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The relationship between cerebral T2 hyperintensity and fixation suppression of vestibulo-ocular reflex in elderly patients with dysequilibrium symptoms

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Abstract

Objectives: To evaluate the relationship between cerebral T2 hyperintensity on MRI and visual suppression of vestibulo-ocular reflex (VOR) in elderly patients with dysequilibrium symptoms.
Methods: Eighty-nine elderly patients with no MRI abnormalities in the infratentorial region aged 60–89 years complaining dysequilibrium symptoms were studied. Cases with whom a definitive diagnosis of peripheral or central disease could be established were not included. T2 hyperintense lesions in the cerebrum: basal ganglia, subcortical white matter and periventricular white matter were evaluated. VOR in darkness and fixation-suppressed VOR using pseudo-sinusoidal rotation stimuli were recorded to calculate visual suppression rate. Correlation between visual suppression rate and semi-quantitative scores for severity of T2 hyperintensity in the cerebrum was investigated.
Results: Patients with T2 hyperintensity in the cerebrum exhibited significantly lower visual suppression rate than those without lesions in the cerebrum. Multiple regression analysis showed that visual suppression rate was significantly and negatively correlated with severity of lesions in the basal ganglia, but not with patient age, severity of subcortical white matter lesions, or that of periventricular white matter lesions.
Conclusions: In elderly patients with dizziness with a non-specific history and otoneurological findings, fixation suppression of vestibular nystagmus was associated with T2 hyperintensities in the basal ganglia.

Keywords: Cerebrum; Ocular fixation; Small vessel disease

1. Introduction

Among elderly patients with dizziness, there are many cases in which clinical history is not specific, there are no otoneurological findings to clearly indicate either peripheral or central disease, and no obvious cardiovascular or cervical disorder is found. The symptom in elderly patients is often attributed to more than one factor, and cardiovascular and cervical diseases play more significant roles than in the other patients [1]. According to previous studies, in the general population, about 50% of patients with dysequilibrium had peripheral vestibulopathies, while 36% of geriatric patients had a cardiovascular cause and 23% had a central neurological cause [2,3]. It is not easy to evaluate radiological findings for the brain in these patients since a significant proportion of normal elderly individuals have ischemic changes, white matter lesions or atrophy of the brain [4].

Some previous studies have discussed possible relationships between dysequilibrium and radiological abnormalities of the cerebrum related to aging and other risk factors [5–11]. However, the correlation between oculomotor

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findings and cerebral abnormalities due to aging remains to be investigated. Since visual–vestibular interaction such as fixation suppression of vestibulo-ocular reflex (VOR) depends on various cerebral regions as well as the cerebellum and the brainstem, cerebral small vessel disease might be expected to affect it.

The purpose of this study is to investigate the pathological significance of these abnormal findings on MRI of the cerebrum in elderly patients with dizziness, through examining the relationship between cerebral T2 hyperintensity and disturbance of fixation suppression of VOR.

2. Patients and methods

At the Department of Otolaryngology, Matsue City Hospital, between January 2003 and May 2005, 155 patients with a complaint of dizziness were categorized as a difficult-to-diagnose group. In these patients, clinical history, general neurological examination and otoneurological examination (audiometry and observation of spontaneous and head reposition-evoked abnormal ocular movements) had failed to establish a definitive diagnosis of either peripheral vestibulopathy, central disease or other cardiovascular or cervical disease. Electrocardiogram, blood count and autonomic function testing for orthostatic dysregulation were also performed in selected cases when necessary, but without diagnostically useful findings. Vertebrobasilar insufficiency was a tentative diagnosis in all these patients. Ninety-seven among the 155 patients were over 60 years. However, 8 of these 97 patients later displayed detectable lesions in the cerebellum, pons or brainstem on MRI or MR-angiography, so that they were excluded from the present study. The remaining 89 patients (age: 60–89 years, mean 69.4 years) were the subjects of the present retrospective case review.

The methods of recording and analyzing VOR in darkness and fixation-suppressed VOR were described in a previous paper [12]. The stimulation mode was pseudo-sinusoidal, whole-body manual rotation of an ENT chair by the examiner around 0.5–0.8 Hz in frequency and 40–60° in amplitude (peak to peak). Head velocity and eye velocity in the horizontal plane were monitored and recorded with an infrared system (Nistamo21, J. Morita MFG. Corp., Kyoto, Japan), to analyze gain of VOR in darkness (Gd), that of fixation-suppressed VOR (Gf) and visual suppression rate ($V = (Gd - Gf)/Gd \times 100\%$). The patient was instructed to fixate on a circular target 1 cm in diameter situated 30 cm from the face moving with the head during a fixation suppression task. Each gain was analyzed by dividing eye velocity by head velocity. Details of methods of computing gain with the system were reported previously [13].

MRI of the brain was performed with a 1.5-T apparatus (MRT200, Toshiba Medical Systems Corp., Tokyo, Japan). T2-weighted axial and coronal section images were produced with a repetition time of 4000 ms, echo time of 111 ms, section thickness of 5 mm and gap of 0 mm. For axial sections, the most caudal slice transected the caudal part of the medulla, and the most cephalad one crossed the superior parts of the thalamus. Coronal sections scanned from the ventral surface of the midbrain to the posterior surface of the cerebellum. The size and number of T2 hyperintense lesions in the subcortical deep white matter,

Table 1
Method of semi-quantification of cerebral T2 hyperintensity on MRI

(a)

score	Subcortical white matter	Basal ganglia
0	no abnormalities	no abnormalities
1	≦ 3mm;n≦ 5	≦ 3mm;n≦ 5
2	≦ 3mm;n > 5	≦ 3mm;n > 5
3	4-10mm;n≦ 5	4-10mm;n≦ 5
4	4-10mm;n > 5	4-10mm;n > 5
5	> 10mm	> 10mm
6	confluent	confluent

(b)

score	Periventricular white matter		
	anterior caps	posterior caps	bands
0	no abnormalities	no abnormalities	no abnormalities
1	≦ 5mm	≦ 5mm	≦ 5mm
2	> 5mm	> 5mm	> 5mm

(a) Subcortical white matter and basal ganglia. (b) Periventricular white matter. Score for periventricular white matter lesion is obtained by summing the scores for anterior caps, posterior caps and bands.