



US DEPARTMENT OF DEFENSE

BLAST INJURY RESEARCH PROGRAM COORDINATING OFFICE

Oxidative Stress and Antioxidant Treatment

Impact of Dietary Omega-3 Fatty Acid Deficiency on Blast TBI and Traumatic Stress

U.S. Soldiers suffer a high incidence of traumatic brain injuries from exposure to explosions (blast TBI). There is also a high co-morbidity of blast TBI and subsequent post traumatic stress disorder (PTSD). Nutritional countermeasures could be a safe, readily translatable approach to preventing these debilitations. Long chain omega-3 polyunsaturated fatty acids (“omega-3s”) may be an important component of such a countermeasure because omega-3s are crucial building blocks of neuronal membranes and attenuate inflammation processes. Dietary deficiency of omega-3s is a known risk factor for neurodegenerative and neuropsychiatric disorders.

Using rats as a model, researchers at the Walter Reed Army Institute of Research (WRAIR; Silver Spring, MD) explored the impact of an omega-3-poor diet on vulnerability to blast TBI and PTSD. Adult male rats were maintained for six weeks on diets devoid of omega-3s. To induce TBI, animals were then exposed to a blast overpressure wave in an advanced blast simulator, followed by a head-concussion caused by a dropped weight. A different group of rats was briefly subjected to immersion underwater to induce traumatic stress. Animals continued their special diet and were assessed out to two weeks post-insult. Neurobehavioral function was evaluated by studying the ability of the rats to maintain balance on a twirled rod, and by using an “elevated plus maze,” a specially designed environment to assess the rats’ preference for darkened, protected environments as a measure of anxiety. Neuropathological status of their brains was determined using silver staining to see the brain cell structures, and by genomic array screening to look for changes in genetic expression in the brain. The rats’ plasma was assayed for stress hormone levels.

Results show that blast TBI leads to neurobehavioral impairments, accompanied by neuronal cell degeneration, and related changes in brain gene expression. Traumatic stress produced aberrant behaviors and neuroendocrine imbalances. Impact of the omega-3 deficient diet is greater on traumatic stress than on blast TBI, an observation that is consistent with omega-3s playing a major role in stabilizing behavior-altering neurotransmitters. Future directions will address the consequences of omega-3 deprivation when the two insults are combined.

This effort was supported by MOMRP/JPC-5.

