

# The interrelations of migraine, vertigo, and migrainous vertigo

H. Neuhauser, MD; M. Leopold; M. von Brevern, MD; G. Arnold, MD; and T. Lempert, MD

---

**Article abstract**—*Objective:* To assess the prevalence of migrainous vertigo in patients with migraine and in patients with vertigo according to explicit diagnostic criteria that are presented for discussion. *Methods:* The authors prospectively evaluated 200 consecutive patients from a dizziness clinic and 200 patients from a migraine clinic for migrainous vertigo based on the following criteria: 1) recurrent vestibular symptoms (rotatory/positional vertigo, other illusory self or object motion, head motion intolerance); 2) migraine according to the criteria of the International Headache Society (IHS); 3) at least one of the following migrainous symptoms during at least two vertiginous attacks: migrainous headache, photophobia, phonophobia, visual or other auras; and 4) other causes ruled out by appropriate investigations. In addition, the authors compared the prevalence of migraine according to the IHS criteria in the dizziness clinic group with a sex- and age-matched control group of 200 orthopedic patients. *Results:* The prevalence of migraine according to the IHS criteria was higher in the dizziness clinic group (38%) compared with the age- and sex-matched control group (24%,  $p < 0.01$ ). The prevalence of migrainous vertigo was 7% in the dizziness clinic group, and 9% in the migraine clinic group. In 15 of 33 patients with migrainous vertigo, vertigo was regularly associated with migrainous headache. In 16 patients, vertigo occurred both with and without headache, and in two patients headache and vertigo never occurred together. The duration of attacks varied from minutes to days. *Conclusion:* These results substantiate the epidemiologic association between migraine and vertigo and indicate that migrainous vertigo affects a significant proportion of patients both in dizziness and headache clinics.

NEUROLOGY 2001;56:436–441

---

Patients with both episodic vertigo and migraine have been reported from the early days of clinical neurology.<sup>1,2</sup> The International Headache Society (IHS) classification of migraine,<sup>3</sup> however, refers to vertigo as a migrainous symptom in adults only within the framework of basilar migraine, which may include vertigo as an aura symptom. A more comprehensive concept of migrainous vertigo appears to take shape from several published case series<sup>4–16</sup> under various names such as benign recurrent vertigo,<sup>5,13,16</sup> migraine-associated dizziness,<sup>6,8</sup> migraine-related vestibulopathy,<sup>7</sup> or vestibular migraine,<sup>9</sup> but is not yet clearly defined. So far, all studies on migrainous vertigo have been retrospective and, with a few exceptions,<sup>7,9</sup> have not been based on explicit inclusion and exclusion criteria. Only one study<sup>6</sup> has strictly adhered to the IHS criteria for the diagnosis of migraine. The understanding of migrainous vertigo is further compromised by the lack of prevalence estimates.

Among clinicians, not surprisingly, the acceptance of migrainous vertigo as a diagnostic entity is still rather poor. In addition to the methodologic short-

comings of previous studies, this may be due to a simple statistical consideration: with a prevalence of migraine of 15 to 17% in women and 5 to 8% in men<sup>17</sup> and a prevalence of dizziness in the general population of more than 20%,<sup>18</sup> one may question whether there is more than a coincidental association of migraine and vertigo.

What data are available to support a true association between migraine and vertigo? Vertigo has been found to be three times more common in patients with migraine than in controls.<sup>19,20</sup> Conversely, a high prevalence of migraine of 30 to 50% was found in patients presenting with vertigo in several case series.<sup>4,15</sup> This finding, however, has not yet been confirmed by a controlled study.

Therefore, we have conducted this study 1) to assess the prevalence of IHS migraine in patients with vertigo as compared with controls; 2) to identify patients with migrainous vertigo according to explicit diagnostic criteria in populations with vertigo and in populations with migraine as the chief complaint; and 3) to delineate the clinical features of migrainous vertigo.

---

See also page 428

From the Neurologische Klinik, Charité, Humboldt-Universität, Berlin, Germany.

Received August 31, 2000. Accepted in final form January 2, 2001.

Address correspondence and reprint requests to Dr. Hannelore Neuhauser, Charité, Campus Virchow-Klinikum, Neurologische Poliklinik, Augustenburger Pl. 1, 13353 Berlin, Germany; e-mail: hanne.neuhauser@charite.de

**Methods.** The study population consisted of three groups: 200 consecutive patients presenting to our dizziness clinic (dizziness clinic group), 200 orthopedic patients from the same hospital matched by age and sex with the first group (control group), and 200 patients with migraine according to the IHS criteria from our headache clinic (migraine clinic group).

The diagnosis of *definite migrainous vertigo* was based on the following criteria:

1. Episodic vestibular symptoms of at least moderate severity (rotational vertigo, other illusory self or object motion, positional vertigo, head motion intolerance, i.e., sensation of imbalance or illusory self or object motion that is provoked by head motion)

2. Migraine according to the IHS criteria

3. At least one of the following migrainous symptoms during at least two vertiginous attacks: migrainous headache, photophobia, phonophobia, visual or other auras

4. Other causes ruled out by appropriate investigations

Vestibular symptoms were defined as "mild" if they did not interfere with daily activities, "moderate" if they interfered with but did not impede daily activities, and "severe" if patients could not continue daily activities. Nonvestibular dizziness such as orthostatic hypotension, which frequently occurs during migraine attacks, was not included.

A separate diagnostic category of *probable migrainous vertigo* was chosen for patients who did not entirely fulfill the above criteria for migrainous vertigo but were still considered to have migrainous vertigo as the most likely diagnosis. The diagnosis of probable migrainous vertigo was based on the following criteria:

1. Episodic vestibular symptoms of at least moderate severity (rotational vertigo, other illusory self or object motion, positional vertigo, head motion intolerance)

2. At least one of the following: migraine according to the criteria of the IHS; migrainous symptoms during vertigo; migraine-specific precipitants of vertigo, e.g., specific foods, sleep irregularities, hormonal changes; response to antimigraine drugs

3. Other causes ruled out by appropriate investigations

A diagnosis of migraine was made according to the IHS criteria by means of a semistructured face-to-face interview. Migraine with and without aura were considered as mutually exclusive. In this study, vertigo was not counted as an aura symptom for the diagnosis of migraine with aura.

The dizziness clinic group comprised 200 consecutive patients presenting to the neurologic dizziness clinic between April 1998 and August 1999 (133 women, 67 men, mean age  $56 \pm 15$  years). During this period no special effort was made to attract patients with migrainous vertigo.

A full neurologic evaluation was performed by a neurologist who specialized in neurotology and included a clinical neurologic examination, electronystagmography with bithermal caloric test, and pure tone audiometry. A migraine interview was conducted with every patient. Further investigations such as brainstem auditory-evoked potentials, MRI, Doppler ultrasound of cerebral arteries, and laboratory tests were performed when considered appropriate.

The control group consisted of 200 unselected patients from an orthopedic ward, matched by sex and age (in 10-

year intervals) with the dizziness clinic group. Thus, mean age was  $56 \pm 13$  years and did not differ significantly from the dizziness clinic group. Orthopedic patients were chosen assuming that the causes for hospitalisation were unrelated to either dizziness or headache. A medical student interviewer, who had been trained both in the headache and the dizziness clinic, performed a semistructured face-to-face interview for the identification of migraine. Patients with migraine were asked about vertigo and about migrainous symptoms during the vertigo attacks. If migrainous vertigo was suspected, patients were invited to undergo a full neurotologic examination at the dizziness clinic.

The migraine clinic group included 200 patients. They were recruited from 296 consecutive patients with migraine with or without aura according to the IHS criteria who were seen in our headache clinic from April 1996 to February 1999 and for whom complete clinical records were available. These 296 patients were sent a short questionnaire asking about a history of episodic dizziness/vertigo. Patients who did not respond within 4 weeks were contacted by telephone in order to increase the response rate and to minimize selection bias. Whenever the written response was incomplete or unclear, patients were called by telephone as well. This screening procedure was performed successively for groups of 50 patients until approximately 180 patients were included. Then, additional groups of 10 patients were screened until an arbitrary number of 200 patients (156 women and 44 men, mean age  $41 \pm 16$  years) was reached. The written response rate was 37.5% (111 patients). The overall response rate, including patients who were reached by telephone, was 67.5%. A trained medical student interviewer performed a detailed, semistructured telephone interview with the patients who had experienced vertigo attacks. Patients with suspected migrainous vertigo were invited for a face-to-face interview and to undergo a full neurotologic examination. The diagnosis of definite migrainous vertigo was based on the above criteria. Probable migrainous vertigo was not assessed in this group because we felt that this diagnosis required a more extensive interview.

In all three groups, the prevalence of migraine and migrainous vertigo was assessed as lifetime prevalence. Additional information was obtained concerning the age at onset of migraine and migrainous vertigo, the temporal association of migrainous headache and vertigo, and the typical duration of attacks.

Statistical analysis was performed using the  $\chi^2$  test and Fisher's exact test to compare proportions, and the Wilcoxon rank-sum test to compare continuous variables. Analysis using the McNemar test provided similar results.

**Results.** The lifetime prevalence of migraine was higher in the dizziness clinic group (38%) than in the age- and sex-matched control group (24%,  $p < 0.01$ ) (table 1). The difference was significant for both men and women. When migraine with and without aura were analyzed separately, the difference remained significant only for migraine with aura even though vertigo was not counted as an aura symptom.

The lifetime prevalence of definite migrainous vertigo was 7% in the dizziness clinic group and 9% in the migraine clinic group (see table 1). The lifetime prevalence of definite migrainous vertigo was higher in women than in

**Table 1** Lifetime prevalence of migraine and migrainous vertigo in the three study groups

	Migraine clinic group	Dizziness clinic group	Control group	Dizziness clinic vs control group
Sex				
Women	156	133	133	
Men	44	67	67	
Migraine	200	75 (38)	47 (24)	<i>p</i> < 0.01
Women	156	58	41	<i>p</i> < 0.05
Men	44	17	6	<i>p</i> < 0.05
Migraine without aura	131	49 (25)	35 (18)	NS
Women	104	38	30	NS
Men	27	11	5	NS
Migraine with aura	69	26 (13)	12 (6)	<i>p</i> < 0.05
Women	52	20	11	NS
Men	17	6	1	NS
Basilar migraine	3	0	0	
Definite migrainous vertigo	18 (9)	14 (7)	1 (0.5)	
Women	16 (10)	10 (8)		
Men	2 (5)	4 (6)		
Probable migrainous vertigo	NA	8 (4)	NA	

Values expressed as n (%).

NS = not significant; NA = not assessed.

men in both groups, although this difference was not significant. In the control group, one patient had migrainous vertigo (0.5%).

Thirty-three of 200 migraine clinic patients and 75 of 200 dizziness clinic patients reported both episodic vertigo and migraine. However, only 18 migraine clinic patients and 14 dizziness clinic patients had definite migrainous vertigo. Of the 18 migraine clinic patients with definite migrainous vertigo according to the detailed telephone in-

terview, 14 also presented to the dizziness clinic for a complete neurotologic work-up. Five dizziness clinic patients had probable migrainous vertigo. Fifty-six dizziness clinic patients had migraine and episodic vertigo due to neurotologic disorders not directly caused by migraine (table 2).

Overall, we identified 33 patients with definite migrainous vertigo in the three groups (27 women, six men, mean age  $46.4 \pm 11.2$  years). Only three of these patients ful-

**Table 2** Diagnoses in 200 patients with and without migraine presenting to a neurologic dizziness clinic

Diagnoses	Dizziness clinic group (n = 200)	Dizziness clinic patients with migraine (n = 75)	Dizziness clinic patients without migraine (n = 125)
Benign paroxysmal positional vertigo	61 (31)	21 (28)	40 (32)
Psychogenic dizziness	40 (20)	12 (16)	28 (22)
Definite migrainous vertigo	14 (7)	14 (19)	0 (0)
Vestibulopathy of unknown origin	14 (7)	5 (7)	9 (7)
Neurologic gait disorder	13 (7)	0 (0)	13 (10)
Menière's disease/delayed hydrops	10 (5)	6 (8)	4 (3)
Orthostatic hypotension	9 (5)	5 (7)	4 (3)
Probable migrainous vertigo	8 (4)	5 (7)	3 (2)
Central vestibular syndromes	7 (4)	5 (7)	2 (2)
Vestibular neuritis	6 (3)	0 (0)	6 (5)
Other diagnoses	8 (4)	8 (11)	0 (0)
Undetermined	13 (7)	5 (7)	8 (6)

Several patients had more than one diagnosis.

Values expressed as n (%).

**Table 3** Clinical features of definite migrainous vertigo in 33 patients

Clinical features	n (%)
Duration of vertigo	
Seconds to 5 min	6 (18)
5 to 60 min	11 (33)
1 h to 1 d	7 (21)
>1 d	9 (27)
Migrainous symptoms during vertigo	
Migrainous headache	31 (94)
Always	15 (45)
Sometimes	16 (48)
No headache	2 (6)
Photophobia	23 (70)
Phonophobia	21 (64)
Visual or other auras	12 (36)

filled the IHS criteria for basilar migraine. Although headache was the most common migrainous symptom during vertigo attacks, the interindividual temporal association of migrainous headache and vertigo was variable; in 15 of 33 patients with migrainous vertigo, vertigo was regularly associated with migrainous headache. In 16 patients, vertigo occurred both with and without headache and in two patients headache and vertigo never occurred together (table 3). The duration of vertigo ranged from minutes to days. Only 11 patients had attacks of the typical duration of an aura as defined by the IHS (5 to 60 minutes). Age at onset of migraine ranged from 5 to 44 years (mean  $22 \pm 11$  years), whereas age at onset of migrainous vertigo ranged from 14 to 66 years (mean  $35 \pm 14$  years). In five patients both symptoms started at approximately the same time and in the remaining 28 patients migraine manifested earlier than migrainous vertigo. Overall, migraine began earlier in life than migrainous vertigo ( $p < 0.001$ ).

Probable migrainous vertigo, which was assessed only in the dizziness clinic group, was diagnosed in eight patients. Three patients with recurrent headaches that failed the IHS criteria for migraine experienced these headaches with photo- or phonophobia during their vertigo attacks. Two patients had migraine and recurrent attacks of vertigo, but recalled only one attack of vertigo with accompanying migrainous symptoms thus far. Two patients had migraine-specific precipitants of vertigo but did not have migrainous symptoms during their attacks. One patient did not have headaches at all, but reported photo- and phonophobia with the vertiginous attacks as well as relief from sleep.

The most common diagnosis both in the dizziness clinic group as a whole and in the dizziness clinic patients with migraine was benign paroxysmal positional vertigo (BPPV). Patients with nontraumatic BPPV of the posterior semicircular canal ( $n = 56$ ) had a higher prevalence of migraine than the sex- and age-matched controls (32 versus 16%,  $p < 0.05$ ).

**Discussion.** Even though migraine has long been associated with vertigo, there is only scarce epidemi-

ologic evidence for this association from controlled studies. Our finding of a significantly higher migraine prevalence in patients presenting with vertigo (38%) compared with age- and sex-matched controls (24%) complements two previous studies that have addressed the problem from the opposite point of view, showing that vertigo occurred more frequently in patients with migraine (24 to 27%) than in controls (8 to 10%).<sup>19,20</sup> These early studies, however, were not based on age- and sex-matched controls and did not use operational criteria for the diagnosis of migraine as introduced in 1988 by the IHS. Therefore, our study may provide the most valid evidence of the statistical association of migraine and vertigo thus far. The high prevalence of migraine in the control group (31% for women and 9% for men) may be explained by the fact that we assessed lifetime prevalence and not 1-year prevalence. Most epidemiologic studies on migraine have reported the 1-year prevalence. For our study, however, this would introduce a considerable bias because many patients with migrainous vertigo had typical migraine headaches earlier in their lives and at the time that vertigo attacks began, the migraine headaches had disappeared or attenuated and no longer fulfilled IHS criteria. A population-based study using IHS criteria that assessed the lifetime prevalence of migraine for a similar age range<sup>21</sup> showed a prevalence of migraine of 25% for women and 8% for men, which comes close to the figures from our control group. The remaining differences may be due to a dissimilar age- and sex-distribution or, considering the sample size of our control group, to chance alone.

In individual patients, the mere association of vertigo and a history of migraine is certainly insufficient to make the diagnosis of migrainous vertigo. This becomes quite obvious in the dizziness clinic group, in which only 19 of 75 vertiginous patients with migraine had definite or probable migrainous vertigo as the final diagnosis, whereas the majority had various neurotologic disorders not directly related to migraine such as BPPV, which alone accounted for the vertigo in 28% of these patients. An interesting side aspect of our study is the association of migraine and BPPV, which has recently been reported by others as well.<sup>22</sup> A tentative explanation is that migraine may cause ischemic damage to the utricle followed by a release of otoconia.

Definition and classification of migrainous vertigo is only beginning. The IHS classification does not include a comprehensive category for this disorder. Benign paroxysmal vertigo of childhood<sup>3</sup> is recognized as a distinct entity of the IHS classification, but does not apply to our patients in whom episodic vertigo invariably started in adulthood. Similarly, the designation *basilar migraine* does not apply to many patients with migrainous vertigo because this diagnosis requires at least two symptoms from the posterior circulation territory, whereas most patients with migrainous vertigo have vestibular symptoms only.<sup>9</sup> Moreover, in basilar migraine the duration of

vertigo should correspond to the length of an aura, i.e., between 5 and 60 minutes. In contrast, only a minority of patients in this and in previous studies had attacks of aura length whereas the majority had prolonged attacks, which prompted several authors to speculate that migrainous vertigo may be due to pathophysiologic mechanisms other than migraine auras.<sup>3,6-9,22-27</sup>

Therefore, we advocate a more comprehensive definition of migrainous vertigo. Which criteria should be met to make the diagnosis? Our data show that the coincidence of migraine and vertigo alone is certainly unspecific. Therefore, our criteria for definite migrainous vertigo require not only the combination of recurrent vestibular symptoms and migraine according to the IHS criteria, but also migrainous symptoms temporally related to the vertigo during at least two attacks. We have specified that accompanying migrainous symptoms could be migrainous headache, phonophobia, photophobia, or migrainous auras. Nausea, which is listed as an accompanying symptom in the IHS criteria for migraine, was discarded because it occurs with many types of vertigo and is therefore unspecific. In analogy with the IHS criteria for migraine, we discarded factors such as osmophobia, relief of vertigo with sleep, and migraine-specific precipitants of vertigo such as hormonal changes, alcohol intake, or lack of sleep. We also feel that response to migraine treatment is not sufficiently specific to be included in the diagnostic criteria. Placebo response rates of 25% and above from migraine trials<sup>28</sup> suggest that placebo effects can likewise be expected in the treatment of migrainous vertigo. To clearly define migrainous vertigo as a vestibular disorder, we have specified the types of vertigo that are considered to be vestibular in nature (rotational vertigo, other illusory self or object motion, positional vertigo, head motion intolerance), whereas nonvestibular types of dizziness are excluded, e.g., dizziness due to orthostatic hypotension during migraine attacks.<sup>29</sup> We have also introduced a severity criterion for the diagnosis of migrainous vertigo, similar to the IHS classification that comprises severity criteria for the diagnosis of migraine such as headache intensity and frequency. Clearly, the proposed criteria need further evaluation both in research and clinical practice as well as discussion among headache and vertigo experts. The sensitivity and specificity of both the proposed and the discarded criteria still need to be determined, which is a difficult task because there is no "gold standard" for the diagnosis of migrainous vertigo.

Definite migrainous vertigo—i.e., migraine as a cause of vertigo in individual patients—was frequent both in unselected patients with migraine and with vertigo (9% in the migraine clinic group and 7% in the dizziness clinic group). Similarly, 6% of 1,370 patients in a dizziness clinic had "vestibular migraine" in a recent retrospective study.<sup>9</sup> Of note, this study used different inclusion criteria, e.g., response to migraine treatment. We cannot exclude a selection

bias in our migraine clinic group because the response rate during patient recruitment was 67.5%. However, even assuming the maximum bias possible, i.e., none of the patients that we could not reach had migrainous vertigo, the prevalence of migrainous vertigo in the migraine clinic group would still have amounted to 6%. In addition, owing to recall bias, the prevalence of migrainous vertigo has probably been underestimated in our study because migrainous symptoms such as phono- or photophobia or even moderate headache during the vertiginous attacks may be easily forgotten by patients. This should apply even more to benign paroxysmal vertigo of childhood, a variant of migrainous vertigo affecting 2.6% of school children according to a recent population-based study.<sup>24</sup>

Thus far, migrainous vertigo appears to be underrepresented in the diagnostic repertoire of neurotologic clinics, particularly from otologic backgrounds.<sup>25</sup> The disorder may be hidden behind terms such as "recurrent vestibulopathy" or "vestibular Menière's disease," a category that is no longer accepted by the current guidelines for the diagnosis of Menière's disease.<sup>26</sup> Interestingly, a recent study showed that 81% of patients with a diagnosis of vestibular Menière's disease had migraine,<sup>27</sup> suggesting that some of these patients may have had migrainous vertigo.

The diagnosis of migrainous vertigo can be challenging when headache is not a regular accompaniment of the vertiginous attacks. Less than half of our patients showed a fixed association of headache and vertigo, which is in agreement with previous reports.<sup>6-8,20,23</sup> Some patients experience an attenuated headache with their vertigo as compared with their usual migraine.<sup>9</sup> This may be a consequence of the vertigo itself as suggested by a study showing disappearance of headache or a decrease in headache intensity by caloric activation of the vestibular systems during migraine attacks.<sup>30</sup> When headache is not a prominent feature of the attacks the diagnosis of migrainous vertigo rests on other symptoms that relate the vertiginous attacks to migraine, such as sensitivity to light or scintillating scotoma. These symptoms require explicit questioning because most patients do not normally volunteer them. Sometimes the links of migraine and vertigo become evident only after prospective monitoring of symptoms in a diary.

We are aware that there are patients who do not fulfill the strict criteria for definite migrainous vertigo, but still appear to have migrainous vertigo as the most likely diagnosis. Some of them may have headaches that do not correspond to the IHS criteria for migraine or have no headaches at all; others may have no migrainous symptoms during their vertiginous episodes. In these patients, other features may indicate a diagnosis, such as vertigo precipitation by hormonal changes or a favorable response to antimigraine drugs.<sup>6,9</sup> Therefore, we have proposed the additional diagnostic category of probable migrainous vertigo (see the Methods section). Such a classifica-

tion of migrainous vertigo at different levels of diagnostic certainty may be useful for different purposes. For scientific studies it appears appropriate to include only patients with definite migrainous vertigo (high specificity/lower sensitivity), whereas in clinical routine, one may also wish to identify patients with probable migrainous vertigo (lower specificity/higher sensitivity) as a provisional diagnosis that may guide therapeutic decisions.

## References

1. Liveing E. On megrim: sick headache and some allied health disorders: a contribution to the pathology of nerve storms. London, UK: Churchill, 1873:120–130.
2. Boenheim F. Über familiäre Hemicrania vestibularis. *Neurol Centralbl* 1917;36:226–229.
3. Olesen J. Classification and diagnostic criteria for headache disorders, cranial neuralgias and facial pain. *Cephalgia* 1988;8(suppl 7):9–96.
4. Aragonés JM, Fortes-Rego J, Fuste J, Cardozo A. Migraine: an alternative in the diagnosis of unclassified vertigo. *Headache* 1993;33:125–128.
5. Behan PO, Carlin J. Benign recurrent vertigo. In: Rose FC, ed. *Advances in migraine research and therapy*. New York, NY: Raven, 1982:49–55.
6. Bikhazi P, Jackson C, Ruckenstein MJ. Efficacy of antimigrainous therapy in the treatment of migraine-associated dizziness. *Am J Otol* 1997;18:350–354.
7. Cass SP, Ankerstjerne JKP, Yetiser S, Furman J, Balaban C, Aydogan B. Migraine-related vestibulopathy. *Ann Otol Rhinol Laryngol* 1997;106:182–189.
8. Cutrer FM, Baloh RW. Migraine-associated dizziness. *Headache* 1992;32:300–304.
9. Dieterich M, Brandt T. Episodic vertigo related to migraine (90 cases): vestibular migraine? *J Neurol* 1999;246:883–892.
10. Harker LA, Rassekh CH. Episodic vertigo in basilar artery migraine. *Otolaryngol Head Neck Surg* 1987;96:239–250.
11. Harker LA, Rassekh C. Migraine equivalent as a cause of episodic vertigo. *Laryngoscope* 1988;98:160–164.
12. Lempert T, Menzhausen L, Tiel-Wilck K. Migräne: Eine Differentialdiagnose des episodischen Schwindels. *Nervenarzt* 1993;64:121–126.
13. Moretti G, Manzoni GC, Caffarra P, Parma M. “Benign recurrent vertigo” and its connection with migraine. *Headache* 1980;20:344–346.
14. Parker W. Migraine and the vestibular system in adults. *Am J Otol* 1991;12:25–34.
15. Savundra PA, Carroll JD, Davies RA, Luxon LM. Migraine-associated vertigo. *Cephalgia* 1997;17:505–510.
16. Slater R. Benign recurrent vertigo. *J Neurol Neurosurg Psychiatry* 1979;42:363–367.
17. Stewart WF, Simon D, Shechter A, Lipton RB. Population variation in migraine prevalence: a meta-analysis. *J Clin Epidemiol* 1995;48:269–280.
18. Kroenke K, Price RK. Symptoms in the community. Prevalence, classification, and psychiatric comorbidity. *Arch Intern Med* 1993;153:2474–2480.
19. Kuritzky A, Ziegler DK, Hassanein R. Vertigo, motion sickness and migraine. *Headache* 1981;21:227–231.
20. Kayan A, Hood JD. Neuro-otological manifestations of Migraine. *Brain* 1984;107:1123–1142.
21. Rasmussen BK, Jensen R, Schroll M, et al. Epidemiology of headache in a general population: a prevalence study. *J Clin Epidemiol* 1991;44:1147–1157.
22. Ishiyama A, Jacobson KM, Baloh RW. Migraine and benign positional vertigo. *Ann Otol Rhinol Laryngol* 2000;109:377–380.
23. Olsson J. Neurotologic findings in basilar migraine. *Laryngoscope* 1991;1:1–41.
24. Abu-Arafah I, Russell G. Paroxysmal vertigo as a migraine equivalent in children: a population-based study. *Cephalgia* 1995;15:22–25.
25. Nedzelski JM, Barber HO, McIlmoyl L. Diagnoses in a dizziness unit. *J Otolaryngol* 1986;15:101–104.
26. Committee on Hearing and Equilibrium. Committee on Hearing and Equilibrium guidelines for the diagnosis and evaluation of therapy in Menière’s disease. *Otolaryngol Head Neck Surg* 1995;113:181–185.
27. Rassekh CH, Harker LA. The prevalence of migraine in Menière’s disease. *Laryngoscope* 1992;102:135–138.
28. Goadsby PJ, Ferrari MD, Olesen J, et al. Eletriptan in acute migraine. *Neurology* 2000;54:156–163.
29. Peroutka SJ. Dopamine and migraine. *Neurology* 1997;49:650–656.
30. Kolev O. How caloric vestibular irritation influences migraine attacks. *Cephalgia* 1990;10:167–169.