The records of 146 patients 80 years of age or older who underwent 183 carotid endarterectomy operations from 1964 through 1990 were reviewed to determine surgical risk. The indications for operation were asymptomatic patients with carotid stenosis (n = 36); ipsilateral transient ischemic attacks (n = 46); ipsilateral stroke (n = 28); ipsilateral retinal embolus (n = 15); nonlateralizing symptoms (n = 40); and asymptomatic side in patients with contralateral symptoms (n = 18). Postoperatively, three patients (1.6% of operations) had a stroke with a residual deficit and three (1.6%) died. All deaths were from myocardial infarction. For comparison, during the same time period, the combined stroke with residual deficit and death rate for patients less than 80 operated upon for similar indications was 3.5%. Since 80-year-old patients have a life expectancy of at least five years, the authors conclude that elderly patients should be evaluated for carotid endarterectomy using criteria similar to that used for younger patients. (Ann Vasc Surg 1992;6:321-324).

KEY WORDS: Carotid endarterectomy; elderly patients.

In the United States stroke is the third leading cause of death, behind heart disease and malignancy, and is a major cause of disability. Both the prevalence and annual incidence rates of stroke increase with increasing age and by age 85 stroke is the second leading cause of death, exceeding malignancy [1]. The approximate average annual incidence rate of stroke for patients 65 to 74 years of age is 510 per 100,000 population. For ages 75-84 the rate is 960 per 100,000 and for those 85 years or older the rate is 1,030 per 100,000 [2].

Most strokes are due to thromboembolism from atherosclerotic disease at the carotid bifurcation [3]. Carotid bifurcation disease is amenable to surgical repair. However, many physicians are reluctant to advise carotid endarterectomy (CEA) for elderly patients because they consider such patients to have a limited life expectancy and a high surgical risk. The life expectancy of elderly patients is improving and, perhaps, greater than that generally appreciated. The United States Census reported that life expectancy at age 80 is 8.3 years and at age 85 is 6.3 years, with females having a slightly longer life expectancy than males [1]. The purpose of this study was to determine the risk of CEA in these elderly patients.
MATERIALS AND METHODS

Information on all patients having a CEA was recorded in a computerized database. The records of patients 80 years of age or older who had a CEA were reviewed and the results were compared to the results for those less than 80. To make the two groups homogeneous we excluded patients who had a simultaneous CEA and coronary bypass operation, patients who required an inflow operation for common carotid disease, patients operated on for recurrent stenosis, and patients operated on for an acute stroke because of the increased morbidity under these conditions. All operations were performed by the authors on a private surgical service.

The diagnosis of carotid stenosis was made by arteriogram or duplex scan. Most arteriograms were performed by retrograde catheterization of the femoral artery and direct injection into the carotid artery. In 1984 duplex scan became available and since that time we have used duplex scan in place of arteriography with increasing frequency [4]. Duplex scanning has a high degree of accuracy in identifying severe carotid stenosis when compared to contrast arteriography [5-8]. The scans were performed by the vascular laboratory using the Diasonics DRF-400 scanner* or the Acuson 128 Computed Color Sonogram System†.

The criterion for operation for asymptomatic patients during the early years of the study was stenosis that narrowed the lumen by 60% of the diameter and in recent years the criterion was 80% stenosis [9,10]. Criteria for symptomatic patients was stenosis or ulceration that seemed likely to be the source of cerebral emboli or decreased cerebral blood flow. The percent of stenosis by arteriography was determined by comparing the degree of narrowing in cross-sectional diameter at the point of maximum stenosis to the diameter of the normal artery distal to the stenosis. In general, the percentage of stenosis was estimated and not measured. Criteria for the diagnosis of stenosis with the Diasonic scanner were a peak systolic frequency greater than 6 KHz, end-diastolic frequency of 3.5-4.5 KHz, and spectral broadening with loss of window. Diagnosis of greater than 80% stenosis with the Acuson system included the above criteria and a peak systolic velocity greater than 250 cm/sec.

RESULTS

From 1964 through 1990, 183 operations were performed on 146 patients 80 years of age or older. Thirty-seven patients had two operations. Patients operated upon more than once were considered an individual patient for each operation. The majority of operations (146) were performed during the last 10 years, reflecting an aging population and our confidence in the safety of the operation. Ninety-six patients were men and 87 were women; their ages ranged from 80 to 91 years, with a mean age of 83 years. Fifty-four patients were operated upon based on duplex scan findings without arteriography.

Indications for operation were asymptomatic patient with carotid stenosis (n = 36, 20%), ipsilateral transient ischemic attack (TIA) (n = 46, 25%), ipsilateral stroke (n = 28, 15%), ipsilateral retinal embolus (n = 15, 8%), nonlateralizing symptoms (n = 40, 22%), and asymptomatic side in a patient with contralateral symptoms (n = 18, 10%). One-hundred eighty-one operations were an endarterectomy, one was a patch angioplasty without endarterectomy and one was repair of a kink.

All operations were performed with general anesthesia and systemic heparinization. Prior to anesthesia an arterial line was placed to facilitate normotension and to monitor heparinization using the activated clotting time. Shunts were used routinely (n = 176) and completion arteriography rarely (n = 3). Fifty-one arteries were closed with a patch; vein 24, Dacron 19, and polytetrafluoroethylene (PTFE) 8. In general, patches were used for small arteries, especially in women. During the past two years we have used completion duplex scan in the operating room prior to closing the wound to evaluate the repair.

Postoperatively, four patients (2%) had a stroke. Three strokes involved areas of the brain that were not in the distribution the carotid operated upon. In these three patients, one underwent operation for an ipsilateral stroke, one for a stroke involving the contralateral hemisphere, and one for nonlateralizing symptoms. One patient operated on for a TIA developed an expressive aphasia four hours postoperatively. The patient was reoperated upon, the internal and common carotid arteries were patent, and there was clot in the external carotid from an intimal flap. The external carotid was repaired. The neurologic deficit cleared completely within three days and computerized tomography (CT) scan did not show an infarct. Three patients died, all from myocardial infarction, and none of the deaths were related to a postoperative stroke. In the patients who died, one was operated on for a TIA, one for a stroke, and one for nonlateralizing symptoms. The combined stroke with residual deficit and death rate was 3.3% (six patients).

Twenty-five complications other than stroke occurred in 23 patients (two patients had two complications) and included wound hematoma requiring reoperation (n = 7), cranial nerve injury (n = 11), myocardial infarction (n = 4), severe cardiac arrhythmia (n = 1), fracture from a fall in the hospital (n = 1), and urinary sepsis (n = 1). There were no

* Diasonics Inc, Milpitas, California.
† Acuson, Mountain View, California.