In 1989 the Food and Drug Administration (FDA) approved a "hot tip" laser for the treatment of femoral-popliteal artery occlusions. Almost immediately, hundreds of hospitals around the country acquired this exciting new, minimally invasive technology and launched aggressive marketing campaigns suggesting that laser angioplasty would replace standard bypass surgery, and thousands of patients were treated. Our team at the Johns Hopkins Hospital began performing laser procedures with poor results; we concluded that this technology was not ready for clinical application, and we stopped using this technique and published our results.1 Whereas our study was criticized initially by enthusiastic proponents of this new endovascular approach, as more centers accumulated similar experiences, they also abandoned the procedure, and within a couple of years laser femoral-popliteal angioplasty had unceremoniously disappeared from the clinical scene.

We are in the midst of a dramatic expansion of endovascular treatment for peripheral arterial disease and one of the most exciting and frankly controversial modalities is carotid angioplasty and stenting. What has laser angioplasty got to do with this? Well, as Santayana said, "Those who cannot remember the past are condemned to repeat it." While I doubt that carotid stenting will be the next laser angioplasty debacle, what concerns me is the not-so-subtle massive marketing effort under way to sell carotid angioplasty to the public and the medical community in a manner reminiscent of the marketing of laser angioplasty.

The newfound interest of contemporary interventional cardiologists and interventional radiologists in the treatment of carotid artery disease is not surprising. Stroke and carotid atherosclerosis are unfortunately a growth area in medical practice, and represent another vascular territory for the application of catheter-based therapy. It has been estimated, for example, that carotid stenting could represent a $600 million annual market for the medical technology industry in the United States.2 It is not surprising that there are, at present, at least a dozen ongoing industry-sponsored registries and trials to achieve FDA approval of the respective manufacturers’ carotid stents and cerebral protection devices. What is disconcerting, however, is that data from these investigations typically are presented in courses and in the lay press, rather than in the peer-reviewed literature, generating momentum for this treatment modality before solid level I evidence is available and can be critically analyzed. The Stenting and Angioplasty with Protection in Patients at High Risk for Endarterectomy (SAPPHIRE) and ACCULINK for Revascularization of Carotids in High-Risk Patients (ARCHER) trials, cited by Dr Alhaddad in his review entitled “Surgery vs Stent: Treatment for Carotid Artery Disease,” are 2 examples. The review nicely summarizes the natural history and treatment options for carotid artery disease, a major cause of stroke and one of the most devastating complications of arteriosclerosis. I would, however, take exception to the implication of his article that carotid stenting has assumed an accepted place as a reasonable alternative to carotid endarterectomy (CEA), based upon his unduly harsh assessment of the risks of CEA and premature acceptance of the safety of carotid stenting.

CEAs have been performed for more than 50 years and the tremendous growth in the number of CEAs performed during the last decade reflects the impact of the National Institutes of Health-sponsored North American Symptomatic Carotid Endarterectomy Trial (NASCET) and Asymptomatic Carotid Atherosclerosis Study (ACAS) trials, nicely summarized by Dr Alhaddad. Like many proponents of carotid stenting, however, Dr Alhaddad argues that these trials were carried out in tertiary referral centers by highly vetted surgeons, and therefore the results do not reflect "real world experience," and he cites a more than decade-old Medicare database study to support that position. I disagree with his premise. The fact is that in the hands of experienced vascular surgeons CEA is an exceptionally safe procedure. Several recent population-based studies have confirmed the safety of CEA, and this reflects the fact that the operation is increasingly being performed by well-trained vascular surgeons. For example, in a review

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of nearly 10,000 unselected CEA.s performed in 48 hospitals in the state of Maryland over a 6-year period, the stroke and death rate was only 2.6%.3 Dr Alhaddad is correct in pointing out that there were a number of clinical exclusionary criteria in NASCET and ACAS, and it has been purported by many stent proponents that NASCET/ACAS ineligibility is therefore a priori synonymous with “high risk” and therefore an indication for carotid stenting. Nothing could be further from the truth. Several reports published in recent years have specifically looked at the outcome of patients undergoing CEA who would have been NASCET or ACAS ineligible (ie, high risk). In 2 recent studies, for example, the combined perioperative stroke and death rates in this patient population ranged from 2.7% to 3.6%.4,5 In one analysis, patients who would have been eligible for the ARCHER high-risk carotid stent registry cited by Dr Alhaddad underwent CEA with a perioperative stroke and death rate of 3.1%, which compares favorably to the stroke and death rate of 6.6% among patients who underwent carotid angioplasty and stent placement in the actual ARCHER trial.6 One patient population historically considered to be at increased risk for CEA is the very elderly. Indeed, individuals over the age of 80 were excluded from NASCET and ACAS. Though individual institutional series have confirmed a low rate of perioperative complications among the very elderly,7 it is argued that these are typically large tertiary referral center reports and not representative of “real world” experience. Yet, in the Maryland study cited above, more than 1000 patients aged 80 and older underwent CEA with a perioperative stroke and death rate of 2.6%, which was the same as in younger patient cohorts. Furthermore, while it is argued that stenting should be safer among the very elderly atherosclerotic population, there is little evidence to support this premise. In the largest single-center registry of carotid stenting cited in the review in this issue, the stroke and death rate was 7.4%, but it was 16% among those ≥80 years of age.8 Although cerebral protection devices were not used in this cohort, in the ongoing Carotid Revascularization Endarterectomy vs Stenting Trial (CREST) multicenter trial of CEA vs carotid stenting, and in which cerebral protection is utilized, the early results are very alarming. Specifically, the stroke and death rate was 12.3% among patients aged 80 and older who underwent carotid stenting.9

What often is overlooked in the comparison of CEA and carotid stenting is the durability of the respective procedures. Proponents of stenting cite the equivalent outcome of CEA and angioplasty in the Carotid and Vertebral Artery Transluminal Angioplasty Study (CAVATAS) trial. This “equivalence” resulted from a perioperative stroke and death rate of 10% among the CEA patients, an unacceptable result by contemporary standards in this country. Unfortunately, the review article in this issue did not cite the 1-year severe internal carotid artery recurrent stenosis rate of 14% among angioplasty vs 4% among the CEA patients.10 CEA is an extremely durable procedure, and for stenting to assume a place in our therapeutic armamentarium we must expect comparable long-term results.

Despite this conflicting data, the momentum for acceptance of carotid stenting for high-risk patients continues. In April 2004, the Circulatory Devices Panel of the FDA recommended approval of stenting for high-risk patients after a protracted and contentious debate, by a narrow 6-to-5 vote. The data upon which that recommendation was based was the SAPPHIRE trial, cited by Dr Alhaddad as a “landmark” study. I would hardly characterize this industry-sponsored trial as landmark, and in fact would argue that it is a highly flawed study, for several reasons.11 First, the inclusion criteria were highly biased against CEA. Patients with unstable angina, a recent myocardial infarction, or documented uncorrected coronary artery disease—clearly at increased risk for surgery—were eligible. Second, SAPPHIRE was the first carotid disease treatment trial in which periprocedural myocardial infarction was considered a primary endpoint, which clearly confounds the assessment of the efficacy of a stroke-preventing intervention. Third, the randomization process appeared flawed. Specifically, 57% of the patients randomized to CEA actually underwent stenting, since either they or their surgeons refused operation, whereas only 9% of individuals randomized to stenting did not undergo that procedure. Inherent in carrying out a valid randomized prospective clinical trial is the assumption that the most appropriate intervention is not clear (ie, there is equipoise). It is clear that clinical equipoise did not exist in the SAPPHIRE trial. Finally, the results of CEA in this trial did not satisfy contemporary standards. Roughly two-thirds of the patients randomized in SAPPHIRE were asymptomatic. Among those undergoing CEA, the perioperative stroke and death rate was 6.1%, including a stroke incidence of 5.1%. In ACAS, the asymptomatic carotid disease trial, the operative stroke rate was only 1.2%. Further, the American Heart Association has recommended that to justify the performance of CEA upon asymptomatic patients the combined perioperative stroke and death rate should be less than 3%.12 Clearly, the equivalence of carotid stenting to CEA in SAPPHIRE was largely predicated upon an unacceptably high surgical complication rate by contemporary standards.

**Conclusion**

I believe that carotid stenting will have a role to play in the treatment of selected high-risk patients with carotid artery disease, and recommend this treatment for some patients in my practice. The conundrum is how one defines “high risk for CEA.” Further well-designed scientific studies, like CREST, are needed to define the proper role of carotid stenting. However, based upon the overwhelming preponderance of evidence available to date, I believe CEA
remains the "gold standard" treatment for the vast majority of patients with significant carotid atherosclerosis, including many historically considered to be at high risk for surgery. Before we can accept carotid stenting as an accepted part of our therapeutic armamentarium, we must see credible evidence that it is as safe, effective, and very importantly, as durable as CEA. That evidence is not yet available.

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