7T MRSI in Temporal Lobe Epilepsy

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Target Audience. Clinicians and clinical researchers interested in MRI imaging and spectroscopy of epilepsy. **Purpose.** Epilepsy is a relatively common disorder, affecting up to 3% of the population. Patients refractory to medical therapy may consider surgical options. For successful surgical treatment, accurate mapping of the seizure focus is necessary. 7.0 T MR spectroscopy (MRS) benefits from the increased SNR and chemical shift at higher field strength, with improved quantification of metabolites. While MRS and MR spectroscopic imaging (MRSI) have been used to study epilepsy at field strengths up to 4T[1-4], relatively fewer studies have been performed at 7T. In this study, control subjects and a cohort of epilepsy patients with a clinical diagnosis of unilateral epilepsy underwent MRSI at 7T. **Methods.** *Experiment.* 17 patients, 10 with clinical evidence of mesial temporal sclerosis (MTS) (of which 7 had MRI evidence of MTS, while 3 had normal MRI exams), and 7 with neocortical epilepsy (with or without abnormal MR scans) were examined at 7 Tesla (Philips Achieva) using a 32-channel head coil (Nova Medical). Nine age-matched healthy volunteers were scanned with the same protocol. Informed consent was obtained under institutional review board approval. *Scan parameters.* Bilateral, single-slice STEAM-MRSI was performed parallel to the long-axis of the hippocampus. Scan parameters were: TR/TE/TM 2500/23/20ms, 10mm slice thickness, FOV 220x178 mm, matrix 32x26, nominal voxel size ≈0.4 cm^3, scan time 12 minutes with circular k-space sampling and SENSE acceleration factor of 2. Spectra were acquired with and without VAPOR water suppression. *Analysis.* LCModel[5] software was used to estimate metabolite concentrations (tNAA=NAA+NAAG, tCho=GPCh+PCh, tCr=Cr+PCr, Glx, mI) relative to brain water, as well as ratios to total creatine (tCr). Three hippocampal voxel locations were selected on each side (anterior, middle and posterior). Spectra were excluded based on visual assessment, Cramer-Rao lower bound error estimates (< 20%) and outlier detection. Metabolite ratios and estimated concentrations were compared between groups using nonparametric statistics (Stata, Tx; Wilcoxon rank-sum test). Data were stratified into affected (AH) and unaffected (UH) hippocampus spectra according to clinical and MR imaging results. Asymmetry index (AI) for the abnormal side was calculated as AI=2(AH-UH)/(AH+UH). **Results.** Spectra of the anterior hippocampus were of insufficient quality to be included in the analysis. Fig.1 shows the estimated tNAA concentrations and tNAA/tCr ratios for middle and posterior hippocampus spectra, stratified by affected and unaffected side and group (control, MTS, cortical). Significant bilateral [tNAA] and tNAA/tCr reductions were found in the mid-hippocampal body in the MTS group compared to controls, but not in the neocortical group. For the posterior hippocampus, only the tNAA/tCr ratio in the AH MTS group was significantly lower than controls. Fig.2 shows results from the asymmetry analysis. Slightly larger variability of AI was found in the middle hippocampal spectra. No significant asymmetry was found between groups. No significant differences between groups for the other included metabolites were observed. **Discussion.** These results show significantly decreased [tNAA] and tNAA/tCr in the mid-hippocampal body of patients with MTS, with a somewhat greater reduction in the ipsilateral hippocampi. These findings are in agreement with prior studies demonstrating bilateral involvement accentuated at the site of clinical and MRI abnormality[3]. The reduction of tNAA in the contralateral mesial temporal lobe may be due to the effects of seizure propagation. While bilateral reductions in tNAA, and variability in individual patients, suggest that MRSI may not be helpful for lateralization in MTS, it may help separate MTS from neocortical groups which did not show the same reductions. **Conclusion.** Similar to prior studies at lower fields, 7T MRSI of the hippocampi showed bilateral mid-hippocampal tNAA decreases, accentuated at the side of clinical and MRI abnormality. Lateralization of the clinical focus was not possible, due to significant contralateral tNAA decrease. Future comparative studies are needed to determine the relative value of 7T vs. 3T MRSI, as well as the relative value of 7T MRSI to other MRI sequences, in patients with temporal lobe epilepsy.

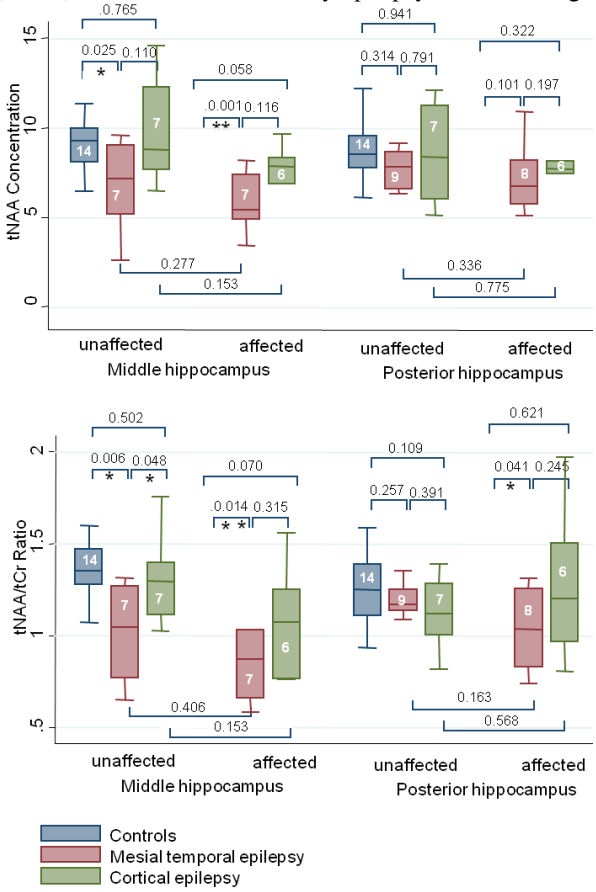

Figure 1

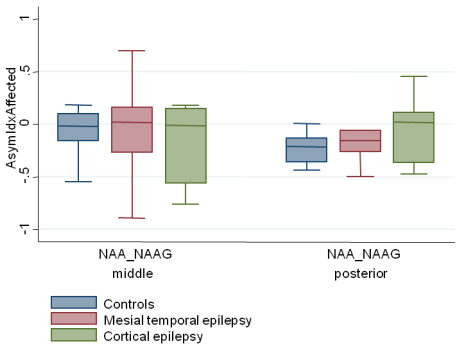

Figure 2

References. *1.* AA Cohen-Gadol, et al. J Neurosurg. 101:613-20, 2004. *2.* HP Hetherington, et al. Epilepsia. 45 Suppl 4:17-23, 2004. *3.* HP Hetherington, et al. Neurology. 69:2256-65, 2007. *4.* JW Pan, et al. Metab Brain Dis. 23:457-68, 2008. *5.* SW Provencher. NMR Biomed. 14:260-4, 2001.

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