House Rules:
- If your pager or cell phone goes off during this presentation, you must stand and sing a Barry Manilow song (Loudly!)

Ringing cell phones & KNOWLEDGE don't mix!

Benign Paroxysmal Positional Vertigo (BPPV)
- Intense but transient vertigo provoked by moving into specific head positions
  - Most common cause of vertigo
  - Accompanied by a characteristic nystagmus
  - Thought to be caused by debris in the semicircular canals

Dix-Hallpike or Nylen Maneuver

Characteristic Response
- Torsional nystagmus (rolling eye movement) & vertiginous sensation
  - Onset latency (5-45 sec)
  - Crescendo then fatigue (typically within 30 sec)
  - Symptom extinction (adapt) over repeated trials

- Can be treated by a simple in office procedure

Our aim is to help sharpen your abilities to:
- Recognize and understand common subtypes of BPPV presentations and how to treat them
- Recognize when “Benign” is not benign
- Appreciate current limits of our understanding of this condition

BPPV: Understanding Eye Movements & Treatment Approaches
David A. Zapala, Ph.D. & Janet Shelfer, Au.D.
Otolaryngology / Head and Neck Surgery / Audiology
Mayo Clinic - Jacksonville

Theories of BPPV

Development of Theories of BPPV
- Adler (1897): First formal description
- Barany (1921): Case report
  - Proposed degeneration of the utricle as cause of condition
- BPPV formally defined by Dix and Hallpike (1952)
  - Described BPPV in 100 cases
  - Demonstrated utricular degeneration in one temporal bone

Cupulolithiasis Theory
- Schuknecht (1969, 1972): “Heavy Cupula” explanation
  - Debris (otoconia?) adheres to cupula of the posterior semicircular canal
  - Weight of otoconia causes cupula to deflect, making it gravity-sensitive.
  - Nystagmus eventually subsides due to central vestibular adaptation

Canalithiasis Theory
**Schuknecht 1974**

- Lim, 1973:
  - Loosened otoconia dissolves in vivo
    - (we now think this may explain the long term remission of symptoms)
- Hall et al., 1979
  - Loose debris don’t necessarily adhere to cupula
- Brandt & Daroff, 1980
  - Exercises for central habituation limit duration of BPPV

**Canalithiasis Theory**

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  - Exercises for central habituation limit duration of BPPV

**Development of Canalithiasis Theory**

- Semont, Fereyss and Vitte, 1988
  - Liberatory Maneuver
    - Dislodges and repositions debris into utricle
      - 84% success rate with one maneuver, 93% success rate with two maneuvers and a recurrence rate of 4.2%

**Canalithiasis Theory (cont.)**

- Pagnini et al., 1989:
  - Horizontal canal conversion of BPPV
- Parnes & McClure, 1990
  - Observation of free-floating particles in PSSC during canal plug surgery

**Evidence for “Canaliths”**

- Epley JM. 1992
  - Canalithiasis
    - Canalith Repositioning Maneuvers to move loose debris into utricle

**Development of Canalithiasis Theory**

- Epley JM. 1992
  - Canalithiasis
    - Canalith Repositioning Maneuvers to move loose debris into utricle
Canalithiasis Theory

- “Canaliths,” which have a heavy specific gravity relative to endolymph, drift to lowest position in membranous labyrinth.
  - Produces movement of endolymph
  - Endolymph movement deflects the cupula, stimulating hair cells and inducing vertigo & nystagmus

Pros of Canalithiasis Theory

- Theory explains:
  - Why there is adaptation:
    - Nystagmus persists only so long as canaliths are moving toward the pull of gravity.
  - Why there is fatigue:
    - Debris spreads out in the canal with repeated movement and loosing effectiveness as a “plunger”
  - Why there is spontaneous remission:
    - Debris leaves the canal

Theory Offers Treatment

- Canaliths may be repositioned using gravity to “drift” debris away from sensory epithelium

Neuronal Degeneration Theory

- Loose basophilic debris not found in temporal bones of patients with BPPV symptoms
- Severe neuronal degeneration of the inferior vestibular nerve in these temporal bones.
- Cupulolithiasis and Canalithiasis cannot account for posterior canal symptoms

Neuronal Degeneration Theory

  - Ganglionitis disrupts otolith / semicircular canal output
    - Loss of inhibitory effect of utricle or saccule on SSC output
    - Produces aberrant nerve activity
      - Adaptation on Dix-Hallpike testing due to central suppression and adaptation.
Summary

• All of these theories have something to offer.
  – Mechanical “Lithiasis” theories offer rational approach to non-surgical treatments
  – Neural theory may explain cases of more persistent positional nystagmus
• Never get too attached to your theories...

BPPV: Brief Anatomy and Functional Review

BPPV: Background Anatomy

• Ocular Motor System
• Vestibular End Organ Anatomy
• Vestibulo-Ocular Reflex (VOR)
  – Interpretation of Eye Movements

Ocular Motor Nerves & Muscles

• CN III: Oculomotor
  – Medial Rectus
  – Superior Rectus
  – Inferior Rectus
  – Inferior Oblique
• CN IV: Trochlear
  – Superior Oblique
• CN VI: Abducens
  – Lateral Rectus

Complementary Muscle Pairs

• “Cardinal” Eye Positions
  – Isolate muscle pairs
  – Failure of one eye to match its complement may betray ocular motor deficit

Peripheral Vestibular System

• Five sensory receptors
  – Three Cristae
    • Horizontal
    • Anterior/superior
    • Posterior/inferior
  – Maculae
    • Saccule
    • Utricle
Ampulla

From: Jay W. McLaren, Ph.D., Mayo Clinic

Semicircular Canals

• Quasi-orthogonal canals on same side
• Coplanar canals between sides
• Law of reciprocal innervation

From: Jay W. McLaren, Ph.D., Mayo Clinic

Vestibular Macula

• Saccule
  – Action:
    • Translational movements
    – Vertical
    – Anterior / Posterior (A/P)
    • Linear Acceleration
  – How to remember:
    • “The Saccule is Stuck to Wall”

From: Jay W. McLaren, Ph.D., Mayo Clinic

Vestibular Macula

• Utricle
  – Action:
    • Lateral translations
    • Acceleration and static head tilt
  – How to remember:
    • “The Utricle is On the floor - YoU step over the Utricle”

From: Jay W. McLaren, Ph.D., Mayo Clinic

Peripheral Vestibular System

• Five sensory receptors
  – Three Cristaea
    • Horizontal
    • Anterior/superior
    • Posterior/inferior
  – Maculae
    • Saccule
    • Utricle

The Ampulla of the horizontal canal is toward the front - Remember that!

From: Jay W. McLaren, Ph.D., Mayo Clinic

Central Vestibular System

• Four Primary Vestibular Nuclei
  – As many others...
• Interact with Ocular Motor System
Vestibulo-Ocular Reflex

• Goal: Maintain “gaze stability” regardless of head / trunk movement

• Gaze stability means:
  – Keep the object of attention on fovea
  – Maintain horizontal meridian orientated to horizon

Three Ways to Understand the Vestibulo-Ocular Reflex

• Method #1: Neuroanatomy…

Easy!??

Three Ways to Understand the Vestibulo-Ocular Reflex

• Method #1: Neuroanatomy…

• Method #2: Ewald’s Laws of Semicircular Canal Dynamics

Ewald’s First Law

• Vestibular evoked eye movements occur in the plane of the canal being stimulated.
  – If you stimulate the horizontal canal, you get a horizontal eye movement.

Ewald’s Second Law

• Vestibular nerve can encode fast (high acceleration) excitatory movements better than inhibitory movements.
  – The resting discharge rate of the vestibular nerve is just under 100 spikes/sec
  – Excitatory acceleration can drive nerve firing rate to +300 spikes/sec
  – Inhibitory acceleration, no matter how fast, can never drive nerve output below 0 spikes/sec
Ewald’s Third Law

- Horizontal Canal Excitation
  - Ampullopetal endolymphatic flow stimulates crista
- Vertical Canal Excitation
  - Ampullofugal endolymphatic flow

Note: “Petal” means toward, “Fugal” means away from

Tellian and Shepard’s Graphic

Vertical Canal Excitation

Three Ways to Understand the Vestibulo-Ocular Reflex

- Method #1: Neuroanatomy…
- Method #2: Ewalds Laws of Semicircular Canal Dynamics
- Method #3: Ecological Approach

Ecological Approach to Vestibular Evoked Eye Movements

- Vestibular evoked eye movements are designed to:
  - Maintain gaze stability during unexpected head / body movements
  - Maintain eye orientation so that the horizon lines up with the horizontal meridian of the retina

Parnes et.al, 2003

Three Ways to Understand the Vestibulo-Ocular Reflex

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Parnes et.al, 2003
SSC Planes

- Six SSCs are matched in complement pairs - three planes...
  - Two Horizontal
  - Right Anterior and Left Posterior (RALP)
  - Left Anterior and Right Posterior (LARP)

Law of Reciprocal Innervation

- Head movements that stimulate the nerve of one canal, inhibit output in the complementary canal
  - Leading Ear Excites
  - Lagging Ear Inhibits

Horizontal Canal Dynamics

- Q: Which way does the cupulla of the horizontal canal bend to excite the vestibular nerve?
  - A: It “swings away from” the leading ear.
    - A.K.A.: “ampullopetal flow” - endolymph flows towards the utricle

Relating Horizontal SSC Output to VOR

- So with Left Head Turn:
  - The Left Horizontal SCC Excites Left Vestibular Nerve
  - Right Horizontal SCC Inhibits Right Vestibular Nerve
  - The Eyes Drift to the Right side of the Orbit to maintain Gaze stability (VOR)

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Relating Horizontal SSC Output to VOR

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  - The Left Horizontal SCC Excites Left Vestibular Nerve
  - Right Horizontal SCC Inhibits Right Vestibular Nerve
  - The Eyes Drift to the **Right** side of the Orbit to maintain **Gaze stability** (VOR)

- At some point, gaze stability cannot be maintained and a saccade moves the eyes to a new fixation target…
  - Nystagmus “Fast phase”
  - Not Vestibular Induced

Understanding Vertical SSCs

- “Goals” of VOR
  - Maintain Gaze stability despite head movement
  - Maintain eyes oriented to the horizon
    - Horizon should line up with horizontal meridian of retina

- What Kind of Eye Movement Is Necessary When Moving in the “Right - Anterior, Left Posterior” (RALP) Plane?

RALP Movement

- Turn Head 45° to Left
- Tilt Forehead Down
- Look Straight Ahead
- What Do Eyes Do?

- Turn Head 45° to Left
- Tilt Forehead Down
- Look Straight Ahead
- What Do Eyes Do?
RALP Movement

- Turn Head 45° to Left
- Tilt Forehead Down
- Look Straight Ahead
- What Do Eyes Do?

RALP Movement

- Right Eye elevates
- Slight Counter Clockwise Torsional eye movement (relative to the patient)

RALP Movement

- At some point, gaze stability cannot be maintained and a saccade moves the eyes to a new fixation target…
  - Nystagmus “Fast phase”
  - Not Vestibular Induced

RALP Movement

- This is the Effect of Right Anterior Canal Stimulation (When looking to the right):
  - Right Eye elevates
  - Slight Counter-clockwise Torsional “Slow phase” eye movement (relative to the patient)

RALP Movement

- When looking to the left of Right Anterior Canal Stimulation provokes:
  - Minimal vertical movement
  - Counter-clockwise Torsional “Slow phase” eye movement (relative to the patient)

RALP Eye Movements

- Vertical component changes with direction of gaze
- Eye movement remains “in the plane of” the dependent canals (Arrow)
RALP Plane Movements

- Plane of rotation is the same regardless of gaze direction
- Trajectory of the pupil depends on direction of gaze

Looking Left
Looking Right

RALP Plane Movements

- Plane of rotation is the same regardless of gaze direction
- Trajectory of the pupil depends on direction of gaze

Looking Left
Looking Right

Vertical Canal Cupula

• How does the cupula of the leading vertical canal move when the head tilts in the RALP plane?
Vertical Canal Dynamics

• It “falls” toward the head tilt.
  – A.K.A.: Ampullofugal Flow or Flow away from the utricle.

Summary Point: #1

• Vestibular Induced Eye Movements:
  – Maintain gaze stability during unexpected head / body movements
  – Maintain eye orientation so that the horizon lines up with the horizontal meridian of the retina

Summary Point: #2

• In Angular Head Movements
  – The leading canal excites the vestibular nerve
  – Lagging canal suppresses vestibular nerve firing
    • provokes a slow eye movement in the opposite direction of the head movement (Ewald).
    • The leading canal will drive eye movements in response to fast accelerations (Ewald).

Summary Point: #3

• For horizontal or “yaw” type of excitatory movements, the cupula lags behind the leading ear

• For vertical movements (RALP or LARP planes), the cupula falls in the direction of the head movement

BPPV-Induced Eye Movements

Understanding BPPV-Induced Eye Movements

• Simple forms are easy to recognize:
  • Posterior SSC BPPV is torsional, with the top pole of the eye rolling to the floor.

• For more complicated types of nystagmus:
  • Relate the eye movement to the type of head movement that would normally drive the eyes in that direction.
  • “Analogous Equivalent Movement”
Analogous Equivalent Head Movement
• For more complicated forms of BPPV:
  – Record and observe the eye movement
  – Visualize how the head would move such that the observed eye movement would maintain the eyes horizontal relationship to the horizon
    • Analogous equivalent head movement
  – Visualize which semicircular canals would be stimulated or inhibited during such a movement
    • This will tell you where the debris rests in the labyrinth.

Posterior Canal BPPV
• Eye movement:
  – Top of eye rolls to the floor
    • Counter clockwise (relative to the patient)
  – Up beating component, > in the contralateral eye
• Eye movement is analogous to falling in the plane of the involved posterior canal

Analogous Head Movement
• Nystagmus is torsional and vertical, with upper pole of eye beating to the floor (fast phase)
  – Nystagmus is the same as if the head was going back for a Dix-Hallpike Maneuver
  – Cupula leans into the movement (excitatory)
Analogous Head Movement

- Nystagmus is torsional and vertical, with upper pole of eye beating to the floor (fast phase)
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Right Posterior Canal BPPV

- Cupula bends
  - Same Up and Clockwise (relative to the patient)
  - Torsional Nystagmus as when moving into the Dix-Hallpike Position From Sitting
    - Onset delay
    - Upward component greatest with gaze to the left

Debris Falls From the Pull of Gravity

- Cupula bends
  - Same Up and Clockwise (relative to the patient)
  - Torsional Nystagmus as when moving into the Dix-Hallpike Position From Sitting
    - Onset delay
    - Upward component greatest with gaze to the left

Head in the Dependent Position

- Same Up and Clockwise (relative to the patient)
  - Torsional Nystagmus as when moving into the Dix-Hallpike Position From Sitting
    - Onset delay
    - Upward component greatest with gaze to the left
Debris Falls From the Pull of Gravity

- Cupula bends
- Same Up and Clockwise (relative to the patient)
  Torsional Nystagmus as when moving into the Dix-Hallpike Position From Sitting.
  - Onset delay
  - Upward component greatest with gaze to the left
Debris Falls From the Pull of Gravity

- Cupula bends
- Same Up and Clockwise (relative to the patient)
  Torsional Nystagmus as when moving into the Dix-Hallpike Position From Sitting.
  - Onset delay
  - Upward component greatest with gaze to the left

Posterior Canal Variety

- Eye movement is analogous to falling in the plane of the involved posterior canal
  - Top of eye rolls to the floor
  - Counter clockwise (relative to the patient)
  - Up beating component, > in the contralateral eye
Superior Canal Variations

Quick Rules of Thumb
- For vertical / torsional nystagmus…
  - Up-beating eye implies the contralateral posterior canal
  - Down-beating eye implies the ipsilateral anterior canal

Left Anterior Canal Stimulation
- Slow Component
  - Clockwise torsional
  - Upward drift in left eye
- Fast Component
  - Counter-Clockwise torsional
  - Downward “jump” in left eye

Left Anterior Canal Stimulation
- Slow Component
  - Clockwise torsional
  - Upward drift in left eye
- Fast Component
  - Counter-Clockwise torsional
  - Downward “jump” in left eye
Left Anterior Canal Stimulation

- Slow Component
  - Clockwise torsional
  - Upward drift in left eye
- Fast Component
  - Counter-Clockwise torsional
  - Downward “jump” in left eye

Left Posterior Canal Stimulation

- Slow Component
  - Clockwise torsional
  - Downward in Right eye
- Fast Component
  - Counter-Clockwise torsional
  - Upward Jump in Right eye
Left Posterior Canal Stimulation

- Slow Component
  - Clockwise torsional
  - Downward in Right eye

- Fast Component
  - Counter-Clockwise torsional
  - Upward Jump in Right eye

Quick Rules of Thumb

- With vertical / torsional nystagmus (fast phase)...
  - Up-beating eye implies the contralateral posterior canal
  - Down-beating eye implies the ipsilateral anterior canal

Examples

Quick Rules of Thumb

- If you can’t remember this, relate the observed eye movement to the horizon line
  - The eyes are trying to move to the “horizon line”
  - How would the head move to require this eye movement...
  - What canal is being stimulated
- This never fails with BPPV

Clinical Approach

Prevalence

- 10.7 to 107 : 100,000 cases / year
- 17 - 18% of patients in Dizzy Clinic
- Increases with age
- Common antecedents:
  - Neurulabyrinthitis in 10-15%
  - Head trauma in 15-20%
  - Surgery, particularly involving the head
- Cause is unknown in 1/2 of cases
Prevalence in Our Clinic

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<th>Vestibulopathy</th>
<th>n</th>
<th>% of Patients</th>
<th>Average Age</th>
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<tbody>
<tr>
<td>No BPPV</td>
<td>1123</td>
<td>7.8%</td>
<td>64.6</td>
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<tr>
<td>R PC BPPV</td>
<td>118</td>
<td>7.8%</td>
<td>70.3</td>
</tr>
<tr>
<td>L PC BPPV</td>
<td>101</td>
<td>6.6%</td>
<td>71.1</td>
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<tr>
<td>Multicanal BPPV</td>
<td>30</td>
<td>2.0%</td>
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<tr>
<td>Bilateral BPPV</td>
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<td>1.7%</td>
<td>65.3</td>
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<tr>
<td>(+) Hx / subtle findings</td>
<td>101</td>
<td>6.6%</td>
<td>68.9</td>
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<td>Apical CNS</td>
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<td>0.8%</td>
<td>64.5</td>
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<td>Superior canal</td>
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<td>0.3%</td>
<td>65.0</td>
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<tr>
<td>Horizontal canal BPPV</td>
<td>5</td>
<td>0.4%</td>
<td>77.2</td>
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<tr>
<td>Total</td>
<td>1522</td>
<td>100.0%</td>
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</table>

BPPV and Perceived Handicap

<table>
<thead>
<tr>
<th>Vestibulopathy</th>
<th>DHI</th>
</tr>
</thead>
<tbody>
<tr>
<td>PC BPPV</td>
<td>39.9%</td>
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<tr>
<td>Horizontal canal BPPV</td>
<td>62.0%</td>
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<td>Multicanal BPPV</td>
<td>33.4%</td>
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<tr>
<td>Central</td>
<td>36.0%</td>
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<tr>
<td>Other vestibular</td>
<td>41.0%</td>
</tr>
<tr>
<td>Non-vestibular</td>
<td>36.3%</td>
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</tbody>
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Approach

- Brief History and Focused Physical Examination
- Diagnostic Maneuvers
- Treatment Strategies
- Post Procedure Instructions
- Follow-up

Brief History

- Type of Dizziness, Time Course and Provocations
  - Movement or position provoked transient vertigo (“Positioning Vertigo”)
    - Ice!
  - Secondary features:
    - Lightheadedness
    - Disequilibrium
      - These get better as the day goes on...

Red Flag Neurological Symptoms

- Diplopia:
  - Double vision from ocular misalignment
    - Implies CN III, IV, VI or brainstem problem
    - Abducens failure: increased ICP
- Dysarthria:
  - Difficulty accurately moving muscles of the mouth - poor articulation
    - Implies CN IX, X, XII or low brainstem lesion

Red Flag Neurological Symptoms

- Dysphagia
  - Difficulty swallowing
    - CN IX, X, XII or low brainstem
- Sensory or Motor Disturbances
  - Change in vision
    - Weakness, numbness, tingling, or impaired ability to move any part of the body
Red Flag Neurological Symptoms

- Change in Voice
  - CN IX and X, lower brainstem
- Aphasia
  - General stroke risk
- Loss of Consciousness (Syncope)
  - Global cerebral ischemia
- History of neck injury or surgery

Other Risk Factors...

- Cardiovascular
  - Syncope or pre-syncope
  - Dizziness that increases upon exertion
- Otologic
  - Hearing
    - Aural pain, pressure, fullness
    - Tinnitus
- Ophthalmologic
  - Recent retinal bleed or retinal Sx

Examination

- Brief ocular motor exam
- Check for signs of persistent vestibular weakness
- Check for neck problems that may preclude typical BPPV maneuvers

Brief Ocular Motor Exam

- Goal:
  - Check for eye muscle weakness (cranial nerves)
  - Check for gaze evoked nystagmus
- Procedure
  - Check ability to follow finger laterally less than 30° to rule out gaze evoked nystagmus
  - Check “cardinal positions”

Cardinal Positions

Gaze at 30 Degrees

Don't Bury the Iris!
Check for Spontaneous Nystagmus

Three Common Diagnostic Errors

- Missing Underlying Vestibulopathy
- Central Positioning Vertigo
  - Lesions around the 4th ventricle
    - Minimal vertigo
    - Possibly ++ nausea
- Third Window in Labyrinth
  - Perilymphatic Fistula
  - Superior or Posterior Canal Dehiscence
  - Large Vestibular Aqueduct

Neck Evaluation

- Goal:
  - Assess range of motion for Dix-Hallpike
  - Check for neck torsion provoked dizziness
    - Vertebral Basilar Artery insufficiency (VBI)
- Procedure:
  - Range of motion: Sitting up, turn head right and left
  - Sitting, hyperextend the neck w/o tilting head

Neck Range of Motion

- 30° angle

Examination

- Neck torsion does not provoke symptoms of lightheadedness
- Neck range of motion is adequate for Dix-Hallpike and CRP

History and Brief Physical Exam

- Screened for neurological, orthopedic and otologic risk factors
- Checked to see if:
  - Ocular motor function was adequate
  - No unexpected gaze nystagmus
- Checked neck range of motion and screened for VBI
Diagnostic Maneuvers

• Three Basic Maneuvers…
  – Vertical (RALP / LARP) planes
    • Dix-Hallpike or Side Lying Maneuver(right and left)
  – Horizontal “Yaw” plane
    • Head / Body Roll
• For each maneuver, assess the direction and duration of any provoked nystagmus

Dix-Hallpike Test (Nylen Maneuver)

• Do test before allowing patient to lie down
• Procedure:
  – Pt. sits with head turned 45º to the side
  – Bring supine with the head angled down about 20º
  – Pt. fixates on your nose (Frenzel lenses may help)
• Repeat if response is positive

Positive Dix-Hallpike

Posterior Canal (PC) BPPV…

• Brief onset latency
• Top of the eye rolls toward the ground
  – For right PC-BPPV:
    • Clockwise and vertical (> left eye)
  – For left PC-BPPV:
    • Counter-clockwise and vertical (> right eye)
• Nystagmus crescendos then fatigues
• Reverses when returned to sitting position
• Adaptation with repeated trials

Left Posterior Canal BPPV...

Side Lying Maneuver
Three Important Observations…

• #1. Duration of nystagmus is important:
  – Canalithiasis: < 1 minute
  – Cupulolithiasis: > 1 minute
  – Central Positioning Nystagmus persists

• #2. Does it adapt over repeated trials?
  – Canalithiasis adapts quickly
  – Cupulolithiasis adapts more slowly,
    • if a fatiguing nystagmus persists, think
      Cupulolithiasis
  – Central Positioning Nystagmus may not fatigue
    or adapt appreciably.

• #3. Perception of vertigo is important:
  – BPPV can be startling, anxiety provoking and
    nauseating
    • Be confident of your preparation of yourself and
      your patient.
  – Strong nystagmus without vertigo is very
    unusual - suspect central positioning nystagmus
    (Cerebellar or Pontine lesions most common.)

PC-BPPV Treatment

• Goal: Move debris away from affected Ampulla
  – Canalithiasis:
    • Epley Canalith Repositioning Maneuver
    • Liberatory Maneuver (Semont)
  – Cupulolithiasis
  • Goal: Minimize patient discomfort
  – Information pre-treatment
  – Ice on the back of the neck
  – Anti-nausea Rx as needed

Epley Canalith Repositioning
Treatment Induced Nystagmus

- Nystagmus from PC BPPV remains the same at each point in the Canalith Repositioning Maneuver.
  - If Nystagmus changes direction, one of three things has happened:
    - Another canal is involved
    - Canaliths are not moving in the desired direction
    - Cupulolithiasis

Semont Maneuver
Cupulolithiasis

Horizontal Canal Variety

- Two subtypes:
  - Horizontal Canal Conversion
    - Starts with posterior canal symptoms
    - With movement (repositioning attempt), horizontal canal symptoms provoked
  - Spontaneous
    - Presents with horizontal symptoms
      - Rare: Horizontal canal elevated +30 degrees w/ head level, opening is on the low side.

Horizontal Canal Conversion

- Conversion nystagmus beats to the floor (geotropic)
- You have a pretty good idea that it is in the same ear the prior PC - BPPV
- What to do?

Example Conversion
Analogous Head Movement

• Dix-Hallpike to the right
  – Provokes right beating horizontal nystagmus
    • "Geotropic"
  – Debris moving from opening of “long arm” to mid-point in the canal. (green arrow)

Horizontal Canal Conversion

• Treatment Options:
  – Bring the patient right up: HC-BPPV clears on its own.
  – Treat: reverse the analogous head movement.
    • Roll to the opposite ear - debris is in the opening (long arm) of the horizontal canal and should come out easily.
      – Perform Log (Barrel) Roll
      – Perform a modified Log (Barrel) Roll

Log Roll - HC Conversion

Modified Log Roll

Modified Barrel Roll

Spontaneous Horizontal Canal BPPV

• Horizontal Nystagmus (plane of the canal)
  – May be seen on Dix-Hallpike or Head Roll
  – Initially, may beat in any direction!
  – Typically provokes strong vegetative symptoms
    • Nausea, diaphoresis, emesis
• Good news: Often self clears
  – +30° angle of horizontal canal is a help!
Transient Right Beating Nystagmus

• Possible Locations
  – Canalithiasis
    • Right beating as part of geotropic positioning nystagmus pattern (A & B)
  – Cupulolithiasis
    • Right beating as part of ageotropic positioning nystagmus pattern (C)

Approach

• Head Roll Test
  – First: Canalithiasis or cupulolithiasis
  – Second: Determine side?
  – Third: Diagnostic trial.

Spontaneous Horizontal Canal

• Diagnostic Head Roll Test
  – Lay in supine position until no nystagmus
  – Turn head to right smartly - measure provoked nystagmus
  – Return to supine until no nystagmus
  – Turn head to left smartly - measure provoked nystagmus

Head Roll Test

The bottom ear on the side of the greatest provoked nystagmus has the debris

Head Roll Test Results

• Geotropic positioning nystagmus:
  – Canalithiasis
  – Involved ear: lower ear on side with stronger response
  – In this case, the right is involved

Diagnostic Head Roll Test

• The bottom ear on the side of the greatest provoked nystagmus has the debris
Log Roll to Left

Horizontal Cupulolithiasis

- Ageotropic Positioning Nystagmus
  - Persists for “longer” time
  - Upward ear on side with greatest response the involved side?
  - May convert to geotropic variety

Cupulolithiasis Time Course

- Head Roll Left
- Head Roll Right

What to do with Cupulolithiasis?

- Trial roll in direction of best guess.
  - Possibly with vestibular suppressants on board.
- Use Vibration
- Use liberatory and Brandt-Darroff Exercises
- Make sure you have excluded CNS (double check)

Appiani Maneuver

Anterior Canal Variations

- Dix - Hallpike Right
  - Should see Clockwise and Upward (>left eye)
  - Instead.....
Anterior Canal Variations

• You see Clockwise and Downward (> right eye)
  
  Where is the debris?

Quick Rule of Thumb

• Up-beating eye implies opposite posterior canal

• Down-beating eye implies the same anterior canal

• This is Right AC-BPPV

What to do?

• In most cases, an ipsilateral anterior canal (relative to Dix-Hallpike) will convert to posterior canal
  – ...on second Dix-Hallpike.
  – ...or during CRP

• If not, go to anterior canal treatments (forthcoming)

Anterior Canal Variations

• Dix - Hallpike Right
  – Should see Clockwise and Upward (>left eye)
  • Instead you see a Clockwise and Downward (>left eye)

Quick Rule of Thumb

• Up-beating eye implies opposite posterior canal

• Down-beating eye implies the same anterior canal

• This is left AC-BPPV

What to Do?

• In most cases, contralateral anterior canal (relative to Dix-Hallpike) will convert to posterior canal
  – ...on second Dix-Hallpike.
  – ...or during CRP

• If not, go to anterior canal treatments (forthcoming)
What if AC-BPPV persists
• First try a reverse Epley Maneuver
  – Example is for left anterior canal...

Post Treatment Care All Canals
• Limit movement and remain upright for 24 hours*
  – Patient fitted with a neck collar to assist.
  – Benefit? Not documented
• Remaining upright at night*
  – Sleep in a semi-upright (no lower than 20-30 degrees) position
• Next 6 nights avoid sleeping on side of ear treated.*
  *Makes no difference: Cohen 2004

Reverse Semont / Liberatory Maneuver (Left AC-BPPV)

Time Course of Recovery
• Successful Treatment
  – Positional Vertigo gone
  – Residual disequilibrium (Utricular stimulation?)
    • Tiltng
    • Bobbing
  – Time course
    • Disequilibrium decreases about 80% within two days
    • May take a full four weeks for disequilibrium to diminish completely
• Vestibular Rehabilitation if incomplete recovery

Short Term Outcomes

<table>
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<tr>
<th>Reference</th>
<th>No. of patients</th>
<th>Income, %</th>
<th>Recurrence, %</th>
<th>Treatment, %</th>
<th>No. of manoeuvres per session</th>
<th>Comparison</th>
<th>Tinnitus</th>
<th>Disease status</th>
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<tr>
<td>Yee et al.</td>
<td>44</td>
<td>80</td>
<td>NA</td>
<td>Single</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>
| Sakaida M; Takeuchi K; Ishinaga H; Adachi M; Majima Y; Neurology, 2003 | Average recurrence rate: 37% at 60 months (5 years)
  – 50% for HC-BPPC
  – 26% for other BPPV

Long Term Outcomes
Persistent Cases

• Medications for vestibular suppression and nausea control
• Time
• Brandt - Daroff Exercises
• Canal Plug Surgery

Diagnosing BPPV

• A Test:
  – What canal is firing?

The Eyes are Incredible!

• We hope this talk has sharpened your abilities to:
  – Recognize and understand common subtypes of BPPV presentations
  – Recognize when “Benign” is not benign
  – Understand the current limits of our understanding of this condition

The End