

# Dizziness and Balance Dysfunction in Traumatic Brain Injury

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## Objectives

- At the end of the lecture the participant will be able to:
  - Describe the anatomy and physiology of the vestibular system
  - Describe the differential diagnosis for dizziness and balance dysfunction following TBI
  - Describe the evaluation for dizziness and balance dysfunction following TBI
  - Describe treatment for common disorders following TBI

## Incidence of Dizziness in TBI

- 24-80% initial symptoms
- 20-47% at 5 years
  - Minor TBI: 20 - 32%
  - Moderate TBI: 37 - 47%
  - Severe TBI: 26%
- 23% of a brigade combat team returning from Iraq had TBI
  - 88% due to blast injuries
  - Dizziness and Balance Disorders among the top 3 complaints of service members following blast injuries
    - Dizziness 59%
    - Balance dysfunction 26%

## Prevalence of Vestibular Dysfunction in TBI

- Of 100 patients with dizziness post-TBI
  - 71% Peripheral Vestibular Dysfunction
  - 61% BPPV
  - 8% Central Vestibular Dysfunction
- Of 58 patients with dizziness post-TBI (military)
  - 28% BPPV
  - 41% Migraine-related Dizziness
  - 19% Spatial Disorientation

## Association of Dizziness and TBI

- Dizziness may be due to TBI pathology (CNS)
- Dizziness may be due to vestibular pathology due to TBI
- Dizziness may be underlying cause for TBI (falls)
- Dizziness may complicate rehabilitation for sequelae of TBI
- Dizziness may mimic cognitive impairments seen with TBI
- Cognitive impairments due to TBI may complicate vestibular rehabilitation

## Vestibular role in Postural Control

- Provides input on head movement and position
- Provides gaze stabilization
- Provides postural adjustments
  - Vestibular spinal reflexes

## Differential Diagnosis for Dizziness Associated with TBI

- Benign Paroxysmal Positional Vertigo
- Labyrinthine Concussion
- Brainstem Concussion
- Central Vestibular Dysfunction
- Cervicogenic Dizziness
- Post-traumatic Meniere's Disease
- Post-traumatic Migraine-related Vestibulopathy
- Perilymphatic Fistula
- Anxiety-related Dizziness
- Non-vestibular causes

## Benign Paroxysmal Positional Vertigo

- Most common form of dizziness
- Presentation
  - Short duration episodic vertigo during head movements
  - May also complain of imbalance, disorientation
  - Worse in am
- Pathophysiology
  - Otoconia become dislodged from utricle and either float in endolymph of semicircular canal or attach to cupula
  - This causes the semicircular canals to respond to gravity
  - Patients demonstrate characteristic nystagmus in response to head movements that has a latency of 2-15 seconds and a duration of <1 minute

## Post-traumatic BPPV

- Onset with mild TBI within a few days *Katsarkas, 1999*
- Higher incidence of bilateral involvement *Katsarkas, 1999*
- Consider checking all 3 canals on both sides before treating
- Recurrence rate of 26-30% *Nunez et al 2000; Epley 1992*
- Results in quicker relapses than non-traumatic *Gordon et al 2004*
- Requires repeated repositioning compared to those with non-traumatic BPPV *Gordon et al 2004; Del Rio et al 2004*

## Labyrinthine Concussion

- Damage to the labyrinth, with or without bony fracture
  - Membranous labyrinth very fragile and easily damaged
- Laboratory findings
  - Unilateral peripheral loss with caloric testing
  - Asymmetric sensorineural hearing loss due to damage to the cochlea
  - Rotational chair testing abnormal if compensation is not complete

## Brainstem Concussion

- Shearing on the root entry zone of the 8<sup>th</sup> cranial nerve may lead to hemorrhage or cell death in the area of the vestibular nuclei
- Signs and Symptoms
  - Dizziness/vertigo
  - Postural instability
  - May be associated with other cranial nerve damage or CNS signs
  - VOR and saccadic eye movement abnormalities
  - Implicated if compensation does not occur with labyrinthine concussion

## Central Vestibular Dysfunction

- Dysfunction of the vestibular nuclei, cerebellum and other vestibular pathways
  - Presentation
    - Depends on where lesion occurs
      - Less likely to have true vertigo
      - More likely to have constant symptoms
      - More likely to have balance dysfunction
      - More likely to have central nervous system signs

## Cervicogenic Dizziness

- A specific form of central vestibular dysfunction
- Responsible for < 1% of all cases of vestibular dizziness
- Diagnostic Criteria
  - History of neck trauma or pathology
  - Symptoms of dizziness and imbalance temporally related to neck pain or headache
  - All other causes of dizziness eliminated
- Current theory of Pathophysiology
  - Aberrant afferent information from C1- C3 causes altered perception of orientation in space

## Meniere's Disease

- Presentation
  - Episodic, usually unilateral (lasts hours to days)
    - Vertigo
    - Hearing Loss
    - Tinnitus
    - Nausea
    - Aural fullness
  - Symptoms are totally reversible early in disease, gradually progress to permanent vestibular and hearing loss
- Current theory of pathophysiology
  - Swelling, or distension, of the endolymphatic compartment of the inner ear leading to rupture of membranous labyrinth resulting in transient potassium palsy of the vestibular nerve fibers

## Migraine-related Vestibulopathy

- A specific form of central vestibular dysfunction
- Current theory of pathophysiology
  - Increased activity in the brainstem
  - Abnormalities in neurotransmitter levels
- Presentation
  - Dizziness may occur before, during, or after a migraine
  - Episodic vertigo, nausea, disorientation, space and motion intolerance associated with headache
  - Symptoms are often exacerbated by specific visual environments
  - Some patients can have migraine without headache, migraine equivalents, with dizziness instead of headaches

## Migraine-related Vestibulopathy

- Diagnostic Criteria
  - Absence of documented vestibular pathology
  - Migraine diagnosis according to the International Headache Society (IHS) Criteria
  - Intermittent vertigo or disequilibrium – at least 2 episodes
  - Accompanied by photo or phonophobia or visual aura, not necessarily headache

## Post-traumatic Migraine-Related Vestibulopathy

- Patients with post-traumatic migraine had significantly impaired neurocognitive function compared to non-migrainous headache or no headache *Mihalik et al 2005*
  - Caution should be exercised when returning to work or play

## Perilymphatic Fistula

- Abnormal communication of the inner-ear and middle-ear spaces via labyrinthine windows or a microfissure of the bony labyrinth
- Episodic vertigo
- Sensorineural hearing loss/tinnitus – may be fluctuating
- Precipitated by increased intrathoracic or intracranial pressure
- Diagnosis difficult
  - Nystagmus or dizziness with Valsalva maneuver
  - Surgical exploration

## Anxiety-related Dizziness

- 41% mild TBI report anxiety 5 years post injury
- Diagnostic Criteria
  - Dizziness is a defining or associated symptom of a psychiatric disorder
  - Dizziness is not correlated with vestibular pathology
- Vestibular abnormalities common in panic disorder and are associated with space and motion discomfort
- Common pathways between anxiety, space and motion discomfort, and perception of dizziness/vertigo

## Non-Vestibular Causes

- Orthostatic Hypotension
- Medications
- Physical deconditioning
- Musculoskeletal injuries

## Evaluation of the Patient with TBI and Dizziness



## Subjective Assessment of Dizziness

- Dizziness Handicap Inventory *Jacobson and Newman, 1990*
  - 25 item test that assess the self perceived handicap due to dizziness
    - 3 subcategories: functional, emotional, and physical
    - Scored No: 0; Sometimes: 2; Yes: 4
    - Maximum: 100
  - High test-retest reliability *Jacobson and Newman, 1990*
  - Useful in directing patient interview
    - Questions 1, 5, 11, 13, and 25 are predictive of BPPV *Whitney et al*
  - Correlates with Physical Function Measures *Whitney, Wisley et al 2004*
    - 0-30 minimal impairment
    - 31-60 moderate impairment
    - 61-100 severe impairment

## Subjective Assessment of Dizziness

- Activities-specific Balance Confidence Scale
  - 16 functional items with varying degrees of difficulty
    - Rated on scale of 0 (not confidence) to 100% (Completely confident)
  - Developed to quantify fear of falling in older adults
    - Lower scores indicate greater fear of falling *Myers et al 1998*
      - Scores < 50 indicate home bound older adult
      - Scores 50-79 indicate older adult with chronic health problems or in retirement centers
      - Scores > 80 indicate highly functioning community dwelling older adult
  - Correlates with DHI in persons with vestibular disorders *Whitney et al 1999*
  - High test-retest reliability *Myers et al 1998*

## Subjective Assessment of Dizziness

- Vestibular Disorders Activities of Daily Living Scale (VADL) *Cohen et al 2000; Cohen and Kimball 2000*
  - Developed to assess self-perceived disability in patients with vestibular impairments
  - Items include 27 activities of daily living
    - Scale rated from 1 (independent) to 10 (ceasing to participate in the activity)
    - Scored as a median so patients can skip an item and the test still has validity
  - Internal consistency high (Cronbach's  $\alpha > .90$ )
  - Excellent test-retest reliability ( $r > .87$ )

## Evaluation of the Patient with TBI and Dizziness

### • Thorough History

- Relevant medical history
  - Acute or chronic medical problems
  - Family history
  - Description of symptoms: dizziness, vertigo, headache, falls
    - Include frequency and duration
- Medications
- Social history
- Environmental Assessment
- Cognition

## Evaluation of the Patient with TBI and Dizziness

### • Physical Examination

- Cardiovascular Status
  - Heart rate and rhythm
  - Postural pulse and blood pressure – supine, sitting, and standing
  - Pulse oximetry
- Musculoskeletal System
  - Joint range of motion
  - Muscle strength

## Examination of the Patient with TBI and Dizziness

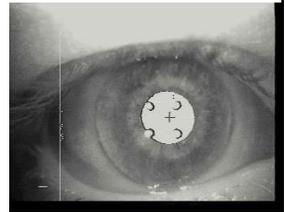
### • Neurological Function

- Sensation
- Reflexes
- Cranial Nerves
  - Ocular motor function
  - Vestibular function
- Visual acuity, visual contrast sensitivity, convergence
- Gait, balance, and mobility levels

## Ocular Motor Function

### • Ocular Motor Function

- Purpose: To determine if CNS problem and to ensure that eye movements are normal so VOR can be tested
- Smooth pursuit
  - Smooth eye movement tracking a slowly moving discrete target
  - Mediated by brainstem eye fields, medial longitudinal fasciculus, and cranial nerves III, IV, and VI
  - Abnormalities are seen with cerebellar or brain stem lesions

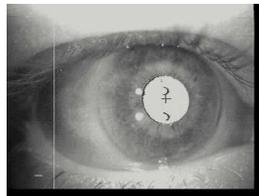


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## Ocular Motor Function

### • Saccades

- A quick eye movement or refixation
- Mediated by frontal eye fields (voluntary saccades), brainstem reticular formation (voluntary and involuntary saccades) and cranial nerves III, IV, and VI
- Abnormalities are seen with cortical, brainstem and cerebellar lesions



[http://library.med.utah.edu/neurologicexam/movies/cranialnerve\\_n\\_10\\_x2.mov](http://library.med.utah.edu/neurologicexam/movies/cranialnerve_n_10_x2.mov)

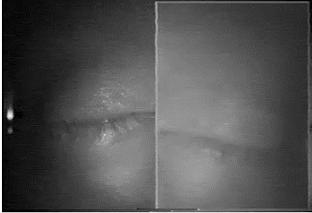
Abnormal smooth pursuit and saccades  
[http://library.med.utah.edu/neurologicexam/movies/cranialnerve\\_ab\\_11\\_x2.mov](http://library.med.utah.edu/neurologicexam/movies/cranialnerve_ab_11_x2.mov)

## Saccadic Disorder



## Convergence Insufficiency

- Convergence Insufficiency observed in 23 -46% of people with TBI  
Alvarez et al 2012



## Convergence Spasm



## Clinical Measures of Vestibular Function

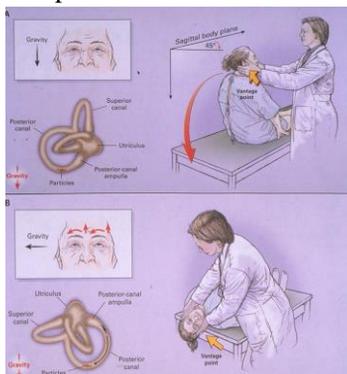
- Eye Head Coordination Testing
  - Active and Passive VOR
    - Mediated by labyrinth, VIII cranial nerve, and vestibular nucleus
  - Active VOR
    - While the patient looks at a target have them move their head horizontally and then vertically at about 2 cycles/second. Look for refixation saccades, note reports of dizziness or nausea
  - Passive VOR
    - Hold the patient's head tipped down approximately 30 degrees, move the patient's head horizontally and vertically at about 2 cycles/second while asking them to focus on your face. Look for refixation saccades, note reports of dizziness or nausea
- Abnormalities are indicative of vestibular dysfunction

## Clinical Measures of Vestibular Function

- Eye Head Coordination Testing
    - Head Thrust (Head Impulse Test) Schubert et al 2004; Halmagyi and Curthoys 1988
      - 95% specificity, 35% sensitivity for detecting vestibular lesion
      - 82% specificity, 71% sensitivity UVL, 84% sensitivity BVL Schubert et al 2004
    - The patient is asked to fixate on a target while the examiner moves the patients head rapidly to each side
    - The examiner looks for any movement of the pupil during the head thrust and a refixation saccade
- [http://library.med.utah.edu/neurologiceam/movies/cranialnerve\\_n\\_13\\_x2.mov](http://library.med.utah.edu/neurologiceam/movies/cranialnerve_n_13_x2.mov)

## Dix-Hallpike Maneuver

**The Dix-Hallpike maneuver-45 degrees rotation and 30 degrees extension over the edge of the bed.**



Furman and Cass. New England Journal of Medicine. 1999;340:1590-1596

## Auditory Testing

- Audiogram and Word Recognition Test (hearing test)
- Tympanometry and Acoustic Reflex Testing
- Brainstem Auditory Evoked Potential Testing
- Electrocochleography

## Objective Tests of Vestibular Function

- Electronystagmography/ Videonystagmography
  - Ocular Motor Testing
  - Caloric Testing
  - Positional Testing
- Earth Vertical Axis Rotation (EVAR or rotational chair testing)
- Computerized Dynamic Posturography

## Vestibular Function Testing

### • Electronystagmography/Videonystagmography

- Ocular motor testing
- Positional testing



### • Caloric testing

- Warm or cool air or water is placed in the external auditory canal
- Slow phase velocity of nystagmus is measured and compared between sides
- Gives indication of side of lesion
  - % asymmetry
  - Directional preponderance



## Vestibular Function Tests

### • Earth Vertical Axis Rotation (Rotational Chair Testing)

- Ocular Motor Testing
- Optokinetic Nystagmus
- Sinusoidal Stimulation
  - Gain
  - Phase
  - Directional Preponderance
- Step Stimulation
  - Time constant



## Vestibular Function Testing

- Otolith Testing
  - Off Vertical Axis Rotation
  - Vestibular Evoked Myogenic Potentials (VEMP)
  - Linear sled



## Vestibular Function Testing

- Computerized Dynamic Posturography
  - Sensory Organization Test
    - Somatosensory and Visual cues are manipulated to determine how a person uses sensory information for balance
  - Motor Control Test
    - Assesses the motor response to platform translations at various velocities
  - Adaptation Test
    - Assesses how a person adapts to repetitive rotational platform translations

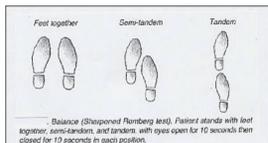
## Sensory Organization Test (SOT)

**SENSORY EVALUATION -SIX CONDITIONS**

| Condition  | Sensory Systems                   |
|--|-----------------------------------|
| 1. Normal Vision<br>Head Support                     | Visual, Vestibular, Somatosensory |
| 2. Absent Vision<br>Head Support                     | Vestibular, Somatosensory         |
| 3. Semi-Referenced Vision<br>Head Support            | Visual, Vestibular, Somatosensory |
| 4. Normal Vision<br>Semi-Referenced Support          | Visual, Vestibular, Somatosensory |
| 5. Absent Vision<br>Semi-Referenced Support          | Vestibular, Somatosensory         |
| 6. Semi-Referenced Vision<br>Semi-Referenced Support | Visual, Vestibular, Somatosensory |

## Evaluation of Gait and Balance

- Single Item Tests
  - Romberg
    - Developed to test posterior column disease
    - Sharpened Romberg (tandem) : holding for < 10 seconds indicate increased risk of falling
  - Single Limb Stance (SLS)
    - Increase risk of injury due to a fall 2 times if cannot perform SLS for 5 seconds *Vellas 1997*



## 30 Second Chair Stand Test Jones et al 1999

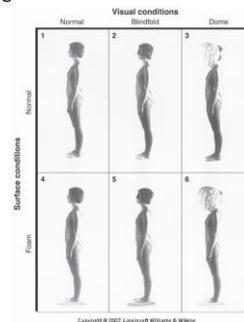
- Administered using a folding chair without arms, placed against a wall
- Measure number of times a person can come to complete standing in 30 seconds without using arms
- Excellent test-retest reliability  $r=0.89$
- Criterion fitness standards to maintain physical independence *Rikli and Jones 2013*

| Age   | 60-64 | 65-69 | 70-74 | 75-79 | 80-84 | 85-89 | 90-94 |
|-------|-------|-------|-------|-------|-------|-------|-------|
| Women | 15    | 15    | 14    | 13    | 12    | 11    | 9     |
| Men   | 17    | 16    | 15    | 14    | 13    | 11    | 9     |

## Evaluation of Gait and Balance

- Clinical Test of Sensory Interaction and Balance Shumway-Cook and Horak 1986
  - Reliable
    - Adults with balance dysfunction Kappa ranged from 0.31 to 0.81 *Loughran et al 2005*
  - Valid
    - Correlates with Sensory Organization Test in people with vestibular dysfunction *Weber and Cass 1993*
    - Inability to maintain stance on foam predicted future multiple falls (OR 4.21)

## Clinical Test of Sensory Interaction and Balance



## Clinical Test of Sensory Interaction on Balance

| Condition | Surface   | Vision               | Sensory Input Available                       | Abnormal Scores Indicate           |
|-----------|-----------|----------------------|---|------------------------------------|
| 1         | Firm      | Eyes Open            | Accurate Vision<br>Accurate Somatosensory     | Possible motor impairment          |
| 2         | Firm      | Eyes Closed          | Absent Vision<br>Accurate Somatosensory       | Impaired use of somatosensory info |
| 3         | Firm      | Visual Conflict Dome | Inaccurate Vision<br>Accurate Somatosensory   | Impaired use of somatosensory info |
| 4         | Compliant | Eyes Open            | Accurate Vision<br>Inaccurate Somatosensory   | Impaired use of visual info        |
| 5         | Compliant | Eyes Closed          | Absent Vision<br>Inaccurate Somatosensory     | Impaired use of vestibular info    |
| 6         | Compliant | Visual Conflict Dome | Inaccurate Vision<br>Inaccurate Somatosensory | Impaired use of vestibular info    |

## Evaluation of Gait and Balance

### • Multiple item balance tests

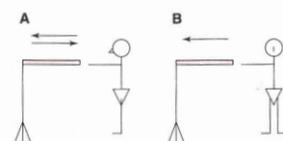
- **Berg Balance Scale (BBS)** *Berg et al 1989*
  - 14 items graded on an ordinal scale 0-4
  - Reliable: ICC  $r=0.91$  in older adults
  - Scores below 45 indicate increased risk of falling in community dwelling older adults *Shumway-Cook et al 1997*
  - Scores of  $< 36$  indicate a 100% chance of falling in the next 6 months

## Evaluation of Gait and Balance

### • Tinetti Performance Oriented Mobility Scale (POMA) *Tinetti et al 1986*

- Balance (10 items, 16 points) and Gait (12 points) Subscales
- Excellent Test-retest reliability in older adults ICC  $r=0.96$  *van Iersel et al 2007*
- Fall risk interpretation
  - 24-28 Low risk of falls
  - 19-23 Moderate risk of falls
  - $< 18$  High risk of falls

## Functional Reach/Multidirectional Reach



## Multidirectional Reach Test Reference Values (mean age 74 years)

| Direction     | Above average (inches) | Below average (inches) |
|---------------|------------------------|------------------------|
| Forward       | $>12.2$                | $<5.6$                 |
| Backward      | $>7.6$                 | $<1.6$                 |
| Right lateral | $>9.4$                 | $<3.8$                 |
| Left lateral  | $>9.4$                 | $<3.8$                 |

## Evaluation of Gait and Balance

### • Gait Tests

- **Timed "Up & Go" (TUG)** *Podsiadlo and Richardson 1991*
  - A person is timed while they stand from a sitting position, walks 3 meters (at self-selected speed), turns, walks back to the chair and sits down
  - Reliable: ICC  $r=0.99$  in community dwelling older adults
  - Scores of  $> 11$  seconds correctly classify older adults who will fall *Podsiadlo and Richardson 1991, Trueblood et al 200, Wisley and Kumar 2010*



## Evaluation of Gait and Balance

- **Dynamic Gait Index** *Shumway-Cook and Woollacott 2012*
  - 8 gait tasks graded on an ordinal scale (0-3)
  - Reliable: ICC  $r=0.82$  community dwelling older adults
  - Scores of  $\leq 19/24$  correctly identify older adults at risk for falling *Shumway-Cook et al 1997*
- **Functional Gait Assessment** *Wisley et al 2004*
  - 10 item test graded on an ordinal scale (0-3)
  - Reliability: ICC  $r= 0.93$  in healthy adults
  - Scores of  $\leq 22/30$  correctly classify older adults who will fall *Wisley and Kumar 2010*
    - LR+: 3.6
    - LR-: 0.00

**Table 1.**  
Functional Gait Assessment Total Scores by Decade

| Age (y) | N   | Minimum Score | Maximum Score | Mean | SD  | 95% Confidence Interval |
|---------|-----|---------------|---------------|------|-----|-------------------------|
| 40-49   | 27  | 24            | 30            | 28.9 | 1.5 | 28.3-29.5               |
| 50-59   | 33  | 25            | 30            | 28.4 | 1.6 | 27.9-29.0               |
| 60-69   | 63  | 20            | 30            | 27.1 | 2.3 | 26.5-27.7               |
| 70-79   | 44  | 16            | 30            | 24.9 | 3.6 | 23.9-26.0               |
| 80-89   | 33  | 10            | 28            | 20.8 | 4.7 | 19.2-22.6               |
| Total   | 200 | 10            | 30            | 26.1 | 4.0 | 25.5-26.6               |

## Evaluation of Gait and Balance

- **Timed Gait**
  - Low gait velocity ( $<0.7$  m/sec) increases risk of falls *Montero-Odasso et al 2005; Verghese et al 2009*
  - Gait variability (step length, double support phase) increases risk of falls

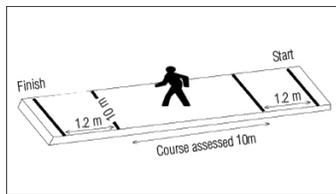
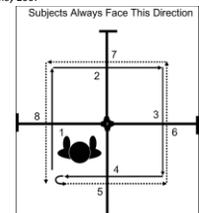


Figure 1. Representative diagram of the 10-meter walk test.

## Four Square Step Test Dite and Temple 2002

- Measure the amount of time it takes to walk around the squares clockwise then counterclockwise
- Scores of  $> 12$  seconds indicate increased risk of falls in people with vestibular dysfunction *Whitney 2007*
- Excellent test-retest reliability
- Concurrent validity established



## Mini-BESTest

- 14 items based on original BESTest
- Scored on ordinal scale of 0-2
- Excellent test-retest reliability
- Excellent correlation with BESTest and Global Rating of Change
- Normative Scores not established
- Scores of  $< 20/28$  indicate increased risk of falling in people with Parkinson Disorder
- [http://www.bestest.us/files/7413/6380/7277/MiniBEST\\_revised\\_fina\\_l\\_3\\_8\\_13.pdf](http://www.bestest.us/files/7413/6380/7277/MiniBEST_revised_fina_l_3_8_13.pdf)

## Mini-Balance Evaluation Systems Test (mini-BESTest)

- I. Anticipatory Postural Adjustments
  1. Sit to Stand
  2. Rise to Toes
  3. Stand on One Leg
- II. Reactive Postural Responses
  4. Compensatory Stepping Correction – Forward
  5. Compensatory Stepping Correction – Backward
  6. Compensatory Stepping Correction – Lateral
- III. Sensory Orientation
  7. Stance feet together – eyes open, firm surface
  8. Stance feet together – eyes closed, foam surface
  9. Incline Toes Up – Eyes Closed
- IV. Stability in Gait
  10. Change in Speed
  11. Walk with Head Turns – Horizontal
  12. Walk with Pivot Turns
  13. Step over obstacle
  14. Timed “Get Up & Go” with Dual Task



#5

## Differential Diagnosis

- Need to determine
  - Is the dizziness vestibular in origin?
  - If it is vestibular is it peripheral, central or both?
  - Is it a loss of function, irritative or mechanical?



## Differential Diagnosis

|           | Unilateral Peripheral Vestibular Dysfunction | Bilateral Peripheral Vestibular Dysfunction | Central Vestibular Dysfunction | BPPV               |
|-----------|--|---|--------------------------------|--------------------|
| Onset     | Sudden                                       | Sudden or gradual                           | Gradual                        | Sudden             |
| Frequency | Episodic                                     | Constant                                    | Constant                       | Episodic           |
| Duration  | Minutes to hours                             | Hours to days                               | Hours to Days                  | Seconds to minutes |
| Symptoms  | Vertigo, nausea, imbalance                   | Dizziness, imbalance                        | Lightheadedness, imbalance     | Vertigo            |

| Assessment tool  | Expected results if   |  |  |
|--|---|--|--|
|  | Central vestibular dysfunction  | Unilateral vestibular dysfunction  | Bilateral vestibular dysfunction   |
| Ocular Motor testing<br>Smooth Pursuit<br>Saccades<br>Spontaneous Nystagmus  | Frequently abnormal<br>Frequently abnormal<br>Frequently abnormal:<br>Non-fatiguable<br>Direction changing<br>Gaze evoked<br>Downbeat | Typically normal<br>Typically normal<br>Acute: frequently abnormal or present<br>Chronic: typically normal   | Typically normal<br>Typically normal<br>Typically normal   |
| Vestibular Ocular Reflex Testing<br>Active and Passive VOR<br>Head thrust<br>Head Shaking<br>VOR cancellation<br>Dynamic Visual Acuity | May be abnormal<br>Usually normal<br>Usually normal<br>May be abnormal<br>Usually normal  | Abnormal if acute<br>Abnormal with head movement in direction of lesion if acute<br>Abnormal if acute<br>Usually normal – may increase symptoms<br>Abnormal if acute | Usually abnormal<br>Usually abnormal bilaterally<br>Usually normal<br>Usually normal<br>Abnormal |
| Dix-Hallpike Test  | May see non-fatiguable nystagmus, downbeat nystagmus  | May see non-fatiguable horizontal nystagmus if acute   | Usually negative   |

## Acute Management Issues

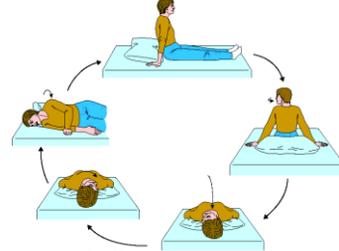
- Musculoskeletal involvement may limit types of exercise a patient can perform
  - Vestibular rehabilitation exercises may need to be modified or postponed
- Due to high prevalence, BPPV should be ruled out on all patients
- Cognitive impairments
  - Memory problems may influence follow through of exercises
    - Family involvement
    - Use of a compliance worksheet
  - Confusion and decreased processing may increase space and motion discomfort

## Chronic Management Issues

- Vestibular function testing if dizziness persists or vestibular pathology suspected
- Increase activity level incrementally as long as symptoms are under control
- Migraine management/prevention
- Sleep disorder management if not resolving
- Stress management may be indicated

## Treatment Considerations

- BPPV
  - Canalith repositioning maneuver



## Treatment Considerations

- Post-traumatic Meniere's Disease
  - Control Fluctuations
  - Vestibular Rehabilitation may decrease frequency and intensity of attacks Dowdal-Osborn 2002; Hahn et al 2001
- Post-traumatic Migraine-related Vestibulopathy
  - Migraine management
  - Control symptoms of space and motion discomfort
  - May need additional emotional support Wisley et al 2004

Questions?

