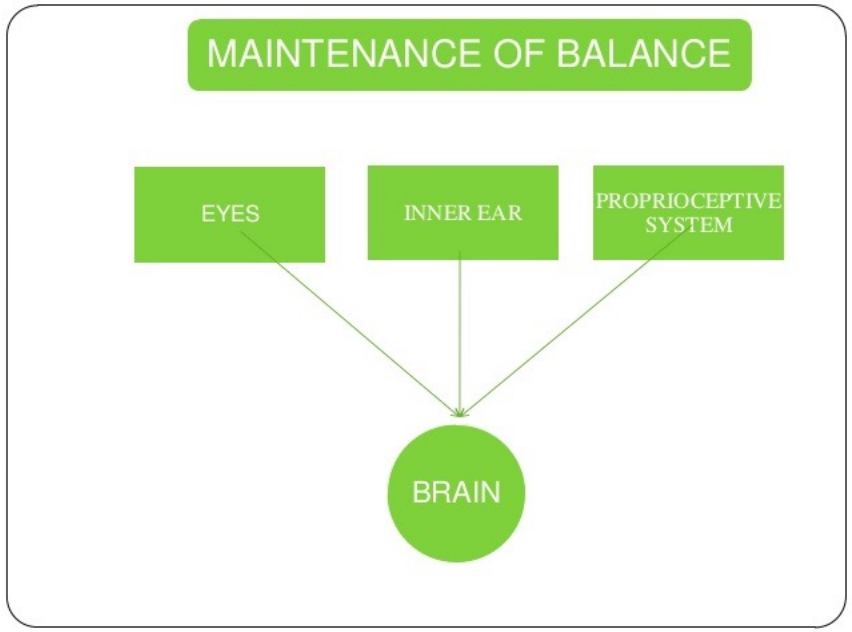
Dizziness

- Vertigo: illusion of movement
- Ataxia: inability to co-ordinate movements (walking or of extremities), "feel as if drunk"
- Dizziness
  - Non-specific term (lightheadedness, swimming sensation inside of head)
    - Different meanings to different people
      - Could mean
        - Vertigo - Syncope - Presyncope
        - Weak - Giddiness - Anxiety
        - Anemia - Depression - Unsteady

- Syncope
  - Transient loss of consciousness with loss of postural tone
- Presyncope
  - Lightheadedness-an impending loss of consciousness
- Psychiatric dizziness
  - Dizziness not related to vestibular dysfunction
- Disequilibrium
  - Feeling of unsteadiness, imbalance or sensation of “floating” while walking


MAINTENANCE OF BALANCE
EYES
INNER EAR
PROPRIOCEPTIVE SYSTEM
BRAIN

Vertigo and Dizziness

- Prevalence
  - 1 in 5 adults report dizziness in last month
  - Increases in elderly
  - Worsened by decreased visual acuity, proprioception and vestibular input

Evaluation of the Dizzy Patient

What type of dizziness is it?

How long does it last? Continuous or episodic

Spontaneous or positional

Duration of vertigo if episodic

Are there otologic symptoms?

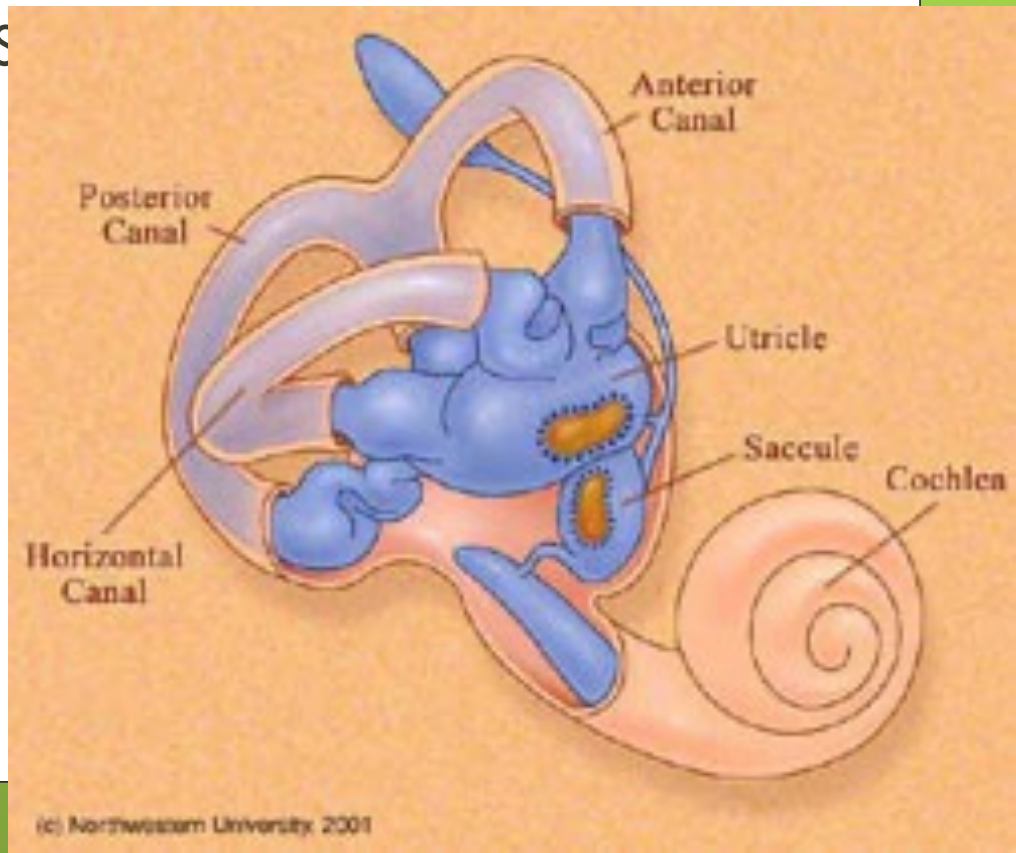
Are there focal neurological symptoms?

CLASSIFICATION OF VERTIGO

- OTOLOGICAL
- CENTRAL
- SYSTEMIC
- UNKNOWN

Vestibular Labyrinth

- Pathophysiology
  - Complex interaction of visual, vestibular and proprioceptive inputs that the CNS integrates as motion and spatial orientation
- 3 semicircular canals
  - rotational movement
  - cupula
- 2 otolithic organs
  - utricle & saccule
  - linear acceleration
  - Macula



Vertigo and Dizziness

- Normally there is balanced input from both vestibular systems
- Vertigo develops from asymmetrical vestibular activity
- Abnormal bilateral vestibular activation results in truncal ataxia

Vertigo and Dizziness

- Nystagmus
  - Rhythmic slow and fast eye movement
    - Direction named by fast component
    - Slow component due to vestibular or brainstem activity
    - Slow component usually ipsilateral to diseased structure
    - Fast component due to cortical correction
- Physiologic Vertigo
  - "motion sickness"
  - A mismatch between visual, proprioceptive and vestibular inputs
  - Not a diseased cochleovestibular system or CNS

Otologic Symptoms in the Dizzy Patient

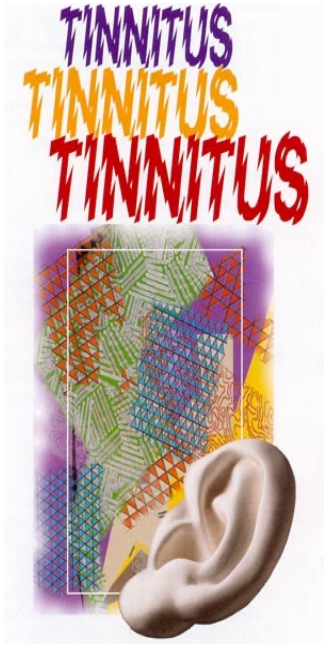
Hearing Loss: progressive, sudden SNHL,congenital, fluctuating

Tinnitus: continuous or episodic

Aural fullness

Ear pain, or chronic drainage

History of ear surgeries/infection



Focal Neurological Symptoms

Vertigo if secondary to cerebrovascular insufficiency is indicative of posterior circulatory problems

Visual loss

Loss of consciousness

Numbness especially if on one side

Weakness especially if on one side

Incoordination as if drunk

Difficulty swallowing

Slurring of the speech

Evaluation of the Dizzy Patient

Family History:

- Hearing Loss
- Vertigo Spells
- Headaches or visual auras
- Gait ataxia or imbalance

Vertigo-History

- Is it true vertigo?
- Autonomic symptoms?
- Pattern of onset and duration
- Auditory disturbances?
- Neurologic disturbances?
- Was there syncope?
- Unusual eye movements?
- Any past head or neck trauma?
- Past medical history?
- Previous symptoms?
- Prescribed and OTC medications?
- Drug and alcohol intake?

Vertigo-Physical Exam

- Cerumen/FB in EAC
- Otitis media
- Pneumatic otoscopy
- Tympanosclerosis or TM perforation
- Nystagmus
- Fundoscopic exam
- Pupillary abnormalities
- Extraocular muscles
- Cranial nerves
- Internuclear ophthalmoplegia
- Auscultate for carotid bruits
- Orthostatic vital signs
- BP and pulse in both arms
- Dix-Hallpike maneuver
- Gross hearing
- Weber-Rinne test
- External auditory canal vesicles
- Muscle strength
- Gait and Cerebellar function

Nystagmus: Features of Peripheral

Spontaneous nystagmus from imbalance of signals from the right and left vestibular periphery

The resulting nystagmus is a combined torsional, horizontal.

Alexander's law: Increased frequency and amplitude of nystagmus with gaze in direction of fast component, reverse effect with gaze opposite to the fast component.

Inhibited by fixation

Features of Central Nystagmus

Prominent with and without fixation

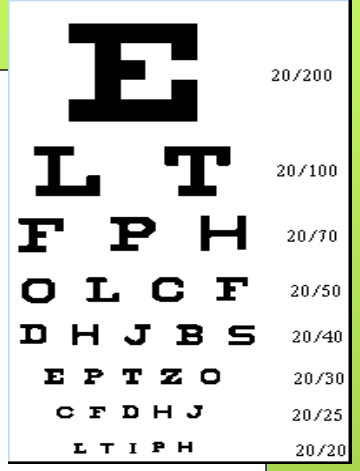
Can be purely vertical (always central), horizontal, or torsional, of have some combination

The rule is if the nystagmus is vertical (upbeat or downbeat), it is central i.e. not coming from the inner ear

Cerebellar: spontaneous downbeat with vertical amplitude increasing with horizontal gaze deviation

or brought out when placed in supine position

Bedside Tests of Vestibular Function: Dynamic Visual Acuity



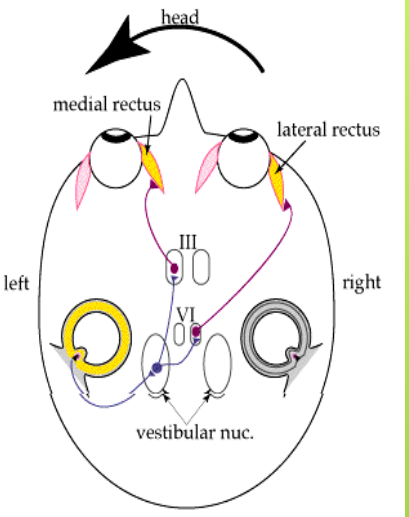
Oscillopsia : perception of environment jumping up and down when walking.

Ask the patient: "Can you read the print on the cans while walking down the grocery store aisle?"

May be a sign of bilateral loss of VOR function

Horizontal passive rotation at 2 Hz. Normal is loss of 1 line of Snellen acuity card, bilateral vestibular loss will lose 5 lines.

Bedside Tests of
Horizontal VOR: **Head Thrust Test**



- Rapid, high-acceleration head thrust with patient fixating on examiner's nose
- Corrective saccade (catch-up saccade) when head is rotated toward the affected vestibular periphery is positive
- Positive in vestibular neuritis, gentamicin ototoxicity (bilateral), idiopathic and autoimmune vestibulopathy
- May be normal to have slight VOR hypometria bilaterally in older patients

Vertigo-Characteristics

	Peripheral	Central
Onset	Sudden	Usually slow
Severity of Vertigo	Intense	Usually mild
Pattern	Paroxysmal	Constant
Exac. by movement	Yes	Variable
Autonomic	Frequent	Variable
Laterality	Unilateral	Uni or bilat
Nystagmus	Horizontorotary	Any
Fatigable/Fixation	Yes	No
Auditory symptoms	Yes	No
TM	May be abnormal	Normal
CNS symptoms	Absent	Present

Vertigo-Differential Diagnoses

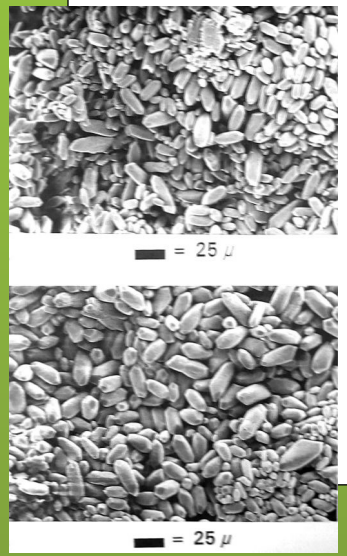
- Etiologies of Vertigo
  - BPPV
  - Labyrintitis
    - Acute suppurative
    - Serous
    - Toxic
    - Chronic
  - Vestibular neuronitis
  - Vestibular ganglionitis
  - Ménière's
  - Acoustic neuroma
  - Perilymphatic fistula
  - Cerumen impaction
  - CNS infection (TB, Syphillis)
  - Tumor (Benign or Neoplastic)
  - Cerebellar infarct
  - Cerebellar hemorrhage
  - Vertebrobasilar insufficiency
  - AICA syndrome
  - PICA syndrome
  - Multiple Sclerosis
  - Basilar artery migraine
  - Hypothyroidism
  - Hypoglycemia
  - Traumatic
  - Hematologic (Waldenstroms)

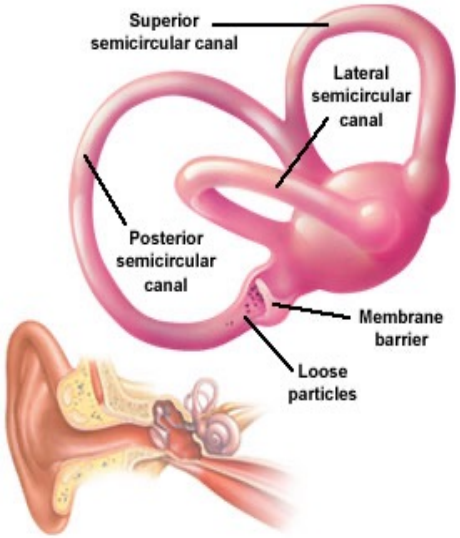
Peripheral Vertigo-Differential

- Labyrinthine Disorders
  - Most common cause of true vertigo
  - Five entities
    - Benign paroxysmal positional vertigo (BPPV)
    - Labyrinthitis
    - Ménière disease
    - Vestibular neuronitis
    - Acoustic Neuroma

Benign Paroxysmal Positional Vertigo

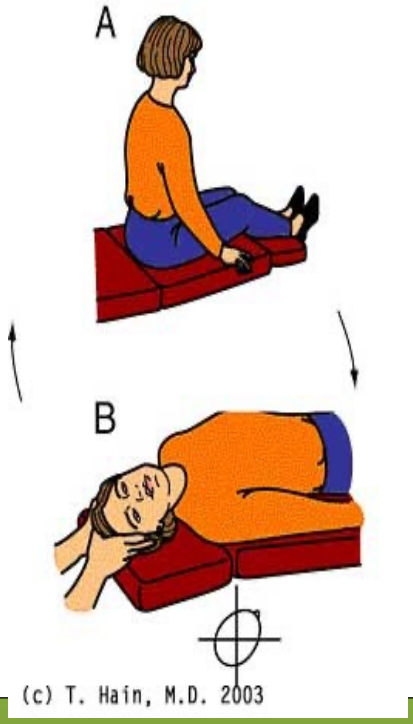
- Otolithic calcium carbonate crystals become loose, and fall into the posterior semicircular canal
- Common with head trauma, older age, inner ear disease
- One of the most common cause of vertigo seen in neurotology clinics, estimated at 20-30% of patients



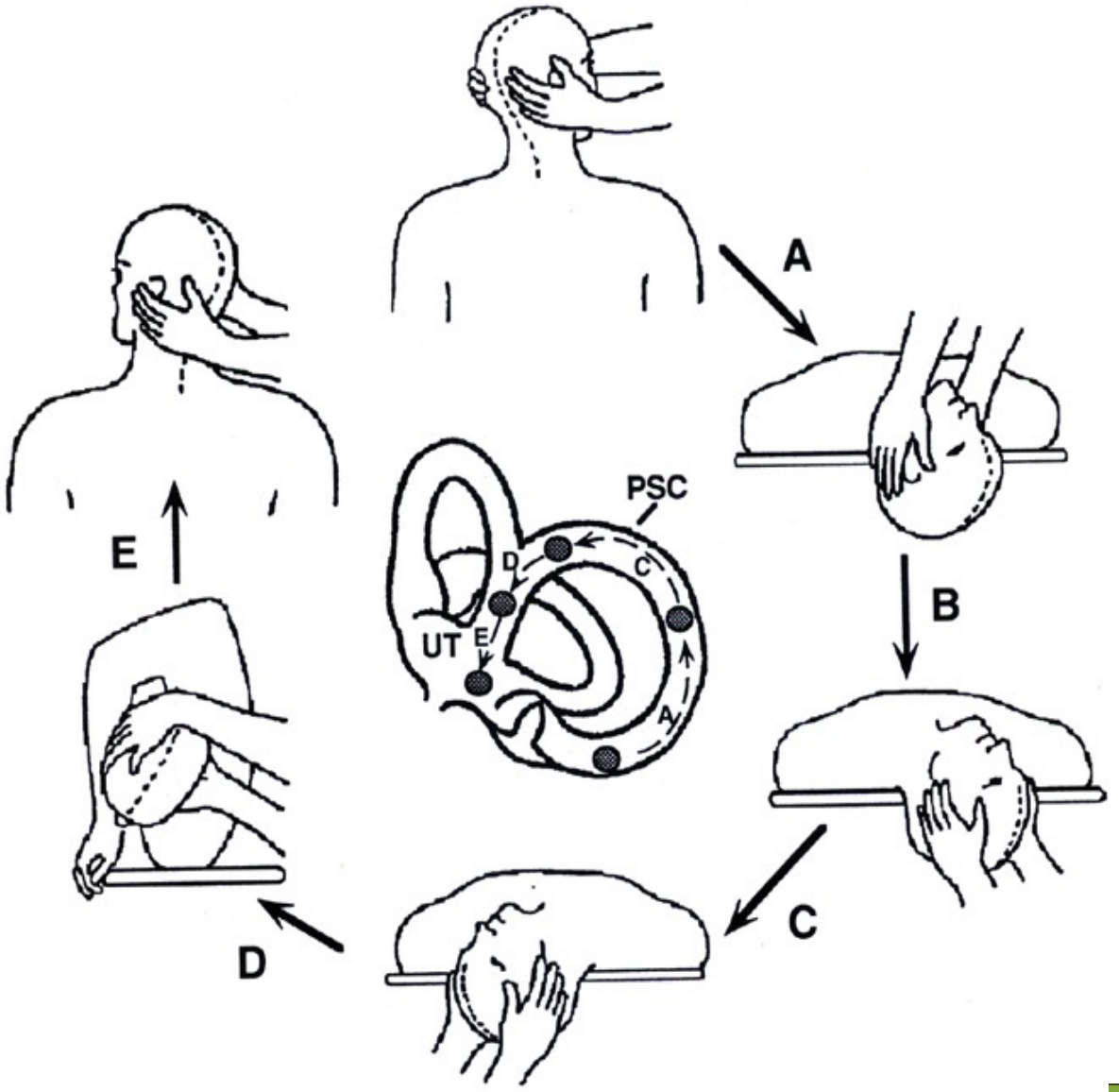


Benign Paroxysmal Positional Vertigo

- Typical complaint: spells of vertigo when turning over in bed
- No hearing loss or tinnitus
- Usually a single position that elicits vertigo Horizontorotary nystagmus with crescendo-decrescendo pattern after slight latency period
- Examine the patient for nystagmus and vertigo in the Dix-Hallpike position : head-hanging R and L
- Vertigo lasts shorter than 1 minute
- torsional nystagmus with upbeat component
- Brought on only by positional changes
- Latency of few seconds up to 45 sec
- Fatigues with repeated testing



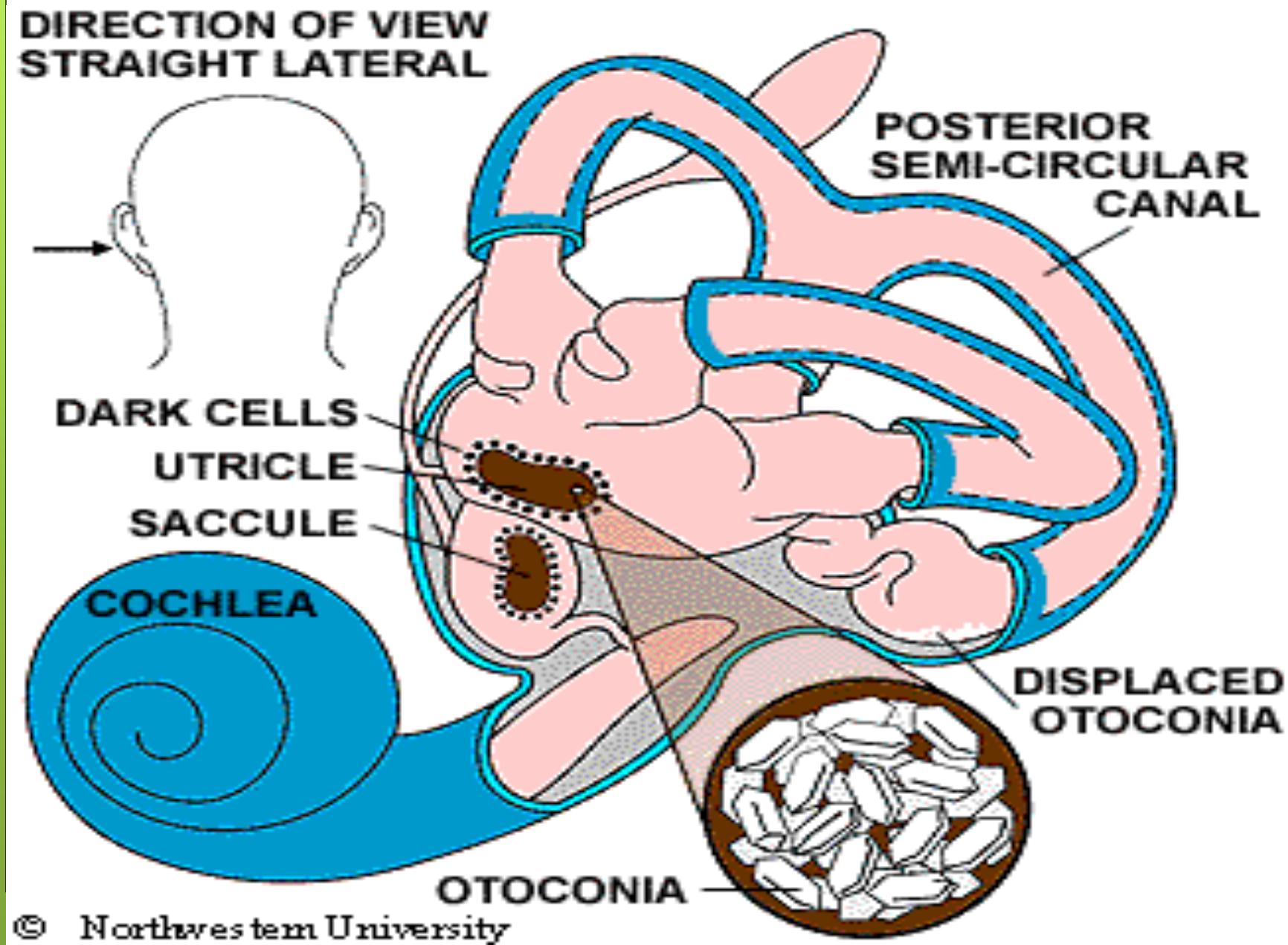
Modified Epley Maneuver



Epidemiology of BPPV

- Lifetime prevalence of 3.2% in females and 1.6% in males
- Of 100 unselected elderly patients, a prevalence of 9% was reported
- Median duration of two weeks
- Female preponderance likely reflects the association of migraine with BPPV
- Association of BPPV with hypertension and hyperlipidemia
- Vascular damage to the inner ear facilitates detachment of the otoconia

Otoconia in BPPV



Labyrinthitis

- Associated hearing loss and tinnitus
- Involves the cochlear and vestibular systems
- Abrupt onset
- Usually continuous
- Four types of Labyrinthitis
  - Serous
  - Acute suppurative
  - Toxic
  - Chronic

Labyrinthitis

- Serous
  - Adjacent inflammation due to ENT or meningeal infection
  - Mild to severe vertigo with nausea and vomiting
  - May have some degree of permanent impairment

- Acute suppurative labyrinthitis
  - Acute bacterial exudative infection in middle ear
  - Secondary to otitis media or meningitis
  - Severe hearing loss and vertigo
  - Treated with admission and IV antibiotics

Labyrinthitis

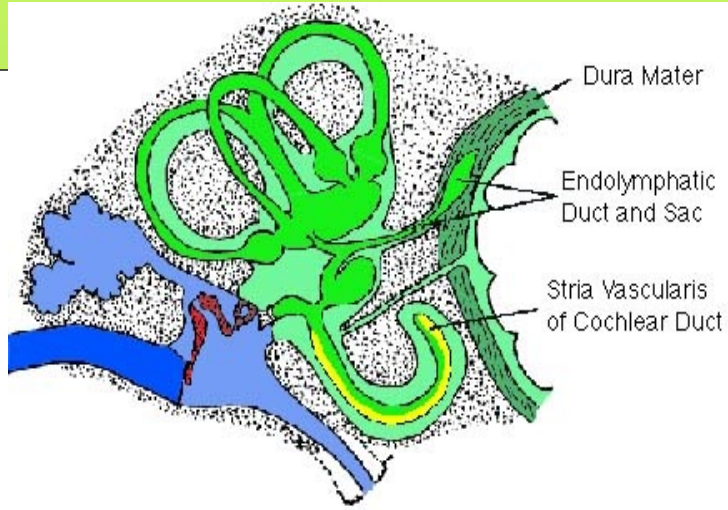
- Toxic
  - Due to toxic effects of medications
  - Still relatively common
  - Mild tinnitus and high frequency hearing loss
  - Vertigo in acute phase
  - Ataxia in the chronic phase
  - Common etiologies

-Aminoglycosides
-Erythromycin
-Phenytoin
-Quinidine
-Alcohol
-Vancomycin
-Barbiturates
-Furosemide
-Salicylates

Labyrinthitis

- Chronic
  - Localized inflammatory process of the inner ear due to fistula formation from middle to inner ear
  - Most occur in horizontal semicircular canal
  - Etiology is due to destruction by a cholesteatoma

Meniere's Disease



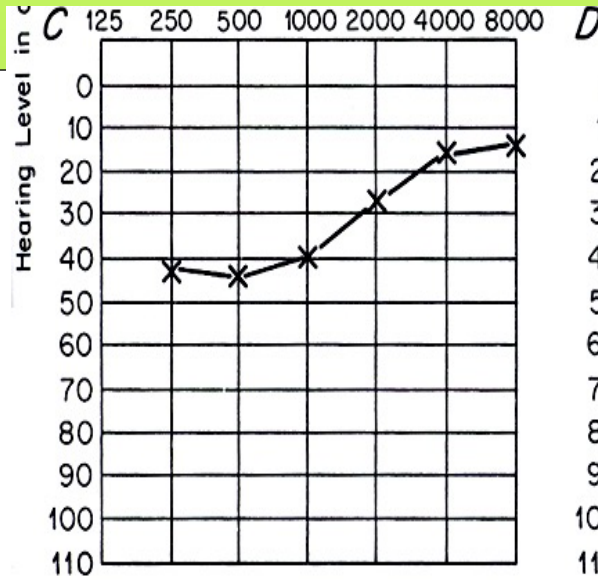
Symptoms: Fluctuating hearing loss, tinnitus, ear fullness, and vertigo. May have initially only hearing loss or only vertigo spells.

Possibly sudden falls (Tumarkin crisis)

Hearing loss, tinnitus, and aural fullness increase during the vertigo attack

Typically lasts 20 minutes or more in duration

Meniere's Disease



- On temporal bone histopathology, there is a distension of the entire endolymphatic system
- Audiogram: often low-frequency sensorineural hearing loss that increases during attacks.

Meniere's Disease: Tumarkin falls

- In about 7-10% of Meniere's disease, there are associated sudden falls "drop attacks"
- No warning, sudden, violent fall without loss of consciousness
- Subjective sensation of being pushed by an external force
- Surgical ablation is curative of these dangerous and frightening drop attacks

Meniere's Disease Variant: Delayed Endolymphatic Hydrops

- Delayed hydrops develops in an ear that has h/o profound SNHL years before (up to 70 years before)
- Many years later: recurrent spells of vertigo of 20 minutes duration or longer
- Often without accompanying otologic symptoms of aural fullness, increased tinnitus and hearing fluctuation
- Can also have Tumarkin falls

Ménière Disease

- First described in 1861
- Triad of vertigo, tinnitus and hearing loss
- Due to cochlea-hydrops
  - Unknown etiology
  - Possibly autoimmune

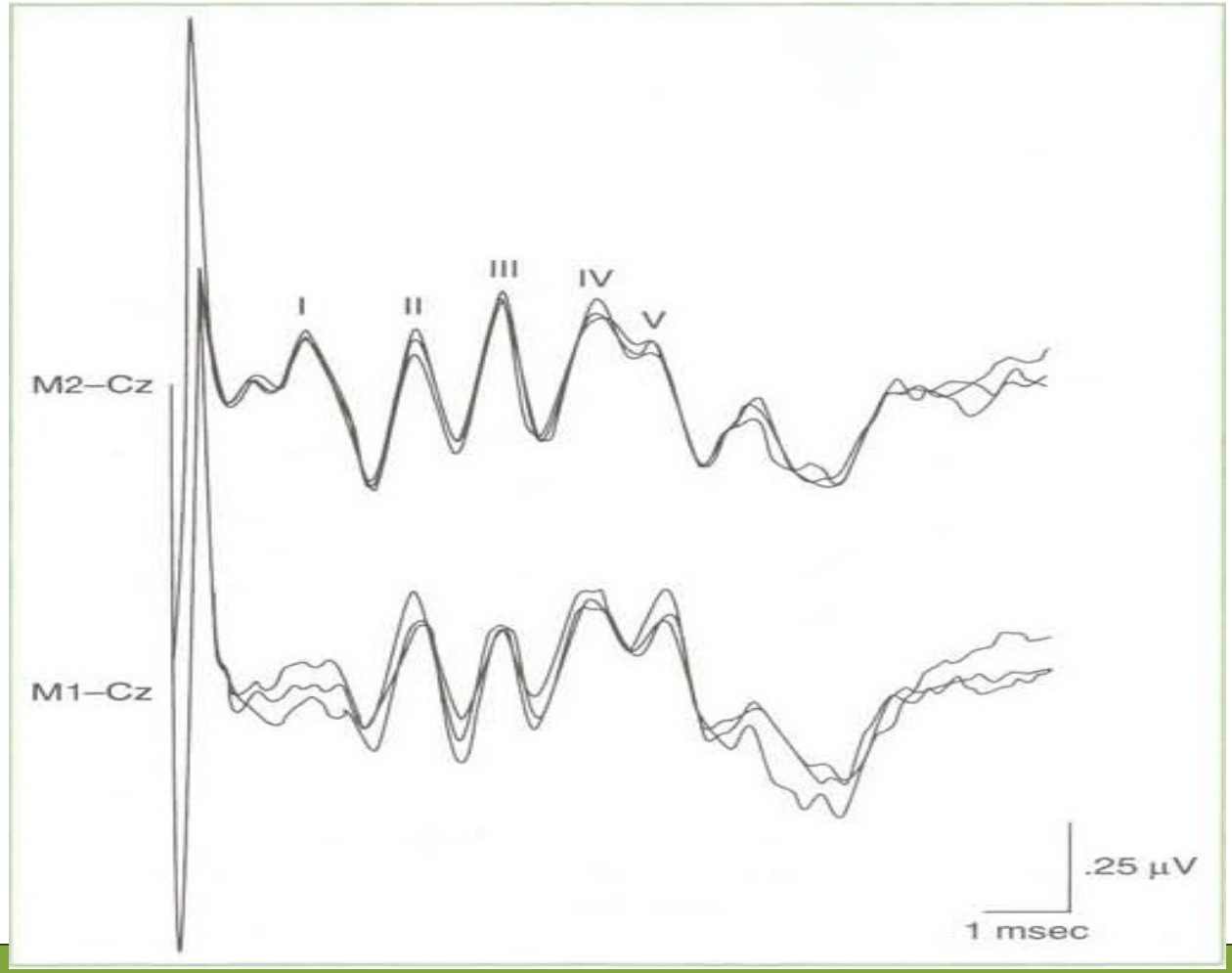
Ménière Disease

- Often patients have eaten a salty meal prior to attacks
- May occur in clusters and have long episode-free remissions
- Usually low pitched tinnitus
- Symptoms subside quickly after attack
- No CNS symptoms or positional vertigo are present

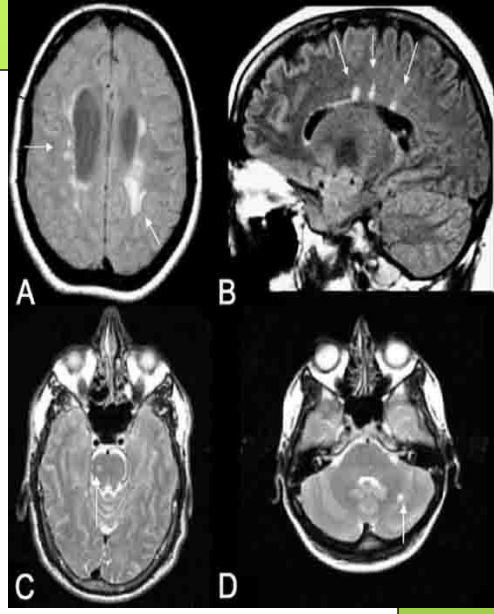
Positional and Spontaneous Vertigo: Multiple Sclerosis

- Vertigo is the initial symptom of MS in 5%, and presents in 50% of MS patients at some time in the course.
- 25% of patients with MS have caloric paresis
- 80% have eye movement abnormalities
- Oftentimes abnormalities on ABR and occasionally retrocochlear hearing loss from involvement at the root entry zone near pons
- May have any type of nystagmus

Brainstem aud itory evoked potentials (BAEPs)



Positional and Spontaneous Vertigo: Multiple Sclerosis



- Demyelinating disease of unknown etiology
- Onset usually in 3rd and 4th decade of life
- Common associated signs and symptoms: INO (internuclear ophthalmoplegia), optic neuritis, Llermitte's sign, vibratory loss, spasticity, sensitivity to temperature
- MRI with FLAIR: plaques

Migraine-associated Vertigo

Vestibular Meniere's, migraine-associated vestibulopathy, benign paroxysmal vertigo

25% of patients with migraine have vertigo spells

Duration of the vertigo varies:
31% few min-2 hr
49% > 24 hrs
7% seconds

25% of patients with migraine have caloric paresis

Isolated vertigo without headache are termed migraine equivalent

Migraine-associated Vertigo

Migraine is an inherited, likely metabolic syndrome with multiple causes, likely autosomal dominant with variable penetrance

Always ask about the family history

Ask about h/o motion sickness (50%)

Ask about h/o altitude sickness

Ask about sensitivity to visual stimuli (bright lights/ patterns, computer work)

Migraine-associated Vertigo

Ask about h/o recurrent abdominal pains or cyclical vomiting as child, which is usually migraine equivalent

Ask women specifically regarding menses: some will call migraine headaches "PMS"

Migraine-associated vertigo often has a catamenial component, or worsened by OCP in women

International Headache Society Criteria for Migraine Headaches

- At least 5 attacks fulfilling B-D

- B. Headache lasting 4-72 hrs
- C. At least 2 of: unilateral, pulsating, moderate or severe, aggravation by physical activity
- D. At least one of N/V, photophobia and phonophobia

- Other causes ruled out

Variants of Migraine

Migraine visual aura: Visual aura may occur isolated without headache: fortification spectra, scotoma, stars, patterns of colored lights lasting usually 15-20 minutes

Retinal migraine: retinal artery vasospasm which can cause monocular blindness: prophylaxis with verapamil

Benign paroxysmal vertigo of childhood: recurrent spells of vertigo in child is usually migraine, may or may not have H/A

Association between Migraine and Vestibulopathy

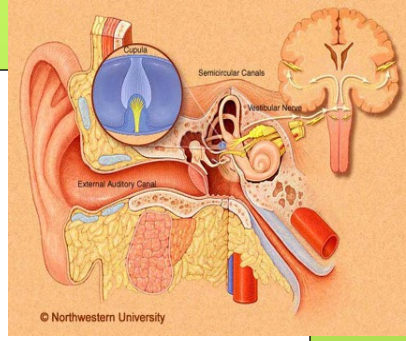
Tumarkin falls may be associated with migraine

Out of 55 patients with Tumarkin falls, 6 had >1yr h/o normal hearing

5 out of 6 had h/o migraine

Tumarkin falls are known to localize to the vestibular periphery since surgery is curative

Vestibular Neuritis



- Subacute onset of vertigo, often with nausea and vomiting
- Vertigo lasts a few days, and crescendos in few hours, and decreases in severity with time
- Suspicion for viral cause but evidence for ischemic causes
- Mild vertigo may last for several weeks
- May have auditory symptoms
- Highest incidence in 3rd and 5th decades
- Temporal bone histopathology: Scarpa's ganglion neuronal loss

Vestibular Ganglionitis

- Usually virally mediated-most often VZV
- Affects vestibular ganglion, but also may affect multiple ganglions
- May be mistaken as BPPV or Ménière disease
- **Ramsay Hunt Syndrome**

  -Deafness -Vertigo

  -Facial Nerve Palsy -EAC Vesicles

Acoustic Neuroma

- Peripheral vertigo that ultimately develops central manifestations
- Tumor of the Schwann cells around the 8th CN
- Vertigo with hearing loss and tinnitus
- With tumor enlargement, it encroaches on the cerebellopontine angle causing neurologic signs
- Earliest sign is decreased corneal reflex
- Later truncal ataxia
- Most occur in women during 3rd and 6th decades

Central Vertigo-Differential

- Central Vertigo
  - Vertebrobasilar Insufficiency
    - Atheromatous plaque
    - Subclavian Steal Syndrome
    - Wallenberg Syndrome
  - Cerebellar Hemorrhage
  - Multiple Sclerosis
  - Head Trauma
  - Neck Injury
  - Temporal lobe seizure
  - Vertebral basilar migraine
  - Metabolic abnormalities
    - Hypoglycemia
    - Hypothyroidism

Vertebrobasilar Insufficiency

- Important causes of central vertigo
- Related to decreased perfusion of vestibular nuclei in brain stem
- Vertigo may be a prominent symptom with ischemia in basilar artery territories
- Unusual for vertigo to be only symptom of ischemia

Vertebrobasilar Insufficiency

- Most commonly will also have:

  -Dysarthria -Ataxia -Facial numbness

  -Hemiparesis -Diplopia -Headache

- Tinnitus and hearing loss unlikely

- Vertical nystagmus is characteristic of a (superior colliculus) brain stem lesion

Vertebrobasilar insufficiency

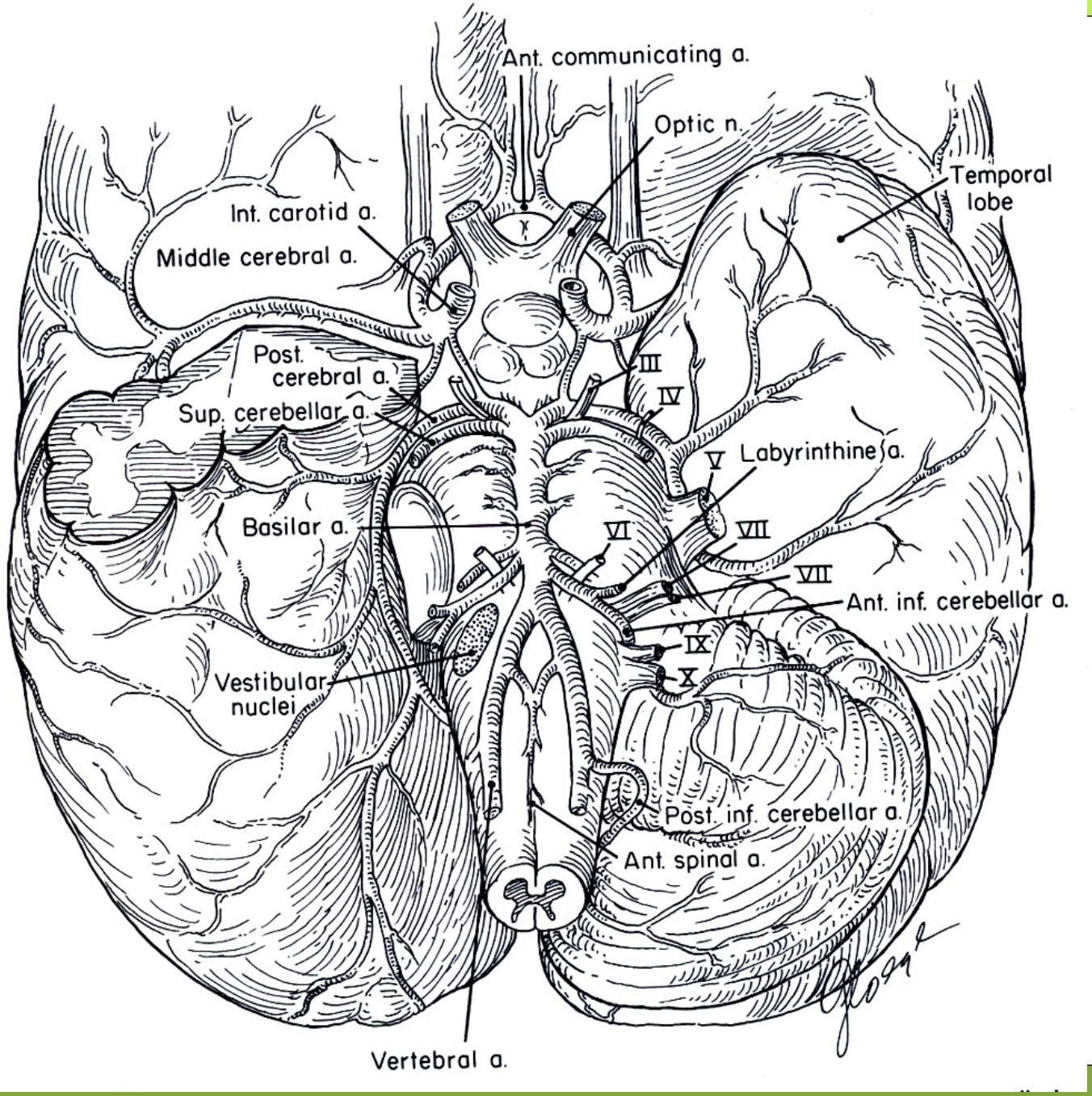
- 20% of all strokes are in the vertebrobasilar distribution
- Usually from atherosclerotic disease, but 1/5 of infarcts may be cardioembolic
- Common cause of episodic, spontaneus vertigo of abrupt onset in older patients
- Several minutes (3-4 min) duration is always suspicious for TIA

Vertebrobasilar insufficiency

Visual (diplopia/ illusions, field defects in 69%
Drop attacks in 33%
Imbalance/ incoordination in 21%
Extremity weakness in 21%
Confusion in 17%
Headache in 14%
Hearing loss in 14%
Loss of consciousness in 9.5%
Extremity numbness in 9.5%
Dysarthira in 9.5%
Tinnitus in 9.5%
Perioral numbness in 5%

Drop attack

- Abruptly falls without warning, but does not loose consciousness
- Believed to be caused by transient quadraparesis due to ischemia at the pyramidal decussation

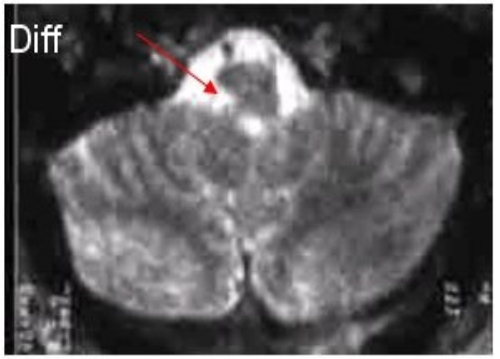

Ant. communicating a.
Optic n.
Temporal lobe
Int. carotid a.
Middle cerebral a.
Post. cerebral a.
Sup. cerebellar a.
III
IV
V
Labyrinthine a.
Basilar a.
VI
VII
VII
Ant. inf. cerebellar a.
IX
X
Vestibular nuclei
Post. inf. cerebellar a.
Ant. spinal a.
Vertebral a.

Subclavian Steal Syndrome

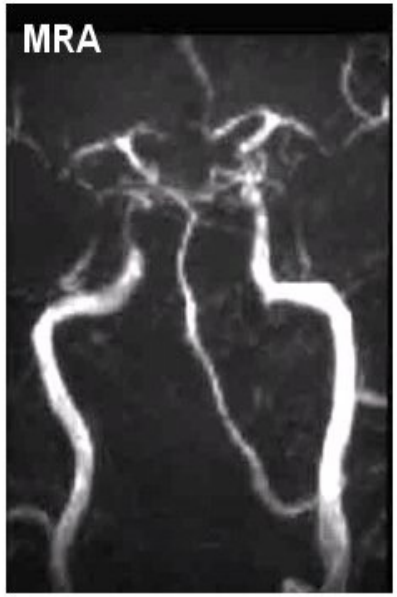
- Rare, but treatable
- Arm exercise on side of stenotic subclavian artery usually causes symptoms of intermittent claudication
- Blood is shunted away from brainstem into ipsilateral vertebral artery
- Classic history occurs only rarely

Stroke syndrome with vertigo: Wallenberg syndrome

- Dorsolateral medullary syndrome
- PICA (posterior inferior cerebellar artery)
- Vertebral atherosclerotic disease (artery to artery emboli) prior to takeoff
- Consider vertebral dissection
- Look for h/o neck trauma or manipulation



Right medulla infarct with Wallenberg syndrome



MRA: Atheromatous basilar and probable occlusion of ri vertebral artery

Wallenberg symptoms

Right Dorsolateral medullary stroke

- Nystagmus and vertigo (vestibular nuclei)
- Difficulty swallowing, hoarse voice, absent gag on R (nucleus ambiguus)
- Difficulty limb coordination on the right FTN, HTS (right cerebellum)
- On walking, veers and falls to the right
- Pain and temperature loss on right face and left leg, trunk, arm (spinothalamic)
- Right Horner's: ptosis, miosis, anhydrosis (reticulospinal fibers in lateral medulla)

Wallenberg Syndrome

- Occlusion of PICA
- Relatively common cause of central vertigo
- Associated Symptoms:

  -nausea -vomiting -nystagmus

  -ataxia -Horner syndrome

  -palate, pharynx and laryngeal paresis

  -loss of pain and temperature on ipsilateral face and contralateral body

Stroke syndrome with vertigo:

Anterior inferior cerebellar artery

- Vertigo
- Tinnitus, hearing loss secondary to infarct of cochlea/nerve or cochlear nucleus
- Ataxia
- Facial paralysis and numbness
- Ispilateral Horner's

Stroke syndrome with vertigo: Labyrinthine infarction

- Occlusion of the internal auditory artery
- Sudden, profound hearing loss
- Acute onset of spontaneous vertigo lasting days
- Consider the diagnosis in older patients with h/o TIA, stroke, or atherosclerotic vascular disease

Cerebellar Hemorrhage

- Etiology is hypertensive vascular disease in 2/3 of patients
- Acute onset of vertigo, nausea, and vomiting and severe headache, inability to stand
- Spontaneous or gaze evoked nystagmus, dysmetria, truncal ataxia
- Often requires prompt evaluation and surgical decompression to prevent progression to coma or even death from herniation
- Motor-sensory exam usually normal
- Gait disturbance often not recognized because patient appears too ill to move

Head and Neck Trauma

- Due to damage to the inner ear and central vestibular nuclei, most often labyrinthine concussion
- Temporal skull fracture may damage the labyrinth or eighth cranial nerve
- Vertigo may occur 7-10 days after whiplash
- Fistula may provide direct route to CNS infection

Vertebral Basilar Migraine

- Syndrome of vertigo, dysarthria, ataxia, visual changes, paresthesias followed by headache
- Distinguishing features of basilar artery migraine
  - -Symptoms precede headache
  - -History of previous attacks
  - -Family history of migraine
  - -No residual neurologic signs
- Symptoms coincide with angiographic evidence of intracranial vasoconstriction

Duration of vertigo

	Duration
BPPV	Seconds, always < 1 min
VBI	Few minutes, ± focal neurological signs
Migraine	Varies sec, minutes, hours or days
Meniere's	20 minutes to hours
Vest.neuritis	Days
Stroke	Days

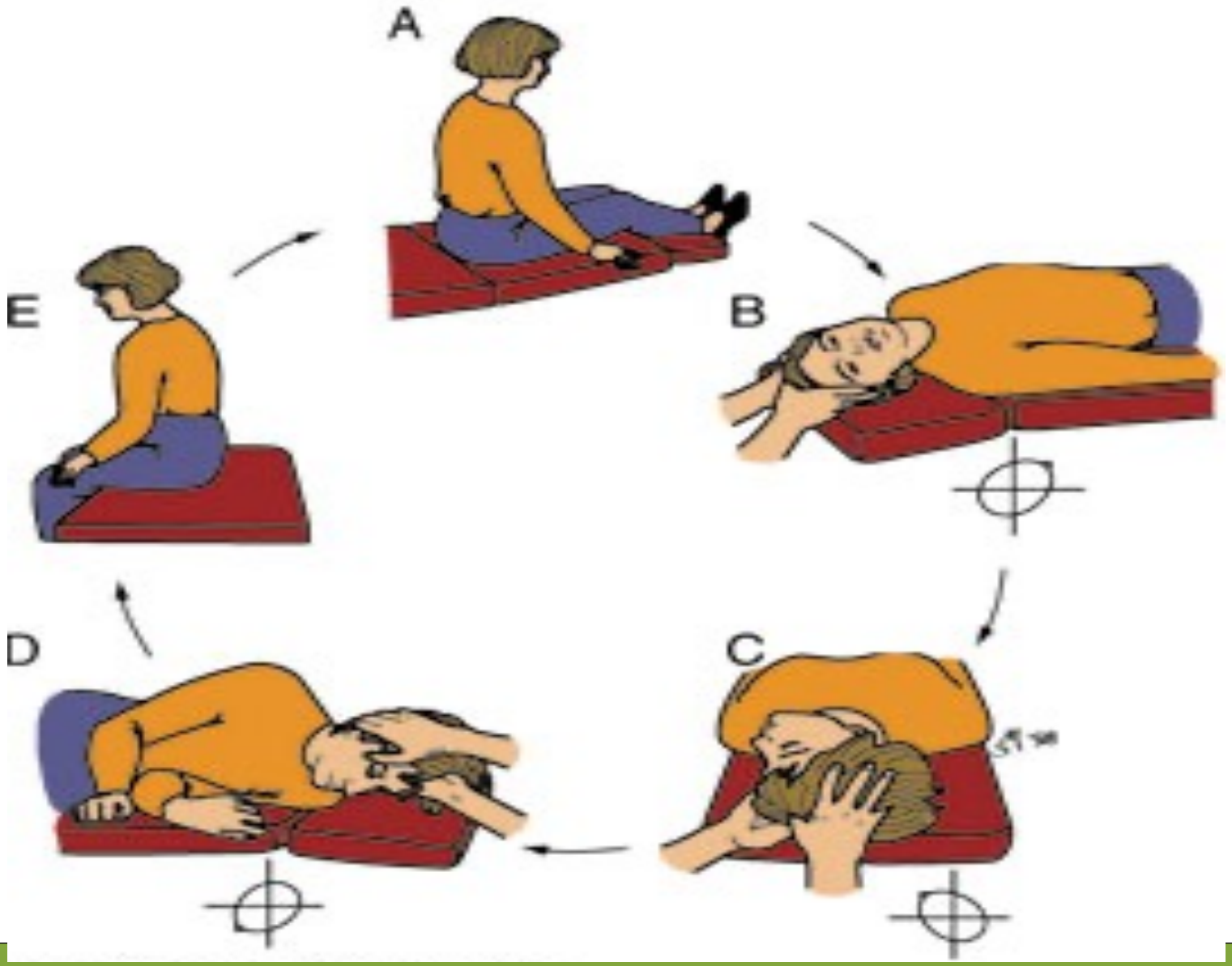
Metabolic Abnormalities

- Hypoglycemia
  - Suspected in any patient with diabetes with associated headache, tachycardia or anxiety
- Hypothyroidism
  - Clinical picture of vertigo, unsteadiness, falling, truncal ataxia and generalized clumsiness

Management

- Severe Ménière disease may require chemical ablation with gentamicin
- Attempt Epley maneuver for BPPV
- Mainstay of peripheral vertigo management are antihistamines that possess anticholinergic properties
  - -Meclizine
  - -Promethazine
  - -Diphenhydramine
  - -Scopolamine

Epley Maneuver



Summary

- Ensure you understand what the patient means by “dizzy”
- Try to differentiate central from peripheral
  - Often there is significant overlap
- Not every patient needs a head CT
- Central causes are usually insidious and more severe while peripheral causes are mostly abrupt and benign
- Most can be discharged with antihistamines