

Editorial

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Blast-Traumatic Brain Injury (TBI) with Post-traumatic Stress Disorder (PTSD): A Treatable Condition?

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Since 2001, about 2.7 million US service members have been deployed overseas in addition to hundreds of thousands from countries worldwide.¹ During conflicts, troops frequently encounter attacks with high explosives. These have been responsible for at least 60% of combat-related casualties.² Explosive devices include improvised explosive devices (IEDs), landmines, and rocket-propelled grenades.³ “Blast injury” is a term that describes biophysical and pathophysiological events as well as clinical symptoms that occur when individuals are subjected to explosions of any kind.⁴ In a series of post-mortem cases, Shively et al sought to determine if the pathology of the blast-associated traumatic brain injuries presented unique patterns of damage that might differ from those associated with impact-induced, non-blast traumatic brain injuries.¹ They found a “distinctive pattern of scarring that may indicate specific areas of damage from blast exposure consistent with the general principles of blast biophysics that could also account for aspects of the neuropsychiatric clinical sequelae reported” and determined that all cases of chronic blast exposure had an ante-mortem diagnosis of post-traumatic stress disorder.¹ So despite the lack of findings with conventional neuroimaging for mild traumatic brain injury (TBI), military personnel who have reported persistent post-concussive symptoms, such as headache, sleep disturbances, concentration impairment, memory problems, depression and anxiety may have structural damage that goes undetected, yet presents as post-concussion syndrome.⁵ This has led to the use of the term “invisible wounds” for those with TBIs and these symptoms.⁶

The deployments to Iraq and Afghanistan have been associated with an increased risk of mental health problems⁷ which tend to increase in the months after returning from deployment.⁸ Unfortunately, only half of the soldiers with a mental problem reported seeking care within a year,⁹ presumably due to stigma and perceived barriers to mental healthcare.¹⁰ Kim et al also found that only 13-53% of U.S. and Canadian veterans who met the criteria for a mental health problem after deployment received care. An additional problem is that veterans who enter mental health treatment often do not receive adequate care.¹¹ Whatever the reason for the failure of these veterans to receive adequate treatment for mental health disorders, the resulting suicide rate among service members, reported to be as high as 22 suicides per day¹² is being called an “epidemic” by former defense secretary Leon Panetta.

It seems that blast-induced TBI is often associated with post-traumatic stress disorder (PTSD). Estimates of the prevalence of PTSD among returning service members vary widely across wars and eras. However, as many as 500,000 U.S. troops who served in the Iraq and Afghanistan wars over the past 13 years have been diagnosed with PTSD.¹³ Complicating the diagnosis and assessment of PTSD in military veterans are the high rates of psychiatric comorbidity such as major depressive disorder and substance use disorder.¹⁴ Veterans, when they are able to obtain an appointment with a provider, are offered pharmacotherapy as a first-line approach.¹⁵ Other interventions such as cognitive behavioral therapy (CBT) are considered to have the strongest evidence for reducing the symptoms of PTSD in veterans and to be more effective than any other non-drug treatment according to the Institute of Medicine (2007). Guidelines suggest that a combination of pharmacotherapy and psychotherapy may be needed for those with severe PTSD or who have not responded.^{16,17} There is also some evidence to suggest that smoking cannabis (marijuana is associated with reduced PTSD symptoms).¹⁸ Unfor-

unately, there are still some patients with PTSD who do not respond to initial drug treatment and so other pharmacological agents are suggested. These include antipsychotics, antiadrenergic drugs, and anxiolytics that have demonstrated some efficacy in treating PTSD.^{18,19}

Is there a treatment currently available that could provide benefits and relieve the symptoms of PTSD without the extensive side effects often experienced with medications or length of time with CBT? As Shively et al determined blast exposure cases showed damage to brain structures that could possibly explain the persistent clinical symptoms of patients with blast TBI¹ that has been termed an invisible wound.⁶ The wound to the brain caused by blast-TBI requires healing. There is a treatment that has been used for decades to heal chronic wounds of which the blast-TBI can become. Hyperbaric oxygen therapy (HBOT) is defined as the use of 100% oxygen at pressure about 1 atmosphere absolute (1 ATA) or sea level. The application of HBOT increases delivery of oxygen throughout the body by increasing the amount dissolved in plasma, increasing the oxygen saturation in the blood.²⁰ The administration of HBOT for TBI is based on the observation that the hypoxia following the injury plays an important role in the secondary injury to the brain. Without adequate oxygenation, neurons revert to anaerobic metabolism, producing an acidotic state. With continued hypoxia, neurons are unable to maintain metabolic homeostasis. Eventually, the changes become irreversible and cell death is the result.²¹

Investigations into the usefulness of hyperbaric oxygen therapy (HBOT) for TBI and stroke have been ongoing for decades.²⁰ More recently, HBOT has been used to treat neuropsychiatric disorder following traumatic brain injury.²² After HBOT treatment, more than 70%, if the single-photon emission computerized tomography (SPECT) scans showed no abnormalities and these patients were clinically improved. Harch et al recruited 16 military subjects with mild to moderate post-concussion syndrome (PCS) or PCS with PTSD, who received 40 HBOT treatments at 1.5 ATA for 60 min. Brain scans, physical and neurological exams and neuropsychological testing were completed before and within one week after treatment. Significant improvements occurred in symptoms, cognitive testing, quality of life measurements as well as significant improvements in SPECT.⁵ Recent clinical investigation have also examined the effects of HBOT on PTSD symptoms in patients with a history of TBI. These studies did not find a statistically significant difference between the treatment group (2.4 ATA, 100% O₂) and the sham group (1.3 ATA, 21% FiO₂) since both groups demonstrated improvement in PTSD symptoms.^{23,24}

The lack of statistically significant differences between the treatment and sham groups has led some to conclude that HBOT does not work in the treatment of TBI with accompanying symptoms of PTSD. Harch (2013) states that the problem lies in the definition of “sham-controlled” which implies placebo design. The sham treatment set at 1.3 ATA is actually a HBOT treatment. The increased pressure increases plasma oxygen above what it would be at sea level.²⁵ To have a control group would require the removal of increased pressure and hyperoxia. Thus, both doses (hyperbaric oxygen and hyperbaric air) demonstrated net improvements in post-concussion syndrome and PTSD in these studies.

The safety of HBOT at dosages of 1.5 ATA and even higher for wound care (2.4 ATA) has been well established so this is not an issue. As Dr. Harch states “*hyperbaric oxygen therapy in mTBI PCS/PTSD has satisfied one of the cardinal rules of medicine, “First, Do No Harm.”*” Dr. Harch also suggests that after all the research money that has been used seeking effective treatments for TBI and PTSD, perhaps the Coverage with Evidence pathway would allow the Department of Defense (DoD) and Veterans Affairs (VA) to begin treating active military and veteran casualties with hyperbaric therapy so that they can experience improved quality of life (QoL).²⁶

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