Vestibular Rehabilitation: Solutions to Common Dysfunction

Nicole Prieto-Lewis, MSPT
Dianna Saunders, MS, PT
Gait and Balance Clinic
Gainesville VAMC

Topics
- Defining dizziness?
- The Dizziness History
  Is this vestibular? (differential diagnosis)
  When to refer to MD?
- The Clinical Exam
  Central Screening
  Testing for BPPV
  Testing VOR
- Treatment
- Lab sessions

“Dizziness Complaint”
- Dizziness/ Imbalance is the #1 reason that an elderly person consults a doctor
- BPPV accounts for 20-50% of vertigo complaints in those over 65

History of Dizziness
- Can be complex, as the complaint of “dizziness” can be a very vague symptom
- Key items for a good history:
  - Timing, Symptoms, Conditions
- Most important part of exam

“Dizziness Complaint”
- In the U.S., the primary complaint of “dizziness” results in nearly 7 million clinic visits per year
- Vestibular disorders account for approximately 85% of these visits
- 90% of vertigo complaints in the over 65 crowd are due to peripheral vestibular impairments

Timing
- How long have you been dizzy?
  - Is it an acute onset vs. chronic
  - Did event occur that immediately precluded dizziness
- Frequency of Dizziness:
  - Is it constant (truly) or episodic
  - Do symptoms last seconds, minutes, hours or days?
Symptoms
- What is meant by “dizziness”?  
  - Helps to distinguish between vertigo vs. lightheaded
- Ask about related symptoms  
  - nausea, hearing tinnitus, headache, balance problems, etc.
- Is there a true loss of consciousness?  
  - if yes refer back to MD

Non-Vestibular Dizziness
Anxiety Disorders/Panic Disorders
- Generalized Anxiety: persistent unrealistic worry with motor tension, autonomic hyperactivity, apprehension for greater than 6 months
- Panic Attack: Discrete spells of intense fear or discomfort that develops abruptly and peaks in 10 minutes

Circumstance
- What brings on your symptoms?  
- What makes the dizziness worse?  
- Tools such as the Dizziness Handicap Inventory (DHI) may be useful  
- Grade dizziness on a scale of 0-10.

Orthostatic Hypotension
- Another cause of positional “dizziness”  
- May be the only cause of positional dizziness or may be acting in conjunction with BPPV  
- Requires measurement of blood pressure and heart rate, after:  
  - at least 10 minutes supine rest
  - immediately standing (not sitting)
  - standing for 3 minutes

Common Causes of “Dizziness”

<table>
<thead>
<tr>
<th>System</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peripheral Vestibular (otologic)</td>
<td>56</td>
</tr>
<tr>
<td>Brainstem/Cerebellum (central)</td>
<td>22</td>
</tr>
<tr>
<td>Proprioceptive (peripheral neuropathy)</td>
<td>7</td>
</tr>
<tr>
<td>Visual</td>
<td>1</td>
</tr>
<tr>
<td>Psychological</td>
<td>3</td>
</tr>
<tr>
<td>Unknown</td>
<td>14</td>
</tr>
</tbody>
</table>

Cervicogenic Dizziness
- Controversial diagnosis  
- Dizziness resulting from disruption or alterations in cervical afferent signals to vestibular nuclei (i.e. cervical proprioceptors)  
- Suspected after cervical trauma, whiplash injuries.
- Diagnosis made by exclusion: all other dx ruled out first + clinical tests
Secondary Problems

- Cervical Dysfunction – loss of ROM, tension headaches, pain
- Deconditioning
- Anxiety
- Loss of confidence/ social withdrawal

Questions to Ponder

- Is this vertigo?
- Does this problem sound vestibular?
- Could this be BPPV (Benign Paroxysmal Positional Vertigo)?
- Should I refer to an MD?

Handicap: Inability to perform ADL/IADL’s

- Bathing and showering
- Shopping
- Cleaning/ Household Chores

Common Vestibular Complaints

- Vertigo or Dizziness
- Imbalance
- Blurred vision
- Nausea
- Hearing changes

Dizziness Questionnaire

Refer to handout

Vertigo

- The Illusion of movement, of self or the world moving (can be rotational or linear)
- Often described as a spinning sensation
- Can be due to loss of function (vestibular neuronitis) or mechanical problems (BPPV)
- common in peripheral lesions, more rare in central lesions
Peripheral vs. Central Vertigo

<table>
<thead>
<tr>
<th></th>
<th>Peripheral</th>
<th>Central</th>
</tr>
</thead>
<tbody>
<tr>
<td>Onset</td>
<td>Sudden</td>
<td>Slow, gradual</td>
</tr>
<tr>
<td>Intensity</td>
<td>Severe</td>
<td>Ill defined</td>
</tr>
<tr>
<td>Duration</td>
<td>Paroxysmal</td>
<td>Constant</td>
</tr>
<tr>
<td>Nausea/Diaphoresis</td>
<td>Frequent</td>
<td>Infrequent</td>
</tr>
<tr>
<td>CNS signs</td>
<td>Absent</td>
<td>Usually present</td>
</tr>
<tr>
<td>Tinnitus/hearing loss</td>
<td>Can be present</td>
<td>Absent</td>
</tr>
<tr>
<td>Nystagmus</td>
<td>Torsional/horizontal</td>
<td>Vertical</td>
</tr>
<tr>
<td>Nystagmus</td>
<td>Fatigable</td>
<td>Non-fatigable</td>
</tr>
</tbody>
</table>

Dysequilibrium
- Imbalance or unsteadiness while standing or walking
  - can be due to many factors perceptual, sensory and/or motor dysfunction
- Commonly mistaken for or referred to as “dizziness”

Watch out for Atypical Complaints
- “I’m feeling like I’m going to pass out”
- “I’m not dizzy just nauseated when I lie down on my left side”
- “I feel swimmy headed…heavy headed…lightheaded…hung over”
- “I get this pressure in the back of my head”
- “I fall when I try to get up”

Oscillopsia
- Blurred vision
  - happens when having nystagmus or with head motions (retinal slip) due to severely impaired VOR (i.e. bilateral vestibular loss)
- Oscillopsia is a subjective illusion of visual motion (occurs with eyes open not closed)

Nausea and Vomiting
- Usually accompanies vertigo
- Due to stimulation of the medulla (autonomic centers)
- Usually mild in peripheral lesions and in proportion to the degree of vertigo (symptoms vary in central lesions)

Motion Sensitivity
- Abnormal or increased sensitivity to motion (head/body or visual motion) leading to vertigo, “dizziness”, nausea
- Common after acute peripheral lesions (may persist)
- Common in central lesions
Most Common Vestibular Disorder

**BPPV**

A Mechanical Problem

**Benign Paroxysmal Positional Vertigo**

- The most common cause of vertigo due to a peripheral disorder

Dissecting BPPV

- **Positional**
  - occurs with change in head position, such as:
    - Lying down
    - Rolling over
    - Bending over
    - Looking up or down
    - Turning head right or left

- **Vertigo**
  - an illusion of motion
  - “The room is spinning”
  - Many Other Descriptions
    - Rocking
    - Tilting
    - Somersaulting
    - Nausea
    - Imbalance or falling
    - Riding an elevator down

Dissecting BPPV

- **Benign**
  - having no significant effect
  - yet for those who suffer from BPPV it can be severe, frightening and disabling

- **Paroxysmal**
  - a sudden attack of symptoms
  - episodes of vertigo due to BPPV tend to be very brief, <60 seconds

Clinical Presentation of BPPV

- Classically, symptoms are:
  - Sudden in onset
  - Typically brief but intense, lasting only seconds
  - Triggered by rapid head movement
  - Often associated with nausea, possibly vomiting
  - Often result in self limiting activities
Clinical Presentation of BPPV

- Commonly described triggers include:
  - lying down or rolling in bed, sitting up from supine, bending over, turning head and looking up
  - Sense of light headedness and imbalance may persist after vertigo

- Between attacks patient may have no symptoms, if there is no other vestibular pathology

- Attacks often occur in clusters that may take place over several days to months

Benign Paroxysmal Positional Vertigo

**CANALITHIASIS** (most common)

- Degenerative debris from the utricle breaks off and is **free-floating** in the SCC
- Debris moves to the dependent part of the canal, moves the endolymph and causes cupular deflection

**CUPULOLITHIASIS**

- Cellular debris adheres to the cupula of the posterior (or other canal)
- Makes the cupula “heavy”, causing cupular deflection and persistent vertigo, in certain head positions.

Mechanism of BPPV

Vertigo/Nystagmus

- Latency to onset 1-40 seconds
- Disappears within 60 seconds

Posterior canal BPPV is by far the most common variant
**Physiology**

- In a normal situation:
  - head turns right → endolymph moves → SCC receptors fire → head is turning right
  - head stops → endolymph stops → SCC receptors stop → head has stopped

**Pathophysiology of BPPV**

- stop turning head → otoliths keep moving → endolymph keeps moving → receptors keep firing → head STILL moving
  - eyes → head is NOT moving
  - brain → room MUST be spinning

**Variations of BPPV**

- Posterior Canal
- Lateral Canal
  - atypical, accounting for about 3-12 percent
- Anterior Canal
  - rare, accounting for only about 2%

**Risk Factors for BPPV**

- Increased age (idiopathic)
- Head trauma (young)
- Preceding viral infection
- Post surgical

**Dix-Hallpike Test**

**Upbeating Torsional Nystagmus**
Upbeating Torsional Nystagmus

Downbeating Torsional Nystagmus

“So, You’ve Got Rocks in Your Head”

Horizontal Nystagmus

Treatment of BPPV
**Canalith Repositioning Techniques**

- Easy to perform
- High success rate in one treatment
- Traditionally post-maneuver instructions were given, latest research suggests not necessary.

**Canalith Repositioning Techniques**

- A specific maneuvers used to treat BPPV by moving the debris back into the utricle by placing the patient head through a series of positions.
- Different maneuvers exist for different canals
- Different maneuvers depending on type of BPPV: canalithiasis vs cupulolithiasis.

**Canalith Repositioning Maneuver**

**Canalith Repositioning Treatment**

- known vertebrobasilar insufficiency
- severe cervical / lumbar disease or trauma
- history of rheumatoid arthritis
- unstable heart disease
- high grade carotid stenosis
- active neurological signs (TIA/stroke)

**Other Treatment Options**

- Semont (Liberatory)
- Liberatory for Horizontal Canal (Canalithiasis)
- Modified Semont for Horizontal Canal (Cupulolithiasis)
Common Dysfunction # 2

VESTIBULAR HYPOFUNCTION

Peripheral Lesions

Loss of Function
1) Acute- unilateral (UVL)
   bilateral (BVL)
2) Progressive- (UVL)
   (BVL)
3) Episodic

Specific Vestibular Lesions
- 2 Main Divisions: Peripheral and Central
- Peripheral: membranous labyrinth and vestibular nerve.
- Central: brainstem (vestibular nuclei), cerebellum and vestibular cortex

Peripheral vs Central

Peripheral Vestibular
- BPPV
- Meniere’s disease
- Ototoxicity
- Vestibular neuronitis
- Acoustic neuroma

Central Vestibular
- Migraine
- CVA/TIA
- TBI
- Multiple sclerosis

General Characteristics
- PERIPHERAL: nystagmus, vertigo, n&v (mild to mod), dysequilibrium (acutely). After several weeks: dysequilibrium, motion sensitivity, oscillopsia with fast head motion.
- CENTRAL: may/may not have vertigo, nystagmus, lateropulsion/tilt, oculomotor abnormalities, motion sensitivity (may be severe)

Peripheral Lesions (Unilateral)

ACUTE LOSS OF FUNCTION (UVL)

Vestibular neuritis/labyrinthitis: infection (viral or bacterial) resulting in vertigo, N&V, severe symptoms last 3-4 days
- gradual resolution of symptoms (several weeks) May c/o dizziness/vertigo with head movement, dysequilibrium, motion sensitivity
Peripheral Lesion (Bilateral)

**ACUTE LOSS OF FUNCTION (BVL)**

**Bilateral Vestibular Loss (Ototoxicity):**
Complete loss of vestibular function, complete destruction of hair cells due to treatment with certain antibiotics that are ototoxic. Ex: gentamicin, streptomycin. No vertigo, but severe dysequilibrium, oscillopsia, gait dysfunction.

Peripheral Lesions (Unilateral)

**PROGRESSIVE LOSS**

**Acoustic Neuroma:** progressive unilateral hearing loss, tinnitus and mild dysequilibrium (vertigo in <20% of cases)
- Usually benign tumor (schwann cells) arising from vestibular nerve. If not discovered, may encroach on the brainstem/cerebellum (central lesion).

**Peripheral Lesions (Unilateral)**

**EPISODIC VESTIBULAR LOSS**

- **Meniere's Disease:** spells of aural fullness, fluctuating hearing loss, tinnitus and vertigo lasting minutes to hours.
- Increased volume of endolymph, rupture of membranes separating endolymph from perilymph.
- Patient's are usually asymptomatic between spells, in later stages may present with UVL.

**Perilymphatic Fistula:** spells of vertigo, dysequilibrium and hearing loss brought on by straining/exertion and loud noises.
- Associated with barotrauma, head trauma. May have residual dysequilibrium and motion sensitivity.
- Controversial diagnosis: leak of perilymph into the middle ear.

Peripheral Lesions (Bilateral)

**PROGRESSIVE LOSS**

- **Idiopathic:** Unknown cause
- **Sequential unilateral loss:** had UVL in the past and now have the other ear affected.
  Progressive dysequilibrium and severe oscillopsia, gait dysfunction.

Peripheral Lesions (Unilateral)

**EPISODIC VESTIBULAR LOSS**

- **Perilymphatic Fistula:** spells of vertigo, dysequilibrium and hearing loss brought on by straining/exertion and loud noises.
- Associated with barotrauma, head trauma. May have residual dysequilibrium and motion sensitivity.
- Controversial diagnosis: leak of perilymph into the middle ear.

Remember

The ONLY type of episodic vertigo we can treat is BPPV.
Another Look at Nystagmus

**Pathological Nystagmus**
- Can appear “spontaneously” with a sudden loss of vestibular activity from one side.
- Can be induced in patients with gaze (gaze-evoked) or head position (positional nystagmus).

**Central Nystagmus**
- Persists, not increased with visual fixation blocked (Frenzel lenses on)
- Often vertical (persistent down beating)
- If positional will not fatigue

**Horizontal Nystagmus**

**Properties of Peripheral Vestibular Nystagmus**
- Increases with visual fixation blocked (Frenzel lenses)
- Beats away from the lesion (R lesion = L beating nystagmus), increases when looking away from lesion side. 3) Disappears within 24 hours

**Pathological Nystagmus**
- Named by the quick phase (although the vestibular system drives the slow phase of nystagmus)
- Can be upbeating, downbeating, right beating, left beating, torsional etc…
- EX: right vestibular lesion
- seen in both peripheral and central lesions

**Properties of Central Vestibular Nystagmus**
- Persists, not increased with visual fixation blocked (Frenzel lenses on)
- Often vertical (persistent down beating)
- If positional will not fatigue
Upbeating Nystagmus

Downbeating Nystagmus

VOR Impairment

- Oscillopsia in some patients can be attributed to a failure of the vestibulo-ocular reflex (VOR) to compensate for head movements.
- Without the stabilizing effect of the VOR, head perturbations can result in retinal slip, which significantly alters visual acuity.

How The World Would Appear Without VOR Function

VOR Testing

2 Quick Tests for VOR:

- **Head Thrust**: Positive test (+) is a refixation of eyes after head thrust (corrective saccade). Indicates decreased VOR on the side that this occurs.

DVA (Dynamic Visual Acuity) Test:

- Tests the difference between static and dynamic visual acuity.
- + test is when a person drops visual acuity with head moving at 2 Hz (2 cycles per second)
- 2-3 lines (unilateral vestibular deficit)
- 5 lines or more (bilateral vestibular deficit)
Arriving at a PT Diagnosis

Diagnosis by Impairment
- VOR hypofunction: gaze stabilization problem
- Mechanical Problem (BPPV)
- Balance Deficit

Treatment

Components of Vestibular Rehabilitation
Common Peripheral Vestibular Disorders
1) Canalith repositioning- for BPPV
2) Vestibular Adaptation- for impaired VOR
3) Compensation/ Substitution- for bilateral loss
4) Balance Training- for balance deficit

Adaptation

- Stimulus to induce adaptation is called “retinal slip.”
- Cerebellum: important role in adaptation.
- Detects the error signal (retinal slip) and adjusts the gain of the VOR.

Adaptation

- Adaptation is context specific: speed dependent and position dependent.
- Research indicates that it takes at least 1.5 minutes of movement with sufficient head speed in order for adaptation exercises to work.
- Example: VORX1 VORX2

Indications for Adaptation Exercise

- Indications
  1) + complaints of blurred vision/oscillopia
  2) + DVA test
  3) + head thrust test
  4) + motion sensitivity to horizontal/vertical head rotation.
  5) UVL>BVL>CENTRAL

Adaptation

ADAPTATION
- Def: Long-term change within neurons in response to an input.
- Exercises that improve gaze stabilization by improving the VOR (VOR Gain)
- Research shows that after a unilateral vestibular loss there is some limited cellular recovery but adaptation must occur.
Contraindications for Adaptation Exercise

1) Poor vision/ blindness

2) Severe cervical dysfunction or c/o pain despite modifications.

Compensation/Substitution Exercises

- Def: promoting the use of an alternative strategy or compensation for deficits that are irreversible.
- Indicated in severe bilateral loss with no remaining vestibular function.
- Exercises to promote use of cervical ocular reflexes, eye and head movements, imaginary targets.
- Balance exercises/Education

Expected Outcomes: Bilateral Vestibular Lesions

- Expect a considerable amount of improvement but will recover more slowly.
- Will always have some deficits: slower gait, risk for falls.
- Bad prognosis if other sensory systems are affected (vision, somatosensory)

Expected Outcomes: Unilateral Vestibular Lesions

- 90% of patient rate themselves as no disability or mild disability.
- May have persistent gaze stability problem (VOR to rapid head movements)
- Expect near normal balance and gait.
- Minor residual symptoms, full recovery 3-6 months.

Expected Outcomes: Central Lesions

- Variable results with vestibular rehab depending on areas involved.
- Longer recovery time

Expected Outcomes: Bilateral Vestibular Lesions

- Expect a considerable amount of improvement but will recover more slowly.
- Will always have some deficits: slower gait, risk for falls.
- Bad prognosis if other sensory systems are affected (vision, somatosensory)
Essential Components of Clinical Exam

- DIZZINESS HISTORY
- CENTRAL SCREENING
- RULE OUT BPPV
- TEST FOR VOR FUNCTION

Clinical Exam

Occulomotor Exam:
- Observe for spontaneous nystagmus, gaze holding nystagmus.
- PRACTICE

LAB # 1

Occulomotor Exam/ Central Screening
- Observe for nystagmus
- Smooth pursuit test
- Saccade Test
- VBI Test

Smooth Pursuit

- Smooth Pursuit: Ask patient to follow your finger with their eyes.
  *Abnormal test would be saccadic eye movements (non-fluid jerky eye movements, eyes trying to catch up)*

Occulomotor Exam (Central Screening Tests)

- Screening for central vestibular problems such as lesions in the:
  - Cerebellum
  - Parieto-occipital cortex
  - Pons
  - Smooth Pursuit
  - Saccade Test

Saccade Test

- Hold target about 9-12 inches apart
- Vertical, horizontal, and diagonal
- Note if patient overshoots or undershoots the target and requires greater than 2 eye movements to reach target.
Video #1
- NORMAL SMOOTH PURSUIT
- ABNORMAL SMOOTH PURSUIT: Indicates a possible central lesion (cerebellum, brainstem, Parkinson’s disease)

Perform VBI Test/ cervical ROM
- Active then passive cervical ROM test
- Quadrant testing
- + Test for VBI would be dizziness, nystagmus, dysarthria, blurred vision.
- Liability Issues.

Normal Smooth Pursuit

LAB # 2
BPPV TESTING
- Dix - Hallpike
- Roll Test
- Modified-Hallpike (Semont position)

Saccadic Intrusions and Abnormal Pursuit

Hallpike-Dix Test for BPPV
- Can be done with or without Frenzel Lenses
- Patient long sitting on mat, head turned 45° toward test ear
- Patient quickly moved to supine with head hanging 20-30 degrees in cervical extension
- Positive test usually includes nystagmus and patient’s report of vertigo
Dix-Hallpike

- Patient is lying on mat with head flexed 20-30 degrees
- Patient turns head 45 degrees to the right while maintaining flexion
- Position is held for at least 30 seconds
- Same is repeated with head turned to the left
- Positive test presents with horizontal nystagmus (usually bilateral) and patient’s report of dizziness

Roll Test

- Patient is lying on mat with head flexed 20-30 degrees
- Patient turns head 45 degrees to the right while maintaining flexion
- Position is held for at least 30 seconds
- Same is repeated with head turned to the left
- Positive test presents with horizontal nystagmus (usually bilateral) and patient’s report of dizziness

VIDEOS

- Name that nystagmus?
  - Upbeating or downbeating
  - right or left horizontal
  - geotropic/ageotropic
  - direction of torsion

Video Demonstration

- Positive Hallpike-Dix
  - Upbeating or downbeating nystagmus with torsional
- Positive Roll Test
  - Horizontal nystagmus – geotropic vs. ageotropic
Downbeating Torsional Nystagmus

LAB # 2
BPPV TREATMENT
• Posterior / Anterior Canals
  • Canalith Repositioning Maneuver (Epley)
  • Semont Maneuvers
• Horizontal Canal
  • Gufoni Maneuvers

Horizontal Nystagmus

Canalith Repositioning Treatment

Demonstrations of Treatment Techniques
• Posterior / Anterior Canals
  • Canalith Repositioning Maneuver (Epley)
  • Semont Maneuvers
• Horizontal Canal
  • Gufoni Maneuvers
Lab # 4

**VOR TESTING**

Head Thrust Test

Dynamic Visual Acuity Test (DVA Test)

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**Practice Head Thrust**

- Slow then Fast
- By now you should have a good feel for patient’s cervical ROM and any limitations and pain that exists. BE CAREFUL!

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**VOR Testing**

2 Quick TESTS for VOR:

- **Head Thrust:** Positive test(+) is a refixation of eyes after head thrust (corrective saccade). Indicates decreased VOR on the side that this occurs.

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**Abnormal Head Thrust**

Head Impulse Test in Unilateral Vestibular Loss

(A) Peak Head Velocity 100°/s

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**VOR Testing**

- **DVA (Dynamic Visual Acuity) Test:**
  - tests the difference between static and dynamic visual acuity.
  - + test is when a person drops visual acuity with head moving at 2 Hz (2 cycles per second)
  - 2-3 lines (unilateral vestibular deficit)
  - 5 lines or more (bilateral vestibular deficit)
LAB #5
- VOR Adaptation : VOR x 1, VOR x2
- Compensation/Substitution Exercises
- Balance training

Balance Screening
- Berg Balance Scale
- Dynamic Gait Index
- Gait observation
- CTSIB (Clinical Test for Sensory Interaction and Balance) “foam and dome”

Example of Adaptation Exercises
- VOR x1
- VOR x 2
- Progression Hints:
  - Increase time FIRST (up to 90 seconds) then increase speed.
  - Sitting - standing - during balance activities
  - Plain to busy backgrounds

Case Studies

Practice VOR Adaptation
- VOR x 1
- VOR x 2

BPPV Case 1
- Mr. Smith 56 yo male
- PMHx: HTN, CABGx1, diabetes, CVA 15 yrs ago
- Patient presents to clinic with c/o episodic “dizziness” for past week
- Last Sunday, patient got out of bed and the room started spinning
- Since then he c/o lightheadedness, off balance, and “dizziness” when he gets up, turns or tries to work under his truck
BPPV Case 1
- Based on simple hx, what do you suspect?
- Mr. Smith is not orthostatic, no central signs noted, normal smooth pursuit, negative head thrust
- Dix-Hallike: left side: no nystagmus or sx complaint; right side: upbeat, right torsional nystagmus observed, significant c/o dizziness from patient

BPPV Case 1
- Diagnosis: BPPV, right posterior canal
- Mr. Smith was treated with Canalith Repositioning Maneuver
- Re-test right Hallpike: Mr. Smith reprtos increase symptom complaint, extremely vertiginous, horizontal nystagmus noted
- Now what?

BPPV Case 2
- She denies sense of spinning, but reports nausea when she’s lightheaded, and occasionally falls
- BERG: 41/56 DGI: 18/2
- Orthostatic measures: BP HR
  - supine 118/69 81
  - standing 92/58 90
  - after 3 minutes 90/52 92

BPPV Case 2
- Is it BPPV?
- Dix-Hallpike
  - Right side: no nystagmus observed, no c/o vertigo
  - Left side: no nystagmus observed, no vertigo, but c/o nausea
- Should you treat for BPPV or not? Or is it just orthostasis?

Case Study #3
- 56 y/o wm with hx of sudden onset of vertigo with severe nausea and vomiting lasting 3 days. Symptoms gradually resolved but still dizzy( constant) and off balance.
- What is history telling us?
Case Study # 3
- What tests would you perform?
- Test Results:
  - What treatments would you choose?

Case Study # 4
- What tests should you perform?
- Test Results:
  - What treatment would be a priority for this patient?
  - Sample goals (STG & LTG)
  - Billing codes

Case Study # 4
- 82 y/o wm with hx of DM and peripheral neuropathy with progressive imbalance and falls. No dizziness or vertigo. Afraid to walk, deconditioned.
- What does the history imply?

Thank You!

DICUSSION
Vestibular Rehabilitation: Solutions to Common Dysfunctions

FPTA Annual Conference 2011
Nicole Prieto-Lewis MSPT, Dianna Saunders MS, PT, Jodi Liphart PT, DHSc, NCS, Kathy Swanick PT, DPT, OCS

What’s is like to be dizzy

www.vestibular.org VEDA

Topics of Discussion

- Anatomy, Pathophysiology and Function of the Vestibular System
- Vestibular Complaints
- Vestibular Examination and treatment for BPPV and Hypofunction
- Interpretation of Nystagmus
- Case Studies
Functions of the Vestibular System

- Gaze stabilization
- Postural stability
- Orientation in space

- The vestibular system is both a sensory and motor system

Vestibular System: One Component of the Balance System

- Sensation and perception of position and motion
- Role in orienting the head and body to vertical
- Role in controlling position of the body’s COM
- Role in stabilizing head during movement

Role of the Vestibular System

- 4 important roles of vestibular system as it relates to postural control/Balance:
  - Sensation and perception of position and motion
  - Role in orienting the head and body to vertical
  - Role in controlling position of the body’s COM
  - Role in stabilizing head during movement
Structures of the Vestibular System

- Peripheral Sensory Apparatus (SCC, Otoliths)
- Central Processor (vestibular nuclei)
- Mechanisms for Motor Output (VOR, VSR)

Peripheral Sensory Apparatus

- 3 Semicircular Canals
  - Bony Labyrinth (filled with perilymph)
  - Membranous Labyrinth (filled with endolymph)
- 2 Otolith Organs
  - Saccule (linear acceleration)
  - Utricle (horizontal linear acceleration)
- Hair Cells
Semicircular Canals

- Detect rotational movement (angular velocity)
- Most sensitive to faster head movements
- Canals are oriented 90 degrees to each other
- The horizontal canal is tilted up 30 degrees
- “Push-Pull” relationship
- The Cupula (gelatinous “sail-like” structure) is found in the ampulla of each SCC
- Hair cells stick up from the Crista ampullaris into the Cupula

Canal Orientation
Semicircular Canals: Push/Pull

• The canals function as coplanar pairs:
  – Right and Left Lateral (horizontal) canals
  – Left Anterior and Right Posterior
  – Left Posterior and Right Anterior
• Similar planes to the extraocular muscles
• Pairing—provides sensory redundancy

1997 Encyclopaedia Brittanica, Inc

Herdman, S. Vestibular Rehabilitation FA Davis Co. 1994 p.6
Head turn Left: 
excites left, inhibits right

Semicircular Canals

- Each side sense rotation
- Excite the side you turn towards as you inhibit the other side ("push-pull")
- Example: excite the left horizontal canal and inhibit the right horizontal canal
- See with the head thrust test - activation of VOR (fast reflex 10 ms)
Otoliths

- Respond to linear acceleration/gravity
- Hair cells arise from the Macula and project up into the otolithic membrane
- **Saccule**: vertically oriented, responds to up/down head translations
- **Utricle**: horizontally oriented, responds to fore/aft tilts
- Curved structures so they respond to linear acceleration in any direction

Otoconia

http://www.ncbi.nlm.nih.gov/books/NBK10792/
Central Processor

- Vestibular Nuclear Complex
- Cerebellum
- Lots of connections!! Vestibular sensory info is processed with somatosensory and visual input

Vestibular Nuclei

Vestibular Nuclear Complex
Mechanisms for Motor Output

- Output for the VOR
  - ocular motor nuclei
- Output for the VSR
  - Medial and Lateral vestibulospinal tracts,
    Reticulospinal tract

VOR

- Purpose: maintain stable vision while your head in moving
- The extraocular muscles are paired with the semicircular canals
- When you stimulate one canal the eye movement will be in the same plane as that canal: (move head back and to the right will stimulate the right posterior canal and the eyes depress and rotate left)
- Gain of the VOR

VSR

- Maintain/stabilize body posture
  - Medial and Lateral Vestibulospinal tracts
    - To motor neurons in the cervical and lumbar spinal cord
Cerebellum
- The adaptive processor
- Adjusts and maintains the gain of the VOR

Vascular Supply
- Labyrinth Artery: comes off AICA or Basilar
  - Branches into Anterior Vestibular Artery and Posterior Vestibular Artery
  - Anterior supplies anterior and lateral SCC and utricle
  - Posterior supplies posterior SCC, saccule and part of cochlea
Innervation

- Vestibular Nerve (CN 8)
  - 2 Branches
    - Superior division: anterior and lateral SCC and utricle
    - Inferior division: posterior SCC and saccule

Vestibular Complaints

- Dizziness
  - Vague term, many causes

  - Common symptoms of vestibular disorders: vertigo, imbalance, tilt, nausea/vomiting, hearing loss, oscillopsia

Incidence of Dizziness

- Dizziness as reason to see MD:
  - 1.3% age 45-64
  - 2.9% age 65–75
  - 3.8% age 75 and over
  - 45% due to vestibular disorders

- 1 year prevalence of dizziness as reason to see Family Practice MD for patients 65 and older was 8.3% (increased with age, women more than men) Maarsingh et al 2010
Vestibular system and aging

- Decrease in hair cells
- Decrease in vestibular neurons
- VOR gain decreases
- This results in greater retinal slip and poorer visual acuity during head movement
- Degeneration in otoconia (higher incidence of BPPV)

Other systems affected with aging

- Visual deficits:
  - Visual acuity, accommodation, smooth pursuits all decrease with age
  - Inability to adapt to dark
- Somatosensory Changes:
  - Decrease in vibration sense
  - Decrease in proprioception of feet
  - Increase LE reaction times

Older adult

- Changes in vestibular function is similar to bilateral vestibular deficit (c/o disequilibrium, gait ataxia, without vertigo
- More likely to need an assistive device
- More likely to have difficulty walking in the dark (need to increase lighting: use nightlights, flashlights)
Peripheral Vs. Central

- Vestibular Disorder can come from peripheral or central sources
- Peripheral: dysfunction of the SCC or otoliths or nerve as it travels back
- Central: dysfunction of vestibular nuclei, cerebellum or their outputs
- The signs and symptoms are different

You made it through the Anatomy!

- Summary
- Now to the "good stuff"