From Vertigo to Brain Stem Syndromes

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102.12.31

ED Pitfalls
- Mistake syncope as vertigo / dizziness
- Miss the stroke without motor weakness
- Cannot pick up central vertigo / VBI from related population
- Always jump from brain stem reflexes
- Consider all peripheral vertigo as OPD cases

What kind of peripheral vertigo should be stayed for admission?

What are these?
- Ramsay-Hunt Syndrome
- Weber’s Syndrome
- Others: Claude, Benedict, Nothnagel, Parinaud, etc.
- Wallenburg’s Syndrome
- Millard-Gübler Syndrome
- Foville’s Syndrome

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
- Dizziness
  - Non-specific term
  - Different meanings to different people
    - Could mean
      - Vertigo
      - Weak
      - Anemia
      - Syncope
      - Dizziness
      - Depression
      - Presyncope
      - Anxiety
      - Unsteadiness

Vertigo and Dizziness
- Vertigo
  - Perception of movement
    - Peripheral or Central
- Syncope
  - Aborted Sudden Death
  - Transient loss of consciousness with loss of postural tone

Vertigo and Dizziness
- 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
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

Vertigo-Differential Diagnoses

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

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 bruises
- 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
1. Nystagmus due to peripheral causes has all of the following features except:
   a. Diminishes with fixation
   b. Unidirectional fast component
   c. Can be horizontorotary or vertical
   d. Nystagmus increases with gaze in direction of fast component
   e. Can be accentuated by head movement

2. Nystagmus due to central causes has all of the following features except:
   a. Does not change with gaze fixation
   b. Can be unidirectional or bidirectional
   c. Can be horizontal, rotary or vertical
   d. Nystagmus increases with gaze in direction of fast component
   e. Can be dramatically accentuated by head movement

3. All of the following will have hearing loss and tinnitus associated with the vertigo except:
   a. Vestibular neuronitis
   b. Acute labrynthitis
   c. BPPV
   d. Acoustic neuroma
   e. Mèniere Disease
4. T or F  The Dix-Halpike maneuver is useful in the treatment of BPPV?

False

The Dix-Halpike is used to precipitate the nystagmus if the nystagmus and vertigo have resolved so a correct diagnosis can be made.

The Epley maneuver is used to relocate the otoliths and therefore treat the BPPV.

5. All of the following have been implicated in causing vertigo including:
   a. Loop diuretics  
   b. Anticonvulsants  
   c. Aminoglycosides  
   d. NSAIDS  
   e. Fluoroquinolones  
   f. All of the above

F  All of the above

Many everyday medications can cause vertigo which is easily reversible if recognized.

Acute vertigo and dizziness are associated with what type(s) of strokes?

a. Middle cerebral artery infarctions
b. Pontine lacunar strokes
c. Lateral medullary infarctions
d. Cerebellar strokes
e. Thalamic hemorrhages

c. and d.

Both cerebellar strokes and lateral medullary infarction (Wallenberg syndrome) typically have prominent vertigo and dizziness as symptoms.

Acute Dizziness: Important Emergency Room Considerations

- Characteristics of peripheral vertigo and dizziness
- Characteristics of vertigo and dizziness of central origin
- Recognizing stroke syndromes that may present with dizziness as a prominent feature
- Treatment considerations in dizziness of central origin
- Treatment of peripheral vestibular dysfunction
Case

A 30-year-old male wakes up in the middle of the night with a headache and dizziness. He is unable to fall back asleep, vomits once, and comes to the ED at 6 AM saying that he needs a note for work so he can stay home. The headache is diffuse, nonspecific, not positional, does not radiate into his neck. He has no past history of headaches. The dizziness is described as spinning and present when lying still with his eyes closed.

Nystagmus: Characteristics

- Nystagmus of Central Origin
  - May be purely vertical
  - May be purely horizontal
  - May be horizonto-rotary
  - May change direction with gaze
  - Not diminished by fixation

Nystagmus: Characteristics

- Nystagmus of Peripheral Origin
  - Horizontal and torsional
  - Diminished by fixation
  - May fatigue (if elicited by head movement)
  - Does not change direction with gaze change
  - Diminishes with fixation

Vertigo-Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Peripheral</th>
<th>Central</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset</td>
<td>Sudden</td>
<td>Usually slow</td>
</tr>
<tr>
<td>Severity of Vertigo</td>
<td>Intense</td>
<td>Usually mild</td>
</tr>
<tr>
<td>Pattern</td>
<td>Paroxysmal</td>
<td>Constant</td>
</tr>
<tr>
<td>Exac. by movement</td>
<td>Yes</td>
<td>Variable</td>
</tr>
<tr>
<td>Autonomic</td>
<td>Frequent</td>
<td>Variable</td>
</tr>
<tr>
<td>Laterality</td>
<td>Unilateral</td>
<td>Uni or bilat</td>
</tr>
<tr>
<td>Nystagmus</td>
<td>Horizonto-rotary</td>
<td>Any</td>
</tr>
<tr>
<td>Fatigable/Fixation</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Auditory symptoms</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>TM</td>
<td>May be abnormal</td>
<td>Normal</td>
</tr>
<tr>
<td>CNS symptoms</td>
<td>Absent</td>
<td>Present</td>
</tr>
</tbody>
</table>

Head - Tilt Test (Nylen-Bárány)

- Produces nystagmus with peripheral lesions
- Nystagmus and vertigo occur when diseased side turned downward
- Peripheral nystagmus may fatigue with repeated maneuvers
- Central lesions are not significantly changed

Head - Tilt Test (Nylen-Bárány)

- Nystagmus with peripheral lesions may have latency of 2-20 second and be of short duration (<30 seconds)
- Symptoms of peripheral nystagmus can be dramatically changes with head movement
- Peripheral nystagmus may fatigue with repeated maneuvers
- Peripheral nystagmus typically produced in one head position
Vertigo-Ancillary Tests
- CT-if cerebellar mass, hemorrhage or infarction suspected
- Glucose and ECG in the “dizzy” patient
- Cold caloric testing
- Angiography for suspected VBI
- MRI
- Electronystagmography and audiology

Acute Dizziness and Vertigo: Peripheral Causes
- Acute vestibular neuronitis
- Acute neuro labyrinthitis
- Meniere’s syndrome (endolymphatic hydrops)
- Head trauma (labyrinth trauma)
- Drug-induced (aminoglycosides, phenytoin, phenobarbital, carbamazepine, salicylates, quinine)

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

Benign Paroxysmal Positional Vertigo
- Extremely common
- Otoconia displacement
- No hearing loss or tinnitus
- Short-lived episodes brought on by rapid changes in head position
- Usually a single position that elicits vertigo
- Horizontal rotatory nystagmus with crescendo-decrescendo pattern after slight latency period
- Less pronounced with repeated stimuli
- Typically can be reproduced at bedside with positioning maneuvers

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

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

Vestibular Neuronitis

- Suspected viral etiology
  - Sudden onset vertigo that increases in intensity over several hours and gradually subsides over several days
  - Mild vertigo may last for several weeks
  - May have auditory symptoms
  - Highest incidence in 3rd and 5th decades

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

Ménière Disease

- First described in 1861
- Triad of vertigo, tinnitus and hearing loss
- Due to cochlea-hydrops
  - Unknown etiology
  - Possibly autoimmune
- Abrupt, episodic, recurrent episodes with severe rotational vertigo
- Usually last for several hours
Menière 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

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

Acute Dizziness and Vertigo: Central Causes
- Cerebellar infarction
- Cerebellar hemorrhage
- Lateral medullary infarction (Wallenberg’s syndrome)
- Other brainstem ischemia
- Multiple sclerosis

Central Vertigo-Differential
- Central Vertigo
  -Vertebrobasilar Insufficiency
    - Atheromatous plaque
    - Subclavian Steal Syndrome
    - Drop Attack
    - 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
  - Hemiparesis
  - Diplopia
  - Facial numbness
  - Headache
- Tinnitus and hearing loss unlikely
- Vertical nystagmus is characteristic of a (superior colliculus) brain stem lesion
- Up to 30% of TIA’s are VBI with pontine symptoms and a focal neurologic lesion
Drop attack
- Abruptly falls without warning, but does not lose consciousness
- Believed to be caused by transient quadraparesis due to ischemia at the pyramidal decussation

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

Wallenberg Syndrome
- Occlusion of PICA
- Relatively common cause of central vertigo
- Associated Symptoms:
  - Nausea
  - Vomiting
  - Nystagmus
  - Ataxia
  - Horner syndrome
  - Palse, pharynx, and laryngeal paresis
  - Loss of pain and temperature on ipsilateral face and contralateral body

Dorsolateral Medullary Infarction: Wallenberg’s Syndrome
- Nystagmus and dizziness
- Nausea and vomiting
- Ataxia and ipsilateral asynergia
- Hoarseness
- Ipsilateral Horner’s syndrome
- Ipsilateral facial analgesia; contralateral body analgesia
- No weakness

Cerebellar Hemorrhage
- Neurosurgical emergency
- Suspected in any patient with sudden onset headache, vertigo, vomiting, and ataxia
- May have gaze preference
- Motor-sensory exam usually normal
- Gait disturbance often not recognized because patient appears too ill to move

Multiple Sclerosis
- Vertigo is presenting symptom in 7-10%
- Thirty percent develop vertigo in the course of the disease
- May have any type of nystagmus
- Internuclear ophthalmoplegia is virtually pathognomonic
- Onset during 2nd to 4th decade
- Rare after 5th decade
- Usually will have had previous neurological symptoms
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
- Persistent episodic flares suggest perilymphatic fistula
- 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

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

Cerebellar Infarction
- Nystagmus and dizziness
- Nausea and vomiting
- Ataxia and ipsilateral asynergia
- No weakness

Imaging in Posterior Circulatory Cerebrovascular Events
- CT good for cerebellar hemorrhage
- CT can miss brainstem acute cerebellar infarctions
- MRI much more sensitive than CT for acute infarction
- Diffusion-weighted imaging may increase yield
- MRA can reveal some, but not all pathology

Vertebral Artery Dissection
- May present with posterior circulatory infarction
- May be associated with neck trauma or manipulation, but may be spontaneous
- MRA may reveal double-lumen, but full angiography has higher yield
- Anticoagulation may prevent occlusion or emboli
Management

- Based on differentiating central from peripheral causes
- VBI should be considered in any elderly patient with new-onset vertigo without an obvious etiology
- Neurological or ENT consult for central vertigo
- Suppurative labyrinthitis-admit and IV antibiotics
- Toxic labyrinthitis-stop offending agent if possible

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
  - Diphenhydramine
  - Promethazine
  - Droperidol
  - Scopolamine

Epley Maneuver

- University of Baltimore
  - 107 patients
  - Diagnosed with BPPV
  - Right ear affected 54%
  - Posterior semicircular canal in 105 patients
  - Treated with 1.23 treatments
  - Successful in 93.4%

Treatment of Cerebellar Infarction or Hemorrhage

- Elevated blood pressure may be reflex response - do not treat unless markedly elevated (>180/120)
- Decreasing level of consciousness or hemiparesis suggests brainstem compression - surgical intervention indicated
- Watch for development of hydrocephalus

Treatment of Posterior Circulatory Ischemia

- Recombinant tissue plasminogen activator (if in first 3 hours)
- Anticoagulation (heparin)
- Antiplatelet agents (aspirin, ticlopidine, clopidogrel)
### Medications for Acute Vertigo

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<thead>
<tr>
<th>Drug</th>
<th>Dosage</th>
<th>Route</th>
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<tbody>
<tr>
<td>Dimenhydramine IV, PR</td>
<td>50 - 100 mg qid</td>
<td>PO, IM, IV, PR</td>
</tr>
<tr>
<td>Diphenhydramine IV</td>
<td>25 - 50 mg tid to qid</td>
<td>PO, IM, IV</td>
</tr>
<tr>
<td>Meclizine IV, PR</td>
<td>12.5 - 25 mg bid to qid</td>
<td>PO</td>
</tr>
<tr>
<td>Promethazine IV, PR</td>
<td>25 mg bid to qid</td>
<td>PO, IM, IV</td>
</tr>
<tr>
<td>Hydroxyzine</td>
<td>25 - 100 mg tid to qid</td>
<td>PO, IM</td>
</tr>
</tbody>
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(adapted from Lerner, 1995)

### 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

### The Neurological Examination

Questions?