^{1}H NMR T_1 relaxation times of the neurochemical profiles in rat brain at 14.1T

C. Cudalbu[1], V. Mlynárik[1], L. Xin[1], and R. Gruetter[1,2]

[1]Laboratory for Functional and Metabolic Imaging, Ecole Polytechnique Federale de Lausanne, Lausanne, Switzerland, [2]Departments of Radiology, Universities of Lausanne and Geneva, Switzerland

Introduction:

Knowledge of T_1 can be important for accurate relative and absolute quantification of brain metabolites when the repetition time is on the order of T_1, such as in quantitative CSI (1, 2). T_1 relaxation times have been measured at 9.4 and 11.7T (2, 3) for proton metabolites and a general trend towards increased T_1 has been noted with increasing B_0. The aim of the present study was to measure *in vivo* T_1 relaxation times of the neurochemical profiles at 14.1T in rat brain.

Methods:

Experimental: ^{1}H spectra were measured in 6 adult rats (Sprague-Dawley, VOI=3x4x5mm^3 including frontal cortex, corpus callosum and striatum). All data were acquired on a 14.1T/26cm system (Varian/Magnex Scientific) using a home-built 14 mm quadrature coil as RF transceiver, and the SPECIAL spectroscopy sequence (160 averages) (4). Field homogeneity was adjusted using FASTMAP (5). T_1 measurements were accomplished using a progressive saturation technique (by increasing TR from 1-10s, 9 measurements, TE=2.8ms), which was validated with an adiabatic inversion recovery measurement (TI=0.1-1.8s and one fully relaxed measurement to obtain the Meq values, TE=20ms) for selected metabolites (Figure 1).

Data analysis: The progressive saturation series were analyzed using the LCModel software (6), combined with a simulated basis-set of metabolites containing the spectrum of macromolecules measured *in vivo* using an inversion recovery technique. The IR measurement was evaluated for the resonances labeled on Figure 1 using jMrui software (7). The T_1 relaxation curves were fitted with two-parameter single exponential functions, fitting the Mo and T_1 for the IR series and Meq and T_1 for the progressive saturation series. To assess the quality of the T_1 fits, the correlation coefficients were also calculated.

Results and Discussions:

The T_1 of 16 metabolites were estimated in the rat brain at 14.1T using the progressive saturation technique and LCModel (mean±SD in Figure 2). The correlation coefficients of the fittings were 0.91-0.99 and the T_1 relaxation times obtained with the two approaches were the same within 15%. The T_1 were found in a relatively narrow range from 1.4s to 1.9s for all metabolites, except for Tau (2.6s). The methylene resonances of NAA and Cr+PCr had lower T_1 than their corresponding methyl resonances and similar to that of Cho. The macromolecules had the lowest T_1 (0.66±0.07s). These results indicate that at 14.1T the T_1 relaxation time corrections are likely to be similar when using rapid pulsing conditions, which will bring a benefit for the CSI. The T_1 measured at 14.1 T is similar (~10%) to those measured at 9.4 and 11.7T (2, 3) suggesting that for metabolites, T_1 increases are of minimal consequence beyond 9.4 Tesla.

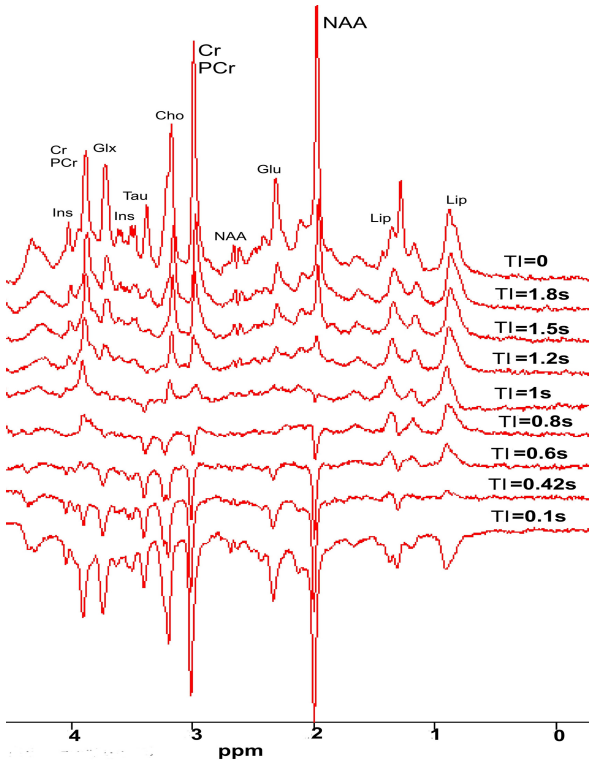

Figure 1: One series of *in vivo* spectra acquired at 14.1T in the rat brain (VOI=3x4x5 mm^3) using the SPECIAL sequence (160 averages) with different inversion times (TI), ranging from 0 to 1.8s and a TE=20ms.

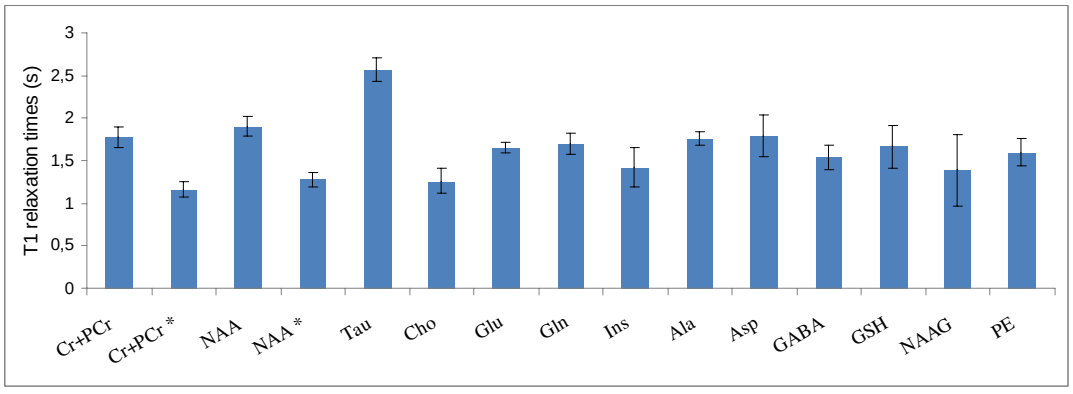

Figure 2: T_1 relaxation times (mean±SD) of 16 metabolites estimated at 14.1T in the rat brain using the progressive saturation technique. * Methylene resonances

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Acknowledgements. Supported by Centre d'Imagerie BioMédicale (CIBM) of the UNIL, UNIGE, HUG, CHUV, EPFL and the Leenaards and Jeantet Foundations.