



US DEPARTMENT OF DEFENSE

BLAST INJURY RESEARCH PROGRAM COORDINATING OFFICE

Injury Models

Development of Occupational Exposure Limits Governing Exposure to Multiple Blast Events

The emergence of evidence linking multiple mild traumatic brain injuries (mTBIs) to progressive, long-term debilitation, neurodegeneration, and the persistence of injury symptoms in some blast casualties diagnosed with mTBI (e.g., post-concussive syndrome (PCS)) has prompted concern over the cumulative deleterious effects of blast exposures on the brain and the need to define standards to mitigate this risk among Service Members. At present, there are no set guidelines for blast exposure limits in military personnel in combat or training operations. Most blast exposures yield mild concussions or subconcussive disruptions which are difficult to diagnose, are inconsistently and somewhat broadly defined, and are often indistinguishable from the symptoms of posttraumatic stress disorder (PTSD). Consequently, it is estimated that 80 percent of the TBIs occurring among Service Members deployed in Iraq or Afghanistan between January 2003 and October 2006 were undocumented. As part of a multi-pronged research effort, investigators at the Walter Reed Army Institute of Research (WRAIR) and the Naval Medical Research Center (NMRC) are using laboratory rats to address fundamental gaps in knowledge regarding the cumulative effects of blast exposure on the central nervous system (CNS) by exploring the impact of multiple blast exposures of varied number, frequency, and intensity on short-, intermediate-, and long-term sequelae. Using a combination of neurobehavioral, neurobiological, and histopathological assessments in a well-characterized experimental model of blast injury in rats, the cumulative disruptive effects of one to five daily blast exposures of mild to moderate severity are being evaluated to identify scaled injury thresholds and neurobiological underpinnings as a step toward defining occupational guidelines and standards for Service Members exposed to blast. As a practical matter, since this research objective is best accomplished under experimental conditions in which other blast-sensitive organs, notably the lung, are not overtly injured, and the potential cumulative effects of repeated blast overpressure (BOP) exposures on the lung have not been investigated, the initial thrust of this project has been to define exposure conditions in an advanced blast simulator (ABS) under which brain injury can be studied unaccompanied by blast-induced lung contusion and hemorrhage. Research completed to date reveals that lungs are largely contusion and hemorrhage-free following repeated frontal and side-oriented exposures to blast intensities ranging up to 16.5 pounds per square inch peak amplitude (6-8 milliseconds positive phase duration), and thus provides the defined scaled conditions under which brain injury investigations are now proceeding. These characterizations are yielding great insight into scaling issues experienced in laboratory experimental efforts to predict and mitigate the risks of mTBI in Service Members.

