History of Carotid Endarterectomy Then and Now
Personal Perspective

J. Donald Easton, MD

It seems the first successful carotid endarterectomy (CE) was done by Michael E. DeBakey1 in 1953, although the first published report of CE was by Eastcott et al2 in 1954. During the subsequent 2 decades, the number of these surgeries grew. In 1969, the Joint Study of Extracranial Arterial Occlusion, a methodologically imperfect study, reported that, in 2400 operations performed between 1961 and 1968, there was a surgical mortality of 4.5%, ranging from <2% to 36% among the 24 participating institutions, although there was a steady decline in surgical mortality during the 8 years.3

Fifteen thousand CEs were performed in the United States in 1971, and this grew to 34000 in 1976.4 By 1976, my colleague, David Sherman, and I were becoming troubled with the growth in the number of CEs because we were observing patients experiencing ischemic strokes and deaths in conjunction with these surgeries. We were at Southern Illinois University (SIU) School of Medicine in Springfield, IL, observing the good and the bad results of CE. Our medical colleagues often asked us, “What is the complication rate for carotid endarterectomy in our two hospitals?” We replied, “We don’t know.” The time had come to answer the question.

We initiated a retrospective study of 228 consecutive CEs during the arbitrary interval from January 1, 1970, to June 30, 1976, in our two 600-bed community hospitals to determine the perioperative stroke and mortality rate. Our primitive methodology is described in the results publication of the study.5

The combined stroke-mortality rate for our series of patients was 21.1% (48 of 228). Eleven CEs were performed for asymptomatic bruits, and the combined stroke-mortality rate was 18.2% (2 of 11). Fifty-seven CEs were performed for transient ischemic attacks in the symptomatic carotid artery distribution, and the combined stroke mortality rate was 21.1% (12 of 57). Seventy-one CEs were performed after a mild-to-moderate stroke in the symptomatic carotid artery distribution, and the combined stroke-mortality rate was 15.5% (11 of 71). Twelve CEs were performed after a severe stroke in the symptomatic carotid artery distribution, and the combined stroke-mortality rate was 41.7% (5 of 12). There was no trend toward more or less operative strokes or deaths from 1970 to 1976.

Some doctors in the community found this high rate difficult to believe. However, the perioperative mortality rate of 6.6% was indisputable. As a rough rule, the stroke rate for CE is typically 2 to 3 times the mortality rate. For example, the first results from the North American Symptomatic Carotid Endarterectomy (NASCET) study, titled “Beneficial effect of carotid endarterectomy in symptomatic patients with high-grade carotid stenosis,” were published 2 decades later.6 They showed the 30-day perioperative stroke and mortality rates to be 5.5% and 1.2%, respectively, a stroke:death ratio of 4.7:1. Of the 5.5% strokes, 1.6% were disabling.

The similarity of results among the 11 board-certified neurologists and general surgeons who performed the 228 CEs in Springfield suggested that the operative stroke and mortality rates for CE that we found were likely to be representative of those in many other US community hospitals in the 1970s. We hoped this would alert doctors to the fact that the usual results of this surgery were not as good as the best results published. Seven years later Barnett et al7 again sounded the alarm in their article, “Carotid endarterectomy—an expression of concern.”

The same year that our study was published, David Sherman and I moved to the University of Missouri in Columbia. Some people rumored at the time that we were “run out of Springfield.” That was not so. Our good colleague and friend, Professor Roland Folse, a thoracic and cardiovascular surgeon and Chair of the Department of Surgery at SIU School of Medicine, welcomed the results of our study. He assessed the situation and made some changes. That does not mean everyone was happy to see our publication.

During the subsequent 2 decades, many important CE studies were performed. In 1994, my colleague, Janet Wilterdink,8 and I published, “Carotid endarterectomy: trials and tribulations.” We reviewed the completed studies of CE and the status of CE at that time. NASCET and the European Carotid Surgery Trial (ECST) had shown that CE is clearly beneficial for symptomatic patients with carotid stenosis ≥70%, and both trials continued to study patients with <70% stenosis. In addition, the Asymptomatic Carotid Atherosclerosis Study (ACAS)9 and the Asymptomatic Carotid Surgery Trial (ACST)10 showed similar trends.

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were studying the effects of CE for patients with asymptomatic stenoses. Both trials subsequently showed modest benefits for CE in these patients. Although a substantial uptick occurred in the number of CEs performed for this indication in the United States, they had minimal effect on CE rates in the UK, where it was judged that the 40 operations needed to prevent 1 disabling or fatal stroke after 5 years did not justify the cost.

Interestingly, a follow-up study, “Evolution of carotid endarterectomy in two community hospitals: Springfield revisited—seventeen years and 2243 operations later,” was published in 1995. It reported 36 operative deaths (1.6%) and 120 operative strokes (5.3%), for a combined stroke-mortality rate of 6.3%. These results were similar to those in asymptomatic patients in NASCET but higher than those in asymptomatic patients in the large ACAS. The surgical results varied in Springfield, with now 31 surgeons performing 1 to 236 CEs during this second interval. The incidence of stroke (2.7%) and the combined stroke-mortality rate (3.7%) of surgeons with additional vascular training were superior to the stroke rate (6.8%) and combined stroke-mortality rate (7.9%) of surgeons who did not. The authors concluded, “Although overall operative complication rates in these two community hospitals have declined dramatically compared with previously reported results, they are still not optimal and probably will remain high as long as individual surgeons with high complication rates continue to perform CEs.” Dave Sherman and I were pleased to note that clear and substantial progress was being made.

Today, we should expect to see the surgical morbidity and mortality rate ≤6% in asymptomatic high-risk patients with carotid stenosis ≥70% and <3% in asymptomatic patients with high-grade stenosis, although these rates are not achieved universally in the real world.

In the 1980s, carotid endovascular treatment (angioplasty and stenting) was developing, and the results of the first substantial trial comparing this with CE were reported in 2001. The disabling stroke and death rate was 5.9% among the surgical patients and 6.4% among the angioplasty patients, and the rates for any stroke lasting >7 days or death were 9.9% for CE versus 10.0% endovascular-treated patients. These rates of serious complications were surprisingly high with both treatments. In late 2000, the Carotid Revascularization Endarterectomy versus Stent Trial (CREST) enrolled its first of ≥2500 subjects. In 2010, CREST reported no significant difference in a composite outcome of stroke, myocardial infarction, and death between CE and carotid-stenting for patients with symptomatic or asymptomatic carotid steno-

Substantial work remains to be performed and is being performed in several trials. The Asymptomatic Carotid Surgery Trial–2 (ACST-2) is comparing carotid artery stenting (CAS) and CE. It plans to enroll 5000 asymptomatic patients with carotid stenosis and follow them for up to 5 years or more. The second European Carotid Surgery Trial (ECST-2) will compare optimized medical therapy versus carotid revascularization (CE or CAS) in 2000 patients. Each recruiting center will decide which revascularization procedure its center will use throughout the trial. The Stent-protected Angioplasty in Asymptomatic Carotid Artery Stenosis versus Endarterectomy (SPACE-2) is a 3-arm trial of 3640 patients: best medical therapy versus revascularization with the revascularization then being subrandomized between CE or CAS. The CREST 2 trial is seeking funding. ACST-2 is registered on ClinicalTrials.gov and SPACE-2 on http://www.controlled-trials.com (ISRCTN78592017).

In much the same way as it has been learned who should undergo percutaneous coronary artery revascularization versus coronary artery bypass graft surgery, we can expect these carotid stenosis trials to shine the light on the future pathways for patients with carotid artery disease.

Carotid artery atherosclerosis remains prevalent in the Western world and seems to be increasing in the East. It would be even more prevalent but for all of the pioneers who worked diligently to identify the atherosclerosis risk factors and discover subsequent treatments with statins, new antihypertension drugs, and effect reduction in the prevalence of smoking. Diabetes mellitus awaits more effective prevention. Also, the value of aspirin and other antithrombotic drugs for stroke prevention, and fibrinolytics for treatment, have been discovered. At the same time, carotid artery endarterectomy and stenting have been discovered and added to our armamentarium. All of this has occurred in my medical lifetime.

Because carotid atherosclerosis remains so prevalent, the search for better prevention and treatments remains highly relevant. Because strokes increase with age, the longer we live, the greater our likelihood of having a stroke, but our goal should be to have first strokes occur at age 80 or 90, not 50 or 60.

David Sherman died on November 29, 2007, and therefore you must trust me to make a couple of comments on our behalf. They are these:

Always seek evidence in preference to expert opinion.
You can always recognize the pioneers by the arrows in their backs.
Do not fear truth’s consequences, including arrows. In the end, you must live with yourself.

Disclosures

None.

References


