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Research Article / Araştırma

The prevalence of vertigo, non-vertiginous dizziness and migrainous vertigo in migraine patients

Migrenli hastalarda vertigo, vertijinöz olmayan baş dönmesi ve migrenöz vertigo sıklığı

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ABSTRACT

Aim: Aim of this study was to investigate the prevalence of vertigo and non-vertiginous dizziness in migraine patients compared to the control group and to define lifetime prevalence of migrainous vertigo. **Materials and Methods:** A total of 206 patients diagnosed with migraine according to the International Headache Society (2004) and 218 healthy individuals were included in this study. **Results**: Vertiginous symptoms were found in migraine patients by 65.5% and in the control group by 30.3% (p=0.000). Rate of the patients who met 2001 vertiginous migraine criteria was found as 30% and 2012 criteria was found 26%. Vertiginous symptoms revealed independently from headache in majority of the patients and were found to be more common in the patients having migraine with aura. **Conclusions**: Our results seems to support the results of previous studies which indicated that lifetime prevalence of migrainous vertigo was high in migraine patients.

ÖZ

Amaç: Bu çalışmanın amacı, migren hastalarında kontrol grubuna göre vertigo ve vertigo olmayan baş dönmesi prevalansını araştırmak ve migrenli vertigonun yaşam boyu prevalansını belirlemektir. Gereç-**Yöntem**: Uluslararası Baş Ağrısı Derneği'ne (2004) göre migren tanısı almış toplam 206 hasta ve 218 sağlıklı birey bu çalışmaya dahil edilmiştir. **Bulgular**: Vertiginöz semptomlar migren hastalarında %65,5, kontrol grubunda %30.3 olarak bulunmuştur (p=0.000). 2001 baş dönmesi migren kriterlerini karşılayan hasta oranı %30, 2012 kriterleri ise %26 olarak bulundu. Hastaların büyük çoğunluğunda baş ağrısından bağımsız olarak ortaya çıkan vertiginöz semptomlar auralı migren hastalarında daha sık bulunmuştur. **Sonuç**: Sonuçlarımız migren hastalarında yaşam boyu migrenöz vertigo prevalansının yüksek olduğunu gösteren önceki çalışmaların sonuçlarını destekler görünmektedir.

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INTRODUCTION

Migraine is a neurovascular disease that affects more than one billion people worldwide. Its incidence has been reported to be 15.9% in adults (1). This rate is approximately 20% for women and 10% for men. Migraine is an important public health problem. It has been the cause of four million annual emergency visits in recent years. Due to its frequency and the loss of workforce it causes, it affects not only those who are affected but also the whole society (2).

Migraine is a disease characterized by mostly unilateral and moderately severe headache attacks. There are types with and without aura, and migraine without aura is more common (3). Migraine-related vertigo is vertigo attacks that occur in a patient with a history of migraine headache that cannot be explained by other reasons (4).

Migraine-related vertigo has been defined as a separate disease. In terminology, it is defined by different names such as migrainous vertigo (MV) and vestibular migraine. The pathophysiology of MV has not been clarified yet, and the lack of biomarkers complicates the diagnosis. International diagnostic criteria are also not available (5).

Cochleo-vestibular complaints are frequently encountered in migraine patients. This frequency varies

considerably in the sources (6). The aim of this study is to determine the frequency of vertigo in migraine patients and to reveal the relationship between vertigo and headache.

MATERIALS - METHODS

Participants

A total of 206 patients aged 18-65 years, who applied to the General Neurology and Headache Outpatient Clinic, and 218 healthy individuals who were not diagnosed with migraine and had no complaints of headache, excluding tension headache, which was not more frequent than once a month, were included in the study.

Study Design

The sociodemographic characteristics of the participants were questioned and presented as descriptive statistics. These are gender, age, marital status and educational status. The characteristics of headache have also been questioned. A detailed physical and neurological examination was performed on the participants. According to the International Headache Classification criteria, appropriate diagnoses were made for migraine subtypes. Headache characteristics of migraine patients have been described. Afterwards, both groups were evaluated in terms of the temporal relationship between migraine attacks and symptoms, frequency and time of onset of symptoms, vertiginous symptoms and non-vertiginous dizziness. Further diagnostic tests, such as blood tests and imaging studies, were performed in patients with suspected other causes of vertigo and non-vertiginous dizziness. While investigating the presence of vertigo, the participants were asked to describe the symptoms. Vertigo was not accepted as an aura symptom in the diagnosis of migraine with aura. The patients were asked to describe their own dizziness. Real vertigo was considered in case of the patients defined the dizziness as the sensations such as linear or rotational hallucination of themselves or their surrounding, rolling and spinning. Whereas definition of the dizziness as feeling of space in the head, imbalance and fainting was considered as non-vertiginous dizziness. Dizziness symptoms defined in both the groups were examined under the title of “vertiginous symptoms”.

A questionnaire

A questionnaire form was prepared by the researchers in order to determine the characteristics of headache and the relationship between migraine and vertigo. The prepared questionnaire was applied to the participants. With the questionnaire, family history, headache frequency, severity and duration, prodrome and aura symptoms, presence of accompanying tension-type headache, accompanying diseases, motion sickness, response to treatment, and drug use were questioned.

Exclusion Criteria

Participants whose sociodemographic characteristics could not be determined, those who refused to participate in the study, those with non-vestibular symptoms such as orthostatic hypotension and symptoms mimicking vertigo, those diagnosed with basilar migraine, those who had severe head trauma and those with additional diseases such as anemia were excluded from the study.

Diagnosis Criteria

Patients who met diagnostic criteria of definitive migrainous vertigo were marked as DMV. DMV diagnosis is still not included in the International Headache Society criteria, although this diagnosis was set according to the following criteria that have been recommended by Neuhauser et al (7) and Barany Society and International Classsificatin of Headache Disorders (8):

1.Repeating, at least with moderate severity, episodic vestibular symptoms

2.Migraine diagnosis which meet IHS criteria

3.At least one accompanying migraine symptom between two vertiginous episodes

4.Ruling out of other causes using proper examination methods

Statistical Analysis

Characteristics of vertigo was compared between the migraine patients who experienced vertigo or non-vertiginous dizziness during their life (MVL) and the control subjects who experienced vertigo or non-vertiginous dizziness during their life (CVL).

Patient data were recorded used SPSS 17 package software. Chi square test was used in categorical data. For comparison of continuous numeric values; t test was used in normal distributed data and Mann-Whitney U test in non-normal distributed data. Normal distribution continuous numeric values were expressed as arithmetic mean ± standard deviation (SS) and non normal distribution values were expressed as median (1.and 3. quartiles). $p<0.05$ values were considered as statistically significant.

RESULTS

Control group included 178 (81.7%) females and 40 (18.3%) males, while there were 173 (84%) females

and 33 (16%) males in migraine group with domination of women in both the groups (p=0.525). No statistically significant difference was found between the patient and control groups in terms of age and gender.

Mean age was found as 36.4±10.6 years in the control and 37.02±10.4 in the patient group (p=0.545). There was a significant difference in the rates of vertiginous migraine between the patient and control groups. A hundred and thirty five (65.5%) of migraine patients and 66 (30.3%) of the controls defined vertiginous symptoms (p=0.000).

No significant difference was found between MVL and CVL groups in distribution of the gender and mean age with women dominated in both the groups. Rate of women was 87.4% in MVL versus 80.3% in CVL (p=0,064). In MVL group, 30 (22.2%) patients had complaints of vertiginous episodes everyday – every other day, 95 (70.4%) patients few times a month and 10 (7.4%) patients 1-3 times lifelong in migrain group. Whereas, 9 (13.6%) patients had complaints of vertiginous episodes everyday – every other day, 47 (71.2%) patients few times a month and 10 (15.2%) patients 1-3 times lifelong in migraine group. No statistically significant difference was found between the groups (p=0.113).

Vertiginous symptoms started earlier in MVL group; vertiginous symptoms started 51.7±61.59 months before our test in this group and 45.23±38.34 months before our test in CVL group (p=0.530). When our patients were asked to describe onset time of their symptoms (MVL vs CVL); these values were reported by

1) 1 (0.7%) vs 2 patients (3.0%) as the childhood period

2) 93 (68.9%) vs 45 (68.2%) patients as an older age of life and

3) 41 (30.4%) vs 19 (28.8%) patients as recently (p=0.450).

When periods in which migraine and vertiginous symptoms occured were questioned, 6 (4.4%) of the patients stated that they experienced vertiginous symptoms in aura phase, 47 (34.8%) in headache phase, 2 (1.5%) following headache and 80 (59.3%) in the other periods.

Existence of vertigo sensation (rotational vertigo, illusions on their own or subjects' movements, positional vertigo) was found in 38 (18.4%) MVL patients vs 32 (14.7%) CVL patients; while existence of non-vertiginous dizziness sensation (head movement intolerence, sense of imbalance or head movement- or subject movement induced illusions) was observed in 97 (47%) MVL patients vs 34 (15.6%) CVL patients (p= 0.004).

No significant difference was observed between MVL and CVL groups in terms of emergence of the symptoms: the symptoms were associated with head movements alone in 50 (75.7%) controls vs 93 (68,9%) migraine patients. Whereas the symptoms were associated in case of a constant state and head movements together in 27 (20%) MVL patients vs 11 (16.7%) in CVL patients (p=0.574).

No significant difference was found between MVL and CVL groups in terms of the vertigo episodes were respectively found to occur in 30 (22.2%) vs 9 (13.6%) persons everyday – every other day, in 95 (70.4%) vs 47 (71.2%) persons few times a month and in 10 (7.4%) vs 10 (15.2%) persons 1-3 times lifelong (p=0.113). All of the situations were showed in Table 1.

Vertigo symptoms were always associated migraine episodes in 39 (18.4%) and sometimes associated with migraine episodes in 62 (30.9%) patients. According to the recommended criteria, in this study 62 (30.9%) migraine patients met the criteria for DMV. Vertiginous symptoms were more common in migraine with aura. Migraine with aura was found in 76 (73.8%) patients, while migraine without aura was observed in 59 (57.3%) patients (p=0.000). Motion sickness was observed in 77 (37.4%) of migraine patients and 54 (24.8)% of the controls (p=0.005). Hearing loss was found to exist in 19 (9.2%) migraine patients vs 3 (1.4%) of the controls, while tinnitus complaint was observed in 71 (34.5%) migraine patients vs 46 (21.1%) controls. There was a significant difference between the groups in terms of these two symptoms (p<0.01).

Of the migraine patients with vertigo; diagnosis of BPPV was found in 11 (5.3%), Meniere's disease in 4 (1.9%) and other vestibular diseases in 1 (0.5%) patient. Whereas BPPV was observed in 9 (4.1%) and other vestibular diseases in 1 (0.5%) of the control subjects.

DISCUSSION

Headache and dizziness are among the most common symptoms in general population. Studies have demonstrated that prevalence of dizziness is high among migraine patients and vice versa (6). However, vertigo is included as a descriptive feature only in the subtitle of "basilar type migraine" under "migraine with aura" and "benign paroxysmal positional vertigo" under "periodical syndromes in the childhood period" in 2004 classification of the International Headache Society. Whereas migrainous vertigo diagnosis is still not included in the International Headache Classification. This study was conducted in order to define the frequency of vertigo, non-vertiginous dizziness and migrainous vertigo in migraine patients

Table 1. All of the situations

	MVL (%)	CVL (%)	p values
Number of the patients			
Patients with vertigo	%18.4	%14.7	**0.004**
Patients with dizziness	%47	%15.6	
Frequency of the episodes			
Everyday – every other day	%22.2	%13.6	
Few episodes a month	%70.4	%71.2	0.113
Lifelong 1-3 attacks	%7.4	%15.2	
Emergence of the symptoms			
Head movement	%68.9	%75.7	0.574
Head movement and constant state	%20	%16.7	
Vertigo onset time			
Childhood period	%0.7	%3	
Older ages of life	%68.9	%68.2	0.450
Recently	%30.4	%28.8	

and to demonstrate the association between vertigo and headache (9).

Results obtained from various studies suggested that the association between migraine and vertigo is not coincidental, 3-4% of the general population is expected to experience migraine and dizziness together (10,11).

In a series by Kayan and Hood which examined the symptoms of vertigo and non-vertiginous dizziness in 200 migraine patients and 116 patients having tension-type headache; vestibular symptoms were found as 55% in migraine patients and 30% in non-vertiginous dizziness patients. In the same series, vertigo was reported as 27% in migraine patients and 8% in tension type headache patients (12). Similarly, Kuritzky et al. demonstrated that vertigo was seen as about three times more frequently in the migraine than in the control group (13).

Besides greater prevalence of dizziness in migraine population, prevalence of migraine has been also proven to be higher in the patients presented due to dizziness. In a retrospective study by Savundra et al migraine was detected in 116 (32%) of 363 vertigo patients presented to neurootolgy clinic, while idiopathic vertigo was observed in 99 (85%) of 116 migraine patients and in 125 (51%) of 247 patients who have not migraine (49% other detectable causes) (14). Neuhauser et al found that rate of the association of migraine and vestibular vertigo in general population by chance was about three folds higher than the expected value. In that study in which vestibular vertigo and migraine was in association in 3.2% of the general population, 1% of the population was diagnosed with migrainous vertigo. Considering the lifelong prevalence values of 16% for migraine and 7% for vestibular vertigo, association of migraine and vertigo by chance could be expected only for 1% of the population. For the remaining 1% portion, BBPV and Meniere's disease that have been already proven to be associated both with migrainous vertigo and migraine may be likely to take place (15).

In a prospective study by Vukovic et al; vertigo or nonvertiginous dizziness symptoms were found in 51.7% of migraine patients and 31.5% of the control group. In that study, 23.2% of migraine patients met the MV criteria (16).

In a prospective study by Neuhauser et al comparing prevalence of migraine between 200 patients presented to vertigo clinics and, age and gender matched 200 patients presented to orthopedics clinic based on the International Headache Society; migraine was found to be more common by 1.6 folds in vertigo clinics (38% vs 24%). Definitive diagnosis of MV was established in 7% of 200 patients presented to vertigo and 9% patients presented to migraine polyclinics. In another study, migraine patients have been reported to experience nonvertiginous dizziness by 2.5 folds higher in the periods without headache than the controls having not headache (7,15).

In this study, we observed that a substantial portion of migraine patients experienced lifelong vertigo or nonvertiginous dizziness. These symptoms were found in 65.5% of migraine patients (MVL) and 35.5% of the control group (CVL) (p=0.000). When both the groups were compared, vestibular symptoms were found to be 2 folds greater in migraine patients, in consistence with

the literature. Of the patients, 30% met the definitive MV criteria with 2001 but %26 met the definitive MV with 2012 criters. Although this value was considerably high than Neuhauser et al, it was observed to be closer to the value found by Vukovic et al (16).

In this study, rate of vestibular symptoms was found to be significantly higher in the patients having migraine with aura (73.8%) than in those having migraine without aura (57.3%). Among the patients with migrainous vertigo; association with visual aura was found to be higher in the patients who reported dizziness than in those who did not report, but the difference was not statistically significant (7). In another study, in line with our findings vertigo or nonvertiginous dizziness symptoms were found to be significantly higher in migraine with aura group (16). Association of aura and vestibular symptoms suggested that at least some pathophysiological mechanisms might be common.

Studies investigating the association of vestibular symptoms with headache in migraine patients report that the symptoms may be associated with headache or may present also without headache (17,18). When patients with the association of vertigo and migrain were compared with migraine patients having not vertigo, vertigo and headache were reported to never being associated in some patients (19–21). The studies demonstrated that among migrainous vertigo patients, vertigo was regularly associated with headache by 24-45%, occurred with or without headache in 48 % and was never associated with headache in two patients (10,19). In a study by Vukovic et al. vertigo symptoms were found to be always associated with migraine episodes in 38 (22.5%) persons, occasionally associated in 38 (22.5%) persons and non-associated in 93 (55%) persons (16). Similar results were found also in our study. Migraine and vertiginous symptoms were not associated in 65 (31.6%), were associated in 39 (18.9%) and were sometimes associated in 31 (15%) patients.

In this study, vestibular symptoms of migraine patients and controls occurred with the head movement to a large extent and both in moving and constant states to a less extent, but no statistically significant difference was found between both the groups in terms of the development of the vestibular symptoms. Frequently seen dizziness in migraine patients both in moving and constant conditions may indicate the role of additional pathways. Vertical vestibuloocular reflex anomalies in high frequency head movements presenting in the patients having migraine with aura and headache seem to support this opinion (22).

MV patients are highly sensitive to the head movements. Of these patients, 40% to 70% complaint from positional vertigo although not in every episode. MV can be differianted from BPPV with short symptomatic episodes and frequent recurrence, emerging in younger ages, existence of migranous symptoms during positional vertigo episodes and atypical positional nystagmus (17). Observation of atypical positional nystagmus suggests positional MV which can be explained by the dysfunction of vestibular structures and vestibulocerebellum in the cerebral trunk (23,24). MV can mimic BPPV and misdiagnosed. Therefore MV should not be neglected in differential diagnosis of positional vertigo. Rates of positional vertigo or nonvertiginous dizziness are between 17-46% in MV patients. Episodic positional MV can be differianted from BPPV through medical history and clinical examination (25). In a study on the patients presented to vertigo clinic, patients diagnosed with non-traumatic BPPV have been found to have significantly higher prevalence of migraine than the controls (22).

Likewise the study by Vukovic et al, prevalence of vertiginous symptoms in migraine and control groups were found as high as 70.4% in migraine and 71.2% in the control group as few times a month and, no significant difference was observed between both the groups (16). In this study, vertiginous symptoms were found to have an earlier onset time in migraine patients than in the controls (51.17±61.59 months in migraine group, 45.23±38.34 months in controls). This may reflect a common pathology for migraine and vertigo.

Migraine-associated vertigo can be seen at any age, but makes a peak between the third and fifth decades and women compose 60% to 85% of all the patients. This condition is 1.5-5 folds higher in women than in men. Similarly, in this study migrainous vertigo was more common in women (85.1%) and in third decade. Instability of head movement, imbalance and wide range of vertiginous symptoms from non-vertiginous dizziness to real vertigo are reported to be associated with migraine. Patients often report spontaneous vertigo or movement hallucination as the spinning of themselves or surroundings (26,27). This is usually in form of rotational vertigo. Remaining patients have the nonspesific symptoms dizziness, light headedness, weakness sensation, moving disease-like situation or the sense of rolling in the head or swimming sensation (28,29). In general, postural imbalance presents, but the patients can walk without any support. Vertigo is triggered in certain positions and movements (25) .

Bayazıt et al. (2001) described non-vertiginous dizziness in 25% and vertigo in 30% of migraine patients (30). In a study by Vukovic et al. no significant difference was found between the controls and migraine patients in terms of the rate of vertigo to non-vertiginous dizziness and, nonvertiginous dizziness has been reported to be higher than vertigo in both the groups (16). Whereas

in our study non-vertiginous dizziness was found to be higher than vertigo in migraine patients and the controls having vertiginous symptoms and, vertiginous symptoms were found to be more common in migraine patients than in the controls.

Vertiginous symptoms may last for seconds, minutes, hours, even longer than one day (31). In the studies, majority of the patients reported short-time vestibular symptoms (shorter than five minutes) and few reported vestibular symptoms lasted longer than one day. In this study, duration of the vestibular symptoms largely lasted between seconds and five minutes as in the other studies and no significant difference was found between migraine and control groups. Since duration of the symptoms is too short, patients usually presented with the complaints of headache rather than vertigo and don't report vertigo unless they are asked. Occasionally they present to the physician with only complaint of dizziness and unnecessary neurologic examination and consultations are ordered, if headache is not questioned. Therefore, investigation of the vertigo-headache association is important. In addition to being very often, identification of MV prevent unnecessary treatment and prophylactic therapy to be administered will treat both headache and vertigo (32).

Hearing loss and tinnitus are rarely reported in MV patients, hearing loss is often mild and temporary. In our study also rates of hearing loss and tinnitus were found to be higher in migraine patients. This suggested that the internal ear may be another lesion location. In the conducted studies, an unilateral decrease was detected in the caloric responses. Its ischemia due to vazospasm of the labyrinth could be considered as the underlying mechanism (33). The condition described by the patients as hearing loss in MV is generally feeling of fullness and pressure in the ear. Progressive hearing loss which is common in Meniere's disease is not observed.

Association of Meniere and BPPV has been frequently reported in migraine patients. In this study, rates of BPPV were similar, while Meniere's disease was more common in migraine patients. In a study investigating 78 unilateral or bilateral Meniere's disease, migraine was demonstrated to by a 2 folds higher rate in the patients than in the controls. It has been proposed that these two condition may emerge with a common pathophysiologic mechanism. These mechanisms may be related to neurotransmitter imbalance or ion channel disease (34). BPPV and migraine association has been also frequently reported. Genetic factors and vascular damage to the labyrinth have been underlined as relationship of these two pictures.

Motion sickness is a symptom seen in migraine patients with more commonly in patients having not headache or having tension-type headaches (%30-50). Researchers proposed that activation of the vestibular nuclei is also major mechanism in motion sickness which emerges with optokinetic stimulation (35). Optokinetic stimulation may induce motion sickness. This condition triggers nausea, headache and prolonged photophobia in migraine patients compared to the controls (36). Association of vertigo and motion sickness with migraine, may be a finding which indicates a vestibular dysfunction not only during migraine episode, but also in the periods without headaches, reflecting migraine tendency (37). Migraine patients have increased rate of visually triggered motion sickness. Consistently with the literature, in our study also motion sickness was more common in migraine patients (38).

Vertigo and motion sickness in the medical histories of migraine patients suggest that the mechanisms that play a role in pathogenesis of migraine affect also the vestibular system. Today pathophysiology of migraine-associated vertigo consists of three main parts: first is the central connections including dorsal rafe nucleus, locus ceruleus, trigeminal and vestibular nuclei; second is the inner ear dysfunction through neuropeptide release and the third is the ischemia causing vazospasms and short-time vestibular symptoms (6,39).

As in migraine, there is not a specific diagnostic laboratory test for MV. The diagnosis is mainly established based on the medical history. Therefore, establishment of recognized diagnostic criteria is important. The 2012 diagnostic criteria for MV restrict the diagnosis of this disease to lesser number of patients. The key features responsible for this reduction were the type of dizziness, and it's intensity and duration. Patients diagnosed migraine and with complaints of an associated dizziness showed improvement of dizziness, after drug prophylaxis for MV (28).

Epidemiological studies support the relationship between migraine and episodic vertigo which are both common. Heterogeneity of clinical findings and lack of the diagnostic criteria are present as the factors which make confirmatory diagnostic and treatment studies difficult. Experimental trials are also needed for MV, further studies about genetic and ion channel dysfunctions seems promising. Wider and multicenter prospective studies are needed for determination of the epidemiyological factors and development of internationally recognized diagnostic criteria.

REFERENCES

1. Ashina M, Katsarava Z, Do TP, Buse DC, Pozo-Rosich P, Özge A, et al. Migraine: epidemiology and systems of care. Lancet (London, England). 2021;397(10283):1485–1495.
2. Stewart WF, Roy J, Lipton RB. Migraine prevalence, socioeconomic status, and social causation. Neurology. 2013;81(11):948–955.

3. O'Connell Ferster AP, Priesol AJ, Isildak H. The clinical manifestations of vestibular migraine: A review. Auris Nasus Larynx. 2017;44(3):249–252.
4. Sheeler RD, Garza I, Vargas BB, O'Neil AE. Chronic daily headache: ten steps for primary care providers to regain control. Headache. 2016;56(10):1675–1684.
5. Udagatti VD, Dinesh Kumar R. Migraine Related Vertigo. Vol. 69, Indian journal of otolaryngology and head and neck surgery : official publication of the Association of Otolaryngologists of India. 2017.
6. Luzeiro I, Luís L, Gonçalves F, Pavão Martins I. Vestibular migraine: clinical challenges and opportunities for multidisciplinarity. Behav Neurol. 2016;2016:6179805.
7. Neuhauser H, Leopold M, von Brevern M, Arnold G, Lempert T. The interrelations of migraine, vertigo, and migrainous vertigo. Neurology. 2001;56(4):436–441.
8. Lempert T, Olesen J, Furman J, Waterston J, Seemungal B, Carey J, et al. Vestibular migraine: diagnostic criteria. J Vestib Res. 2012;22(4):167–172.
9. Headache Classification Committee of the International Headache Society (IHS) The international classification of headache disorders, 3rd edition. Cephalalgia. 2018;38(1):1–211.
10. Dieterich M, Obermann M, Celebisoy N. Vestibular migraine: the most frequent entity of episodic vertigo. J Neurol. 2016;263 Suppl:S82-89.
11. Murofushi T, Tsubota M, Kitao K, Yoshimura E. Simultaneous Presentation of definite vestibular migraine and definite ménière's disease: overlapping syndrome of two diseases. Front Neurol. 2018;9:749.
12. Kayan A, Hood JD. Neuro-otological manifestations of migraine. Brain. 1984;107(4):1123–1142.
13. Kuritzky A, Ziegler DK, Hassanein R. Vertigo, motion sickness and migraine. Headache. 1981;21(5):227–231.
14. Savundra PA, Carroll JD, Davies RA, Luxon LM. Migraine-associated vertigo. Cephalalgia. 1997;17(4):505–510.
15. Neuhauser HK, Radtke A, von Brevern M, Feldmann M, Lezius F, Ziese T, et al. Migrainous vertigo: prevalence and impact on quality of life. Neurology. 2006;67(6):1028–1033.
16. Vuković V, Plavec D, Galinović I, Lovrencić-Huzjan A, Budisić M, Demarin V. Prevalence of vertigo, dizziness, and migrainous vertigo in patients with migraine. Headache. 2007;47(10):1427–1435.
17. Baloh RW. Vestibular Migraine i: mechanisms, diagnosis, and clinical features. Semin Neurol. 2020;40(1):76–82.
18. Shen Y, Qi X, Wan T. The Treatment of Vestibular migraine: a narrative review. Ann Indian Acad Neurol. 2020;23(5):602–607.
19. Abouzari M, Goshtasbi K, Moshtaghi O, Tan D, Lin HW, Djalilian HR. Association between vestibular migraine and migraine headache: yet to explore. Otol Neurotol. 2020;41(3):392–396.
20. Cha Y-H, Lee H, Santell LS, Baloh RW. Association of benign recurrent vertigo and migraine in 208 patients. Cephalalgia. 2009;29(5):550–555.
21. Beh SC. Vestibular Migraine: how to sort it out and what to do about it. J Neuro-Ophthalmology. 2019;39(2):208–219.
22. Helm MR. Vestibulo-ocular reflex abnormalities in patients with migraine. Headache. 2005;45(4):332–336.
23. Neff BA, Staab JP, Eggers SD, Carlson ML, Schmitt WR, Van Abel KM, et al. Auditory and vestibular symptoms and chronic subjective dizziness in patients with Ménière's disease, vestibular migraine, and Ménière's disease with concomitant vestibular migraine. Otol Neurotol. 2012;33(7):1235–1244.
24. Yu J, Yu Q, Guan B, Lu Y, Chen C, Yu S. Pseudo-Benign paroxysmal positional vertigo: a retrospective study and case report. Front Neurol. 2020;11:187.
25. von Brevern M, Radtke A, Clarke AH, Lempert T. Migrainous vertigo presenting as episodic positional vertigo. Neurology. 2004;62(3):469–472.
26. Akarsu EO, Baykan B, Ertaş M, Zarifoğlu M, Kocasoy Orhan E, Saip S, et al. Sex Differences of migraine: results of a nationwide home-based study in Turkey. Noro Psikiyatr Ars. 2020;57(2):126–130.
27. Kim SK, Hong SM, Park I-S, Choi HG. Association between migraine and benign paroxysmal positional vertigo among adults in South Korea. JAMA Otolaryngol Head Neck Surg. 2019;145(4):307–312.
28. Salmito MC, Morganti LOG, Nakao BH, Simões JC, Duarte JA, Ganança FF. Vestibular migraine: comparative analysis between diagnostic criteria. Braz J Otorhinolaryngol. 2015;81(5):485–490.
29. Cromwell C, Tyler J, Nobbs R, Hockaday A, Donnelly S, Clendaniel R. The Necessity for Post-maneuver restrictions in the treatment of benign paroxysmal positional vertigo: an updated meta-analysis of the literature. Otol Neurotol. 2018;39(6):671–679.
30. Bayazit Y, Yilmaz M, Mumbuç S, Kanlikama M. Assessment of migraine-related cochleovestibular symptoms. Rev Laryngol Otol Rhinol (Bord). 2001;122(2):85–88.
31. Sunitha M, Asokan L, Sambandan AP. Vertigo: Incidences, diagnosis and its relations with hearing loss. Indian J Otolaryngol Head Neck Surg. 2019;71(Suppl 2):1282–1286.
32. Cherian N. Vertigo as a migraine phenomenon. Curr Neurol Neurosci Rep. 2013;13(4):343.
33. Furman JM, Marcus DA, Balaban CD. Migrainous vertigo: development of a pathogenetic model and structured diagnostic interview. Curr Opin Neurol. 2003;16(1):5–13.
34. Radtke A, Lempert T, Gresty MA, Brookes GB, Bronstein AM, Neuhauser H. Migraine and ménière's disease: is there a link? Neurology. 2002;59(11):1700–1704.
35. Oman CM, Cullen KE. Brainstem processing of vestibular sensory exafference: implications for motion sickness etiology. Exp Brain Res. 2014;232(8):2483–2492.
36. Lackner JR. Motion sickness: more than nausea and vomiting. Exp Brain Res. 2014;232(8):2493–2510.
37. Drummond PD. Motion sickness and migraine: optokinetic stimulation increases scalp tenderness, pain sensitivity in the fingers and photophobia. Cephalalgia. 2002;22(2):117–24.
38. Drummond PD. Triggers of motion sickness in migraine sufferers. Headache. 2005;45(6):653–6.
39. Espinosa-Sanchez JM, Lopez-Escamez JA. New insights into pathophysiology of vestibular migraine. Front Neurol. 2015;6:12.