

ORIGINAL ARTICLE

Neuro-otological findings in patients with very small (border zone) cerebellar infarcts

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Abstract

Conclusions. The symptoms and signs in patients with very small (border zone) cerebellar infarcts (VSCIs) may mimic those in benign peripheral vestibular disorders, except that smooth pursuit eye movement is disturbed in patients with VSCI. **Objectives.** VSCIs are located at the boundary territories between well-defined cerebellar arteries and are frequently manifested by dizziness or vertigo. The aim of the current study was to clarify the clinical characteristics of vestibular symptoms and signs associated with VSCI. **Patients and methods.** We studied the neuro-otological findings in five vertiginous patients, who were diagnosed as having VSCI based on magnetic resonance imaging (MRI). **Results.** Four patients complained of only dizziness or only vertigo, and one complained of dizziness with dysarthria. Horizontal spontaneous nystagmus and saccadic eye movement on eye tracking test were observed in all patients, but there were no abnormalities on examinations for saccade, optokinetic pattern, or visual suppression. Canal paresis was present in three patients.

Keywords: *Dizziness, vertigo, nystagmus, dysarthria*

Introduction

Dizziness or vertigo is the most common symptom of transient or persistent ischemia of the hindbrain, though it produces a complex and varied clinical presentation. When it occurs accompanied by its characteristic symptoms and signs, the clinical diagnosis is straightforward. However, the typical symptoms and signs are sometimes absent, especially in small infarcts in the upper brainstem [1] and the cerebellum [2–5], and the patient may complain of only dizziness or vertigo. In such cases, it is often difficult to differentiate this ischemia from other benign disorders involving the inner ear.

Magnetic resonance imaging (MRI) technology has enabled us to demonstrate very small (border zone) cerebellar infarcts (VSCIs), which are located at the boundary territories among the well-defined cerebellar arteries [6,7]. Some studies have shown that VSCIs are frequently accompanied by dizziness or vertigo, and are often associated with large artery or cardiac diseases [6,7]. However, their neuro-

otological findings have seldom been demonstrated. In this report, we describe the clinical presentation and neuro-otological findings in five patients with VSCI, and we discuss the essential elements in the diagnosis of VSCI.

Patients and methods

The patients consisted of four men and one woman whose ages ranged from 59 to 80 years. They were among 300 vertiginous patients we have examined since 1990, when we introduced MRI into the routine examination of elderly patients (60 years of age and over) with dizziness and vertigo because of the high incidence of ischemic brain disease in this age group [1,8–11]. Patients under 60 years old with suspected central vestibular disorders have also been examined with MRI.

We selected these five patients because they had an isolated very small infarct, <1 cm in diameter, in the border zone of the unilateral cerebellar hemisphere.

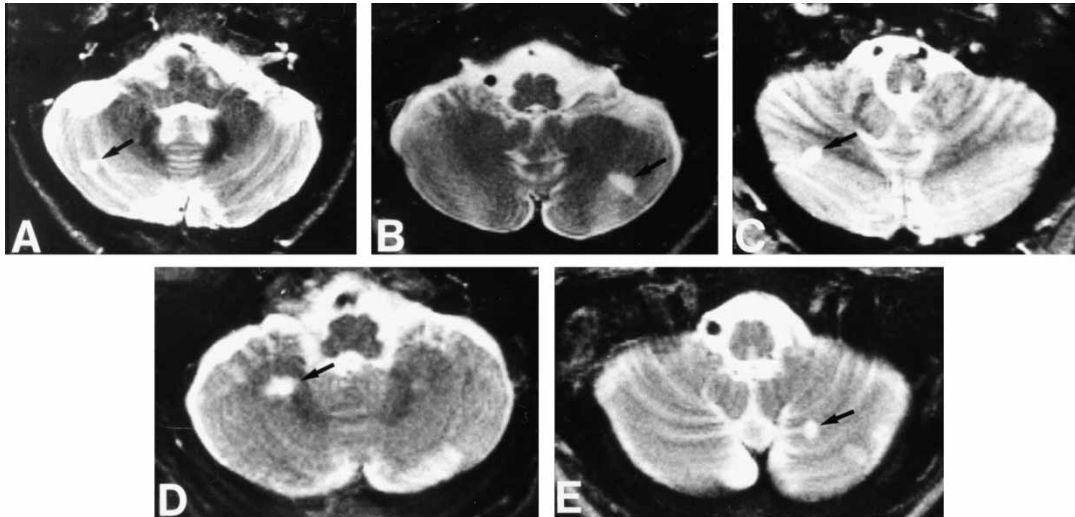


Figure 1. T2-weighted MRI in the five patients. Arrows indicate the very small cerebellar infarcts, which involve the deep white matter of the cerebellum and are located at the boundary area among the large cerebellar arteries. A through E correspond to patients 1 to 5, respectively.

We excluded patients with brainstem lacunae or large cerebral infarcts from the study.

The five patients had each visited our clinic within 1 week of the onset of symptoms and had undergone routine neuro-otological examinations. Electronystagmography (ENG) and MRI were performed at about 2 weeks after the onset. The neuro-otological tests, including ENG, were as follows: calibration and gaze test; eye tracking test (ETT); saccade test; optokinetic pattern test (OKP); observation for spontaneous, positional, and positioning nystagmus; caloric test; and visual suppression test (VS). MRI was performed using a superconducting 1.5 T MR system with slice thickness of 4 mm, and proton-density, T1-weighted and T2-weighted images were obtained in both the axial and coronal planes. In addition, using MRI, we also examined slow blood flow in the vertebrobasilar system and the vascular abnormalities in the vertebrobasilar arteries, such as dolichoectasia and narrowing of these arteries.

Results

The clinical and MRI findings in the five patients with VSCI are shown in Table I. Dizziness or vertigo was the only symptom in four patients, and the other patient complained of temporary dysarthria accompanied by dizziness. No patients were aware of any other central nervous symptoms such as ataxic gait. All patients showed bilateral high tone sensorineural hearing loss. However, no hearing laterality was found in any patient. Although spontaneous nystagmus disappeared within several days, patients usually complained of persistent dizzy sensation. Four patients had vascular risk factors, such as hypertension and atrial fibrillation. MRI disclosed atherosclerotic vascular changes in the vertebrobasilar system in three patients.

All VSCIs found in our patients involved the deep white matter of the cerebellum and were located at the boundary area among the anterior inferior (AICA), the posterior inferior (PICA), and the superior cerebellar artery (SCA) territories (Figure 1).

Table I. Background and MRI findings.

Patient no.	Age/ gender	Initial symptoms	Vascular risk factors	Side of infarct	Other abnormalities found in MRI
1	80 F	Dizziness	None	Left	Not found
2	67 M	Rotatory vertigo	Hypertension Atrial fibrillation	Right	Dolichoectasia of BA Slow blood flow in BA
3	59 M	Dizziness	Myocardial infarction	Left	Not found
4	76 M	Dizziness	Hypertension Diabetes mellitus	Left	Dolichoectasia and narrowing of BA
5	72 M	Dizziness	Hypertension	Right	Dolichoectasia and narrowing of BA Slow blood flow in BA

Patient 3 complained of temporary dysarthria with dizziness; however, dizziness or vertigo was the only symptom in the remaining four patients. Vascular risk factors were found in four patients and vascular abnormalities were observed in three patients. BA, basilar artery.

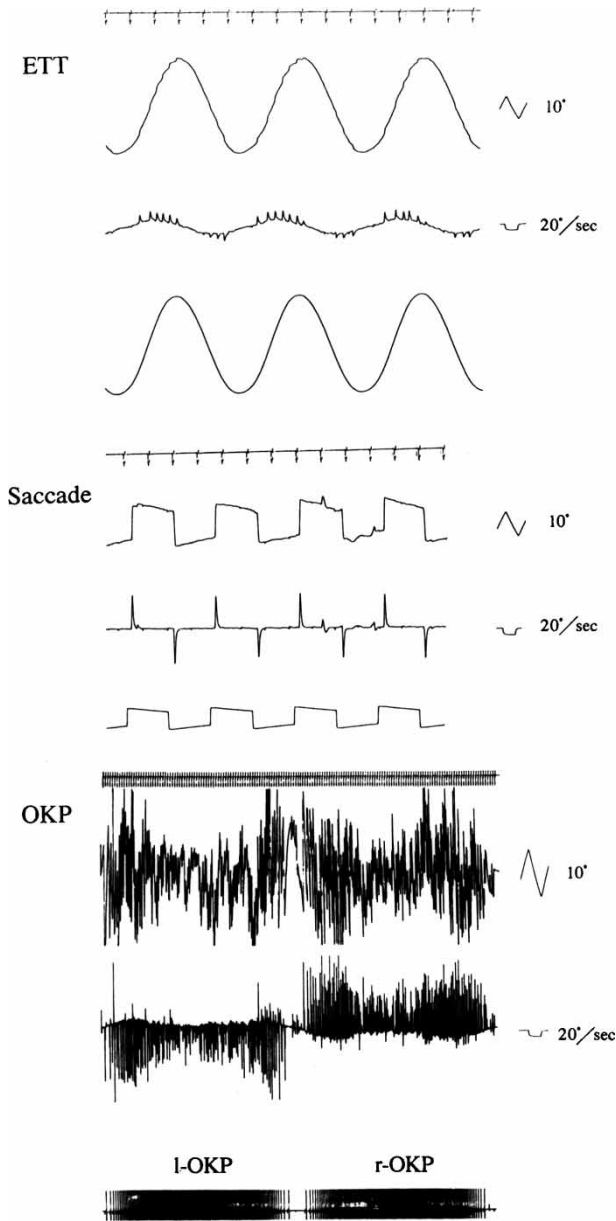


Figure 2. ENG findings in patient 1. Eye movement was slightly saccadic on the eye tracking test (ETT), however, no abnormalities were found on saccade test and optokinetic pattern test (OKP).

However, the VSCI did not involve the dentate nucleus, the cerebellar flocculus, or the cerebellar peduncles in any patient. MRI also disclosed atherosclerotic vascular changes in the basilar artery in three patients.

The ENG findings in patients 1 and 3 are presented in Figures 2 and 3, respectively. Although both patients showed saccadic eye movement, no abnormalities were found on saccade test and OKP. Table II summarizes the neuro-otological findings in the five patients. Horizontally beating spontaneous nystagmus was initially observed in all patients. The

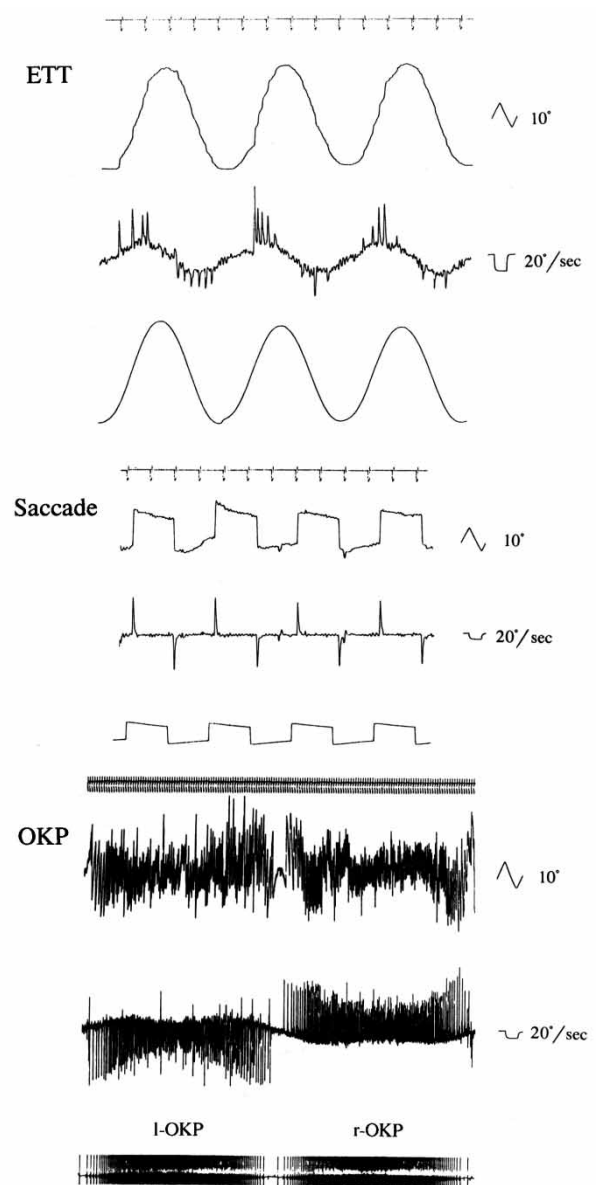


Figure 3. ENG findings in patient 3. Saccadic eye movement was observed on the eye tracking test (ETT). Saccade test and optokinetic pattern test (OKP) showed normal patterns.

direction of the spontaneous nystagmus was toward the lesion side in one patient and toward the contralateral side in four patients. The nystagmus subsided within several days, and no apparent nystagmus was recorded on ENG performed about 2 weeks after the onset of symptoms. Examinations with ENG disclosed saccadic eye movement on ETT in all patients, whereas no patient showed ocular dysmetria on saccade test, abnormal patterns on OKP, or reduced fixation suppression on VS. Caloric response was moderately decreased in the ear on the lesion side in two patients, and severely impaired in both ears in one patient.

Table II. Neuro-otological findings.

Patient no.	Spontaneous nystagmus	Eye tracking test	Saccade test	Optokinetic pattern test	Caloric test	Visual suppression test
1	Right-beating	Saccadic R >L	WNL	WNL	CP (L)	WNL
2	Right-beating	Saccadic R =L	WNL	WNL	CP (B)	Not done
3	Right-beating	Saccadic R >L	WNL	WNL	CP (L)	WNL
4	Right-beating	Saccadic R >L	WNL	WNL	WNL	WNL
5	Left-beating	Saccadic R =L	WNL	WNL	WNL	WNL

Spontaneous nystagmus was found in all patients and caloric response was decreased in three patients. Saccadic eye movement on eye tracking test was observed in all patients; however, no abnormalities were found on saccade test, optokinetic pattern test, and visual suppression test in any patient. CP, canal paresis (L, lesion side; B, both sides); WNL, within normal limits.

Discussion

VSCIs are localized between the territories of well-defined large cerebellar arteries and were classified into five groups according to the distribution by Amarenco et al [6]. According to that classification, the VSCIs found in our patients corresponded to group II border zone cerebellar infarcts, which involve the deep white matter of the cerebellum and are located at the boundary area among the AICA, the PICA, and the SCA territories [6].

Cerebellar border zone infarcts are reported to be often associated with cardiac or large artery diseases [6,7]. This association is found more frequently in very small infarcts involving the deep cerebellum than in those involving the cerebellar cortex [6]. In this study, arterial abnormalities in the posterior circulation were found in three patients and risk factors for atherosclerotic vascular diseases in four patients.

Four of our patients complained of only dizziness or vertigo, lacking the characteristic symptoms and signs of cerebellar infarcts. Only one patient developed dysarthria concurrent with dizziness. In this regard, VSCI can mimic benign peripheral vestibular disorders.

Cerebellar lesions can cause impaired pursuit tracking [12–14], dysmetric saccades [15,16], decreased slow-phase velocity in optokinetic nystagmus [16,17], and reduced fixation suppression of caloric-induced nystagmus [17]. Thus ENG has been used for the detection of cerebellar disorders. However, none of our patients showed any abnormalities on saccade test, OKP, or VS, and impaired pursuit on ETT was the only abnormal ENG result, suggesting the presence of central disorders. This observation suggests that voluntary saccade, optokinetic nystagmus, and visual fixation of induced nystagmus may not be impeded until the cerebellar lesion has become more extensive. Since smooth pursuit eye movement is also disturbed in other intracranial lesions [16] and even in normal elderly individuals [2,18], an abnormal finding on ETT is not specific to cerebellar disorders. However, ETT is helpful in the detection of VSCIs.

Three patients showed decreased caloric response, suggesting involvement of the peripheral vestibular system. Because the brainstem and the peripheral vestibular system, including the inner ear, are also supplied by the posterior circulation, they might also be affected simultaneously.

In conclusion, the symptoms and signs of VSCI may mimic those of benign peripheral vestibular disorders, except that smooth pursuit eye movement is disturbed in VSCI. When abnormal pursuit eye tracking is found in an elderly vertiginous patient with vascular risk factors, the presence of VSCI should be kept in mind. We recommend MRI for the detection of VSCI, because CT may not visualize these spotty cerebellar lesions. Since VSCIs are often associated with cardiac or large artery diseases and they may be precursors of large infarcts, patients with VSCIs should be followed up and treated to prevent more severe ischemic brain diseases.

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