

MRI AND HISTOLOGICAL CHARACTERIZATION OF A PORCINE MCAO ISCHEMIC BRAIN INJURY MODEL

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ABSTRACT

Stroke is the number one cause of long term disability and third leading cause of death in the United States. The devastating health, social and economic effects of stroke have led to a concerted effort to develop a treatment. However, only one treatment has been developed with significant limitations. The limited success in treatment development is believed to be due in part to testing of treatments in rodent models, which have significant differences in brain size, composition and architecture. These differences have led to a call for a better model more similar to humans, such as the pig. Our goal in this study was to characterize middle cerebral artery occlusion (MCAO) ischemic stroke within a pig model utilizing magnetic resonance imaging (MRI) and histology. The MCAO stroke was surgically induced by cauterization of the MCA in 4 male Yucatan miniature pigs. MRI was performed 24 hrs post stroke on a GE 16-channel fixed-site Signa HDx 3.0 Tesla MRI system. Diffusion weighted imaging (DWI) and apparent diffusion coefficient (ADC) maps were analyzed using Osirix (R) software. At day 90 post stroke, brains were extracted, sectioned and hematoxylin and eosin stained. Infarct mean ADC values and volumes were determined by MRI to ascertain the extent and size of the damaged region. Regions with an 80% reduction in ADC value were considered damaged, and a 40% reduction indicated a region of complete ablation. Mean ADC value of normal control tissue ($731.75 \pm 40.49 \times 10^{-6}$ mm/s) was significantly (p -value < 0.05) higher than both 80% ($508.86 \pm 31.01 \times 10^{-6}$ mm/s) and 40% ($320.43 \pm 3.22 \times 10^{-6}$ mm/s) ADC means. Average infarct volumes were 91.76 ± 21.70 cc and 10.56 ± 5.21 cc for 80% and 40% ADC thresholds, respectively. Histological examination at day 90 supported MRI stroke findings. Coronal sections of brain through the area of infarction demonstrated severe atrophy, and white matter in affected cortex regions could not be defined due to loss of normal elements. In this study, we demonstrated that MCA occlusion resulted in significant infarction by both MRI and histology. These results were similar to what has been previously seen in humans and suggest that the pig may be a robust model for further ischemic stroke studies.