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Ménière's Disease: Current Pharmacological and Surgical Approaches. A Review of Therapeutic Strategies

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Abstract
Ménière's disease (MD) is a chronic inner ear disorder characterised by recurrent vertigo episodes, fluctuating sensorineural hearing loss, tinnitus, and aural fullness, which may severely compromise quality of life. The etiopathogenesis of MD remains incompletely understood; however, the presence of endolymphatic hydrops is recognised as a central pathophysiological mechanism with additional contributions from autoimmune, infectious, genetic and microcirculatory factors . Consequently, therapeutic approaches are predominantly symptomatic, aiming to improve functional outcomes rather than provide a definitive cure. Current management includes pharmacological therapies, local (intratympanic) interventions and various surgical modalities. This review critically evaluates recent meta-analyses and systematic reviews with the goal of guiding evidence-based clinical decision-making and balancing therapeutic efficacy against potential adverse outcomes.

Keywords
Ménière's disease, inner-ear disorder, chronic, pharmacological approaches, surgical approaches

1. Introduction

The clinical constellation originally described by Prosper Ménière in 1861 continues to pose diagnostic and therapeutic challenges due to its heterogeneous manifestations - namely episodic vertigo, fluctuating sensorineural hearing loss, tinnitus and a sensation of aural fullness [1]. Despite longstanding recognition, the pathophysiology remains elusive and no universally accepted treatment algorithm has been established [2]. The absence of large-scale Phase 3 randomized trials - as confirmed by a current review of ClinicalTrials.gov - underscores the reliance on lower-tier evidence, including observational studies and systematic reviews. This review aims to summarise and contextualise contemporary evidence on both pharmacological and surgical strategies in the management of MD with a focus on clinical applicability and individualized care [3].

2. Pathophysiology and Clinical Picture

Endolymphatic hydrops, which is defined as an abnormal expansion of the endolymphatic space within the membranous labyrinth is considered the principal pathological hallmark of MD [4]. The etiological underpinnings are multifactorial and may involve autoimmune dysregulation, viral-mediated inner ear inflammation, genetic susceptibility and compromised microvascular perfusion [5]. Clinically, MD is characterised by spontaneous vertigo episodes, sensorineural hearing loss, tinnitus and fluctuating aural pressure, often accompanied by nausea and vomiting [2]. In recent years, Meniere's disease has been clinically diagnosed based on the criteria established by the American Academy of Otolaryngology–Head and Neck Surgery (AAO-HNS). These include experiencing two or more spontaneous episodes of vertigo lasting between 20 minutes and 12 hours, documented fluctuating sensorineural hearing loss in the low to mid frequencies in the affected ear as well as variable ear-related symptoms such as tinnitus or a sensation of fullness [6]. The diagnosis remains clinical and audiometric, in the absence of a definitive biomarker and is complicated by the natural variability and episodic nature of the disease course [7].

3. Pharmacological Treatment

The primary aim of pharmacological therapy in MS is to reduce both the frequency and severity of vertigo episodes while attempting to stabilize fluctuating hearing loss and alleviate tinnitus and aural fullness; however, the evidence base regarding many of these agents remains mixed and, in many cases, controversial [3].

3.1 Betahistine

Betahistine is one of the most commonly prescribed agents for MS. It is believed to act as a weak agonist at histamine H1 receptors and a strong antagonist at H3 receptors, thereby potentially improving cochlear and vestibular microcirculation via vasodilatory effects [8]. Although betahistine is widely used clinically, recent meta-analyses and systematic reviews reveal that its efficacy in reducing vertigo frequency or severity is modest at best with several studies failing to show statistically significant benefits over placebo [9]. Evidence suggests that while betahistine has a favorable safety profile, the overall quality of studies evaluating its use in MS remains low due to heterogeneity in study design, diagnostic criteria and outcome measures [5]. As a result, current clinical guidelines recommend betahistine primarily as a first-line symptomatic therapy, particularly for patients with mild-to-moderate symptoms, with the understanding that further rigorously designed trials are needed to confirm its effectiveness [9].

3.2 Diuretics

Another cornerstone of MD treatment is the use of diuretics, such as hydrochlorothiazide, which are thought to reduce endolymphatic fluid pressure by promoting sodium and water excretion [3]. Although the mechanism by which diuretics affect inner ear fluid dynamics is not fully elucidated, observational data and small clinical trials suggest a potential benefit in reducing the frequency of vertigo episodes [3]. However, the lack of robustness in large-scale randomized controlled trials means that recommendations for diuretic use in MS are made with caution. Patients are often advised to implement concurrent lifestyle modifications such as low salt intake [3;10].

3.3 Glucocorticosteroids

Glucocorticosteroids, including systemic agents like prednisone and local formulations administered intratympanically are utilized in MS for their anti-inflammatory and immunosuppressive effects [11]. Systemic corticosteroids have been particularly recommended in cases where an autoimmune component is suspected, while intratympanic steroid injections have gained popularity due to their ability to deliver high drug concentrations directly into the inner ear with minimal systemic side effects [11]. Meta-analyses indicate that intratympanic steroids can be effective in reducing vertigo symptoms and may even provide modest improvements in hearing preservation compared to other local therapies [12]. Nonetheless, studies have highlighted that the optimal dosing regimen and frequency of administration remain subjects of ongoing research and clinicians are advised to tailor therapy to individual patient profiles [12].

3.4 Antiemetics and Anxiolytics

In addition to primary pharmacological treatments, supportive agents such as antiemetics and anxiolytics (e.g., meclizine and diazepam) are frequently administered to alleviate the symptomatic distress associated with acute vertigo attacks [2]. Although these agents do not modify the course of MS, they do improve patient comfort during episodes and facilitate vestibular compensation by reducing anxiety and nausea [2]. Their role remains adjunctive, complementing the action of primary therapeutic agents rather than serving as stand-alone treatments [7].

3.5 Migraine medications

Patients diagnosed with MD have demonstrated a favorable response to migraine-directed therapies. In a prospective cohort study involving 25 patients with definite MD who did not meet standard diagnostic criteria and had previously failed diuretic therapy, the introduction of migraine prophylactic treatment resulted in over 90% of participants reporting significant improvement in their quality of life [13]. Recommended pharmacologic agents for prophylaxis include calcium channel blockers such as verapamil, tricyclic antidepressants like nortriptyline and antiepileptic drugs such as topiramate with titration based on clinical response [13;14]. Additional therapeutic options may include beta-adrenergic blockers, gepants and monoclonal antibodies targeting calcitonin gene-related peptide (CGRP). Notably, patients presenting with MD symptoms may benefit from migraine prophylactic strategies either as an adjunct to or a substitute for conventional thiazide diuretic therapy [15]. Furthermore, migraine-directed prophylaxis incorporating dietary and lifestyle modifications as well as supplementation with magnesium and riboflavin, has also demonstrated efficacy in mitigating the symptoms associated with MD [16].

4. Local (Intratympanic) Therapy

Local therapeutic modalities comprise intratympanic drug delivery, which has emerged as an attractive alternative to systemic administration due to its ability to achieve high inner ear drug concentrations while minimizing systemic exposure [11]. These approaches are particularly valuable for patients with refractory symptoms or those with contraindications to systemic therapy.

4.1 Intratympanic Gentamicin

Intratympanic gentamicin (ITG) is an aminoglycoside antibiotic utilized for its vestibulotoxic properties, which selectively ablate aberrant vestibular hair cells and thereby reduce the frequency and severity of vertigo episodes [12]. The evidence from network meta-analyses and controlled trials supports the efficacy of ITG in controlling vertigo, albeit with the important caveat that its ototoxic potential may result in further sensorineural hearing loss [12]. Current protocols often advocate for a low-dose, titrated approach to minimize cochlear damage and patient selection is critical with ITG generally reserved for patients with poor hearing or those in whom hearing preservation is of lesser concern [17;12].

4.2 Intratympanic Glucocorticosteroids

By contrast, intratympanic glucocorticosteroid administration (typically dexamethasone ITD or methylprednisolone ITM) is employed in an attempt to control vertigo while concurrently protecting hearing function [11]. Methyloprednisolone represents a more effective therapeutic option compared to dexamethasone, ITD is recommended when ITM is not available [18]. Meta-analytic evidence suggests that intratympanic steroids may offer a safer profile compared to gentamicin, particularly in patients with serviceable hearing [11]. Though the magnitude of the therapeutic benefit in terms of vertigo control may be less pronounced than with ITG, the balance of efficacy and safety makes intratympanic steroids an attractive option for those prioritizing the preservation of auditory function [19].

Furthermore, evidence from several studies indicates that the intratympanic administration of a combined gentamicin–dexamethasone mixture may achieve higher rates of vertigo control than monotherapy with either gentamicin or dexamethasone [20;21].

5. Surgical Treatment

Surgical interventions are typically considered in patients who remain refractory to both systemic and local pharmacological treatments [22]. In these cases, procedures are aimed at reducing endolymphatic pressure or ablating vestibular function entirely, with the goal of controlling debilitating vertigo attacks while accepting potential trade-offs in terms of hearing preservation.

5.1 Endolymphatic Sac Decompression

Endolymphatic sac decompression (ESD) is a non-ablative surgical procedure designed to alleviate endolymphatic hydrops by decompressing the endolymphatic sac and facilitating fluid drainage [23]. Based on current literature, surgery for control of vertigo in Meniere's disease has control rates ranging from 53% to 90% for at least 1 and up to 13.5 years [24]. In many series, improvements in functional level and quality of life have been documented, although potential limitations include variable long-term hearing outcomes and a complex risk-benefit balance that requires careful informed consent [22]. Despite these challenges, many experts advocate for ESD as a viable, hearing-preserving alternative for patients who do not respond adequately to conservative medical management [23].

5.2 Vestibular Neurectomy

For patients with intractable vertigo who do not achieve satisfactory symptom control with ESD or intratympanic therapies, vestibular neurectomy offers another surgical option [22]. This procedure involves sectioning the vestibular nerve to disrupt abnormal vestibular input while preserving cochlear function, although it is more invasive and carries the risk of complications such as facial nerve injury or incomplete vestibular compensation [22]. Comparative studies and meta-analyses suggest that vestibular neurectomy provides excellent vertigo control, but its use is generally reserved for severe, refractory cases where the benefit outweighs the substantial surgical risks [24]. The decision to proceed with vestibular neurectomy must be individualized, taking into account patient age, hearing status, and overall comorbidities, as well as the expertise of the surgical team [24].

5.3 Other Surgical Modalities

Additional surgical approaches, including labyrinthectomy and combined procedures with cochlear implantation, have been reported in patients with profound hearing loss and intractable symptoms [22]. Labyrinthectomy offers definitive vertigo control by removing the labyrinth; however, this procedure is inherently destructive and results in permanent hearing loss [25]. In select circumstances, a combination of labyrinthectomy with cochlear implantation may be considered to restore auditory perception while effectively eliminating vertigo [26]. The overall evidence base for these surgical options derives primarily from non-randomized studies and retrospective meta-analyses, underscoring the need for further high-quality trials to refine patient selection and optimize outcome measures [24].

6. Discussion

The management of Menière's Disease remains a significant clinical challenge, as current therapeutic strategies are largely palliative and aimed primarily at symptom control rather than disease modification [3]. Pharmacological approaches, while widely employed, suffer from a lack of definitive evidence particularly for agents such as betahistine and diuretics whose long-term efficacy in reducing vertigo episodes and stabilizing hearing remains uncertain [9; 3]. In contrast, local therapies such as intratympanic gentamicin and steroids offer the advantage of high local drug concentrations with lower systemic exposure, though each modality carries a distinct risk profile that must be carefully considered [12;11].

Surgical interventions represent the final recourse for patients who have exhausted conservative management with endolymphatic sac decompression and vestibular neurectomy emerging as the most viable options [22]. While non-ablative procedures such as ESD aim to preserve hearing and improve quality of life, destructive techniques like vestibular neurectomy and labyrinthectomy may be justified in severe, refractory cases despite their high risk of adverse outcomes [23;24].

Recent systematic reviews underscore the need for high-quality, well-powered randomized controlled trials with standardized diagnostic criteria and outcome measures to clarify the true efficacy and safety profiles of the various treatments used in MD [3;27]. A key aspect in the therapeutic decision-making process is the consideration of patient-specific factors including baseline hearing status, severity and frequency of vertigo attacks, and individual response to previous treatments [28]. Emerging approaches, such as the integration of vestibular rehabilitation therapy to support postural compensation following intratympanic gentamicin treatment, add another layer to the multimodal management of MD and show promise in further improving patient outcomes [7].

7. Future Directions

Given the heterogeneity in study populations and the variable natural history of Menière's Disease, future research should aim to develop a core outcome set that reflects patient-centered measures and facilitates more uniform comparisons across studies [27]. Advances in imaging techniques and the identification of potential biomarkers may eventually lead to improved diagnostic accuracy and individualized treatment regimens [24].

In addition, further exploration into the molecular mechanisms underlying endolymphatic hydrops may reveal new therapeutic targets and allow for the development of disease-modifying treatments rather than solely palliative measures [5].
The integration of multidisciplinary treatment strategies - including pharmacotherapy, localized intratympanic interventions, surgical approaches, and adjunctive vestibular rehabilitation - appears to be the most promising pathway forward for achieving sustained symptom control and enhancing quality of life in affected patients [11;12]. Moreover, patient stratification based on clinical phenotype and baseline functional status is essential in tailoring interventions to maximize benefits while minimizing risks and this personalized approach should be a focus of upcoming clinical trials [2].

8. Conclusion

Menière's Disease remains a complex and multifactorial disorder with substantial variability in clinical expression and response to therapy [2]. Current treatment strategies, ranging from systemic pharmacological agents such as betahistine, diuretics and glucocorticosteroids to local intratympanic therapies and surgical procedures, provide symptomatic relief, but are marred by inadequacies in high-quality evidence, significant heterogeneity in outcomes, and the inherent challenge of balancing therapeutic efficacy against potential adverse effects [3;12]. Until more definitive clinical trials are conducted, clinicians must rely on an individualized, multidisciplinary approach that integrates the best available evidence with patient-specific factors to guide management decisions.
In summary, although effective control of vertigo and maintenance of auditory function in MD remain challenging, recent advances in intratympanic drug delivery and surgical techniques provide promising avenues for future improvements in patient care [22;23]. Continued progress in the development of core outcome sets, along with rigorous, standardized clinical research, will be essential for ultimately transforming the management of Menière's Disease from predominantly palliative to potentially disease-modifying [27].
Future research priorities should include the design of high-quality RCTs that incorporate patient-centered outcomes and detailed safety assessments, especially in the context of intratympanic interventions and surgical procedures [3;24]. Additionally, emerging techniques such as vestibular rehabilitation and novel drug delivery systems (for example, sustained-release formulations) hold promise in enhancing treatment tolerability and long-term efficacy [7]. By addressing these challenges and gaps in the current literature, the therapeutic landscape for MS can be better optimized to meet the diverse needs of patients.
In conclusion, while the current evidence from meta-analyses and systematic reviews published between 2022 and 2024 provides valuable insights into both pharmacological and surgical treatment modalities for Menière's Disease, significant uncertainties remain. Clinicians must carefully weigh the modest benefits of systemic agents like betahistine and diuretics against their limited supporting data and the robust yet sometimes risky outcomes associated with intratympanic therapies and surgical procedures [9;12]. Given the variable natural history of MD and the multifactorial etiology of its symptoms, a personalized, patient-centered management strategy - preferably within a multidisciplinary framework - represents the current gold standard until more definitive data become available [29].

Ultimately, the goal of MD treatment remains the alleviation of vertigo, stabilization or improvement of hearing thresholds, and enhancement of overall quality of life. With ongoing research aimed at better elucidating the pathophysiology of endolymphatic hydrops and the molecular underpinnings of MD, future therapeutic approaches may shift from symptomatic management to targeted, disease-modifying interventions [5; 3]. In this evolving landscape, clinicians should remain abreast of emerging evidence and incorporate a rational, evidence-based approach in their therapeutic decision-making for patients with Menière's Disease. As the field advances, expanding collaborative efforts to standardize outcome measurement and facilitate multicenter clinical trials will be critical in refining treatment paradigms for this challenging inner-ear disorder [24;27].

In summary, while the management of Menière's Disease remains complex and somewhat empiric, the integration of pharmacological, local and surgical treatment options - guided by an individualized evaluation of patient characteristics and supported by the latest systematic reviews - provides a rational framework for improving patient outcomes [3;11]. Continued research efforts are needed to evolve these strategies, reduce the burden of this disabling disorder and ultimately advance the standard of care in Menière's Disease [30].

This review, based on the latest available meta-analyses and systematic reviews, highlights both the progress and limitations in the current therapeutic landscape of Menière's Disease and calls for future rigorously designed clinical trials to address remaining uncertainties [3;12]. By consolidating current evidence and fostering an integrated, patient-centered treatment approach, it is anticipated that the management of MD will increasingly shift towards strategies that not only control symptoms, but also modify the disease process, thereby offering renewed hope for improved quality of life in affected patients.

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