Dizziness and Mild Traumatic Brain Injury

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Objectives
- Identify and understand vestibular signs and symptoms found in patients with mTBI.
- Identify the different vestibular disorders with patients who sustain mTBI.
- Identify how to differentiate between the different vestibular disorders of patients reporting increase in dizziness after an injury.
- Apply and learn potential treatments strategies associated with vestibular disorders.

Mild Traumatic Brain Injury (mTBI) vs. Concussion

- mTBI: Definition
  - A patient with an mTBI is a person who has had a traumatically induced physiological disruption of the brain.

- Concussion: Definition
  - A concussion is defined as a complex pathophysiological process affecting the brain, induced by traumatic biomechanical forces.

mTBI vs. Concussion

- Both injuries are caused by a blow to the body/head which results in a significant movement or spinning sensation at the time of impact.
- This spinning sensation is called rotation acceleration.
- Typically once there is contact to the head, body or face the brain is sent spinning in the opposite direction.
- This acceleration or rapid movement is what causes the brain to malfunction and this is when you start to experience signs and symptoms of a concussion or a mTBI.

mTBI vs. Concussion

- mTBI or a concussion:
  - Caused by a traumatic direct blow to the head, face, neck, or a blow elsewhere on the body with an "impulsive force" transmitted to the head.


Signs and Symptoms

- Observed symptoms:
  - Physical Symptoms
    - Headache, Vertigo (Dizziness), Nausea, Balance problems, Fatigue, Drowsiness, Blurred Vision, Vomiting, Mood Changes, Irritability, Sensitivity to light, Confusion, Can’t recall events
  - Cognitive Deficits
    - Attention deficit, Concentration difficulties, Perception, memory, speech/language, and inability to execute functions
  - Behavioral Changes
    - Irritability, quickness to anger; disinhibition, and emotional liability.
• Two of the most major symptoms that are typically seen in therapy regarding mTBI and concussions are headaches and vertigo.

• Typically, these symptoms may last a few weeks in many patients, but in some instances the symptoms may last much longer and impede ability to return to work or full functional activities.

• Post concussion dizziness is most commonly described as a rocking or swaying sensation, floating lightheadedness, and feeling of drunkenness, or general imbalance worsened by head motion.

- Post Concussion Dizziness:
  - Posttraumatic migrainous vertigo, labyrinthine dizziness, cervicogenic dizziness, anxiety related dizziness, positional vertigo (BPPV)
  - Dizziness is either continuous or occurs on/off.

- Vertigo is a persistent or recurrent dizziness that may cause difficulty with dynamic and static balance.
  - Types of Vertigo associated with mild traumatic brain injury and concussion:
    - BPPV
    - Labyrinthine concussion
    - Cervicogenic Dizziness
    - Vestibular nerve injury
    - Less common traumatic endolymphatic hydrops (meniere's disease)

- Vertigo: sensation of spinning

- Causes of BPPV
  - Occurs Spontaneously
  - Common after head trauma
  - Common after inner ear infection
  - Ischemia in the distribution of the anterior vestibular artery

- BPPV
  - Definition: Characterized by brief episodes of vertigo when the head is moved in certain positions.
    - Benign: not malignant
    - Paroxysmal: comes on suddenly
    - Positional: position
    - Vertigo: sensation of spinning

- Pathophysiology
  - There are presently 2 theories to explain BPPV
    - Cupulolithiasis - Condition where debris (otoconia) from the utricle is displaced into the semicircular canal and attaches to the cupula, which the semicircular canal responds to gravity.
      - Characterization: immediate onset of vertigo, nystagmus last as long as vertigo, least common form of BPPV.
    - Canalithiasis - Condition where debris (otoconia) from the utricle is floating in the endolymph in the semicircular canal.
      - Characterization: delayed onset of vertigo, nystagmus with complaint of vertigo, decrease in symptoms within 60 seconds, most common form of BPPV.

- Patient History
  - Patient’s with BPPV commonly complain of sudden onset of vertigo when the head is moved in certain positions such as lying down, rolling over in bed, rinsing hair in the shower, or bending over.

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Pathophysiology: Caused by abnormal afferent input to the vestibular nuclei from damaged joint receptors in the upper cervical spine. Diagnosis of exclusion. All other potential causes of dizziness must be ruled out before arriving at this diagnosis.

Patient Complaints: Unsteadiness associated with neck pain, limited cervical range of motion, dizziness, and headaches. Complaints of neck pain must be present.

Clinical Findings:
- Ocular motor exam is variable.
- Postural stability: difficulty with Romberg test, walking with head turns, and standing or walking on compliant surface.

Treatment: Treatment is targeted toward decreasing soft tissue and joint restrictions, and addressing postural abnormalities. Treatments include manual therapy, traction, balance exercises, dry needle, vestibular adaptation and habituation exercises.

Outcome: Patients should see improvements with a treatment combination of manual therapy and vestibular rehabilitation. However, continued use of vestibular suppressants may impede progress.

Patient Complaints: The pt may complain of acute onset of hearing loss, vertigo, nausea and vomiting that occur after the trauma. Chronically may continue to complain of motion provoked dizziness, positional vertigo, and unsteadiness in the dark or busy locations.

Clinical Findings:
- Oculomotor exam: Saccadic VOR with head rotation toward involved side, head shaking induced nystagmus, oscillopsia.
- Postural Stability: Sharpened Romberg is typically abnormal. Pt’s typically ambulate with little or no head or trunk rotation. Pt develops ataxia when asked to rotate head with ambulation.

Treatments:
- Habituation exercises to decrease dizziness with motion provoked symptoms are to be used with central vestibular lesions.
- Adaptation exercises, postural control exercises, and treatment of any cervical pain and ROM issues may be initiated with peripheral and/or central involvement.

Are you feeling Dizzy?
1. I feel like I am swaying all the time.
   - Smooth Pursuits: Limitations with driving, walking in grocery store
   - Saccades: Limitations with reading, watching TV, or busy environments
   - Convergence: Limitations with reading, computer work, driving
   - VOR: Limitations with head turns, and grocery shopping
   - Visual motion sensitivity testing: Limitations with riding in a car, exercising, performing house work
   - Treatments: Compensatory training, balance training

Is the room spinning?
1. Perform Dix Hall Pike Exam
   - Observation of nystagmus to either right or left side.
     - Nystagmus is upbeatling
       - ≤ 60 seconds
       - >60 seconds
     - Right or Left Posterior Canalithiasis
     - Treatment: Canalith Reposition Treatments
   - Nystagmus is Downbeating
     - ≤ 60 seconds
     - >60 seconds
     - Right or Left Anterior Canalithiasis
     - Treatment: Canalith Reposition Treatments
   - Examination: Liberatory Maneuver
   - Treatment: Liberatory Maneuver
Assessment of BPPV– Algorithm

I. Is the room spinning with positional changes?
   I. Negative Dix hall pike exam
      I. Perform Roll test
         I. Nystagmus is noted on either right or left side
         I. Geotropic nystagmus
         I. Horizontal Canal Canalithiasis
            I. Canalith Reposition Treatment– Appiani technique.
         II. Ageotropic Nystagmus
            I. Horizontal Canal Cupulolithiasis
               I. Treatment- Brandt-Daroff exercises
         III. No nystagmus is present
            I. No BPPV or mild BPPV
               I. Treatment- Brandt-Daroff exercises or refer back to MD.

Treatment– CRT

Treatment– Liberator Maneuver

Liberatory or Semont Maneuver

- Used for Cupulolithiasis
- Posterior and Anterior Canal
- Rotate head 45 degrees away from affected side.
- Quick movements to jar otoconia loose

Treatment– Appiani

Vestibulo–ocular Dysfunction

- The vestibular system includes parts of the inner ear and brain that help control our balance and eye movements.
- Damage to this area can cause hypofunction and unspecific vestibular dysfunction.
- The system can be damaged by disease, aging, or brain injury.

Vestibular Oculomotor Exam

- Allows for therapist to examine the interaction between the patient’s visual and vestibular system by having the patient perform a variety of head movements.
- The exam may differentially diagnosis vestibular disorders.
- May assist in determining part of the treatment plan.
Eye Movements on Exam

- **Nystagmus**
  - Involuntary oscillation of the eyes.
  - Typically has a fast and a slow component that alternates in opposite directions.
- **Saccade**
  - Rapid eye movement to bring a peripheral visual object to the center of the patient’s vision as quickly as possible.
- **Oscillopia**
  - A visual disturbance in which objects in the visual field appear to oscillate.

Visual Vestibular Interaction

- The three visual systems work together to maintain gaze as individuals attempt to identify moving objects in space and to maintain gaze stabilization.
  - Saccade system – The saccade system brings objects in focus as quickly as possible when there was an error in the direction of gaze.
  - Smooth Pursuits – This system maintains a gaze on a moving target.
  - Optokinetic System- This system is defined by a slow eye movement in the direction of a moving object and a rapid return of eye position in the opposite direction.

Oculomotor Screen

- **Spontaneous Nystagmus**
  - As the patient sits quietly have the patient look directly at your nose.
  - The pt’s eyes should look straight ahead.
  - Look for the presence of spontaneous nystagmus.
- **Gaze-Holding Nystagmus**
  - The pt should keep head neutral and have them look 30 degrees to the right and then left.
  - Look for signs of nystagmus.
- **Smooth Pursuit**
  - Instruct the patient to follow your finger or object side to side and up/down.
  - The eye movements need to be smooth.

Oculomotor Exam Guidelines

- When the patient is viewing an object, make sure the object is 18–24 inches away for the patient’s nose.
- Instruct the patient on the intended movements before moving their head.

Treatment– Vestibulo–ocular

- Habituation
- Adaptation
- Substitution
The goal is to reduce the dizziness through repeated exposure to specific movements or visual stimuli that provoke the patient’s dizziness.

Habituation exercises are indicated for patients who report increase dizziness when they move around, especially when the patient make quick head movements or when they change positions like bending over or look up to reach over their head.

Exercise programs must match the stimulus type and intensity of symptoms.

Treatments—Adaptation

Adaptation exercises are based on the ability of the vestibular system to modify the magnitude of the vestibulo-ocular reflex (VOR) in response to a given input (head movement).

- Adaptation exercises should incorporate head movements.
- Adaptation is context-specific—a single frequency of head rotation will result in the greatest change.
- The brain needs time to resolve the error signal. The exercises will produce vertigo and nausea. If a patient stops after 10–15 seconds the exercises will not be effective.
- Adaptation can be induced in 1–2 minutes. They should be done for 1 min at a time several times a day, and then increase to 2 minute periods.

X1 Gaze Stability exercises, X2 Gaze Stability exercises.

Substitution treatment is used when there is a complete bilateral loss of vestibular function, and there is no expectation of return of vestibular function.

Substitution examples include the use of night lights (to enhance visual input) or the use of a cane or walker to increase somatosensory input.

Dysfunction of the sensory system
- Visual System
- Vestibular System
- Somatosensory system
- Impaired response to changing environment.
“Dizziness is the second most commonly reported concussion-related symptom following headache. Studies of high school and college athletes have shown that 67-77% of athletes self-report dizziness after the concussion.”

The authors suggest that more recent evidence has suggested that an initial presentation of dizziness is one predictor of a protracted recovery following sports-related concussion. The findings are similar to non-athletic patients that found those with mild to moderate mTBI with dizziness 66.7% more anxious, had higher reports of depression, higher scores on outcomes identifying psychosocial dysfunction and were less likely to return to work.

The authors suggested that dizziness is an adverse prognostic indicator and one that should be assessed with the goal of treating the underlying cause as a means to aid recovery post-TBI.


