



US DEPARTMENT OF DEFENSE

BLAST INJURY RESEARCH PROGRAM COORDINATING OFFICE

Injury to Sensory Systems

Injury to the Retina and Brain Visual Centers by Primary Blast Waves

Exposure to blast shock waves is a leading cause of loss of vision in military personnel. Blindness is a long-term disability that has a profound impact on the Service Member's quality of life (QOL). Researchers at the Walter Reed Army Institute of Research (WRAIR), with support from Vision Research Program (VRP) managed by the Congressionally Directed Medical Research Program (CDMRP), have characterized the nature of blast wave injuries to the eyes (retina) and brain visual processing centers, and have explored therapies to halt the progression of neuronal cell degeneration.¹ Using a rat model of whole body exposure to blast overpressure (BOP) in a shock tube, visual function has been assessed by electroretinogram recordings, visual acuity testing (e.g., eye-tracking), and eye and brain histopathology. Exposure to moderate pressure blast waves (20 pounds per square inch peak amplitude, 6-8 millisecond duration) leads to marked visual system dysfunction that is associated with neuronal degeneration throughout the visual system (e.g., retina, optic tracts, and visual cortex). Novel drugs derived from n-3 and -6 polyunsaturated fatty acids (PUFAs), which are known to be potent pro-resolving lipid mediators of inflammation (lipoxins, neuroprotectins, and resolvins), have been evaluated for therapeutic efficacy. Researchers have also looked at indirectly elevating these metabolites by giving the animals daily high dose n-3 fatty acid supplements (fish oil) prior to and post-injury. Despite subtle improvements in visual function, these treatments have not significantly impacted neuronal cell degeneration in the retina and brain or activation of immune cells involved in neuroinflammation processes (e.g., macrophage infiltration and cytokine release). One likely explanation for this lack of efficacy is that the pro-resolving lipid mediators of inflammation are not reaching presumed sites of action in adequate concentrations, prompting targeted drug delivery using nanoparticle platforms to eliminate drug stability and tissue permeability issues. By revealing the neurobiological mechanisms that underlie BOP-induced ocular injury and vision impairments, these experiments will provide valuable insights into mitigation strategies and therapeutic countermeasures for affected Service Members.

¹ DeMar, J., Sharrow, K., Hill, M., Berman, J., Oliver, T., & Long, J. (2016). Effects of Primary Blast Overpressure on Retina and Optic Tract in Rats. *Frontiers in Neurology*, 7, 59. <https://doi.org/10.3389/fneur.2016.00059>

