Vestibular Rehabilitation in the acute setting

Presentation by: Whitney Wilson, SPT
Learning Objectives

• At the end of the presentation you will be able to:
  – Briefly describe the anatomy and physiology of the vestibular system
  – Understand the role of vestibular system in balance and posture
  – Describe terminology related to dizziness
  – Perform basic PT exam for Pt with dizziness
  – Determine if a Pt has BPPV and utilize the Eply maneuver
  – Prescribe vestibular rehabilitation including adaptation, habituation exercises
Are we there yet?

- Anatomy and physiology
- Role of vestibular system in balance and posture
- Terminology related to dizziness
- PT exam
- BPPV and the Eply maneuver
- Vestibular rehabilitation
Anatomy and Physiology of Vestibular System$^{1,2}$

- **Labyrinth**: Includes the vestibule and three canals.
- **Vestibule**: Important for balance.
- **Organ of hearing**: Located in the cochlea, responsible for hearing.
Semicircular Canals\textsuperscript{1,2}

Angular acceleration
Otolith Organs: Utricle and Saccule

Static and linear acceleration
Vestibular Projection Pathways

Figure 16.21
Physiology of the Vestibular System$^{1,2}$

- **1. Vestibular Ocular Reflex (VOR)**
  - Stabilization of gaze during head motion
- **2. Vestibulospinal Reflex (VSR)**
  - Postural responses to head movement for stabilization of the body
- **3. Vestibulo-collic reflex (VCR)**
  - Stabilization of the neck mm in relation to head movements
VOR³
VSR \(^4\)

- Maintains Equilibrium and center of gravity
Physiology of the Vestibular System: VCR²

Medial Vestibular Nucleus

MLF
Are we there yet?

- Anatomy and physiology
- Role of vestibular system in balance and posture
- Terminology related to dizziness
- PT exam
- BPPV and the Eply maneuver
- Vestibular rehabilitation
Purpose of the Vestibular System

• Sensory
  – Perception of motion and orientation
    • Angular acceleration
    • Linear acceleration
    • Position in relation to gravity

• Motor
  – Control of eye movement to permit clear visual image of surroundings
  – Maintenance of equilibrium and position in relation to gravity
Vestibular System Roles in Balance and Postural Control\(^2,4\)

- Vestibular mechanisms control neck, trunk and hip mm activation in order to stabilize the head

**Somatosensory more responsible:**
- Firm, big surface
- Slow, low amp perturbation
- Mm recruited distal-prox
- Head in phase with hips

**Vestibular system more responsible:**
- Unstable, small surface
- Fast, large amp perturbation
- Mm recruited prox-distal
- Head out of phase with hips
Are we there yet?

- Anatomy and physiology
- Role of vestibular system in balance and posture
- Terminology related to dizziness
- PT exam
- BPPV and the Eply maneuver
- Vestibular rehabilitation
Terminology: What do you mean dizzy?! 

– Dizziness$^{4,6}$: 
  • Distortion of spatial awareness 

– 4 Main types$^{1,2,4}$: 
  • 1. Vertigo 
  • 2. Imbalance/Disequilibrium 
  • 3. Lightheadedness/presyncope 
  • 4. Other (psychiatric, hyperventilation, encephalopathies, multisensory, etc.) 

This being said... Type of dizziness is least reliable factor, but we must work with what we’ve got, right?
Vertigo$^{1,4,5}$

• an *illusion of movement* (self or surroundings)
  – *rotation* is most common
  – can also be *translational* (rising) or *static reorientation* (tilting)

• BPPV
• ear infections
• viral neurolabyrinthitis
• Meniere’s disease (or endolymphatic hydrops)
Imbalance/Disequilibrium\textsuperscript{1,4}

- “dizzy in your head or in your feet?”

- Vestibular loss
- Proprioceptive or somatosensory loss
- Motor and cerebellar lesions
Lightheadedness/Presyncope

Lightheaded

Orthostatic Changes of position

Spontaneous

Orthostatic Hypotension:
- Dehydration
- Adverse effect of CV med
- Cardiac Dysfunction

Arrhythmia
Are we there yet?

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Meclizine\(^4\) = CNS depressant

- Neg. impact on Vest. Rehab program 2/2 prevention of central adaptation
- Dec. Nystagmus and vertigo response to testing
PT evaluation for a “dizzy” Pt

- History
- Dizziness inventory/questionnaire
- Medications
- Vision/Gaze Stability Testing
- VOR/VOR cancellation
- Positional testing
- Postural control assessment/Balance Assessment
History\textsuperscript{1,4}

- Type of dizziness
- Spontaneous v. motion induced
- Duration
- Frequency
- Provocative factors
- Auditory complaints
- Falls

“Wboa—way too much information!”

\textsuperscript{1,4}
Red Flags$^4$

- Decline in hearing
- Dysarthria
- Discoordination
- Diplopia
- Decreased mentation and urinary incontinence
- Decline in strength/weight
- Decreased consciousness
- Dysfunction attributable to CN dysfunction
# Dizziness Handicap Inventory

**Instructions:** The purpose of this scale is to identify difficulties that you may be experiencing because of your dizziness or unsteadiness. Please answer “yes”, “no” or “sometimes” to each question. 

*Answer each question as it applies to your dizziness or unsteadiness only.*

<table>
<thead>
<tr>
<th>ITEM</th>
<th>QUESTION</th>
<th>Y</th>
<th>N</th>
<th>S</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Does looking up increase your problem?</td>
<td>P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Because of your problem, do you feel frustrated?</td>
<td></td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Because of your problem, do you restrict your travel for business or recreation?</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Does walking down the aisle of a supermarket increase your problem?</td>
<td>P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Because of your problem, do you have difficulty getting into or out of bed?</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Does your problem significantly restrict your participation in social activities such as going out to dinner, the movies, dancing or to parties?</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Because of your problem, do you have difficulty reading?</td>
<td></td>
<td>F</td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Does performing more ambitious activities such as sports or dancing or household chores such as sweeping or putting dishes away increase your problem?</td>
<td></td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Because of your problem, are you afraid to leave your home without having someone accompany you?</td>
<td></td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Because of your problem, are you embarrassed in front of others?</td>
<td></td>
<td>E</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Do quick movements of your head increase your problem?</td>
<td>P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Because of your problem, do you avoid heights?</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Does turning over in bed increase your problem?</td>
<td></td>
<td>P</td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>Because of your problem, is it difficult for you to do strenuous housework or yard work?</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Because of your problem, are you afraid people may think you are intoxicated?</td>
<td>E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16</td>
<td>Because of your problem, is it difficult for you to walk by yourself?</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17</td>
<td>Does walking down a sidewalk increase your problem?</td>
<td>P</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18</td>
<td>Because of your problem, is it difficult for you to concentrate?</td>
<td>E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>19</td>
<td>Because of your problem, is it difficult for you to walk around the house in the dark?</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td>Because of your problem, are you afraid to stay at home alone?</td>
<td>E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21</td>
<td>Because of your problem, do you feel handicapped?</td>
<td>E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Has your problem placed stress on your relationship with members of your family or friends?</td>
<td>E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>23</td>
<td>Because of your problem, are you depressed?</td>
<td>E</td>
<td></td>
<td></td>
</tr>
<tr>
<td>24</td>
<td>Does your problem interfere with your job or household responsibilities?</td>
<td>F</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>Does bending over increase your problem?</td>
<td>P</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Total:  **X** = **4**  **X** = **0**  **X** = **2**

**TOTAL**

P _______ E _______ F _______

100-70= severe perception of having a handicap,  69-40= moderate perception of handicap,  39-0= low perception of handicap
Medications

Table 3: Medications with Potential Dizziness Side Effects

<table>
<thead>
<tr>
<th>Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stimulants for fatigue</td>
</tr>
<tr>
<td>NSAIDs for headache</td>
</tr>
<tr>
<td>Abortive agents for migraine or migraine-like headaches</td>
</tr>
<tr>
<td>Prophylactic headache agents</td>
</tr>
<tr>
<td>Anti-hypertensives</td>
</tr>
<tr>
<td>Antidepressants</td>
</tr>
<tr>
<td>Anti-epileptic medications</td>
</tr>
<tr>
<td>Sedative-hypnotics</td>
</tr>
<tr>
<td>Sleep medications</td>
</tr>
<tr>
<td>Analgesics</td>
</tr>
<tr>
<td>Psychotropic medications</td>
</tr>
<tr>
<td>Anxiolytics</td>
</tr>
</tbody>
</table>

*Note this is not an all-inclusive list.*
Nystagmus

- Named by fast phase
- Peripheral nystagmus:
  - fast=away from lesion
  - always to same side no matter where gaze
- Central nystagmus:
  - Changes directions

+ Dix Hallpike
PT Evaluation\textsuperscript{1,4,7}

- Eye movement- “H”
  - Smooth pursuits
  - Extra ocular eye movement
  - End range nystagmus
- Convergence
- Saccades
- VOR
- VOR cancellation
- Head thrust
Head Thrust Test$^{1,4,7}$

- Tests high frequency VOR
- Normal: Pts gaze should remain fixed on examiner’s nose
- Abnormal:
  - Hypoactive: corrective saccade in direction opposite head thrust=diminished ipsi VOR
  - Hyperactive: corrective saccade in direction of head thrust=central vestibular dysfunction
- Sensitivity is maximized when:
  - Unpredictable head thrusts are performed
  - Velocity >180deg/sec
Peripheral or Central?*

<table>
<thead>
<tr>
<th>Feature</th>
<th>Peripheral</th>
<th>Central</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disease of vestibular origin</td>
<td>Disease of the brainstem</td>
<td></td>
</tr>
<tr>
<td>Rotary nystagmus</td>
<td>Pure horizontal, vertical</td>
<td></td>
</tr>
<tr>
<td>Direction</td>
<td>Decreased innervation-slow component towards</td>
<td>Direction of nystagmus may change with gaze</td>
</tr>
<tr>
<td></td>
<td>affected ear</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Increased innervation-fast component toward</td>
<td>Lesion contralateral to fast component</td>
</tr>
<tr>
<td></td>
<td>affected ear</td>
<td></td>
</tr>
<tr>
<td>Visual fixation</td>
<td>Inhibits nystagmus</td>
<td>No inhibition</td>
</tr>
<tr>
<td>Severity of vertigo</td>
<td>Severe</td>
<td>Mild</td>
</tr>
<tr>
<td>Induced by head movements</td>
<td>Often</td>
<td>Rare</td>
</tr>
<tr>
<td>Associated eye movement</td>
<td>None</td>
<td>Pursuit or saccadic defects</td>
</tr>
<tr>
<td>movement deficits</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other findings</td>
<td>Hearing loss, tinnitus</td>
<td>CNS involvement</td>
</tr>
</tbody>
</table>

*References: [8]
Balance Assessment$^{1,4}$

- Rhomberg/Sharpened Rhomberg
- Functional Reach
- Berg Balance Scale
- Tinetti Balance and Gait Assessment
- Timed “Up and Go” test
- Dynamic Gait Index
- Physical Performance Test
- Clinical Test of Sensory Interaction in Balance (CTSIB)
- Balance Master

Others to consider:
- Gait speed
- 5x STS or 30sec STS
- TUG
- Functional Reach
Are we there yet?

- Anatomy and physiology
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Alternative causes of positional dizziness/nystagmus

- Migrainous positional vertigo
- Orthostatic hypotension
- Peripheral vestibular hypofunction
- Phobia

- MS
- Tumor or CVA near cerebellar vermis
- Superior canal dehiscence
- Vestibular Paroxysmia/vascular compression of 8th nerve
Benign Paroxysmal Positional Vertigo $^{4,9,10}$

- Common Complaints:
  - Rolling
  - Reaching to floor, ceiling or top shelf
  - Washing hair
  - Working under car
  - Changing lightbulb
  - Dental chair
  - Diagnostic procedures involving head position

### Diagnostic criteria for posterior canal BPPV

<table>
<thead>
<tr>
<th>History</th>
<th>Physical examination</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient reports repeated episodes of vertigo with changes in head position.</td>
<td>Each of the following criteria are fulfilled:</td>
</tr>
<tr>
<td>• Vertigo associated with nystagmus is provoked by the Dix-Hallpike test.</td>
<td>• There is a latency period between the completion of the Dix-Hallpike test and the onset of vertigo and nystagmus.</td>
</tr>
</tbody>
</table>
| &bullet; The provoked vertigo and nystagmus increase and then resolve within a time period of 60 seconds from onset of nystagmus. | }
<table>
<thead>
<tr>
<th>Disorder</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>Otologic disorders</td>
<td></td>
</tr>
<tr>
<td>Ménière disease</td>
<td>Vertigo lasting hours, decline in sensorineural hearing, tinnitus</td>
</tr>
<tr>
<td>Vestibular neuritis or labyrinthitis</td>
<td>Gradual onset of vertigo lasting days to weeks, present at rest</td>
</tr>
<tr>
<td>Neurologic disorders</td>
<td></td>
</tr>
<tr>
<td>Migraine-associated dizziness</td>
<td>Migrainous headache, photophobia, phonophobia</td>
</tr>
<tr>
<td>Vertebrobasilar insufficiency</td>
<td>Vertigo lasting &lt;30 s, nystagmus does not fatigue</td>
</tr>
<tr>
<td>Other</td>
<td></td>
</tr>
<tr>
<td>Cervicogenic vertigo</td>
<td>Vertigo with head movement relative to body rather than gravity</td>
</tr>
<tr>
<td>Postural hypotension</td>
<td>Vertigo with transitioning from supine to sit or sit to stand</td>
</tr>
</tbody>
</table>
Cupulolithiasis$^{4,9,10}$

- Otoconia adhere to cupula of affected semicircular canal
- Canal becomes gravity sensitive (not normal fx)
- Characteristics:
  - Immediate onset vertigo and nystagmus
  - Sx duration: long lasting, gradually decays over a period of minutes
Canalithiasis$^{4,9,10}$

- Free floating otoconia within the semicircular canal = abnormal endolymphatic flow in affected canal
- Characteristics:
  - Latency range: 1-40sec
  - Nystagmus and vertigo following latency (5-45sec)
  - Reversal of nystagmus
  - Temporarily fatigues with repetition
Testing Maneuvers: Posterior BPPV

- Dix Hallpike$^{4,9,10}$
- Sidelying$^{11}$
Eye movements for BPPV

• Posterior Canal BPPV- Canalithiasis
  – Torsion ipsi to the ear down and upbeat

• Horizontal Canal BPPV- Canalithiasis
  – Horizontal geotrophic (toward the ground)

• Horizontal Canal BPPV- Cupulolithiasis
  – Horizontal ageotrophic (away from the ground)

• Anterior Canal BPPV (rare)- Canalith or Cupulo
  – Torsion to the affected side and downbeat
Treatment for BPPV: Eply’s$^{4, 9, 10, 12}$
Post Maneuver Instructions

• Sleep in Recliner
  – Slightly elevate head end of bed: wedge/extra pillow
  – Sleep on unaffected side to reduce recurrence (shingeno 2012)
• Education: It can reoccur so teach Pt how to self-diagnose
Are we there yet?

- Anatomy and physiology
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- PT exam
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Gaze Stabilization Exercises\textsuperscript{4,7}

\textbf{VOR x1 & x2}

Figure 2A: Look straight ahead.

Figure 2B: Turn your head 45 degrees towards the right.

Figure 2C: Turn your head 45 degrees towards the left.

Note: Business card should be positioned at eye level.

\textcopyright{} T.C. Hain, 2002
## Table 1

### Exercise Progression

<table>
<thead>
<tr>
<th>Gaze-Stabilization Exercises</th>
<th>Week</th>
<th>Habituation Exercises</th>
</tr>
</thead>
<tbody>
<tr>
<td>Horizontal and vertical x1 viewing exercise with near target, 1 minute duration, sitting</td>
<td>1</td>
<td>Large amplitude, rapid cervical rotation (horizontal or vertical), each set of exercise consisted of 5 complete movements (cycles) and the individual performed 3 sets, sitting</td>
</tr>
<tr>
<td>Horizontal and vertical x1 viewing exercise with near target, 2 minute duration, sitting</td>
<td>2</td>
<td>Large amplitude, rapid horizontal cervical rotation (seated) and standing pivots, or large amplitude, rapid vertical cervical rotation (seated) and seated trunk flexion-extension, 3 sets of 5 cycles</td>
</tr>
<tr>
<td>Horizontal and vertical x1 viewing</td>
<td>3</td>
<td>Large amplitude, rapid horizontal</td>
</tr>
</tbody>
</table>

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13
Balance Exercises

tandem walking

double leg balance, arms crossed

2 feet dynodisk arms crossed

single leg foam pad or pillow

single leg balance ball toss
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  – Perform basic PT exam for Pt with dizziness
  – Determine if a Pt has BPPV and utilize the Eply maneuver
  – Prescribe vestibular rehabilitation including adaptation, habituation exercises
Yes! We’re There! Any Questions?!
References