Comparison of Carotid and Cerebrovascular Stenosis between Diabetic and Nondiabetic Patients Using Digital Subtraction Angiography

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Background: The aim of our study was to evaluate the differences of prevalence and manifestation of extracranial and intracranial artery stenosis between patients with and without type 2 diabetes using digital subtraction angiography. *Methods:* A retrospective study was conducted by analyzing clinical and lifestyle data collected from 1137 patients enrolled in the Nanjing Stroke Registry Program between June 2004 and March 2011. Vascular risk factors were analyzed, and carotid and cerebrovascular artery stenoses were measured in 383 patients with type 2 diabetes mellitus and 754 nondiabetic patients by digital subtraction angiography. *Results:* In all, 1069 stenoses were found among 383 diabetic patients and 1990 among 754 nondiabetic patients. No statistical differences were observed for the distribution of stenosis in intracranial–extracranial vessels between diabetic and nondiabetic patients ($P = .210$). There was no difference in the distribution of stenosis in the anterior and posterior circulation vessels between these 2 groups ($P = .628$). Among diabetic patients with stenosis, a single stenosis was found in 116 (30.29%) and multiple stenoses were found in 267 (69.71%). In their nondiabetic counterparts, a single stenosis was found in 249 (33.02%) and multiple stenoses were found in 505 (66.98%). Compared with nondiabetic patients, the diabetic patients have a tendency of a higher incidence of multiple stenosis. Nonobstructive stenosis occurs more often in diabetic than in nondiabetic patients ($P = .002$). *Conclusions:* This retrospective study suggests that diabetes be associated with higher incidence of nonobstructive stenosis and that there be no significant difference observed in the extent and distribution of the extra- and intracranial artery stenoses between diabetic and nondiabetic patients. **Key Words:** Atherosclerosis—diabetes mellitus—stenosis—digital subtraction angiography.

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Background

The prevalence of diabetes mellitus (DM) in most Western countries is 2%-5%, and in Asian countries, the prevalence of DM is rapidly increasing because of changes in dietary habits.[1,2] In 2010, 285 million people worldwide were estimated to suffer from DM,[3] and this number is expected to double by 2025.[4] DM is considered to be an increasingly significant health problem in most countries, and DM is listed as a major risk factor for cerebrovascular disease.[5] Cerebrovascular disease leads to disability and premature mortality and a considerable loss of productivity and increasing demand on health care facilities.[6-8] Most morbidity and nearly 80% mortality in type 2 DM patients can be attributable to macrovascular events, characterized by atherosclerotic changes in large blood vessels.[9] According to the World Health Organization, 1 of 20 deaths can be linked to diabetes, which equates to 8700 deaths per day or approximately equal to 6 deaths per minute.[10,11] Several different manifestations of stroke exist in the diabetic population. Although a great progress has been made in understanding the link between diabetes and coronary heart disease, literature on diabetes and stroke has been less enlightening.[12] Here, we carried out a retrospective study to evaluate the difference in distribution of carotid and cerebrovascular stenosis with digital subtraction angiography (DSA) between diabetic and nondiabetic patients.

Methods

Retrospective Study Patients

This study was approved by the ethics committee of our institution. Written informed consent was obtained from all patients and their family.

We retrospectively analyzed data from the Nanjing Stroke Registry Program between June 2004 and March 2011; 1137 ischemic stroke patients with stenosis of the extracrainal and intracranial arteries detected by DSA were enrolled including 383 diabetic (263 men, mean age, 61.02 ± 10.90 years) and 754 nondiabetic patients (554 men, mean age, 55.99 ± 12.96 years). All stroke patients with etiological subclassification of large-artery atherosclerosis, who were referred to our department for cerebral angiography during the study interval and had stenosis of extracranial and intracranial arteries detected, were included. Information was retrieved on age, gender, serum cholesterol level, hypertension history, and smoking habits. Exclusion criteria were those patients with nonatherosclerotic stroke including cardioembolism, small-artery occlusion, other determined etiology, and other undetermined etiology. All stroke patients in Nanjing Stroke Registry Program were received a variety of auxiliary examination and laboratory testing to look for stroke etiology and risk factors. Laboratory examinations included complete blood counts and a full set of clinical chemistry. Routine tests included a chest X-ray, various neuroimaging (brain computed tomography or magnetic resonance imaging scan and angiography), and cardiac tests such as electrocardiograph (ECG) and contrast and/or transthoracic ECG and/or transesophageal ECG performed to exclude some cryptogenic heart disease such as patent foramen ovale.

DM diagnosis was based on a plasma glucose level of 11.1 mmol/L or more or a fasting plasma glucose level of 7.0 mmol/L or more. All images were evaluated by 2 experienced observers blinded to the clinical history of the patients. In our clinical center, lipid profile routinely tested including cholesterol (normal range: 2.8-5.7 mmol/L), triglycerides (normal range: .29-1.83 mmol/L), high-density lipoprotein cholesterol (normal range: >.9 mmol/L), and low-density lipoprotein cholesterol (LDL-C; normal range: <4.0 mmol/L).

DSA Protocols

DSA is the gold standard for confirmation of stenosis. All examinations were performed with a dynaCT angiography machine (Advantx LCAz; GE Medical Systems, Europe, or Siemens Axiom Artis dTA; Siemens Healthcare, Germany) under local anesthesia. Extracranial vessel analysis was performed on a segmental basis, according to the North American Symptomatic Carotid Endarterectomy Trial criteria[13] and intracranial vessel analysis according to Warfarin-Aspirin Symptomatic Intracranial Disease (WASID) trial.[14] Briefly, carotid and cerebrovascular vessels were partitioned into 38 segments including the common carotid artery (CCA), carotid bifurcation, internal carotid arteries (C1-C7), extracranial vertebral artery, intracranial vertebral artery, basilar artery, anterior cerebral artery (A1 and A2), middle cerebral artery (M1-M2), posterior cerebral artery (P1-P2), anterior communicating artery, and posterior communicating artery. These segments were also divided into 2 categories: extracranial arteries (CCA, carotid bifurcation, CA, C1, C2, C3, and extracranial vertebral artery) and intracranial arteries (C4-C7, intracranial vertebral artery, basilar artery, A1, A2, M1, M2, P1, P2, anterior communicating artery, and posterior communicating artery). The distinction of the intracranial and extracranial vessels was based on the observation that the internal carotid artery pierced the inner dura immediately proximal to the origin of the ophthalmic artery in the anterior circulation. For the vertebral artery, the distinction was made at the point where the artery pierced the dura at the level of foramen magnum. Any disagreement among the independent examiners regarding the degree of stenosis was arbitrated and settled by means of angiographic review by 2 of the authors (Q.Y. and R.L.Z.). Locations of severe stenosis were categorized as being in the anterior or posterior circulation and in the intracranial or extracranial vessels. When a stenosis was present, they measured its degree and categorized it as mild (1%-29%), moderate (30%-69%), severe (70%-99%), or occlusion (100%).