

Vertigo of Cerebrovascular Origin Proven by CT Scan or MRI: Pitfalls in clinical differentiation from vertigo of aural origin

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To get a better insight into the clinical differentiation between vertigo of cerebrovascular origin and of aural origin, we investigated radiologically proven stroke patients who presented with vertigo as an initial clinical manifestation. Of 154 stroke patients, 30 patients with vertigo (20%) had the relevant lesion, demonstrated with the initial computerized tomographic scan (13 patients) or the follow-up magnetic resonance imaging (MRI) study (17 patients) of the brain. Every lesion was in the vertebrobasilar arterial territory; 19 in the cerebellum, 8 in the pons, and 3 in the medulla oblongata. Although 12 of the 30 patients (40%) presented with vertigo in isolation at the onset of stroke, eight patients (27%) developed additional neurologic abnormalities from four hours to seven days later. Patients with isolated vertigo (13%) had the small lesion exclusively in the cerebellum of the PICA medial branch territory. The most frequent accompanying neurological sign was swaying in the cerebellar and medullary lesion, and dysarthria in the pontine lesion. The direction of nystagmus or swaying did not match the lesion side in some patients. Our findings suggest that cerebellar stroke may commonly manifest isolated vertigo or vertigo with swaying mimicking labyrinthine disorder, particularly at the onset of the disease. MRI study and tests for truncal ataxia and lateropulsion may be crucial for the detection of vertigo of cerebrovascular origin.

Key Words: Vertigo, cerebrovascular disorders, cerebellum, MRI

Detection of vertigo of a cerebrovascular origin is important because it must be immediately treated as stroke (Norrving *et al.* 1995). Although the recognition of vertigo is not difficult, the clinical differentiation between peripheral vertigo and central vertigo is not always easy unless the vertigo is associated with certain neurologic signs suggestive of central origin. Some clinical guidelines have been suggested for

the differentiation of vertigo of cerebrovascular origin and aural origin (Duncan *et al.* 1975; Troost, 1980; Adams and Victor, 1993), but their clinical utility remains contentious (Guiang and Ellington, 1977; Feely, 1979; Rubenstein *et al.* 1980; Huang and Yu, 1985; Amarenco *et al.* 1990). Therefore, to get a better insight into this matter, we prospectively investigated the following in radiologically demonstrated stroke patients with vertigo with the following questions in mind: ① which lesion is frequently accompanied by vertigo, ② how often does vertigo occur in isolation, ③ which and when are other neurological abnormalities accompanied or followed by vertigo, and ④ how often are the direction

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of nystagmus and the side of falling the same as the radiological lesion side?

MATERIALS AND METHODS

We prospectively investigated stroke patients, admitted to Yonsei Medical Center from August 1994 to February 1995. Of these patients, those who presented with vertigo as an initial clinical manifestation were enrolled. Analyses were restricted to subjects who showed the relevant lesion on radiological studies. Every patient initially had a computerized tomographic (CT) scan of the brain and was examined with follow-up magnetic resonance imaging (MRI) when normal results were obtained on the initial CT scan. Tests of standing, walking, and tandem walking were included in the evaluation of every patient. Isolated vertigo was defined when a patient did not show any other neurological symptoms and signs except vertigo with or without nystagmus. Patients presenting with definite swaying or a tendency to fall were considered to have an additional neurologic sign. We carefully checked the neurologic symptoms and signs other than vertigo. The direction of nystagmus and the side of falling were also checked and were compared with the radiological lesion side.

RESULTS

Characteristics of patients

One hundred fifty-two patients with stroke were admitted. Of these patients, 30 patients (20%) who presented with vertigo, had relevant lesions on radiological studies. Relevant lesions on the initial CT scan were found in 13 patients. MRI follow-up verified lesions in the other 17 patients. The mean age of the 30 patients was 59.1 years, and the man/woman ratio was 17/13. Patients were classified as atherothrombotic infarction in 18; cardioembolic infarction in 4; lacunar infarction in 2; un-

certain etiology in 4; and intracerebral hemorrhage in 2.

Location and vascular territory

Each patient with vertigo had a lesion in the posterior fossa, distributed by the vertebrobasilar artery. Nineteen patients had the lesion in the cerebellum, 8 in the pons, and 3 in the medulla oblongata. All of the 18 patients with cerebellar infarctions had lesions in the vascular territory of the posterior inferior cerebellar artery (PICA); 17 in the territory of PICA, and 1 in the territory of both PICA and the anterior inferior cerebellar artery (AICA). One patient had a small hemorrhage in the inferior medial portion of the cerebellum, which was also presumed to be in the territory of PICA.

Neurological manifestations

Four patients had isolated vertigo, 8 had initial vertigo followed by other neurological abnormalities from 4 hours to 7 days, and 18 had vertigo with other neurological abnormalities from onset. Isolated vertigo was found only in the cerebellar lesions (3 infarction, 1 hemorrhage), while each patient with vertigo who had a lesion in the brainstem (8 pons, 3 medulla oblongata) was associated with or followed by certain neurological abnormalities (Fig. 1).

Associated neurological abnormalities in-

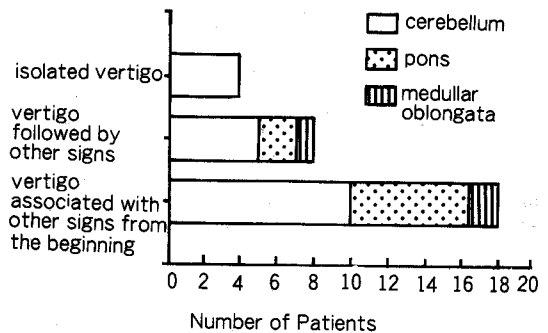


Fig. 1. The frequency of vertigo in isolation, followed by, or associated with other neurological abnormalities according to the site of the lesion.

Table 1. Frequency of associated neurological abnormalities in stroke patients with vertigo

	Cerebellum	Pons	Medulla oblongata
Swaying only	7		
Swaying plus other sign	8	1	3
Limb ataxia	6	2	2
Dysarthria	3	6	1
Hemiparesis		4	
Loss of consciousness	2		
Dysphagia		2	
Facial weakness		2	
Sensory change		2	
Diplopia		1	1

cluded swaying (19 patients), limb ataxia (10 patients), dysarthria (10 patients), hemiparesis (4 patients), loss of consciousness (2 patients), dysphagia (2 patients), facial weakness (2 patients), sensory change (2 patients), and diplopia (2 patients) (Table 1). Swaying was the only accompanying sign in 7 patients with cerebellar stroke (Table 1).

Direction of nystagmus and swaying

Nystagmus was detected in 17 patients. The directions of nystagmus were against the lesion side in 3 patients (2 cerebellum, 1 pons), and were on the same side with the lesion in the other patients. Four of the 19 patients with swaying, showed a tendency to fall to the side against the lesion and the other 15 patients showed a tendency to fall to the side of the lesion. These findings are summarized in Table 2.

DISCUSSION

We found that the frequency of vertigo of cerebrovascular origin was in about 20 percent of the total number of admitted stroke patients. This suggests that vertigo

Table 2. Direction of nystagmus and swaying compared with the lesion side

	Cerebellum	pons	medulla oblongata
Direction of nystagmus			
Same	11	1	2
Opposite	2	1	
Direction of swaying			
Same	12		3
Opposite	3	1	

as a manifestation of stroke may not be an infrequent symptom. Every relevant lesion was found in the distribution of the vertebrobasilar artery, most commonly in the cerebellum. Surprisingly, all cerebellar lesions encompassed the PICA territory. The invariable involvement of PICA in our study may be attributable to the preponderance of PICA involvement in cerebellar infarctions (Sybert and Alvord, 1975) as well as to the predominant presentation of vertigo in patients with stroke involving PICA (Duncan *et al.* 1975; Grad and Baloh, 1989), which supplies the flocculonodular lobe and inferior vermis with abundant vestibular connections (Fernandez and Fredrickson, 1964).

Adams and Victor (1993) postulate that vertigo as the sole manifestation of disease of the vertebrobasilar system is so rare that it nearly always excludes vascular disease of the vertebrobasilar system unless other symptoms and signs of vertebrobasilar disorder appear within one or two weeks. In contrast to their suggestion, it has been described that isolated vertigo may sometimes be caused by such potentially serious conditions as cerebellar infarction or impending basilar artery occlusion (Fisher, 1967; Guiang and Ellington, 1977; Feely, 1979; Rubenstein *et al.* 1980; Huang and Yu, 1985; Amarenco *et al.* 1990). In our study, four patients (13%) manifested isolated vertigo. They had a small lesion exclusively in the cerebellum of the PICA medial branch territory, which cor-

roborated with the previous notion in unselected cases that vertigo may be the only presenting symptom in some patients with PICA territory infarction (Amarenco *et al.* 1990). Moreover, twelve of the 30 patients (40%) manifested with vertigo in isolation at the onset of stroke, although eight patients (27%) developed additional neurologic abnormalities from four hours to seven days later. Our results suggest that the absence of associated neurological abnormalities in patients with vertigo does not provide an effective clinical clue to exclude vertigo of cerebrovascular origin, especially at the onset of the disease.

The frequency of isolated vertigo in stroke has rarely been described. Grad and Baloh (1989) reported that, in their retrospective study, 12 of the 42 patients (29%) with infarction in the territory of the vertebrobasilar artery had isolated vertigo from one day to two years before the infarction. Recently, Norrving *et al.* (1995) reported that one fourth of elderly patients with isolated vertigo had cerebellar infarctions. Isolated vertigo was less frequently observed in our study (13 %). Although we could not directly compare the results of our study with those of previous studies because of differences in study design, we believe that vertigo not infrequently manifests in isolation in patients with stroke.

The most common signs accompanying vertigo were swaying, nystagmus, limb ataxia, dysarthria, and hemiparesis, in that order of frequency. Facial weakness, sensory change, loss of consciousness, and diplopia were less commonly accompanied by vertigo. Fisher (1967) reported that the most common accompaniments of dizziness as initial signs in patients with basilar occlusion were diplopia, dysarthria, and weakness, in this order of frequency. Grad and Baloh (1989) mentioned that visual symptoms including diplopia were most frequently accompanied by vertigo in patients with vertebrobasilar insufficiency. The discrepancy between previous studies and ours may be attributable to differing study design and group. We included pa-

tients who had the relevant lesion demonstrated with brain CT scan or MRI study, while their diagnoses of stroke were based on the clinical history and examination. The advent of CT scan and MRI enabled the visualization of small lesions, especially in the posterior fossa (Bogousslavsky *et al.* 1986; Simmons *et al.* 1986), thus enabling the diagnosis of small cerebellar stroke, mimicking the benign labyrinthine disorders. Frequency of swaying might be underestimated in their studies because it is sometimes difficult to differentiate between small cerebellar stroke manifesting vertigo with minor swaying and the labyrinthine disorders, based on the clinical history and examination.

The different patterns of accompanying neurological abnormalities were evident according to the site of the lesion. Swaying or lateropulsion were most commonly accompanied by vertigo in cerebellar and medullary stroke. The most striking feature in patients who had the lesion in the cerebellum was the overwhelming tendency of association with swaying or lateropulsion (15 patients). About a half of them (7 patients) presented only with vertigo and swaying, mimicking the labyrinthine disorders. Limb ataxia was not a prominent feature. In contrast to cerebellar stroke, dysarthria was the most common accompanying symptom or sign in patients with pontine stroke. Seventy-five percent of patients with pontine stroke had accompanying dysarthria, while only 3 of the 19 patients with cerebellar stroke showed dysarthria. In some patients with vertigo, examination for truncal or gait ataxia may be omitted, simply because those tests exacerbate symptoms (Norrving *et al.* 1995). However, our findings of frequent association with swaying highlighted the importance of these tests. Although swaying may occur in peripheral vertigo as well as in central vertigo (Duncan *et al.* 1975), our observation was that patients with cerebellar stroke showed more severe and lateralizing swaying than ones with peripheral vertigo. We therefore suggest that

tests for truncal ataxia and lateropulsion should be performed along with every effort to find additional neurological signs in patients with vertigo, especially in those who have risk factors for stroke.

To differentiate between peripheral and central vertigo, particular attention is directed to the direction of nystagmus and swaying. Duncan *et al.* (1975) postulate that nystagmus is in the direction towards the side of the lesion in central vertigo, and is in the opposite direction in peripheral vertigo. Contradictorily, Huang and Yu (1985) reported that 3 of their 5 patients with cerebellar infarcts showed nystagmus in the opposite direction to the side of the lesion. In our study, the direction of nystagmus was against the side of the lesion in 3 of the 18 patients, mimicking peripheral vertigo. Duncan *et al.* (1975) also suggest that patients with central vertigo show a tendency to fall towards the side of the lesion. However, in our study, the direction of swaying was against the side of the lesion in 4 of the 19 patients. Our findings suggest that we can not solely rely on the direction of nystagmus to diagnose central vertigo, and on the direction of swaying to localize the side of the lesion.

In conclusion, our findings of the frequent cerebellar involvement and the overwhelming accompaniment of swaying in stroke patients with vertigo highlight the importance of tests for truncal ataxia and lateropulsion. Our findings also suggest that clinical guidelines to differentiate central vertigo from peripheral vertigo, such as the presence or absence of accompanying signs and the direction of nystagmus or swaying, should be cautiously applied to patients with vertigo. MRI study may be mandatory in patients who are prone to stroke, because some cerebellar stroke may manifest vertigo in isolation, mimicking benign labyrinthine disorders.

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