



VESTIBULAR DYSFUNCTION ASSOCIATED WITH BLAST INJURIES

OBJECTIVES

- Understand the mechanism of injury behind Traumatic Brain Injury Blast Injuries
- Recognize Signs and Symptoms associated with Blast Injuries
- Understand the need for assessment and treatment of vestibular dysfunction in this patient population



OCCURRENCE

- In 2009 Pentagon released that up to 360,000 veterans of the wars in Iraq and Afghanistan have suffered Brain Injuries
- Of those veterans, 90% are so called mild cases and recovery is expected.
- Estimated 45,000 to 60,000 victims however suffer persistent symptoms such as memory loss, lack of balance and problem solving difficulties
- These numbers may be a lot higher secondary to difficulty monitoring the injuries and the failure to report mild concussive injuries



TRAUMATIC BRAIN INJURY

- Is the result of a blow or jolt to the head or a penetrating head injury that disrupts the function of the brain.
- Mild Injury: a brief change in mental status or consciousness
- Severe Injury: an extended period of unconsciousness or amnesia after the injury



LEADING CAUSES OF TBI IN THE MILITARY

- Bullets, fragments, blasts
 - Falls
 - Motor vehicle- traffic crashes
 - Assaults
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- Blasts are the leading cause of TBI for Active Duty Military in war zones



WHAT IS THE VESTIBULAR SYSTEM?

- Provides information concerning gravity, rotation and acceleration for the body in space
- Serves as a reference for the somatosensory & visual systems
- Contributes to integration of arousal, conscious awareness of the body via connections with the brain
- Allows for:
 - gaze & postural stability
 - sense of orientation
 - detection of movement of body in different planes



NON BLAST RELATED TBI INJURY

- 80% reported “dizziness”
- Vestibular pathology present in 30-65% of individuals
- Vestibular screening needs to be done in all patient's with TBI



WHY IS THE VESTIBULAR COMPONENT SO COMPLICATED?

- No objective evidence in humans to support the theory that blasts cause neuronal damage and subsequent brain injury
- “Dizziness” is subjective
- Incidences of dizziness, vestibular pathology and TBI secondary to blast injury is unknown
- Complicated by physical and psychological stresses associated with injuries in a war zone
- Debate on whether symptoms associated with mTBI originate from pathophysiological process or from psychosomatic



WHAT IS A BLAST INJURY?

- Primary: injuries from impact or shearing from overpressure wave
- Secondary: injuries from projectiles (shrapnel or debris)
- Tertiary: injury from displacement of the individual by blast wind
- Quaternary: other injuries



PRIMARY INJURY

- Caused by barotrauma, attributable to either overpressurization or underpressurization relative to the atmospheric pressure
- Affect the hollow organs in the chest abdomen and middle ear as well as great vessels in neck, inner ear and possibly the brain
- Inner ear trauma is common- considered a sensitive indicator of blast exposure with 35-50% experiencing some sort of hearing loss
- 15-40% complain of dizziness or vertigo



CLOSED HEAD INJURY RELATED TO BLAST

- Diffuse axonal injury, contusion and subdural hemorrhage
- Axonal injury is the most common frequently associated with mTBI and characterizes the vast majority of blast injuries sustained by service members
 - Occurs when shearing, stretching or traction on small nerves leads to impaired axonal transport, focal axonal swelling and possible axonal disconnection
 - MRI/CT inconclusive



SYMPTOMS ASSOCIATED WITH MTBI

- Headaches
- Dizziness
- Excessive fatigue (tiredness)
- Difficulty concentrating
- Forgetfulness
- Irritability
- Balance problems
- Vision changes
- Sleep disturbance



VESTIBULAR PATHOLOGY AFTER HEAD TRAUMA

- Temporal bone fractures
- Labryinthine concussion
- Post traumatic endolymphatic hydrops
- Benign paroxysmal positional vertigo (BPPV)
- Perilymphatic fistula
- Vascular or central lesions



CHARACTERISTIC'S AND SENSORIMOTOR DEFICITS

- Reports of dizziness , vertigo and Oscillopsia (blurry vision) in days/weeks after blast injury and persistence of symptoms for ongoing months
- Symptoms sometimes not noticed until redeployment and in home environment
- Recent studies show a total of 71% of survivors with initial complaints of dizziness continued to be symptomatic > 6 months
- Feeling of “off balance” or postural instability, hearing loss, light sensitivity and inability to read for long durations



WHAT DOES THIS MEAN FOR CLINICAL PRACTICE?

- Comprehensive assessment is needed to identify exact deficits
- Rule out differential diagnosis such as vascular compromise (vertebral a), C1/C2 involvement, cervicogenic/postural deficit or orthostatic hypotension
- Currently there is no “gold standard” and no agreement about diagnostic measures for blast related dizziness
- Rehab community has an opportunity to contribute data toward a consensus on optimal diagnostic and treatment practices



REFERRAL TO VESTIBULAR REHAB

- Screenings done by TBI clinics on Military Installations
 - MACE (Military Acute Concussion Evaluation) and the Blast Injury Questionnaire are useful for directing the initial screening and characterization of patients with blast exposure and suspected TBI or vestibular pathology
 - Dizziness Handicap Inventory and Activities-specific Balance Confidence Scale provide insight into a patient's self perceived limitations
 - Pre-deployment and post deployment questionnaires are now being completed.



PHYSICAL THERAPY ASSESSMENT

○ History and Subjective

- Document patient's functional problems and the many sensory, motor and cognitive limitations contributing to loss of functional independence
- When are they experiencing dizziness/vertigo or imbalance or what provokes symptoms
- Other complaints and symptoms such as headaches/light sensitivity, cognitive impairments, insomnia, depression, anxiety or agitation



PHYSICAL THERAPY ASSESSMENT

○ Physical exam

- Cervical Spine ROM/Limitations
 - C1/C2 mobility
 - Vertebral artery compression test
 - Postural deficits/muscular imbalances
- Visual/Vestibular system examination (Eye Head Coordination)
 - Oculo-motor ROM
 - Nystagmus both fixed gaze and head shaking
 - Smooth Pursuits
 - Vestibulo-Occular Reflex of VOR
 - Dynamic Visual Acuity (DVA)



PHYSICAL THERAPY ASSESSMENT

- Vertigo assessment/Motion sensitivity
 - Spontaneous
 - Provoked: positional changes
 - Hallpike Dix Test
 - Movement or motion sensitivity
- Postural Control/Balance in sitting/standing and walking
 - Romberg, Sharpened Romberg, Single Leg Stance
 - Ambulation with head turns
 - Quick Ambulation with Quick changes in position
 - Stair negotiation
 - BERG balance exam/Dynamic Gait Index (DGI)
 - Sensory Organization Test/Balance Master



MAKING SENSE OF IT ALL

- Sorting out the relative contribution of vestibular pathology to overall loss of function can be difficult
- Functional deficits after TBI are usually due to combination of many interacting factors
- Rule of thumb; treat the symptoms!



PHYSICAL THERAPY MANAGEMENT

- Individualized treatment plans based on symptoms and objective findings
- Recent findings show significant improvement in all areas of vestibular rehab after 8-12 weeks of vestibular physical therapy
- Marked decreases in subjective reports of dizziness and headaches and feeling of “off balance” as well
- Objective measures such as DGI and SOT scores significantly improved after 12 weeks



RECOVERY FROM TBI

- Plenty of sleep at night and rest during day
- Return to normal activities gradually
- Avoid exposure to high risk activities until healing has occurred (recreational sports etc)
- Avoid alcohol- slows brain recovery
- Use strategies to aid in memory impairment
- Use structure and routine each day
- One thing at a time for better focus less distractability
- Use relaxation techniques, yoga, meditation for irritability and remove self from situations
- Be patient! It will take time!



RETURN TO DUTY

- Too soon can cause temporary worsening of symptoms if brain is not fully healed
- Physical Exertion tests are helpful in gauging if symptoms will re-occur
- Gradually resuming duties may be helpful
 - Shortened work day
 - Allow for breaks when symptoms increase
 - Reduced task assignments and responsibilities



WHERE DO WE GO FROM HERE?

- Expected that current research in animal models and clinical work with survivors of blasts will yield important evidence in support of neurotrauma after blast injuries
- Rehab community has an opportunity to contribute to the growing body of knowledge and help investigate mechanisms of injury and effective recovery strategies



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