

## Early Metabolic Changes of Mild Traumatic Brain Injury Revealed by 3D MRSI at 3T

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### Introduction

Conventional MR imaging does not accurately predict outcome in mild TBI, but MR diffusion [1] and proton spectroscopy [2] has shown promise as potential biomarkers for injury severity and long-term neurocognitive and functional outcome. In this study, we utilized 3D MRSI at 3T with wide anatomic coverage to assess TBI in specific association, commissural, and projection white matter tracts.

### Materials and Methods

18 patients with mild TBI (GCS 13-15) and 10 healthy volunteers were scanned with informed consent on a GE 3T EXCITE scanner (Waukesha, WI, USA) equipped with an 8 channel receive coil. Control subjects were matched to the TBI patients by age and gender. All TBI patients had witnessed loss of consciousness and post-traumatic amnesia, and were scanned with two weeks of injury. The protocol included T2 FLAIR, T2\* MPGR, and 3D T1 SPGR. The 3D MRSI was acquired using PRESS with TE/TR 144ms/1.1s, 12x12x8 matrix, 1cc resolution with reduced k-space sampling for a total scanning time of 9.5 minutes. Four slices were acquired with bottom slice at the level of the basal ganglia. Spectra were processed and analyzed using methods previously published [3]. NAA/Cho ratios from the patient group was compared with control subjects using the heteroscedastic two-tailed t-test, with statistical significance at p=0.05. Regional comparisons were performed in posterior cingulum bundle (PCB), anterior cingulum bundle (ACB), superior longitudinal fasciculus (SLF), splenium of the corpus callosum (SCC), and superior corona radiata (SCR). Bilateral ROIs were placed in all the regions except SCC to evaluate for hemisphere asymmetry. The study was approved by our institutional review board.

### Results

NAA/Cho ratios for the right and left ROIs in PCB and ACB did not show statistically significant differences for both the control and patient groups and were averaged for the analysis. NAA/Cho ratios for the left and right ROIs in SLF and SCR did show significant differences and were not combined. NAA/Cho ratios were significantly lower in the TBI group than the control group for PCB and right SLF, with a strong trend towards lower NAA/Cho ratio in the left SLF. ACB also trended towards lower values in the TBI group.

### Discussion

This 3T MRSI study of early mild TBI demonstrates reduced NAA/Cho ratios in association tracts, specifically the cingulum bundle and the superior longitudinal fasciculus, but not in projection tracts such as the corona radiata and posterior commissural tracts such as the splenium of the corpus callosum. This regional metabolic variation among white matter tracts may reflect the cognitive impairment of mild TBI. Future work will correlate this tract-specific variability to neurocognitive and functional outcome measures to validate MRSI as a biomarker for mild TBI.

### References

1. Niogi S et al. Brain 2008;131:3209-3221. 2. Cohen BA et al. 2007;28:907-913. 3. Nelson SJ. MRM 2001;46(2):228-239

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Table 1. NAA/Cho ratios for various regions.

	PCB	ACB	R SLF	L SLF	SCC	R SCR	L SCR
Mild TBI	2.26 ± 0.31	1.69 ± 0.36	2.64 ± 0.28	2.22 ± 0.52	2.47 ± 0.54	2.00 ± 0.60	2.20 ± 0.35
Control	2.78 ± 0.61	1.97 ± 0.53	3.34 ± 1.33	2.63 ± 0.50	2.54 ± 0.54	1.90 ± 0.52	2.39 ± 0.49
P value	<b>0.006</b>	0.12	<b>0.040</b>	0.067	0.72	0.66	0.25