Title: Evaluating Hippocampal Metabolism using 7T Magnetic Resonance Spectroscopy in MRI Normal Temporal Lobe Epilepsy Patients

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Structured Abstract:

Introduction: Pre-surgical identification of epileptic regions in patients with multiple techniques has been shown to improve post-surgical outcomes for patients who require surgery to control their seizures. Magnetic resonance spectroscopy (MRS) has been explored to aid tissue localization in patients with normal appearing MRI brain scans. However, MRS is difficult to acquire in the temporal lobe due to magnetic field inhomogeneities, limiting its usefulness in localizing one of the common forms of intractable epilepsy, temporal lobe epilepsy (TLE) (Pan J, et Al. Epilepsia. 2013). The improved signal to noise ratio and spectral dispersion that comes with ultra-high field strengths, along with improved shimming hardware on 7T systems, combine to produce high quality spectra from this region. The purpose of the current study was to examine MRI normal TLE patients on a 7T MRI system to evaluate the utility of 7T MRS in identifying epileptic tissue within the hippocampus.

Methods: Eight patients (4 female, 4 male, average age= 36± 13 years) were recruited through the Epilepsy Program at London Health Sciences Centre, London, ON. Eleven age, sex, and handedness matched healthy participants were recruited to serve as a control group (5 female, 6 male, average age= 29± 8 years). All patients were diagnosed with unilateral drug resistant TLE and had normal MRI brain scans when imaged on a 1.5T system as part of routine clinical care. Seizure lateralization for each patient was determined using clinical EEG recordings and seizure semiology. All participants were scanned on a 7T Siemens head-only MR system, with spectroscopic data collected using a semi-LASER single voxel acquisition (TE= 60 ms, TR= 7.5s, voxel size 2.7x1.7x1.7 cm3). Both a water suppressed metabolite spectrum (64 averages) and a water spectrum (4 averages) were acquired from each hippocampus. Metabolite concentrations were calculated using software coded by our lab (Rupsingh R et Al. Neurobiology of Aging). A one-way ANOVA was used to compare metabolite levels from hippocampi ipsilateral to seizure focus, contralateral to seizure focus, and healthy controls.

Results: Metabolites with a coefficient of variation less than 35% in our control group were included in the statistical analysis. Our ANOVA analysis revealed a trend in the absolute concentration of creatine, which trended lower in hippocampi ipsilateral to seizure focus compared to the contralateral side (p = 0.067). No other noteworthy metabolite changes were found.

Conclusion: While disruption of energy metabolism in TLE is commonly observed in FDG-PET images, an absolute reduction in the concentration of total creatine has not been reported (Cendes, Fernando. Continuum. 2013). This may be part due to the common use of creatine as a reference signal for calculating the concentration of other metabolites. Recruitment is ongoing, to improve sample size and confirm these findings.