Benign paroxysmal positional vertigo and motion sickness

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Abstract

Symptomatology of Benign Paroxysmal Positional Vertigo (BPPV) is known to have great inter-divisional variability and different impact on patients' quality of life (QoL). It has been observed that subjects suffering from pre-existing Motion Sickness (MS) experience more severe symptoms at the onset of the disease and have a worse course despite the success of the treatment with the canalith repositioning procedure (CRP). The aim of this study was to verify whether the BPPV symptomatology is different in patients with pre-existing MS and how much this condition adversely affects QoL. To recognize and quantify the presence of the pre-existing MS, the Motion Sickness Susceptibility Questionnaire-short (MSSQ-short) was proposed; to quantify the QoL, the Italian version of the Dizziness Handicap Index (DHI-I) questionnaire was proposed. We selected 43 patients with unilateral idiopathic BPPV who responded positively to a single CRP. Based on the responses of the MSSQ-short, 17 patients had a moderate degree MS. The data collect from these patients was compared with those from 26 patients without MS. The average DHI-I score of MS patients collected in the first evaluation before the CRP was 55.4 (min 20 and max 92), while in patients without MS it was 37.5; the difference was statistically significant ($p = 0.014$). Both groups showed a significant reduction in the total DHI-I score after the successful CRP, although the scores in the two groups remained significantly different (p 0.004). The differences in the DHI-I values between the two groups after 15 and 30 days were not statistically significant. The results of this study show that patients suffering from MS in our sample had a more intense symptomatology compared to patients not affected by pre-existent MS. Therefore, we suggest identifying MS during the anamnestic data collection, as for these patients the CRP may not be able to fully alleviate the dizzying symptoms. These conclusions have implications for the therapeutic and pharmacological strategy aimed at controlling MS, and at intervening more effectively on BPPV symptoms.

Keywords: benign paroxysmal positional vertigo, Motion Sickness, Motion Sickness Susceptibility Questionnaire-short, Dizziness Handicap Index

Abbreviations: benign paroxysmal positional vertigo (BPPV), quality of life (QoL), Motion Sickness (MS), video nystagmography (VNG), Motion Sickness Susceptibility Questionnaire-short (MSSQ-short), Dizziness Handicap Index (DHI-I), standard deviation (SD), posterior canal (PC), anterior canal (AC), lateral canal (LC), canalith repositioning procedure (CPR).

Introduction

Benign paroxysmal positional vertigo (BPPV) is one of the most frequent vertigo diseases characterized by nystagmus and dizziness caused by head movements (Neuhauser 2007, Von Brevern 2007). Symptomatology is known to have great inter-divisional variability and impacts differently on quality of life (QoL). Recently, it has been observed that subjects suffering from pre-existing Motion Sickness (MS) may have more severe symptoms at the onset of the disease and experience a worse course, despite the success of the treatment with the canalith repositioning procedure (CRP).

MS is a common condition experienced especially by sensitive people exposed to a moving environment with low frequency accelerations (Golding 2016). Its prevalence is around 28% of the general population, with some

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differences between car-sickness, sea-sickness and air-sickness (Lackner 2014, Sharma 1997). The occurrence of MS can be linked to the inability of the system to respond to hypersensitive conditions. MS is characterized by a wide range of signs and symptoms with different levels of intensity: drowsiness, dizziness, malaise, restlessness, yawning, stomach pain, nausea, pallor, sweating, headache, bradycardia, hypotension, vomiting and apathy. Frequently, multiple symptoms occur at the same time.

Although MS is a known condition, its pathogenesis is not yet fully understood. The most common theory is that of "sensory conflict" (Bles 2000). The theory is based on two principles: the first is that the movements that stimulate our body can generate constant messages between the visual, vestibular and somatosensory system (Flanagan 2004, Reason 1978); the second is that the vestibular system plays an important role in MS generation. Indeed, patients with total loss of vestibular function have been shown to be insensitive to MS (Cheung 1991). In this hypothesis, the reflex is accidentally activated by sensory conflicts induced by any disruption of the expected models by the vestibular, visual and somatosensory system. These inputs, if conflicting, are interpreted as a malfunction of the central nervous system and activate nausea and vomiting as a defense against the possible ingestion of a possible neurotoxin. Therefore, MS can be considered as the activation of this ancient defense reflex against sensorineural conflicts (Muth 1996). There is a wide interindividual variability as regards a different combination of signs and symptoms.

The aim of the study was to verify whether the symptomatology of the BPPV before and after a successful CRP is different in patients with pre-existing MS and how much this condition adversely affects QoL.

Patients and Methods

We observed 72 consecutive patients referring to the Department of Otolaryngology of the Sapienza University of Rome, Italy, with a diagnosis of BPPV.

Only patients with unilateral idiopathic BPPV without concomitant vestibular disorders who responded positively to a single CRP were included in the study. The patients selected according to these criteria were 43. The BPPV diagnosis was formulated on the basis of a detailed medical history, a complete otoneurological examination and on the positive response of the Dix-Hallpike and Pagnini diagnostic maneuvers recorded with video nystagmography (VNG). The patients underwent Epley's modified maneuver for the posterior semicircular canal BPPV and the Pagnini-McClure maneuver for BPPV of the lateral semicircular canal. The diagnostic maneuvers with VNG were repeated after 3, 15 and 30 days.

To recognize and quantify the presence of the pre-existing MS, the Motion Sickness Susceptibility

Questionnaire-short (MSSQ-short) was proposed. The MSSQ-short is the reduced revision of the Motion Sickness Susceptibility Questionnaire which was conceived by Reason and Brand (Reason 1978), revised and shortened in the MSSQ-Short version by Golding (Golding 2006 e Golding 1998) and subsequently validated in several languages including Italian. The MSSQ-short includes questions related to individual sensitivity to MS and the types of motion that mostly cause it. It is divided into two sections: section A investigates childhood experience and the presence of MS before the age of 12; section B investigates the presence of MS in the past 10 years (Table 1) (Appendix 1).

To quantify QoL in patients with BPPV, the Italian version of the Dizziness Handicap Index questionnaire (DHI-I) was proposed (Nola 2010). The questionnaire developed by Jacobson and Newman (1990) (Jacobson 1990) is an internationally validated tool that evaluates the perception of the effects of vertigo on the QoL by analyzing the physical, functional and emotional aspect. Both questionnaires were proposed during the first visit; DHI-I was also administered in follow up visits after 3, 15 and 30 days (Appendix 2).

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Table 1. MSSQ-Short

	Not applicable - Never tried	Never been sick	Seldom	Sometimes	Often
Car					
Buses or wagons					
Prain					
Plane					
Boat					
Ship station and ferries					
Swing					
Rides					
Clash					
	t	0	1	2	3

Appendix 1: MSSQ-short score

The MSSQ questionnaire assesses the frequency of MS through the analysis of 9 different conditions experienced in childhood and over the past 10 years. Scores are determined on the basis of the following formula: never been bad (0 points), rarely (1 point), sometimes (2 points), or often (3 points). The points assigned to each of the 9 types of conditions are summed together and then divided by the number of transport types tested, excluding from the calculation the conditions never tested. The result of the calculation for childhood experiences is added to that of adulthood. The total score ranges from 0 (no MS experience) to 54 (MS tested for each type of transport). Based on the scores obtained, it is possible to divide the population into MS susceptibility groups based on the quartiles defined by Golding (2006): Low sensitivity = first quartile, Mild-moderate susceptibility =second and third quartiles, High susceptibility = fourth quartiles.

Appendix 2: DHI-I score

The DHI-I questionnaire is divided into 36 questions concerning physical function, physical role, physical pain, general health, vitality, social activity, emotional role and mental health. For each item the following scores are assigned: No = 0, sometimes = 2, Yes = 4. The various groups of questions are collected by affinity into three groups called the functional scale (F), physical (P), and (E) emotional scale. The 3 scales are calculated individually on the basis of the answers to the individual questions and subsequently their respective values are added together resulting in a value from 0 to 100; the lower score indicates better health, while the higher score indicates poor health. Based on the scores obtained at the MSSQ-Short, the participants were divided into two groups. The first included those without MS or with low sensitivity. In the second, those who had mild, moderate or high susceptibility. DHI-I values obtained during the first visit and subsequent checks were calculated in each group.

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Statistical analysis

The statistical analysis was carried out using central trend measures (average and median), as well as dispersion measures (standard deviation, SD; range: minimum - maximum). The univariate analysis was carried out for the differences between test groups, using nonparametric tests (Mann Whitney and Chi-square, for continuous and categorical variables, respectively). Differences between patients over two different time periods were assessed using a Wilcoxon signed rank test. The bivariate analysis was carried out using the Spearman correlation coefficient in order to examine the correlation between the DHI-I subscales. Finally, the linear regression models were constructed in order to find the variables significantly associated with the change in the levels of DHI (for the total score and for the individual subscales). Statistical significance was set at $p < 0.05$. The statistical analysis was conducted using SPSS 23.0.

Results

Forty-three patients out of 72 (59.7%) met the inclusion criteria and were included in the study. The average age was 63.1 years (max 87 years and minimum 19 years); 34 were females, 9 were males; 18 patients had a right posterior canal BPPV, while 19 had a left posterior canal BPPV. Four patients had a left and 2 right lateral canal BPPV. Nineteen patients (44.1%) reported migraine.

Based on the responses of the MSSQ-short, 17 patients had a moderate degree MS (MSSQ-short score greater than 9). The mean MSSQ-short score in patients with moderate degree MS was 22.9 (from 9.0-29). Eleven patients reported suffering or having suffered from migraine. Patients with moderate MS were distinguished from those without evident MS for age ($p > 0.003$) and the incidence of migraine ($p > 0.028$) (Table 2).

At the first evaluation before CRP, the average DHI-I score of MS patients was 55.4 (min 20 and max 92), while in patients without MS was 37.5 (6-92). The difference was statistically significant ($p = 0.014$). There was a statistically significant difference ($p = 0.032$; 0.032; 0.026) for the three DHI-I scales (Table 3). At this timepoint, the correlation between the physical and functional aspects was strongly positive ($r = 0.844$; $p < 0.001$), and the correlation between the emotional and functional aspects was moderately positive ($r = 0.6565$; $p < 0.001$) (Table 4). This indicates the interrelationship of these factors on the QoL of the patients (the positivity of the functional aspects influences and is influenced by the physical and emotional aspects).

Both groups showed a significant reduction in the total DHI-I score after the successful CRP; the MS group gained 10.59 points at DHI-I, compared to the 13.39 points of the non-MS group. The mean value of DHI-I showed a statistically significant difference (44.82 vs 24.15, p 0.004). The comparison of the values of the three scales of the two groups showed a statistically significant difference ($p = 0.009$; 0.008; 0.044, respectively): the values of the group without MS was 9.6; 4.9; 9.7 and with MS was 15.5; 12.6; 17 (Table 5).

In the pre and post CRP analysis, no correlation between age and gender with the DHI-I scores was found, suggesting that CRP results are not conditioned by age or gender

In our series only 8/26 (29.6%) patients without MS and 4/17 (23.5%) patients with MS showed a reduction >18 points ($p = 0.7395$). Two patients with MS (16.6%) despite the positive result of CRP recorded a worsening of DHI-I while 4 patients without MS were unchanged ($p = 0.1857$).

Patients were evaluated after 15 and 30 days. In MS patients, the DHI-I score after 15 days was 25.4 (10;5;10), while after 30 days it was reduced to 16 (7;4;6). In patients without MS, the DHI-I at the control of 15 days after CRP was equal to 15.8 (6;3;6), while after 30 days it was reduced to 12 (4;3;4). The differences in the DHI-I values in the two groups were not statistically significant for both values at 15 and 30 days, even if a difference was seen at each timepoint.

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Table2. Comparison between patients without MS (n 26) and patients with moderate MS (n 17)

	n 26 (no MS)	n17 (MS)	
Average age	69,2 y	53,8 y	p=0.003
Gender	18 female (69,2%)	16 female (94,1%)	p=0.065
BPPV post dx	11 p (42,3%)	7 p (42,2%)	p= 0,941
BPPV post sn	12 p (46,2%)	7 p (41,2%)	p=0.748
BPPV lat dx	1 p (3,8%)	3 p (17,6%)	p=0.384
BPPV lat sn Migraine	2 p (7,7%) 8 p (30,8%)	0 p (0%) 11 p (68,7%)	p=0.511 p=0.028

Table3. Comparison DHI-I pre ML broken down into the functional and physical scales between patients without MS (n 26) and patients with MS moderate (n 17)

	n 26 (no MS)	n 17 (MS)	
DHI-I	37,5	55,4	p=0.014
Functional scale	19,3	14,4	p=0.032
Emotional scale	16,4	9,31	p= 0,032
Physical scale	20,4	13,8	p=0.026

Table 4. Spearman correlation coefficients (r) of the relationship between age and DHI-I score

	DHI r (p)	DHI Phys R (p)	DHI E R (p)	DHI Fun R (p)
Pre	0.010	-0.180	0.146	-0.018
	(0.948)	(0.254)	(0.358)	(0.911)
Post	-0.025	-0.195	0.045	0.060
	(0.876)	(0.217)	(0.778)	(0.708)

Table 5. Comparison DHI-I after CPR broken down into the functional and physical scales between patients without MS (n 26) and patients with MS moderate (n 17)

	n 26 (no MS)	n 17 (MS)	
DHI-I	24,15	44,8	p=0.004
Functional scale	9,6	15,5	p=0.009
Emotional scale	4,9	12,6	p= 0,008
Physical scale	9,7	17,1	p=0.044

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Discussion

In this study we evaluated whether the presence of MS could affect the presentation symptoms of BPPV and the course after a successful CRP. To pursue this aim, we excluded from the study all the patients with bilateral or multiple canal BPPV or concomitant pathologies such as Meniere's disease or vestibular neuritis. Moreover, we selected patients in which only one CRP was needed, in order to have a study population as homogeneous as possible and to avoid variables related to failure of maneuvers. The exclusion criteria also included: 1) failure of CRP, 2) history of inner ear disease, or 3) positional nystagmus at follow up.

Analyzing the results of our study, it is clear that patients suffering from MS experience a more intense symptomatology than patients not affected by pre-existing MS, as for the physical, functional and emotional aspects of their symptomatology (p=0.032; 0.032; 0.026). This is a very important fact in the management of patients with BPPV.

In our study we used the DHI questionnaire to evaluate the perception of the effects of vertigo on the QoL of patients with BPPV. In the literature, the DHI questionnaire has already been used to evaluate the impact on the QoL of residual symptoms after Epley's maneuver, although some authors believe that residual symptoms cannot be effectively assessed by the DHI questionnaire score alone (Baran 2014). Looking at the total DHI scores obtained in patients who complained of MS, we saw that the score was significantly higher at the time of diagnosis compared to the time of the first clinical follow-up after successful CRP (p = 0.7395). This difference was mainly due to the scores obtained by two subscales: the DHI-F and the DHI-E. The DHI-F expresses the functional limitation in daily life, which can be influenced, for example, by concern about the occurrence of further episodes of vertigo; DHI-E refers to the emotional impact caused by dizziness. In particular, the questions of the DHI-E questionnaire are better able to investigate the feelings of insecurity, anxiety and depression experienced by patients in response to their vestibular disorders.

In our experience, the DHI-E score constitutes the most important predictive factor for the presence of MS. The emotional aspect plays a predominant role in the development of MS, and this suggests that DHI could be a simple tool to predict the occurrence of this disorder, especially by referring to the DHI-E score. In fact, the DHI score is also useful to predict the BPPV. Several studies show that the probability of a correct diagnosis of BPPV is 16 times higher if the DHI score is greater than or equal to 50. The trend of the DHI score, together with a detailed clinical history, could be one of the useful parameters for early identification of patients with VPPB. This could prevent further investigations. Furthermore, the results of DHI may indicate a high level of diagnostic suspicion for BPPV in those patients who have difficulty performing the Dix Hallpike maneuver, therefore including pathologically obese patients, patients suffering from severe anxiety, extremely fragile patients with limited motility (Baran 2014).

Conclusion

The results obtained in our study show that the presence of MS may affect the severity of the BPPV symptoms. The physical, emotional and functional disorders associated with the different types of dizziness damage the professional, social and domestic activities of the patients. This has an effect on the capability in carrying out the normal activities of daily life and consequently leads to a deterioration in the QoL. Therefore, it is useful to identify, during the anamnestic data collection, patients suffering from MS, as for them the CRP may not be able to completely alleviate the dizzying symptoms. What has been said above has implications for the therapeutic and pharmacological strategy aimed at controlling MS, and at intervening more effectively on the symptoms of BPPV.

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