# Dizziness

IU Medical Student Lecture at Purdue University
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https://www.balancemd.net/home.html

BalanceMD
Solutions for Dizziness and Hearing Loss

## Format of Presentation

- Types of Dizziness (I-IV)
- Dizzy Patient History
- Acute Vestibular Syndrome (AVS)
- List common peripheral and central causes of AVS
- Discuss why differentiating peripheral from central causes is important
- Review history and examination findings that help differentiate peripheral from central AVS
- Introduce infrared video-oculography and vestibular function testing
- Discuss specific peripheral and central disorders in case presentation format
- Q&A

## Types of Dizziness

- Type I - Vertigo - "spinning" sensation, mild or intense
  - vestibular migraine (#1 cause) - 50%
  - BPPV (Benign Paroxysmal Positional Vertigo) - 15%
  - vestibular neuritis/labyrinthitis - 12%
  - Meniere's disease - 3%
  - stroke or MS (multiple sclerosis)

From BalanceMD study of every new 'dizzy' patient seen (904) in 2014

## Types of Dizziness

- Type II - Presyncopal Dizziness - feel faint, transient tunnel vision or graying of vision, palpitations
  - (orthostatic) hypotension ± related to BP meds
  - vasovagal
  - cardiac arrhythmia

## Types of Dizziness

- Type III - Disequilibrium Dizziness - mostly imbalance
  - vestibular migraine (not classically placed in this category)
  - vestibular nerve hypofunction (one or both nerves)
    - h/o vestibular neuritis
    - h/o Meniere's
    - h/o vestibular schwannoma
  - loss of 2 of 3 - inner ear, vision, proprioception
    - peripheral neuropathy - B12 deficiency - AND close eyes
    - vision loss (macular degeneration, glaucoma) in combination with a peripheral neuropathy or vestibular nerve hypofunction
  - multifactorial and presbyastasis (age-related)
  - medication side effect - incorrectly felt to be more common than it really is
  - central - cerebellum, brainstem, spinal cord - neurologic symptoms - rare

## Types of Dizziness

- Type IV - Non-specific Dizziness (antiquated categorization)
  - vague description
  - stress and/or anxiety related
  - reproduced by hyperventilation

CAUTION

- vague description is common in migraine
- **anxiety related is uncommon - but there is a new ICD-11 diagnosis of 3PD - Persistent Postural-Perceptual Dizziness - treated mainly with SSRI medications**
- hyperventilation-induced dizziness or vertigo could be due to a tumor

# History

- Dizziness vs Vertigo - Characteristics
- Associated Symptoms
- Duration and Frequency of symptoms
- Triggers
- **Migraine Questions**
- Past History
  - Past Ear History
  - Past Medical History
  - Medication History

# Dizziness vs Vertigo - Characteristics

- Single Spell
- Constant
  - Better since onset
  - Worse since onset
  - Same
  - Fluctuates in severity - what makes it better or worse?
- Episodic - periods of feeling normal in between spells
  - Duration
  - Frequency
  - Severity
  - Triggers (see "Triggers" slide)

# Associated Symptoms

- See "Migraine Questions" slide
- Nausea or Vomiting
- Tinnitus
- Hearing Loss
- Aural Fullness
- Neurologic Symptoms - diplopia, visual field loss, incoordination, dysarthria, weakness, numbness
- Syncope or pre-syncope

# Duration

- Seconds - **Migraine**, BPPV, Cardiovascular
- Minutes - **Migraine**, Anxiety, Meniere's, TIA
- Hours - **Migraine**, Meniere's
- Days - **Migraine**, Vestibular Neuritis
- Chronic - **Migraine**, 3PD (anxiety-related), Multifactorial Disequilibrium, Ototoxins, Stroke or Brain Tumor, Paraneoplastic Syndrome, Downbeat Nystagmus

# Triggers

- Head Position
- Head Movement
- Visual Stimuli, including bright lights or complex patterns
- Weather Changes
- Lack of Sleep
- Hormonal Changes
- Anxiety/Stress
- Dietary items or Lack of Food
- Pressure Changes or Loud Noise (Tullio's)

# Migraine Questions

- Prior history of migraines?
- Prior history of any headaches at all (esp "sinus" headaches - or headaches triggered by changes in weather or menstrual cycle)?
- Any "pressure" in the face, ears or head? Head feels like a balloon?
- Visual symptoms that might fit for ocular migraine?
- Difficulty explaining dizzy symptoms
- Morning predominance of dizzy symptoms
- Eyes seem to lag behind head movement
- Visual motion sensitivity
- Sensitivity to complex patterns, light sensitivity
- Trouble in grocery stores or "big box" stores
- History of motion intolerance/car sickness in childhood

## Focus - Type I Dizziness
## Acute Vestibular Syndrome

## Define Acute Vestibular Syndrome (AVS)

- Dizziness or Vertigo that develops acutely
- May be accompanied by nausea/vomiting, gait instability, nystagmus and/or head-motion intolerance
- Persists for a day or longer (but symptoms may come and go)

## Causes of AVS

**Peripheral**

- BPPV* (#2)
- Vestibular Neuritis
- Labyrinthitis
- Meniere's*
- Trauma
- Stroke (Labyrinthine artery)
- Autoimmune Inner Ear Disease

**Central**

- Migraine(#1)
- Stroke (brainstem/cerebellum)
- Multiple Sclerosis
- Trauma
- Toxicity
- Wernicke syndrome
- Encephalitis

*Individual spells rarely last > 24 hours

## Why is Differentiating Peripheral from Central Causes Important?

- If you don't know why the patient is dizzy, you will not likely provide the most appropriate treatment
  - Where is it?
  - What is it?
- Unidentified brainstem/cerebellar stroke may lead to death
- Reduce unnecessary CT/MRI scans

## AVS Clinical History

- Characteristics of vertigo - duration, isolated or recurrent, triggers, associated symptoms
- Prior history of dizziness/vertigo
- History of migraine or migraine-like symptoms
- History of cancer
- History of autoimmune disease
- Recent trauma
- Vascular risk factors
- Current or prior neurologic symptoms
- Hearing loss

## AVS Clinical Symptoms

**Peripheral**

- Dizziness/Vertigo
- Nausea/Vomiting
- Imbalance - but able to walk
- Hearing loss
- Tinnitus

**Central**

- Dizziness/Vertigo
- Nausea/Vomiting
- Headache
- Double vision/visual field loss
- Face and/or limb weakness or numbness
- Dysarthria/dysphagia
- Ataxia
- Imbalance - unable to walk

# AVS Exam Findings

**Peripheral**

- Nystagmus - Horizontal (follows Alexander's law) or torsional - fixation-suppression
- Positive head thrust test
- Hearing loss
- Unsteady, but able to walk

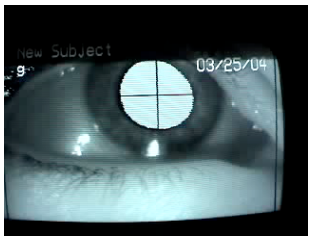
**Central**

- Horizontal, torsional, vertical or direction-changing - NO fixation-suppression
- Weakness of CN 3,4,6, INO, skew deviation
- Asymmetric pursuit, saccades or OKN
- Neurologic exam abnormal
- Unsteady and UNable to walk

# Vestibular Function Testing

https://www.balancemd.net/vestibular-function-testing.html

# Infrared Video-oculography




# Vestibular Function Testing

- Utilizes infrared video goggles
- Series of tests to analyze and differentiate between peripheral and central causes
  - Spontaneous and positional nystagmus
  - Caloric testing
  - Pursuit, Saccades, OKN
  - Rotational chair*
  - VEMP*
  - Audiogram
- Results direct appropriate treatment

*Very few facilities offer

# Peripheral vs Central

# An Aside

- Our knowledge and technology when it comes to the diagnosis and treatment of dizziness/vertigo/imbalance has literally exploded in the past 2 decades
- No one can properly treat the "dizzy" patient without knowing the underlying cause
- Treatment, depending on the cause, might include
  - Canalith repositioning maneuver specific for BPPV type
  - Medication (not meclizine or diazepam unless acute vestibular loss)
  - PT/vestibular rehabilitation
- CT/MRI, carotid doppler, EEG, EKG, Labs rarely help establish diagnosis

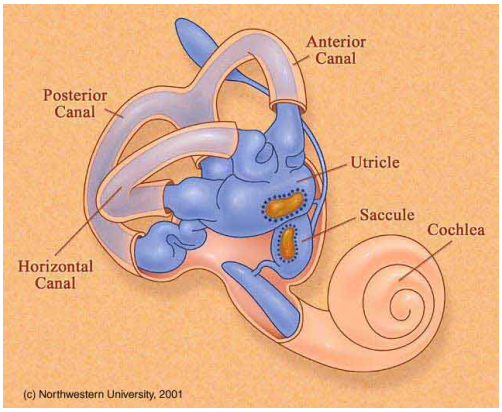
# Peripheral vs Central

| | Peripheral | Central |
|---|---|---|
| Nausea and vomiting | Severe | *Variable, may be absent |
| Imbalance | Mild to moderate | Severe |
| Neurological symptoms | Rare | Common |
| Nystagmus | Unidirectional in all gaze positions; inhibited with fixation | Direction changing in different gaze positions; not inhibited with fixation |
| Head thrust test | Positive | Negative |
| Compensation | Rapid | Slow |

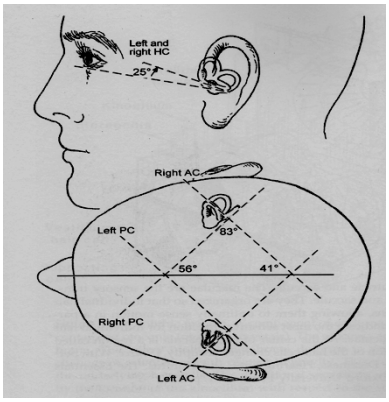
*But can be severe a protracted for weeks - months, especially with cerebellar stroke

# Peripheral Eye Findings

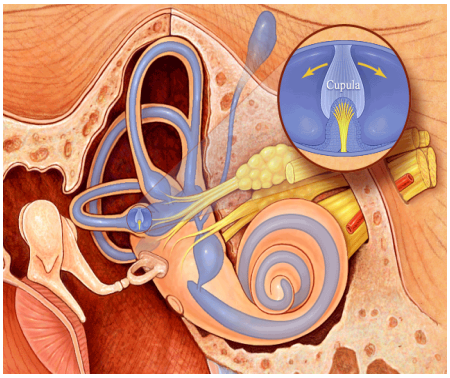
# Inner Ear Anatomy



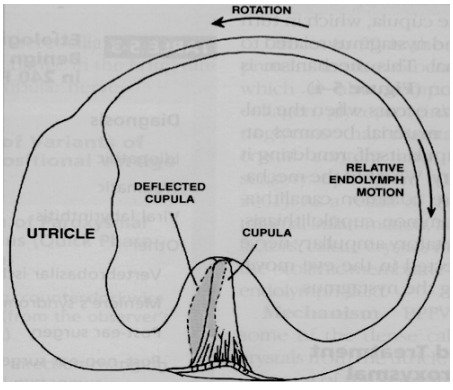

# Semicircular Canal Orientation



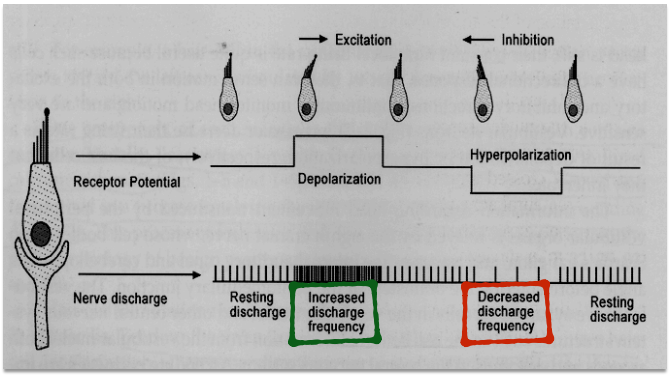

# Cupula of Semicircular Canal



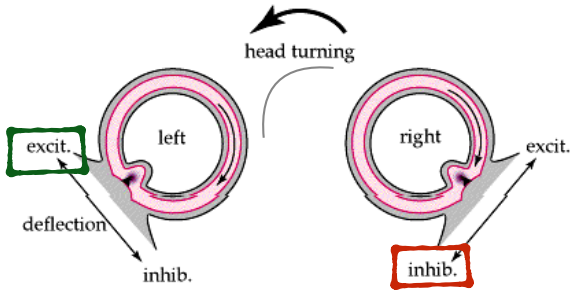

# Deflection of Cupula



## Firing Rate Varies With Head Movement



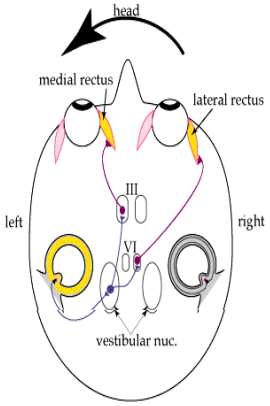

## Excitation vs Inhibition




## VOR - Vestibulo-Ocular Reflex

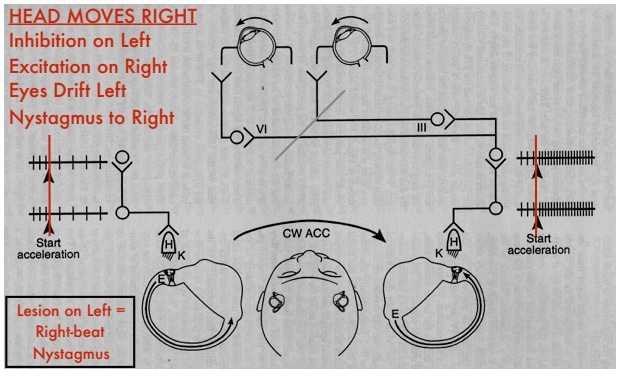
Head movement to Left

- excitation on left
- inhibition on right
- eyes drift right
- nystagmus beats left

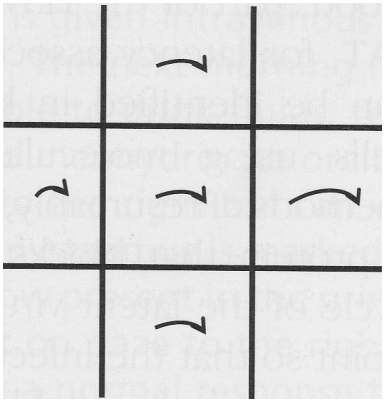



## Nystagmus Beats in Direction of Head Turn

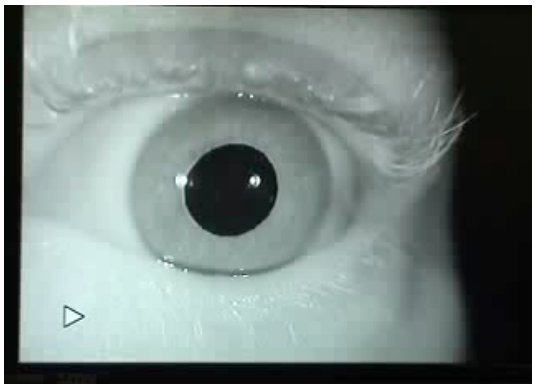
## Head Movement to the Right Mimics Lesion on the Left



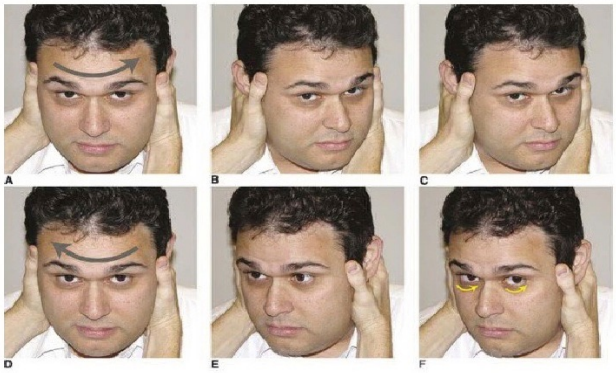

## Alexander's Law



## Alexander's Law

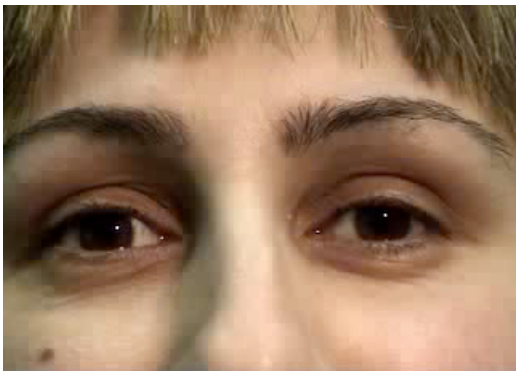


## Head Thrust Test



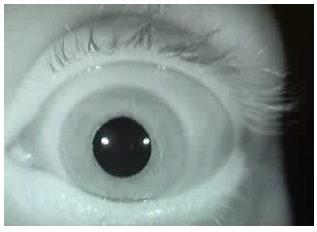

## Central Eye Findings

## Bilateral INO



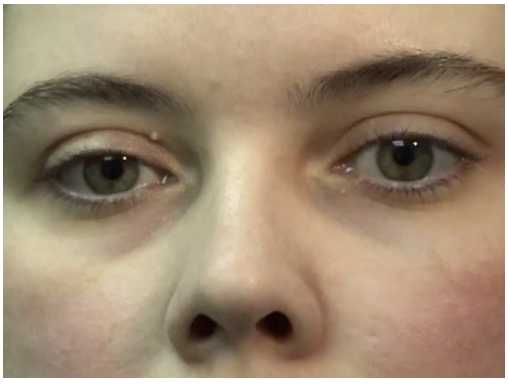
## Nystagmus

Upbeat



Downbeat

## Pendular Nystagmus



# Peripheral Vestibular Disorders

## Peripheral Cases (Classic Presentations)

- Benign Paroxysmal Positional Vertigo (BPPV)
- Vestibular Neuritis
- Meniere's Syndrome

# BPPV

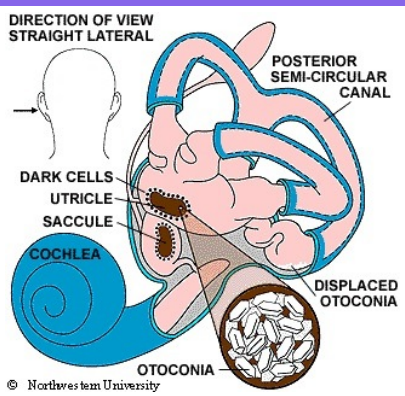
https://www.balancemd.net/bppv.html

## Benign Paroxysmal Positional Vertigo (BPPV)

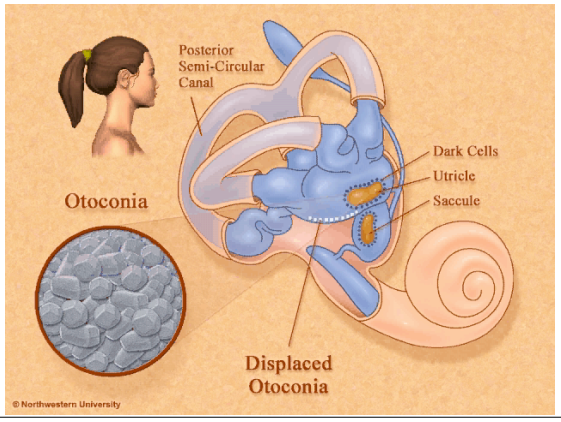
- 52 year old woman who has started sleeping with her head elevated on 3 pillows because she usually develops vertigo lying down in bed
- Vertigo lasts 10-15 seconds and may also occur when she gets up from bed, rolls over in bed, looks up or looks down
- She was evaluated in the ER and given meclizine, but this just made her sleepy

## Dix-Hallpike Position for Posterior Canal BPPV

## Otoconia "Crystals"



## "Crystals" Displaced into Posterior Canal

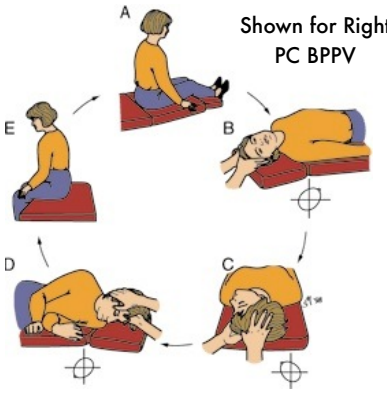



## Treatment of PC BPPV

- Canalith Repositioning Maneuvers (CRM)
  - (modified) Epley
  - Semont
  - Half Somersault
- **NOT** vestibular suppressant medications (meclizine, diazepam, phenergan) or habituation exercises (Cawthorne-Cooksey, Brandt-Daroff) or have the patient do their own Epley maneuver at home 10 times/day

## (Modified) Epley Maneuver

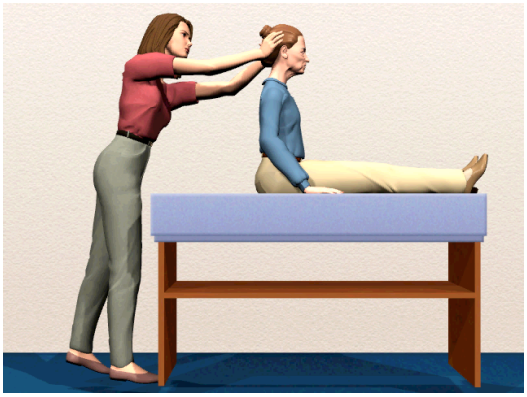
Turn head to left and move opposite direction for Left PC BPPV




Shown for Right PC BPPV

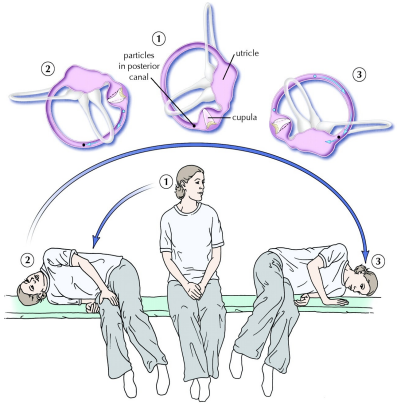
## (Modified) Epley Maneuver

Shown for Right PC BPPV



Turn head to left and move opposite direction for Left PC BPPV

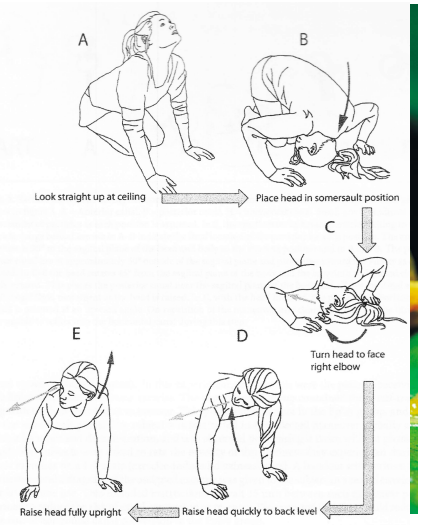
## Semont Maneuver for Right PC BPPV




Opposite for left PC BPPV

## Half Somersault for Right PC BPPV

Audiology & Neurotology 2012;2:16-23




Head turn to left elbow in "C" for Left PC BPPV

# The Goal of CRMs

- Put the "crystals" back in the utricle
- Enzymes (dark cells) that dissolve loose "crystals"

# BPPV

- Associations
  - Maturity :-)
  - Head Injury
  - After vestibular neuritis/ labyrinthitis
  - Meniere's
- Treatment
  - CRM - Canalith Repositioning Maneuver
  - Maneuver to perform depends on type of BPPV (see Table)
  - For PSC BPPV - 92% cure after 1 maneuver - 99% after 3 maneuvers
- Prognosis
  - Excellent
  - 30% recur in first year, then 15% per year

# Variations of BPPV

| Canal | Position | Nystagmus | Treatment (CRM) |
|---|---|---|---|
| Posterior (85-90%) | Dix-Hallpike | Upbeat rotational | Epley, Semont, 1/2 somersault |
| Horizontal Canalithiasis (<5%) | Supine, head elevated right, left | Horizontal geotropic | Lempert or BBQ roll |
| Horizontal Cupulolithiasis (5%) | Supine, head elevated right, left | Horizontal ageotropic | Headshake, Gufoni |
| Anterior (<2%) | Dix-Hallpike | Downbeat rotational | Epley from deep Hallpike |

*Cupulolithiasis - "crystals" stuck to cupula

BPPV is over diagnosed

# Vestibular Neuritis

https://www.balancemd.net/vestibular-neuritis.html

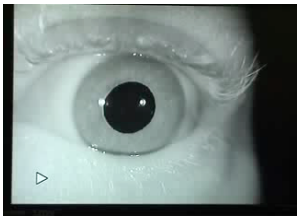
# Vestibular Neuritis

- 61 year old man with no prior medical history, except for a recent viral illness, awakened from sleep with the room spinning and crawled to the bathroom to vomit
- He was taken to the ER and given IVF and anti-emetics, underwent MRI, EKG, basic labs, all normal
- He was admitted for observation, then released the next day, no longer with vertigo, but dizziness exacerbated by head movement and gait instability

# Vestibular Neuritis

**Examination**

- Vestibular function evaluation
  - right-beat nystagmus
  - left caloric weakness
  - VOR asymmetry
- Positive head thrust to the left
- No focal neurologic findings
- No hearing loss (if hearing loss, then Labyrinthitis)
- Unstable gait, but able to walk



# Vestibular Neuritis

**Treatment**

- Pulse of prednisone
- Vestibular suppressants (meclizine, diazepam) for a few days, then stop
- PT/vestibular rehabilitation - promotes central (brain) compensation for the damaged vestibular nerve

**Prognosis**

- Excellent - near 100% recovery over 1-3 months with rare recurrence
- May later develop BPPV on the affected side

# Meniere's Disease

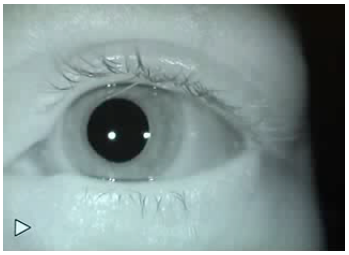
https://www.balancemd.net/meniere-s-syndrome.html

# Meniere's Syndrome

- 47 year old man presents with the sudden onset of fullness, pressure, roaring tinnitus and hearing loss on the right, followed by a 3 hour spell of vertigo
- He stays in bed and finally falls asleep, awakening feeling nearly back to normal
- He has several more spells over the next couple of months, noting spells triggered after eating a salty meal

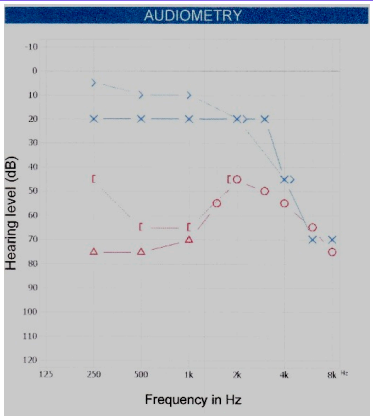
# Meniere's Syndrome

- Examination (in between attacks)
  - Vestibular function evaluation - normal
  - Audiogram - low frequency sensorineural hearing loss
  - No focal neurologic findings



Nystagmus during an attack

# Meniere's Syndrome




# Meniere's Syndrome

**Treatment**

- Diet - low sodium, reduce caffeine and alcohol
- Medications
  - acute - vestibular suppressants (diazepam, meclizine), prednisone
  - chronic - diuretic (triamterene-HCTZ)
- Surgery
  - transtympanic steroid or gentamicin
  - endolymphatic shunt
  - labyrinthectomy

**Prognosis**

- chronic disease with 20-50% bilateral

**Over diagnosed**

- diagnostic criteria includes hearing loss
- 20-30:1 Migraine:Meniere's

# Central Vestibular Disorders

## Central Cases

- Migraine
- Cerebellar Stroke
- Multiple Sclerosis

# Vestibular Migraine

https://www.balancemd.net/vestibular-migraine.html

## Migraine-associated Dizziness

- 41 year old woman presents with morning dizziness, which she finds difficult to describe, often lasting several hours
- She had problems with migraine headaches when she was in high school and college, but only has an occasional mild headache lately
- Her symptoms worsen when driving, going into the grocery store, when under fluorescent lights, and looking at patterns of carpeting or clothing that are visually 'busy'
- Examination is normal

## Migraine-associated Dizziness

**Treatment**

- Identification and modification/elimination of triggers
- Preventative Medications
  - Tricyclic
    - amitriptyine
    - nortriptyline
  - Anti-hypertensive
    - verapamil
    - propranolol
  - Anti-seizure
    - valproic acid
    - topirimate
    - gabapentin

**Prognosis** - Excellent!

## Migraine-associated Dizziness

- The #1 cause of dizziness
- Under-recognized
- Often have mild or no concurrent headaches, but usually have a headache history ('sinus headache' = migraine)

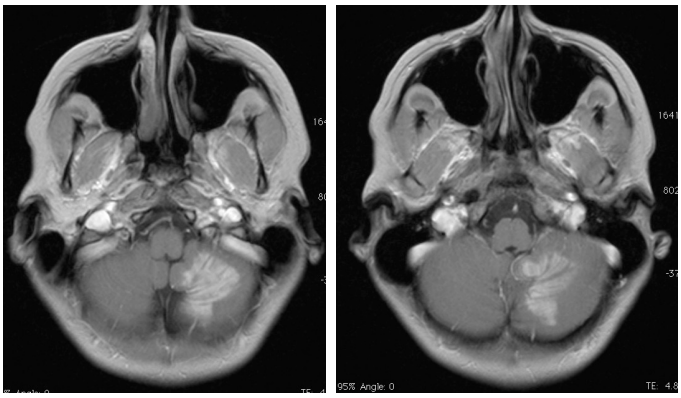
# Cerebellar Stroke

- 22 year old college student who had been studying for finals developed a sore neck and went to her chiropractor, where she had a neck manipulation performed
- Later that evening, she was at a bar with friends celebrating the end of the semester when she became acutely vertiginous
- She began to vomit and was unable to walk
- Her friends carried her into the ER, where she underwent a CT of the brain and was discharged with a prescription for meclizine and phenergan

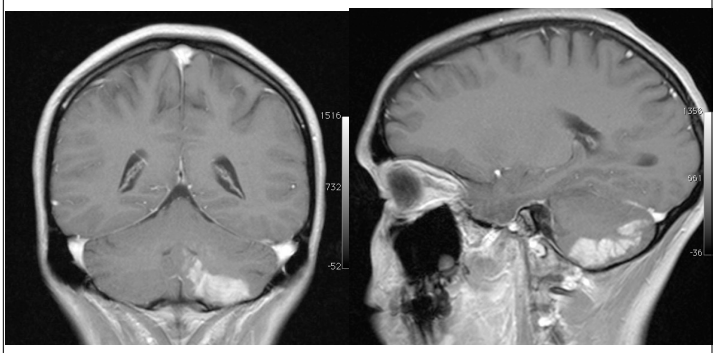
# Cerebellar Stroke

- As she was still unable to walk, her friends carried her back to her apartment, where she continued to vomit for the next 12 hours
- She also felt that the world was "shifted to the left"
- Her tongue and lips felt numb
- She had diplopia when she tried to focus
- She had a focal headache on the left, from the back of her head to behind her left eye

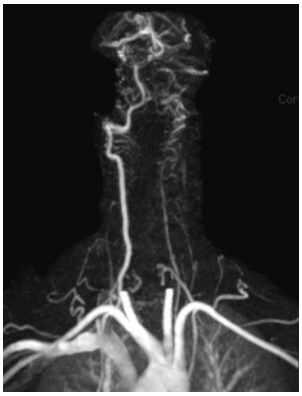
# Cerebellar Stroke

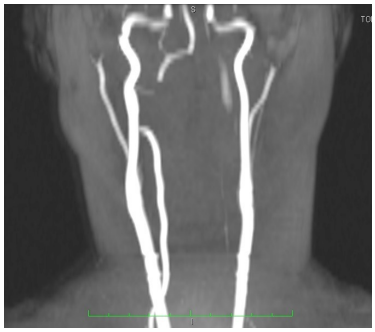


# Cerebellar Stroke



# Cerebellar Stroke



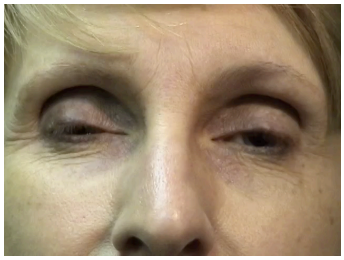


# Multiple Sclerosis

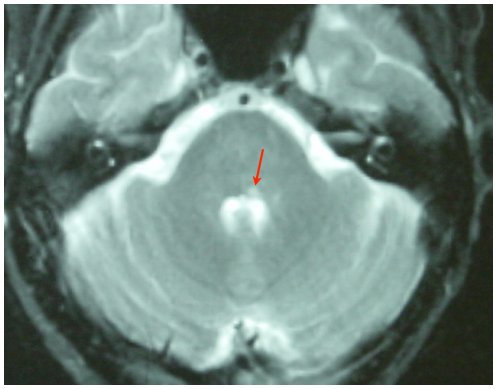
- 55 year old woman presents with recent onset diplopia, dizziness and imbalance
- She has a prior history of vision loss in one eye when she was in her 20s. The vision returned in a month to (near) normal
- She was diagnosed with a stroke based on "small vessel ischemic changes" on her MRI

# Multiple Sclerosis

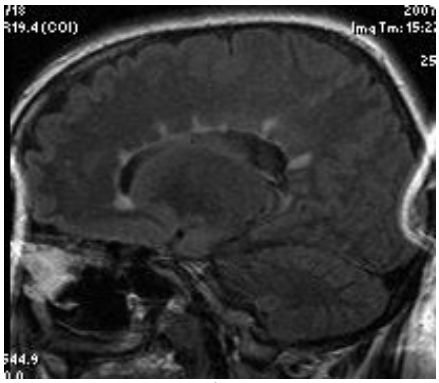
- Examination
  - Rightward saccades are abnormal, revealing a slow left medical rectus saccade and right abducting nystagmus = left INO
  - Pale right optic nerve with a small RAPD



# MLF Lesion of INO



# Multiple Sclerosis



Dawson's Fingers

# 3PD - New in ICD-11

https://www.balancemd.net/3pd.html

# 3PD - What is it?

- Persistent Postural-Perceptual Dizziness
- Non-vertiginous, waxing-waning dizziness and/or unsteadiness, persisting for at least 3 months, with symptoms present at least 15 days per month, but typically daily
- Often follows a separate triggering event (vestibular neuritis, vestibular migraine, head injury) that caused dizziness, vertigo or unsteadiness
- With the anxiety or worry over an underlying sinister cause or with the anticipation of having another vestibular event, symptoms of 3PD develop

# 3PD Symptoms

- Dizziness and /or unsteadiness, worse when upright, head or body in motion, and in visually busy environments, becoming worse later in the day
- Exacerbation of symptoms in grocery or large stores, when reading, scrolling on the computer or cell phone, and with exposure to complex patterns on carpeting, wallpaper or clothing
- Dizziness and/or unsteadiness become intrusive and those affected often report trouble focusing/ concentrating or "brain fog"

# 3PD Treatment

- Medications - benzodiazepines and SSRIs (selective serotonin reuptake inhibitors)
- Vestibular rehabilitation therapy
- Cognitive behavioral therapy

# SUMMARY

# Summary of AVS

- Most common causes
  - Central - Migraine (#1 overall)
  - Peripheral - BPPV (#2 overall)
- Listen to the patient's description of symptoms
  - Probe about a prior history of headaches or "migraine"-like symptoms
  - Inquire about hearing loss or neurologic symptoms
- Observe for nystagmus, do head thrust test
- Treat BPPV if present (>90% instant cure)
- Proceed with highest value diagnostic test if necessary
  - Vestibular function evaluation - VNG, Rotary Chair, VEMP, Audiogram
  - MRI brain if neurologic signs or symptoms or abnormalities on vestibular testing
- Treatment is individualized and based on most likely diagnosis

# Summary of AVS

**Treatment based on diagnosis**

- BPPV - determine canal(s) involved and perform appropriate CRM
- Migraine - eliminate triggers, preventative medication
- Vestibular Neuritis - prednisone pulse, short-term vestibular suppressant, PT/vestibular rehabilitation
- Meniere's Syndrome - short-term vestibular suppressant, low salt diet and other dietary modifications, diuretic, sometimes PT/vestibular rehabilitation if inactive Meniere's and have fixed deficit
- Multiple Sclerosis - steroid treatment, then DMA and PT depending on response to steroid
- Stroke - short-term vestibular suppressant, vascular and vascular risk factor evaluation/modification, appropriate antiplatelet or anticoagulant, PT
- Trauma - determine cerebellar/brainstem contusion, vestibulopathy (peripheral) and/or BPPV - PT specific to the underlying deficits

# Vestibular Suppressants

- Vestibular suppressant medications - meclizine, diazepam, promethazine
  - Should RARELY be used more than 3 days at a time
  - Indications include AVS or motion sickness associated with travel
  - Prolonged use PREVENTS patient recovery from vestibular nerve disfunction and interferes with PT/vestibular rehabilitation in general
  - Especially in elderly, may lead to increased risk of falls

# Thank You - Questions?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