A Cardiologist in the Carotids

William A. Gray, MD, FACC
Seattle, Washington

Carotid endarterectomy for stroke prevention has been the standard of care for 50 years in patients with extra-cranial carotid bifurcation disease. Over the past decade, carotid stenting has emerged as a viable alternative to surgery. Combined with filter embolic protection devices, both a randomized control trial (Stenting and Angioplasty with Protection in Patients at High Risk for Endarterectomy registry [SAPPHIRE]) as well as registry data (ACCULINK for Revascularization of Carotids in High Risk Patients registry [ARCHER] and Registry Study to evaluate the Neuroshield Bare-Wire Cerebral Protection System and X-Act Stent in patients at high risk for Carotid Endarterectomy [SECURITY]) have compared favorably to endarterectomy in patients at high risk for operative revascularization. Conditions associated with high operative risk included patients with significant cardiac, pulmonary, and renal disease; previous neck operation; previous radiation; and anatomically difficult surgical access. On the basis of these results, a carotid stent system approved by the Food and Drug Administration (FDA) is anticipated in 2004. Although this will be a welcome addition to endarterectomy in the armamentarium of therapeutic options for patients with carotid disease, several challenges lie ahead. Coverage and reimbursement for the carotid stenting has been severely restricted to include only those procedures performed as part of an FDA investigational device exemption trial protocol, and a national noncoverage decision will have to be reckoned with before broader coverage can be put into place (assuming FDA approval). In addition, the level of national expertise in carotid endovascular intervention is limited, and training will need to be tailored to the three specialties likely to perform the procedure: cardiology, radiology, and vascular surgery. Each of these specialties will have specific, and different, requirements for their training, further complicating the task of education.

Carotid stenting can generally trace its origins to Europe in the early 1980s, with the work of Mathias (6) and Theron et al. (7) on carotid angioplasty. In the U.S., its practice was sporadic until the mid-1990s, when Deitrich (a surgeon) and then Roubin (a cardiologist) expanded its use, largely in high-risk patients. A progression in technique and move to self-expanding stents, albeit tracheobronchial (the only devices with enough delivery length to reach the carotid), resulted in improved outcomes, and early published reports of stroke and death ranged from 7% to 11% (8,9). In observing these early efforts, the majority of vascular surgery national leaders, along with their societies, did not serve their constituency well. Rather than approaching the emerging carotid stent method as a potential adjunct to their care of the patient with carotid disease—therefore in their domain—and integrating into the investigational process going forward, a pitched, all-or-nothing strategy to limit its use and demonize its practitioners was chosen instead (10,11). This has been unfortunate not only for many surgeons who now find themselves on the outside looking in (the majority of procedures currently are performed by cardiologists) (12,13) but also, and more importantly, for patients whose option to choose a more convenient, less invasive, and potentially safer treatment continues to be delayed.

On the basis of the promise of these and other early reports from single centers, further research and device
development followed, including dedicated low-profile nitinol stents and embolic protection devices, which have led to improved outcomes (14–19). But what are the most recent relevant clinical data? In the first randomized multicenter study ever performed to examine the role of endarterectomy in the management of the high-surgical-risk patient, the landmark Stenting and Angioplasty with Protection in Patients at High Risk for Endarterectomy (SAPPHIRE) trial enrolled 307 patients with high-risk characteristics to either endarterectomy or carotid stenting with filter embolic protection. Patients were eligible if they had severe carotid stenosis and the following characteristics, putting them at higher-than-usual risk for surgical revascularization: two or more severely stenosed coronary arteries, unstable angina, myocardial infarction in the previous 30 days, concurrent need for bypass or valve surgery, contralateral carotid artery occlusion, need for major organ transplantation, significant left ventricular dysfunction or significant clinical congestive heart failure, forced expiratory volume (FEV) <30%, dialysis-dependent renal failure, uncontrolled diabetes mellitus, previous radical neck surgery, previous neck irradiation, spinal immobility, contralateral laryngeal nerve paralysis, or severe restenosis after prior endarterectomy. These patients are commonly encountered in clinical practice and were excluded from previous randomized trials examining endarterectomy versus medical therapy but, based on extrapolations from the previous “low-risk” data, nevertheless continue undergo operations. Another 408 patients in SAPPHIRE were treated with stenting in a registry designed to accommodate those whom the surgeons judged an operative risk to be excessive or prohibitive. The 30-day outcomes for the composite end point of stroke, myocardial infarction, and death for the randomized groups were striking: 5.8% for the stent arm and 12.6% for the surgical arm (p = 0.047) (20); these differences have continued at the one-year analysis. In the surgical refusal registry, the 30-day composite end point was 7.8%. These data have been confirmed in two separate prospective multicenter trials: ACCULINK for Revascularization of Carotids in High Risk Patients (ARCHeR) registry in high-surgical-risk patients enrolled in a nonrandomized registry, with the same 7.8% rate of stroke, myocardial infarction, and death (21) and the Registry Study to evaluate the Neuroshield Bare-Wire Cerebral Protection System and X-Act Stent in patients at high risk for Carotid Endarterectomy (SECuRITY) demonstrated a rate of 7.2% for the same 30-day end points. The SAPPHIRE, ARCHeR, and SECuRITY results demonstrate a robust consistency in outcomes across trials, devices, and operators. Other registries are to report 30-day outcomes this year and appear to be on similar tracks. One-year data in SAPPHIRE and ARCHeR demonstrate ipsilateral major/fatal stroke rates of approximately 1.5%, comparable to many low-risk endarterectomy trials. After analyzing the results, it has been suggested by some enlightened surgical colleagues that once stent systems are approved, it will be unethical to offer these patients surgery instead of stenting, much less fail to even discuss it, assuming stenting with embolic protection is available in their community from trained and expert operators, including potentially themselves.

Recent data on cost and length of stay are also compelling. In a single-center comparison of resource use, stenting resulted in patients’ length of stay at the hospital being 50% shorter than patients undergoing endarterectomy and with similar clinical outcomes (22). Although this study found that hospital costs for stent patients were one-third less than surgery, it did not include the cost, nor benefits, of embolic protection devices, which will likely mitigate differences in direct hospital costs. In a separate analysis of 100 randomized patients at a single-center either operated on or stented by the same surgeon, the length of stay for stenting was again 50% that of surgery, and in an interesting analysis found that patients returned to full activity more frequently within a week after stenting compared with surgery (23).

Although these objective results are remarkable, the pace of patient access to the procedure has been slowed by the continued open opposition of nonaligned physicians at local levels making patient recruitment difficult, along with an adverse regulatory and reimbursement environment, in no small part the result of intense lobbying at a national level. Despite these considerable obstacles to adoption and testing, carotid stenting has achieved at least parity in the high-surgical-risk patient, and quite possibly superiority, to surgery in these multi- and single-center head-to-head comparisons and single-arm registries. The lack of broad hospital reimbursement, limited currently by the Centers for Medicare and Medicaid Services (formerly Health Care Financing Administration) to Food and Drug Administration (FDA) to Investigational Device Exemption trial requirements, makes the barriers to entering this promising field almost prohibitive for many talented potential operators, among them surgeons attempting to embrace advancing therapies. Physicians cannot get into a trial without previous experience of 20 to 30 procedures and cannot perform these procedures without considerable nonreimbursed hospital costs or committing Medicare fraud by billing and coding the procedure alternatively. This leads to important questions as to when device approval and proce-
dural reimbursement will finally support the practice, to what extent, by whom, and how pathways to training and credentialing will evolve.

Given the results of SAPPHIRE, ARCHER, and SE-CuRITY, FDA approval for at least one, and possibly two, systems is anticipated in 2004. It is hoped that reimbursement will follow closely. Unfortunately, the completion of most of the high-risk registries has resulted in many experienced investigational carotid stent programs slowing considerably. This means high-risk patients’ access to a therapy that appears at least equivalent to surgery, and potentially safer, at accomplished centers is significantly restricted. At a minimum, ongoing access for operators involved in these trials would allow continued treatment of these at-risk patients. Continued NIH/NHLBI support of The Carotid Revascularization by Endarterectomy or Stenting trial currently randomizing standard-surgical-risk patients with recent nondisabling stroke or transient ischemic attack does maintain some access for patients, albeit in a different population, and will be important in assessing the technique in this key subgroup.

Endarterectomy volume in the U.S. alone is estimated to be over 150,000 per annum. Even if the diffusion of carotid stent and embolic protection device technology is relatively measured and a third of these surgeries convert to endovascular procedures in the first two or three years, there will be significant demands placed on existing operators. Unfortunately, physician training has slowed significantly because of the national noncoverage decision proscribing reimbursement for hospital costs except in a Category B FDA investigational device exemption trial. This is a critical issue because it has been well demonstrated that outcomes are related to procedural volumes (24). If after device approval the procedure is performed by unskilled or untrained operators either trying to maintain an established carotid surgical practice volume or start anew, the results could be disastrous not only for the patient but also for the field at large. It would also be a gross betrayal of patient confidence.

What, then, can be done to assure adequate training for this restricted procedure? Continued access and institutional reimbursement are obvious prerequisites and in their absence efforts to articulate a coherent, multidiscipline-based strategy for training and credentialing have been significantly hampered. Until the national cardiology and vascular surgical societies weigh in on this issue, local institutional requirements will be the key to assuring appropriately trained operators performing these procedures and assuring the best possible patient outcomes. Training needs will not be uniform, and one size will not fit all given the diverse talents of the specialties to be involved. Undoubtedly physicians with credentials in other endovascular territories of treatment will claim expertise in carotids as well, but the level of operator experience at entry is a crucial stratifier as to the type and intensity of training required. A physician without catheter-based skills should not start acquiring those skills in the carotid territory and will require significant “schooling” before attempting to do so. Physicians with rudimentary peripheral 0.035-inch wire-based equipment experience will need training on 0.014-inch wires and catheters and rapid-exchange systems, in addition to specific training in cerebrovascular access and intervention. Most noncardiologists will require preparation in the management of carotid body-induced asystole and hypotension or postprocedure hypotension to avoid cerebral hemorrhage. Physicians with extensive 0.014-inch wire experience, the majority of whom will be cardiologists, will need training in specific device systems, anatomy, and the clinical diagnosis, Doppler, and office-based management of the neurovascular patient. Any combination of training needs is imaginable—a dearth of 0.014-inch wire experience, embolic filter device experience, cognitive skills related to noninvasive testing, cerebrovascular diagnosis, management, and anatomy—thus complicating the algorithms for training. In an early experience, careful case selection and proctoring of several cases will be critical components to maximally assure patient safety. Institutional program development, including appropriate inventory, nursing education, and interventional lab personnel training and support, is fundamental to successful patient outcomes, and procedures should not be attempted until these important pieces are also in place.

I have been fortunate enough to be involved with carotid stenting since visiting Alabama in 1995. The advancements in technique and technology have been rapid and gratifying and have resulted in a safe treatment option for patients. Almost a decade later, it has also been the longest intervention research project, without timely approval or reimbursement, in which I have ever been, or hope to be, involved. Although it is now generally acknowledged that carotid stenting likely will have an expanding role in the care of patients with bifurcation carotid disease, it is not the time for a victory lap; much is yet to be studied and undertaken before carotid stenting can be broadly incorporated. However, patients clearly prefer a nonoperative means of carotid disease management and are openly disappointed to learn of its unavailability even if they are otherwise good candidates for a safe operation. They ultimately will be the primary drivers, and beneficiaries, of a well-selected and well-performed procedure, and delaying their option to choose stenting seems no longer justifiable. The time for arguing about the primacy of one therapy, or discipline, over the other has passed. . .there’s work to do.

Reprint requests and correspondence: Dr. William A. Gray, Director, Endovascular Care, Swedish Cardiovascular Research, Suite 1020, 1221 Arnold, Seattle, Washington 98104. E-mail: william.gray@swedish.org.

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