

Review Article

Current diagnostic criteria of Meniere's disease: a review

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ABSTRACT

Meniere's disease (MD) is a chronic inner ear disease that severely affects the quality of life. MD often remains a diagnostic dilemma that challenges clinicians for its treatment. The clinical variability found in MD makes it necessary for the improvement of the diagnostic criteria with clinical findings and patient history. Taking into account the frequent nature of MD, proper diagnostic criteria are reliable for early diagnosis which is helpful for successful management of this morbid disease and undoubtedly cost-effective for the health care system. This review paper discusses on diagnostic criteria for MD jointly formulated by the equilibrium committee of the American academy of otolaryngology-head and neck surgery (AAO-HNS), the classification committee of the Barany society, the Japan society for equilibrium research, the European academy of otology and neurotology (EAONO) and the Korean balance society. The classification for MD includes two categories such as definite MD and probable MD. Diagnosis of definite MD is based on certain clinical criteria and need observation of episodic vertigo along with low to medium frequency sensorineural hearing loss (SNHL) and fluctuating aural symptoms such as hearing loss, tinnitus, and/or fullness in the affected ear. The duration of vertigo is lasting from 20 min to 12 hours. The probable MD is a broader concept defined by episodic vertigo associated with fluctuating aural symptoms lasting for 20 min to 24 hours.

Keywords: MD, Diagnostic criteria, Vertigo, tinnitus, Sensorineural hearing loss, Aural fullness

INTRODUCTION

Meniere's disease (MD) is a chronic inner ear disorder presenting with recurrent episodes of vertigo, fluctuating hearing loss, tinnitus, and aural fullness.¹ MD is a multifactorial disease where environmental and genetic factors often determine the onset of the disease.² episodic vertigo is usually much common in the first year of the disease, but the cochlear symptom such as hearing loss and vestibular hypofunction show great variability among patients of MD, making the exact phenotyping of the disease difficult.³ Moreover, a patient who present bilateral sensorineural hearing loss (SNHL) and other comorbidities like migraine, benign paroxysmal positional vertigo, systemic autoimmune disorders, further complicate diagnosis and treatment.⁴ There are multiple efforts have been sought for defining the consensus diagnosis for MD. MD continues to pose a difficult diagnostic problem for a clinician, resulting in

heterogeneous approaches for managing the diseases.⁵ If MD is undiagnosed or diagnosed late may result in physical consequences such as imbalance and hearing impairment and psychological manifestations such as anxiety, depression, panic and cognitive defects, particularly in the elderly age group.⁶ The objective of this review article is to discuss on current diagnostic criteria for MD for improving the quality of patient care by early treatment of this morbid disease.

METHODS OF LITERATURE SEARCH

Multiple systematic methods were used to find current research publications on the current diagnostic approach of MD. We started by searching the Scopus, Pub Med, Medline, and Google Scholar databases online. A search strategy using PRISMA (Preferred reporting items for systematic reviews and meta-analysis) guidelines was developed. This search strategy recognized the abstracts

of published articles, while other research articles were discovered manually from the citations. Randomized controlled studies, observational studies, comparative studies, case series, and case reports were evaluated for eligibility. There were total numbers of articles 96 (32 case reports; 34 cases series; 30 original articles) (Figure 1). This paper focuses only on diagnostic criteria of MD. This paper examines epidemiology, historical diagnostic criteria, diagnosis, diagnostic criteria, clinical variants and investigations of MD. This analysis provides a better understanding for easy diagnosis of MD which will provide prompt treatment. It will also serve as catalyst for additional study into newer diagnostic protocol for MD.

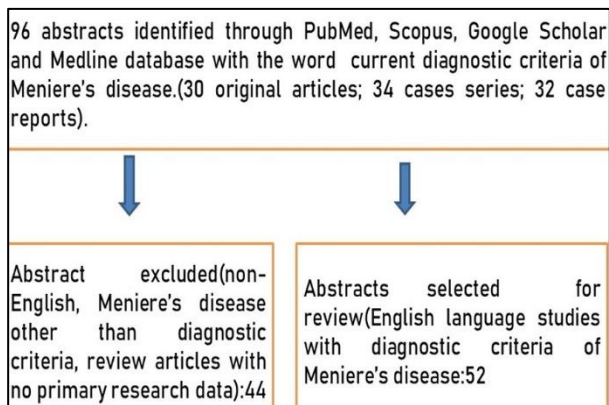


Figure 1: Flow chart showing method of literature search.

EPIDEMIOLOGY

MD is a chronic disorder of the inner ear characterized by episodic vertigo, fluctuating sensorineural hearing loss, aural fullness, and tinnitus, all of which reduce the quality of life and could manifest permanent hearing loss. The prevalence of MD in the United States is approximately 190 per 100,000 and is more often found in females.⁷ The prevalence of MD is increasing significantly with aging.⁷ The age of onset for MD ranges from third to seventh decades of life. MD is characterized by a variable course of clinical manifestations and the development of cochlear and vestibular symptoms may take years in an individual patient.⁸ Initially, MD often afflicts one year (unilateral MD), but both ears can be affected (bilateral MD) later on. In the early part of the disease, the most disabling symptom is vertigo. Acute episodes usually occur with a frequency of 5 to 10 episodes per year, and these continue with remission stages of variable duration of months or years.⁹ The annual incidence of MD was around 8 to 400 per 100,000 in early 2000s.¹⁰ One recent study showed similar higher values and a steep increase from 30.02 in 2013 to 118.48 in 2018 per 100,000 population.¹¹ One recent study in the UK showed the annual health care costs related to MD were estimated between 829.9 to 934.2 million USD, equating to 5112\$ to 5748\$ per person per year.¹² MD is either unilateral or bilateral. Although unilateral MD is more common, bilateral MD increases with increased

duration of illness. Approximately 45% of cases of unilateral MD will develop contralateral involvement over period of time, within 20 years follow-up period.¹³

HISTORICAL DIAGNOSTIC GUIDELINES

The American academy of otolaryngology-head and neck surgery (AAO-HNS) introduced a guideline for diagnosis and treatment evaluation of MD in 1972 and revised this in 1985 and 1995 (Table. 1).¹⁴ The Japanese society for equilibrium research proposed a clinical criterion for diagnosis of MD in 1974 (Table 2). Despite the effective contribution of these guidelines for diagnosis and management of MD, no effective biological markers for diagnosis or prognosis have been detected for MD so far, but an evolving understanding of MD points out the need for updating these criteria. The Barany society has made an international classification of vestibular disorders and promoted a consensus definition for several vestibular disorders including MD. The diagnostic criteria were made in a coordinated effort by American academy otolaryngology-head and neck surgery (AAO-HNS), the European academy otology and neurotology, the Japan society for equilibrium research, and the Korean balance Society in 2015, considering two categories such as definite and probable MD.¹⁵ Definite MD: A. Two or more spontaneous episodes of vertigo, lasting for 20 minutes to 12 hours; B. Pure tone audiometry presented with low to medium frequency SNHL in one ear, defining the affected ear on at least one occasion before, during, or after one episode of vertigo; C. Fluctuating ear symptoms such as hearing, tinnitus, or fullness in the affected ear; D. Not better accounted for by another vestibular diagnosis. Probable MD: A. Two or more episodes of vertigo or dizziness lasting for 20 minutes to 24 hours; B. Fluctuating ear symptoms such as hearing, tinnitus, or fullness in the affected ear; C. Not better accounted for another vestibular diagnosis.

Table 1: Diagnostic scale of MD (Committee on hearing and equilibrium AAO-HNS 1995).

Types	Characteristic features
Certain MD	Definitive MD plus histopathological confirmation
Definite MD	Two or more definitive spontaneous episodes of vertigo lasting 20 min or longer, audiometrically documented hearing loss on at least 1 occasion, tinnitus or aural fullness in the affected ear. Other causes excluded.
Probable MD	One definitive episode of vertigo, audiometrically documented hearing loss on at least 1 occasion, tinnitus or aural fullness in affected ear. Other causes are excluded.
Possible MD	Episodic vertigo without documented hearing loss/ sensorineural hearing loss, fluctuating/fixed with disequilibrium but without definitive episodes. Other causes are excluded.

Table 2: Diagnostic criteria for MD (MD research committee of Japan 1974).

Conditions	Criteria
Repeated episodes of whirling vertigo	Dizzy spells in the absence of a specific cause which is associated with nausea or vomiting lasting for several minutes to several hours. There may be few episodes of non-whirling dizziness present in the series of whirling vertigo; mixed patterns of nystagmus horizontal and rotatory is seen in the majority of cases during symptoms; in cases with a single first episode, differential diagnosis with sudden SNHL is important.
Fluctuating cochlear symptoms	Hearing loss and tinnitus often show fluctuation synchronous with vertiginous attacks; many patients present with fullness of the ear and hypersensitivity to intense sound in the affected ear. The hearing test shows a marked fluctuation of a threshold of hearing in the low and middle tone range, recruitment of loudness will be seen; usually, only one ear is affected, however, both ear involvement is not uncommon.
Exclusion of central nervous system involvement	VIII th nerve tumor and other cochleovestibular disorders. To rule out these other disorders, a thorough history taking, neurological examination, and specific clinical tests, hearing tests must be done and sometimes it is required to follow up the patients' diseases course to get chronological information necessary for establishing the correct diagnosis.
Diagnostic criteria	Definite MD: Condition 1 to 3. Suspicious or uncertain MD 1 and 3 or 2 and 3.

DIAGNOSIS

The diagnosis of MD is based on clinical presentations such as episodic vertigo, SNHL (usually unilateral) involving low and medium frequencies, tinnitus, and aural fullness in the affected ear. The primary histopathological study of MD has been presented with hydrops, which has been thought to be due to disruption in endolymphatic production, resorption, or flow, among others.¹⁶ There are no established biological markers for diagnosis of MD, as this condition is not a single disease, and further research is required for getting molecular markers.¹⁷ However, there are a series of complementary

diagnostic tests available to confirm or reject the presence of other clinical comorbidities.¹⁸

CLINICAL VARIATIONS OF MD

Different clinical variants

Tumarkin crisis (Drop attacks): The patient presents with acute episodes of sudden collapse without loss of consciousness, forewarning, or focal neurological deficits.¹⁹ Patients feel as if an external force suddenly pushes them to the ground. It can be followed by instability or vertigo. It is thought that it might be due to abrupt distortion or discharge related to maculae of the saccule or utricle leading to loss of vertical references.¹⁹ This is common in bilateral MD.

Lermoyez syndrome: It is an uncommon type of MD characterized by the disappearance of aural symptoms after a vertigo episode. Here, hearing loss progresses slowly.

Partial syndromes: Patients present with hearing impairment without vertigo (cochlear MD) and vertigo without hearing impairment (vestibular MD) are considered as incomplete phenotypes, commonly found in familial MD.

Delayed MD: It includes MD with vertigo in a patient with previous severe to profound SNHL occurring for many years (up to 50) after the development of hearing impairment.

Drop attacks

A small number of patients with MD present a life-threatening sudden fall called drop attacks. Drop attacks with MD were initially called an otolithic catastrophe by Tumarkin in 1936.²⁰ This type of sudden fall which is known as Tumarkin's otolithic crisis or Tumarkin attack occurs without warning and without loss of consciousness but occurs in patients with a history of MD. The mechanism of drop attacks is thought to be an abrupt mechanical deformation of the otolithic membrane by saccular and/or utricular signal stimulating vestibule-spinal reflex pathways.²¹ This causes in loss of postural tone and balance. The function of otolithic organs plays an important role in the whole process of drop attack episode.

MD overlapping with vestibular migraine

Studies show that migraine is more common in patients with MD in comparison to healthy controls.²² Patients with clinical features of both MD and vestibular migraine have been frequently reported.²³ MD and vestibular migraine can be inherited as a symptom cluster. Fluctuating SNHL, tinnitus, and aural fullness may be found in vestibular migraine, but SNHL does not progress to severe hearing loss over the years in case of

migraine.²⁴ When hearing loss occurs in vestibular migraine, it is usually bilateral whereas the involvement of bilateral ears from the beginning of the disease is uncommon in MD.²³ Although headache and phonophobia of migraine may be found during attacks of MD, the pathophysiological relationship between MD and vestibular migraine is not clear. Some suggest common pathophysiology, perhaps associated with an ion channel dysfunction and endolymphatic hydrops has been documented in patients of vestibular migraine and aural symptoms.²⁵

DIAGNOSTIC CRITERIA OF MD

Symptoms

The clinical symptoms include that recurrent attacks of vertigo. Each episode of vertigo occurs spontaneously, lasting for 10 minutes to several hours; vertigo attacks are accompanied by fluctuating cochlear symptoms such as hearing loss, tinnitus, and aural fullness and no neurological symptoms except for the eighth cranial nerves.

Signs

The examination findings include that audiometry shows sensorineural hearing loss. There is a fluctuation of hearing loss found in association with episodic vertigo, especially in the early stage of the disease; peripheral vestibular dysfunction like horizontal/torsional nystagmus and/or postural imbalance; no neurological abnormalities except for the eighth cranial nerve; other known causes of vertigo associated with hearing impairment can be excluded and identification of the endolymphatic hydrops in the affected ear with contrast-enhanced MRI.

DIAGNOSTIC CRITERIA FOR ATYPICAL MD

Cochlear type of atypical MD

Symptoms: Recurrent cochlear symptoms such as hearing loss, tinnitus or aural fullness without vertigo attack and no neurological symptoms except for the eighth cranial nerve.

Signs: Audiometry findings demonstrate sensorineural hearing loss, low or pan frequency sensorineural hearing loss; no neurological dysfunction except for the eighth cranial nerve and other known diseases causing recurrent cochlear symptoms can be ruled out.

Vestibular type of atypical MD

Symptoms: Recurrent episodes of vertigo-like typical MD. The vertigo attacks are not associated with fluctuating cochlear symptoms and no neurological symptoms except the eighth cranial nerve.

Signs: Peripheral vestibular dysfunction such as horizontal/torsional nystagmus and/or postural imbalance; no neurological dysfunction except the eighth cranial nerve and other known causes of recurrent attacks of vertigo can be ruled out.

INVESTIGATION FOR MD

Pure tone audiometry (PTA) usually shows low-frequency SNHL at the early stage of MD. The SNHL is usually fluctuating in nature and is reversible. As episodic vertigo recurs, hearing loss tends to progress and begins to affect middle and high frequency.²⁶ After a flat type of hearing loss of more than 40 decibels, it becomes irreversible. In some cases, unaffected ears are involved during the course of MD, leading to bilateral involvement.^{27,28} There are few important investigations available for MD. These tests are available for estimating the endolymphatic hydrops and these include electrocochleography, glycerol test, glycerol/furosemide test, furosemide test, and cervical vestibular evoked myogenic potential (cVEMP). The positive ratios of endolymphatic hydrops in patients of definite MD estimated by the electrocochleography and glycerol test range from 46% to 71% and from 43% to 63% respectively.²⁹ The investigations such as electrocochleography, glycerol test, furosemide test, and glycerol/furosemide cervical vestibular evoked myogenic potential (cVEMP) are useful to confirm the presence of endolymphatic hydrops.^{29,30} Positive ratios of endolymphatic hydrops in patients of MD estimated by electrocochleography and glycerol test range from 46% and from 43% to 63% respectively.³¹ The summing potential (SP) and action potential (AP) obtained from electrocochleography shows increased SP/AP ratio in patients with endolymphatic hydrops. ECOG has been advocated as a reliable test that is diagnostic for MD. Cervical vestibular evoked myogenic potential (cVEMP) corresponds to an inhibitory sacculo-colic reflex documented in the ipsilateral sternocleidomastoid muscle in response to acoustic stimulation. Distended sacculle comes in contact with footplate of stapes, increases the saccular macula sensitivity to the loud sound, leading to abnormal cVEMP.³² The cVEMP is widely considered as an effective method to determine the saccular function and vestibulocollic pathway and oVEMP reflects utricular function and otolith-colic reflex pathway.³³

Imaging for MD

The use of magnetic resonance imaging (MRI) for the diagnosis of MD is under debate. Although MRI is a useful investigation for the diagnosis of endolymphatic hydrops and exclusion of other diseases, the 2015 MD criteria emphasize the clinical symptoms and signs for establishing the diagnosis.³⁴ Endolymphatic hydrops has been reported using three-dimensional fluid-attenuated inversion recovery sequences in patients with MD, vestibular migraine, isolated SNHL, and even in healthy persons, so endolymphatic hydrops cannot be considered

specific findings of MD.³⁴ Contrast enhance (intravenous gadolinium) MRI helps to visualize the endolymphatic hydrops.³⁵ However, the best way to assess the endolymphatic hydrops on MRI is based on the inversion of the sacculo-utricle area ratio, evaluated by semiquantitative grading technique.³⁶ In patients of MD diagnostic criteria, the presence of endolymphatic hydrops in MRI is related to hearing loss and probably with duration of the diseases.³⁷

Vestibular function tests

These clinical tests are helpful to confirm the vestibular hypofunction in MD. These tests include caloric test, vestibular evoked myogenic potential (VEMP), and head impulse test.³⁸ Caloric test is an objective test that demonstrates peripheral vestibular dysfunction.³⁹ This test is based on aural stimulation by different temperatures for evaluating horizontal semicircular canal function and it can confirm the unilateral vestibular hypofunction in approximately 75% of cases of unilateral MD.⁴⁰ VEMP test uses cervical or ocular muscles reflexes evoked by a loud noise in the ear or high-frequency vibration. VEMP is helpful to evaluate the function of saccule (cVEMP) and utricle (oVEMP).⁴¹ The role of VEMP in MD is so far unestablished (sensitivity: 50%; specificity: 49%).⁴² video head impulse test is an objective test that measures vestibulo-ocular reflex (VOR) for each semicircular canal. The VOR gain is used for tracking vestibular function in follow-up period.⁴⁰

Blood tests

Blood tests are usually nonspecific and used to evaluate vascular risk factors, autoimmunity, and thyroid functions.⁴³ The blood tests include hemogram and erythrocyte sedimentation rate. The biochemistry tests include lipid and complement levels. Prestin and otolin-1 levels are differed between patients with MD in comparison to vestibular migraine. However, prestin behaves as a biomarker for inner ear function, but its role in differentiating MD from vestibular migraine remains unclear.⁴⁴

CONCLUSION

Meniere's disease is a chronic disorder that affects a substantial number of people each ear worldwide. MD represents a persistent and recurrent problem for individuals and affects their quality of life, particularly during periods of acute symptomatology. It is characterized by intermittent episodic vertigo, fluctuating sensorineural hearing loss, tinnitus, and aural fullness. The morbid relapsing nature of MD may significantly affect the daily life of the patients. The diagnosis of the MD is often challenging for clinicians because of its clinical overlapping with a few other diseases manifesting vertigo. Taking into account the frequent nature of MD in certain countries, prompt referral and successful diagnosis result in prompt treatment which

will be undoubtedly cost-effective for the health care system.

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