Carotid Endarterectomy in Nonagenarians

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Hypothesis: The North American Symptomatic Carotid Endarterectomy Trial and the European Carotid Surgery Trial demonstrated that a greater benefit from carotid endarterectomy (CEA) was seen in elderly compared with younger patients. However, no patients older than 89 years were included in either study. We hypothesized that CEA is safe and effective in patients 89 years and older.

Design and Setting: This is a retrospective review of 3 neurosurgeons' CEA experience with nonagenarian patients.

Participants and Interventions: Of our 1800 patients who underwent CEA, 26 were 89 years or older. Twenty-three patients had had cerebral ischemic symptoms (unilateral hemispheric symptoms in 21 and 2 dizzy spells associated with bilateral high-grade stenosis). Cerebral angiography was performed in 3 patients. Twenty-three patients underwent noninvasive imaging. Four patients had bilateral high-grade stenosis and underwent staged bilateral CEA. All procedures were performed after the induction of general anesthesia with electroencephalographic (and, more recently, transcranial Doppler) monitoring and etomidate-induced burst suppression for cerebral protection during cross-clamping.

Results: Unusual technical difficulties were frequently noted, including high bifurcations, looping rotated internal carotid arteries, and marked adherence of surrounding soft tissues. In 3 of the 30 procedures, a shunt was used. There were no perioperative cerebral ischemic or cardiac events. The mean hospital stay was 2 days. One patient had a transient vocal cord paresis. Twenty-two patients were alive and well 24 months following the procedure. Four patients died of non–stroke-related causes.

Conclusions: Carotid endarterectomy was successfully performed without perioperative cerebral or cardiac complications in our series of 26 patients 89 years and older undergoing 30 CEAs. Extrapolating from reported results from the North American Symptomatic Carotid Endarterectomy Trial and the European Carotid Surgery Trial, we believe CEA should be considered in nonagenarian patients with high-grade symptomatic carotid stenosis who are otherwise well medically. Our recommendations are less certain in the case of asymptomatic disease.

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The Framingham Study showed that the stroke rate more than doubles for each decade after the age of 55 years. Increasing age is associated with increasing disability from a stroke. Internal carotid artery stenosis is a major cause of cerebral ischemia, and increasing degrees of stenosis are associated with an increasing risk of stroke.

Three multicenter trials, the North American Symptomatic Carotid Endarterectomy Trial (NASCET), the European Carotid Surgery Trial (ECST), and the Asymptomatic Carotid Atherosclerosis Study (ACAS), have demonstrated the efficacy of carotid endarterectomy (CEA) in preventing a future stroke in patients with severe stenosis (70%-99% in the NASCET and ECST) and moderate stenosis (50%-69% in the NASCET and >60% in the ACAS).

The relationship between age and risk of subsequent stroke after a minor stroke or transient ischemic attack has been the subject of debate, with conflicting results from several studies. Similarly, the relationship between age and the risk of perioperative stroke and death from CEA has been controversial. Sundt et al considered age older than 75 years to place patients into a significantly higher risk grade.

See Invited Critique at end of article

Age-specific analysis of the NASCET and the ECST has recently confirmed an increasing risk of stroke from symptomatic carotid stenosis with increasing age.
In the NASCET, the absolute risk reduction for CEA during the 2-year follow-up was 9.7% for those younger than 65 years, 15.1% for those aged 65 to 74 years, and 28.9% for those 75 years or older. The ECST corroborated these findings for the elderly patient with symptomatic carotid stenosis. With advancing age, there was a higher risk of stroke without surgery, but no increase in operative risks. For the properly selected elderly surgical candidate, the NASCET suggested that operative risks tended to decrease with increasing age.7

Although there was no upper age limit in the NASCET and ECST, few patients older than 85 years were enrolled (only 9 in the NASCET) and no nonagenarians were enrolled.

In this report, we reviewed our surgical experience with patients older than those enrolled in the large CEA trials to determine if this group of very elderly patients (“advanced elderly”) has different results compared with the younger patients described in these trials.

METHODS

We (Q.J.D., T.S.R., and R.F.R.) have performed more than 1800 CEAs. A standard technique has been used, using general anesthesia, pharmacologic cerebral protection during the cross-clamp, and intraoperative monitoring with electroencephalography (EEG), and, for the past 11 years, with transcranial Doppler (TCD) monitoring combined with EEG. Selective shunting is used when indicated by EEG and/or TCD criteria. A shunt is used for sustained reduction of EEG amplitude of the ipsilateral hemisphere and/or reduction of ipsilateral middle cerebral artery TCD flow velocity below 20 cm/s.

For the past 10 years, intraoperative duplex scanning has also been added to our protocol. Our routine practice is to close the endarterectomy site without a patch. Selective carotid patching has been performed based on intraoperative ultrasonographic assessment of the vessel and arterotomy site after completion of the primary closure. We have found on ultrasonographic interrogation that a flow-reducing vessel kink occurs in approximately 6% of our patients.7,13 This kink is not apparent on visual inspection. In these patients, the arterotomy is reopened and patched, with subsequent ultrasonographic confirmation of correction of the kink.

Since 1995, we have operated on 26 patients aged 89 to 96 years. There were 9 CEAs performed in patients aged 89 years, 5 in patients aged 90 years, 5 in patients aged 91 years, 6 in patients aged 92 years, 1 in a patient aged 93 years, 2 in patients aged 94 years, and 2 in patients aged 96 years. The mean patient age was 91.3 years. Four of the patients underwent bilateral CEA as separate procedures.

Of the 30 endarterectomies, 21 were performed after a symptomatic ipsilateral carotid transient ischemic attack or minor stroke. Two symptomatic patients had dizzy spells associated with bilateral high-grade stenosis. All symptomatic patients had greater than 70% carotid stenosis by duplex and/or magnetic resonance angiographic criteria or catheter carotid angiography. Seven of the CEAs were performed for asymptomatic stenosis. All of these 7 asymptomatic lesions had greater than 80% stenosis by duplex or magnetic resonance angiographic criteria; in 6, there had been progressive stenosis demonstrated on periodic repeat duplex scanning.

Twenty-three of the patients were operated on based solely on noninvasive imaging (duplex scanning with or without magnetic resonance angiography). Three patients underwent catheter carotid angiography.

RESULTS

The 26 patients were all leading independent lives at the time of surgical consideration. Comorbid medical risk factors were common, including hypertension (15 patients [58%]), ischemic cardiac disease (13 patients [50%]), hypercholesterolemia (5 patients [19%]), diabetes mellitus (3 patients [12%]), and current smoking (1 patient [4%]). However, all patients had been cleared for surgery by an internal medicine specialist or cardiologist.

Technically, the carotid bifurcations in these operated-on patients who were 89 years or older had more frequent anatomical variations than seen in younger patients. Tortuosity and vessel rotation requiring extensive mobilization and derotation were required in 5 patients, and in 3 patients, the bifurcations were high. In 3 of the 30 operations, a shunt was required based on EEG/TCD criteria, as previously described.

Three patients required patch graft angioplasty because of hemodynamically significant postendarterectomy kinking identified by intraoperative duplex imaging. There were no significant perioperative complications. One patient had a transient hoarse voice postoperatively (unilateral vocal cord paresis). Hospital stays were from 1 to 3 days (mean, 2 days).

Four deaths occurred in the follow-up period (2 at 2 months postoperatively, 1 at 15 months postoperatively, and 1 at 24 months postoperatively). The surviving 22 patients were followed up for a minimum of 2 years postoperatively. No patients had a postoperative stroke. Postoperative duplex scanning was performed on 24 patients. One patient developed an asymptomatic ipsilateral carotid occlusion 6 weeks postoperatively. All other endarterectomy sites were patent.

COMMENT

In the NASCET, the largest symptomatic CEA study to date, CEA was proved efficacious in preventing strokes in patients with symptomatic carotid stenosis of greater than 50% during the 2-year follow-up of that study.3 The benefit was greater the higher the degree of stenosis. In the NASCET, 409 of the 2885 patients enrolled were 75 years or older (defined as elderly).7 Two hundred thirty-two of these elderly patients were assigned medical treatment. Factoring in crossover, 226 of the elderly patients underwent CEA. In the medically assigned group, increasing age was associated with increasing risk of stroke. This was seen in the 50% to 69% stenosis group and the 70% and greater stenosis group. In comparing the surgically assigned group, the elderly patients (≥75 years) had a lower risk of ipsilateral postoperative stroke compared with the 2 younger cohorts (those aged <65 and 65-74 years). This age-related lower risk was seen irrespective of the degree of stenosis. The authors of the NASCET ascribe the decreasing surgical risk with increasing age to the observation that those who underwent endarterectomy at an elderly age had fewer comorbid risk factors, such as hypertension, smoking, diabetes mellitus, and ischemic cardiac disease. They were, in fact, relatively healthy individuals.
Because of these independent variables of increasing risk of stroke with increasing age and decreasing risk of surgery with increasing age, the benefits of CEA for symptomatic carotid stenosis were magnified in elderly patients. An analysis of the NASCET elderly group indicated that only 3 patients had to undergo CEA to prevent an ipsilateral stroke, whereas 7 patients in the 65- to 74-year-old group and 10 patients in the younger than 65-year-old group needed to undergo CEA to prevent a single stroke event.5

The NASCET also followed the course of contralateral asymptomatic stenosis (>60%) in 1820 patients managed medically. The risk of ipsilateral ischemic stroke during the initial 2 years was relatively low (7.5%), with no significant difference between age categories. However, analysis of stroke incidence at 5 years showed that the risk of stroke in the territory of these originally asymptomatic stenoses of greater than 60% was 25% in the 75 years or older group vs 13% in those younger than 75 years. None of the patients with asymptomatic stenosis underwent CEA of that vessel in the NASCET. The perioperative risk of stroke and death in symptomatic elderly patients was 5.2% in the NASCET and 4.4% in the ECST. One might infer from the ACAS that the risk of endarterectomy for asymptomatic stenosis in elderly patients would be less than these figures. However, in the ACAS, patients older than 80 years were excluded, so no similar data addressing surgical risk for elderly patients are available.6

In determining whether a patient 89 years or older with high-grade carotid stenosis would benefit from endarterectomy, the patient's estimated life expectancy must also be considered. Data from the US National Vital Statistics Report show that the average 89- to 90-year-old patient has a life expectancy of 4.9 years and that the average 95- to 96-year-old patient has a life expectancy of 3.4 years.13 This suggests that nonagenarian patients have sufficient reasonable life expectancy to potentially benefit from CEA. Extrapolation from the NASCET and the ECST suggests that patients older than those studied by either the NASCET or the ECST (ie, those >89 years) may gain increased benefit from CEA. To our knowledge, no published data addressing this issue are available, other than an occasional isolated nonagenarian patient who has been included with other patients in reviews of CEA.14-18

Our study reports the outcome of CEA in 26 patients 89 years or older with symptomatic carotid stenosis (>70% [23 patients]) or asymptomatic carotid stenosis (>80% [7 patients, 6 with demonstrable progression under observation]). We used our routine general anesthesia technique with pharmacologic cerebral protection, intraoperative EEG/TCD monitoring with selective shunting. There were no cardiac or carotid ischemic events and no deaths in these 30 operations of 26 patients, which compose our complete experience since 1995 of patients in this advanced elderly age group.

In our experience, certain technical difficulties were more frequent in these advanced elderly surgical patients. There was marked tortuosity in 5 patients, requiring extensive mobilization and derotation of the carotid artery to gain access for endarterectomy. Also, 3 of the patients had extremely high carotid bifurcations due to age-related lengthening of the carotid artery. All procedures, however, were accomplished with technically and clinically satisfactory results (although subsequently, 1 patient did experience occlusion without symptoms).

At the 24-month follow-up (which was the length of follow-up in the NASCET), 22 of the patients were still alive and none had experienced a stroke. Four patients died of suspected cardiac events before the 24-month follow-up.

This report of CEA in the advanced elderly nonagenarian population is limited by its small sample size and its lack of a medically treated control group. We believe, however, that the data from the large CEA trials pertaining to elderly patients, and known data of the life expectancy of nonagenarians, support our conclusion that CEA can be beneficial for those 89 years and older. We recommend this procedure for appropriately selected patients with symptomatic carotid stenosis of more than 70%. Our experience with asymptomatic higher-grade (>80%) carotid stenosis has also been successful. Despite published study data suggesting that the increased risk of age for asymptomatic carotid stenosis is not as great as that for symptomatic stenosis, we believe endarterectomy is also a reasonable option for some asymptomatic nonagenarian patients.

In conclusion, we recommend an aggressive approach to the examination and surgical management of nonagenarians with cerebral ischemia secondary to carotid stenosis. Consideration should be given to those with stenosis of greater than 70% if medical risk factors are acceptable. We also believe that in appropriately selected patients, high-grade (>80%) asymptomatic stenosis warrants surgical consideration.

References

5. European Carotid Surgery Trialists’ Collaborative Group. MRC European Carotid Surger Trial: interim results for symptomatic patients with severe (70-99%) or with mild (0-29%) carotid stenosis. Lancet. 1991;337:1235-1243.
The NASCET demonstrated the highest level of absolute risk reduction for carotid endarterectomy performed in patients 75 years and older (28.9%). Operative risk also decreased with increasing age in this trial. This, together with the increased morbidity of stroke in the elderly patients, provides a rationale for studying the effectiveness of carotid endarterectomy in nonagenarian patients. The authors are to be commended for their excellent results in treating a small subset of 26 patients 89 years or older with carotid endarterectomy; these patients were essentially devoid of perioperative stroke and cardiac morbidity. One could argue that this was a relatively healthy group of very elderly patients without the usual comorbid risk factors present in the typical vascular surgery patient population. Nevertheless, many surgeons would still consider nonagenarians to be at increased risk for perioperative complications. Because the morbidity and mortality of carotid endarterectomy has been shown to be inversely proportional to surgeon and facility volume, a case could be made for operating on such a high-risk group at regionalized centers. This is particularly relevant because unusual technical difficulties, such as high carotid bifurcations, dense adherence of surrounding tissues, and looping internal carotid arteries requiring derotation, were common.

The ethical question that must be considered in response to the authors’ study is whether it is inherently unjust to allow elderly patients to compete with younger patients for expensive and scarce health care resources. The reality is that the US government no longer has the capability to pay for unlimited access to health care for all of its citizens, a fact that has led to proposals for rationing. One such proposal is based on the quality-adjusted life years method, similar to the Oregon Health Plan. Based on the limited life expectancy of nonagenarian patients, it may be difficult to make a valid case for carotid endarterectomy in those with asymptomatic carotid stenosis in this age group. Even for symptomatic carotid stenosis, resource scarcity requires the setting of variables and priorities based on the best available evidence-based medicine. Recently, Gray et al. analyzed the cost differential between carotid stenting and endarterectomy. Cost ($5409 vs $3417) was significantly greater for the surgical group, while outcome analysis showed similar stroke and death rates in both groups. This suggests that further study is needed to evaluate carotid stenting as a more cost-effective means of stroke prevention in the very elderly with symptomatic carotid stenosis in the hope that treatment would not be withheld merely based on resource scarcity.

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