A Comparative Literature Review of Benign Paroxysmal Positional Vertigo and Ménière's Disease: Symptoms, Causes, Diagnostic Methods, and Treatment Options

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Abstract

Vertigo can cause individuals to feel that the world is spinning despite them being still. Vertigo affects one in 15 adults in their lifetime (Columbia University, 2023). Among patients who are diagnosed with vertigo and are above the age of 60, 20% report extreme dizziness, which can cause them to have mobility issues (Holmes & Padgham, 2011). In particular, the prevalence of Benign Paroxysmal Positional Vertigo (BPPV) and Meniere's Disease (MD) is increasing, causing it to affect patients' quality of life, and, at present, BPPV and MD are on the rise and require increased attention and research. BPPV is when an otoconia crystal (calcium carbonate crystals) gets dislodged, causing vertigo and nausea, and can be managed using various approaches (Bhattacharyya et al., 2017). Similarly, MD is a condition that may cause dizziness that is caused by a build-up of fluid in the ear (Rizk et al., 2022). In the 21st century, treatment options and diagnostic methods have significantly improved. BPPV and MD are, as of now, the most common vestibular disorders diagnosed in patients. BPPV is one of the most common disorders found in patients who experience vertigo (Bhattacharyya et al., 2017). MD is another frequent cause of vertigo, though not as common as BPPV. MD is a chronic inner ear disorder that can cause dizziness, hearing loss, and the feeling that your ears are full (Rizk et al., 2022). I will review the similarities and differences between BPPV and MD, focusing on their symptoms, causes, diagnostic methods, and treatment options.

Keywords: Benign Paroxysmal Positional Vertigo (BPPV), Meniere's Disease (MD), Vertigo, Vestibular Disorders, Epley Maneuver.

Introduction

The term "vertigo" describes the feeling of disorientation, spinning, and a host of other side effects caused by disorders and diseases of the brain's sense of balance. Patients suffering from vertigo find that it significantly affects daily life and commonly leads to mental and physical distress (Holmes & Padgham, 2011). Vertigo can be categorized into two main classes: peripheral and central.

Peripheral vertigo is among the classes of vertigo that are most commonly diagnosed. This disorder originates from the inner ear, particularly within the vestibular system, which contains the semicircular canals and otolith organs (saccule and utricle). These organs are involved in the perception and adjustment of balance and spatial orientation. More specifically, the semicircular canals detect rotational movement, and the saccule and utricle detect linear movement and the effects of gravity (Thompson & Amedee, 2009). Peripheral vertigo can also be caused by dysfunction in the vestibular system (Heffernan et al., 2021).

Central vertigo, as its name suggests, originates from the central nervous system. Specifically, central vertigo is typically attributed to problems involving the brainstem or cerebellum, two brain regions responsible for processing balance and spatial orientation (Lawal & Navaratnam, 2019). Conditions such as tumours, strokes and multiple sclerosis can cause harm to important parts of the brain that control movement (Karatas, 2008). When these regions are affected, it can disrupt the typical neural processes involved in the perception and regulation of balance, resulting in the sensation of vertigo (Dieterich, 2007).

Methods:

This literature review used scientific journals such as PubMed, Google Scholar, and SpringerLink to review symptoms, causes, diagnostics, and treatments for MD and BPPV. A structured search using tools such as Boolean operators with terms like “BPPV,” “Meniere’s Disease,” and “Treatments” narrowed down peer-reviewed studies, systematic reviews, and clinical trials published between 2000 and 2024. Studies were reviewed to determine whether they focused on biological mechanisms, therapeutic efficacy, and external dietary factors. Data was gathered and structured to elaborate on diagnostic techniques, therapeutic approaches, and external risk factors to evaluate treatment efficacy, recurrence likelihood, and unwanted side effects. In addition, limitations of several studies were observed, namely long-term treatments and the influence of environmental and genetic variables.

Importance of understanding and managing vertigo

Vertigo can significantly disrupt a person's daily life, leading to issues with balance and coordination, an increased risk of falling, and injuries. Because it occurs frequently, some patients may develop psychological effects stemming from spontaneous episodes (Franco et al., 2023).

The Epley manoeuvre is a treatment method for BPPV. During the Epley manoeuvre, a physician performs a series of precise head movements to reposition the crystals in the accurate spot in the inner ear (Cole & Honaker, 2022). Hilton and Pinder (2014) reported that after the completion of this manoeuvre, a 36% chance of recurrence of BPPV was found.

Similarly, treatments for MD also have side effects that may cause more harm than good. A standard procedure is intratympanic gentamicin injection, in which a physician injects a small dose of gentamicin directly into the middle ear (Chen et al., 2019). According to Choudhary et al. (2019), 2 out of 16 patients (12.5%) tend to experience hearing loss after this procedure. While these treatments may relieve many, their limitations highlight the need for discussion.

Understanding the Demographics and Influences of Vertigo

Vertigo affects a broad spectrum of people and can be influenced by a combination of lifestyle, demographic, and environmental factors, which shape the impact of the disease. Furthermore, certain vestibular disorders can have more potent effects on one, making them prone to problems with balance (Filippopulos et al., 2017). In addition, women have an increased likelihood of

disorders that cause vertigo; thus, factors like pregnancy and menopause can trigger hormonal changes and result in an elevated risk of vertigo (Jeong, 2020). Beyond demographic factors, poor diets and sedentary lifestyles correlate with vertigo, and people deficient in B12 can contribute to dizziness (Gunes-Bayir., 2023; Aydın et al., 2012). Increased exposure to pollutants and allergens could cause one to be more prone to vestibular disorders, which could result in spells of vertigo (Aydın et al., 2012). Specifically, particulate matter (PM2.5) can cause inflammation and imbalances with pressure, causing a sense of vertigo (Petropoulou et al., 2023).

Vertigo affects many demographics, including various age groups and genders. Sogebi et al. (2014) provide a comprehensive review of epidemiological factors for BPPV, focusing on those primarily affected by this vestibular disorder. However, a limitation of *Vestibular Disorders in elderly patients: Characteristics, causes and consequences* by Sogebi et al. (2014) is that it concentrates mainly on age groups and lacks discussion of diversity in patient demographics, such as socio-economic status, race, and environmental factors, which could hinder in a complete understanding of vertigo's impact across different populations. Regardless of these limitations, Sogebi et al. (2014) studied elderly patients affected with BPPV. The study discovered that people aged 61 to 81 had a 33.3% occurrence rate of BPPV. These findings emphasize the role of age and how it corresponds with BPPV. As seen in Figure 1, BPPV occurrence increases significantly with age, particularly in individuals aged 61–100 years, aligning with the findings of Sogebi et al. (2014). All these studies concluded that aging correlates with BPPV occurrence, emphasizing that age is an important factor.

Similarly, MD also has a higher prevalence in older populations (Alexander & Harris, 2010). Alexander & Harris (2010) discovered 9 cases per 100,000 in younger adults and 440 cases per 100,000 in individuals aged 65 and older in the United States. Similarly, a study in the Netherlands conducted by Van Esch et al. (2016) explored 296 patients diagnosed with Meniere's Disease. Among them, 71% (209) were between 40 and 60 years old and diagnosed with Meniere's Disease. These findings support the connection between age and vestibular disease.
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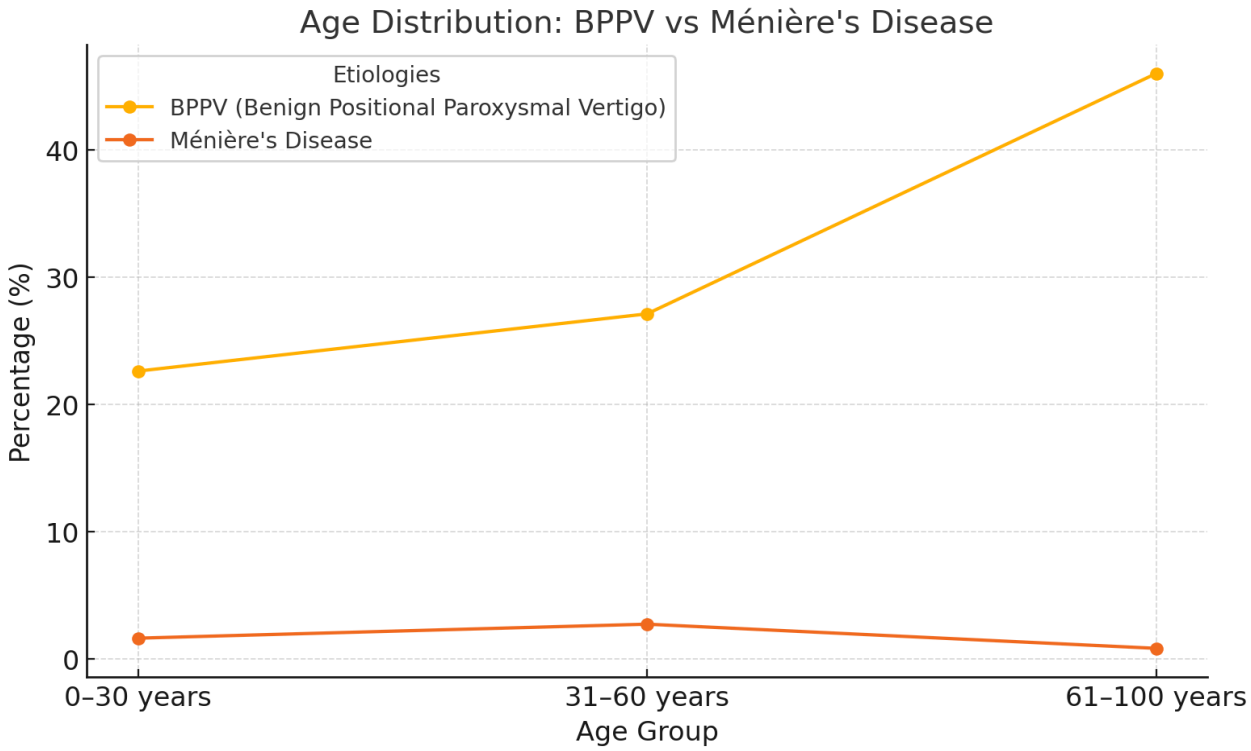

FIGURE 1 - Age distribution of BPPV vs Ménière's Disease: Etiologic distribution of dizziness/vertigo in a neurological outpatient clinic according to the criteria of the international classification of vestibular disorders: A single-center study. *Journal of Neurology, 271*(1), 2446–2457. https://doi.org/10.1007/s00415-023-12166-3. Based on data from Xing, Y., Si, L., Zhang, W., Wang, Y., Li, K., & Yang, X. (2024).

The Role of Nutrition in B.P.P.V and MD

While age is a significant factor in BPPV, many other factors, including nutrition, may contribute to the vestibular disorder. Wood et al. (2024) analyzed 35 articles with 9,843 participants exploring the relationship between vitamin D levels and BPPV. The meta-analysis discovered that patients with lower 25-hydroxyvitamin D had a higher prevalence of BPPV.

Similarly, nutrition in MD plays a factor that may contribute to the symptoms. A study done by Gao et al. (2024) provided a comprehensive overview of 941,280 participants and analyzed salt, alcohol, and coffee intake. This research found no substantial link between Meniere's disease and nutrition factors. A similar survey by Oguz et al. (2021) discovered that low sodium intake, caffeine reduction, and alcohol restriction may help with symptoms of Meniere's disease (Oguz et al., 2021). A Japanese study conducted by Miyashita et al. (2017) explored the effect of low sodium on patients with Meniere's disease. They placed 13 people on a low-sodium diet (2g/day). Results discovered that 84% of participants in the study had a lower presence of vertigo. Studies accomplished by Oguz et al. (2021) and Miyashita et al. (2017) discuss the positive connection between dietary factors and MD, in contrast to the study conducted by Gao et al. (2024).

Notwithstanding the mixed results, based on the two studies examined, this underscores a potential connection between MD and nutritional aspects.

Environmental Contributions to BPPV and Ménière's Disease

Although nutrition and age may contribute to BPPV symptoms and MD, environmental factors also play a huge role. A study conducted in Seoul, South Korea, by Mun et al. (2021) discovered that nitrogen dioxide has been shown to cause a higher prevalence of vertigo. Notably, as 1 part per billion (ppb, meaning one part of a substance in a billion parts of air) increased, BPPV cases increased by 1.3%. Subsequently, another study in Seoul, South Korea, led by Oh et al. (2020), concluded that excessive cloud cover causes a surge in BPPV occurrence. Excessive cloud cover blocks sunlight, thereby reducing the production of vitamin D (Oh et al.). In a related finding, another study conducted at Beijing Tiantan Hospital in Beijing, China, led by Cao et al. (2020), discovered that the highest prevalence of BPPV was reported in December when the amount of sunlight was the least. This research had 1,409 participants recently diagnosed with BPPV, which provides highly comprehensive research and robust data. However, this research does not include behavioural factors such as physical activity levels, dietary habits, and lifestyle choices, causing the paper to ignore physical activity and diet, which may not portray the full image. The presented findings suggest a high likelihood of a strong correlation between environmental factors and the commonality of BPPV.

Environmental factors such as air pollutants may augment cases of Meniere's disease (Lee et al., 2021). This research executed by Lee et al. (2021) concluded that air pollutants such as sulfur dioxide, nitrogen dioxide, carbon monoxide, and particulate matter elevate the cases of MD. Lee et al. (2021) reported that hospital visits for Meniere's disease also amplified with the increase in air pollutants. Notably, a 1-ppb increase in sulfur dioxide was linked with a 5% increase in hospital admissions, and a 1-ppb increase in nitrogen dioxide was linked to an 8% increase in hospital visits (Lee et al., 2021). Correspondingly, a 1-ppm increase in carbon monoxide (CO) resulted in a 7% rise in hospital admissions (Lee et al., 2021). In comparison, a 10-μg/m³ increase in $PM_{2.5}$ was linked to a 6% (Figure 2.) increase in hospital visits (Lee et al., 2021). Moreover, research by Gürkov et al. (2016) found a relationship between atmospheric pressure and MD incidence. Gürkov et al.'s (2016) analysis indicated an increase of 10 hPa (hectopascal), a unit used to measure the pressure in the air. As per Gürkov et al. (2016), an increase in hPa increases the odds of episodes of MD by 24%. In summary, these studies emphasize the notable effect of environmental factors on BPPV and MD.

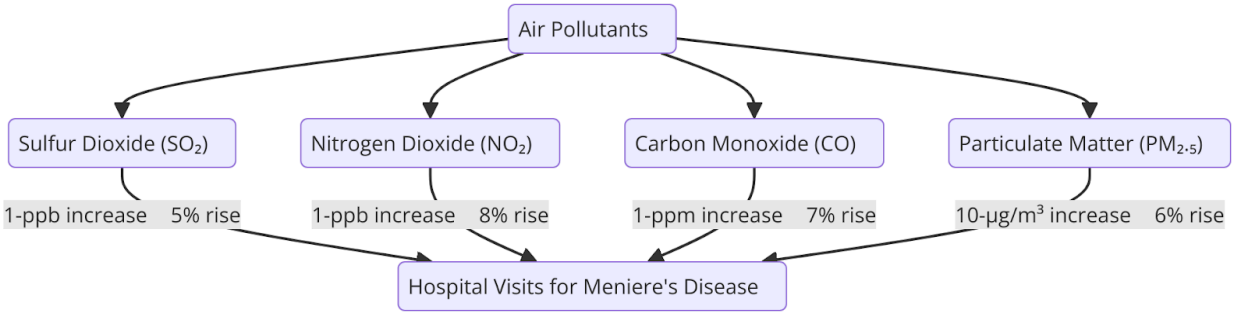

FIGURE 2 - Association between air pollution and Meniere's Disease: Based on data from Lee, S., Lee, J., Lee, H., & Park, H. (2021). Association between Meniere's disease and air pollution in South Korea. *Scientific Reports*, 11, Article 13373. https://doi.org/10.1038/s41598-021-92355-0

Comprehensive Treatment Strategies for BPPV and Meniere's Disease

BPPV is when an otoconia crystal (calcium carbonate crystals) gets dislodged, causing vertigo and nausea, and can be managed using various approaches (Bhattacharyya et al., 2017). A common approach by physicians is the Epley manoeuvre. A medical professional rotates the patient's head and aims to reposition a dislodged otoconia crystal (Moreno et al., 2014). However, in some instances when physical therapy is shown to be ineffective when patients present other symptoms of BPPV, like nausea or vomiting, vestibular suppressant medications may be needed. In particular, ATA et al. (2023) orchestrated a study with 30 patients and split them into groups: the vestibular rehabilitation group (VRG) and the pharmacological control group (PCG). The VRG underwent physical therapy and underwent manoeuvres such as the Epley, and the PCG was administered dimenhydrinate and betahistine to alleviate symptoms. Patients who underwent physical therapy or received anti-nausea drugs both had positive effects (Ata et al., 2023). Although vestibular suppressant medications were noted to improve symptoms, they were not more efficient than vestibular rehabilitation for BPPV (Ata et al., 2023).

Similarly, MD is a condition that may cause dizziness that is caused by a build-up of fluid in the ear (Rizk et al., 2022). Furthermore, it may present in other manners, such as tinnitus and hearing loss (Rizk et al., 2022). MD can be managed mainly in two ways: pharmacological options and non-pharmacological options. Options for pharmacological include intratympanic gentamicin (ITG) and intratympanic corticosteroid (ITC) injections. ITG is primarily used for managing vertigo caused by MD and is administered directly into the ear (Carey et al., 2002). Additionally, Carey et al. (2002) identified that people who faced vertigo due to MD had a 100% success rate in controlling vertigo with the administration of ITG with weekly injections of 20 mg/mL for 1–3 weeks. However, ITG may cause hearing loss, and its side effects should be considered before use (Carey et al., 2002). On the other hand, ITC is also used to manage vertigo and does not pose severe side effects such as hearing loss, but it may not be as effective for controlling symptoms (Li et al., 2022). Moreover, non-pharmacological alternatives may be implemented if pharmacological does

not prove to be effective. Some non-pharmacological treatments may be surgical interventions. Endolymphatic sac drainage is one of the most common procedures to alleviate symptoms of MD; it is done by exposing the ear sac, placing a Silastic T-tube, and letting the clogged fluid keep draining (Bento et al., 2016). Bento et al. (2016) conducted a study on the success rates of endolymphatic sac drainage; people who had unilateral cases (MD in one ear) had a 94.3% rate of vertigo control, and Bilateral cases (MD in both ears) had an 85.7% rate.

Research Gaps and Future Directions

As of now, treatment for MD and BPPV may be impactful, but it has some limitations, such as increased recurrence rates and severe side effects. In particular, the Epley manoeuvre is used to relieve symptoms of BPPV, but Hilton and Pinder (2014) reported a 36% chance of symptom recurrence in a year. Likewise, intratympanic gentamicin is a pharmaceutical method to help alleviate symptoms of MD. However, Choudhary et al. (2019) documented a 12.5 percent chance of patients experiencing hearing loss after using the medication. These flaws emphasize the need to advocate for research for safer and long-term treatment, which can have a significant negative impact on a patient's life. Research should primarily focus on simpler and safer treatments, such as increasing the effectiveness of manoeuvres or medication that does not harm patients for BPPV and treatments that relieve MD symptoms without surgical intervention or medication with critical side effects. Also, research on genetic and molecular bases can hold information that could prevent invasive treatments and change patient care significantly.

Conclusions

This study compares Benign Paroxysmal Positional Vertigo (BPPV) and Meniere's Disease (MD): symptoms, causes, diagnostics, and treatment options. Both of these highlighted conditions harm the lives of their patients. MD is diagnosed by build-up fluid inside the inner ear, which primarily causes vertigo, hearing loss and tinnitus, and BPPV is diagnosed when a calcium crystal in an ear is dislodged. While treatments, as of now, may help with symptoms minimally, they pose significant risks. For BPPV, one of the treatments includes physical therapy like the Epley maneuver, which may help some, but it has a moderate recurrence rate of vertigo. Similarly, the standard treatment for MD is intratympanic gentamicin, which carries a high risk of hearing loss.

Steering attention to these issues is essential and requires increased focus on enhancing suitable, safe, and permanent solutions, such as safer medication or effective maneuvers. Additionally, genetic and molecular research may be necessary for optimal treatments. Furthermore, this vestibular disorder's nutritional and environmental effects may require additional research to develop preventative remedies. Resolving these gaps with BPPV and MD will enhance the treatment of these vestibular disorders and improve patients' quality of life.

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