Chapter 19 – Dizziness and Vertigo

Episode overview:

1) Compare characteristics of peripheral and central vertigo
2) What are risk factors for central causes of vertigo?
3) List 4 vestibulotoxic drugs.
4) Describe the Hallpike Maneuver and the Epley Maneuver
5) List 5 causes of Peripheral Vertigo and describe features of illness
6) List 5 causes of Central Vertigo and describe the features of illness

Wisecracks:
1) HINTS exam
2) Pathophysiology stumper:
   - Why does dizziness or vertigo lead to nausea, sweating, malaise?
3) What is the barbecue roll?

Rosen’s in Perspective:

Dizziness
- Very common yet complex neurologic symptom, reflecting a disturbance in:
  - Balance perception and spatial orientation
- It is often used as a catch all word for many things:
  - Weakness, light-headedness, unsteadiness, depression, etc.
- Despite the experts not uniformly agreeing, think four historical categories:
  1) Vertigo - illusion of spinning or motion
  2) Near syncope - impending feeling of fainting
  3) Disequilibrium - loss of equilibrium when walking
  4) Non-specific dizziness
- These categories are of limited use practically, but help us think through the differential diagnosis list.

Pathophysiology

The body’s ability to regulate its equilibrium and awareness relies on:
- Visual impulses (eyes)
  - Body position in space
- Proprioceptive (muscles, joints, small nerves in the body)
  - Relative positions of parts of the body
  - Neck position particularly important in relation to visual and otic input
- Vestibular systems (otic labyrinth)
  - Maintain head position and stabilize head movement

Any disease that interferes with any of these systems gives rise to vertigo/dizzy symptoms
Vestibular apparatus

- **Maintains** head position and movement
  - Within the inner ear in the temporal bone
  - Vulnerable to:
    - *Trauma, infection, blood-borne toxins*

Consists of **canals** and **otolithic** structures connected to each other containing endolymph

- Three semicircular canals
  - *Movement* and *angular momentum*
- Two otolithic structures (utricle and saccule)
  - Orientation with respect to gravity
  - Contain CaCO₃ structures called **otoliths**

- Both semicircular canals (either ear) work together and help people respond to symmetrically to stimuli. A disease in **either inner ear or motion stimulation** gives the asymmetrical perception of vertigo
  - For example: when otoliths are inappropriately located in the semicircular canals (as in BPPV) they can lead to positional vertigo as the otoliths move in the semicircular canals in response to gravity

**Nerve supply** extending from these structures:
- Impulses from the inner ear structures leave via the acoustic nerve (CN VIII)
- Enter the brainstem below the pons and anterior to the cerebellum
- Pass through the four vestibular nuclei of the brainstem and cerebellum

They then travel on two pathways leading to the clinical manifestations of vertigo:

- Medial longitudinal fasciculus (MLF)
- Vestibulospinal tract

In normal healthy vestibular systems these connections allow for eye<->body compensation in response to movement in different directions, and maintaining a stable visual axis.

**Nystagmus:**

Occurs when the normally “synced” vestibular information becomes unbalanced

- Usually this is in unilateral vestibular disease leading to asymmetrical stimulation of the **medial & lateral** rectus muscles of the eye.
- Unopposed activity leads to **SLOW** eye movement **TOWARDS** the *affected* side of the stimulus (*regardless* of where the eyes are looking).
- The cerebral cortex then **corrects** for these eye movements and RAPIDLY brings the eyes back to midline, repeating itself cyclically and manifesting as nystagmus

Nystagmus direction is conventionally described by the FAST “cortical” component (the correction of the gaze deviation away from the diseased vestibular apparatus)

- Unilateral **horizontal-rotatory** nystagmus arises from vestibular disease
- **Vertical** nystagmus is usually a **central cause** - in the **brainstem or cerebellum**
1) Compare characteristics of peripheral and central vertigo

**Table 19-1: Characteristics of Peripheral and Central Vertigo**

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>PERIPHERAL</th>
<th>CENTRAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset</td>
<td>Sudden</td>
<td>Gradual or sudden</td>
</tr>
<tr>
<td>Intensity</td>
<td>Severe</td>
<td>Mild</td>
</tr>
<tr>
<td>Duration</td>
<td>Usually seconds or minutes (intermittent)</td>
<td>Usually weeks, months (continuous) but can be seconds or minutes with vascular causes</td>
</tr>
<tr>
<td>Direction of nystagmus</td>
<td>One direction (usually horizontal)</td>
<td>Vertical, downbeating</td>
</tr>
<tr>
<td>Effect of head position</td>
<td>Worsened by position, often single critical position</td>
<td>Little change, associated with more than one position</td>
</tr>
<tr>
<td>Associated neurologic findings</td>
<td>None</td>
<td>Usually present</td>
</tr>
<tr>
<td>Associated auditory findings</td>
<td>May be present, including tinnitus</td>
<td>None</td>
</tr>
</tbody>
</table>

**Table 19-2: Distinguishing Characteristics of Nystagmus with Central and Peripheral Vertigo**

<table>
<thead>
<tr>
<th>CHARACTERISTIC</th>
<th>CENTRAL</th>
<th>PERIPHERAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direction</td>
<td>Can be any direction, downbeating (fast phase beats toward nose)</td>
<td>Horizontal or horizontal, upbeating (fast phase beats toward forehead)</td>
</tr>
<tr>
<td>Latency</td>
<td>Short</td>
<td>Sustained</td>
</tr>
<tr>
<td>Duration</td>
<td>Intensity</td>
<td>Mild</td>
</tr>
<tr>
<td>Fatigability</td>
<td>Nonfatigable</td>
<td>Nonfatigable</td>
</tr>
<tr>
<td>Position testing effects</td>
<td>Not suppressed, may be enhanced</td>
<td>Suppressed</td>
</tr>
</tbody>
</table>

**Peripheral**

<table>
<thead>
<tr>
<th>History:</th>
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<tbody>
<tr>
<td>1. Sudden onset</td>
</tr>
<tr>
<td>2. Severe symptoms</td>
</tr>
<tr>
<td>3. Usually seconds-minutes (may be hrs.)</td>
</tr>
<tr>
<td>4. Worsened by head position changes - may have a single comfortable position</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical exam:</th>
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</thead>
<tbody>
<tr>
<td>1. Normal neurological exam</td>
</tr>
<tr>
<td>2. May have a fever</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nystagmus:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unidirectional, horizontal-rotatory</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Auditory findings:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tinnitus, hearing loss</td>
</tr>
</tbody>
</table>

**Central**

<table>
<thead>
<tr>
<th>History:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Advanced age</td>
</tr>
<tr>
<td>2. New onset - never occurred before</td>
</tr>
<tr>
<td>3. CAD, HTN, DM, A fib, strokes</td>
</tr>
<tr>
<td>4. Neck trauma</td>
</tr>
<tr>
<td>5. Sudden onset, severe symptoms or weeks/months of mild symptoms</td>
</tr>
<tr>
<td>6. Vertigo followed by headache</td>
</tr>
<tr>
<td>7. ALOC, altered mentation, syncope</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Physical exam:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. D’s - diplopia, dysarthria, dysmetria, dysdiadochokinesis</td>
</tr>
<tr>
<td>2. Ataxia / gait disturbance / imbalance</td>
</tr>
<tr>
<td>3. Vital sign abnormalities = think central or systemic cause</td>
</tr>
<tr>
<td>a. Hypotension - syncope or near syncope</td>
</tr>
<tr>
<td>b. Fever - meningitis</td>
</tr>
<tr>
<td>c. Pulse and blood pressure discrepancy between arms - subclavian steal syndrome / vertebrobasilar insufficiency</td>
</tr>
<tr>
<td>4. CN abnormalities (EOM’s)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nystagmus:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vertical / downbeating</td>
</tr>
<tr>
<td>Non-fatigable</td>
</tr>
<tr>
<td>Not affected by repositioning maneuvers</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Auditory findings:</th>
</tr>
</thead>
<tbody>
<tr>
<td>NONE</td>
</tr>
</tbody>
</table>
Fecaliths or pearls?
- There are a lot of similarities in the exam and history
- HINTS exam - to be discussed in wisecracks

2) What are RFs for central cause or vertigo?
- TIA and stroke risk factors, including: older age, male, HTN, CAD, DM, A fib.
- Interesting facts in Rosens:
  - **Isolated vertigo** can be the only initial sign of cerebellar and posterior circulation strokes / TIA's / infarctions
  - Often missed by ED physicians

| “Stroke is seen in 3.2% of patients with dizziness syndrome, but only 0.7% of those with isolated dizziness had stroke” |
| “Recent study: fewer than 1/500 of patients discharged with dizziness or vertigo had a major vascular event in the month post discharge” |

3) List 4 vestibulotoxic drugs.
- Vestibulotoxic drugs: important to consider as potential contributors to vertigo
  - Aminoglycosides
  - Anticonvulsants
  - Alcohols
  - Quinine
  - Quinidine
  - Minocycline
4) Describe the Hallpike Maneuver and the Epley Maneuver

**Dix-Hallpike Maneuver**
- “Can confirm the diagnosis of posterior canal BPPV”
- Useful diagnostic tool

**EXPLANATION**

I. “With the head turned 45 degrees to one side while the patient is sitting up, the patient is moved to a supine position with the head hanging over the edge of the bed”

II. “Patient is asked about vertigo symptoms and observed for nystagmus”

III. The patient is brought back upright

IV. The test is repeated with the patient looking 45 degrees in the other direction (e.g. left rather than to the right)

--- If the patient has a **posterior canal BPPV** only one side should be positive for symptoms of nystagmus ---

--- CAVEAT ---

**Roll Test**
If the DH test is negative or bilaterally positive, use the “ROLL TEST”
- Examines for the **horizontal canal variant** of BPPV
- Useful diagnostic tool

**EXPLANATION**
- Patient lies supine with forward gaze (no need for head to hang over edge of bed)
- Physician turns their head 90 degrees to one side
- Patient is asked about symptoms
- Physician straightens head and turns it the other direction.

**FINDINGS**
- If there are otoliths in the horizontal canal the patient will develop vertigo and horizontal nystagmus, with the direction of the nystagmus will change depending on the way the head is turned.
  - With horizontal canal BPPV, the patient should have symptoms with their head in either direction - but the side with the worse symptoms (e.g. looking to the right) is the side that is most involved (the right side is diseased).
Epley Maneuver

- **Useful treatment tool**
- **In essence, sequential rotations of the head 90 degrees - three times right over to left**

A) Started and finished in a sitting up position
B) Lie down with head turned 45° to right
   - 30 seconds or until symptoms resolve
C) Turn head 90° left, at 45° left
   - 30 seconds or until symptoms resolve
D) Turn head additional 90° left, along with body so that patient is on left shoulder
   - 30 seconds or until symptoms resolve
E) Sit up patient

5) **List 5 causes of Peripheral Vertigo + describe features of illness**

Most common causes for peripheral vertigo:

1. **BPPV**
   - a. Short lived, positional, fatigueable - with nausea / vomiting
   - b. **NO tinnitus or hearing loss**

2. **Vestibular neuronitis**
   - a. History: sudden severe vertigo, increasing intensity over hours → then subsiding over days to weeks. Positional changes. Usually exposure to infections, toxins.
   - b. Physical: N/V. **No auditory symptoms.** Spontaneous Nystagmus.

3. **Labyrinthitis**
   - a. **Acute suppurative**
     - i. With coexisting acute exudative inner ear infection. SEVERE symptoms
     - ii. Severe hearing loss, N/V
     - iii. Febrile patient, toxic appearing, ACUTE otitis media
   - b. **Serous**
     - i. Mild to severe positional symptoms. Pre/coexisting ENT infection
     - ii. Mild to severe hearing loss,
     - iii. Non toxic patient, with low or no fever
   - c. **Toxic**
     - i. Gradually progressive symptoms on vestibulotoxic drug
     - ii. Hearing loss, severe N/V
     - iii. Hearing loss, ataxia (if chronic)

4. **Meniere’s disease**
   - a. Recurrent episodes of abrupt, severe rotational vertigo lasting HOURS. May occur in clusters with symptom free periods
b. N/V. Tinnitus, hearing loss,
c. Usually doesn’t have positional vertigo

5. **Acoustic neuroma**
   a. Gradual onset hearing loss in women 30-60 yrs.
   b. Hearing loss, tinnitus; in later stages: ataxia
   c. Unilateral decreased hearing
   d. Later stages: truncal ataxia, diminution or absence of corneal reflex, CN VIII

6) List 5 causes of Central Vertigo + describe the features of illness

Most common causes of central vertigo

1. **Vascular disorders**
   a. **Vertebrobasilar insufficiency**
      i. Patient with ++vascular risk factors and vertigo
      ii. May be associated with neck trauma
      iii. Seconds to minutes of vertigo WITH dysarthria, ataxia, weakness, numbness, double vision, headache
      iv. Usually have neurological deficits
   b. **Cerebellar hemorrhage**
      i. Sudden, severe symptoms
      ii. Headache, vomiting, ataxia
      iii. Toxic exam, dysmetria, ataxia, ipsilateral CN VI palsy
   c. **Posterior inferior cerebellar artery occlusion (Wallenberg's syndrome)**
      i. Vertigo WITH neurological complaints
      ii. N/V, loss of pain and temp sensation, ataxia, hoarse voice
      iii. Ipsilateral loss of pain and temp sensation on the side of the lesion, and contralateral palate/pharynx/larynx paralysis; Homer’s syndrome

2. **Head trauma**
   a. Post trauma positional and self-limited nausea
   b. Rarely basilar skull fracture

3. **Vertebrobasilar migraine**
   a. Vertigo → headache. Similar episodes in the past with onset in adolescence, and family history of migraines
   b. Headache preceded by dysarthria, ataxia, visual disturbances, paresthesias
   c. NO residual neurologic or otologic symptoms post-attack

4. **Multiple sclerosis**
   a. 7-10% of people have vertigo as a presenting symptom.
   b. May be severe, occurring in 20-40 year olds
   c. Usually have other attacks with varying neurological signs/symptoms
   d. Multidirectional nystagmus which may persist after vertiginous symptoms resolve. *Bilateral INO and ataxic eye movements* - suggest MS
   e. Treat as migraine (consider trial of migraine therapy in an undifferentiated patient)

5. **Temporal lobe epilepsy**
   a. Vertiginous symptoms
   b. May have memory impairment, hallucinations, trancelike states, epilepsy.
   c. May have aphasia or convulsions

6. **Hypoglycemia**
   a. Should always be assessed for
   b. Have sweating and anxiety, tachycardia, mental status changes
**Wisecracks**

1) What is the HINTS exam? - Head impulse - Nystagmus - Test of Skew

**SOURCE**

i. Shout-out to WikEM journal club - thanks to WikEM crew
   - Reported that HINTS has *higher sensitivity* for detecting a central cause of vertigo than MRI with DWI. (100% vs. 72%)

**PERFORMING THE EXAM**

I. **HI** - Test of vestibulo-ocular reflex
   a. Have the patient looking at your nose, and turn their head to either side while looking at their eye movements.
   b. An ABNORMAL (failed) corrective saccade as you turn their head to the affected side is ‘normal’ (*reassuring* that it is a peripheral cause)

II. **Nystagmus** - in primary, left and right gaze
   a. Looking for vertical, downbeating, non-fatigueable

III. **TS** - alternating cover test
   a. Cover their eyes one at a time while they look at your nose, uncover rapidly to see if there is any corrective eye re-alignment (ask about old strabismus)
   b. Repeat with each eye

**NOTES ABOUT THE STUDY**

*Exclusions:* People with a history of recurrent vertigo with/without auditory symptoms
*Methods:* Performed in an outpatient setting by NEURO-OPHTHALMOLOGISTS
*Bottom line:* Is this exam practical to use clinically?
   - Most people need a CTA, although this rarely changes management immediately

2) Why do people with vertigo get systemic symptoms?

- Extra-vestibular connections:
  - Vestibular nuclei send info to the lateral vestibulospinal tract and connect with motor neurons that supply muscles in the extremities
    - Leads to “false steps” and correcting body movements in people with disease vestibular systems who “feel” like they are moving
  - There are also connections of vestibular nuclei with the **autonomic system** which leads to:
    - Perspiration
    - Nausea
    - Vomiting
    - Fatigue, malaise etc.
  - The vestibular nuclei also connect with the cerebellum to aid in movement modulation
3) What is the “barbecue roll”?
   a. See Rosens pg. 165

   “Barbecue roll” - Used to treat the HORIZONTAL variant of BPPV:
   i. Patient lies supine with the head turned 90° to the affected side
   ii. They then sequentially rotate their head 45° away from the affected side.
   iii. Eventually the patient turns over (like a barbecue) into the prone position
   iv. The maneuver is over when their head is in the original starting position.

   **NOTE:** Each held for 30 seconds or until their symptoms/nystagmus terminate