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Effects of treatment on anxiety levels among patients with benign paroxysmal positional vertigo

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Abstract

Purpose The association of vertigo with anxiety disorders is well known. Herein, we aimed to determine the relationship between pre-treatment and post-treatment anxiety levels, assessed with Beck anxiety inventory, with educational status among patients diagnosed with and treated for Benign paroxysmal positional vertigo (BPPV), and to evaluate the effect of treatment on the sub-parameters of the Beck anxiety inventory.

Methods Our study included a total of 33 patients that presented to the otorhinolaryngology outpatient clinic with acute vertigo and were diagnosed to have posterior canal BPPV. Patients diagnosed with posterior BPPV were applied Beck anxiety inventory prior to the treatment as well as 1 week and 4 weeks after the treatment.

Results Compared to the control group, statistically significant changes were observed in relation to pre-treatment and post-treatment inventory scores ($p < 0.05$). A comparison of the pre-treatment and post-treatment assessments revealed significant differences ($p < 0.05$). Improvements were observed in 48% (10/21) of the subparameters by the end of the first week at the earliest. Educational status had no significant effect on inventory scores ($p > 0.05$).

Conclusion Anxiety-related subjective symptoms mostly started to improve 1 week after the treatment at the earliest, and symptoms showed persistence at a certain level even at the end of the first month. Inequalities between the patients' educational levels affect anxiety levels. It should be remembered that educational status should be considered when approaching patients.

Keywords Anxiety · Beck anxiety inventory · Vertigo · Benign paroxysmal positional vertigo · BPPV

Introduction

Benign paroxysmal positional vertigo (BPPV) is the most common peripheral vestibular system disorder. Albeit variable, it is responsible for 20–40% of cases on average [1]. The disorder was first described by Barany in 1921. In 1952 Dix and Hallpike defined its characteristic features [2]. BPPV is a vertigo syndrome dependent on postural changes and characterized by nystagmus. It was first described by a type of vertigo brought about by changes of head position [3]. It is the most common cause of recurrent vertigo. It is characterized by acute, short attacks of severe dizziness brought about by sudden head movements [4].

The exact cause of BPPV mostly remains obscure, and thus called idiopathic. Considering its high prevalence among middle-aged women, hormonal changes may be playing a role in its etiopathogenesis [5]. BPPV histopathology is most commonly explained by the canalolithiasis theory which is based on calcium carbonate crystal particles that are most commonly accumulated in the descending parts of the posterior semicircular canal [6]. With sudden head movements these crystal particles move in the ampullofugal direction and act like a piston in the narrow posterior semicircular canal. This causes endolymph to move, triggering vertigo and nystagmus [6]. BPPV of posterior semicircular canal origin is the most common form and diagnosed by the Dix-Hallpike maneuver [7]. BPPV may occur secondarily to various disorders injuring inner ear and separating otolith from utricular macula [8]. The most common cause of BPPV is head trauma resulting in mechanical ear injury [8]. In a

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report of a large number of patients with BPPV the cause of otoconia detachment could not be identified in 34–66% of the cases. As acquired or secondary forms, head trauma and inner ear disorders like viral neuro labyrinthitis and Meniere disease are considered the most common causes [9]. Posterior canal BPPV is the most common form. In only 5–22% it originates from the horizontal or, more rarely, anterior canal [9].

It has been suggested that BPPV is related to psychiatric disorders like depression, panic attacks, and other anxiety disorders in susceptible persons [4]. The sensation of dizziness has been regarded as the most worrying sensation compared to other bodily sensations [10]. Particularly vestibular vertigo may trigger symptoms of anxiety. Information obtained from the vestibular apparatus are processed in amygdala, infralimbic cortex, and hypothalamus where emotional reactions are modulated, and, through more advanced connections, parabrachial nucleus [11].

Connections from the vestibular nuclei to the parabrachial nucleus provide a direct communication between neural networks that also include anxiety and emotions that manifest with the vestibular system. This parabrachial nuclear network comprises certain regions that produce the psychological manifestations of emotions, fear, and anxiety. It is hypothesized that the parabrachial nuclear network is essential for the maintenance of the explanation of emotional information, somatic motor activity, and visceral motor activity [12, 13].

Vertigo and/o imbalance is an unpleasant and frightening condition and thus the association of vertigo with anxiety disorders is well known [14, 15]. Several studies have related benign paroxysmal positional vertigo (BPPV), the most common cause of dizziness among adults, and anxiety levels [16]. Although psychiatric comorbidities have been defined in some vestibular disorders like Meniere disease or vestibular neuronitis or non-specific vertigo or dizziness, albeit on a relationship basis, there is a limited number of studies about psychiatric disorders in BPPV patients [17–19].

Beck anxiety inventory (BAI) is a self assessment scale. It is used to determine the frequency of an individual's anxiety symptoms. It provides a Likert type (sum of grades) rating. The point score that a patient attains indicates the severity of anxiety [20].

A literature review found a study using BAI for rating anxiety among patients diagnosed with BPPV, which revealed significantly higher validity the Beck anxiety inventory scores (BAIS) in the BPPV patients compared to the control group on the 7th and 14th day of therapy [21]. However, that study did not assess a relationship between treatment efficacy and educational level. Moreover, it did not study in detail the sub-parameters of the BAI. It did not evaluate the responses of the sub-parameters to the treatment, either. We aimed to assess the relationship between pre-treatment and post-treatment anxiety levels rated by BAI and educational level among patients with BPPV and, by this way, to contribute to the available literature. We also aimed to assess the effect of treatment on anxiety level more in detail by assessing BAI sub-parameters.

Materials and method

Patients who presented to otorhinolaryngology outpatient clinic with acute dizziness and were diagnosed with posterior canal BPPV were enrolled. The study was started with 37 participants who were informed and who agreed to participate in the study. However, four patients were excluded at the end of the first week due to positive findings in Dix-Hallpike test; therefore, the study was continued with the remaining 33 patients.

All patients first underwent a comprehensive otorhinolaryngological examination. Patients with acute or chronic signs were excluded. Patients with vestibular system disorders or central disease states other than BPPV, such as chronic otitis media, perilymph fistula, labyrinthitis, and vestibular neuritis, were also excluded. Additionally, patients with cervical or lumbar pathological conditions precluding the Epley maneuver were excluded, as were those who were unwilling to undergo Epley maneuver after Dix-Hallpike Maneuver. Patients with any neurological complaint other than dizziness, systemic disease, history of psychiatric drug use, cervical hernia, and other otological symptoms were also excluded. Patients with hearing loss and those with abnormalities in hemogram, biochemistry, and hormone tests were eliminated.

All patients underwent a fistula test, a pure tone audiometry, tympanogram, routine hemogram, and biochemistry; they also underwent Dix-Hallpike maneuver with Frenzel glasses. Patients who had dizziness and horizonto-rotatory nystagmus and whose full direction determination was performed were enrolled.

The control group (n:33) consisted of individuals with no significant differences from the patient group with respect to the number of subjects, educational level, age, sex distribution. All exclusion criteria applied to the patient group also applied to the control group. Participants with any pathological condition were excluded. BAI was applied once to the control subjects, and their results were compared with those of the patient groups.

The examination revealed left posterior BPPV in 11 (33%) patients and right posterior BPPV in 22 (67%) patients. The study only included patients diagnosed with posterior canal BPPV for the purpose of standardization. The patients were not begun on any anti-vertiginous therapy or anti-emetic medication. The patients that required medical therapy were excluded.

Patients diagnosed with BPPV after Dix-Hallpike maneuver were applied BAI. The latter only took into account symptoms occurring for the last week including the day of questionnaire. 21 different questions were assigned 0–3 points and the total point score was recorded. Zero point was assigned to "not at all"; 1 point to "Mildly, but it didn't bother me much"; 2 points to "Moderately—it wasn't pleasant at times"; and 3 points to "Severely—it bothered me a lot". The score ranged between 0 and 63 points. A score of 0–21 indicates a low level of anxiety; 22–35 a moderate level of anxiety; and 36–63 a severe level of anxiety [22]. All patients were applied Epley maneuver and they were called for a control visit 1 week later. Patients who had bilaterally negative results in Dix-Hallpike test were re-applied BAI. The patients were called for a control visit 4 weeks later and re-applied BAI at that time. Table 1 shows the questions asked to the participants.

Statistical analysis

All statistical analyses were performed using SPSS for Windows 18.0 (Chicago, IL). The descriptive statistics included mean ± standard deviation for normally distributed variables. The inter-group analyses were performed using Chi-Square test, Kolmogorov–Smirnov test, *t* test, and one-way anova test. Reliability Analysis was performed with Cronbach's Alpha. $p < 0.05$ was considered statistically significant for all analyses.

Table 1 Beck anxiety inventory questions

1. Numbness or tingling sensation
2. Feeling hot
3. Wobbliness in legs
4. Inability to relax
5. Fear of worst happening
6. Feeling Dizzy or lightheaded
7. Heart pounding/racing
8. Feeling unsteady
9. Feeling terrified or afraid
10. Nervousness
11. Feeling of choking
12. Hands trembling
13. Feeling shaky/unsteady
14. Fear of losing control
15. Difficulty in breathing
16. Fear of dying
17. Being scared
18. Indigestion
19. Faint/lightheaded
20. Facial flushing
21. Sweating (unrelated to ambient temperature)

Results

Our study included a total of 33 patients of whom 19 (57.6%) were female and 14 (42.4%) were male. 13 (39.4%) patients were primary school graduates; 10 (30.3%) high school graduates; and 10 (30.3%) college or higher graduates. The mean age of the study population was 43.97 (min.21−max.63) years.

The pre-Treatment questionnaire results revealed a Cronbach's Alpha level of 0.919; the one performed 1 week after the treatment 0.932; and the one performed 4 weeks later 0.716. A Cronbach's Alpha analysis revealed a reliability index of > 0.7, thus suggesting that our data were reliable. Women had a pre-treatment BAIS of 26 ± 13.518 and men 11.71 ± 6.673 ($p = 0.000$, $p < 0.05$). Among patients who had a bilaterally negative Epley maneuver and were applied BAI, women had a mean score of 13.53 ± 13.517 and men 5.71 ± 6.366 ($p = 036$, $p < 0.05$). At control examination 4 weeks after treatment, mean BAIS was 3.05 ± 2.571 in women and 1.21 ± 1.672 in men ($p = 0.019$, $p < 0.05$) (Table 2).

Pre-treatment, post-treatment, and 4th-week analyses showed that the difference in educational level had no significant effect on BAIS ($p = 0.374$, $p = 0.396$, $p = 0.383$, $p > 0.05$) (Table 3).

Table 2 Inter-gender differences between Beck anxiety inventory scores (BAIS)

	Female *N*:19	Male *N*: 14	*p*
1[a]	26 ± 13.518	11.71 ± 6.673	0.000
2[b]	13.53 ± 13.517	5.71 ± 6.366	0.036
3[c]	3.05 ± 2.571	1.21 ± 1.672	0.019

[a]1 Mean pre-treatment BAIS + standard deviation

[b]2 Mean immediately post-treatment BAIS + standard deviation

[c]3 Mean 4th-week BAIS + standard deviation

Table 3 The relationship between Beck anxiety inventory scores (BAIS) and educational level

	Primary school *N*:13	High school *N*:10	College *N*:10	*p*
1[a]	23.38 ± 14.460	19.90 ± 12.206	15.50 ± 12.213	0.374
2[b]	13.15 ± 14.955	10.20 ± 8.108	6.40 ± 9.276	0.396
3[c]	2.54 ± 2.634	2.80 ± 2.821	1.40 ± 1.350	0.383

[a]1 Mean pre-treatment BAIS + standard deviation

[b]2 Mean immediately post-treatment BAIS + standard deviation

[c]3 Mean 4th-week BAIS + standard deviation

The participants had a mean total pre-treatment BAIS of 19.94 ± 13.162, an immediately post-treatment mean total BAIS of 10.21 ± 11.602, and a mean 4th-week total BAIS of 2.27 ± 2.388.

There was a significant difference between pre-treatment and post-treatment mean BAIS ($p = 0.000$, $p < 0.05$). There was also a significant difference between pre-treatment and post-treatment 4th-week BAIS ($p = 0.000$, $p < 0.05$). Furthermore, BAIS immediately post-treatment and 4th post-treatment were also significantly different ($p = 0.000$, $p < 0.05$) (Table 4).

A comparison of the BAI sub-parameters between the pre-treatment assessment of the participants made at the time of admission and the assessment of patients who were called for a control visit at 1st week and had a bilaterally negative result in Dix-Hallpike test showed no significant differences with respect to feeling hot, inability to relax, heart pounding / racing, feeling of choking, feeling shaky/unsteady, difficulty in breathing, facial flushing, and sweating (unrelated to ambient temperature) ($p > 0.05$). However, these complaints showed significant differences at control assessments 4 weeks later ($p < 0.05$).

There were significant differences between the rates of these complaints at control assessments performed at 1 and 4 weeks. These complaints were reduced only after a week ($p < 0.05$) (Table 5).

An comparison of the BAI sub-parameters between the pre-treatment assessment of the participants made at the time of admission and the assessment of patients who were called for a control visit at 1st week and had a bilaterally negative result in Dix-Hallpike test showed significant differences in numbness or tingling sensation, wobbliness in legs, feeling shaky/unsteady, fear of worst happening, feeling dizzy or lightheaded, feeling unsteady, feeling terrified or afraid, nervousness, hands trembling, fear of losing control, indigestion or dyspepsia, faint/lightheaded, and these complaints regressed starting from the first week ($p < 0.05$) (Table 5).

In the control group there were 33 volunteers of whom 18 (54.5%) were female and 15 (45.5%) were male. In the control group 12 (36.4%) participants were of primary school graduates; 11 (33.3%) high-school graduates, and 10 (30.3%) college graduates. A comparison with the control group showed significant results with respect to the pre-treatment BAIS ($p = 0.005$, $p < 0.05$). There were significant differences between the patient and control groups at first week of treatment ($p = 0.000$, $p < 0.05$) and at 1 month ($p = 0.000$, $p < 0.05$).

No significant difference was shown between the patient and control groups with respect to distribution of sex ($p = 0.808$, $p > 0.05$). There was no significant difference between the patient and control groups with regard to the educational level, either ($p = 0.883$, $p > 0.05$). Moreover, there was no significant difference between the patient and control groups with respect to age ($p = 0.626$, $p > 0.05$). This suggests that there existed no significant differences between the two groups with regard to age, sex, and educational level, and that they were of adequate level for statistical comparison of other variables.

Table 4 Treatment-induced changes in Beck Anxiety Inventory Score (BAIS)

Mean BAIS + standard deviation	
Mean pre-treatment BAIS + standard deviation	19.94 ± 13.162
Mean immediately post-treatment BAIS + standard deviation	10.21 ± 11.602
Mean 4th-week BAIS + standard deviation	2.27 ± 2.388
p values	
[a]1–2	0.000
[b]1–3	0.000
[c]2–3	0.000

[a]1–2 statistical comparison of pre-treatment and immediately post-treatment inventory scores

[b]1–3 statistical comparison of pre-treatment and 4th-week post-treatment inventory scores

[c]2–3 statistical comparison of immediately post-treatment and 4th-week post-treatment inventory scores

Discussion

BPPV is treated by canalith repositioning maneuvers. Epley maneuver is used for treatment purposes for cases of posterior canal BPPV. Cure is achieved after a single maneuver in 75% of cases [7]. We obtained positive results in the Dix-Hallpike test performed at the control visits 1 week after treatment in only 4 of 37 patients, and we found a cure rate of 79% after a single maneuver.

There are concurrent psychiatric symptoms in 20–50% of patients with vertigo [23–25]. This risk is greater among patients with psychiatric disorders. However, psychiatric symptoms may be triggered by vertigo even in patients without psychiatric problems [26]. Patients with vertigo who have comorbid psychiatric symptoms suffer vertigo sensation in the absence of objective signs in the neuro-otological tests [27].

Irrespective of the etiology of vertigo, patients with both dizziness and psychological disorders may remain symptomatic even after normal vestibular compensation [28]. In patients with BPPV the probable cause of anxiety is the unpredictable nature of vertigo attacks or the residual effects of vestibular dysfunction. As a reflex reaction to it, patients may have a physical postural limitation and hence social restrictions. Persistence of dizziness even after canalith

Table 5 Relationship between Beck anxiety inventory (BAI) sub-parameters and treatment

BAI questions	p 1[a]–2[b]	p 1[a]–3[c]	p 2[b]–3[c]
1. Tingling or numbness in any of your body parts?	0.001	0.000	0.002
2. Feeling hot?	0.067	0.000	0.000
3. Wobbliness of legs	0.000	0.000	0.001
4. Unable to relax	0.187	0.001	0.016
5. Fear of worst happening	0.000	0.000	0.044
6. Feeling Dizzy or lightheaded	0.000	0.000	0.000
7. Heart pounding/racing	0.165	0.002	0.010
8. Feeling unsteady	0.000	0.000	0.000
9. Feeling terrified or afraid	0.001	0.001	0.110
10. Nervousness	0.010	0.000	0.000
11. Feeling of choking	0.737	0.014	0.010
12. Hands trembling	0.001	0.000	0.025
13. Feeling shaky/unsteady	0.423	0.008	0.023
14. Fear of losing control	0.002	0.000	0.005
15. Difficulty in breathing	0.274	0.003	0.031
16. Fear of dying	0.071	0.017	0.134
17. Being scared	0.051	0.002	0.058
18. Indigestion	0.007	0.000	0.001
19. Faint/lightheaded	0.017	0.007	0.160
20. Facial flushing	0.058	0.000	0.004
21. Sweating (unrelated to ambient temperature)	0.130	0.000	0.000

1–2 statistical comparison of pre-treatment and immediately post-treatment inventory scores

1–3 statistical comparison of pre-treatment and 4th-week post-treatment inventory scores

2–3 statistical comparison of immediately post-treatment and 4th-week post-treatment inventory scores

[a]1 Pre-treatment score

[b]2 Immediately post-treatment score

[c]3 4th-week post-treatment score

repositioning maneuver despite the absence of abnormal signs in follow-up examinations or laboratory tests may be strongly associated with anxiety [29].

A study assessed subjective symptoms with Dizziness handicap index (DHI), and activity-specific Balance Confidence scale before and after canalith repositioning. Both groups showed significant improvement in DHI scores [29]. We assessed in detail the BAI sub-parameters. The sub-parameters like feeling hot, inability to relax, heart pounding/racing, feeling of choking, feeling shaky/unsteady, difficulty in breathing, fear of dying, being scared, facial flushing, and sweating unrelated to ambient temperature showed no significant decreases despite a bilaterally negative Dix-Hallpike test at the end of the first week. An improvement that started after the first week at the earliest in 10 of 21 parameters indicates that the effects of the disorder persist after treatment.

In a study it was reported that 27% of the patients had dizziness attacks affecting their quality of life. That study also reported that imbalance and significant disturbances in quality of life persisted for a long time despite canalith repositioning maneuvers [7].

Patients with vestibular disorders may have psychological sequela like panic attacks, anxiety disorders, and depression [30–33].

In a study 66% of patients with peripheral vertigo attacks had occupational problems [32]. In another study, 75% of the patients could not travel alone and 66% had their social life limited to a certain limit [33]. Another study showed that 67.85% of patients had limitations in daily activities [34]. Another study reported that 22% of patients stated that they could not travel alone; 25% stated that their social life was limited; and 29% had difficulties in Professional life [7].

Several methods have been defined to rate anxiety Yardley et al., used Hospital Anxiety and Depression Scale (HAD) and Spielberger's State-Trait Anxiety Inventory and reported an incidence of 30% [30, 32, 33]. Another study showed a rate of 29.2% for the association of vertigo and anxiety using Hamilton anxiety scale. They reported that patients with severe, moderately severe, and mild anxiety had involvement of their social lives at rates of 100%, 52%, and 33%, respectively [7].

The relationship between dizziness and anxiety disorders is quite striking. Eckhardt-Henn et al. [35] reported a corresponding rate of 45%.

In a study of Staab, where the relationship between dizziness and anxiety disorder was investigated, a third of patients had anxiety-induced dizziness and another third of patients had neuro-otological symptoms added to the already existing anxiety symptoms [36]. A study reported an incidence of 73.5% for anxiety and 41% for depression among patients with BPPV [37, 38]. Irrespective of the primary reason of vertigo, symptoms of anxiety are common in patients having vertigo, ranging between 15% and 16% [39, 40].

A study found a general anxiety incidence of 15.2% among patients with BPPV and 2.7% among the control group. The incidence of anxiety was higher than the incidences of anxiety and diffuse anxiety disorders in the overall population [41]. We detected anxiety in all patients. According to the BAI, women usually had moderately severe anxiety and men had a low level of anxiety prior to the treatment. Furthermore, we compared educational level and anxiety level. We did not come across any study that examined the differences between anxiety levels by educational level using BAI.

Our study demonstrated that high school and college graduates generally had a lower pre-treatment anxiety level whereas primary school graduates had a moderate level of anxiety. A review of the literature showed a tendency for reduction of anxiety level of the BPPV patients at 2 weeks after the treatment at the long-term follow-up, with residual symptoms having being self-limited and no need for anxiolytic therapy having arisen. A review of the literature has shown that a regression tendency in anxiety was observed 2 weeks after treatment among BPPV patients, and residual symptoms limited themselves, obviating the need for anxiolytic therapy [29]. Another study reported that imbalance was eliminated in 31.3–51.3% of patients about 14 days after canalith repositioning maneuver, and that provocative tests became negative on the 11th day of treatment.

However, despite improvements in objective tests, subjective symptoms persisted for a long time in more than a half of these patients. Although provocative tests were normal, 90% improvement of symptoms were observed within only 2 months [21]. Our results were in agreement with the literature reports. Observing significant differences in the rates of symptoms like feeling hot, inability to relax, palpitation, feeling of choking, shakiness, difficulty in breathing, blushing, and perspiration unrelated to heat stress even by the first month of treatment supports the view that these complaints persist for a long time despite treatment. However, subjective symptoms like fear of dying and panic regressed after the first week of treatment and became eliminated in the first month. Another study demonstrated that the patients' anxiety levels were higher than those of the control group. Observing a significant drop in BAIS after canalith repositioning following the maneuver indicates that the treatment was beneficial, but scores were slightly higher compared to the control group 14 days after the treatment. Although scale scores were at low levels, it was noted that patients' concerns persisted for a long time [29].

The present study revealed significant differences compared to the control group with respect to pre-treatment anxiety levels as well as post-treatment and 4th week anxiety levels. This suggests long-term symptom persistence despite treatment. The limitations of our study include a small number of participants, which may have precluded an adequate assessment of the relationship between educational level and anxiety. The relationship between BAI sub-parameters and educational level might be examined to contribute to the existing literature in a different manner. However, a greater number of participants are needed for that study. Our work only included patients with posterior canal BPPV. Studies with a larger number of participants comparing posterior and horizontal canal BPPV cases may be conducted to investigate how variations of involved semicircular canals affect anxiety levels.

In conclusion, our study demonstrated that anxiety levels were markedly reduced after the treatment and at 4th week controls compared to the pre-treatment levels among patients who were diagnosed with BPPV and underwent Epley maneuver. However, it was noted that patients 'subjective symptoms usually begin to improve 1 week after treatment initiation at the earliest, and their symptoms persist at a certain level even at the end of the first month. Differences in patients' educational levels affect their anxiety levels. It should be remembered that educational level should be taken into consideration when approaching patients.

Professional support may be needed for persistently elevated anxiety levels despite therapy.

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Compliance with ethical standards

Conflict of interest Akif Gunes declares that he has no conflict of interest. Yucel Yuzbasioglu declares that he has no conflict of interest.

Ethical approval All procedures performed in studies involving human participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Informed consent Informed consent was obtained from all individual participants included in the study.

References

1. Cohen HS (2006) Disability and rehabilitation in the dizzy patient. Curr Opin Neurol 19(1):49–54. https://doi.org/10.1097/01.wco.0000194373.08203.33
2. Akkuzu G, Akkuzu B, Ozluoglu LN (2006) Vestibular evoked myogenic potentials in benign paroxysmal positional vertigo and Meniere's disease. Eur Arch Oto-Rhino-Laryngol Head Neck 263(6):510–517. https://doi.org/10.1007/s00405-005-0002-x
3. Tang H, Li W (2017) Advances in the diagnosis and treatment of benign paroxysmal positional vertigo. Exp Ther Med 14(3):2424–2430. https://doi.org/10.3892/etm.2017.4837
4. Kozak HH, Dundar MA, Uca AU et al (2018) Anxiety, mood, and personality disorders in patients with benign paroxysmal positional vertigo. Noro Psikiyatr 55(1):49–53. https://doi.org/10.5152/npa.2016.18143
5. Lee S-H, Kim JS (2010) Benign paroxysmal positional vertigo. J Clin Neurol 6(2):51–63. https://doi.org/10.3988/jcn.2010.6.2.51
6. Baloh R, Halmagyi M (1996) Handbook of neuro-otology/vestibular system, New York
7. Magliulo G, Bertin S, Ruggieri M, Gagliardi M (2005) Benign paroxysmal positional vertigo and post-treatment quality of life. Eur Arch Otorhinolaryngol 262(8):627–630. https://doi.org/10.1007/s00405-004-0784-2
8. Katsarkas A (1999) Benign paroxysmal positional vertigo (BPPV): idiopathic versus post-traumatic. Acta Otolaryngol 119(7):745–749
9. Gordon CR, Levite R, Joffe V, Gadoth N (2004) Is posttraumatic benign paroxysmal positional vertigo different from the idiopathic form? Arch Neurol 61(10):1590–1593. https://doi.org/10.1001/archneur.61.10.1590
10. Asmundson GJ, Larsen DK, Stein MB (1998) Panic disorder and vestibular disturbance: an overview of empirical findings and clinical implications. J Psychosom Res 44(1):107–120
11. Staab JP (2006) Chronic dizziness: the interface between psychiatry and neuro-otology. Curr Opin Neurol 19(1):41–48. https://doi.org/10.1097/01.wco.0000198102.95294.1f
12. Sklare DA, Konrad HR, Maser JD, Jacob RG (2001) Special issue on the interface of balance disorders and anxiety: an introduction and overview. J Anxiety Disord 15(1–2):1–7. https://doi.org/10.1016/S0887-6185(00)00039-6
13. Balaban CD, Thayer JF (2001) Neurological bases for balance–anxiety links. J Anxiety Disord 15(1–2):53–79. https://doi.org/10.1016/S0887-6185(00)00042-6
14. Yardley L, Medina S, Jurado C, Morales T, Martinez R, Villegas H (1999) Relationship between physical and psychosocial dysfunction in Mexican patients with vertigo: a cross-cultural validation of the vertigo symptom scale. J Psychosom Res 46(1):63–74. https://doi.org/10.1016/S0022-3999(98)00056-7
15. Reale L, Guarnera M, Grillo C, Maiolino L, Ruta L, Mazzone L (2011) Psychological assessment in children and adolescents with benign paroxysmal vertigo. Brain Dev 33(2):125–130. https://doi.org/10.1016/j.braindev.2010.03.006
16. Pollak L, Segal P, Stryjer R, Stern HG (2012) Beliefs and emotional reactions in patients with benign paroxysmal positional vertigo: a longitudinal study. Am J Otolaryngol 33(2):221–225. https://doi.org/10.1016/j.amjoto.2011.07.002
17. Clark MR, Sullivan MD, Katon WJ et al (1993) Psychiatric and medical factors associated with disability in patients with dizziness. Psychosomatics 34(5):409–415. https://doi.org/10.1016/S0033-3182(93)71844-7
18. Kirby SE, Yardley L (2009) The contribution of symptoms of posttraumatic stress disorder, health anxiety and intolerance of uncertainty to distress in Ménière's disease. J Nerv Mental Dis 197(5):324–329. https://doi.org/10.1097/NMD.0b013e3181a20866
19. Godemann F, Linden M, Neu P, Heipp E, Dörr P (2004) A prospective study on the course of anxiety after vestibular neuronitis. J Psychosom Res 56(3):351–354. https://doi.org/10.1016/S0022-3999(03)00079-5
20. Steer RA, Ranieri WF, Beck AT, Clark DA (1993) Further evidence for the validity of the Beck anxiety inventory with psychiatric outpatients. J Anxiety Disord 7(3):195–205. https://doi.org/10.1016/0887-6185(93)90002-3
21. Kahraman SS, Arli C, Copoglu US, Kokacya MH, Colak S (2017) The evaluation of anxiety and panic agarophobia scores in patients with benign paroxysmal positional vertigo on initial presentation and at the follow-up visit. Acta Otolaryngol 137(5):485–489. https://doi.org/10.1080/00016489.2016.1247986
22. Beck AT, Epstein N, Brown G, Steer RA (1988) An inventory for measuring clinical anxiety: psychometric properties. J Consul Clin Psychol 56(6):893–897. https://doi.org/10.1037/0022-006X.56.6.893
23. Eagger S, Luxon L, Davies R, Coelho A, Ron M (1992) Psychiatric morbidity in patients with peripheral vestibular disorder: a clinical and neuro-otological study. J Neurol Neurosurg Psychiatry 55(5):383–387. https://doi.org/10.1136/jnnp.55.5.383
24. Mckenna L, Hallam RS, Hinchcliffef R (1991) The prevalence of psychological disturbance in neuro-otology outpatients. Clin Otolaryngol Allied Sci 16(5):452–456. https://doi.org/10.1111/j.1365-2273.1991.tb02091.x
25. Clark DB, Hirsch BE, Smith MG, Furman J, Jacob RG (1994) Panic in otolaryngology patients presenting with dizziness or hearing loss. Am J Psychiatry 151(8):1223. https://doi.org/10.1176/ajp.151.8.1223
26. Best C, Eckhardt-Henn A, Tschan R, Dieterich M (2009) Psychiatric morbidity and comorbidity in different vestibular vertigo syndromes. J Neurol 256(1):58–65. https://doi.org/10.1007/s00415-009-0038-8
27. Best C, Eckhardt-Henn A, Diener G, Bense S, Breuer P, Dieterich M (2006) Interaction of somatoform and vestibular disorders. J Neurol Neurosurg Psychiatry 77(5):658–664. https://doi.org/10.1136/jnnp.2005.072934
28. Yardley L (2000) Overview of psychologic effects of chronic dizziness and balance disorders. Otolaryngol Clin North Am 33(3):603–616. https://doi.org/10.1016/S0030-6665(05)70229-2
29. Jung HJ, Koo J-W, Kim CS, Kim JS, Song J-J (2012) Anxiolytics reduce residual dizziness after successful canalith repositioning maneuvers in benign paroxysmal positional vertigo. Acta Otolaryngol 132(3):277–284. https://doi.org/10.3109/00016489.2011.637179
30. Yardley L (1994) Contribution of symptoms and beliefs to handicap in people with vertigo: a longitudinal study. Br J Clin Psychol 33(1):101–113
31. Jacob RG, Lilienfeld SO, Furman JM, Durrant JD, Turner SM (1989) Panic disorder with vestibular dysfunction: further clinical observations and description of space and motion phobic stimuli. J Anxiety Disord 3(2):117–130
32. Yardley L, Verschuur C, Masson E, Luxon L, Haacke N (1992) Somatic and psychological factors contributing to handicap in people with vertigo. Br J Audiol 26(5):283–290
33. Yardley L, Luxon L, Haacke N (1994) A longitudinal study of symptoms, anxiety and subjective well-being in patients with vertigo. Clin Otolaryngol Allied Sci 19(2):109–116. https://doi.org/10.1111/j.1365-2273.1994.tb01192.x
34. Fielder H, Denholm S, Lyons R, Fielder C (1996) Measurement of health status in patients with vertigo. Clin Otolaryngol Allied Sci 21(2):124–126. https://doi.org/10.1111/j.1365-2273.1996.tb01314.x

35. Eckhardt-Henn A, Breuer P, Thomalske C, Hoffmann S, Hopf H (2003) Anxiety disorders and other psychiatric subgroups in patients complaining of dizziness. J Anxiety Disord 17(4):369–388. https://doi.org/10.1016/S0887-6185(02)00226-8
36. Staab JP, Ruckenstein MJ (2003) Which comes first? Psychogenic dizziness versus otogenic anxiety. Laryngoscope 113(10):1714–1718. https://doi.org/10.1097/00005537-200310000-00010
37. Nagarkar AN, Gupta AK, Mann SBS (2000) Psychological findings in benign paroxysmal positional vertigo and psychogenic vertigo. J Otolaryngol 29(3):154–158
38. Monzani D, Genovese E, Rovatti V, LudovicaMalagoli M, Rigatelli M, Guidetti G (2006) Life events and benign paroxysmal positional vertigo: a case-controlled study. Acta Otolaryngol 126(9):987–992. https://doi.org/10.1080/00016480500546383
39. Yardley L, Burgneay J, Nazareth I, Luxon L (1998) Neuro-otological and psychiatric abnormalities in a community sample of people with dizziness: a blind, controlled investigation. J Neurol Neurosurg Psychiatry 65(5):679–684. https://doi.org/10.1136/jnnp.65.5.679
40. Sullivan M, Clark MR, Katon WJ et al (1993) Psychiatric and otologic diagnoses in patients complaining of dizziness. Arch Intern Med 153(12):1479–1484. https://doi.org/10.1001/archinte.1993.00410120059008
41. Wiltink J, Tschan R, Michal M et al (2009) Dizziness: anxiety, health care utilization and health behavior: results from a representative German community survey. J Psychosom Res 66(5):417–424. https://doi.org/10.1016/j.jpsychores.2008.09.012