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Hands-on Course 4/8

**Vestibular evoked myogenic potentials
(Level 1)**

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Vestibular Evoked Myogenic Potentials (VEMPs)

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Introduction: The Vestibular System

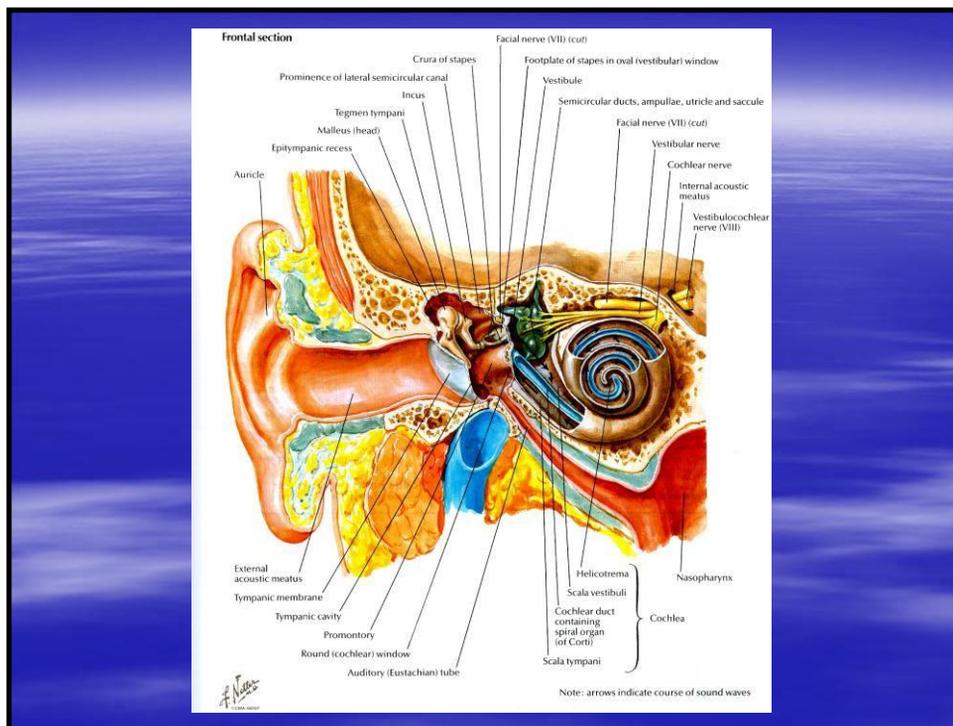
- The vestibular system is responsible for the sensation of balance.
- The end organs (receptors) of the vestibular system are located in the inner ear.
- Semicircular canals-Angular Acceleration.
- Otolith organs (sacculae and utricle)-Linear acceleration.

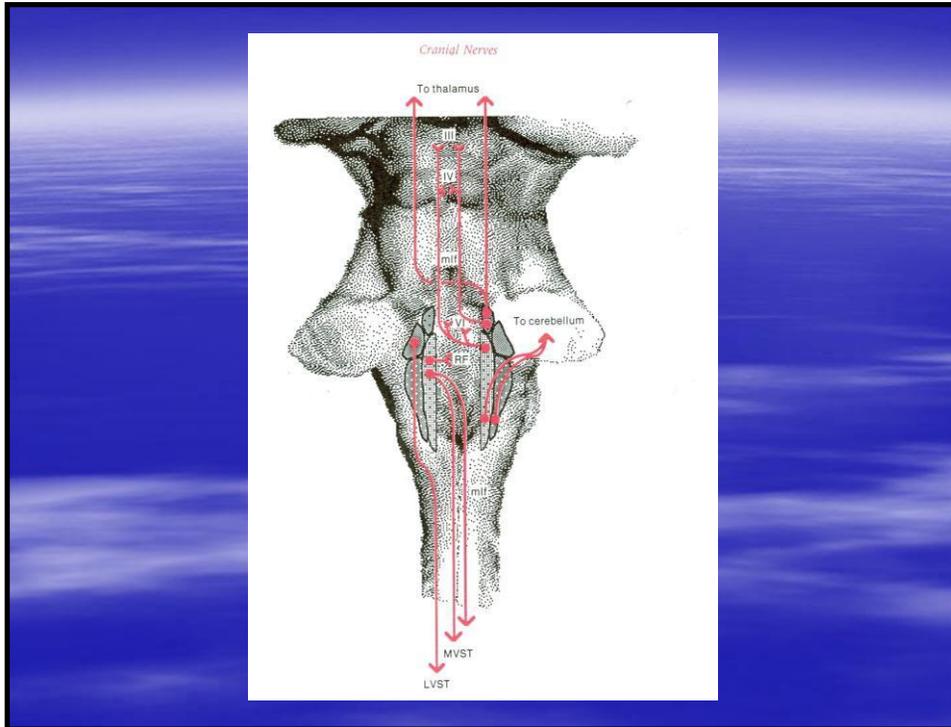
Introduction

- Rotating chairs and head drops, that have been used in the past to stimulate the vestibular end organs to record evoked potentials have the disadvantage of having a slow rise time, a tendency not to be 100% reproducible, and not a nice experience for the patient.

Vestibular Evoked Myogenic Potentials (VEMPs)

- Vestibular evoked myogenic potentials (VEMPs) have become an accepted test of vestibular function.
- A non-invasive method of recording function (and dysfunction) from the vestibular system
- Vestibular afferents can be activated by nonphysiological techniques such as moderate intensity (120 dB pSPL \approx 90 dB nHL) sound (500 Hz tone) or vibration (mastoid, forehead stimulation, or impulsive lateral acceleration).
- Galvanic (Electrical) stimulation applied over the mastoid processes is technically difficult to perform and is now performed in only a few laboratories.

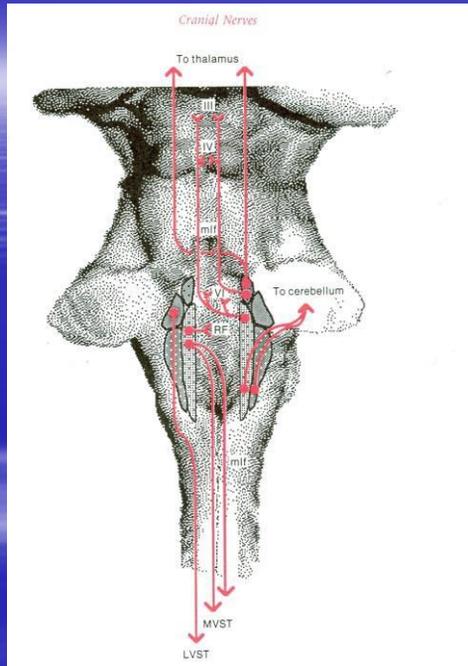
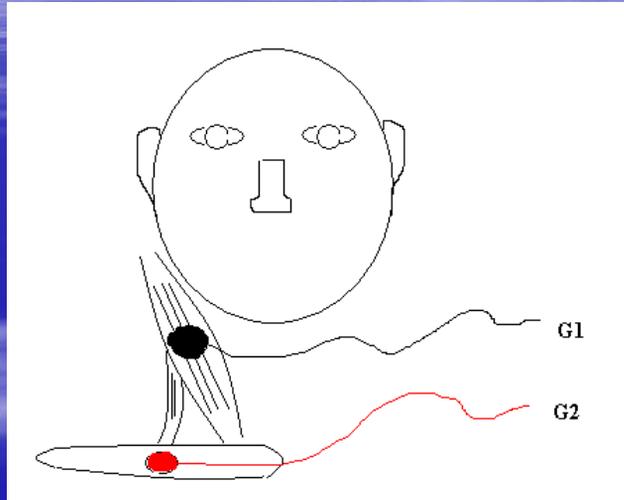


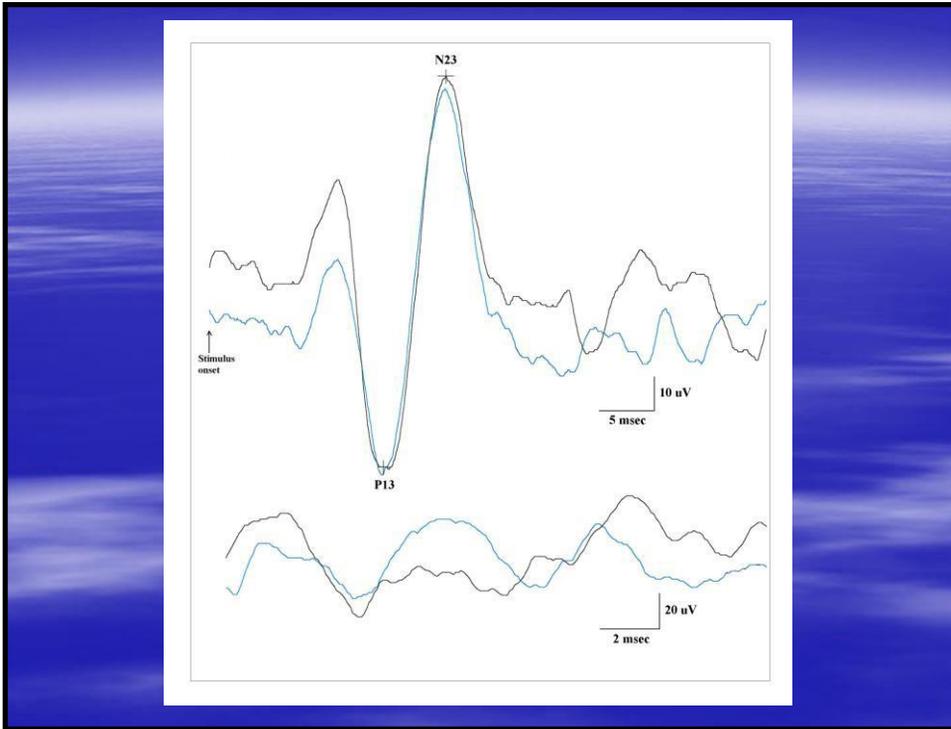


Cervical VEMPs (cVEMPs)

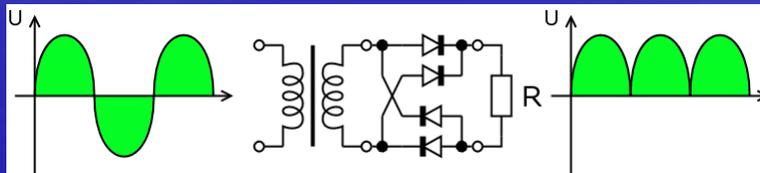
- Cervical vestibular evoked myogenic potentials (cVEMPs) are recorded from the **tonically** active ipsilateral sternocleidomastoid muscle.
- Specifically, it records function from the saccule, **inferior** vestibular nerve, vestibular nuclear complex, medial vestibulospinal tract, motor nucleus of the sternocleidomastoid muscle and spinal accessory nerve.
- The response is mainly an inhibitory one.

cVEMPs





EMG Rectification



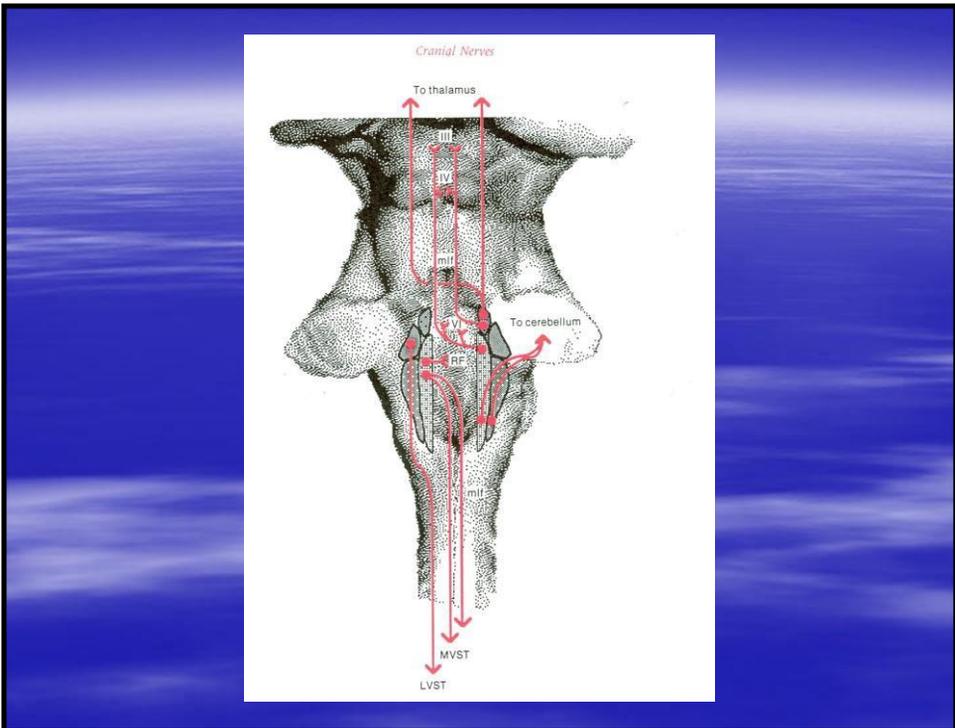
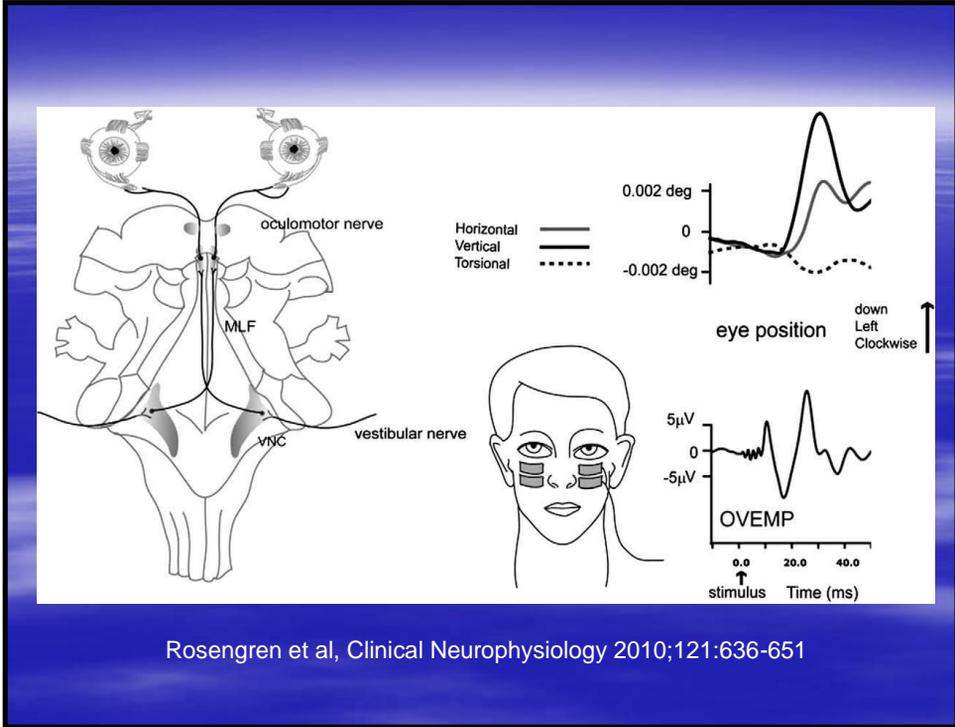
cVEMPs

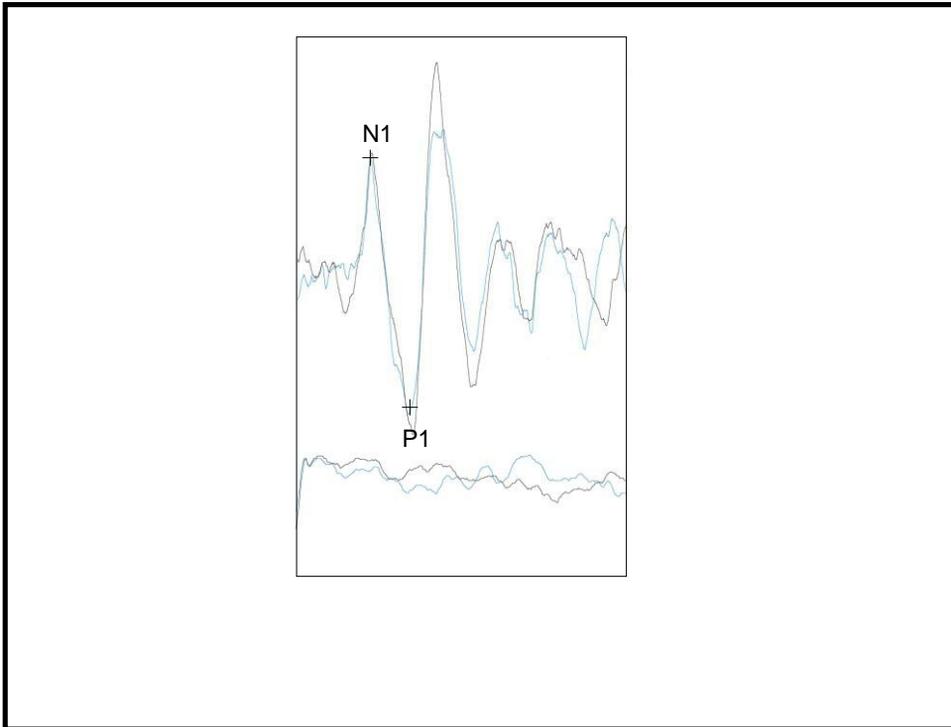
(can be performed on any neurophysiology system that normally does BAEPs)

- Recording Parameters:
 - Bandwidth 10 Hz – 2 kHz
 - Sensitivity 10 μ V/Div
 - Sweep 10 msec/Div.
 - Speaker On.
 - Rejection Off.
- **Gain between 2,500 and 5,000** depending on system (Hands-on will use 2,000 based on experience of own recording system)
 - (Biotronics/VikingSelect= Amplifier Sensitivity (SNS) of 500 μ V).
- Stimulation Parameters:
 - Tone frequency of 500 Hz.
 - Stimulation rate of presentation of 5 Hz.
 - Rise/Fall of 1 cycle
 - Duration of 3.5 cycles (7 msec)
 - Stimulus polarity does not appear to be critical (unpublished data).
 - Contralateral masking noise of 30 dB less than stimulation intensity.
 - Stimulation intensity of 90 dB nHL (120 dB pSPL).

Ocular VEMPs (oVEMPs)

- The oVEMP is recorded from the tonically active *contralateral* inferior oblique muscle.
- Specifically, it records function from the utricle, superior vestibular nerve, vestibular nuclear complex, medial longitudinal fasciculus, oculomotor nucleus, III CN, inferior oblique muscle.
- The response is mainly an excitatory one.





oVEMPs

- Recording Parameters:
 - Bandwidth 5 Hz – 1 kHz
 - Sensitivity 2 uV/Div
 - Sweep 5 msec/Div.
 - Speaker On
 - Rejection Off.
 - **Gain between 2,500 and 5,000** depending on system (Hands-on will use 5,000 based on experience of own recording system). (Stepping).
 - (Biotronics/VikingSelect= Amplifier Sensitivity (SNS) of 200 uV).
- Stimulation Parameters:
 - Tone frequency of 500 Hz.
 - Stimulation rate of presentation of 5 Hz.
 - Rise/Fall of 1 cycle
 - Duration of 2 msec
 - Rarefaction
 - Contralateral masking noise of 30 dB less than stimulation intensity.
 - Stimulation intensity of 90 dB nHL (120 dB pSPL).

Meniere's Disease

- A clinical syndrome that consists of episodes of spontaneous vertigo usually associated with unilateral fluctuating sensorineural hearing loss, tinnitus and aural fullness.
- Associated with the accumulation of endolymph in the cochlear duct and the vestibular organs in histopathological studies.

Vestibular Migraine

- Also is associated with episodes of vertigo with or without migraine.
- However, this usually coexists with separate episodes of migraine without vertigo.
- The cause of this clinical entity is unclear, as there is evidence for both central and peripheral causes.
- One study has shown the presence of endolymphatic hydrops in both ears in patients with VM.

Meniere's Disease vs Vestibular Migraine.

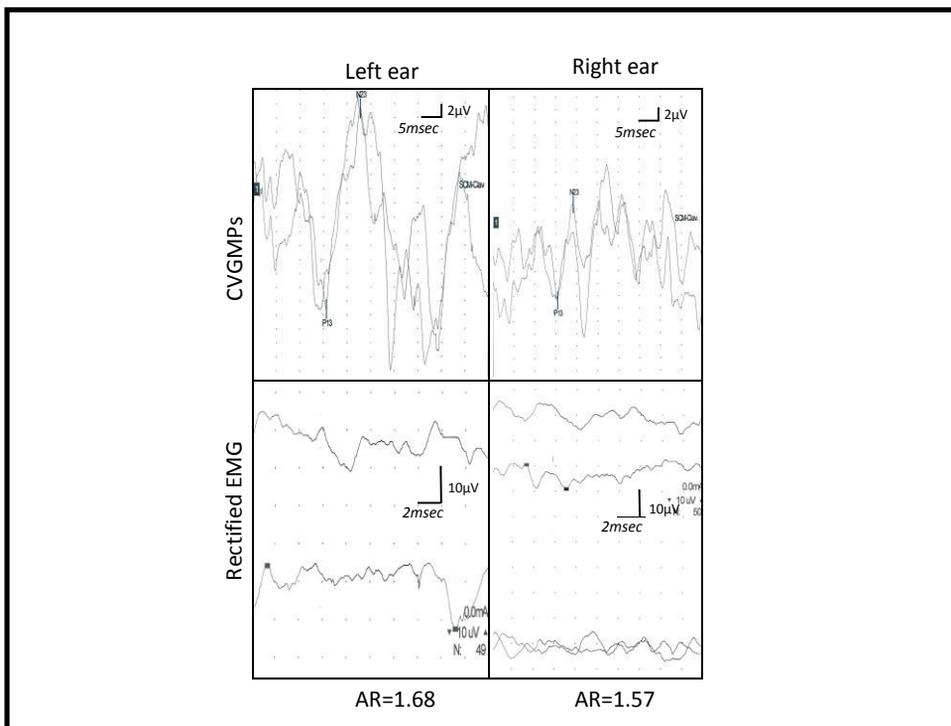
- Although the characteristic of Meniere's disease is tinnitus with aural fullness, vestibular migraine can show this also.
- Also, meniere's disease, as well as other vestibular disorders, can also present with migraine.
- Sometimes, a patient can have both Meniere's disease and Vestibular Migraine.

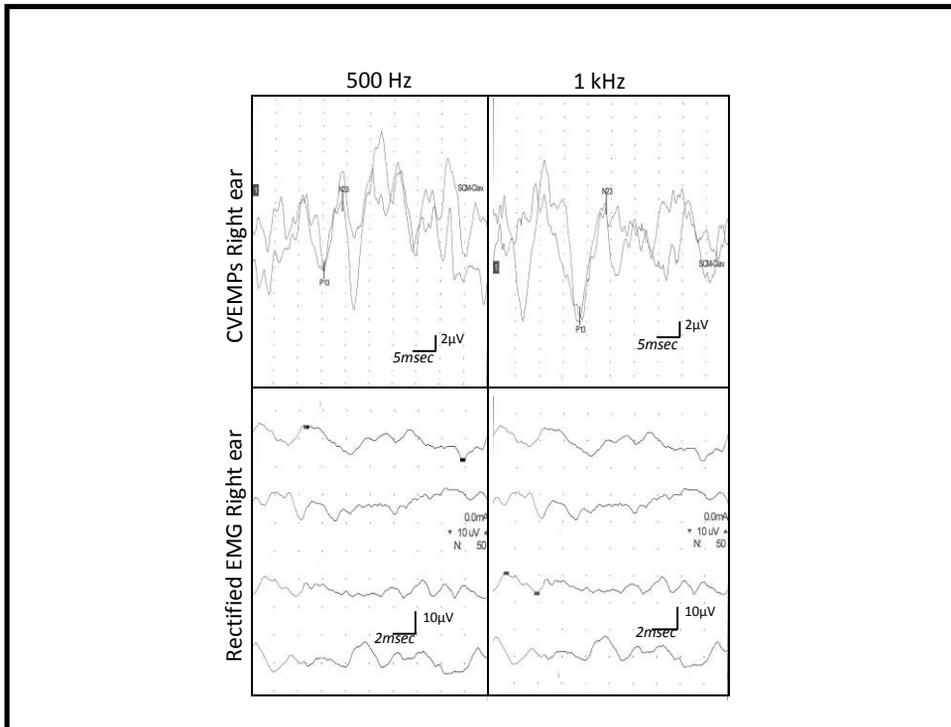
Modification of VEMP protocol dependent on differential diagnosis

- Meniere's Disease vs Vestibular Migraine
 - Perform the cVEMP study not only at 500 Hz but also at 1 kHz (Frequency tuning).
 - An amplitude assymetry in the cVEMP response becomes more sensitive and specific to MD when combined with an abnormal asymmetric caloric test and responses that are best obtained at 1 kHz compared to 500 Hz (0.5/1 kHz frequency ratio) (Taylor et al., 2011).

History

- 41-year-old female with vertigo/imbalance for 2 weeks. History of epilepsy.
- Negative Dix-Hallpike maneuver.
- VPA, Stemetil, Betaserc.
- Rule out Vestibular Migraine.
- PTA was within normal limits bilaterally.





Other Paramedical Examinations

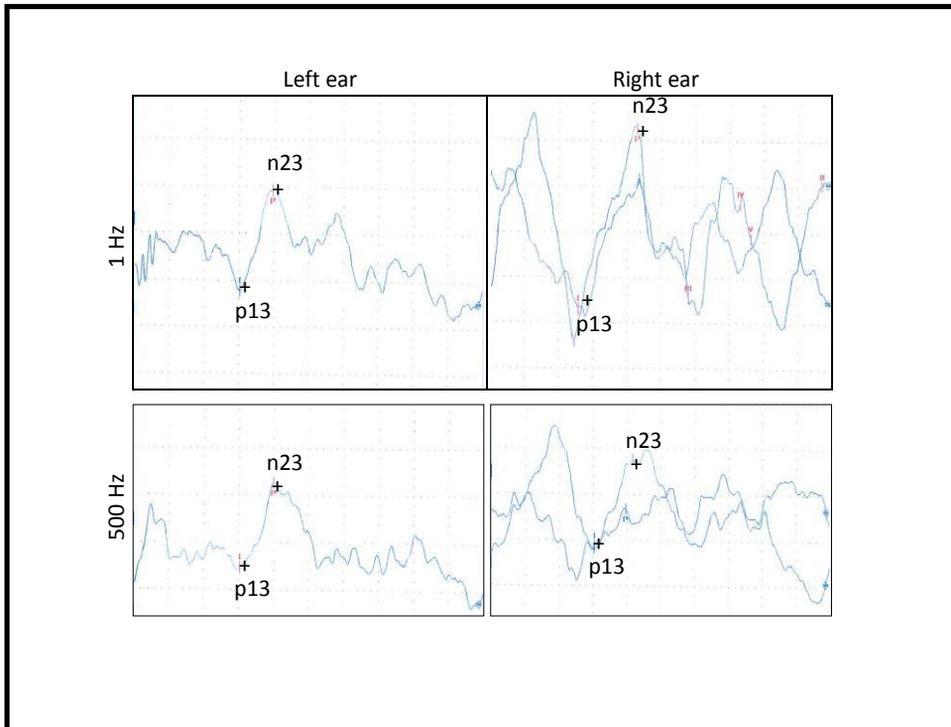
- Audiogram is within normal limits (tends to rule out Meniere's disease or endolymphatic hydrops involving the cochlea)
- The caloric test has not been done yet at the time of writing (but has been recommended).
- Impression: Probable endolymphatic hydrops involving the right ear (left ear was not examined at 1 kHz).

Impression

- In the presence of a normal audiogram, this may be a case of Recurrent Peripheral Vestibulopathy (endolymphatic hydrops involving the vestibular labyrinth alone).
- Calorics were recommended to be performed.

History

- 56-year-old female with probable Meniere's disease.
- Pure tone audiometry was reported by the patient as showing low frequency hearing loss for the left ear.



Endolymphatic hydrops

- It appears in this case that the EH is affecting predominantly:
 - The cochlea on the left (abnormal PTA).
 - The saccule on the right (frequency tuning of cVEMP).

Case by Case Evaluation

- Assistance with future cases and advice on when to perform VEMPs and if it will be useful:
 - neurophy@cing.ac.cy