Carotid Artery Endarterectomy in the Octogenarian: A Community Hospital Experience

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Abstract

Between May 1995 and April 1998 three vascular surgeons performed 310 consecutive primary carotid endarterectomies (CEAs) in a 224-bed community hospital. Seventy-six CEAs were performed in octogenarians (Group 1) and 234 CEAs were performed in nonoctogenarians (Group 2). There were no strokes or deaths in Group 1; there was a single death and three strokes in Group 2. The overall rates of death, stroke and combined death and stroke were .3%, 1%, and 1% respectively. No statistically significant difference existed in rates of moribundity and mortality in Groups 1 and 2. On follow-up (mean = 18 months), 94% of the patients were alive without stroke, 5% were dead, and 1% were alive with stroke. These data demonstrate that CEA can be performed safely in the octogenarian in the community hospital setting.

Introduction

The safety and therapeutic effacy of carotid endarterectomy (CEA) in the treatment of both symptomatic and asymptomatic carotid artery stanzas have been established by several randomized, prospective studies. In patients with appropriate indications, CEA has a long-term protective effect that outweighs the operative risk of morbidity and mortality. As indications for CEA have become better defined, the procedure has been performed with increasing frequency.

The performance of CEA in the community hospital setting has been the subject of debate. In 1977, Easton and Sherman published a series of CEAs performed in two large community hospitals with a disturbing mortality rate of 6.6% and a combined stroke and mortality rate of 21.1%. Mattos et al reexamined the outcomes at the same two hospitals 17 years later and found markedly improved outcomes. However, the morbidity and mortality rates were still higher than those published in series from academic centers. In

contrast, Buchbinder et al reported on 181 consecutive CEAs performed in a community hospital with a mortality rate of .6% and a combined stroke and mortality rate of 1.2%. Hoyne, in his personal experience of 272 consecutive CEAs performed in community hospitals, reported a mortality rate of .4% and a combined stroke and mortality rate of 3.3%. These data demonstrate that CEA can be performed safely in certain community hospital settings.

Stroke remains the second leading cause of death in octogenarians in the United States. Epidemiologic studies estimate the annual incidence of stroke in this group to be greater than 20 per 1000 (range: 20/1000-24/1000). However, the indications for performing CEA in this age group have not been established by any randomized, prospective trial. Two specific issues have been raised about performing CEA on octogenarians. First, Amman are concerned that there may be an increased rate of perioperative morbidity and mortality in this age group. Second, some are concerned that the benefit derived from performing CEA to prevent cerebrovascular accident (CVA) may be less given that the estimated life span of a male octogenarian is 7.0 years and of a female octogenarian is 9.1 years. Furthermore, a recent article has shown that CEA in the elderly asymptomatic patient may not be cost effective. Regardless, several series in this decade have documented the safety of CEAs in octogenarians.

Almost one-fourth of our patients were octogenarians. We chose, therefore, to address the issue of CEA in the octogenarian in the community hospital setting. We reviewed the results of 310 primary CEAs in a single community hospital, of which 76 were performed in octogenarians. We have stratified the patients by the following: age, sex, preoperative neurologic symptoms, contralateral high-grade stanzas and/or occlusion, cardiovascular disease, hypertension, diabetes mellitus, and tobacco use. No patient was denied surgery because of age. We compared the demographics, indications for surgery, and outcomes in the octogenarian and nonoctogenarian groups.

Methods

All 310 consecutive primary carotid endarterectomies that were performed from April 1995 to May 1998 by three vascular surgeons (KAG, SPK, JTD) at a single 224 bed community hospital were included in this study. Indications for surgery were (1) carotid stanzas greater than 70% with neurologic symptoms, (2) asymptomatic carotid stanzas greater than 80%, and (3) asymptomatic stanzas between 70% and 80%. All patients had preoperative carotid artery duplex examination and the majority also had magnetic resonance angiography (MRA). When possible, duplex scans were performed by a single technician in our vascular laboratory (ATL HDI 3000). University of Washington criteria were utilized in our laboratory. In patients with moderate disease (50-79%) by University of Washington criteria, stanzas was considered to be greater than 70% when the internal carotid artery/common carotid artery ratio (ICA/CCA) velocity ratio exceeded 4 to 1 or when the peak systolic velocity was greater than 325cm/sec. MRA was used as a

confirmatory test. In the few cases were discrepancies existed between duplex and MRA results, patients were referred for conventional angiography.

All patients were evaluated by history, physical examination, and a standard 12-lead electrocardiogram. Preoperative echocardiogram or cardiac stress testing was reserved for the patients with worsening cardiac symptoms of valvular heart disease. Some patients had a cardiac evaluation at the discretion of the primary care physician before referral.

Two of the surgeons (KAG, SPK) preferred regional cervical block anesthesia. When regional anesthesia was used, mental status and contralateral motor function were assessed throughout surgery. The third surgeon (JTD) routinely used general anesthesia and measured stump pressures. Patients with mean stump pressures of less than 50 mm Hg were treated by placement of a Sundt shunt. Carotid patching was performed based on the surgeons preference. For all surgeons, patients with acute strokes or contralateral occlusion were routinely shunted. The vast majority of the patients were patched with either knitted Dacron or autologous saphenous vein graft. All patients were monitored with a radial arterial line intraoperatively and postoperatively. Systolic blood pressure was maintained between 110 and 170 mm Hg. Patients remained in an intensive care unit (ICU) bed overnight and in the vast majority of cases were discharged on the second postoperative day.

The data were gathered by a retrospective review of patient's hospital and office chart and by telephone interview. Risk factors for atherosclerotic disease were examined. These included hypertension, hypercholesterolemia, diabetes, and smoking history. History of coronary artery disease (CAD) was defined as previous myocardial infarction (MI), coronary artery bypass grafting (CABG), percutaneous transluminal coronary angioplasty (PTCA), hospitalization for congestive heart failure (CHF), or angina. In addition, history of a previous neurologic event was noted and, when available, results of preoperative computed axial tomography (CAT) scan or magnetic resonance imaging (MRI) of the brain were reviewed. Patients had a repeat physical examination and carotid duplex 6 months postoperatively and yearly thereafter. End points chosen included stroke or death. Patient demographics, indications for surgery, comorbid conditions, and surgical results were compared by use of student's t test.

Table 1
Male and Female Demographics

	Men	Women
Octogenarians	46(61%)	30(39%)
Nonoctogenerians	134(57%)	100(43%)
Total(n=310)	180(58%)	130(42%)

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Results

A total of 310 primary carotid endarterectomies were performed on 266 patients from April 1995 to May 1998 (Table I). The patients' ages ranged from 41 to 88 years old. Seventy-six CEAs (68 patients) were performed in patients who were more than or equal to 80 years of age. The mean age of the octogenarians (Group 1) was 83.2 years (range 80-88 years). Two hundred thirty four CEAs (198 patients) were performed in the nonoctogenarian group (Group 2) whose mean age was 69.6 years (41-79 years). Overall, 58% of the patients were male. Group 1 was 61% male and group 2 was 57% male. No statistical difference existed in sex distribution between the groups. The majority of the patients were white. The patients' risk factors for cardiovascular disease are shown in Table II. These included patient's sex, history of coronary artery disease (CAD), diabetes mellitus (DM), hypertension (HTN) peripheral vascular disease (PVD), and smoking. Coronary heart disease, diabetes, and hyperlipidemia were more prevalent in Group 2 than in Group 1. The difference in prevalence of hyperlidemia was statistically significant ($p<0.05$); none of the other differences achieved statistical significance.

Preoperative indications for surgery are shown in Table III. Symptomatic disease was defined as history of transient ischemic attack (TIA), reversible ischemic neurologic disability (RIND) or CVA within the proceeding 24 months. Severe disease was defined as greater than 80% stanzas by use of either duplex sonography or angiography. Moderate disease was considered to be between 70% and 80% stanzas. Thirty-one percent of CEAs were performed for symptomatic disease, 48% for asymptomatic moderate stanzas. Twenty (26% procedures in Group 1 were in symptomatic patients compared with 77 (33%) procedures in Group 2.

Forty-nine (64%) procedures in Group 1 were in patients with asymptomatic stanzas exceeding 80% versus 100 (43%) procedures in Group 2 patients. Seven (10% operations in Group 1 were in patients with asymptomatic stanzas between 70% and 80% versus 57 (24%) operations in Group 2. The difference in rate of surgery for asymptomatic moderate and asymptomatic severe stanzas was statistically significant for the two groups ($p<0.05$).

Post operative complications are shown in Table IV. The single perioperative fatality occurred in a 74-year-old man who had a CEA for repetitive focal TIAs despite medical therapy with both ticlpidine and aspirin. Duplex sonography demonstrated 50-79% stanzas and conventional angiography demonstrated 70% stanzas with an ulcerated atherosclerotic plaque. CEA was performed and the patient was discharged after an apparently uncomplicated postoperative course. He presented with recurrent TIAs 18 days postoperatively. Evaluation demonstrated a patent carotid endarterectomy site without discernible defect. Extensive neurologic evaluation (MRI, CAT scan, and single photon emission computed tomography [SPECT] scan and neurological consultation) was unremarkable. He had a progressively deteriorating clinical course and succumbed

from MI and respiratory failure on postoperative day 28. Postmortem examination was refused, but our neurology service felt the patient likely succumbed to amyloid angiopathy. This patient was considered a stroke and mortality in this series.

Two additional perioperative strokes occurred for a total of 1%. One patient demonstrated hemiparesis associated with hyptension in the ICU. He was immediately reexplored and found to have thromus at the endarterectomy site. At 3 months, he demonstrated good resolution of his stroke and presently has mild residual upper extremity weakness. The second patient demonstrated a CVA on the side contalateral to CEA on postoperative day 3. Duplex at that time revealed the CEA to be patent. She had a 50% stanzas on the contralateral side and was treated with antiplatelet medicate.on. The patient recovered completely from here CVA at 3 months and has had no further symptoms

There were no postoperative TIAs in Group 1 versus three (1%) TIAs in Group 2. These resolved in a matter of hours with no deficit detected at 24 hours, and the patients were subsequently evaluated with CAT scan or MRI of the brain, which demonstrated no new lesion. Five nonfatal myocardial infarctions occurred. Two (3%) CN palsies were in Group 1 and one (0.4%) was in Group 2. In all three cases, discharge from the hospital was not delayed; each of these was clinically resolved by 6 weeks postoperatively. Three (1%) patients were returned to the Operating Room (OR). One patient (1%) in Group 1 was brought back for a neck hematoma. Of the two patients (0.9%) in Group 2 who were returned to the OP, one was reexplored for stroke and the other had exploration of a superficial neck infection. Additional miscellaneous complications are included in Table IV and include neck hematoma (1.3%), wound infection (0.3%), and groin hematoma (0.3%). No statistical difference existed between the two groups with respect to TIA, MI, CN palsy, or reexploration.

Follow-up results appear in Table V. Of the 266 patients undergoing CEA, three were excluded from follow-up because of either perioperative stroke or death, leaving 263 available for follow-up. Sixty-five (96%) of Group 1 patients and 190 (97%) of Group 2 patients were followed up (mean length = 18 months). Eight patients were lost to follow-up. Four patients (6%) in Group 1 died during follow-up. Of these deaths, one was attributed to cancer, one to arrhythmia, and one to a motor vehicle accident (MVA). The fourth cause was unknown. Nine patients (5%0 died in Group 2. Four died of cancer, two of MI, and one from MVA. Two causes were unidentified. Fifty-nine (91%) of patients in Group 1 and 180 (95%) of patients in Group 2 were alive without stroke at the time of the follow-up period. None was attributable to the operated-on carotid artery.

Postoperative duplex results were available on 258 of the CEAs performed (mean length = 16 months) (Table VI). When multiple sonograms were performed the most recent results were used. Degree of restenosis was determined in our laboratory by use of University of Washington criteria and duplexes performed outside our institution were re-

reviewed with use of the same criteria. Of those CEAs with duplex results available, 238 (92%) demonstrated papten repair without evidence of hemodynamically significant stanzas. Four CEAs (7%) in Group 1 and 16 CEAs (9%) in Group 2 had stanzas greater than 50% on follow-up duplex. There were no occlusions in Group 1; there was one asymptomatic occlusion in Group 2 (overall rate occlusion = 0.5%).

Table II
Perioperative Risk Factors

	Octogenarians (n=76)	Nonoctogenarians (n=234)	Total (n=310)	p
CAD	31(41%)	119(51%)	150(48%)	NSS
DM	14(18%)	66(28%)	80(26%)	NSS
HTN	51(67%)	166(71%)	217(70%)	NSS
PVD	16(21%)	61(26%)	77(25%)	NSS
COPD	9(12%)	21(9%)	30(10%)	NSS
Hyperlipidemia	12(22%)	83(35%)	100(32%)	.05
Smoking	22(29%)	86(37%)	108(35%)	NSS
Prior CVA	8(11%)	22(9.4%)	30(10%)	NSS
Contralateral occlusion	3(4%)	15(6%)	18(6%)	NSS
Critical contralateral stenosis	14(18%)	29(12%)	43(13%)	NSS

Table III
Indications for Carotid Endarterectomy

	Octogenarians (n=76)	Nonoctogenarians (n=234)	Total (n=310)
Symptomatic	20(26%)	77(33%)	97(31%)
Asymptomatic severe (>80% stenosis)	49(64%)	100(43%)	149(48%)
Asymptomatic moderate (70-79% stenosis)	7(10%)	57(24%)	64(21%)

Table IV
Perioperative Complications

	Octogenarians (n=76)	Nonoctogenarians (n=234)	Total (n=310)	p
Death	0	1(.4%)	1(.3%)	NSS
Stoke	0	3(1%)	3(1%)	NSS
Combined stroke and death	0	3(1%)	3(1%)	NSS
TIA	0	3(1%)	3(1%)	NSS

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Myocardial infarction	2(3%)	3(1%)	5(2%)	NSS
CN injury	2(3%)	1(.4%)	3(1%)	NSS
Reoperation	1(1%)	2(.9%)	3(1%)	NSS
CHF	0	1(.4%)	1(.3%)	NSS
Neck hematoma	2(3%)	2(.9%)	4(1.3%)	NSS
Groin hematoma	0	1(.4%)	1(.3%)	NSS
Wound infection	0	1(.4%)	1(.3%)	NSS

Table V
Follow-Up

	Octogenarians (n=68)	Nonoctogenarians (n=198)	Total (n=266)
Perioperative stroke and death	0	3(1%)	3(1%)
Patients available for follow-up	68(100%)	195(98%)	263(99%)
Lost to follow-up	3(4%)	5(3%)	8(3%)
Patients followed up	65(96%)	190(97%)	255(97%)
Dead	4(6%)	9(5%)	13(5%)
Alive without stroke	59(91%)	180(95%)	239(94%)
Alive with stroke	2(3%)	1(.5%)	3(1%)
Mean follow-up	16 Months	18 Months	18 Months

Discussion

The treatment of carotid artery disease in the octogenarian has not been addressed by a randomized trial. The literature supports CEA in the symptomatic but otherwise healthy octogenarian with high-grade stanzas.16-21 No consensus exists, however, on the appropriate treatment of the asymptomatic octogenarian with high-grade stanzas. This study is one of several that have shown that CEA can be performed safely in this age group with acceptable morbidity and mortality as defined by the American Heart Association. 24

In this series, we report on 310 consecutive primary CEAs performed with a 30-day operative mortality rate of 0.3% and a combined stroke and mortality rate of 1.0%. The overall low rates of morbidity and mortality in this series are likely multifactorial. Included in these factors is the frequency of performance of this procedure in our institution, the frequency with which this procedure was performed for asymptomatic carotid stanzas, and the absence of combined carotid artery endarterectomy/coronary artery bypass grafting (CABG) procedures. A higher volume of carotid artery

endarterectomy correlates with mower morbidity and mortality rates. 6,25 Karp, et al, 5 in a review of 1,945 consecutive CEAs performed on Medicare beneficiaries in Georgia in 1993, found an inverse correlation between surgical volume and morbidity and mortality rates. An odds ratio for stroke occurrence was 2.6 to 1 in hospitals performing fewer than 10 cases versus those performing more than 50 cases per year. Hsia et al, 25 in a review of 63,137 CEAs performed on Medicare beneficiaries in 1985, demonstrated that the lowest mortality rate was at institutions where greater numbers of these procedures were performed.

Since the release of the Asymptomatic Carotid Atherosclerosis Study (ACAS) trial results, there has been a steady increase in the referral of patients with asymptomatic carotid disease to our practice. Sixty-nine percent of operations were performed on patients with asymptomatic stenosis in this series. Several series have demonstrated reduced rates of operative morbidity and mortality in patients undergoing CEA for asymptomatic disease. Riles et al reported on 100 consecutive carotid artery endarterectomies performed for asymptomatic carotid stenosis with no strokes or deaths. During this same time period, their overall mortality rate was.4% and combined stroke and mortality rate was 1.4%. Further, no combined CEA/CABG procedures were performed in this series, a combination that carries increased risks of operative morbidity and mortality. In the Cleveland Clinic series, combined CEA/CABG carried 10 times the risk of mortality and 2.4 times the rate of stroke compared with CEA alone.

Overall, 31% of our patients were operated on for symptomatic carotid disease, 48% for asymptomatic severe stenosis, and 21% for asymptomatic moderate stenosis (Table III). Of the asymptomatic patients, 64% of the octogenarians and 43% of the nonoctogenarians had greater than 80% stenosis. Early in our series we had operated on a moderate number of asymptomatic patients with 70% to 80% stenosis. Several recent studies have documented a low rate of permanent neurologic events in asymptomatic patients who have less than 80% stenosis. In each of these studies, asymptomatic patients with 50-79% stenosis had ipsilateral neurologic events at a rate of approximately 1% per year. In these studies aggressive surveillance with duplex ultrasoundography was recommended. Surgical intervention was reserved for patients who developed symptoms or progressed in their stenosis. Our practice has shifted, therefore, to regularly monitoring asymptomatic patients with 50-79% stenosis and recommending surgery for those patients who develop or progress in their stenosis.

In this series, almost one in four carotid artery endarterectomies were performed on patients over the age of 80. Several factors may have led to this high percentage of octogenarians including geography, socioeconomics, and referral practices. We are situated in close proximity to several large retirements communities with minimal age requirements. The average age of these communities is quite high and residents of these communities commonly live alone, are highly functional, and are in generally good health despite their advanced ages. There is a consensus on the part of local referring

physicians that age us not a contradiction to carotid surgery. Elderly patients with both symptomatic and asymptomatic carotid disease are often referred for evaluation.

Socioeconomic factors also account for increased longevity in some of our surrounding communities. Lynch et al demonstrated that risk factors for atherosclerosis are more prevalent in lower socioeconomic groups. When comparing the relative prevalence of risk factors for development of atherosclerosis and other comorbid conditions between groups, we found a trend toward increasing prevalence of certain comorbid factors in the nonoctogenarian group (Group 2). Group 2 had a higher prevalence of CAD, DM, and hyperlipidemia. Only the increased incidence of hyperlipidemia, however, was statistically significant ($P<0.05$). The relative incidence of hypertension and chronic obtrusive pulmonary disease (COPD) was quite similar in the two groups. It is not surprising that the nonoctogenarian group had a greater prevalence of risk factors for atherosclerosis since these factors certainly played a role in the development of carotid stenosis at a younger age. Conversely, absence of these factors may have played a role in the octogenarian's overall longevity. Coyle et al reported a similar finding, with their octogenarians demonstrating a lower prevalence of associated risk factors for atherosclerosis. In contrast, the octogenarians undergoing CEA in a recent VA series were less healthy than their nonoctogenarian cohorts. Therefore, it is not surprising that CEA in the octogenarian was associated with greater morbidity and mortality in this study. The authors of this study clearly recognize their population bias and conclude that overall health rather than age is the most significant determinant of surgical outcome.

The overall rates of death, stroke, and combined stroke and death in this series were .3%, 1.0%, and 1.0% respectively. There were no perioperative deaths or strokes in the octogenarian group (Group 1), and there was one death and three strokes within the nonoctogenarian group (Group 2). These results support the concept that CEA can be performed in octogenarians with acceptable rates of morbidity and mortality. This finding has previously been demonstrated in several series. Pinkerton, in a series of 685 CEAs, showed no relationship between age and operative mortality or perioperative stroke morbidity. Perler found that age did not adversely effect CEA results, although he found an increased length of stay in the more elderly patients. O'Hara et al, in the largest published series of octogenarian CEAs (182 CEAs over a 7 year period), reported a rate of mortality of .6 and a rate of CVA of 1.6%. They demonstrated both that CEA was safe in selected octogenarians and that the majority of these patients would live the rest of their lives stroke free. Our early follow-up results suggest the same finding (Table V), and long term follow-up is planned

Table V
Follow-Up Duplex Results

	Octogenarians (n=78)	Nonoctogenarians (n=234	Total (n=310)

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Perioperative stroke and death	57(73%)	201(86%)	258(83%)
Patients available for follow-up	53(93%)	185(92%)	238(92%)
Lost to follow-up	4(7%)	16(9%)	20(8%)
Patients followed up	0	1(.5%)	1(.4%)
Mean follow-up	14 Months	16 Months	16 Months

Conclusion

The overall safety of carotid artery endarterectomy performed in the community hospital is once again demonstrated. Octogenarians underwent carotid artery endarterectomy without increased risk of morbidity or mortality. These results support the view that age shouldn't be viewed as contraindication to carotid artery endarterectomy. An individual patient's risk of stroke and operative risk, as well as estimated patient longevity, should continue to dictate the recommended treatment of carotid stenosis.

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