appropriate and indicated for only a relatively small number of patients. Some might argue CAS has gone from "total triumph" in 2004 to "near defeat" in 2006. The pendulum appears to be swinging back to CEA at the moment, but I would not discount CAS just yet. CEA is a very good operation, 50 years in development, with real science and level-1 evidence behind it, but unlikely to improve much from this point on. In contrast, CAS technologies and progress with embolic protection and access techniques, for example, are just getting started. My advice to vascular surgeons is to learn and become proficient with CAS, but apply it wisely. Do not repeat, on the reverse, the cardiologists' shortsighted predictions of announcing CEA's demise too early, because CAS is not going away.

How would you compare the respective relationships of endovascular aneurysm repair (EVAR) and CAS to their surgical alternatives? Have they received equal scrutiny, and do they deserve it? The high morbidity rate and prolonged (often incomplete) recovery associated with major intracavitary surgery explain the enormous appeal of less-

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invasive catheter-based endovascular treatment in various areas. In the case of thoracic and abdominal aortic procedures, it is clear that avoiding major surgery would be more appealing and immediately embraced by most interventionists. CAS, on the other hand, is an intervention that faces a steeper uphill battle. It is meant to replace CEA, arguably the most validated and best operation in vascular surgery, and one that patients recover from with little pain and disability. Downstream embolization, a constant in every endovascular intervention, can have devastating consequences on the brain. Also, the incomplete and conflicting nature of the currently available outcome data continue to fuel the controversy and generate doubt. Viewed from this perspective, it is not surprising that CAS is having difficulty establishing itself. Adding fuel to a raging fire, the brain specialists, particularly neurologists and neurointerventional radiologists, are rather nonsupportive of these developments. This would be equivalent to vascular surgeons discouraging endografts, or interventional cardiologists doubting coronary stents!

The initial 76-patient results of the APEX trial were released this month and declared remote pressure sensing safe and feasible. Do you anticipate this technology will replace intraoperative aortography as the primary method to detect endoleaks? What might future generations of this technology look like? Remote pressure sensing is an important new technology, and I feel fortunate to have been involved with the project almost from the very beginning through CardioMEMS, Inc. (Atlanta, GA). The results of the APEX study confirm the validity of the concept and its safety, but these are only initial and early results. The Holy Grail would be to demonstrate that such pressure measurements over time can replace the current CT-based standard for follow-up after EVAR. Unfortunately, no supporting data exist at this time. We can only hope that such information becomes available within the next few years.

Regarding the future, I have no doubt these devices will be further miniaturized and the implantation technique made more user-friendly. The real impact of this technology may well lie outside AAA or even our specialty. Heart failure, some forms of structural heart disease, hypertension, and pulmonary hypertension, among others, may prove to be the most significant future applications.

You recently published an article on a technique designed to place stents to preserve arch branch patency during TEVAR. Can you discuss the role of creativity in managing endovascular repair? The evolution of thoracic endovascular aneurysm repair (TEVAR) is a good reflection

of what is currently happening in the endovascular arena. Much like the events surrounding the development of aortic surgery in the 1950s and 1960s, knowledge and technologies for endograft repair are literally exploding at this time. Although progress has occurred quite rapidly and impressively, it is only the beginning. Innovative solutions to these old and complex conditions are being created everywhere.

Percutaneous retrograde catheterization and stenting of arch branches to preserve patency during TEVAR is an excellent example of a newly adopted strategy based on techniques and devices we have used for other indications for many years. The creativity, if any, relates to the adaptation of available technologies to develop a better solution for a complex problem. We surely do not have all the answers; in fact, in many instances, we still do not even know what questions to ask. . . Overall, it is indeed exciting to be a player in such a dynamic field and to contribute to the development of better care for our patients.

You were one of the first physicians to adopt EVAR when the technology was developed more than a decade ago, and among the first vascular surgeons in the US to embrace endovascular therapy in general. What advice would you offer a physician beginning to perform endovascular intervention and EVAR? What lessons did you learn in the early days and in your 20 years of endovascular experience? Vascular surgeons have been rather slow and even reluctant to adopt and embrace endovascular procedures. Historically, some of them have been antagonistic of all such developments. I remember this well. The first 5 years of my own interventional journey, from 1987 to 1992, were marked by many things, and peer-antagonism ranks high on that list. Wake-up calls and the writing-on-the-wall speeches were commonplace in the crusade to transform our specialty. Some of us, in fact, almost literally made a career out of speaking to these issues and in front of nonbelieving surgical audiences.

The development and subsequent availability of stent graft repair for AAA changed all that for good. Today, most if not all vascular surgeons have come to view that there is no viable future without endovascular procedures—and not much of a chance to make a living! My 20 years performing endovascular procedures have taught me many things, most notably that you just cannot dabble and expect to be any good! This is image-guided therapy and, as such, endovascular techniques (unlike standard open surgery) require remote actions and indirect visualization: working in the proper environment is thus a key component. Lastly, the strategy (espoused by some colleagues) of learning just a few techniques and skills is generally flawed and frequently counterproductive. ■