

BENIGN PAROXYSMAL POSITIONAL VERTIGO (BPPV)

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ABSTRACT

Benign Paroxysmal Positional Vertigo (BPPV) is a common peripheral vestibular disorder, particularly in elderly women, characterized by brief vertigo attacks caused by changes in head position. This study aims to present a comprehensive clinical review of the etiology, pathophysiology, diagnosis, and non-pharmacological and pharmacological management of BPPV. Using a descriptive qualitative approach based on a literature review, this study analyzed selected literature sources from 2019 to 2024. The results indicate that the primary mechanism of BPPV is the displacement of otoconia from the utricle into the semicircular canals, causing vertigo through abnormal stimulation of the vestibular system. Diagnosis is confirmed through provocative maneuvers such as the Dix-Hallpike and Supine Roll Tests. Primary management includes the Epley maneuver, Semont, and Brandt-Daroff exercises, which have proven effective and safe, even for self-administration at home. Pharmacological therapy is only given to relieve acute symptoms, while surgery is considered in refractory cases. This study emphasizes the importance of accurate diagnosis, appropriate mechanical therapy approaches, and patient education as key strategies for improving treatment success and preventing long-term recurrence. Integrating anatomical-physiological understanding with clinical application is key to everyday medical practice.

Keywords: Benign Paroxysmal Positional Vertigo (BPPV), Positional vertigo, Otoconia displacement, Epley maneuver, Vestibular rehabilitation.

INTRODUCTION

Benign Paroxysmal Positional Vertigo (BPPV) is a significant peripheral vestibular disorder that causes sudden episodes of vertigo triggered by changes in head position. In Indonesia, vertigo is the third most common complaint among patients aged 40–50, following headaches and strokes (Faturachman & Wisnu, 2021). This condition poses a practical clinical problem, as it frequently leads to diminished quality of life, falls, and increased healthcare utilization, especially among the elderly population. Theoretically, BPPV remains a challenge due to its recurrent nature and the unclear etiology in many idiopathic cases. Understanding and improving diagnostic accuracy and therapeutic strategies for BPPV is crucial for both clinical and scientific advancements.

Recent studies have explored various aspects of BPPV, including its

pathophysiology, diagnostic tests, and treatment maneuvers. For instance, You et al. (2019) emphasized the utility of repositioning maneuvers such as the Epley and Semont procedures in treating posterior canal BPPV. Other researchers, such as Hafidah et al. (2024), demonstrated the effectiveness of Brandt-Daroff exercises as a self-administered home therapy to reduce recurrence rates. Meanwhile, Kusumasari and Rakhma (2022) provided a continuing medical education perspective on the prevalence of BPPV in older adults, with an emphasis on clinical examination tools like the Dix-Hallpike test. Despite these findings, the literature still shows inconsistencies in the optimal duration, repetition, and sequence of repositioning maneuvers, and limited clarity remains in differentiating canalolithiasis from cupulolithiasis in clinical settings.

Moreover, existing studies often lack comprehensive analysis that links anatomical and physiological aspects of the vestibular system with clinical manifestations and tailored interventions. Most recent studies have been focused either on pathophysiological mechanisms or isolated therapeutic techniques, without an integrative framework combining diagnosis, treatment, and follow-up care in a clinical workflow. This gap highlights the need for more practical, consolidated resources that bring together epidemiological data, clinical features, diagnostic approaches, and evidence-based treatment strategies for BPPV. Additionally, patient education and self-treatment practices such as home-based maneuvers are underreported in many studies, limiting their broader clinical implementation.

To address these limitations, the current study aims to provide a comprehensive clinical review of BPPV, covering its etiology, pathophysiology, diagnostic process, and therapeutic management, both pharmacological and non-pharmacological. Specifically, the authors aim to bridge the gap between anatomical-physiological knowledge and clinical applications through an integrative literature-based review. This study contributes novelty by presenting a systematic, multidisciplinary summary of BPPV that is suitable for both educational purposes and clinical practice, especially within ENT (Ear, Nose, and Throat) departments. It is expected to enhance understanding, improve patient outcomes, and support evidence-based decision-making in vertigo management.

The primary concept in this study is *Benign Paroxysmal Positional Vertigo* (BPPV), a peripheral vestibular disorder characterized by sudden, brief, and recurrent episodes of vertigo triggered by specific head movements. BPPV commonly results from the dislodgement of calcium carbonate crystals (*otoconia*) from the utricular macula into the semicircular canals, leading to abnormal stimulation of the vestibulocochlear nerve and the onset of vertigo symptoms. Two major mechanisms underlie this condition: *canalolithiasis*, where free-floating otoconia move within the endolymph, and *cupulolithiasis*, in which otoconia adhere to the cupula, increasing its sensitivity to movement (Firdiansari, 2022; Hafidah et al., 2024).

The diagnostic process of BPPV involves clinical positional tests that provoke vertigo and nystagmus, such as the Dix-Hallpike maneuver for posterior canal

involvement and the Supine Roll Test for horizontal canal BPPV. You, Instrum, and Parnes (2019) emphasized the importance of these tests as part of standard clinical procedures to localize and confirm the type of BPPV. These maneuvers are essential in eliciting the characteristic response of positional nystagmus, enabling non-invasive and reliable diagnosis.

Several studies have also evaluated the effectiveness of non-pharmacological treatment strategies for BPPV. Hafidah et al. (2024) demonstrated that the Epley maneuver and Brandt-Daroff exercises significantly reduce the frequency and severity of vertigo. Brandt-Daroff exercises are particularly beneficial for home-based self-therapy, especially in recurrent cases. Similarly, Mu'jizatillah et al. (2021), in a physiotherapy intervention study in Banjarmasin, found that the Semont Liberatory Maneuver effectively reduced vertigo symptoms, supporting the use of rehabilitative approaches outside of hospital-based care.

From an epidemiological perspective, Kusumasari and Rakhma (2022) reported that BPPV is most prevalent in individuals over 50 years old and occurs more frequently in females. Risk factors such as aging, head trauma, and migraine contribute to the etiology, although approximately 50% of BPPV cases remain idiopathic. A case study by Zein et al. (2024) combined Semont and Brandt-Daroff maneuvers, highlighting the importance of integrated approaches in managing persistent or recurrent BPPV cases and underscoring the need for individualized therapy.

Overall, previous studies provide a strong foundation for the current research. However, most existing investigations tend to focus on either diagnostic or therapeutic aspects in isolation. This study seeks to bridge the gap by offering a comprehensive clinical review of BPPV, encompassing anatomy, physiology, diagnosis, and treatment. The novelty of this paper lies in its integrated, multidisciplinary synthesis aimed at supporting both medical education and clinical practice in otorhinolaryngology, while also promoting patient education to prevent long-term recurrence.

METHODOLOGY

This study adopted a descriptive qualitative research design through a literature review approach aimed at compiling and synthesizing current knowledge about Benign Paroxysmal Positional Vertigo (BPPV). The design is appropriate for answering the research questions, as it allows the authors to analyze multiple clinical perspectives and integrate them into a comprehensive overview relevant to both medical education and clinical practice. The review focuses on essential aspects such as etiology, pathophysiology, clinical manifestations, diagnostic approaches, and therapeutic interventions for BPPV.

The subjects of this study were selected academic publications and clinical literature that discuss BPPV in depth. The sample population included scientific articles, clinical case studies, review papers, and educational materials published between 2019 and 2024. The literature was selected through purposive sampling, prioritizing relevance to BPPV, credibility, and recency. A total of ten main references were analyzed, providing a solid foundation for thematic

interpretation and practical implications.

Data collection was conducted using document analysis techniques. The researchers accessed open-access journals, institutional databases, and textbooks. A structured instrument in the form of a literature extraction matrix was employed to assess each study systematically. The matrix captured essential data such as the type and mechanism of vertigo described, diagnostic tools used, clinical population characteristics (e.g., age and sex), and the types and effectiveness of therapeutic maneuvers. This method ensured that all relevant information was reviewed consistently across sources.

The research procedure began by identifying the main topic and formulating objectives related to BPPV. Following that, a targeted literature search was conducted using keywords such as "BPPV," "positional vertigo," "Epley maneuver," and "vestibular rehabilitation." Articles were screened based on inclusion criteria that emphasized publication date, topic relevance, and scientific rigor. The next step involved reviewing and extracting thematic data from each selected article. This information was categorized into sections—namely anatomy and physiology, clinical symptoms, diagnosis, and treatment—and then synthesized to create a structured overview. This step-by-step process was logically ordered and clearly documented, making it replicable for other researchers conducting similar literature-based studies.

The data were analyzed using qualitative thematic analysis, focusing on identifying common patterns and differences across the studies reviewed. Thematic comparison was made on several dimensions, such as clinical presentation, diagnostic accuracy, and therapeutic efficacy. The findings were presented narratively and supported by cross-comparisons among studies. No advanced statistical methods were used, as the purpose of this research was to provide a conceptual and practical synthesis rather than a meta-analysis. The analysis emphasizes clarity, consistency, and direct clinical relevance. Equipment, measurement tools, and types of data (e.g., vertigo symptoms, duration, recurrence rates) were clearly described based on the literature, and specific criteria used in analyzing each article were systematically applied. In conclusion, this methodology provides sufficient detail to replicate the review and ensures that the collected and analyzed data accurately reflect the current state of research and clinical practice regarding BPPV. The design and steps followed are clearly structured, reliable, and appropriate for achieving the study's objectives.

FINDINGS AND DISCUSSION

This study is a literature review analyzing several articles related to Benign Paroxysmal Positional Vertigo (BPPV). The results of the literature analysis indicate that BPPV is primarily caused by the release of otoconia particles from the utricle into the semicircular canals, particularly the posterior canal. This triggers a mechanical disruption of endolymph flow, leading to vertigo when the head changes position (Firdiansari, 2022) dan (P, R, & L, 2019).

The inner ear is a key structure in the body's balance system, consisting of the bony labyrinth and the membranous labyrinth, which contain perilymph and endolymph fluids. Important components of the inner ear include the vestibule, semicircular canals, and cochlea. The vestibule contains two sacs, the utricle and saccule, which detect linear motion. Meanwhile, the three semicircular canals detect rotational movement of the head.

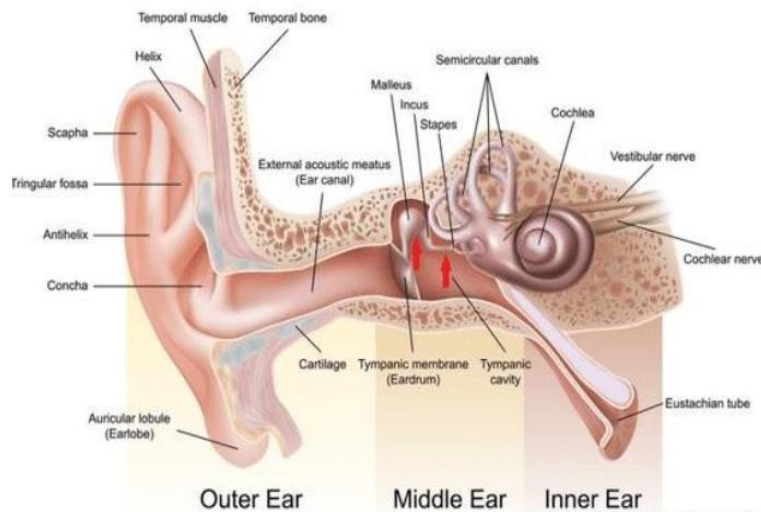


Figure 1. The Anatomy of the Inner Ear and the Bony Labyrinth

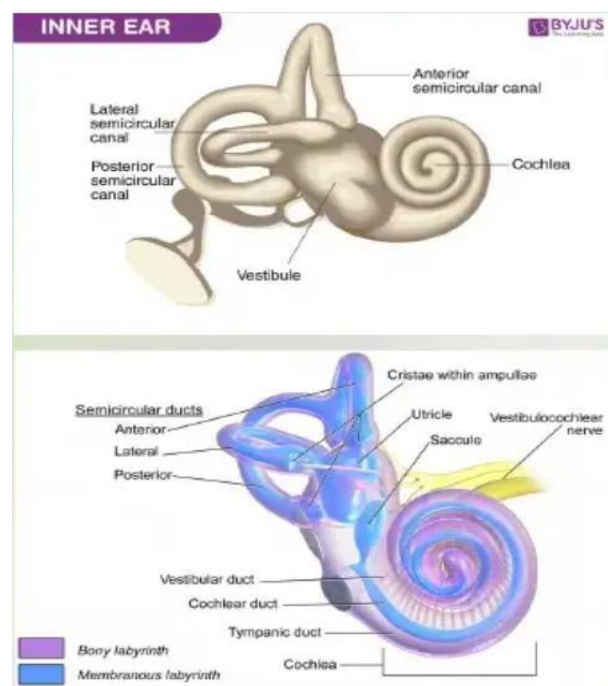
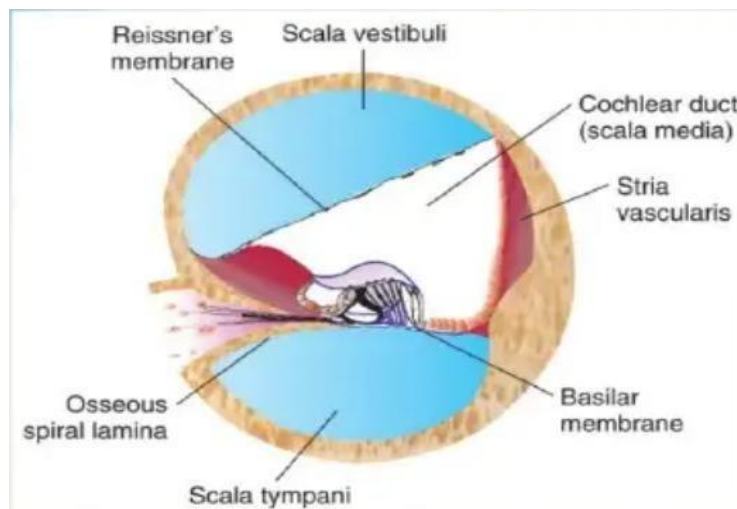


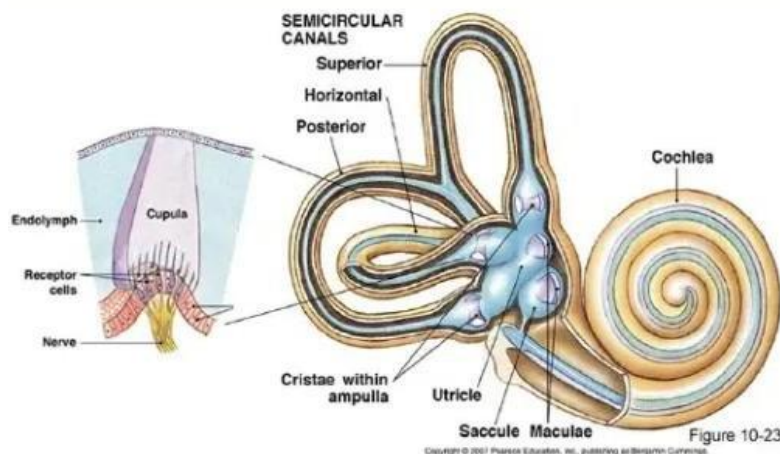
Figure 2. The Anatomy of the Inner Ear

Signals from head movements are converted into electrical impulses by hair cells in the cupula and macula. These impulses are then transmitted through the vestibular nerve to the brain. If a disturbance occurs, such as the displacement of otoconia into the semicircular canals, it causes abnormal stimulation and leads to vertigo.

Disruption of this system, primarily due to the release of calcium carbonate crystals (otoconia) from the macula of the utricle into the semicircular canals, causes BPPV. This results in two main mechanisms: canalolithiasis, in which otoconia float freely in the endolymph and stimulate the cupula during positional changes; and cupulolithiasis, in which otoconia adhere directly to the cupula and produce more persistent vertigo (You, 2019).



(3)



(4)

Figure 3 and 4. The Physiology of the Labyrinth and Vestibular System

BPPV is caused by the release of otoconia (calcium carbonate crystals) from the utricle macula into the semicircular canals, which then stimulate the cupula when the head changes position. This condition is divided into two main mechanisms: canalolithiasis (otoconia floating freely in the endolymph) and cupulolithiasis (otoconia attached directly to the cupula).

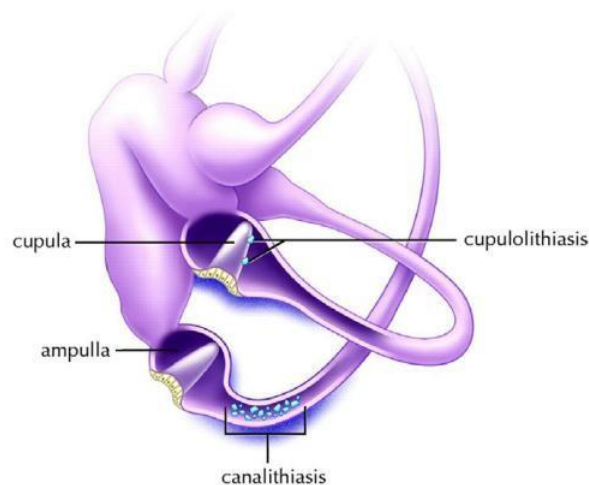


Figure 5. Pathophysiological Diagram of BPPV

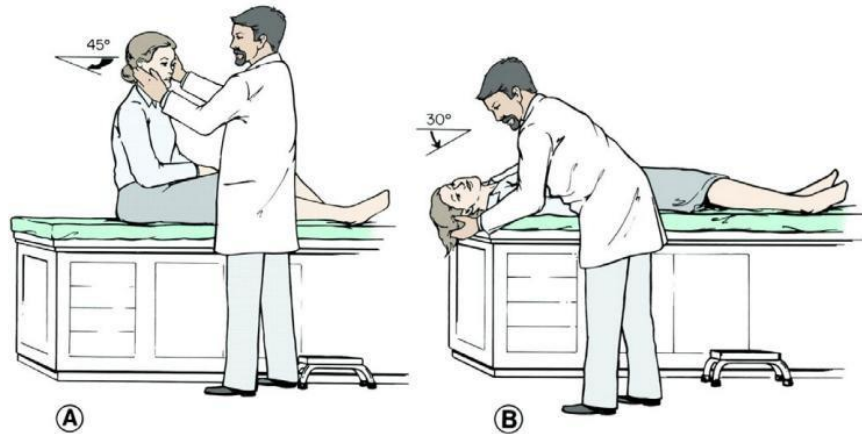
Canalolithiasis causes transient, intense vertigo when the head changes position, while cupulolithiasis causes more persistent and intense symptoms.

BPPV most often occurs in people aged 50–75 years and is more common in women (a ratio of 2.2:1). Its global prevalence is estimated at 2.4%–9% of the general population. Besides idiopathic, causes of BPPV include head trauma, vestibular neuritis, migraines, dental procedures, and other ear conditions such as Meniere's disease (Hafidah HH, 2024) and (Kusumasari & T., 2022). The primary cause of BPPV is idiopathic, but it can also be caused by head trauma, migraines, vestibular neuritis, dental procedures, and other ear disorders. Other risk factors include fatigue, gastrointestinal disorders, hypertension, and impaired cerebral circulation. Patients typically complain of sudden dizziness when changing position, such as getting up from bed, bending over, or turning to the side. These symptoms are brief and may be accompanied by nausea, vomiting, tinnitus, and loss of balance. Patients can experience recurrent attacks, significantly disrupting daily activities. Clinical manifestations of BPPV include brief positional vertigo that occurs when changing head position, such as getting up from bed or bending over. Patients may also experience nausea, vomiting, and loss of balance. Diagnosis is made through history and physical examination, including the Dix-Hallpike Test, Side-Lying Test, and Supine Roll Test, which are

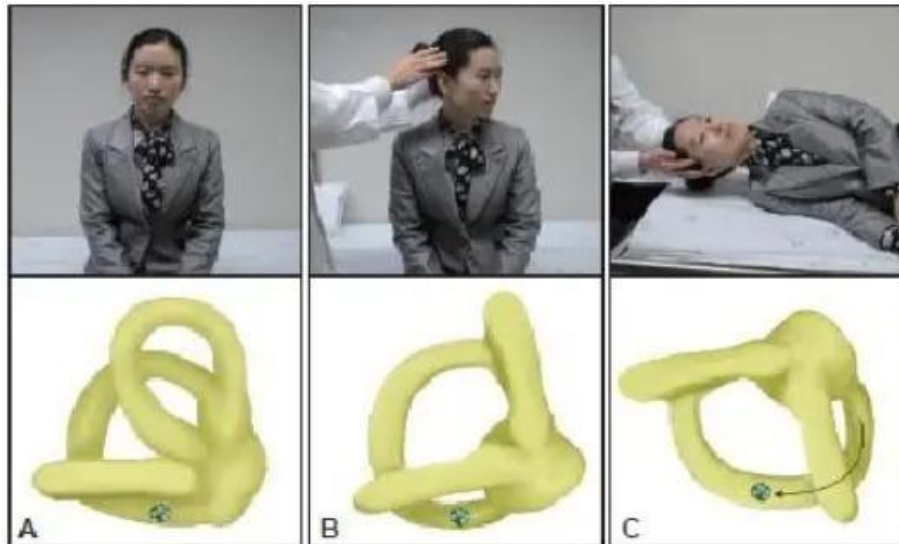
used to assess the presence of nystagmus, a sign of abnormal vestibular stimulation (Tobing, et al., 2022).

The diagnosis of BPPV is made through anamnesis and physical examination, especially provocative maneuvers:

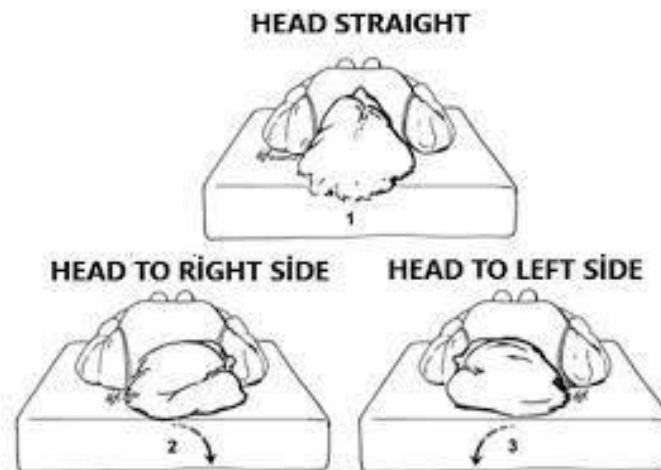
- a. The Dix-Hallpike test is used to detect posterior canal BPPV.



- b. Side-Lying Test as an alternative if the patient has limited neck movement.



- c. Supine Roll Test for lateral canal.

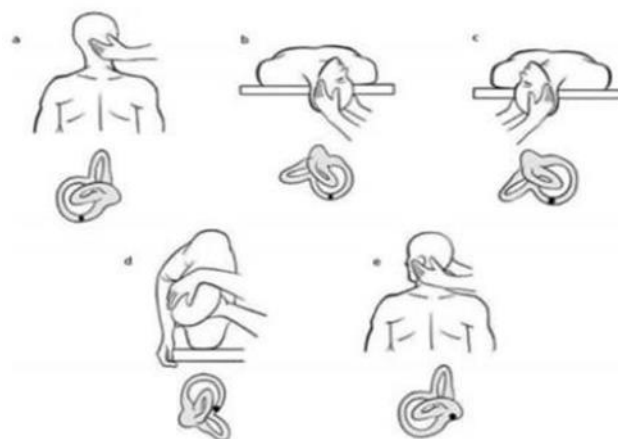


- d. Calorie Test to examine vestibular response to temperature stimulation.

This examination reveals paroxysmal positional nystagmus, a hallmark of BPPV. Slow nystagmus lasting approximately 40 seconds indicates canalolithiasis, while longer durations suggest cupulolithiasis. The primary treatment for BPPV is the particle repositioning maneuver (PRM), which aims to reposition the otoconia toward the utricle. The Epley maneuver is the most common technique for posterior canal BPPV, while the Semont maneuver is used for cupulolithiasis. For lateral canal BPPV, the Lempert maneuver (BBQ Roll) is used. Patients can also perform Brandt-Daroff exercises at home, and in some cases, forced prolongation of the position can be applied to accelerate crystal repositioning (Mu'jizatillah M, 2021) dan (Zein, et al., 2024).

The primary management of BPPV is with otoconial particle repositioning techniques using various therapeutic maneuvers:

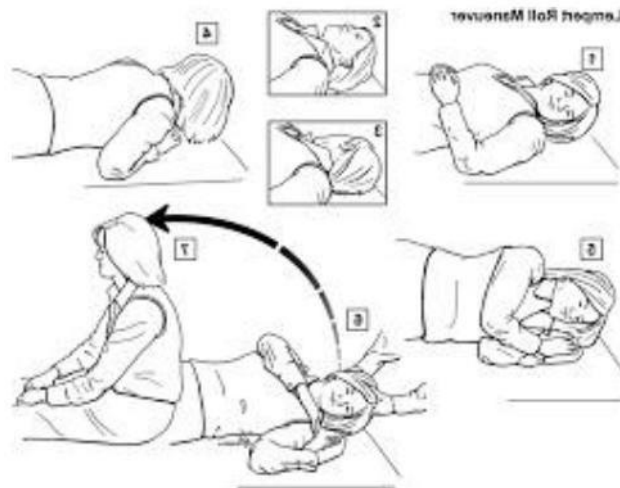
1. Epley maneuver: most common and effective for posterior canal.



2. Semont maneuver: an alternative for cases of cupulolithiasis.



3. Lempert maneuver (BBQ Roll): used in lateral canal BPPV.



4. Brandt-Daroff exercises: can be done at home as self-therapy.
5. Forced Prolonged Position: maintaining a sleeping position on a particular side to help with the displacement of the otoconia.

Pharmacological therapy is only used to treat severe vertigo symptoms, such as nausea and vomiting, especially after maneuvers. Commonly prescribed medications include benzodiazepines (e.g., diazepam) and antihistamines (e.g., meclizine). However, their use is limited because they can interfere with central vestibular compensation. (Firdiansari, 2022). Medications are given only to relieve acute symptoms such as nausea and severe vertigo, and their use is short-term. These medications include: These medications should be used with caution because they can inhibit central compensation of the vestibular system. In refractory or severely recurrent cases, surgery such as singular neurectomy or posterior semicircular canal occlusion may be performed. Although these procedures are invasive and rarely needed (<1% of cases), they can be very effective in cases of BPPV that do not respond to conservative therapy (You, 2019).

In conclusion, BPPV is a common peripheral balance disorder, particularly in elderly women. Management is generally effective through physical maneuvers without the need for pharmacological or surgical therapy, except in

refractory cases. Accurate diagnosis and early intervention are crucial in preventing recurrence and improving patients' quality of life.

Table 1. The important findings

Aspect	Description	Source
Etiology	Dislocation of otoconia into the semicircular canals (canalolithiasis)	(Firdiansari, 2022) dan (You, 2019)
Age & Gender	More common in women aged >50 years	(Kusumasari & T., 2022)
Clinical Symptoms	Brief vertigo due to change in head position; nausea and imbalance without tinnitus	(Hafidah HH, 2024)
Diagnostic	Dix-Hallpike Maneuver and Roll Test to induce nystagmus according to the canal	(You, 2019)
Primary Therapy	Epley maneuver (primary); Semont and Brandt-Daroff as alternative or home therapy	(Hafidah HH, 2024) dan (Zein, et al., 2024)
Pharmacology	For symptom relief only (e.g. antihistamines, vestibular suppressants)	(Mu'jizatillah M, 2021)

These results demonstrate that an accurate understanding of vestibular anatomy, the mechanisms of BPPV, and maneuver-based therapeutic approaches are crucial for establishing a diagnosis and effectively managing BPPV. In conclusion, BPPV is a common peripheral balance disorder, particularly in elderly women. Its management is generally effective through physical maneuvers without the need for pharmacological or surgical therapy, except in refractory cases. Accurate diagnosis and early intervention are crucial for preventing recurrence and improving patients' quality of life.

The findings summarized in Table 1 indicate that the primary cause of Benign Paroxysmal Positional Vertigo (BPPV) is the dislodgement of otoconia from the utricle into one of the semicircular canals, typically the posterior canal. This is consistent with the canalolithiasis theory, which explains that the free-floating otoliths disrupt normal endolymph flow and stimulate the vestibular hair cells inappropriately, resulting in brief episodes of vertigo when the head moves in certain directions (Firdiansari, 2022) and (P, R, & L, 2019). The pathophysiological basis of BPPV aligns with the hypothesis that it is a mechanical disorder of the peripheral vestibular system. These findings reinforce that the clinical manifestation sudden, brief vertigo triggered by head movement has a mechanical origin that requires a mechanical solution.

The clinical characteristics of BPPV brief, recurrent vertigo without hearing loss are consistent throughout the reviewed literature. The Dix-Hallpike and Roll Test maneuvers are widely used to provoke diagnostic nystagmus,

which helps localize the affected canal. For example, the presence of torsional, upbeat nystagmus during the Dix-Hallpike test is indicative of posterior canal involvement. These tests confirm the mechanical disruption in the vestibular system and directly support the hypothesis that BPPV diagnosis should be canal-specific (You, 2019). The results confirm the expectation that the semicircular canal involved determines both the pattern of nystagmus and the appropriate therapeutic approach.

Repositioning maneuvers such as the Epley and Semont are shown to be effective in resolving symptoms by facilitating the return of dislodged otoconia to the utricle. The data consistently show a high success rate up to 90% in some studies after one to three sessions of the Epley maneuver (Hafidah HH, 2024). This outcome is directly aligned with the theory of canalolithiasis and supports the mechanical rationale for the maneuver. Meanwhile, the Brandt-Daroff exercises, though slower in onset, serve as a complementary therapy for patients experiencing recurrent or residual symptoms and can be performed independently at home (Zein, et al., 2024).

Pharmacological treatment plays only a limited role in BPPV management. Medications such as antihistamines or vestibular suppressants may reduce nausea and discomfort during acute attacks but do not address the underlying mechanical problem. The literature clearly shows that medication should not be considered the primary treatment, as it does not reposition otoconia or restore vestibular balance (Mu'jizatillah M, 2021). This evidence supports the notion that pharmacological therapy offers only symptomatic relief, not curative benefit.

These findings provide strong support for the initial hypothesis that BPPV is best diagnosed and treated through a mechanical approach that directly addresses the displacement of otoconia. The results confirm the theoretical model that specific maneuvers, aligned with vestibular anatomy, are essential to restoring balance function. Furthermore, these findings do not contradict previous theories; instead, they provide clear, structured evidence for clinical application and guide practitioners in delivering effective, targeted care. The interpretation of these results emphasizes that successful treatment depends not on pharmacology or generalized vestibular rehabilitation, but on canal-specific mechanical repositioning aligned with precise diagnostic assessment.

CONCLUSION

This study concludes that Benign Paroxysmal Positional Vertigo (BPPV) is the most common peripheral vestibular disorder, particularly in elderly women. BPPV is caused by the release of otoconia particles from the utricle into the semicircular canals, which abnormally stimulate the vestibular system, resulting in vertigo upon head movement. The diagnosis of BPPV can be effectively established through provocative maneuvers such as the Dix-Hallpike and Supine Roll Tests, which produce characteristic nystagmus depending on the canal involved. Primary treatment for BPPV involves particle repositioning techniques such as the Epley maneuver, Semont maneuver, and Brandt-Daroff

exercises, which have proven effective in relieving symptoms and preventing recurrence. Pharmacotherapy is only supportive, and surgical therapy is reserved for rare, refractory cases.

This study makes an important contribution to bridging the gap between theoretical understanding of the anatomy and physiology of the vestibular system and clinical practice in the diagnosis and management of BPPV. The integration of literature approaches from various perspectives allows for a comprehensive understanding that is applicable to both clinicians and medical students. These findings also emphasize the need for patient education regarding self-exercise techniques to prevent recurrence and the importance of early, accurate diagnosis to avoid dependence on pharmacological therapy. By presenting a systematic and integrated review, this study enriches the scientific literature on BPPV and emphasizes the importance of a non-invasive, practical, and evidence-based approach to managing this disorder. This approach is expected to be widely implemented in various primary health care services to improve the quality of life of patients with BPPV.

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