A Dilated Surface Appearance on Basiparallel Anatomic Scanning–Magnetic Resonance Imaging Is a Useful Tool for the Diagnosis of Spontaneous Vertebral Artery Dissection in Lateral Medullary Infarction

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Spontaneous dissection of the vertebral artery (VA) is a major vascular lesion causing lateral medullary infarction (LMI). A dilated surface appearance of the VA is a feature of VA dissection and can be observed on basiparallel anatomic scanning (BPAS)–magnetic resonance imaging (MRI). The aim of this study was to validate BPAS-MRI in the diagnosis of VA dissection in patients with LMI. The subjects of the present study were 41 consecutive patients with LMI within 7 days of onset. The diagnosis of VA dissection was made with the clinical criteria-based diagnosis. Percent (%) dilatation of the VA on BPAS-MRI was calculated by comparing the maximum surface diameter of the intracranial VA to the diameter of the distal normal surface of the VA. Fourteen patients (34%) were diagnosed with VA dissection. The optimal cutoff % dilatation of the VA for dissection was more than 169%. The sensitivity and specificity of % dilatation of VA more than 169% and aneurysmal dilatation, stenosis, or occlusion on magnetic resonance angiography (MRA) for VA dissection were 92.9% and 81.5%, respectively. BPAS-MRI combined with time-of-flight–MRA is a useful tool for the diagnosis of VA dissection in patients with acute LMI. **Key Words:** Acute stroke—lateral medullary infarction—vertebral artery—dissection—magnetic resonance imaging—magnetic resonance angiography.

Introduction

In Japan, the most common site of cervicocephalic arterial dissection is the intracranial vertebral artery (VA), according to a retrospective, multicenter, registration study (the Spontaneous Cervicocephalic Arterial Dissections Study [SCADS]),[1] whereas both the extracranial carotid and vertebral arteries are equally involved in Western countries.[2] VA dissection is the second most common cause of lateral medullary infarction (LMI) (14%-33%) after atherothrombosis of the VA or posterior inferior cerebellar artery.[3,4] Although dilatation of the outer wall of the VA is a feature of VA dissection associated with aneurysmal formation, regular magnetic resonance imaging (MRI) and magnetic resonance angiography (MRA) usually fail to demonstrate it because of the effect of blood flow or thrombus.

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Nagahata et al[5] modified the surface anatomic scanning–MRI technique and developed basiparallel anatomic scanning (BPAS)–MRI to observe the surface appearance of the intracranial vertebrobasilar artery. BPAS-MRI demonstrates the outer contour of the vertebrobasilar artery free from the effect of flow or thrombus. Because a dilated surface appearance of the VA with vessel stenosis on MRA has been described in a case report of LMI caused by VA dissection,[6] BPAS-MRI is a promising tool for screening for VA dissection in LMI patients.[7] However, the value of BPAS-MRI has not been determined in the diagnosis of LMI. The aim of the present study was to validate BPAS-MRI in the diagnosis of spontaneous VA dissection in patients with LMI.

Methods

Study Population

The subjects of the present study were 41 consecutive patients (60.6 ± 15.0 years old, 30 men) with acute LMI who were admitted to Kohnan Hospital Stroke Center (Sendai, Japan) between August 2006 and December 2012. All patients with acute stroke admitted to the center during this period were examined by neurologists, neurosurgeons, or both and screened by routine laboratory tests and computed tomography (CT) or MRI. Ischemic stroke was diagnosed by vascular neurologists (board-certified neurologists specializing in the care of stroke patients) based on the clinical and brain imaging findings. The clinical and investigative data, thus, prospectively collected in a standardized fashion were entered into the Kohnan Hospital Stroke Registry, in which 2950 patients with ischemic stroke were identified. The inclusion criteria for the present study were acute (within 7 days after onset) isolated LMI verified on MRI with diffusion-weighted imaging (DWI) during the hospital stay and at least one of the following acute neurological symptoms/signs because of LMI: limb ataxia, lateropulsion, Horner syndrome, dysphagia, and sensory disturbance. LMI associated with other VA territory infarcts were not included. Other exclusion criteria were histories of head trauma, coagulopathy, and cerebral angiitis.

MRI Study

DWI, BPAS-MRI, and time-of-flight (TOF)–MRA were performed at least once during the hospital stay with a 1.5-T unit (SIGNA EXCITE; GE Medical Systems, Milwaukee, WI). DWI was obtained using echo-planar imaging with b_{max} = 1000 s/mm^2, repetition time (TR) 8000 ms, echo time (TE) 76.3 ms, and field of view 18 × 18 mm. Cranial MRA was obtained using a 3-dimensional (3D) TOF technique. Imaging parameters were TR 29 ms, TE 6.9 ms, 20° flip angle, field of view 160 × 160 mm, 256 × 128 matrix, and 129 sections with a 1.2-mm effective thickness that resulted in the coverage of a volume of 77 mm in the craniocaudal direction. BPAS-MRI was performed in a 20-mm-thick coronal section parallel to the clivus using the fast spin-echo sequence. The following imaging parameters were used: TR 5000 ms, TE 760 ms, field of view 160 × 160 mm, 384 × 224 matrix. Acquisition time was 25 seconds. Gray-scale reversal was added in the postprocessing. The dilated appearance of the ipsilateral VA was viewed on the BPAS-MRI. When obtained on multiple occasions, the most dilated image during the hospital stay was used. Percent (%) dilatation of the VA was measured as % dilatation = $D_{dilatation}/D_{normal} \times 100$, where $D_{dilatation}$ = the maximum diameter of the intracranial surface of the ipsilateral VA and D_{normal} = the diameter of the distal ipsilateral VA at its non-tortuous normal segment on BPAS-MRI (Fig 1). Using a hand-held digital caliper, 1 investigator (R.I.), who was unaware of all clinical data, measured $D_{dilatation}$ and D_{normal} on BPAS-MRI. We addressed test–retest reliability of this method on randomly selected 20 patients. Intraclass correlation coefficient was .774 (95% confidence interval [CI]: .52-.90). We adopted the data from the first measurement for the analyses.

MRA performed simultaneously with BPAS-MRI was also reviewed, especially about aneurysmal dilatation, stenosis (presence of 50%-99% atherosclerotic stenosis using a method similar to the WASID method[8]), or occlusion of the ipsilateral VA.

Etiological Diagnosis

The diagnosis of VA dissection was made when 1 or more SCADS major criteria were present[1,9]: (1) "double

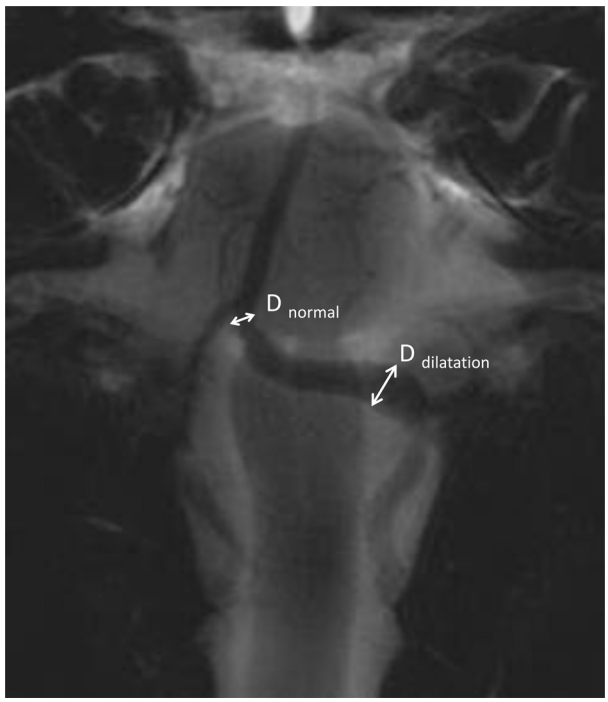

Figure 1. *% Dilatation of the VA on BPAS-MRI (% dilatation = $D_{dilatation}/D_{normal} \times 100$). Abbreviations: BPAS, basiparallel anatomic scanning; MRI, magnetic resonance imaging; VA, vertebral artery.*