Silent Coronary Artery Disease in Japanese Patients Undergoing Carotid Artery Stenting

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Background: The aim of this retrospective study was to determine the prevalence of silent coronary artery disease (CAD) and the risk factors associated with concomitant CAD in Japanese patients undergoing carotid artery stenting (CAS). *Methods:* The records of 112 consecutive patients (99 men and 13 women; mean age 70 ± 8 years) who underwent elective CAS at our institution for extracranial carotid artery stenosis between January 2006 and January 2011 were reviewed retrospectively. During this period, preoperative CAD screening by coronary angiography was performed in all patients. Patients were diagnosed with CAD when ≥1 coronary arteries had stenosis ≥75% and were classified into 2 groups: (1) a group with CAD that was based on preoperative coronary angiography or a history of percutaneous coronary intervention (PCI) and/or coronary artery bypass grafting (CABG), and (2) a group without CAD that had no angiographically documented stenosis ≥75%. *Results:* Sixteen (14.3%) patients had CAD that had already been treated by PCI and/or CABG. Silent CAD was detected in 39 (34.8%) of 112 patients. Taken together, 55 (49.1%) patients had clinically significant CAD. The patients with CAD were more likely to have diabetes mellitus (DM; $P = .001$), dyslipidemia ($P = .013$), and bilateral carotid disease ($P = .033$). Multivariate analysis revealed that DM (odds ratio 3.07; 95% confidence interval 1.25-7.53) and bilateral carotid stenosis (odds ratio 2.72; 95% confidence interval 1.10-6.75) were independent variables associated with concomitant CAD. *Conclusions:* Perioperative CAD screening revealed that silent CAD was frequently diagnosed in Japanese patients scheduled for CAS, particularly in those with DM and/or bilateral carotid stenosis. **Key Words:** Carotid artery stenting—coronary artery disease—diabetes mellitus.

Patients with extracranial carotid artery stenosis usually have multiple risk factors associated with atherosclerosis. Studies of patients undergoing carotid endarterectomy (CEA) have reported that 30% to 40% of patients with carotid artery stenosis have coronary artery disease (CAD).[1,2] Although the appropriate treatment for patients with concurrent carotid artery stenosis and CAD remains unclear, CAD is one of the predictors of perioperative death or myocardial infarction (MI) after CEA.[3]

Carotid artery stenting (CAS) is a less invasive alternative to CEA that may reduce periprocedural MI.[4,5] However, the rate of periprocedural MI with this alternative was 1.1% to 2.5%,[4,5] which might have been caused by pre-existing, clinically silent CAD. Therefore, concomitant CAD should be evaluated in patients undergoing CAS, even when patients have no history of angina.

The prevalence of concomitant CAD in Japanese patients undergoing CAS has not been determined. The

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aim of this retrospective study was to determine the prevalence of silent CAD in patients undergoing CAS and to identify the risk factors associated with concomitant CAD.

Methods

Study Population and Protocol

We conducted a retrospective review of 112 consecutive patients (99 men and 13 women; mean age 70 ± 8 years) who underwent elective CAS at our institution for extracranial carotid artery stenosis between January 2006 and January 2011. The following criteria were adopted as indications for CAS: (1) patients with angiographically documented carotid artery stenosis ≥50% and transient ischemic attack, amaurosis fugax, or stroke within the last 6 months; and (2) patients with angiographically documented carotid artery stenosis ≥80% in the absence of symptoms. Patients were considered ineligible for CAS regardless of their indication if they met any of the exclusion criteria of the Stenting and Angioplasty with Protection in Patients at High Risk for Endarterectomy (SAPPHIRE) trial.[5] The degree of stenosis was assessed according to the method described in the North American Symptomatic Carotid Endarterectomy Trial (NASCET) study.[6]

All patients underwent coronary angiography and cerebral angiography as simultaneously as possible before CAS with collaboration between the cardiologist and neuroradiologist. Patients were diagnosed with CAD when ≥1 coronary arteries had stenosis ≥75%. Risk factors for CAD, including hypertension (medication-dependent or blood pressure >140/90 mm Hg), type 2 diabetes mellitus (DM; medication-dependent or defined with the American Diabetes Association criteria[7]), dyslipidemia (medication-dependent or low-density lipoprotein ≥140 mg/dL or triglyceride ≥150 mg/dL or high-density lipoprotein <40 mg/dL), or current smoking, were evaluated in each patient. Preoperative medication use was also evaluated in each patient.

Patients were classified into 2 groups: (1) a group with CAD that was based on coronary angiography before CAS or a history of percutaneous coronary intervention (PCI) and/or coronary artery bypass grafting (CABG), and (2) a group without CAD that had no angiographically documented stenosis ≥75%. The following clinical variables were evaluated in the statistical analysis: patient demographics (age, sex, body mass index, risk factor profile, medication use, and laboratory data), lesion characteristics (percent stenosis according to NASCET and either symptomatic or asymptomatic), presence of peripheral arterial disease (Fontaine stage II or greater), abdominal aortic aneurysm (>5 cm in diameter), and bilateral carotid stenosis defined by contralateral occlusion or stenosis (≥50% according to NASCET).

All clinical events within 30 days after the CAS procedure and acute coronary syndrome within 1 year after the CAS procedure were recorded and analyzed. Acute coronary syndrome was defined by the presence of specific cardiac enzyme more than twice the upper limit of normal, history of chest pain or discomfort for at least 30 minutes, or the development of specific abnormalities on a standard electrocardiography. This study was approved by the institutional ethics committee.

Statistical Analysis

All data were expressed as mean ± standard deviation, and $P < .05$ was considered statistically significant. Factors were compared between groups with and without CAD using the Chi-square or unpaired *t* tests. In addition, multivariate logistic regression analysis was performed to determine the clinical variables associated with concomitant CAD.

Results

Carotid Artery Stenting

A total of 112 consecutive patients (99 men and 13 women; mean age 70 ± 8 years) underwent elective CAS. The degree of carotid stenosis in the 112 patients was 80 ± 13%, and 67 (59.8%) patients were symptomatic. Bilateral carotid stenosis was found in 41 (36.6%) patients, 13 of whom received bilateral CAS. The success rate of CAS was 100%. Periprocedural major stroke—a new neurologic deficit with an increase of 4 in the National Institutes of Health Stroke Scale score longer than 30 days—occurred in 2 (1.8%) patients as a result of hyperperfusion syndrome, and minor strokes—a new nondisabling neurologic deficit that completely resolved within 30 days—were reported in 3 (2.7%) patients. Prolonged (>24 hours) bradycardia (heart rate of <50 beats/minute) was noticed in 10 (8.9%) patients. Prolonged hypotension (systolic blood pressure <90 mm Hg) was noticed in 30 (26.8%) patients, and all of them needed intravenous administration of vasoconstrictors.

Prevalence of Silent CAD in Patients with Carotid Artery Disease

Sixteen (14.3%) patients had CAD that had been previously treated by PCI and/or CABG. In addition, silent CAD was found in 39 (34.8%) patients. Coronary revascularization was performed in 27 (69.2%) of these silent CAD patients (PCI before CAS in 11 patients; PCI after CAS in 11 patients; CABG after CAS in 5 patients). The remaining 12 patients were treated using medical therapy alone. The total number of patients with previously treated CAD and silent CAD was 55 (49.1%; Fig 1). None of the patients suffered from acute coronary syndrome during the periprocedural period or the 1-year follow-up period. On standard electrocardiography, although 32 (28.6%)