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Comparison of Treatment Results for Clinical Types of Benign Paroxysmal Positional Vertigo

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Objective: To compare the clinical characteristics and treatment results of different clinical types of benign paroxysmal positional vertigo (BPPV). **Methods:** A total of 162 patients diagnosed with BPPV between January 2019 to January 2021 at EMJJ ENT Hospital's vestibular laboratory in Mongolia were included in our study. The diagnosis of BPPV was made according to the 2017 AAO-HNS clinical practice guideline for BPPV. Clinical questionnaires, Dizziness Handicap Inventory (DHI) questionnaires, and videonystgamography were obtained for all patients. **Results:** From a total of 162 patients diagnosed as BPPV, 62.4% had posterior canal BPPV, 27.1% had horizontal canal BPPV, and 10.5% had anterior canal BPPV. Fischer's exact test showed a higher incidence on the right side ($p = 0.000$). The mean age 50 ± 11.7; the male to female ratio 1:4. When the relationship between the effectiveness and duration of the treatment was assessed, 123 (75.9%) recovered after 7 days. DHI score after treatment significantly after treatment ($p = 0.000$) regardless of the clinical type. **Conclusions:** Patients who had a longer duration of symptoms underwent unnecessary diagnostic tests and developed additional psychologic problems. There were no statistically significant differences when we compared the characteristics and treatment between the three clinical types of BPPV.

Keywords: Benign Paroxysmal Positional Vertigo, Semicircular Canals, Vertigo,

Introduction

Many diseases present with dizziness as the main symptom. We can divide these diseases as central or peripheral by the cause. Peripheral vestibular disease accounts for 80%, as central diseases account for only 20% [1]. Among peripheral vestibular disorders, benign paroxysmal positional vertigo (BPPV) is the most common [2, 3]. BPPV results when the tiny calcium carbonate crystals called otoconia, normally embedded in gel in the utricle, dislodge and migrate into one or more of the three semicircular canals in the inner ear, where they do not belong. BPPV patients feel sudden debilitating vertigo, nausea, vomiting

when they change their head position and have nystagmus, involuntary repetitive eye movements from side to side, up and down, or in circles during vertigo. BPPV can be divided into three clinical types depending upon which semicircular canal is involved (anterior, horizontal, and posterior). These types have different diagnostic tests and treatments. The treatments involve simple head maneuvers to repositioning the otoconia to a part of the ear where they do not cause dizziness.

The prevalence of BPPV has been reported to range from 10.7 to 140 per 100,000 people [4-6]. In the elderly population, this number reaches up to 900 per 100,000 [7-9]. Other studies found that the lifetime prevalence of BPPV to be 2.4% and a 1-year prevalence of 0.6% [10]. BPPV occurs more in women than men, with a ratio of 1: 3, and has a higher incidence between the fifth to seventh decades of life [11, 12]. BPPV also affects the life quality of older individuals, and 9% of elderly patients with dizziness have BPPV [13]. More recent studies of symptomatic individuals suggest that 40% of these geriatric patients seen for dizziness have BPPV, with an overall general prevalence of 3.4% in individuals aged > 60 [10, 14]. Older patients with BPPV experience a greater incidence of falls, depression, and impairment of their daily activities [15]. In addition, more than 65% of the patients undergo additional unnecessary diagnostic testing [13]. According to one study, 70% underwent MRI, 45% had CT, 41% had ECG, and 53% received medication [14]. Estimates for the cost of health care for BPPV are high. One study done in Shanghai showed that an average of $2000 was spent on diagnosing BPPV, and the healthcare-associated cost for the diagnosis of BPPV might approach $2 billion per year. By improving the diagnosis and treatment of BPPV, we can reduce healthcare costs and improve the quality of care.

Due to the lack of information and education in Mongolia, most patients with BPPV have difficulty getting diagnosed and receiving proper treatment, resulting in additional problems such as anxiety, depression, and injury. Scarcity of appropriate diagnostic tools, research studies and specialty doctors also lead to under-diagnosis of vestibular diseases. The first vestibular laboratory in Mongolia was established in 2016; from then on, we have been diagnosing and treating peripheral vestibular disease. Until now, we are not aware of any studies on peripheral vestibular disorders in Mongolia. Our study's primary objective was to compare the clinical characteristics and treatment results of different clinical types of BPPV. Our study differs from other studies in several ways. Of these, it is the first study of BPPV in Mongolia that we are aware of, verifies the diagnosis, correlates illness duration with psychological problems, and scrutinizes unnecessary use of MRI scans.

Materials and Methods

A total of 162 patients diagnosed with BPPV between January 2019 to January 2021 at EMJJ ENT Hospital's vestibular laboratory were included in our study. Cross-sectional and clinical trial study designs were used. The diagnosis of BPPV was made according to the 2017 American Academy of Otolaryngology, Head and Neck Surgery (AAO-HNS) BPPV guideline. Clinical questionnaires, Dizziness Handicap Inventory questionnaires were obtained, and videonystgamography was done in all patients.

Inclusion criteria

Patients diagnosed with BPPV, > 18 years of age, who agreed to participate in the study and had follow-up evaluations were included. Exclusion criteria: Patients diagnosed with a central vestibular disorder, other peripheral vestibular disorder, had dizziness related to cardiovascular diseases, has dizziness related to psychogenic disorders, diagnosed with other systemic diseases, and pregnant or lactating women were excluded.

Clinical questionnaire

The questionnaire consisted of general information of the patient (name, age, sex, and address), history of current illness (start of the symptom, last episode, frequency and duration of the episodes, risk factors), and 4 questions regarding the major signs and symptoms of BPPV according to 2017 AAO-HNS BPPV guideline [16].

Dizziness Handicap Inventory (DHI)

We used AAO-HNS's dizziness handicap inventory to evaluate the severity of the patient's perception of the handicap caused by dizziness [17]. DHI was taken before and after the treatment.

Videonystagmography

We used SLMED "Easy-eyes" videonystagmography to evaluate the nystagmus and objectively diagnose and evaluate the treatment results. Video recording was done during supine roll test, Dix-hallpike test, head bend and head hanging positions.

Research design

The treatments involved simple head maneuvers to move the otoconia to a part of the ear where they would not cause dizziness. Patients diagnosed with posterior canal BPPV performed the Epley maneuver once a day and 3 consecutive Semont maneuvers three times a day for a total of 9 times daily. Patients diagnosed with horizontal canal BPPV performed the BBQ roll maneuver once a day and 3 consecutive Gufoni maneuvers, three times a day for a total of 9 times daily. Patients diagnosed with anterior canal BPPV did 3 consecutive Yacovino maneuvers three times a day, totaling 9 times daily.

We evaluated the treatment results at 7, 14, and 30 days later. If the nystagmus was still present at the follow-up visit, we continued the treatment and reevaluated them at the next follow-up visit.

Statistical analysis

The chi-square and ANOVA tests were used for the hypotheses, and differences were considered statistically significant when $p < 0.05$. The paired t-test was used to compare the means of repeated measurements. The un-paired t-test was carried out to for between group subjects. Statistical analysis was done using SPSS 23.0 and RStudio 4.0.4 program.

Ethical statement

The study was approved by the Research Ethical Committee of Mongolian National University of Medical Sciences on December 21, 2018 (№2018/3-18). Informed consent was obtained from all the participants.

Results

From a total of 162 patients diagnosed as BPPV, 101 (62.4%) had posterior canal BPPV, 44 (27.1%) had horizontal canal BPPV, and 17 (10.5%) had anterior canal BPPV. Of the 44 patients who had horizontal canal BPPV, 21 (12.9%) were geotropic (nystagmus beating toward the ground), 23 (14.2%) were apogeotropic (nystagmus beating away from the ground). There were 5 cases (3.1%) of multiple canal BPPV, which all involved the posterior canal. The right side (96 cases, 59.3%) was affected more than left (60 cases, 37%); 2 cases (1.2%) of bilateral BPPV and in 4 cases (2.4%) that were all anterior canal BPPV, the side of which the BPPV was not determined.

The mean age of the patients was 50 ± 11.7 (min 22, max 82), 32 patients (19.8%) were male, and 130 patients (80.2%) were female. The male-to-female ratio was 1: 4. The mean duration since the onset of the symptoms to diagnosis was 16.4 (SD 18.1) days. The approximate number of BPPV episodes was 1.5 (SD 1.5, min 0, max 12). When asked about possible causes of BPPV, 80 (49.4%) were without cause, 40 (24.7%) due to injury or concussion, 18 (11.1%) due to workload and fatigue, 13 (8%) due to stress, 4 (2.46%) due to constant lying on one side, 4 (2.46%) due to sudden movement and 3 (1.85%) for other reasons.

Of the 162 patients, 102 (62.5%) were referred from other hospitals, and only 6 (5.8%) patients were diagnosed with BPPV before coming to our hospital. Others were either referred to verify diagnosis or were diagnosed as a transient ischemic attack (TIA), neurasthenia, vestibulopathy, neck injury, stroke, menstruation-related dizziness, and cerebellar diseases.

All the patients answered "yes" to 3 questions: 1. "Vertigo (dizziness) is provoked by a change in head position (lying down, turning over in supine position, bending down)," 2. "Duration of dizziness is 5 - 60 sec," 3. "I feel nauseous." To the fourth question, "I have blurry vision," 142 (87.7%) patients answered "yes."

Comparing the characteristics between the three clinical types of BPPV by age, gender, duration, and the number of BPPV episodes, there were no statistically significant differences. The DHI score before the treatment was also similar between three clinical types of BPPV ($p = 0.313$). MRI is unnecessary in diagnosing BPPV, and the number of patients that underwent MRI was similar in the three groups ($p = 0.581$). The total number of patients that underwent MRI was 88 (54.3%). The Fischer exact test showed a higher proportion on the right side ($p = 0.000$). Trauma caused 40 (24.7%) cases of BPPV, but there was no difference between clinical types ($p = 0.834$) (Table 1).

A total of 162 people with and without MRI scans were classified according to the duration of illness and age. Patients who underwent MRI had a longer duration of illness and were older (24.3 ± 19.5 vs. 52.2 ± 11.8 days, $p = 0.000$) (Table 2). The patient who did not recover had no vertigo at the end of the treatment but had nystagmus during positional testing. Most people were successfully treated at one week, and 99.4% completely recovered within 1 month.

Table 1. Comparison of characteristics between clinical types of BPPV.

Characteristics	Posterior SCC (n = 101)	Horizontal SCC (n = 44)	Anterior SCC (n = 17)	All BPPV (n = 162)	p-value
	Mean ± SD	Mean ± SD	Mean ± SD	Mean ± SD	
Age	50.7 ± 11.79	51.1 ± 13.87	52.1 ± 10.53	50.7 ± 11.7	0.589
Duration (days)	18.3 ± 18.2	13.3 ± 14.90	15.6 ± 14.8	16.4 ± 18.1	0.321
Number of episodes	1.62 ± 1.69	1.65 ± 1.70	1.29 ± 0.68	1.5 ± 1.5	0.322
DHI before treatment	40.8 ± 19.6	38.2 ± 16.5	39.3 ± 23.9	39.93 ± 19.3	0.313
DHI after treatment	3.9 ± 4.7	4.2 ± 4.3	5.3 ± 5.6	4.12 ± 4.6	0.133
Sex	N (%)	N (%)	N (%)	N (%)	
Male	19 (18.8)	9 (20.45)	4 (23.52)	32 (19.8)	0.894
Female	82 (81.2)	35 (79.54)	13 (76.47)	130 (80.2)	
MRI					
Underwent MRI	58 (57.4)	22 (50)	8 (47)	88 (54.3)	0.581
No MRI	43 (42.5)	22 (50)	9 (53)	74 (45.7)	
Side of the BPPV					
Right	64 (63.3)	22 (50)	10 (58.82)	96 (59.3)	
Left	35 (34.6)	22 (50)	3 (17.64)	60 (37)	
Previous hospital visit					
Verify diagnosis	44 (43.5)	21 (47.72)	10 (58.82)	75 (46.3)	
BPPV	5 (4.95)	-	1 (5.88)	6 (3.7)	
General physical status					
Mild	26 (25.75)	16 (36.36)	4 (23.52)	46 (28.4)	0.274
Moderate	75 (74.25)	28 (61.36)	13 (76.47)	116 (71)	

Note: BPPV-Benign paroxysmal positional vertigo; SCC-semicircular canal; DHI-Dizziness Handicap Inventory; MRI-Magnetic resonance imaging; Comparing the characteristics between clinical 3 types of BPPV, the difference is significant ($p < 0.05$).
ANOVA test and Chi-square test were performed. Since there was not a significant ANOVA result, we did not conduct multiple comparison tests.

Table 2. Relationship between MRI testing, duration of the disease, and age of the patient.

	Underwent MRI (n = 88)	No MRI (n = 74)	p-value
	Mean ± SD	Mean ± SD	
Age (years)	52.2 ± 11.8	49.1 ± 11.5	0.000
Duration (days)	24.3 ± 19.5	7.5 ± 5.9	0.000

Note: MRI-Magnetic resonance imaging; Correlate to all patients with MRI scans and without images were classified according to the duration of illness and age, the difference is significant ($p < 0.05$). Unpaired t-test was performed.

Table 3. DHI score before and after treatment.

	Before treatment	After treatment	p-value
	Mean ± SD	Mean ± SD	
Posterior canal	40.8 ± 19.6	3.9 ± 4.7	[a]0.000
Horizontal canal	38.2 ± 16.5	4.2 ± 4.3	[a]0.000
Anterior canal	39.3 ± 23.9	5.3 ± 5.6	[a]0.000
All canals	39.93±19.3	4.12±4.6	[a]0.000

Note: DHI-Dizziness Handicap Inventory; Comparing DHI score before and after the treatment, the difference is significant ($p < 0.05$). [a]Paired t-test was carried out.

When evaluating the results of the DHI questionnaire, the average score was higher for the five questions that indicate BPPV: 1. Does looking up increase your problem? - 2.71 points, 2. Does turning over in bed increase your problem? - 2.88 points, 3. Does bending over increase your problem? - 2.43 points, 4. Because of your problem, do you have difficulty getting into or out of bed? - 2.93 points, 5. Do quick movements of your head increase your problem? - 2.71 points. The question regarding emotional health, "Because of your problem, are you depressed?" had a relatively high score of 2.19. For other questions, the score was between 1.61 - 0.62.

The answers to several emotional and functional questions correlated with the duration of BPPV. Those who answered "always" in the question "Because of your problem, are you afraid to leave your home without having someone accompany you?" had symptoms for an average of 24.9 days ($p = 0.015$). Additionally, people who answered "always" the question "Because of your problem, do you feel handicapped?" had a longer duration of symptoms of 32.3 days ($p = 0.000$). Whereas people who answered "always" for the question "Because of your problem, are you depressed?" had symptoms for an average of 19 days ($p = 0.063$).

When it came to functional changes, "Does your problem significantly restrict your participation in social activities, such as going out to dinner, going to movies, dancing or to parties?" was directly correlated to the symptom duration ($p = 0.009$). But "Because of your problem, do you have difficulty getting into or out of bed?" or "Does your problem interfere with your job or household responsibilities?" questions did not correlate with the duration.

We compared the DHI score before and after the treatment using paired t-tests. After the treatment, the average DHI score of posterior canal BPPV patients decreased from 40.8 ± 19.6 to 3.9 ± 4.7 ($p = 0.000$). The horizontal canal DHI score decreased from 38.2 ± 16.6 to 4.2 ± 4.3 after treatment ($p = 0.000$). The anterior canal DHI score decreased from 39.3 ± 23.9 to 5.3 ± 5.6 ($p = 0.000$) (Table 3).

Before treatment, 15 (9.25%) people had no handicap caused by dizziness, 62 (38.27%) people were mildly handicapped, 35 (21.6%) were moderately handicapped, and 50 (30.86%) people were severely handicapped. After treatment, 161 (99.4%) people had no handicap, and 1 (0.6%) person was mildly handicapped.

Discussion

In our study, 62.4% had posterior canal BPPV, 27.1% had horizontal canal, and 10.5% had anterior canal BPPV. Our proportion of higher anterior canal BPP was higher than in other studies. In one study done in Korea of 1692 BPPV patients, 60.9% involved the posterior canal, 31.9% the horizontal canal and 2.2% were anterior canal BPPV. Also, in our study, the most common type was right posterior canal BPPV ($p = 0.000$), which we could not find subcategorized in previous studies.

The mean age of our patients was 50 ± 11.7 years, which was comparable with other studies [15, 17, 18]. Our patients' male to female ratio was 1:4, unlike in other similar studies where it was 1:1 - 2 [11, 15, 19]. Fewer male patients were diagnosed with BPPV, likely because in Mongolia, men care little about their health and do not seek medical attention as much as women.

From the start of the symptoms to diagnosis, the mean duration was 16.4 days, which is 4 - 7 days longer than other similar studies conducted in other countries [15, 18]. Several factors such as lack of hospitals that diagnose vestibular diseases, lack of awareness of Mongolian patients could be the reason for late diagnosis.

Most of our patients (62.5%) had been referred from other hospitals. Of these, most were sent to verify a diagnosis (73.5%); only 5.8% were correctly diagnosed as BPPV, but the affected side or canal was not determined, and 20.7% were incorrectly diagnosed. The diagnosis of BPPV seems to be poorly understood by clinicians, and the underdiagnosis rate might be higher in Mongolia.

The majority of our patients underwent MRI (54.3%) before being referred to us, similar to other studies that report a rate of 50 - 70% of MRI [13, 18]. Notably, in our study, the duration of the symptoms and age of the patient directly correlated with the MRI rate ($p = 0.000$). Also, emotional and functional changes were noted in these patients ($p = 0.000$). Therefore, early diagnosis and treatment will lead to less suffering, decrease the health care costs and prevent related psychological problems.

DHI score after treatment significantly after treatment ($p = 0.000$) regardless of the clinical type.

Our treatment success rate was 99.4%, and most patients (75.9%) were successfully treated with repositioning maneuvers alone by 7 days. There was no difference between clinical types

regarding treatment success rate, ranging from 67% to 100% [19]. In a study conducted in China in 2017, the horizontal canal BPPV treatment success rate was similarly high at 90.7% in the first week [20].

There are a few limitations to our study. First, BPPV is a comparatively rare disorder. Second, the population of our country is small and scattered, resulting in difficulties for those suffering from BPPV in getting the correct diagnosis, workup and treatment. Third, there is only one balance laboratory required to obtain the correct diagnosis in our country. Because of these limitations, the number of participants in our two-year study is relatively small. Future studies need to be conducted over a longer time, involving more people. It would also be helpful to compare many different treatment maneuvers.

Conclusions

There was no statistically significant difference when we compared the characteristics and the effects of treatment between the three clinical types of BPPV. Repositioning maneuvers alone were effective treatment regardless of BPPV type, and most patients were successfully treated within one week. Patients who had a longer duration of symptoms underwent unnecessary diagnostic tests and developed additional psychologic problems.

Conflict of Interest

The authors state no conflict of interest.

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