# MULTIFREQUENCY ADMITTANCEMETRY IN DIAGNOSIS OF MENIÈRE'S DISEASE

**A Thesis submitted for partial fullfilment of the requirements for Master Degree in Audiology**

**By:**


**Dr. Rabab Ahmed Koura**

M.B.,B. CH. Bani-Suef University


**Supervisors:**


**Prof. Dr. Mohamed Ibrahim Shabana**

Professor of Audiology and Head of the Audiology Unit
Faculty of Medicine,
Cairo University.

**Dr. Mohamed Sherif El-Minawi**

Lecturer of Audiology,
Faculty of Medicine,
Cairo University.

**Dr. Abeir Osman Dabbous**

Lecturer of Audiology,
Faculty of Medicine,
Cairo University.



**Kasr El-Aini Faculty of Medicine**
**Cairo University**
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# Abstract:

***OBJECTIVE:*** To assess the multifrequency tympanometry (MFT) in Menière's disease (MD). ***METHODS:*** MFT was performed in 20 adult patients having definitive MD, and 20 well-matched controls. Measurements included: Tympanograms for admittance (Y), conductance (G), susceptance (B), and phase angle (∅) at different probe frequencies and resonant frequency (RF). Y, B, and G tympanograms were done at R.F and at 2000 Hz. Amplitude, tympanometric width (TW), peak pressure value, and +200 daPa value of G at 2000 Hz were determined. ***RESULTS:*** The RF of affected ears of MD (group IA) (607.50 Hz ± 217.20) is lower than that of the non-affected ears MD (group IB) (642.50 Hz ± 216.60), which in turn is lower than the controls' ears (group II) RF (725.00 Hz ± 219.15) however, this difference was not statistically significant ($p < 0.05$). There was a statistically significant difference among the 3 groups as regards +200 daPa value There was no statistically significant difference among the 3 groups as regards the Δ ∅, or the amplitude or peak pressure value of G at 2000 Hz. The mean TW of group IA was 155.5 daPa ± 104.69 and is higher than that of group IB (132.25 daPa ± 80.91). Both groups show higher means than that of group II (88 daPa ± 31.89). This difference was statistically significant. This suggests that MD results in modification of G tympanograms at 2 KHz, and there may also be sub-clinical affection of the asymptomatic ears of MD. There was no correlation between quantitative tympanogram criteria and duration of MD or pure tone thresholds except for a statistically significant direct correlation between RF and age and hearing level at 250, 1000 and 4000 Hz. ***CONCLUSION:*** MFT specially the measurement of RF of the middle ear and measurement of the TW of G tympanogram at 2 kHz has a role in the assessment of MD and its possible sub-clinical bilaterality.



## *Keywords:*

Menière's disease, Endolymphatic Hydrops, Multifrequency tympanometry, Resonant Frequency, Tympanometric Width, Conductance Tympanogram.

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| | |
|---|---|
| **AL** | **Annular Ligament** |
| **AP** | **Action Potential** |
| **ART** | **Acoustic Reflex Threshold** |
| **B** | **Susceptance** |
| **Contra.** | **Contralaterally** |
| **CT** | **computed tomography** |
| **daPa** | **decaPascals** |
| **dBHTL** | **Decibel Hearing Threshold Level** |
| **Δ ∅** | **Change In Phase Angle** |
| **ESD** | **Endolymphatic Sac Decompression** |
| **F-VEMP** | **furosemide loading Vestibular Evoked Myogenic Potential** |
| **G** | **Conductance** |
| **Hz** | **Hertz** |
| **IAD** | **inter-aural amplitude difference** |
| **Ipsi.** | **Ipsilaterally** |
| **KHz** | **kiloHertz** |
| **MD** | **Menière's Disease** |
| **MFT** | **Multifrequency Tympanometry** |
| **RF** | **Resonant Frequency** |
| **RWM** | **Round Window Membrane** |
| **SNHL** | **Sensorineural Hearing Loss** |
| **SP** | **Summating Potential** |
| **TPP** | **Tympanometric Peak Pressure** |
| **TW** | **Tympanometric Width** |
| **VEMP** | **Vestibular Evoked Myogenic Potential** |
| **Y** | **Admittance** |

# *CONTENTS*

# INTRODUCTION and RATIONALE:

Menière's disease is a disorder of the inner ear. It is also called idiopathic endolymphatic hydrops. It probably results from an abnormality in the fluids of the inner ear. It is characterized by distension of the membranous labyrinth especially affecting scala media. In most cases only one ear is affected, but both may be affected in about 15% of cases. It usually starts between 20 – 50 years. It appears in the form of episodic rotational vertigo, hearing loss, tinnitus and sensation of ear fullness. Vertigo may last from 20 minutes to 2 hours or longer **(AAO-HNS, 1995).**

Tympanometry has been established as a sensitive, specific , non-invasive and simple test for diagnosis of middle ear disease and is traditionally performed using low sound probe frequency (226 Hz.) **(Franco-Vidal et al., 2005).**

Static acoustic compliance is a noninvasive procedure that is thought to measure perilymphatic pressure at the footplate. An increase in mechanical fluid pressure in the inner ear is transmitted to the footplate of the stapes. This causes a reduction in the compliance at the drum **(Sennaroglu, et al., (2001)**

The new generation of otoadmittancemeters makes it possible to measure vectors of complex admittance (Y) by detection of susceptance (B), and conductance (G) at different frequencies ranging from 200 to 2000 Hz. **(Margolis and Goycoolea, 1993).**

Using higher frequencies gained acceptance in ossicular chain disease. Few clinical studies have assessed multifrequency tympanometry (MFT) in inner ear disease especially in Meniere's disease. A significant decrease in middle ear resonance frequency outside of episodes was detected, and changes in inner ear pressure may induce reproducible tympanogram at 2 kHz. probe tone frequency **(Franco-Vidal et al., 2005).**

# AIM OF THE WORK

To assess the quantitative and qualitative aspects of multifrequency tympanometry in Menière’s disease.

# MENIÈRE'S DISEASE

## The Clinical syndrome:

In 1861, the French physician Prosper Menière's described a condition which now bears his name. Meniere's disease (MD) is a disorder of the inner ear characterized by recurring attacks of vertigo, sensorineural hearing loss (SNHL), tinnitus, and in some individuals, a fluctuating fullness in the ear. Acute attacks are superimposed on gradual deterioration in sensorineural hearing in the involved ear, typically in the low frequencies initially. Over time, a reduction in responsiveness of the involved peripheral vestibular system occurs. The area of the ear affected is the entire labyrinth, which includes both the semicircular canals and the cochlea **(Lacour, et al, 1997)**.

The American Academy of Otolaryngology and Head and Neck Surgery **(AAO-HNS, 1995)** has refined the definition of Meniere's several times The most recent revision was set forth by the AAO-HNS Committee on Hearing and Equilibrium in 1995.The definitions are:

- Possible MD: Episodic vertigo of the Meniere's type (20 minute, associated with horizontal rotatory nystagmus) without documented hearing loss, or SNHL, fluctuating or fixed, with dysequilibrium but without definitive episodes. Other causes are excluded
- Probable MD: One definitive episode of vertigo. Audiometrically documented SNHL on at least one occasion; tinnitus or aural fullness in the treated ear. Other causes are excluded
- Definite MD: Two or more definitive spontaneous episodes of vertigo 20 minutes or longer. Audiometrically documented SNHL on at least one occasion; tinnitus or aural fullness in the treated ear. Other causes are excluded.
- Certain MD: Definite MD, plus histopathologic confirmation **(AAO-HNS Committee on Hearing and Equilibrium in 1995).**

## Incidence:

MD affects roughly 0.2% of the population. The preferred age lies in the fourth to sixth decades, and there is a slight preponderance of females. MD usually starts confined to one ear but it often extends to involve both ears over time so that after 30 years, 50% of patients with Meniere's have bilateral disease **(Stahle et al, 1991).** There is some controversy about this statistic. The prevalence of bilaterality is as low as 17% due to a lower duration of follow-up and the 50% figure is more likely to be correct. Other possibilities, however, are selection bias and different patterns of the disease in different countries. Seventy five percent of persons destined to become bilateral do so within 5 years **(Silverstein, 1991).**

Familial occurrence of MD has been reported in 10% to 20% of cases **(Plontke, 2002).** In a Swedish study, 14% of 91 patients were noted to have a familial distribution of the disease. An autosomal dominant mode of inheritance has been documented in several studies **(Morrison, 1995)** Other studies have concluded that genetic inheritance played a role, but the mode of transmission was variable **(Birgerson, 1987).**

## Pathogenesis of Menière's Disease:

The pathologic basis thought to underscore MD findings is a distortion of the membranous labyrinth. The hallmark of this is endolymphatic hydrops **(Schaknecht and Igarishi, 1986).** This reflects the changes in the anatomy of the membranous labyrinth as a consequence, of the over accumulation of endolymph (figure 1). This occurs at the expense of the perilymphatic space **(Klis et al., 1990).**

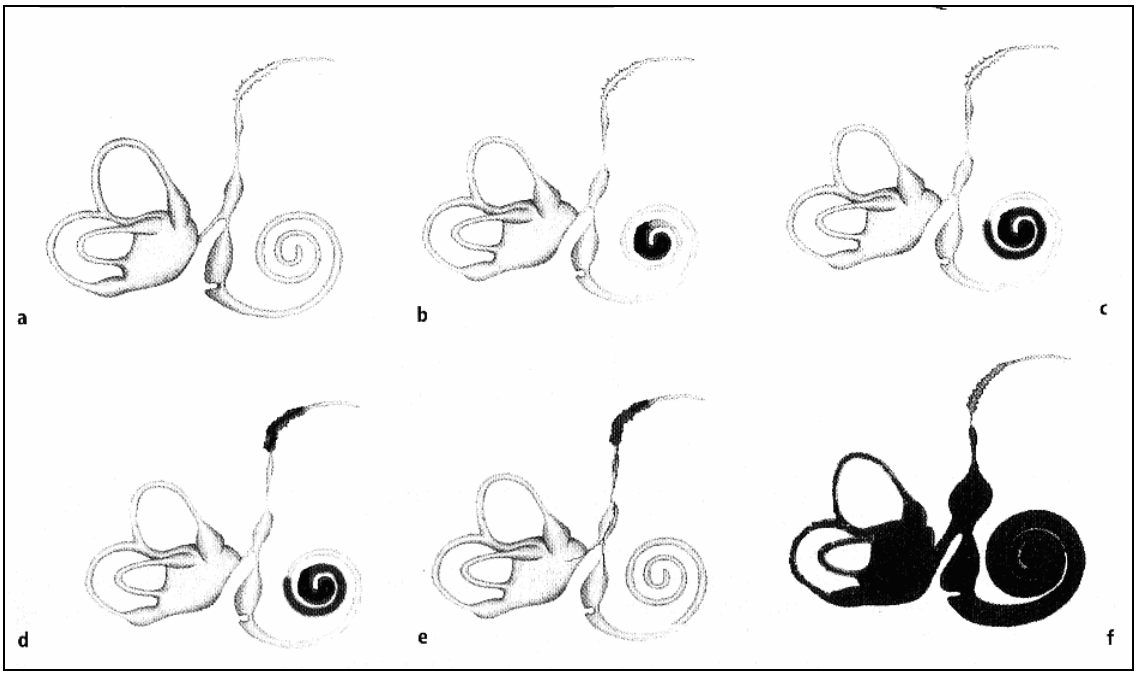


Figure 1: a) A diagram of the normal membranous labyrinth. b) In the normal ear, some hydrops has occurred. The ear can act swiftly to move the excess endolymph by increasing longitudinal flow. c) In the Meniere's ear, a narrow endolymphatic duct slits up, preventing longitudinal flow and endolymphatic hydrops increases. d) The endolymphatic sac senses it is 'empty' and secretes glycoproteins and "saccin". e) The obstruction is overcome with sudden onset of longitudinal drainage of endolymph towards the endolymphatic sac. f) Eventually the mechanisms fail and the duct remains blocked. There is gross endolymphatic hydrops but the attacks of vertigo cease (burnt out Meniere's disease) **(Gibson and Arenberg, 1997).**