Reliability of Quantifying Small Resonances in Single Voxel Short Echo Time Human Brain MRS: Concentrations Measured at 3 T and 7 T

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Introduction

Feasibility of using ultra-short-TE ^{1}H MRS to measure biologically relevant differences in human brain glutathione (GSH) concentrations was recently demonstrated via synthetically altered spectra that were measured at 7 T[1]. Such feasibility is dependent upon spectral quality. Another recent study showed strong correlation (r=0.77) between GSH concentrations quantified at 3 and 7 T from short-TE spectra measured from six participants on two occasions.[2] Herein we investigate reliability of quantifying differences in concentrations for the full neurochemical profile.

Methods

We re-evaluated data from the previous study on GSH[2]. Variability was inherent in spectra measured from participants with Parkinson's disease and healthy controls before and 4 weeks after treatment with 3000 mg oral N-acetylcysteine taken twice daily. Semi-LASER (TE 26 ms for 7 T, 28 ms for 3 T, TR 5 s) spectra were acquired from the occipital cortex (22 x 22 x 22 mm^3 VOI) on Siemens systems (quadrature surface T/R coil at 7 T, 32-channel Siemens receive coil at 3 T). Spectra were analyzed with LCModel (simulated basis set plus measured macromolecules) and normalized to 8 mM total creatine. Only metabolites that were fitted with average CRLB ≤ 20 % at 7 T were considered.

Results

Concentrations measured at the two field strengths were correlated for several neurochemicals (table 1), including GSH and *scyllo*-inositol *(scyllo*-Ins). Fig. 1 illustrates agreement between concentrations measured at 3 and 7 T for *scyllo*-Ins.

Neurochem	**Corr**	**CV 3 T**	**CV 7 T**
Aspartate	0.01	0.10	0.21
GABA	-0.05	0.55	0.31
Glutamine	0.23	0.16	0.15
Glutamate	0.32	0.06	0.07
GSH	0.77	0.17	0.24
myo-Ins	0.92	0.15	0.14
scyllo-Ins	0.99	0.61	0.72
Lactate	0.73	1.03	0.73
PE	0.32	1.11	0.18
NAA	0.75	0.06	0.06
NAAG	0.49	2.15	0.40
total Choline	0.24	0.04	0.06
Glucose+Tau	0.63	0.23	0.32

Table 1. Correlation (Corr) between Neurochemical (Neurochem) concentrations measured at 3 T and 7 T and coefficients of variation (CV) in the 12 measured concentrations (6 participants x 2 treatment states).

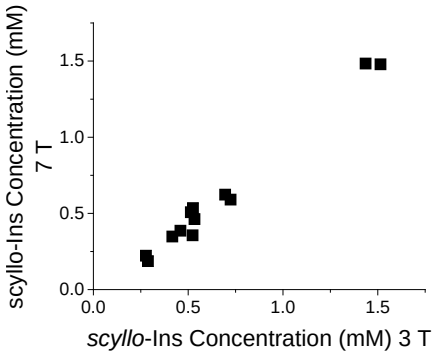

Fig. 1. Concentrations were measured at 3 T and 7 T on the same day from 6 participants pre and post N-acetylcysteine.

Discussion

Reliability of quantifying differences in concentration for several neurochemicals is indicated by reproducibility at different field strengths. The highest correlation occurred when there were strong resonances (NAA, *myo*-Ins) or high variation in concentration (GSH, *scyllo*-Ins). Absence of correlation for the strong tCho resonance was likely due to low dynamic range in concentration. Other neurochemicals that had high variation at both field strengths tended to correlate moderately (Lac, PE, NAAG, Glucose+Tau) except for GABA. We plan to explore using water as an internal reference.

References and Acknowledgements
[1]Deelchand et al NMR Biomed 2016 **29**:600, [2]Coles et al J Clin Pharm 2018 **58**:158, Parkinson's UK, University of MN Foundation, participants and NIH R01AG039396, P41 EB015894, P30 NS076408, and UL1TR000114.