

### TELE-REHABILITATION GUIDELINE

#### Dizziness and Balance Disturbances after Traumatic Brain Injury

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#### I. Definition, Assessment, Diagnosis (Shepard, Handelsman, & Clendaniel, 2012) (Lan & Hoffer, 2019)

A. Definitions: Balance function is determined by multiple systems including sensory input from nerves and muscles, the visual system, the vestibular system, and the brain. While the cerebellum plays a large role in balance and coordination, all areas of the brain can influence balance function.

1. Dizziness: Perception of light-headedness, floating, tilting, other imbalance, or disorientation
2. Vertigo: A subtype of dizziness in which asymmetric or impaired input into the vestibular system results in the illusion of movement
3. Dizziness is a common complaint after all severities of Traumatic Brain Injury (TBI) and has been reported to occur in up to 80% of TBI cases.
4. Vestibular System: Balance is controlled via the vestibular system both peripherally and centrally.
  - a. Peripheral system: this includes the visual system, the inner ear (i.e., labyrinth with semicircular canals, cochlea), and cranial nerve VIII. Dizziness may occur with hearing loss.

- i. Benign Paroxysmal Positional Vertigo (BPPV): One of the most common reasons for dizziness/vertigo. Results from debris (otoliths) freely floating in the semicircular canals. Positional changes result in vertigo.
- ii. Labyrinthine Concussion: Sudden onset hearing loss and vertigo following head trauma. Not associated with temporal bone fracture. The forceful movement of fluid and tissues within the inner ear results in tissue injury and deterioration/death of metabolically active inner ear cells. Can result in secondary Meniere's disease.
- iii. Temporal Bone Fracture: Longitudinal fractures through the temporal bone can affect the external auditory canal and middle ear. Transverse fractures can affect the vestibular system and internal auditory canal.
- iv. Perilymphatic Fistula: Due to a compromise in the boundary between the inner and middle ear resulting leakage of perilymph fluid.

b. Central system: Direct trauma to the brainstem and cerebellum will result

in balance impairments and dizziness. Post traumatic migraines, seizures, and psychological disturbances may also result in imbalance and dizziness.

5. Nonvestibular causes of dizziness (Maskel, 2006) (Lan & Hoffer, 2019)
  - a. Orthostatic hypotension: Hypotension resulting from inadequate physiological response changes in position. This can result from deconditioning, medullary injury, medication side-effects, etc. Work up will show a decrease in systolic blood pressure of 20mmHG or a decrease in diastolic blood pressure of 10mmHG or more within 3 minutes of position change.
  - b. Cervical injury/Whiplash associated disorders resulting in cervicogenic dizziness- this is uncommon and can be difficult to diagnose.
  - c. Seizures
  - d. Preexisting medical conditions: Cardiac diseases and Diabetes Mellitus
6. Balance impairments have been associated with severity of TBI, older age, and acute hospital length of stay. (Greenwald, et al., 2001)

### B. Assessment

1. History:
  - a. Blunt force head trauma
  - b. Penetrating head trauma
  - c. Blast injury
  - d. Skull fracture (especially temporal bone)
2. Signs and Symptoms:
  - a. Dizziness
  - b. Light-headedness
  - c. Spinning sensation
  - d. Ataxia
  - e. Impaired balance
  - f. Frequent falls or near-falls
  - g. Syncope
  - h. Vision impairment, nystagmus, convergence disorder
  - i. Hearing impairment (including but not limited to tinnitus and sensation or aural fullness)
  - j. Peripheral Disorders (Lan & Hoffer, 2019) (Shepard, Handelsman, & Clendaniel, 2012)
    - i. *Benign Paroxysmal Positional Vertigo*: Frequent episodes of paroxysmal vertigo that typically lasts less than 1 minute. Associated with position change, nystagmus, lightheadedness, and imbalance.
    - ii. *Labyrinth Concussion*: Sudden onset vertigo that is

continuous and associated with hearing loss. Can last anywhere from 5 minutes to days. May be related to positional changes.

- iii. *Temporal Bone Fractures*: Variable presentation, prognosis, and duration due to location and extent of fracture. Symptoms include hearing loss, vertigo, imbalance, sanguinous otorrhea, and pain.
  - iv. *Perilymphatic Fistula*: Intermittent vertigo associated with straining (i.e., sneezing, coughing, lifting, etc.).
- k. Central Disorders
- i. *Trauma to Brainstem/Cerebellum*: Symptoms may include nausea, vomiting, nystagmus, and imbalance with preservation of the VOR.

3. Objective Measures ( (Maskel, 2006)):

- a. Dizziness Handicap Inventory
- b. Dynamic Gait Index
- c. Berg Balance Scale

4. Physical Exam:

- a. Orthostatic vital signs
- b. Cranial Nerve examination
- c. Observation for nystagmus, saccades, smooth pursuit
- d. Bedside vestibule-ocular reflex testing (VOR)
- e. Dix-Hallpike maneuver
- f. Cerebellar testing including Romberg testing and coordination testing

C. Diagnosis

1. Imaging

- a. CT head to evaluate for temporal bone fracture or mass lesion
- b. MRI brain

2. Otolaryngology and Audiology consultation for evaluation and laboratory testing:

Testing includes but is not limited to Electro-oculography (EOG), Video-oculography (VOG), Optokinetic nystagmus, Caloric testing, Rotational testing, Posturography, Vestibular-evoked myogenic potential.

- II. Management and treatment recommendations (Lan & Hoffer, 2019) (Sabini, 2016)
- A. Treatment options for post-traumatic vestibular disorders include medications, surgery, and Vestibular and Balance Rehabilitation Therapy (VBRT)
  - B. VBRT: A rehabilitation program that takes advantage of neural mechanisms and plasticity to promote habituation, adaptation, compensatory techniques to manage vertigo, dizziness, and imbalance.
    - a. Types of VBRT:
      - i. Habituation – Repeated exposure to stimuli- in this case, head movements- with goals of symptom reduction toward the stimulus.
      - ii. Adaption – Similar to exercises for habituation but with goals of reducing symptoms by using head movements to produce long-term plastic changes in the neural response to a given movement.
      - iii. Substitution – Used in individuals with bilateral vestibular loss, this technique utilizes alternative strategies for gaze stability and postural control.
      - iv. BPPV- rehabilitation technique includes Dix-Hallpike maneuver which is a series of positional changes designed to move otoconia out of the involved canal.
  - C. Medications used to help with dizziness and vertigo should be used short term and on an “as needed basis” as they can impeded the development of compensatory techniques/neural pathways and can affect the VBRT process. (Shepard, Handelsman, & Clendaniel, 2012) (Sabini, 2016)
    - a. Antihistamines:
      - i. Meclizine 25-100mg/day divided BID to TID.
      - ii. Promethazine – 25mg PO BID
    - b. Anticholinergics: Scopolamine 1.5mg transdermal patch, apply one patch every 3 days.
    - c. Phenothiazine: Prochlorperazine 5-10mg every 6-8 hours, max dose 40mg/day. Monitor for leukocytopenia.
    - d. Benzodiazepines (Diazepam, Lorazepam & Clonazepam) – This drug class is used in patients who are unable to tolerate antihistamines and/or anticholinergics (e.g., patients with glaucoma or benign prostatic hypertrophy, other urinary retention disorders)
  - D. Surgery: Although not routinely done, surgery may be considered in patients with temporal bone injuries and/or perilymphatic fistulas. (Shepard, Handelsman, & Clendaniel, 2012)
    - a. Temporal bone fractures: if no dural tears/brain exposure, the external ear canal can be microdebrided and repair can be done to injured structures
    - b. Perilymphatic fistulas: Typically treated conservatively with relative rest, elevation of head, and avoidance of straining. If symptoms do not resolve, surgical exploration may be warranted.

### III. Prevention and Education

- A. Patients and family should be educated regarding the process of VBRT and should be told that the exercises will provoke symptoms.
- B. Medications are only recommended for short term use and can prolong treatment and recovery from vestibular disorders.
- C. Patients and families should be provided with educational material for fall prevention including environmental modifications (i.e., improved lighting, removal of rugs and electrical cords, installation of handrails).

*This guideline was developed to improve health care access in Arkansas and to aid health care providers in making decisions about appropriate patient care. The needs of the individual patient, resources available, and limitations unique to the institution or type of practice may warrant variations.*

#### Guideline Developers

Guideline developed by Rani Haley Lindberg, MD, in collaboration with the TRIUMPH team led by Thomas S. Kiser, MD, and Rani H Lindberg, MD.

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