Outcome of 312 Japanese Patients with Carotid Endarterectomy and Factors Associated with Cardiovascular Events—A Single-center Study in Japan

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Background: There have only been a few reports regarding the outcomes and risk factors after CEA. To clarify the factors associated with outcome in patients with carotid stenosis who underwent carotid endarterectomy (CEA), we investigated cardiovascular events and mortality in the Kyushu Medical Center in Japan. *Methods:* We consecutively registered patients with significant carotid stenosis who had CEA performed over 10 years and compared the incidences of stroke, myocardial infarction, and death. On admission, we evaluated medical records for stroke risk factors, including hypertension, diabetes mellitus, hypercholesterolemia, atrial fibrillation, and current smoking habits. When performing CEA, blood pressure, heart rate, blood gases, and Doppler flow parameters in the carotid artery, and an electroencephalogram, were continuously monitored during the procedure. A shunt tube was inserted into both ends of the carotid artery, and a microscope was used. Although it was recommended that patients be evaluated by magnetic resonance imaging and ultrasound after the operation, we attempted to obtain information from the patient or a family member through a questionnaire or telephone survey if a patient did not come for assessment. We determined the factors associated with stroke, myocardial infarction, and death using Kaplan–Meier analyses. *Results:* Of 312 CEA patients, 302 (96.8%) with confirmed outcomes were analyzed. We found that a factor associated with stroke was a history of ischemic stroke ($P = .028$). A history of myocardial infarction ($P = .009$) and the presence of peripheral arterial disease (PAD) ($P = .001$) were factors related to the future occurrence of myocardial infarction. Perioperative complications occurred in 6 patients (1.99%) including 1 death because of sepsis and 1 major ipsilateral stroke. Of the 302 patients who underwent CEA, 43 patients died in the follow-up period, and the 5-year survival rate was 83.9%. The number of patients who died because of myocardial infarction and cancer was 9 for each, and they were the leading causes of their death. Only 1 patient died because of stroke (2.3%). Patients with PAD had a significantly high mortality ($P < .001$). *Conclusions:* In patients who underwent CEA, a risk factor of future stroke was a history of stroke. A history of myocardial infarction or PAD was strongly associated with future occurrence of myocardial infarction or high mortality. **Key Words:** Carotid stenosis—carotid endarterectomy—outcome—cardiovascular diseases.

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Background

Some randomized control trials have shown the preventive effect of carotid endarterectomy (CEA) against ischemic stroke in patients with severe carotid stenosis.[1-3] Although these studies were conducted in North America or Europe, and the efficacy of CEA in nonwhite populations, including the Japanese, has not been clarified, we previously reported the efficacy of CEA in Japanese patients with moderate carotid stenosis, especially symptomatic carotid stenosis.[4] However, there have only been a few reports regarding the outcomes and risk factors after CEA. Rothwell indicated that the factors associated with poor outcomes of patients who underwent CEA were female patients, the presence of peripheral arterial disease (PAD), and a systolic blood pressure greater than 180 mm Hg.[5] Recently, reports have described an increase in stroke patients with large artery atherosclerosis in Japan.[6] Therefore, it is important to clarify the factors associated with risk factors of future cardiovascular events. In addition, Japanese people have a significantly higher cervical level of carotid bifurcation compared with Western people,[7] and as a result, carotid atherosclerosis is difficult to remove perfectly and safely. Therefore, most Japanese surgeons perform CEA by means of a microscope.

The current study was conducted to clarify the outcome and factors associated with future cardiovascular events in patients with carotid stenosis who underwent CEA.

Materials and Methods

Between July 1994 and September 2005, we consecutively registered Japanese patients with significant carotid stenosis evaluated by ultrasound who came to our hospital for further examination. According to the degree of stenosis, we recommended either CEA or medication for these patients. The method of therapy, that is, CEA or medication, was decided based on our previous reports.[4,8,9] On admission, we evaluated medical records for stroke risk factors, including hypertension, diabetes mellitus, hypercholesterolemia, atrial fibrillation, and current smoking habits. The definitions of hypertension, diabetes mellitus, and hypercholesterolemia are described in our previous reports.[4,8,9] PAD was diagnosed when a patient had a significant intermittent claudication and/or ankle–brachial index of less than .9.

All CEA procedures were performed by the same neurosurgical team.[10] Anesthesia was achieved by fentanyl citrate, thiamylal sodium, and propofol. Blood pressure, heart rate, blood gases, and Doppler flow parameters in the carotid artery, and an electroencephalogram, were continuously monitored during the procedure. A shunt tube was inserted into both ends of the carotid artery to reserve bypass flow to the distal intracranial arteries, and an endarterectomy was carefully performed using a microscope. After CEA, propofol sedation was continued until the next morning. Blood pressure was maintained at less than 150 mm Hg of systolic and less than 90 mm Hg of diastolic pressure in all patients using nitroglycerin and/or diltiazem until 7 days after CEA. Perioperative complications were defined as those that occurred within 30 days and they were recorded.

We excluded patients who had undergone carotid artery stenting or those with a modified Rankin scale score of greater than 3 at the time of the evaluation. All patients were recommended to be evaluated by MRI and ultrasound 6 months after treatment and every year thereafter. We recorded the occurrence and date of stroke, myocardial infarction, and death. If a patient did not visit our department for assessment after the first examination, we attempted to obtain information from the patient or his or her family member through a questionnaire or telephone survey, which was conducted between October 2006 and March 2007. We also reviewed all medical records. The study protocol was approved by our hospital's Ethics Committee. Informed consent was obtained from all patients.

The occurrence of stroke, myocardial infarction, and death after CEA were defined as end points. Stroke and myocardial infarction occurred in the perioperative period and over the long term. Stroke included not only the ipsilateral carotid stenosis side but also the contralateral side and vertebrobasilar artery territory. When the patients underwent revascularization because of carotid restenosis, their follow-up was considered finished on the day of revascularization. We investigated each end point in the presence and absence of clinical characteristics using Kaplan–Meier analysis. P values less than .05 were considered statistically significant. Data were analyzed using SPSS for Windows version 16.0 (SPSS, IBM, Somer, NY).

Results

A total of 312 patients underwent CEA, and of these, 302 (70.2 $\pm$ 7.1 years old, 255 men and 47 women) had their outcomes confirmed. The patients' characteristics are shown in Table 1.

Perioperative complications occurred in 6 patients (1.99%). No patient had myocardial infarction. Although 4 patients had ischemic stroke, only 1 patient had a disabling stroke. One patient had ischemic stroke in the contralateral side. One patient died because of sepsis and another had cerebral hemorrhage because of hyperperfusion.

With regard to factors associated with the occurrence of stroke after CEA, a history of ischemic stroke was the only significant factor (P = .028, Fig 1). When the patients were divided by the median of the patients' age, patients with an older age tended to have a higher risk of future ischemic stroke (P = .07). Additionally, there were no