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Oral Presentation
Class of 2016

Pathological Assessment of a Piglet Model of Traumatic Brain Injury Utilizing Non-Invasive Magnetic Resonance Imaging

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Traumatic brain injury (TBI) is a major cause of death and disability in the United States. Stem cell therapies offer a promising treatment for TBI by producing regenerative and anti-inflammatory growth factors while also functioning as a cell replacement therapy. Animal models that are not truly representative of the human condition have impeded development of a translatable TBI treatment, suggesting a more human-like animal model, such as a piglet, is necessary for developing a successful cell therapy. Magnetic resonance imaging (MRI) is pertinent in the analysis and treatment of TBI, and combining multiple MR parameters provides a comprehensive understanding of TBI pathophysiology. We hypothesize that controlled cortical impact (CCI) TBI in piglets will result in substantial deficits at the lesion site that can be measured and quantified non-invasively through MRI. TBI was induced in six male piglets. 24 hours post-TBI, T2 FLAIR was implemented to visualize the lesion. Lesion size and midline shift were measured from T2 weighted coronal images. Lesion size at 24 hours post-TBI was 3.44 cm³ (0.52) with a midline shift of +1.80 mm (0.46), indicating significant brain swelling. Lesion size was reduced at 12 weeks to 1.95 cm³ (0.44) with a midline shift of -2.98 mm (0.29), indicating brain tissue atrophy. The observed directional change in midline shift can be attributed to attenuated swelling and significant brain atrophy. Development and characterization of key cytoarchitectural changes in the CCI TBI piglet model utilizing MRI in this study will enable more robust and predictive assessment of novel therapeutics and treatments that will likely lead to more success in human clinical trials.