USE OF MRI TO STUDY EXCITOTOXIC SPINAL CORD INJURY

S.A. Berens, R.P. Yezierski (UF, Orthodontics); T.H. Mareci (UF, Biochemistry and Molecular Biology)

Introduction

Using a non-invasive imaging technique, it should be possible to follow the temporal profile of specific pathological events and thus factors contributing to secondary tissue damage following excitotoxic spinal cord injury. The application of a comprehensive imaging protocol will also provide a method to study the protective mechanism of a known neuroprotective agent (agmatine) following injury. Using magnetic resonance imaging (MRI) it will be possible to expand our understanding of the temporal profile of the neuroprotective properties of this agent on specific pathological events; information important to understanding the basic mechanism(s) of neuroprotection. Technological advances in MRI will provide new insights into the temporal characteristics and interrelationships of different pathological events responsible for secondary injury and how these events are affected by a neuroprotective agent with known pharmacological properties.

Experimental

Following a pre-injury contrast-enhanced and high resolution MRI (NHMFL Facility, 11T), which includes sagittal and transverse T1- and T2-weighted images; rats received quisqualic acid spinal cord injury. Animals were separated into 3 treatment groups: (1) SCI plus agmatine (25mg/kg); (2) SCI plus agmatine (100 mg/kg); and (3) SCI plus vehicle (0.9% saline). Rats will be given treatment i.p. 30 minutes post-QUIS injury and once a day for 14 days. Injured rats underwent MRI on days 1, 3, 7, 15, and 25 days post-injury to characterize the lesion. On day 30 post injury, rats were sacrificed, and spinal cord removed to undergo excised imaging (NHMFL Facility, 14.1T).

Results and Discussion

Results showed edema formation by day 1 following injury, subsiding 15 days post-injury. Hemorrhage was also evident by day 1 post-injury, and progressively increased as the injury expanded. Cavitation (a delayed pathological change) was present by day 15 post-injury. Contrast-enhanced MRI showed permeability of the blood-spinal cord-barrier, and revealed an opening at day 1, with a return to baseline at day 7. Excised MR images confirmed pathological details observed in vivo.

Conclusions

First, high-resolution MRI can be used to study experimental SCI quantitatively and qualitatively with high field magnets using customized coils and optimized methods. Second, there is a specific temporal profile of pathological changes following excitotoxic spinal cord injury as well as a significant difference in the longitudinal distribution of pathological changes, i.e., edema, cavitation, hemorrhage, and neuronal loss, following excitotoxic injury. Third, there is a specific pattern of change in the integrity of the blood-spinal cord-barrier following excitotoxic spinal cord injury.

Acknowledgements

The authors would like to thank Gary Blaskowski for his expert imaging assistance and Ty Black for providing his expertise with image processing. All MRI data was obtained at the Advanced Magnetic Resonance Imaging and Spectroscopy (AMRIS) facility in the McKnight Brain Institute at the University of Florida. The work was supported by the McKnight Brain Institute at the University of Florida Neurotrauma Research Seed Program, and the National Institutes of Health by grants R01 NS40096 (RPY), R01 NS42075 (THM), and P41 RR16105 (THM).