

NEUROPATHOLOGICAL APPROACH FOR BLAST-WAVE INDUCED MILD BRAIN INJURY

Callie Meece (Jinhui Chen, Xiang Gao), Stark Neurosciences Research Institute, Indiana University School of Medicine, Indiana University–Purdue University Indianapolis, Indianapolis, Indiana 46202

Veterans of Iraq and Afghanistan are extremely susceptible to complications derived from blast-wave induced mild traumatic brain injury (mTBI) sustained from road-side bombs and IEDs. Furthermore, there are 1.5 million civilian incidences of TBIs annually in the United States, and as many as nearly 75% of them are mTBIs. An mTBI is an important medical concern because it can lead to long-term cognitive, emotional difficulties and behavioral disturbances. Neuroimaging with CT or MRI is usually negative. That is why mTBI has been called an “invisible wound.” There are no effective treatments for these disorders, partially due to the fact that the pathological basis leading to neurological disorders are poorly understood. Using a blast-wave injury model, several mice were given injuries similar to those from the front lines. The damaged brains were collected, mounted, stained, and imaged to track the dendrite and spine degeneration, both over all and by type of spine. After quantification, the results showed that the injured brain is intact without showing dramatic lesion or cell death, however, when we further assessed the morphologies of the spared neurons by using Golgi staining to visualize the individual neurons including their processes and spines in a very high resolution, we found that the dendrites of the spared neurons in the injured cortex demonstrated dramatic swelling with beading, a hallmark of dendritic injury, and there was a significant decrease in the number of mature (mushroom) spines, as well as a significant decrease in the overall number of spines. The function of the central nervous system critically relies on the synaptic connection from the different neurons between the spines. The widespread synapse loss disrupts neural circuitry following mTBI and will certainly contribute to neurological disorders. Our results showed that mild blast-wave induced injury led to extensive dendrite degeneration and synapse reduction in the cortex in an animal model. This experimental study sheds light on the neuropathology of mild TBI in humans, and suggests that neurodegeneration may be a novel target for developing diagnostic methods and therapeutic approaches for mTBI in the future.