Correlation of X-ray Fluorescence Spectroscopic Imaging and Magnetic Resonance Imaging of Neurodegenerative Disorders

Richard McCrea, University of Saskatchewan

Dr. Sheri Harder, MD, FRCP(C),Associate Professor, Department of Medical Imaging, College of Medicine, University of Saskatchewan

Dr. Helen Nichol, Assistant Professor
University of Saskatchewan

The clinical diagnosis of many neurodegenerative disorders rely primarily or exclusively on observed behaviors rather than measurable physical tests. One of the hallmarks of Alzheimers disease (AD) is the presence of amyloid plaques associated with deposits of iron, copper and/or zinc. Work in other laboratories has shown that iron-rich plaques can be seen in the mouse brain in vivo using a high field strength magnet but this iron cannot be visualized in humans using clinical magnets. The aim of this study is to determine which of the MR contrast methods is best to image brain metal deposits associated with AD. MR series were collected of a mouse model of AD using T1, T2 and susceptibility weighted magnetic resonance and x-ray fluorescence spectroscopy to correlate iron accumulation between modalities. We show XRF maps of iron K-alpha fluorescence from entire slices of human brain. We found that the SWI modality is superior to T2 and T1 for visualizing iron. Human brains were obtained at autopsy following approved ethical guidelines for the use of human tissue and were imaged using SWI at the University of Saskatchewan in a clinical MRI. Areas of potential pathology were identified on the susceptibility weighted image, and 1 mm-thick sections were obtained from the surrounding regions. The sections near features highlighted in MRI were then mapped for metal accumulation using XRF on BL-10-2 using the same method as for mice. X-ray imaged brain sections and MR slices are aligned and an intensity map demonstrating the relationship between the modalities was used to highlight the correlation between the susceptibility weighted MR and the XRF images.

KEYWORDS: X-ray fluorescence, Rapid Scanning, Magnetic Resonance Imaging, Susceptibility Weighted Imaging, Alzheimer's Disease, Parkinson's Disease, Rapid scanning, Neurodegeneration