International Tinnitus Journal, Vol. 15, No. 2, 193–195 (2009)

Correlation Between Arteriosclerotic Changes and Prognosis in Patients with Peripheral Vestibular Disorders

Masaoki Wada, Hideaki Naganuma, Koji Tokumasu, and Makito Okamoto
Department of Otolaryngology, School of Medicine, Kitasato University, Kanagawa, Japan

Abstract: Symptoms such as vertigo and unsteady gait occur in various diseases and are among the relatively common chief complaints. Even at present, the mechanisms underlying these disorders are unclear. We report a significant correlation between a prolonged period of resolution of benign paroxysmal positional vertigo (BPPV) and histories of lifestyle-related illnesses. We consider the possibility of correlating between BPPV prognosis and arteriosclerotic changes. Using carotid ultrasonography, we examined maximum intima-media thickness (IMT), maximum common carotid artery IMT, and biochemical examinations in 105 patients with peripheral vertigo. We divided patients with BPPV into groups with and without abnormal thickness of the IMT. The maximum IMT was 1.35 mm in patients with peripheral vestibular disorders. The proportion of peripheral vestibular disorder patients with a maximum IMT of ≥1.1 mm (i.e., thickening) was 58%. The rate at which the feeling of positional vertigo remained at the halfway point in the observation period was significantly higher in the group of patients with an IMT of ≥1.1 mm ($p = .0007$). Our results indicate that cervical ultrasonography is useful for noninvasive examination of arteriosclerotic changes in patients with peripheral vestibular disorders. We saw indications that such patients show progression of arteriosclerotic changes. This study suggested that the arteriosclerotic change was related to prognosis.

Key Words: atherosclerosis; benign paroxysmal positional vertigo (BPPV); intima-media thickness; prognosis

Symptoms such as vertigo and unsteady gait occur in various diseases and are among the relatively common chief complaints. In our otorhinolaryngology department, patients with chief complaints of vertigo and unsteady gait—considered to be attributable mainly to peripheral vestibular disorders—are routinely examined and treated. Typical examples of peripheral vestibular disorders are benign paroxysmal positional vertigo (BPPV), Ménière's disease, and vestibular neuronitis. Currently, the mechanisms underlying these disorders are unclear. Therefore, a sizable number of patients have experienced distress in treatment. However, we reported [1] that patients with peripheral vestibular disorders show progression of arteriosclerotic changes. Also, we reported a significant correlation between a prolonged period until resolution of BPPV and histories of lifestyle-related illnesses, including hypertension and hyperlipemia [2]. We considered the possibility of correlating BPPV prognosis with arteriosclerotic changes.

We examined patients with peripheral vestibular disorders for the presence or absence of hypertension, diabetes mellitus (DM), and lipid abnormalities and determined carotid artery intima-media thickness (IMT) by carotid (arterial) ultrasonography. IMT can be determined simply and noninvasively by ultrasonography and is regarded as a nonspecific indicator of systemic arteriosclerosis promoted by various factors, including hypertension, DM, lipid abnormalities, and aging. Previous studies have shown cross-sectional associations between IMT and cardiovascular risk factors and the prevalence of cardiovascular disease [3–5].

However, only one report has considered IMT thickness in patients with peripheral vestibular disorders [1].

Reprint requests: Masaoki Wada, MD, 1-15-1 Kitasato, Sagamihara, 228-8555 Kanagawa, Japan. Phone: +81 42 778 8111; Fax: +81 42 778 9371; E-mail: mitarashi2007@yahoo.co.jp

We examined arteriosclerotic changes with B-mode ultrasonographic images of the carotid artery, and we examined the relation of IMT to the recovery period for patients with BPPV, a representative disease of peripheral vestibular disorders.

We divided patients with BPPV into groups with and without an abnormally thick IMT and discussed the relation of IMT to the rate of a residual feeling of positional vertigo.

PATIENTS AND METHODS

Our subjects were 110 patients who had been examined at Kitasato University Hospital between April 2007 and December 2008 and reported vertigo and unsteady gait as chief complaints. They had diagnoses of peripheral vestibular disorders based on comprehensive evaluation of magnetic resonance imaging (MRI) findings, neurological findings, presence of nystagmus, and equilibrium test findings. We diagnosed peripheral vestibular disorders by the following: (1) a clinical history of clearly defined rotational vertigo or presence of spontaneous nystagmus, (2) normal results in the eye-tracking test, (3) absence of a structural abnormal lesion on MRI, and (4) absence of any central nervous system symptom. Within 1 month after our initial examination, we conducted ultrasonography and MRI.

At the initial examination, we determined serum total cholesterol, low-density lipoprotein (LDL) cholesterol, high-density lipoprotein (HDL) cholesterol, triglycerides, blood glucose levels, and HbA1c. When fasting blood glucose was ≥126 mg/dl, nonfasting blood glucose was ≥200 mg/dl, or HbA1c was ≥6.5%, we rendered a diagnosis of DM. When total cholesterol was ≥220 mg/dl, LDL cholesterol was ≤140 mg/dl, or HDL cholesterol was ≤40 mg/dl, the diagnosis was determined to be hypercholesterolemia. When systolic blood pressure was ≥140 mmHg or diastolic blood pressure was ≥90 mmHg, the patient was determined to have hypertension.

We conducted cervical ultrasonography with SSD-5500 (Aloka Co., Ltd., Tokyo) with a B-mode linear probe (15 MHz) in all patients. We conducted the test with patients in a supine position. The maximum IMT was defined as the maximum thickness of the blood vessel wall in the area of the common carotid artery (CCA). When IMT was ≥1.1 mm, the diagnosis was abnormal blood vessel wall thickening. We obtained all B-mode ultrasonographic images of the carotid artery with an Aloka SSD-5500 system with a 15-MHz probe.

The protocol involved obtaining a single longitudinal lateral view of the distal 10 mm of the right and left CCA and three longitudinal views (anterior-oblique, lateral, and posterior-oblique) of each internal carotid artery. The internal carotid artery was defined as including the carotid bulb. When an inner carotid region had a thickening, we measured the inner carotid artery. Maximum IMT (max IMT) was defined as the single thickest wall of the far right and left walls of the CCA and internal carotid artery. Maximum CCA IMT (max CCA IMT) was defined as the thickest wall of the far right and left walls of the CCA. In addition, we defined a thickness of ≥1.1 mm as abnormal.

We evaluated the rate of a residual feeling of positional vertigo at the halfway point in the observation period in patients with BPPV who had an IMT of ≥ 1.1 mm or of <1.0 mm. The data were analyzed by the Kaplan-Meier method. We considered p values of <.05 to be significant.

RESULTS

Table 1 shows clinical data for patients with peripheral vestibular disorders (N = 110). As regards the rate of a residual feeling of positional vertigo at the halfway point in the observation period in patients with BPPV, the rate was significantly higher in the group of patients with an IMT of ≥1.1 mm than in those with an IMT of <1.0 mm (p = .0007).

DISCUSSION

The present cross-sectional study suggests that the rate of a residual feeling of positional vertigo at the halfway point in the observation period correlates with max IMT in patients with BPPV. However, as this study is not prospective, the results must be interpreted cautiously.

Carotid ultrasonography, a noninvasive examination for arteriosclerotic changes, is useful for determining max IMT and max CCA IMT. According to the determination guidelines established by the Japanese Society

Table 1. Clinical Data Regarding Peripheral Vestibular Disorders in Patient Group (N = 110)

Gender, male	n = 42 (38%)
Age	62.8 ± 11.0 yr
Hypertension	n = 53 (48%)
Diabetes mellitus	n = 31 (28%)
Hypercholesterolemia	n = 72 (65%)
Serum total cholesterol	227.7 ± 36.9 mg/dl
Serum HDL cholesterol	63.7 ± 15.2 mg/dl
Serum LDL cholesterol	140.6 ± 35.4 mg/dl
Serum triglycerides	157.2 ± 96.2 mg/dl
Serum HbAlc	5.64 ± 0.85%
Max IMT	1.35 ± 0.77 mm
Max CCA IMT	1.03 ± 0.58 mm
Abnormal thickening (max IMT ≥1.1 mm)	n = 64 (58%)

HDL = high-density lipoprotein; LDL = low-density lipoprotein; Max IMT = maximum intima-media thickness; Max CCA IMT = maximum common carotid artery intima-media thickness.

for Ultrasonography, normal values of both max IMT and max CCA IMT are <1.1 mm. The max IMT was 1.35 mm in the patients with peripheral vestibular disorders.

The proportion of patients with peripheral vestibular disorders with max IMT ≥1.1 mm (i.e., thickening) was 58%. It can be said that this group (i.e., peripheral vestibular disorder patients as a whole) showed progression of arteriosclerotic changes when evaluated using max IMT as the indicator because normal max IMT is <1.1 mm.

Watanabe et al. [6] reported that monocytic active oxygen production is significantly increased in those with a max IMT ≥1.1 mm, as compared to subjects with a max IMT <1.1 mm. Oxidative stress, such as active oxygen species, is known to play an important role in the morbid condition of cardiovascular disorders. This finding is expected to lead to elucidation of the mechanisms underlying cardiovascular disorders in patients with progressive arteriosclerosis with a max IMT ≥1.1 mm.

Our results indicate that cervical ultrasonography is useful for noninvasive examination of arteriosclerotic changes in patients with peripheral vestibular disorders. They also indicate that patients with peripheral vestibular disorders show progression of arteriosclerotic changes. This study further suggests that the arteriosclerotic change was related to the rate of a residual feeling of positional vertigo at the halfway point in the observation period in patients with BPPV.

These observations indicate that precise evaluation and treatment of arteriosclerotic changes, which are present as background factors in patients with peripheral vestibular disorders, can reduce the risk of cerebral infarction, cerebral hemorrhage, myocardial infarction, and angina pectoris and can improve the prognosis in peripheral vestibular disorders.

REFERENCES

1. Wada M, Naganuma H, Tokumasu K, et al. Arteriosclerotic changes as background factors in patients with peripheral vestibular disorders. *Int Tinnitus J* 14(2):131–134, 2008.
2. Wada M, Naganuma H, Tokumasu K, Okamoto M. Inner ear function test in cases of posterior canal type benign paroxysmal positional vertigo. *Int Tinnitus J* 15(1):91–93, 2009.
3. O'Leary DH, Polak JF, Kronmal RA, et al. Carotid-artery intima and media thickness as a risk factor for myocardial infarction and stroke in older adults: Cardiovascular Health Study Collaborative Research Group. *N Engl J Med* 340: 14–22, 1999.
4. Kitahara A, Iso H, Imano H, et al. Carotid intima-media thickness and plaque characteristics as a risk factor for stroke in Japanese elderly men. *Stroke* 35:2788–2794, 2004.
5. Bots ML, Hoes AW, Koudstaal PJ, et al. Common carotid intima-media thickness and risk of stroke and myocardial infarction: The Rotterdam Study. *Circulation* 96:1432–1437, 1997.
6. Watanabe T, Yasunari K, Nakamura M, Maeda K. Carotid artery intima-media thickness and reactive oxygen species formation by monocytes in hypertensive patients. *J Hum Hypertens* 20:336–340, 2006.