REPLICATING BLAST-INDUCED TRAUMATIC BRAIN INJURY IN THE LABORATORY: A COMPREHENSIVE APPROACH

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ABSTRACT

The role of primary blast in blast-induced TBI is controversial. The identification of well documented clinical cases is difficult and rare, while the technical difficulties associated with simulating primary blast in the laboratory are considerable, resulting in an inconsistent literature that is difficult to interpret. This laboratory initiated a multidisciplinary effort in order to understand how primary blast impacts the brain and employed exposure and biological models of increasing complexity. A brain cell aggregate culture model system was developed in order to eliminate the complexity of an organism's whole body response to shock and isolate the damage inflicted at the cellular level. Underwater blast allowed for exposures of the brain cells to free-field underwater shock waves and enabled the assessment of the effect of principal stress without shear or global acceleration. The highly hydrolyzed dialysis tubing used to contain the aggregates in suspension presented no barrier to the shock wave. Subtle biological effects were noted in these samples. An Advanced Blast Simulator (ABS) was then used to expose brain aggregates in suspension and enclosed within a spherical shell, to single pulse air blast. In this more complex and realistic exposure environment, significant differences in the biological endpoints were observed compared to those found in aggregates exposed to the single pulse underwater blast waves. Similar subtle changes were also noted when rats were exposed in head-only fashion to simulated blast using the ABS. In addition, this work showed that exaggerated global acceleration artifacts due to dynamic scaling issues occurred when head movement was not restrained. This resulted in very different changes in brain endpoints compared to when head movement was minimized, and illustrates that a fundamental difference exists between the brain injury caused by primary blast, and that caused by impact-acceleration. Work is ongoing in identifying the specific features of blast and primary blast that are responsible for brain injury.