

## AN OVERLOOKED CLINICAL CONDITION: MULTI-CANAL BENIGN PAROXYSMAL POSITIONAL VERTIGO

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### ABSTRACT

#### Objective

Benign paroxysmal positional vertigo (BPPV), which is most common peripheral vestibular disorder caused by changes in head position relative to the direction of gravity, characterized by recurrent temporary dizziness and characteristic nystagmus. BPPV is self-limiting and recurrent. It is generally believed that BPPV arises from otoliths that separate from the utricular macula, fall into the semicircular canals, or attach to the cupula, resulting in a range of signs and symptoms. The Bárány Society International Classification Committee of Vestibular Disorders published an expert consensus paper on BPPV diagnostic criteria in 2015 in the Journal of Vestibular Research.<sup>[1]</sup> BPPV most often involves a single semicircular canal and posterior canal (PC) is the most frequently affected canal, accounting for 70-90% of all BPPV cases<sup>[2]</sup>, this is followed by the horizontal canal (HC) which accounts for 10%-30% of all cases<sup>[3]</sup>, and the anterior canal (AC) accounting for only 1%-2% of all cases<sup>[4]</sup>, respectively. Multi-canal benign paroxysmal positional vertigo (MC-BPPV) is considered to be a rare and controversial type in the new diagnostic guidelines of Bárány because the nystagmus is more complicated or atypical. For this reason, MC-BPPV often remains a diagnostic challenge for the clinician. This is both due to the complex anatomy of the labyrinth and to the complex and often simultaneous ocular responses resulting from stimulation of multiple. Diagnosis was made by Dix- Hallpike test (DH-T) and Roll test (RT). Treatment was performed with the Semont, Epley, Lempert and Yacovino reposition maneuvers according to the affected canals. In this study, we aimed to investigate the clinical features, diagnosis, and treatment of patients with MC-BPPV and to contribute to the literature.

**KEYWORDS:** BPPV, multi -canal, nystagmus, reposition maneuver.

### METHODS

Only patients with MC-BPPV without systemic disease and who met the diagnostic criteria for MC-BPPV recommended below by the International Bárány Association<sup>[5]</sup> were included in the study. These criteria: recurrent episodes of vertigo or dizziness, usually triggered by lying down or rolling on your back; coexistence of positional

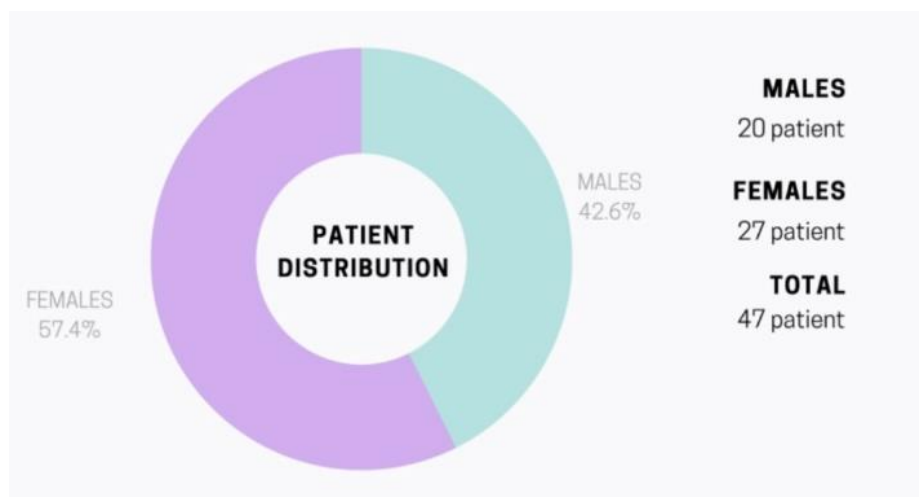
nystagmus due to canalolithiasis in multiple semicircular canals stimulated by Dix-Hallpike and Roll maneuvers and absence of other vestibular disease.

We conducted a retrospective analysis of 47 with MC-BPPV patients admitted to vertigo department our hospital from January 2022 to 28 February 2023. Detailed clinical data of all patients were collected. At the first admission of the patients, otoscopic examination of each patient was performed and anamnesis was taken.

Pure tone audiometry test, Dix-Hallpike (DH-T) and Roll (RT) maneuvers were applied to all patients. Nystagmus was recorded using videonystagmography (VNG). The clinical features of the patients were analyzed. Afterwards, Frenzel glasses were worn in each patient, and then oculomotor tests were performed. These tests are spontaneous, gaze, saccade, pursuit, optokinetic, post headshake. The appropriate manual reduction method was selected according to the type of MC-BPPV. If nystagmus was detected in the DH-T it was evaluated whether it was geotropic or ageotropic. Ageotropic nystagmus is evaluated bilaterally, it guides us according to the greater severity gives the clue. By looking at the time between the onset of manipulation and the onset of nystagmus, it was interpreted with or without latency, and it was decided whether canalolithiasis or cupulolithiasis is present. Current theories generally believe that BPPV is caused by the detached otoliths from the macula that fall into the semicircular canals. When the head moves in the plane of the affected semicircular canal, the otoliths move under the action of gravity, that drives endolymphatic fluid flow, leads to cupula displacement, thereby inducing positional vertigo and nystagmus, this condition is known as canalolithiasis. Another much rarer type of BPPV is cupulolithiasis, when otoliths adhere to the cupula of the semicircular canal, the density of the cupula is higher than that of the endolymph, then changes in head position can cause the displacement of cupula under the action of gravity, thus inducing positional vertigo and nystagmus.

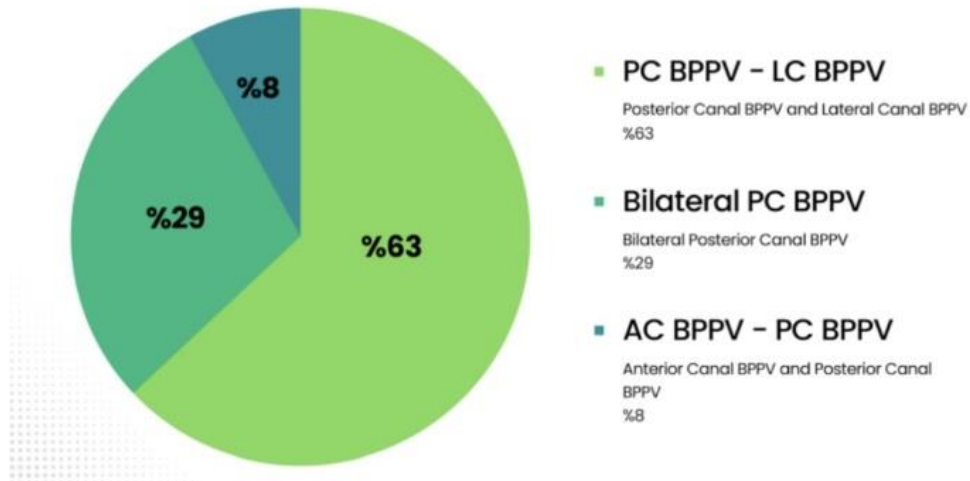
## RESULTS

A total of 47 patients with MC-BPPV were included in the study. There were 20 males (42.6%), 27 females (57.4%), with a women-to-men ratio of 1:1.34 (figure 1).



**Figure 1: Distribution of patients with MC-BPPV by age.**

The mean age of the patients was  $30 \pm 55$  years. In our study, PC-BPPV and LC-BPPV coexistence was the most common, accounting for 63% of all cases. Subsequently, 29% bilateral PC-BPPV and 8% AC-BPPV and PC-BPPV coexisted, respectively (figure 2).



**Figure 2: The incidence of different types of MC-BPPV.**

Although MC-BPPV affects different semicircular canals on one or both sides, unilateral MC-BPPV is more common. In our study, the right side was more frequently affected in patients with unilateral MC-BPPV, accounted for 64.8% of all cases, which was consistent with the results of previous studies.<sup>[6,7,8]</sup> This may be related to the habit of sleeping in the right-side lying position. In this study, 20 of 47 patients with MC-BPPV had cupulolithiasis (42.5%) and 27 had canalolithiasis (% 57.5).

Patients with MC-BPPV were successfully treated with manual reposition maneuvers according to the involved canal and an average of three reposition maneuvers were performed.

Epley reposition maneuver was used in the treatment of PC-BPPV, barbecue reposition maneuver in the treatment of LC-BPPV, and Yacovino reposition maneuver in the treatment of AC-BPPV. The treatment efficacy was evaluated by VNG at 2 hours after the reposition maneuver. All patients were followed up one week later. For non curable patients, DH-T, RT and reposition maneuvers were performed again. The treatment efficacy was also evaluated at 2 hours after reduction.

## DISCUSSION

BPPV is a peripheral vestibular disease caused by changes in head position relative to the direction of gravity, characterized by recurrent temporary dizziness and characteristic nystagmus.

Current theories generally believe that BPPV is caused by otoliths leaving the macula falling into the semicircular canals. When the head moves in the plane of the affected semicircular canal, the otoliths move under the influence of gravity, diverting the endolymphatic fluid flow and causing cupula displacement, causing positional vertigo and nystagmus, a condition known as canalithiasis. The less common type of BPPV is cupulolithiasis; when the otoliths adhere to the cupula of the semicircular canal, when the density of the cupula is higher than that of the endolymph, changes in head position can cause the cupula to displace under the action of gravity, thereby inducing positional vertigo and nystagmus.

BPPV usually involves a single canal (SC-BPPV), posterior canal (PC) is the most frequently affected canal, followed by the lateral canal (LC), while BPPV involving the anterior canal (AC) is rare. BPPV may also contain multiple canal

(MC-BPPV). Because of the involvement of different canals on different sides in MC-BPPV patients, forms of nystagmus are more complex or atypical and often have both vertical and horizontal components. Thus, accurate diagnosis and treatment of MC-BPPV is difficult. Patients with MC-BPPV had an older age of onset and a higher proportion of women compared with patients with single-BPPV.

Compared to SC-BPPV, several forms of nystagmus can be observed in MC-BPPV that can be easily confused with central positional nystagmus. The nystagmus produced by some types of SC-BPPV may be like that found in MC-BPPV, posing challenges for the clinical diagnosis and treatment of MC-BPPV. Correct interpretation of eye movements is crucial for accurate diagnosis of the affected canal, laterality of the disease, and differentiation from cupulo-canalithiasis.

In various studies, involvement of multiple canals has been reported in 6.8-20% of BPPV cases<sup>[9-14]</sup> and therefore, this condition continues to be often overlooked and underdiagnosed by clinicians. In clinical practice, the most common multiple canal presentations are bilateral posterior canalithiasis and ipsilateral posterior and horizontal canalithiasis.<sup>[15]</sup>

In our study, according to the nystagmus characteristics, in patients were diagnosed as PC-LC-BPPV (63%), as those patients showed both vertical torsional up-beating nystagmus and geotropic, apogeotropic horizontal nystagmus. Vertical up-beating nystagmus with torsional component on one side and vertical down-beating nystagmus with or without torsional component on the other side was induced by the Dix-Hallpike test in patients, and those patients were diagnosed with AC- PC-BPPV (8%). Patients with torsional component on both sides were diagnosed with bilateral PC-BPPV (29%). Ipsilateral MC-BPPV often develops with patients who has ipsilateral peripheral vestibular diseases such as Meniere's disease and sudden hearing loss and is prone to recurrence.<sup>[16]</sup> Bilateral MC-BPPV may be secondary to head trauma.<sup>[17,18]</sup>

PC-BPPV was diagnosed if up-beating nystagmus with torsional component was induced by D-HT when the affected ear is directed towards to floor, and the torsional component was directed to the affected ear, the nystagmus direction reversed upon sitting up. (2) LC-BPPV was diagnosed if geotropic, apogeotropic horizontal nystagmus on both sides was induced by RT. (3) AC-BPPV was diagnosed if vertical down-beating nystagmus with/without torsional component was induced by D-HT. (4) MC-BPPV was diagnosed if the typical nystagmus of multiple canals involved on D-HT and RT was observed.

## CONCLUSION

In our study results showed that; 1) MC-BPPV was not uncommon in clinical practice, 2) PC-LC-BPPV was the most common type of MC-BPPV, 3) The right side is more frequently involved in MC-BPPV, 4) MC-BPPV involvement is more common in women than men. 5) Otoliths reposition maneuver was effective in most of the patients with MC-BPPV.

Although BPPV usually involves a single semicircular canal, it should be kept in mind that multi-canal involvement may occur in cases where diagnosis and treatment are difficult.

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