Association between Microbleeds Observed on T2*-weighted Magnetic Resonance Images and Dysphagia in Patients with Acute Supratentorial Cerebral Hemorrhage

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Background: Approximately one-half of all patients with acute intracerebral hemorrhage (ICH) develop dysphagia that can lead to pneumonia or fatal outcomes; however, there are no reports about the relationship between swallowing function and cerebral microbleeds (CMBs) in these patients. Therefore, we investigated whether CMBs were associated with dysphagia in patients with ICH. *Methods:* A total of 100 patients (mean age, 65.1 ± 14.1 years; range, 36-95 years) with acute supratentorial ICH were included in this study. CMBs were detected on T2*-weighted magnetic resonance imaging performed during admission using a 1.5-T scanner (mean duration from onset to magnetic resonance imaging, 12.6 ± 8.4 days). We assessed swallowing function by using bedside swallowing assessments on admission and by monitoring the mode of nutritional intake at discharge in relation to the number and location of CMBs. *Results:* CMBs were detected in 60 of the 100 patients (60%) and were related to dysphagia. The number of CMBs and dysphagia were not related, but a significant relationship was observed in the presence of bilateral hematomas and CMBs. *Conclusions:* In addition to assessing just the presence or absence of CMBs, clinicians should identify the presence of bilateral or deep lesions in patients with ICH from the perspective of swallowing dysfunction. **Key Words:** Cerebral hemorrhage—cerebral microbleeds—dysphagia—neuroradiology—rehabilitation.

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Background

Dysphagia frequently is observed in patients who have suffered a stroke. It has been detected in 29%-81% cases in the acute phase[1,2] and is a known risk factor for complications such as aspiration pneumonia, dehydration, malnutrition, and suffocation.[3,4]

Lesions located in the brainstem, cerebral cortex, and subcortical structures such as the basal ganglia may be associated with dysphagia[5,6]; however, in clinical settings, it can be difficult to identify the number and location of the lesions responsible for dysphagia in recurrent cases and in cases with multiple lesions.

Within the central nervous system, T2*-weighted (T2*WI) magnetic resonance imaging (MRI) is commonly used to detect hemosiderin deposits; these manifest as small spots with attenuated signals and are referred to

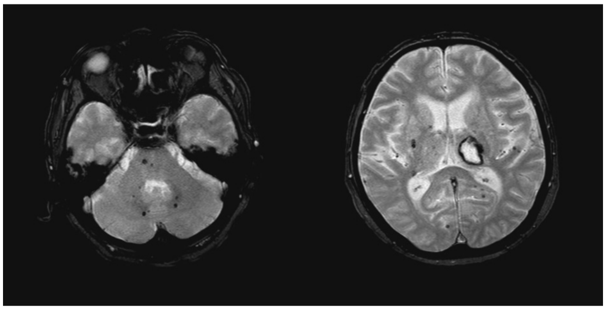

Figure 1. *Cerebral microbleeds in patients with intracerebral hemorrhage Gradient-echo T2*-weighted magnetic resonance imaging is used to detect hemosiderin deposits; these manifest as small spots with attenuated signals and are referred to as cerebral microbleeds in patients with stroke.*

as cerebral microbleeds (CMBs) in patients with stroke (Fig 1). Histopathologic analysis indicates that these hemosiderin deposits belong to red blood cells that have presumably leaked out of small brain vessels.[7] CMBs are found in a relatively high number of patients with spontanous intracerebral hemorrhage (ICH).[8,9] Because they have been considered as asymptomatic counterparts of ICH, few studies on the relationship between clinical symptoms and CMBs have been conducted. Some recent studies, however, have suggested that CMBs may contribute to clinical deficits.[10-12] Therefore, we investigated whether CMBs identified via the use of T2*WI MRI were associated with dysphagia in patients with acute ICH.

Methods

Procedures

Swallowing Assessment and Nutritional Intake

For the initial evaluation of bedside swallowing, the repetitive saliva swallowing test (RSST)[13] and modified water swallowing test (MWST)[14] were conducted by speech pathologists. These can be excellent screening methods for swallowing function and do not require the use of videofluoroscopy; the results are highly correlated with videofluoroscopy assessments.[13,14] In addition, these bedside swallowing assessments (BSAs) have been strongly recommended by the Japanese Guidelines for the Management of Stroke.[15] In this study, patients in the acute stroke phase were considered to have normal swallowing function if speech pathologists observed ≥3 swallows within 30 seconds during RSST and if they were assigned ≥4 points during MWST. On the other hand, patients were diagnosed with impaired swallowing if speech pathologists observed ≤2 swallows within 30 seconds during RSST and/or if they were assigned ≤3 points during MWST.

When the BSA results were normal, oral intake was initiated. If a patient experienced difficulties during these bedside tests, the speech pathologists re-evaluated swallowing function when the patient demonstrated an improvement. Oral intake was subsequently initiated when normal BSA findings were obtained, and the number of patients who could consume a regular diet at discharge was counted.

Computed Tomography/MRI

For each patient in this study, ICH was verified on admission by the use of plain computed tomography, and the hematoma volume was estimated using the ABC/2 formula (cm^3).[16] MRI was performed using a 1.5-T scanner (MAGNETOM Avanto; Siemens Japan, Tokyo). Gradient-recalled echo (GRE) MRI was performed in the axial plane using the following parameters: repetition time (TR), 729 ms; echo time (TE), 18 ms; flip angle, 20°; section thickness, 7 mm; gap width, 1.4 mm; matrix, 203 × 320; and field of view, 20.8 × 23 cm. Conventional MRI techniques such as axial T1-weighted imaging (TR, 460 ms; TE, 8.4 ms), axial fluid-attenuated inversion recovery imaging (TR, 8000 ms; inversion time, 2500 ms; TE, 88 ms), or axial fast spin-echo T2*WI (TR, 5000 ms; TE, 72 ms) were also performed with the same section thickness and matrix.

CMBs were defined as rounded areas of signal loss on GRE MRI (diameter, 2-10 mm). Two investigators blinded to clinical data reviewed the presence, number, and location of CMBs. Symmetrical hypointensities in the globus pallidus caused by calcification and flow void artifacts of the pial vessels were carefully excluded by the investigators.

In this study, unilateral hematomas without CMBs or unilateral hematomas with unilateral CMBs on the same side were defined as unilateral lesions, whereas unilateral hematomas with CMBs on the contralateral or both sides were defined as bilateral lesions. The severity of CMBs was graded as mild (total number of CMBs, 1-5), moderate (6-15), or severe (>15). The locations of CMBs were categorized according to cerebral regions: lobar (cortical gray and subcortical or periventricular white matter), deep (deep gray matter such as basal ganglia and thalamus and the white matter of the corpus callosum, internal, external, and extreme capsules), and infratentorial (brainstem and cerebellum).[17]

We examined the number of CMBs using T2*WI MRI and assessed the relationships with age, gender, hematoma volume, Canadian Neurological Scale (CNS) score, Mini-Mental State Examination (MMSE) score, vascular risk factors, length of hospitalization, pneumonia, swallowing function (BSA findings), and mode of nutritional intake at discharge.

Patients

This was an observational clinical study. We retrospectively analyzed data from 353 patients with ICH who were consecutively referred to our rehabilitation unit at the Saitama Medical University International Medical Center between January 2008 and December 2011. Subjects