Prevalences of Peripheral Arterial Disease Diagnosed by Computed Tomography Angiography in Patients with Acute Ischemic Stroke

Hiroyuki Naito, MD,*† Hiromitsu Naka, MD, PhD,* Megumi Kobayashi, MD,* Yuhei Kanaya, MD,*‡ Kasane Naito, MD,* Takashi Kurashige, MD, PhD,*§ Hiroshi Tokinobu, MD,* and Masayasu Matsumoto, MD, PhD†

Background: Few studies have examined the prevalence of peripheral arterial disease (PAD) with the use of computed tomography angiography (CTA) in patients with acute ischemic stroke (AIS), although several reports have examined its prevalence using an ankle brachial index (ABI). We aimed to determine the prevalence of PAD indicated by CTA in patients with AIS and to clarify the prevalence of PAD in each clinical ischemic stroke subtype. *Methods:* We included 199 consecutive patients with AIS admitted to our hospital and divided them into PAD and non-PAD groups according to the CTA findings. *Results:* Of the 199 patients, 40 (20.1%) had PAD; 27 (67.5%) of the PAD patients were asymptomatic. The prevalence of abnormal ABI (≤.9) was 12.2%. Patients with PAD were older (78.3 ± 10.2 versus 71.5 ± 10.9, $P < .001$) and had a significantly lower ABI value (.89 ± .24 versus 1.15 ± .09, $P < .001$) and higher prevalence of diabetes mellitus (50.0% versus 31.4%, $P = .028$), atrial fibrillation (40.0% versus 16.4%, $P = .001$), coronary artery disease (32.5% versus 8.2%, $P < .001$), and intracranial arterial stenosis (47.5% versus 28.9%, $P = .025$) than patients without PAD. The prevalence of cerebral microbleeds was not different between patients with PAD and those without PAD (25.6% versus 25.4%, $P = .985$). The prevalence of PAD among ischemic stroke subtypes was highest in patients with cardioembolic infarction (40.5%). *Conclusions:* Almost one fourth of the AIS patients examined had PAD on CTA. Cardioembolic infarction patients showed the highest prevalence of PAD among the clinical ischemic subtypes, suggesting the coexistence of atheromatous diseases and atrial fibrillation. **Key Words:** Acute ischemic stroke—ankle brachial index—computed tomography angiography—peripheral arterial disease.

From the *Department of Neurology, Hiroshima Prefectural Hospital, Hiroshima, Japan; †Department of Clinical Neuroscience and Therapeutics, Hiroshima University Graduate School of Biomedical and Health Sciences, Hiroshima, Japan; ‡Department of Neurology, National Hospital Organization Kure Medical Center, Hiroshima, Japan; and §Department of Neurology, Brain Attack Center Ota Memorial Hospital, Hiroshima, Japan.

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Address correspondence to Hiroyuki Naito, MD, Department of Clinical Neuroscience and Therapeutics, Hiroshima University Graduate School of Biomedical and Health Sciences, 1-2-3 Kasumi, Minami-ku, Hiroshima 734-8551, Japan. E-mail: hi-naito@outlook.jp.

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Introduction

Recently, cerebral vascular disease (CVD), coronary artery disease (CAD), and peripheral arterial disease (PAD) have been recognized not as individual entities but comprehensively as atherothrombosis.[1] The German Epidemiological Trial on Ankle Brachial Index study for elderly people aged 65 years or older reported that the presence of PAD with or without symptoms doubled the risk of stroke onset and increased the risk of myocardial infarction.[2] When Japanese patients with CVD were assessed for their cardiovascular onset rate 1 year later, the stroke onset rate was significantly higher in patients with PAD.[3] Various clinical studies, including the REACH Registry,[4] have clarified that the prevalence of PAD is 10%-20% in CVD patients and that the risk of CVD onset is higher in the presence of PAD regardless of whether symptoms are present.

Acute ischemic stroke (AIS) patients with PAD were also reported to have an increased cardiovascular risk and worsened prognosis.[5-7] Although previous reports have examined the prevalence of PAD in patients with chronic ischemic stroke in Japan,[8] there have been few reports on the prevalence of PAD in those with AIS.[9] Furthermore, all of the previous reports that described the association between CVD and PAD were based on ankle brachial index (ABI) abnormalities for the diagnosis of PAD; there have been no similar reports based on 3-dimensional computed tomography angiography findings. While some reports have examined the prevalence of PAD among clinical ischemic stroke subtypes, no studies have specifically examined branch atheromatous disease (BAD).

In the present study, we evaluated the prevalence of PAD diagnosed by computed angiography (CTA) in patients with AIS and examined the association between PAD and clinical ischemic stroke subtypes including BAD.

Methods

We conducted a hospital-based prospective study involving consecutive patients with AIS hospitalized in the Department of Neurology at the Hiroshima Prefectural Hospital between May 2013 and April 2015. The participants were eligible if they were hospitalized within 1 week of the onset of stroke with evidence of acute infarction on brain magnetic resonance imaging (MRI) and underwent CTA during hospitalization. The ethics committee of our institution approved the study protocol, and written informed consent was obtained from all included patients.

AIS was defined as the sudden onset of acute neurological deficits with evidence of acute infarction on brain MRI. The severity of the event was assessed according to the National Institutes of Health Stroke Scale (NIHSS) score. Stroke subtypes were classified on the basis of the Trial of Org 10172 in Acute Stroke Treatment (TOAST) classification.[10] Diagnosis of large-artery atherosclerosis required significant (>50%) stenosis of a large artery that was relevant to the infarct lesion. Cardioembolic infarction was diagnosed when a patient had at least 1 potential cardiac source of embolism based on the TOAST classification. Small-vessel occlusion was diagnosed when a patient presented with a classic lacunar syndrome, a small infarct lesion (<15 mm) in the perforating artery, no stenosis of a large artery, and no potential cardiac sources of embolism or large-artery atherosclerosis. Cases with other determined etiologies and undetermined cerebral infarctions were categorized as BAD and other cerebral infarction, respectively. BAD was defined as ischemic infarction in the perforator region with a diameter greater than 15 mm and visible as 3 or more lesions on an axial slice.[11] In addition, BAD cases showed no significant (>50%) large-artery stenosis and no potential sources of embolism.

Hypertension was diagnosed if the patient's blood pressure was 140/90 mmHg or higher, or if the patient had received any antihypertensive medication. Dyslipidemia was diagnosed if the patient had a low-density lipoprotein cholesterol level of 140 mg/dL or higher, triglyceride level of 150 mg/dL or higher, and/or a high-density lipoprotein cholesterol level lower than 40 mg/dL, according to the criteria established by the Japan Atherosclerosis Society,[12] or if the patient had a medical history of hypercholesterolemia. Diabetes mellitus was diagnosed as a fasting serum glucose level of 126 mg/dL or higher, a serum glucose level of 200 mg/dL or higher on 2 random measurements, an HbA1c level of 6.5% or higher, or a medical history of diabetes mellitus. Patients were classified as either current or noncurrent smokers. Intracranial arterial stenosis of 50% or more on magnetic resonance angiography or 3-dimensional computed tomography angiography was considered a significant finding. Carotid arterial stenosis of 50% or more was diagnosed by carotid magnetic resonance angiography, CTA, or carotid artery ultrasonography. Cerebral microbleeds (CMBs) were diagnosed by T2*-weighted MRI. CAD was defined as a history of angina pectoris or myocardial infarction, with or without coronary artery bypass surgery or percutaneous transluminal coronary angioplasty. Atrial fibrillation was diagnosed when a previous electrocardiogram or electrocardiogram monitoring performed on admission revealed atrial fibrillation.

ABI was measured using a noninvasive automatic pulse wave analyzer (form PWV/ABI; Colin Co. Ltd., Komaki, Japan) after a 5-minute rest in the supine position. According to the recommendations of the American Heart Association,[13] ABI was calculated as the ratio of the systolic pressure in the posterior tibial artery to the highest systolic pressure in the 2 brachial arteries. After the individual calibration process, blood pressure was measured simultaneously using cuffs on both upper limbs (brachial arteries) and lower limbs (posterior tibial arteries).