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Epidemiology of vertigo, migraine and vestibular migraine

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■ **Abstract** Both migraine and vertigo are common in the general population with lifetime prevalences of about 16 % for migraine and 7 % for vertigo. Therefore, a concurrence of the two conditions can be expected in about 1.1 % of the general population by chance alone. However, recent epidemiological evidence suggests that the actual comorbidity is higher, namely 3.2 %. This can be explained by the fact that several dizziness and vertigo syndromes occur more frequently in migraineurs than in controls including benign paroxysmal positional vertigo, Meniere's disease, motion sickness, cerebellar disorders and anxiety syndromes which may present with dizziness. In addition, there is increasing recognition of a syndrome called vestibular migraine (VM), which is vertigo directly caused by migraine. VM affects more than 1 % of the general population, about 10 % of patients in dizziness clinics and at least 9 % of patients in migraine clinics.

Clinically, VM presents with attacks of spontaneous or positional vertigo lasting seconds to days. Migrainous accompaniments such as headache, phonophobia, photophobia or auras are common but not mandatory. Cochlear symptoms may be associated but are mostly mild and non-progressive. During acute attacks one may find central spontaneous or positional nystagmus and, less commonly, unilateral vestibular hypofunction. In the symptom-free interval, vestibular testing adds little to the diagnosis as findings are mostly minor and non-specific. In the absence of controlled studies, treatment of VM is adopted from the migraine sphere comprising avoidance of triggers, stress management as well as pharmacotherapy for acute attacks and prophylaxis.

■ **Key words** migraine · vestibular · vertigo · dizziness

Introduction

Recognition of an association between migraine and vertigo dates back almost 150 years when the English physician Edward Living noted that six out of 60 patients with migraine had spontaneous attacks of vertigo, as documented in his monograph *On megrim: a contribution to the study of nerve storms* [37]. That about 10 % of migraineurs suffer from vertigo caused by migraine has been confirmed quite recently [41], but the interrelations of migraine and vertigo are more complex. First of all, vertigo and migraine may coexist in the same individual by chance alone, as both are common conditions in the general population. Moreover, several vertigo syndromes have been shown to be epidemiologically associated with migraine: benign paroxysmal positional vertigo, Meniere's disease, motion sickness, cerebellar

disorders and several psychiatric syndromes which may present with dizziness. Finally, there is vestibular migraine (VM), which is recurrent vertigo as a symptom of migraine.

Epidemiology of migraine

The epidemiology of migraine has been investigated by population-based studies in various countries on the basis of the International Classification of Headache Disorders [28]. Lifetime prevalences have been largely consistent across industrialized countries ranging from 13 % [11, 36] to 16 % [21, 49]. Women were affected two to three times more often than men. The one year prevalence of migraine has been estimated at 11 % according to a metaanalysis comprising numerous studies from around the world [55].

Epidemiology of vertigo

Several studies have tried to assess the epidemiology of *dizziness,* which is a broad term, that includes vertigo and non-vestibular dizziness. Dizziness was found to be one of the most common complaints in medicine, affecting approximately 20 % to 30 % of the general population [25, 32, 63]. The epidemiology of *vestibular vertigo* was investigated only recently by means of a two-stage approach [46]. The first step was a telephone screening of a representative general population sample (German National Health Interview Survey, n = 4,869) for moderate or severe dizziness or vertigo, followed by detailed validated neurotologic interviews (n = 1003). The lifetime prevalence of vertigo in adults aged 18–79 was 7 %, the one-year prevalence 4.9 % and the one-year incidence 1.4 %. Interestingly, there was a marked female preponderance among individuals with vertigo (one year prevalence ratio male to female 1:2.7). The study also showed that vertigo is recurrent in the vast majority of patients (88 %). Vertigo has a considerable individual and social impact, causing interruption of daily activities in 40 % of affected individuals, sick leave in 41 % and avoidance of leaving the house in 19 % according to a recent survey [44].

Epidemiological association of migraine and vertigo

An increased comorbidity of migraine and vertigo, which exceeds what random chance would predict, was identified in various selected patient groups and later confirmed on the population level. Notably there is no single study that did *not* confirm such an association. Vertigo is two to three times more common in patients with migraine than in headache-free controls [33, 59] and in patients with tension-type headaches [31]. Vice versa, the prevalence of migraine has been shown to be elevated among patients with unclassified or idiopathic vertigo [2, 34, 54]. Similarly, migraine prevalence was 1.6 times higher in 200 consective patients from a dizziness clinic than in matched orthopedic controls [41].

The lifetime prevalences of migraine (16 %) and vertigo (7 %) lead to an expected comorbidity of the two conditions in 1.1 % of the general population. The actual comorbidity, however, as identified by the German National Health Survey, was 3.2 % [42]. A more recent population-based study showed that individuals with migraine were much more likely to have vertigo and vertigo with accompanying headache (OR 3.8 and 8, respectively) than non-migraineurs after adjustment for age and sex [45].

Specific vertigo syndromes associated with migraine

■ Benign paroxysmal positional vertigo

Benign paroxysmal positional vertigo (BPPV) is the most common vestibular disorder both in unselected patients [7] and in migraineurs [41] presenting to a dizziness clinic. Migraine is three times more common in patients with idiopathic BPPV than in patients with BPPV secondary to trauma or surgical procedures [29]. Moreover, migraine was two times more common in patients with idiopathic BPPV than in age- and sex-matched controls [35]. Genetic factors and vascular damage to the labyrinth have been discussed as pathogenetic mechanisms linking the two conditions [29].

■ Menière's disease

An increased prevalence of migraine in patients with Menière's disease (MD) is well documented [50, 51]. Migraine was twice as high in a group of 78 patients with unilateral or bilateral MD (based on the American Academy of Otolaryngology criteria), than in an age- and sex-matched control group (56 % vs. 25 %, p < 0.001) [51]. Migraine leads to a greater susceptibility of developing MD, as suggested by a study in which MD patients had an earlier onset of symptoms and a greater frequency of bilateral hearing loss when they also had migraine [15].

■ Motion sickness

Motion sickness is more prevalent in patients with migraine (30 % to 70 %) than in headache-free controls or

tension-type headaches (20 % to 40 %)[19, 31, 33, 38]. The association is more pronounced in children [6] and in migraine with aura [33]. Migraineurs are also prone to "visual vertigo" induced by optokinetic stimuli [19, 33], which can be conceptualized as a decreased threshold for visual-vestibular interaction.

■ Cerebellar disorders

Cerebellar dysfunction is linked in various ways to migraine [60], but does not normally present with "true" vertigo. However, both patients with familial hemiplegic migraine and episodic ataxia type 2 may have symptoms of basilar-type migraine including headaches and vertigo attacks [24] on the background of slowly progressive cerebellar dysfunction. The genetic basis of these disorders are mutations in the CACNA1A gene coding for the α_{1A} subunit of a neuronal Ca^{2+} channel, which is heavily expressed in the cerebellum [17]. Cerebellar signs are usually not present in the common types of migraine, but some investigators found subclinical hypermetria and other subtle cerebellar signs in patients with migraine with or without aura [27, 53].

■ Psychiatric syndromes

Dizziness, sometimes perceived as spinning vertigo, is the second most common symptom of panic attacks after palpitations [39] and can be a symptom of major depression as well. There are bidirectional associations of migraine with both major depression and panic disorder, with migraine being a risk factor for first-onset major depression and panic disorder and vice versa [10, 12].

Vestibular migraine

■ Diagnostic criteria

Vestibular migraine (synonyms: migrainous vertigo, migraine-associated dizziness, benign recurrent vertigo) designates vertigo attacks which are directly caused by migraine. The current International Classification of Headache Disorders (ICHD) of the International Headache Society does not include vertigo as a migrainous symptom in adults, except in the framework of basilar-type migraine (Internat. Classif). For a diagnosis of basilar-type migraine, the ICHD requires at least two posterior circulation manifestations lasting between 5 and 60 minutes, followed by a migraine headache. Less than 10 % of patients with VM fulfill these criteria [14, 18, 30, 41], meaning that most adult patients with VM cannot be classified with the current criteria.

Like migraine itself, VM is diagnosed on the basis of clinical information as there are no specific biological markers. A preliminary classification, using operational clinical criteria modeled on the ICHD, proposed two separate diagnostic categories: definite VM and the more sensitive but less specific, probable VM [41] (Table 1).

■ Epidemiology and demographic features of vestibular migraine

According to these diagnostic criteria, the frequency of definite VM was 7 % in a group of 200 consecutive dizziness clinic patients, and 9 % in a group of 200 migraine patients [41]. In a population-based study (n = 4869 adults) with screening interviews followed by expert

Table 1 Diagnostic criteria for vestibular migraine [41]

Definite vestibular migraine
A. Episodic vestibular symptoms of at least moderate severity
B. Current or previous history of migraine according to the 2004 criteria of the International Headache Society
C. One of the following migrainous symptoms during ≥ 2 attacks of vertigo: migrainous headache, photophobia, phonophobia, visual or other auras
D. Other causes ruled out by appropriate investigations *Comment:* Vestibular symptoms are rotational vertigo or another illusory self or object motion. They may be spontaneous or positional. Vestibular symptoms are "moderate" if they interfere with but do not prohibit daily activities and "severe" if patients cannot continue daily activities.
Probable vestibular migraine
A. Episodic vestibular symptoms of at least moderate severity
B. One of the following: a) Current or previous history of migraine according to the 2004 criteria of the IHS b) Migrainous symptoms during vestibular symptoms c) Migraine-precipitants of vertigo in more than 50 % of attacks: food triggers, sleep irregularities, hormonal change d) Response to migraine medications in more than 50 % of attacks
C. Other causes ruled out by appropriate investigations

telephone interviews (German National Health Survey), the lifetime prevalence of *definite* VM was estimated at 0.98 % (95 % CI 0.7–1.37) [42]. Interestingly, this is considerably less than the 3.2 % from the same sample who had both migraine and vertigo, partly because *probable* VM was not included and partly because patients with migraine may suffer from other vestibular disorders (see above). This emphasizes the necessity of a thorough neurotological evaluation of all patients with migraine and vertigo before making a diagnosis of VM.

VM may occur at any age [14, 16, 30] with a reported female to male ratio between 1.5 and 5 to 1 [14, 18, 30, 41]. Familial occurrence is not uncommon, probably based on an autosomal dominant pattern of inheritance with decreased penetrance in men [47]. In most patients, migraine headaches begin earlier in life than VM [18, 41]. Some patients are headache-free for years before VM manifests itself [18]. *Benign paroxysmal vertigo of childhood* is probably an early manifestation of VM and affects about 2.8 % of unselected children between the ages of 6 and 12 years [1].

■ Clinical features

The clinical characteristics of VM have been elucidated by several large case series from specialized dizziness clinics [14, 16, 18, 26, 30, 31, 41]. Patients with VM present with spontaneous or positional vertigo. Some experience a sequence of spontaneous vertigo transforming into positional vertigo later in the attack [40, 56]. Altogether, 40–70 % of patients have positional vertigo (but not benign paroxysmal positional vertigo) in the course of the disease [26, 31, 56]. Head motion intolerance, i.e., imbalance, illusory motion and nausea aggravated or provoked by head movements, is a frequent additional symptom [14, 30]. Visual vertigo, which is vertigo provoked by moving visual scenes (traffic, cinema) can be another prominent feature of VM [14, 61]. Nausea and imbalance are frequent but unspecific accompaniments of acute VM.

Both duration and frequency of attacks can vary between patients and in individual patients over time. The duration of vertigo ranges from seconds (about 10 %) and minutes (30 %) to hours (30 %) and several days (30 %) [16, 18, 30, 31, 58] For some patients, it may take weeks to fully recover from an attack. The attacks may occur days, months or even years apart in an irregular fashion. Overall, between 10 % and 30 % of patients have vertigo with the typical duration of a migraine aura, i.e., 5 to 60 minutes [18, 41]. VM often misses not only the duration criterion for an aura as defined by the IHS, but also the temporal relationship to migraine headaches: vertigo can precede headache as would be typical for an aura, may begin with headache or appear late in the headache phase. Many patients experience both attacks

with and without headache and, in some, vertigo and headache never occur together [16, 30, 41].

Photophobia, phonophobia, osmophobia and visual or other auras are common accompaniments of VM. These phenomena are of diagnostic importance, since they may represent the only apparent link between vertigo and migraine. Hearing loss and tinnitus are not prominent symptoms of VM but have been reported in individual patients with VM [14, 30, 31, 48]. Hearing loss is usually mild and transient, without progression in the course of the disorder which discriminates VM from Meniere's disease [30].

Precipitants of attacks may serve as diagnostic clues: menstruation, deficient or irregular sleep, excessive stress, relief from stress (weekends, beginning of a holiday), specific foods such as matured cheese, red wine and glutamate and finally sensory stimuli such as bright or scintillating lights, intense smells or noise. The triggers are highly individual and each one applies only for a few percent of the migraine population.

Psychiatric comorbidity, particularly with anxiety disorders, reaches 65 % in VM as compared to only 22 % in BPPV [20]. In an individual patient, both vestibular and psychiatric mechanisms may contribute to the dizziness [22]. These factors need to be weighed carefully to direct treatment appropriately.

■ Findings on examination

The general neurologic, vestibular and otologic examination is usually normal in the symptom-free period [16]. About 10–20 % of VM patients have unilateral hypoexcitability to caloric stimulation [16]. Neuro-ophthalmological evaluation may reveal mild central oculomotor deficits in the absence of other brainstem or cerebellar signs [18]. During the acute phase of VM patients often have imbalance and central vestibular findings such as spontaneous downbeating, upbeating or pure torsional nystagmus and/or persistent positional nystagmus [56, 57]. Some have a transient unilateral peripheral hypofunction with spontaneous horizontal nystagmus and an abnormal head thrust test [57]. The pathophysiology of VM is unknown. Various hypotheses have been proposed but, so far, none has had any impact on the management of these patients [23].

■ Treatment

When attacks of VM attacks are severe and frequent, acute or prophylactic treatment is warranted. However, apart from one small and inconclusive study on the use of zolmitriptan for acute VM [43] current treatment recommendations are based on expert opinion rather than randomized placebo-controlled trials. A few case reports

suggest that drugs used for migraine prophylaxis may be effective. These include propranolol [26], metoprolol [18], tricyclic antidepressants [52], pizotifen [52, 61], topiramate [13], and flunarizine [18]. Lamotrigine [9] and the carbonic anhydrase-inhibitors acetazolamide [4] and dichlorphenamid [3], which are not ordinarily used for migraine prophylaxis, have also been tried successfully, but these studies were not randomized or controlled.

Treatment of acute VM with acute migraine medication can be attempted with triptans [43] and vestibular suppressants such as promethazine, dimenhydrinate, and meclizine [5]. A retrospective study found that the effect of triptans on vertigo correlated with its effect on headache [8]. Non-pharmaceutical approaches may be more efficacious than drugs in individual patients. A thorough explanation of the migrainous origin of the attacks may relieve unnecessary fears. Avoidance of identified triggers, stress management and vestibular rehabilitation [62] can be helpful.

■ **Conflict of interest** The authors declare no conflict of interest.

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