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Development of the standardized protocol for quantification of the brain metabolites in 3-Tesla MR spectroscopy

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Purpose: The purpose of this study is to experimentally optimize MRS parameters at 3Tesla for quantification of the biochemical metabolite concentrations from the brain phantom and normal healthy volunteers.

Subjects & Methods: Together with a brain phantom, seventeen normal volunteers(mean age 25 years, range 23 to 31) underwent 3.0T (Magnetom Trio MR Scanner Siemens Medical Solutions, Germany) and 1.5T(Signa Twinspeed MR scanner GE Medical Systems, U.S.A.) MRS examinations. The optimal MRS parameters with short TE at 3T were determined in terms of spectral resolution and SNR.

Results & Discussion: The optimal MRS parameters at 3.0T were determined in terms of spectral resolution and signal-to-noise ratio(SNR) by the brain phantom study, giving time-to-repeat(TR)=2000ms, time-to-echo(TE)=30ms, number of acquisition (NA)=96, and voxel size=20x20x20m³. The spectra in brain phantom and normal volunteers demonstrated significantly improved overall spectral resolution and SNR at 3.0T compared to 1.5T, especially Glx and NAA-2 regions of the spectra were better resolved at 3.0T. In normal volunteers at 3T, the concentrations of β,γ -Glx, Lac and Lip in GM were higher than in WM, while the levels of NAA, α -Glx, Cho, and ml were higher in WM compared with GM. However, only three metabolites including NAA, α -Glx and Cho showed concentration differences between WM and GM at the significance level(P<0.01). As for the brain lobe-based examination, none of the metabolites except α -Glx in GM-related frontal and occipitoparietal areas, and Cho and Lac in WM-related temporal and occipitoparietal areas, showed concentration difference between GM and WM(P<0.05).

Conclusion: The optimized MRS parameters at 3T protocol for quantification of the brain metabolites is potentially useful as a gold standard to monitor the changes of biochemical metabolites concentration in human brain, although the significance of our preliminary study requires verification in a larger volunteer population, and the gender and age differences as well.

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