Benign paroxysmal positional vertigo and migraine: analysis of 186 cases

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Abstract. *Benign paroxysmal positional vertigo and migraine: analysis of 186 cases*. *Objective*: This retrospective study assessed several clinical, case history and functional parameters to investigate benign paroxysmal positional vertigo (BPPV) in patients with migraine.
Methods: Two groups of patients were compared: those affected by BPPV and migraine (group A), as defined by International Headache Society criteria, and those with BPPV without migraine or with another form of headache (group B). The following parameters were investigated: onset of BPPV, recovery time, residual dizziness, recurrence of BPPV, atypical eye movement patterns and Meniere-like vertigo in the inter-critical BPPV period.
Results: Mean age at BPPV onset was 39 years±9.2 in Group A and 53 years±7.3 in Group B (p=0.00). No significant difference emerged in the number of manoeuvres needed to achieve recovery (Group A: 1.7±0.94; Group B: 1.9±0.89; p >0.05). Highly recurrent BPPV (at least 4 documented episodes) was observed in 15 patients from group A (19.4%) and in 8 patients from group B (7.3%). Atypical eyes movements and Meniere-like vertigo were more frequent in migraineurs with highly recurrent BPPV (Chi square=5.76; p<0.016).
Conclusions: A high prevalence of BPPV and earlier onset in migraine are the main findings of this study. There is a higher incidence of a range of neurotological patterns in the intervals between BPPV episodes in migraineurs with recurrent vertigo. No direct pathophysiological link between migraine and BPPV has yet been established; comorbidity seems to affect clinical features in a sub-population of patients and make BPPV more debilitating.

Introduction

Benign paroxysmal positional vertigo (BPPV), which affects the posterior labyrinth, is the most common vestibular disturbance in clinical practice. It is ubiquitous and onset is possible at any age, although incidence increases in the elderly.[1] The pathogenesis involves a form of otolithiasis[2] in a semicircular canal. BPPV is caused by floating otoconial material that triggers the critical endolymphatic currents underlying attacks. Paroxysmal nystagmus, the objective pathognomic sign of BPPV, is triggered by diagnostic manoeuvres and presents with typical morphological and temporal characteristics that support the canal lithiasis theory.[3] Although several hypotheses have been formulated, trauma[4] appears to be the only valid aetiology of BPPV when cause and effect are correlated over time to establish a causal relationship. Clinically, BPPV is characterised by brief, objective attacks of vertigo which are triggered by head movements affecting the semicircular canal in question. Vertigo is associated with neuro-vegetative manifestations but not with disturbances in hearing or other neurological signs or symptoms. In the inter-critical phase, or immediately after rehabilitation-induced resolution, patients complain of dizziness which could be due to functional modifications in macular receptors or the endolymphatic dispersion of otoconial debris, with the latter reducing the critical mass that induces significant endolymphatic currents. The links between vertigo and migraine have long been subject to debate.[5,6] BPPV is the most common vestibular disorder in patients with migraine[5] who are referred to an ENT clinic with vertigo symptoms. Migraine is significantly more frequent in idiopathic BPPV than in patients with BPPV secondary to trauma or surgery.[7] In idiopathic BPPV patients, migraine is significantly more prevalent than in healthy age- and sex-matched controls.[8] Even though the principal mechanisms in the pathogenetic association of BPPV and migraine are reported to be genetic factors and migraine-linked recurrent vascular damage to the inner ear,[7] the pathogenesis of more marked clinical manifestations in patients with migraine still requires elucidation. It is probable that repetitive ischaemic injuries to the

posterior labyrinth caused by migraine attacks result in chronic neuro-epithelial damage that predisposes to recurrent bouts of BPPV.[7]

In fact, the prolongation of mean latency values for p13 to the absence of VEMP waves indicates a pathogenetic connection between BPPV and neuronal degeneration in the macula of the saccule.[9] The present study was designed to provide a qualitative and quantitative assessment of BPPV-migraine comorbidity. Several clinical, case-history and functional parameters were systematically analysed and comparatively assessed to define BPPV in patients with migraine.

Materials and methods

This retrospective study recruited 186 consecutive patients (119 females, 67 males) with idiopathic BPPV, who were referred to our institute between 1 September 2009 and 31 January 2011. All underwent repositioning manoeuvres targeted in line with the BPPV site in the relevant semicircular canal. During the quiescent phase of the disease, at least one week after positional nystagmus had resolved, all patients underwent hearing and vestibular tests (caloric, VEMPs) to investigate vestibular function and labyrinth abnormalities, and to confirm the presence of labyrinth disease that had already been diagnosed or mentioned to the patient. Patients with recurrent BPPV and disturbances in eye movement also underwent a neurological examination and cerebral magnetic resonance imaging (MRI) to exclude compression, ischaemia or degeneration of the posterior cranial fossa. Headache assessment in all patients was designed to identify patients with forms of migraine in accordance with International Headache Society (IHS) criteria.[10] Patients were then divided into those with migraine (**group A)** and those without **(group B)** and the following clinical, case-history and functional parameters were investigated:

1) *Onset of BPPV* - Age at first documented episode.

2) *Recovery time* – The number of manoeuvres required to achieve the cessation of paroxysmal positional nystagmus and clinical recovery.

3) *Residual post-BPPV dizziness* – Four days after nystagmus had ceased, the patients underwent a check-up during which residual instability without overt vertigo, which often follows recovery from a BPPV episode, was assessed by means of the Dizziness Handicap Inventory (DHI) questionnaire.[11] Patients were invited specifically to reflect on the last few days following the symptomatic period and not to consider vertigo during the active phase of BPPV. The subjective visual vertical (SVV) was also determined to investigate whether instability was caused by abnormalities in utricular otolith function.

4) *Recurrent BPPV*-BPPV was defined as recurrent if the patient had undergone at least two documented episodes with an interval free of positional nystagmus lasting one month or more. Patients were considered to have recurrent BPPV even when the first episode preceded the period of time covered by this retrospective study. BPPV was defined as highly recurrent when patients had a history of at least four documented episodes.

5) *Abnormal eye movements* – this expression indicated clinical pictures other than typical BPPV episodes in patients with positional-like symptoms and a prior or subsequent history of documented BPPV who were referred to us during the time frame of the study. Semiological vestibular manoeuvres elicited nystagmus associated with an atypical eye movement pattern characterised by morphological and temporal features that were not encompassed by the canal lithiasis theory.

6) *Meniere-like Vertigo* – The present study also included patients with BPPV who, during the BPPV inactive phase, suffered episodes of spinning vertigo. Horizontal rotatory nystagmus, the main feature of these episodes, lasting at least 20 minutes and usually some hours, was sometimes associated with fluctuating hypacusia, auricular fullness and tinnitus. Clinical and functional recovery was complete.[12]

Student's t-test was used for statistical analyses. The comparison of mean values resulted in a statistical significance of $p<0.05$.

Chi-square testing was used to compare percentages.

Results

Group A included 77 patients (16 males, 61 females) and Group B 109 (51 males, 58 females). Migraine without aura was diagnosed in 68/77 patients in Group A. The other 9 had migraine with aura. Mean age at BPPV onset was 39 years±9.2 in Group A and 53 years±7.3 in Group B (p=0.00) (Figure 1). No significant difference emerged in the number of
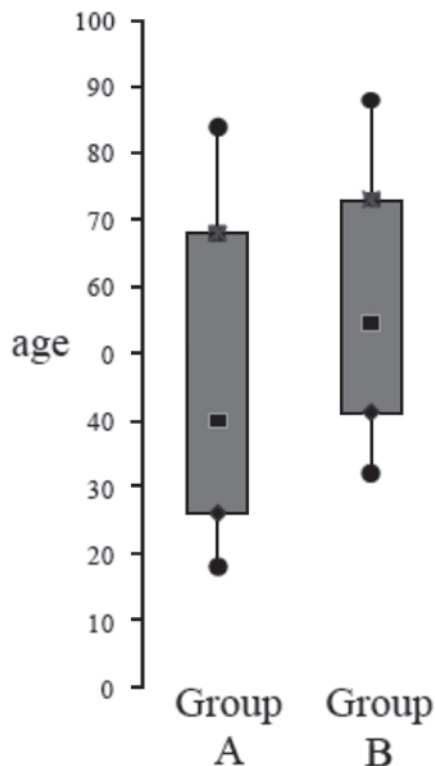
Figure 1
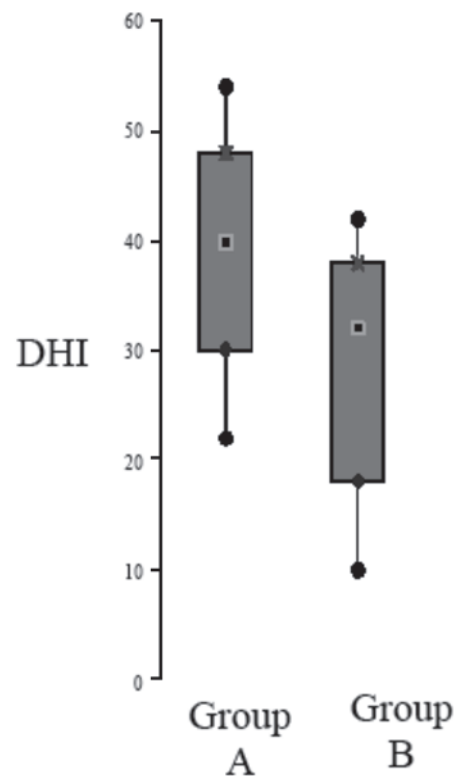Onset of BPPV and distribution by age in the two groups of patients.

Figure 2
DHI and distribution score in the two groups of patients

manoeuvres needed to achieve recovery (Group A: 1.7±0.94; Group B: 1.9±0.89: p>0.05). The mean DHI score was significantly higher in Group A (42.2±12.2) than in Group B (34.6±10.4: p<0.05), indicating that residual post-BPPV dizziness was more marked in patients with migraine (Figure 2). Mean SVV values did not differ significantly (1.1°±0.5 in Group A and 0.9°±0.6 in Group B). SVV values did not exceed the normal limit of 2° except when vestibular testing revealed a concomitant deficit in canal function.[13] Recurrent BPPV was present in 98 patients (52.6% of the total cohort), 41 patients (53.2%) in Group A and 57 (52.2%) in Group B. In Group A, 15 patients (19.4%) had had 2 episodes of BPPV; 11 (14.2%) had had 3 episodes and the other 15 patients (19.4%) had highly recurrent BPPV with at least 4 documented episodes. In Group B 35 patients (32.1%) had had 2 episodes of BPPV, 14 (12.8%) had had 3 episodes and the other 8 patients (7.3%) had had at least 4 episodes. Highly recurrent BPPV was more frequent among migraine patients to a statistically significant degree (Chi square=6.14; p<0.0132) (Table 1). An atypical eye movement pattern was observed in a total of 22 patients (11.8%): 18 in Group A (23.3%) and 4 in Group B (3.6%). A statistical difference was found between the groups (Chi square 16.8; p<0.001) (Table 1). In group A semiological findings were present in 8/15 patients (53.3%) with highly recurrrent BPPV (Figure 3). Onset of Meniere-like Vertigo, as defined by international criteria (Commitee on Hearing 1995), during the inter-critical BPPV period was observed in a total of 46 patients (21 males, 25 females): 26 in Group A (33.7%) and 20 in Group B (18.3%). A statistical difference was also found between the groups (Chi square=5.76; p<0.016) (Table 1). Transient auditory symptoms or permanent monolateral hypoacusia were associated with Meniere-like vertigo in 32/46 patients (69.5%): 17 (53.1%) in Group A and 15 (46.1%) in Group B. Meniere-like vertigo was an isolated symptom in the other 14 cases, 11 of whom (78.5%) were in group A and 3 (22.5%) in Group B (Figure 4). Finally 7/11 patients (46.6%) in Group A had highly recurrent BPPV. Caloric tests and head thrust tests in the inter-episode interval identified a monolateral deficit in vestibular function in a total of 18 patients

Clinical features and statistical findings in patients recruited in the study

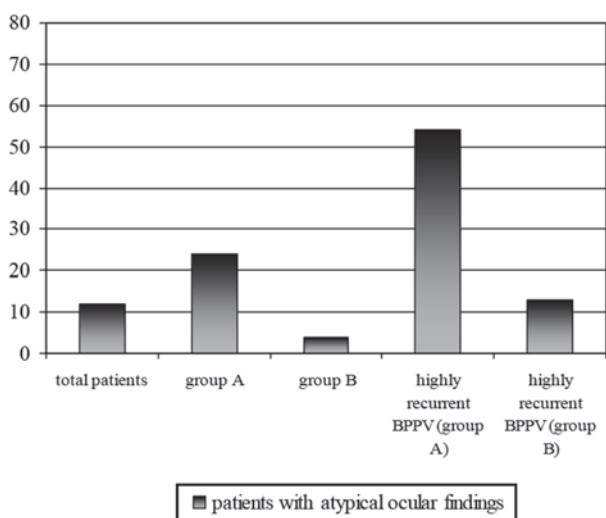| Clinical features	Total patients %	Group A %	Group B %	Statistical findings (Chi square test) group A and group B
Highly recurrent vertigo	23 (12.3%)	15 (19.4%)	8 (7.3%)	6.14 p = 0.0132
Atypical ocular findings other than typical BPPV episodes	22 (11.8%)	18 (23.3%)	4 (3.6%)	16.8 p < 0.001
Meniere-like vertigo	46 (24.5%)	26 (33.7%)	20 (18.3%)	5.76 p < 0.016

Figure 3
Incidence of atypical ocular findings in the interval between BPPV episodes in group A and group B, with and without highly recurrent vertigo.

Figure 4
Meniere-like vertigo with and without auditory symptoms in the two groups of patients.

(9.6%): 8 in Group A (10.3%) and 10 in Group B (9.2%). No significant difference was found in cervical VEMPs. The p13 wave was abnormal in 13 patients (16.9%): 5 in Group A (6.4%) and 8 in Group B (7.3%).

Discussion

Some aspects of the epidemiology, case histories, and clinical and functional profiles which emerge from this study merit further attention. As observed by others, BBPV onset is earlier in patients with migraine[7], with the first episode often occurring while women are fertile, in other words when the pathogenetic mechanisms of migraine are more active and the clinical manifestations of diseases like migraine and vertigo are more common. The present observation of the onset of BPPV in
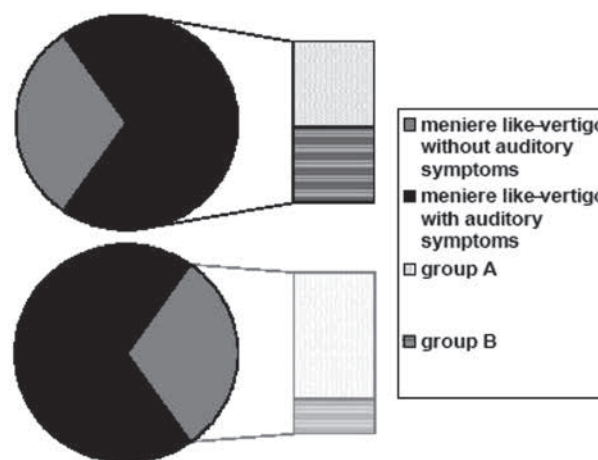
5 patients under 30 years of age, all in Group A and all with a strong family history of migraine, supports this epidemiological finding. The clinical course of BPPV did not differ significantly in patients with migraine: no significant differences were seen in the stages of disease evolution when compared with patients who were migraine-free. The finding that BBPV was highly recurrent in 15 migraine patients (19.4% in Group A) who were also affected by labyrinth disorders and abnormal eye movements suggests that the pathogenetic mechanisms underlying migraine can trigger disturbances in the entire vestibular, central and peripheral networks, which may manifest clinically in a range of ways. Indeed, during the BPPV-quiescent period we found a high incidence of Meniere-type vertigo episodes. Although the association between migraine and Meniere's disease has been widely documented[13,14], no significant differences emerged in our two groups with respect to vertigo episodes associated

Table 2

Bedside examination of 8 patients in group A (highly recurrent BPPV) with positional-like symptoms who were referred to us during the inter-critical BPPV period. Semiological vestibular manoeuvres elicited nystagmus associated with an atypical eye movement pattern characterised by morphological and temporal features that were not explained by the canal lithiasis theory

Patient	Sitting Position	supine position	Dix-Hallpike right side	Dix-Hallpike left side	Mc-Clure right side	Mc-Clure left side	Head hanging Position
1		persistent positional down-beating nystagmus					persistent positional down-beating nystagmus
2			persistent positional torsional (ccw) nystagmus	persistent positional torsional (cw) nystagmus	persistent positional torsional (ccw) nystagmus	persistent positional torsional (cw) nystagmus	
3			persistent positional down-beating nystagmus		persistent positional torsional (ccw) nystagmus		
4	Spontaneous down-beating nystagmus	persistent positional down-beating nystagmus					Persistent positional down-beating nystagmus
5	Spontaneous up-beating nystagmus			persistent positional torsional (cw) nystagmus			
6		persistent positional torsional (ccw) nystagmus		persistent positional down-beating nystagmus	persistent positional torsional (ccw) nystagmus	persistent positional torsional (ccw) nystagmus	
7					persistent positional up-beating nystagmus		
8							Persistent positional down-beating nystagmus

with hearing symptoms. On the other hand, Group A patients had a higher incidence of vertigo episodes without hearing deficits which were similar to, and often overlapped with, episodes of migraine-linked vertigo, suggesting that the pathogenesis of BPPV and migraine could be linked and confirming that a range of clinical manifestations that include BPPV are found in these patients. Among these heterogeneous clinical manifestations it is worth noting the higher incidence of abnormal eye movements occurring in the interval between BPPV episodes in patients with migraine who largely complained of positional-type vertigo symptoms. Vestibular semiological manoeuvres at the onset of symptoms in these patients evoked nystagmus which did not conform to the morpho-

logical and time parameters proposed by the canal lithiasis theory. Nystagmus patterns were described as long-lasting, vertical and down-beating, often without frank paroxysms or torsion, as induced by ampoule stimulation of the semi-circular vertical canals. They were evoked by head movements that did not always correspond to the standard positions that are used to diagnose BPPV. The eye movement pattern clearly indicated a central vestibular dysfunction, confirming other reports of clinical data about spontaneous downbeating-upbeating nystagmus, torsional nystagmus or persistent positional nystagmus (Table 2) which are characteristic of acute-phase migraine vertigo.[15,16] Although the origin of these nystagmus symptoms is still unclear, the finding of sub-clinical
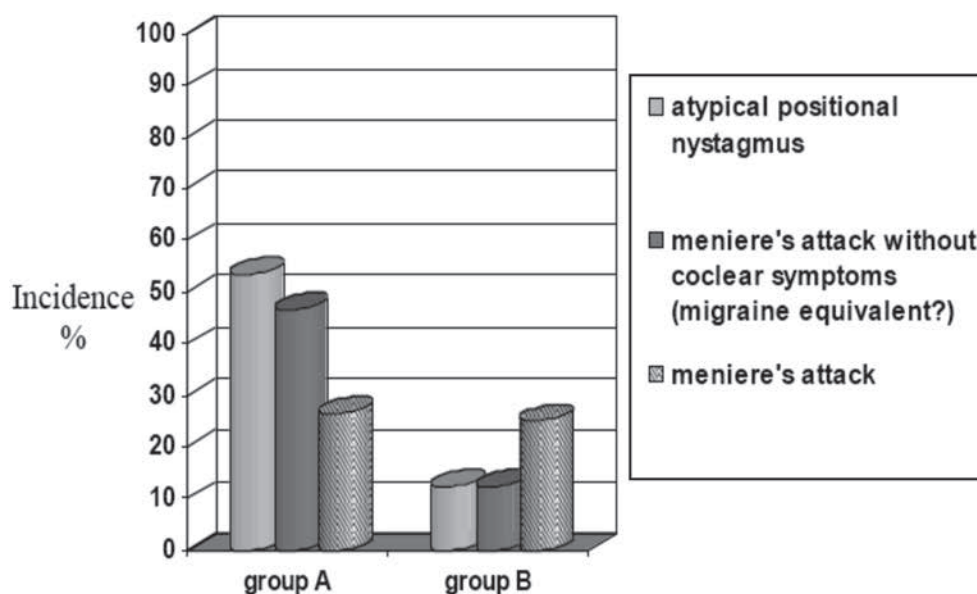
Figure 5
Percentage incidence of other neuro-otological patterns in the BPPV-quiescent period in patients with highly recurrent BPPV (Group A and Group B).

hypermetrics and other subtle abnormalities in the cerebellum of patients with migraine[17,18], whether aura is present or not, suggests that the cerebellum might play a role in the genesis of eye movement dysfunctions. On the other hand, it is more difficult to account for post-BPPV dizziness and its increased incidence in patients with migraine. Several authors[19,20] have observed an SVV abnormality immediately after manoeuvres resolving BPPV, claiming that this is due to the residual otolithic deficit after a marked loss of otocones and relative drop in otolithic dust density and specific weight. Since the SVV abnormality was slight and transient, it was hardly sufficient in itself to account for the marked dizziness in many cases.[19] Furthermore, in our series, the absence of significant differences in the SSV in our two groups of patients suggests that other pathogenetic mechanisms such as stress and case-history-related high-level anxiety are involved.[21,22] Anxiety and migraine are co-morbidities and both are frequently associated with dizziness.[23] One could speculate that high levels of anxiety can exacerbate residual post-BPPV symptoms, particularly with movement and sensory conflict. Indeed, patients with migraine-linked vertigo often complain of being unable to tolerate head movements and they also complain that

moving visual stimuli cause dizziness and visual vertigo.[23-25] In summary, although BPPV simply co-exists with migraine in the majority of patients, the data from the present study indicate that it may be possible to correlate the pathogenesis of the two conditions. BPPV may be one of the many possible clinical manifestations of a variable, non-stereotyped neuro-otological profile underlying the vertigo syndrome in a patient with migraine. BPPV and migraine appear to be correlated in a sub-population of patients (Figure 5) who, since significant markers of vestibular function are lacking, can only be identified by clinical features and case histories.

Conclusions

The high prevalence of BPPV and earlier onset in migraine patients are the main findings of this study. Another relevant finding is the higher incidence of Meniere-type vertigo and abnormal eye movements in the intervals between BPPV episodes. Although there is no direct patho-physiological link between migraine and BPPV, comorbidity seems to affect clinical features in a sub-population of patients and make BPPV more debilitating.

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