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PHYT 820 – Advanced Patient Management

TBI Module Final Assignment

Due: November 14, 2018

**Physical Therapy Considerations for Post-Concussion Syndrome Treatment in Servicemembers:**

*Based on a Health Sciences Library search (you may also need to access sports database, i.e. SportDiscus) describe outcome measures and treatment activities that would be appropriate for a patient with post-concussive symptoms who is experiencing mild balance problems with vestibular complaints (you may choose to focus on patients with an orthopedic injury or individuals with polytrauma/blast injury, depending on your interest).  Is there evidence to support interventions for mild brain injury to improve balance or address post-concussive symptoms? It is not possible to address this topic without delving into vestibular issues, so make sure that is part of what you research.  Your assignment should include review of the literature pertinent to the questions,****with citations as appropriate****.*

 With the most recent changes in weaponry and protective armor in the past few decades of military warfare, the types of injuries that medical professionals have seen has dramatically changed. The intent of the majority of weaponry efforts has been to optimize ordinance’s explosive efficiency thereby overcoming the enemy’s protective capacity in order to maximize blunt and penetrating injuries.1 This intent has produced devastating injuries which has altered the medical approach to traumatic care and, more importantly, the lives of servicemembers who have dedicated their lives to protecting their country. Advances in traumatic care interventions have improved survival rates in many of these servicemembers, but this innovation has also introduced complex disorders that medical and allied health clinicians must treat and rehabilitate. The “signature injury” of the most recent conflicts in Iraq and Afghanistan is Traumatic Brain Injury (TBI), as up to two-thirds of medical evacuations have been due to blast exposures.2 Since 2000, Helmick reports that 300,000 servicemembers have been diagnosed with TBI with 80% being mild TBIs (mTBI), or commonly referred to as concussion.3 With such a high prevalence of servicemembers returning with concussions, it is imperative that clinicians understand the mechanism of injury, evaluation, and treatment of common deficits associated with mTBI and how it impacts the individual servicemember as well as force readiness at large.2–4

 “Military” concussions can be sustained from multiple sources, but are generally characterized as blunt mTBI or blast mTBI.5 When servicemembers are stateside, blunt mTBI is understandably more common, often occurring as a result of bad airborne operations (BAO), such as having a hard parachute landing, hitting the head during physical training activities, motor vehicle accidents, as well as “bar fights.”4 Alternatively, blast mTBI can be caused by proximity to explosions during door breaches, heavy weaponry, or improvised explosive devices (IED).3 While both causes can produce similar symptoms, the pathophysiology and symptom presentation of each need to be differentiated. Blunt mTBI is often more associated with potential diffuse axonal injury and dizziness due to positional changes, migraine, exercise, or spatial disorientation.5,6 Whereas, blast mTBI have these same symptoms often compounded by episodic vertigo, ear pressure, tinnitus, and hearing loss.5

 Furthermore, blast mTBI needs to be evaluated with heavy consideration for the multiple systems that can be affected by exposure to explosion and not the “simple” direct trauma to the head with blunt mTBI. The physics of explosives and material characteristics should be considered with blast mTBI.1 For example, peak initial positive-pressure wave, distance from the blast, duration of overpressure, density of medium in which the explosion occurred (air vs. water), and extent of blast wave reflection can impact the extent of damage and severity of injuries inflicted.1 Low frequency (<0.5 kHz), high-amplitude blasts are more related to gray-white brain matter damage due to generating local motions that overcome the tissue’s natural elasticity.1 Blasts produce multiple levels of injury and are typically differentiated into primary, secondary, tertiary, quaternary, and quinary blast injuries. Interactions between the living body and the blast wave can produce primary blast injuries, such as the reflection, absorption, and propagation of the tissue-transmitted shock wave through the body.1,2 The blast can also propel debris fragmentation that produces secondary blast injuries of blunt or penetrating interactions with the body. Tertiary blast injuries from acceleration and deceleration of the body can produce whiplash-type injuries. Intense, transient heat can produce flash burns, quantified as quaternary blast injuries. Finally, broad factors can produce quinary blast injuries, including post-detonation environmental contaminants, carbon monoxide, and tissue response to metal or fuel residues. The varying types of injuries due to blast exposure can impact the necessary treatment for servicemembers as well as the timeline for recovery.

 For many servicemembers who sustain an mTBI, symptoms can typically resolve within three months or even as low as twenty-one days as seen in adolescent athletes.7,8 However, many individuals continue to struggle with symptoms and do not fully recover over time, and therefore referral to physical therapy is appropriate with the interventions focused on adaptation or compensation for vestibular deficits, management of exercise intolerance, or treatment of comcomitant cervical injury.7 The Department of Defense (DoD) has developed the Defense Veterans Brain Injury Center (DVBIC) in order integrate TBI care, research, and education for military personnel and improve the access to needed care from multiple specialized disciplines.9

Patients may present with a wide array of complaints, including hearing, memory, exertion, sleeping, memory, or pathologies of a more vestibular origin such as dizziness, unsteadiness, vertigo, and oscillopsia.2 However, there is some debate that some of these symptoms have a psychosomatic nature that is confounded by post-traumatic stress disorder (PTSD).1,2 Many soldiers who are exposed to “blast syndrome” report losses of consciousness and being “stunned,” with later complaints of headaches, tinnitus, deafness, dizziness, tension or dullness, apathy, and poor memory.1” Furthermore, patients who have experienced blast mTBI as compared to blunt, impact, non-blast TBIs were more irritated by crowds and/or noises and experienced greater physical and emotional exhaustion.1 Psychological distress can also contribute to or even exacerbate symptoms of post-concussion syndrome with each presenting patient. However, many servicemembers can present with physical therapy appropriate diagnoses including unilateral vestibular hypofunction, benign paroxysmal positional vertigo, gaze instability, dual-task deficits, cervicogenic headaches, post-traumatic headaches, gait impairment, static and/or dynamic balance dysfunctions, sensory disorganization, motion sensitivity, temporomandibular disorders, and exertional headaches.2,8

Outcome measures are useful tools for diagnosing as well as measuring recovery for servicemembers following concussion. There are multiple types of tests that can be used for many complaints that the patient may present with, though the clinician should be prepared to utilize multiple tests as many are not appropriate in isolation. For visual complaints, utilizing the Vestibular Ocular Motor Screening for Concussion (VOMS) is useful for assessing symptom provocation. 7 Whereas, the Dynamic Visual Acuity (DVA) test is a useful test for assessing Vestibulo-Ocular Reflex (VOR) function and the patient’s ability to stabilize vision with movement, which is very important with tracking during aiming weaponry.7,10 When the therapist is evaluating vestibular complaints, utilizing the Head Impulse Test or Head Shake Test can be useful in determining vestibular hypofunction that contributes to deficits in VOR, although these are not explicitly outcome measures but rather diagnostic tools.7 Furthermore, the clinician may want to rule in or out Benign Positional Paroxysmal Vertigo (BPPV) by utilizing the Dix Hallpike Maneuver Supine Roll Test which can identify dysfunction in the posterior canals of the vestibular system based off of characteristic directional nystagmus.11 Objective assessment of balance will also be important, such as the integration of the somatosensory, vision, and vestibular systems, by utilizing the Modified Clinical Test of Sensory Interaction in Balance (MCTSIB).12,13 If the equipment is available, the clinician could use a NeuroCom to perform the Sensory Organization Test (SOT) or further tease out vestibular function with the Head-Shake sub-test (HS-SOT).10,14,15 Dynamic balance is also very important for active-duty servicemembers, therefore the Functional Gait Assessment (FGA) can be helpful in observing the patient’s ability to maintain balance with ambulatory activities and dual tasks.5 Furthermore, the Activities-Specific Balance Confidence scale (ABC) can be employed in order to recognize the patient’s subjective opinion of their own balance in order to individualize the patient’s plan of care.5 Dizziness is often a major complaint following concussion, therefore performing a physical, objective measure, such as the Motion Sensitivity Questionnaire (MSQ), can be useful in establishing a baseline and measuring progress of dizziness symptoms impacted by position changes.16–19 The clinician might also utilize the Dizziness Handicap Inventory (DHI) to assess subjective feelings of dizziness or visual vertigo with motion sensitivity.5,17 Finally, a major complaint that impacts full return to duty in many concussed servicemembers is exercise-induced dizziness and headaches. The Buffalo Concussion Treadmill Test (BCTT) is a graded aerobic capacity and headache assessment that is helpful in assessing activity tolerance as well as can drive exercise progression.8,20,21

Once the servicemember’s deficits are identified, appropriate evidence-based interventions can be utilized in the clinic setting as well as in a home exercise program. A common visual deficit that patients can struggle with is convergence and divergence, and therefore prescribing “pencil push-ups” to promote ocular muscle strengthening is appropriate.22 If a deficit is noted in VOR, applying VOR progression exercises can be indicated, such as initiating VOR1 in a stable position, and then progressing to VOR2 and VOR cancellation while potentially incorporating balance and dynamic activities for further progression options.22 Sometimes patients might also struggle with symptoms of dizziness due to VOR hypofunction, therefore gaze stabilization activities will also be appropriate.22 Servicemembers exposed to blasts may also be apt to develop BPPV due to otolith displacement from the force of the blast and would benefit from canalith repositioning by utilizing the Epley Maneuver or other advanced maneuvers.23,24 Brandt-Daroff exercises may also be appropriate for habituation-type exercises to decrease symptoms of dizziness or for self-directed repositioning.25 However, Brandt Daroff exercises have been shown to be less effective than canalith repositioning maneuvers, but may be appropriate as a generalized habituation exercise for symptomatic patients.23

As many servicemembers will have difficulty with static and dynamic balance due to decreased input from the vestibular system, balance progression activities will also be indicated.8,22,26 To isolate the use of the vestibular system in order to improve its function, using a NeuroCom for “neuro-games” such as weight shifting games in which the vision and somatosensory systems are negated and progressively increasing the responsiveness of the computer system can challenge and improve the vestibular system’s function. When this expensive equipment is not available in a clinic, doing activities with similar intent is appropriate, such as standing on an unsteady surface (i.e., foam pad, Bosu ball, etc.) with eyes closed will challenge the vestibular system. Furthermore, enhancing the other systems involved with balance may be helpful in providing compensatory strategies to maintain balance. Servicemembers exposed to blast are also likely to develop hyperacusis, which is important to address, as active duty soldiers are still likely to be exposed to loud noises (i.e., gunfire, etc.) in which they will have to maintain high function with their work duties. Habituation activities may be appropriate in more advanced stages of rehabilitation, such as incorporating balance activities on a BOSU ball while bouncing a ball off of a rebounder, as the sound of the rebounder is typically irritating and is relatively similar to the sound of repetitive gunfire.27,28

Headaches are very common in servicemembers following concussion and can be due to varying etiologies whether from sensory overstimulation or cervicogenic origins. Differentiating the cause of the headaches is necessary in order to improve the patient’s symptoms. Cervicogenic headaches are common following concussion, often due to whiplash-type injuries that produce muscle tension.29,30 This can often be aggravated by poor posture or the use of heavy helmets. While in clinic, patients may benefit from orthopedic-directed interventions, such as manual therapy, dry-needling, traction, and postural re-education.22 Headaches may also be aggravated by exertional activities. Many servicemembers report headaches that are increased during morning physical training, particularly with running. This may be due to the vertical oscillation and “jarring” movements of the head that aggravate VOR symptoms, but there is also evidence of autonomic dysregulation as evidenced by changes in cardiovascular responses to aerobic activity.22 Incorporating treatment in-clinic or at home is typically indicated, such as a graded aerobic progression. Home exercises might include a running program starting with one-minute running and one-minute walking at a pace that does not increase symptoms by greater than one value on the Visual Analog Scale and progressing running time ratios to walking. Another clinic option is using an anti-gravity treadmill that decreases the vascular load on the body and slowly increasing the gravity demands on the body to replicate realistic running.22,31–38

Servicemembers also have difficulty with combining motor and cognitive activities following a concussive event.8 For example, concussed athletes demonstrate performance deficits in motor planning and execution in novel, visuomotor tasks.39 Furthermore, there are changes in reaction time, movement time, and precision when comparing motor integration for subjects with concussion as compared to healthy controls.39 Residual deficits following concussion can be evidence in motor functions in dual-task conditions.40 This is relatively concerning for servicemembers in military duty-tasks as precision and integration of motor and cognitive tasks are important for stateside activities and safety in combat situations. However, recovery patterns of improvement can be seen over time and particularly with treatment.40 Therefore, therapists should incorporate dual-task activities, such as ambulation with cognitive tasks like counting backwards by values of three.

Overall, understanding concussion care in servicemembers is a very complex task. It is important that clinicians differentiate the varying etiologies of concussion, such as blunt mTBI or blast mTBI. The pathophysiology of exposure to blasts can impact the servicemember’s neuroanatomy, psychological response to traumatic events, as well as additional orthopedic injuries. Furthermore, therapists need to be able to systematically identify and analyze symptoms related to concussion in order to implement appropriate interventions. There is bountiful evidence of appropriate interventions for the varying degrees of complaints following concussion, however, there is always need for additional, high-quality evidence that supports each unique intervention.

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