



## **Brain Injury Biomarkers and Behavioral Characterization on mTBI in Soldiers Following Repeated, Low-level Blast Exposure**

Traumatic Brain Injury (TBI) has been referred to as one of the “invisible wounds of war”. Disrupting the normal function of the brain, TBI is the result of a blow or jolt to the head. Over 320,000 service members have been diagnosed with TBI from the years 2000 - 2014. Mild TBI (mTBI), the most prevalent form of TBI in both service members and civilians, emerged as a critical health concern of Operation Iraqi Freedom and Operation Enduring Freedom and is considered the signature wound of those conflicts<sup>1</sup>.

Mild Traumatic Brain Injury (a term used interchangeably with concussion) brings on a multitude of physical, emotional, and cognitive symptoms that can severely impact and halt the quality of life of a service member. Subjective symptoms associated with mTBI include headaches, postural imbalance, insomnia, memory problems, fatigue, irritability, depression, and interpersonal problems. These symptoms may resolve within days, or they may persist for months or even years.

With moderate or severe TBI, the diagnosis is often evident at the time of injury. However, mTBI is frequently overlooked, unreported, or undiagnosed at initial injury, as the symptoms may not be immediately apparent. For this reason, mTBI can be extremely difficult to detect, diagnose, and treat.

Dr. Gary Kamimori, Senior Scientist in the Department of Behavioral Biology at the Walter Reed Army Institute of Research, conducted a multi-phase study that aimed to provide a first-ever comprehensive examination of the relationship of TBI biomarkers to other markers of mTBI, including behavioral and neurocognitive metrics, symptoms reporting, brain imaging, and blast over pressure exposure. The primary goal of the study was to evaluate the effects of repetitive low level blast exposure on the aforementioned variables along with with the measurement of over pressure exposure to identify possible indicators of brain injury. A secondary goal was to identify diagnostic tools that might be sensitive to and specific for mTBI, and that could be used in theatre as close to the injury event as possible so that medical personnel could identify undiagnosed brain injury and determine severity to facilitate treatment.

Dr. Kamimori’s study was conducted under the relatively controlled conditions of repeated low-level blast exposure during multiple explosive entry (“Breacher”) training courses on otherwise unexposed special forces soldiers. Breachers are unique military and law enforcement populations that use explosives as a means of gaining access to barricaded or hardened structures. Because of this, they are routinely exposed to multiple low-level blasts, and experience symptoms that have been associated with mTBI, including headache, fatigue, sleep and short term memory issues which has been termed “Breachers brain”

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<sup>1</sup> Okie, 2005



To evaluate the utility of TBI biomarkers as a diagnostic and monitoring tool, serum samples were collected before, during, and after Breacher training in conjunction with objective measures of: blast exposure via helmet sensors, behavioral/neurocognitive measures and measures of brain function via MRI.

In the initial phase of the study, a significant relationship between specific blood biomarkers, mental performance, and self-reported symptoms of mTBI, which suggested a measurable degree of brain disturbance linked to blast exposure, was reported<sup>2</sup>.

Dr. Kamimori's groundbreaking work has future implications for both military and civilian populations. The identification and development of a diagnostic tool sensitive to and specific for mTBI would allow for a targeted and rapid medical response, which in turn may limit the severity of the injury and resulting in a shorter recovery time. Such technologies have the potential to be used in the civilian world in ambulatory and emergency medicine and on the sports field, treating patients and restoring their quality of life in a much more effective and swift manner.

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<sup>2</sup> Okie, 2005