Original Article / Çalışma - Araştırma

An investigation of atherosclerotic markers in patients with posterior semi-circular canal benign paroxysmal positional vertigo

Arka yarı dairesel kanal benign paroksismal pozisyonel vertigolu hastalarda aterosklerotik belirteçlerin araştırılması

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Objectives: This study aims to investigate the presence and incidence of arteriosclerosis in patients with benign paroxysmal positional vertigo (BPPV).

Patients and Methods: A total of 89 patients who were admitted to the ear, nose, throat outpatient clinic with complaint of vertigo and were diagnosed with BPPV based on the positive Dix-Hallpike test results were included (BPPV group) between January 2010 and July 2010. Data from otological asymptomatic controls (n=129) who were referred to the radiology department from other clinics for ultrasound examination were obtained. Intima-media thickness and arteriosclerosis measurements were carried out. Arteriosclerosis measurement was performed through a Doppler ultrasound.

Results: No statistically significant difference in carotid, femoral intima-media thicknesses and elastic modulus measurements between the controls and BPPV group. In the BPPV group, carotid artery cross-sectional compliance, cross-sectional distensibility, femoral artery cross-sectional compliance and cross-sectional distensibility were statistically significantly lower.

Conclusion: Our study results suggest that atherosclerotic changes may play a role in the underlying etiology of BPPV.

Key Words: Arteriosclerosis; benign paroxysmal positional vertigo; intima-media thickness.

Amaç: Bu çalışmada benign paroksismal pozisyonel vertigo (BBPV) olan hastalarda arteriyoskleroz varlığı ve insidansı araştırıldı.

Hastalar ve Yöntemler: Ocak 2010 ve Temmuz 2010 tarihleri arasında vertigo yakınması ile kulak, burun, boğaz polikliniğine başvuran ve pozitif Dix-Hallpike test sonucuna göre BPPV tanısı konan toplam 89 hasta (BPPV grubu) çalışmaya alındı. Diğer kliniklerden ultrason incelemesi için radyoloji kliniğine sevk edilen otolojik asemptomatik kontrollerin verileri elde edildi. İntima-media kalınlığı ve arteriyoskleroz ölçümleri yapıldı. Arteriyoskleroz ölçümü Doppler ultrason ile yapıldı.

Bulgular: Karotis, femoral intima-media kalınlığı ve elastik modülüs ölçümleri açısından kontroller ve BPPV grubu arasında istatistiksel olarak anlamlı bir fark yoktu. Karotis arter çapraz kesitsel uyum, çapraz kesitsel distansibilite, femoral arter çapraz kesitsel uyum ve çapraz kesitsel distansibilite BPPV grubunda istatistiksel anlamlı olarak daha düşüktü.

Sonuç: Çalışma bulgularımız, aterosklerotik değişikliklerin BPPV'nin altta yatan etyolojisinde bir rolü olabileceğini göstermektedir.

Anahtar Sözcükler: Arteriyoskleroz; benign paroksismal pozisyonel vertigo; intima-media kalınlığı.

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Vertigo is a disruption of vertical orientation or an illusion of movement. Benign paroxysmal positional vertigo (BPPV) is a common entity and is a component of peripheral vestibular disorders, which are especially encountered with an older patient.[1] Since the underlying pathophysiological mechanism of vertigo cannot be explained precisely,[2] the intended success of patient treatment is sometimes not achieved. Sunami[3] claim that there may be a relationship between BPPV recurrence and diseases such as hypertension and hyperlipidemia which are associated with certain life styles. Wada et al.[4] report that there is a significant correlation between BPPV, which requires long-term treatment, and diseases such as hypertension and hyperlipidemia. Results of the recent studies suggest that there may be a relationship between arteriosclerosis, which accompanies diseases associated with certain life styles, and BPPV.

Numerous methods have been developed in order to determine the existence and prevalence of arteriosclerosis. Noninvasive intima-media thickness (IMT) and arterial stiffness measurements are among the most common methods.[5,6] The factor that causes mechanical stress in the physiology of arterial structures is called pressure. While the changes in the diameter due to pressure are called strain. The relationship between these two physiological conditions reflects arterial elasticity or stiffness. Quantitative counterparts of elasticity and stiffness are compliance and distensibility. Distensibility implies proportional changes due to an increase in pressure while compliance implies the absolute changes in diameter due to the increase in pressure.

This study aims to investigate the existence or frequency of arteriosclerosis through non-invasive methods on patients who were referred to ear nose and throat (ENT) clinics with BPPV by measuring IMT and arterial stiffness in carotid and femoral arteries.

PATIENTS AND METHODS

Ethical approval was obtained from the Ethics Committee of our institution and patient consents were obtained.

Patients that were referred to ENT clinics with vertigo were compiled in the first half of 2010. Patients that were clinically diagnosed with BPPV with normal results during routine audiological, biochemical, and imagining tests and positive Dix-Hallpike tests were included in this study. Otological asymptomatic control group data was obtained by getting permission from cases referred to the radiology department for ultrasound (US) examination who did not demonstrate any pathology in their US examinations.

Body mass index (BMI) and waist hip ratio (WHR) were assessed in all cases. Intima-media thickness was measured in all the cases. Arterial stiffness measurements were taken as follows:

Measurements were carried out 2 cm before the right carotid artery bifurcation and 2 cm after the deep branch division of the right femoral artery.

All non-invasive measurements were made by the same investigator, who used and a US imager [SSA-660A (Xario), PLT-704AT Prob, (Toshiba Medical Systems Corporation, Tochigi, Japan)]. Intima-media thickness, lumen diastolic (dD) and systolic (sD) diameters were measured at the common carotid and femoral arteries according to the previously described procedure.[7]

The lumen cross-sectional area was calculated as $\pi dD^2/4$ and the wall cross-sectional area as $\pi(dD/2+IMT)^2-\pi(dD/2)^2$. Cross-sectional compliance and distensibility of the common carotid artery were calculated from diameter changes during systole and from simultaneously measured pulse pressures (ΔP) according to the following formulae:

Cross-sectional compliance= $\pi[(sD^2-dD^2)]/4\Delta P$;

Cross-sectional distensibility= $(sD^2-dD^2)/(dD^2.\Delta P)$

Diastolic wall stress was calculated using the mean arterial pressure multiplied by dD/2IMT. Whereas compliance provides information on the elasticity of the artery as a hollow structure, the incremental elastic modulus provides information on the properties of the wall material independently from the arterial geometry. This variable was calculated as 3/(1+lumen cross-sectional area/wall cross-sectional area) divided by cross-sectional distensibility.

Statistical analysis

Data was expressed as mean ± standard deviation (SD). The differences between data were studied using the Student t test and the

Table 1. Ages, body mass index, waist hip ratio values of the investigated groups

	Controls	BPPV	
	Mean±SD	Mean±SD	*p*
Age	48.93±19.65	46.52±17.44	0.352
Body mass index (kg/m^2)	28.55±5.38	27.94±5.35	0.410
Waist/hip ratio	0.82±0.06	0.81±0.08	0.293

BPPV: Benign paroxysmal positional vertigo; SD: Standard deviation.

Mann-Whitney U test. The level of statistical significance was taken as $p<0.05$. Data was analyzed using SPSS for Windows version 15.0 software program (SPSS Inc., Chicago, IL, USA).

RESULTS

There was no significant difference between the demographic characteristics of individuals in both groups, such as a history of arterial hypertension, diabetes, high cholesterol, smoking, previous stroke, etc.

There were 89 BPPV patients (57 males and 32 females) with an average age of 46 (range 15-85). There were 129 controls (73 males and 56 females), with average age of 48 (range 13-78), (Table 1).

The distribution of sexes between the control and BPPV groups was proportional. There was no statistically significant difference between the ages (p=0.352), BMI (p=0.410) and WHR (p=0.293) of these groups.

There were no statistically significant differences observed between carotid and femoral IMT and elastic modulus measurements between the control and BPPV groups.

In the BPPV group, carotid artery cross-sectional compliance and cross-sectional distensibility were found to be low in statistically significance ($p<0.001$) (Table 2).

DISCUSSION

Vertigo is the illusion of motion.[8] Cases referred with vertigo complaints should be considered with medical, neurological, and otological reasons.[9] It is especially important to distinguish the peripheral (otologic) and central (neurologic) reasons for vertigo. Benign paroxysmal positional vertigo, Meniere's disease, and vestibular neuritis can be considered among the otologic reasons. Benign paroxysmal positional vertigo is the most common vestibular disorder. Epidemiological studies show that the average age of the onset of vertigo is 54. However, they may occur in some people between the ages of 11 to 84.[10] Recently peripheral vestibular disorders have been reported to be related to arteriosclerosis and other diseases associated with the certain life styles.[11]

Sonographic investigation of carotid and femoral arteries is quite important for noninvasive assessment of arteriosclerosis. Arterial stiffness is a term, which implies stiffness of the vessel walls while arterials tend to lose their elasticity and is considered a component of arteriosclerosis. Numerous parameters were shown as a marker of arterial stiffness and these parameters have no superiority over one another. Changes of vessel walls at an early arteriosclerosis stage, which generally occur before having a clinical symptom, were mainly investigated in the aorta, brachial, and femoral arteries.[12] Arterial stiffness measurements in carotid arteries were noted in previous studies

Table 2. Carotid and femoral arteries intima-media thickness and arterial stiffness measures of investigated groups

	Controls	BPPV	
	Mean±SD	Mean±SD	*p*
Carotid intima-media thickness (mm)	0.39±0.13	0.42±0.15	0.117
Carotid cross-sectional compliance	0.201±0.006	0.156±0.006	0.001
Carotid cross-sectional distensibility	0.0082±0.0003	0.0067±0.0003	0.001
Femoral intima-media thickness (mm)	0.39±0.15	0.42±0.9	0.710
Femoral cross-sectional compliance	0.18±0.01	0.14±0.04	0.001
Femoral cross-sectional distensibility	0.0079±0.0004	0.0074±0.0003	0.001

BPPV: Benign paroxysmal positional vertigo; SD: Standard deviation.

such as ARIC and SMART. They are now accepted as a new risk factor for arteriosclerosis.[13-15] In addition, IMT measurements in the carotid artery have shown to be a noninvasive and reliable marker in order to show the existence and prevalence of arteriosclerosis.

In the study carried out by Cruz et al.[11] it is claimed that arteriosclerotic risk factors such as smoking, alcohol drinking, and hypertension together with emotional stress are all independent factors which increase the prevalence of balance disorders in young adults. These are all associated with the arteriosclerotic process. In some epidemiological studies it is reported that older women with low high-density lipoprotein (HDL) values and abdominal obesity tend to show more balance disorders.[16]

The study on the relationship between prognosis and arteriosclerosis in BPPV cases, which was carried out by Wada et al.,[2] carotid IMT was found to be higher in the BPPV group compared to the control group. No statistically significant differences were noted between the carotid and femoral IMT measurements of the BPPV and the control groups in our study. However, in the study of arterial distensibility and compliance, which are markers of arteriosclerotic process in carotid and femoral arteries, the vertigo group was found to be lower compared to the control group. Hemenway and Lindsay[17] reported that the etiology of BPPV, which is based on the degeneration due to the obstruction of vestibular artery, is a circulatory impairment. Microcirculation disorders that may occur in the inner ear will result in more mobile otolith development and BPPV.[18] Results show that increases in arterial stiffness and arteriosclerosis are more common in cases with BPPV.

This trial suggests that atherosclerotic changes are more commonly observed in BPPV cases and should be assessed as a factor, which may have a role in BPPV etiology. Diagnosis and treatment of underlying arteriosclerosis in these patients can decrease the symptoms of BPPV along with the risk of cerebrovascular and cardiovascular events.

Declaration of conflicting interests

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