

Editorial

Multidisciplinary approach to psychiatric symptoms in mild traumatic brain injury: Complex sequelae necessitate a cadre of treatment providers

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Acute and chronic psychiatric consequences of concussion, mild traumatic brain injury (mTBI), and repeated head injury have gained widespread attention, in part, due to the highly publicized cases of professional athletes and active military with repeated head injuries or chronic symptoms of head injury who have committed suicide in recent years. Nonscientific coverage of chronic traumatic encephalopathy (CTE) further adds to the fractured information the lay population is accumulating in the area of concussion and mTBI. Epidemiological studies report that 1.7 million individuals in the United States alone suffer mTBI, with over 300,000 occurring in sports-related injury. The World Health Organization estimates that 100-300/100,000 in the population are treated for mTBI, but that population base rates likely approach 600/100,000 including those who do not seek medical attention.^[3] Primary epidemiological studies derive from North American populations and less is known about world-wide incidence, particularly in nondeveloped countries without access to organized healthcare.

The terms “concussion” and “mild traumatic brain injury” are often used interchangeably and describe a blow or force to the head that results in an alteration of mental status with or without loss of consciousness. Primary sources of concussion include motor vehicle accidents and falls, and occur in sports-related injury and military service and combat. The acute phase of recovery from mTBI generally occurs within 3 months postinjury, with many patients reporting recovery of symptoms within the first 10 days.^[6] The chronic phase represents symptoms persisting for past 3 months, described as postconcussion syndrome (PCS).^[1]

Chronic sequelae of concussion are complex, have been debated, and can include changes in cognition (i.e., learning, memory, and attention), physical symptoms (i.e., headaches, fatigue, sleep disruption), and emotional functioning (i.e., behavioral changes, depression, anxiety). Silverberg and Iverson^[15] have posited a model of both neurobiological and psychological contributions to protracted recovery and development of emotional distress in mTBI. This builds upon work by Lishman^[9] who suggested that acute symptoms result from pathophysiologic causes and chronic symptoms are perpetuated by psychological factors. The more recent scientific-based research illuminates that there is likely a central common pathway to psychiatric consequences of mTBI, and repeated mTBI, related to neurophysiological and molecular changes, rather than older models that suggest that persistent concussive symptoms are psychiatric (e.g., stress-based) without neurologic underpinnings.

Individuals who sustain a concussion typically consult with neurosurgeons, primary care physicians, pediatricians, neurologists, sports medicine physicians,

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and neuropsychologists. Each discipline offers a unique perspective to treatment. Postinjury recommendations often include cognitive and physical rest, pharmacologic interventions for pain or headaches, neurosurgical consultation, and vestibular treatment when warranted. Psychiatric symptoms are well documented sequelae of concussion and mTBI, with psychiatrists often absent the list of providers involved in the framework of treaters and as contributors of evidence-based research.

Concussion is an injury that occurs at the molecular level due to biomechanical forces on brain tissue.^[10] Localization of damage is difficult due to the diffuse nature of injury (i.e., closed head injury, rotational injury, etc.). An examination of a central common pathway to injury is occurring in the scientific community. Immunotoxicity leading to progressive neuroinflammation and excitotoxic injury is one mechanism posited, among others.^[2] Diffusion tensor imaging studies have demonstrated increases in diffusivity in brain regions including diffuse white matter tracts and regions such as the posterior cingulate, hippocampal formation, left temporal, frontal, and occipital cortices in head injury of heterogeneous etiology.^[7,14]

In regard to psychiatric symptoms in particular, functional magnetic resonance imaging studies have shown that concussed athletes with symptoms of depression had diminished neural activity in parahippocampal and posterior cingulate regions that was positively correlated with severity of depression.^[4] Repeated injury, as in sports or combat-related brain injury, may reflect confluent changes involving both neurometabolic, neurophysiologic and psychiatric reaction, with potential for cumulative physiological effects. Additionally, altered brain physiology may make individuals more susceptible to and less resilient against situational stressors postinjury.

An alternate explanation for psychiatric consequences to mTBI is that the injury may cause neurometabolic changes in the brain affecting endogenous neurotransmitter system responsible for depressive disorder, for example.^[15] Studies have shown an increased risk of developing depression in individuals with varying degrees of TBI.^[8] Guskiewicz *et al.*^[5] showed a 3-fold prevalence ratio for depression in retired football players who sustained three or more concussions. However, results were based on a retrospective self-report analysis, rather than prospective analysis. In military personal in particular, posttraumatic stress disorder (PTSD) plays a complex role in recovery from TBI as a concomitant factor in recovery, and the role of alteration in neurophysiology and premorbid factors is unknown. Silverberg and Iverson^[15] posit a biopsychosocial conceptualization of poor outcomes in mTBI, highlighting the role of intervention from psychiatry, neurosurgery, neuropsychology, and neurology in the treatment of chronic neurologic, physical, cognitive, and emotional sequelae.

Neurologic mechanisms, neuropsychological profiles, and neuropathological studies are abundant in the mTBI literature. Neurosurgeons play an integral role in treating mild TBI when there is evidence of cerebral and extracranial injuries, as highlighted previously in this journal.^[12] Neurosurgeons may need to refer on to colleagues in neurology, sports medicine, and neuropsychology for symptom management after surgical intervention, or when surgical intervention is not warranted but the patient continues to report symptoms. Psychiatric referrals are also important in these cases, to address any immediate or untreated persistent emotional changes. However, there is a paucity of studies on the psychiatric sequelae and psychological interventions of these individuals *in vivo*. We would argue that psychiatrists and neuropsychiatrists who attend to populations most at risk for mTBI and concussion should also be educated in concussion management, and in particular as it relates to repeated head injury and possible long-term consequences of concussion. The Veteran's Administration and the Department of Defense in the United States have taken steps to incorporate psychological treatment into the armamentarium of providers that care for mTBI in active and retired military.^[17] Treatment includes an assessment of behavioral symptoms in all individuals with concussion and/or mTBI, and strategies and treatment plans for psychiatric symptoms. Akin to recent efforts to incorporate and educate the neurosurgical community^[12] efforts should include education of providers in the behavioral sciences, such as psychiatry, neuropsychiatry, and psychology. In addition, awareness of psychiatric and neuropsychological consequences is particularly germane to neurosurgeons as they may be the initial level of treatment providers. While the exact nature of the psychiatric symptoms following mTBI may be unclear, it is unequivocal that psychiatric symptoms are part of the spectrum of experience for some of these patients.

At an international level, an assessment of behavioral symptoms would, at the least, only necessitate educated healthcare providers, rather than expensive equipment that can be sparse in developing countries. Nonpharmacologic treatment can be assigned to individuals who lack resources to pharmacologic treatment, such as education, behavioral strategies to monitor symptoms of depression and anxiety, and examination of sleep hygiene for appropriate rest after incident, for example. Studies have demonstrated cost-effective interventions to diminish chronic psychiatric symptom development, such as informational booklets to explain symptoms and coping strategies, cognitive rehabilitation strategies, and guidance for emotional support.^[11,13,16]

Psychiatric and behavioral symptoms following concussion and mTBI are complex and efforts are

underway to establish accurate diagnosis and treatment of emotional changes *in vivo*, as well as elucidating neurophysiologic mechanisms that contribute to behavioral change. The United States Veterans Association and Department of Defense, in particular are addressing such issues in active and retired military personnel. Organized professional sports organizations in the United States are also in the forefront of scientific investigation into cognitive, behavioral, psychiatric, and physical sequelae of concussion and mTBI. Such efforts include a prominent role for Psychiatry in this field. It is evident that a cadre of treatment providers is necessary to address the spectrum of brain injury from physiologic to psychiatric symptoms. Advancement in the areas of psychological and behavioral symptoms is warranted, and disseminating information at an international level in the form, at the least, of education is an attainable goal through a multidisciplinary approach to treatment.

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