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Comparison of the T_1 of the neurochemical profile in rat brain at 9.4T and 14.1T

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Abstract:
Introduction:
T_1 relaxation times can be important for accurate relative and absolute quantification of brain metabolites when the repetition time is comparable (i.e. quantitative CSI (1, 2)). T_1s have been reported at 9.4 and 11.7T (2, 3) for some proton metabolites. A general trend towards increased T_1 was noted with increasing B_0. The goal of this study was to determine whether T_1 of the neurochemical profile further increases at 14.1T in rat brain.
Methods:
Experimental: ^{1}H spectra were measured in 6 SD rats (VOI=3x4x5mm^3) using a 14 mm quadrature coil with SPECIAL localization (4). Data was acquired on a 9.4T/31 cm and 14.1T/26cm magnet (Varian/Magnex Scientific). T_1 measurements were accomplished using a progressive saturation technique (increasing TR from 1-10s, 9 measurements, TE=2.8ms, 160 scans @ 14.1T and 320 scans @ 9.4T), which was validated with an adiabatic inversion recovery measurement (TI=0.1-1.8s plus a measurement without inversion for M_{eq} values, TE=20ms) (Figure 1).
Data analysis: The progressive saturation series were analyzed using LCModel including the measured macromolecule signal. The IR measurement was evaluated for the resonances labeled on Figure 1 using jMrui. The T_1 relaxation curves were fitted with two-parameter single exponential functions, fitting the M_o and T_1 for the IR series and M_{eq} and T_1 for the progressive saturation series.

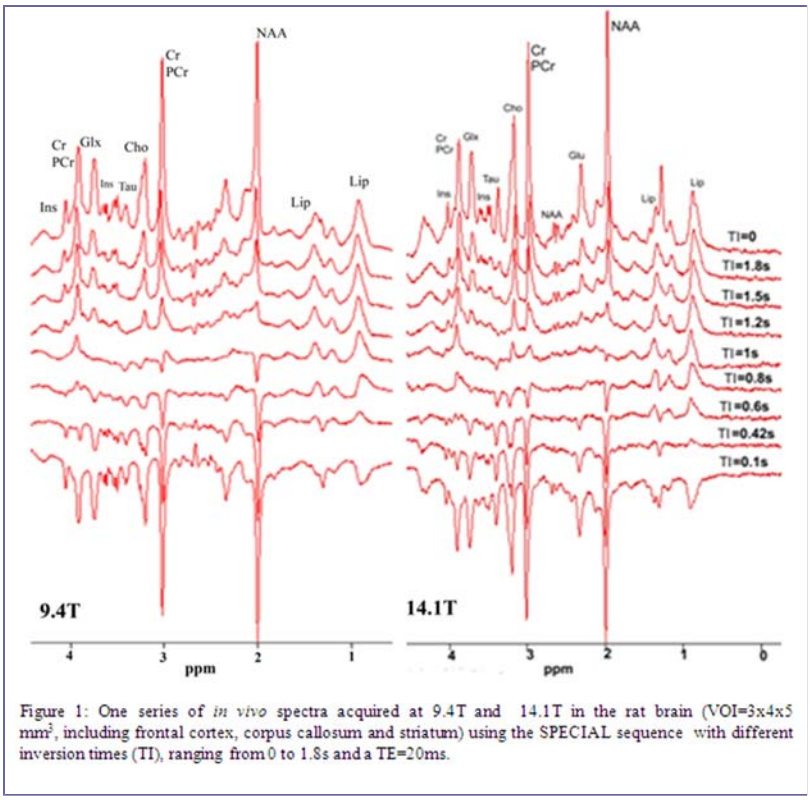

Figure 1: One series of *in vivo* spectra acquired at 9.4T and 14.1T in the rat brain (VOI=3x4x5 mm^3, including frontal cortex, corpus callosum and striatum) using the SPECIAL sequence with different inversion times (TI), ranging from 0 to 1.8s and a TE=20ms.

Results and Discussions:

T_1 was estimated for 16 metabolites in the rat brain at 9.4T and 14.1T and for most metabolites the T_1 measured at 14.1 T are similar within ~10% to those measured at 9.4T. Our values are also similar with those published at lower field (2, 3). For those metabolites evaluated with IR, the T_1 obtained were within ~15% of those obtained with progressive saturation. 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 slightly lower T_1 similar to that of Cho. Macromolecule T_1 was 0.66±0.07s@14.1T and 0.51±0.07s@9.4T. These results indicate that at 14.1T the T_1 relaxation time corrections are likely to be similar. We can conclude that the potentially increased T_1s of metabolites are of minimal importance for sensitivity considerations when increasing B_0 beyond 11.7T.

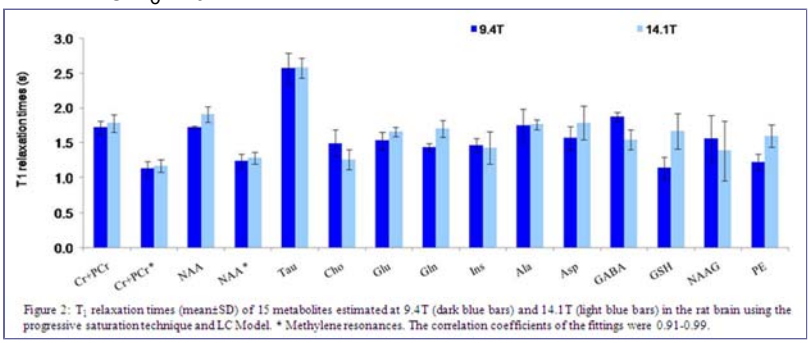

Figure 2: T_1 relaxation times (mean±SD) of 15 metabolites estimated at 9.4T (dark blue bars) and 14.1T (light blue bars) in the rat brain using the progressive saturation technique and LC Model. * Methylene resonances. The correlation coefficients of the fittings were 0.91-0.99.

References: [1] Mlynarik V et al.,NMRBiomed.2001;14:325. [2] deGraaf RA et al.,MagnResonMed.2006;56:386. [3] Pfeuffer J et al.,JMagnReson.1999:141:104.[4] Mlynarik V et al.,MagnResonMed.2006;56:965.

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Topic (Complete): 220 Processing and Quantification: Spectroscopy

Presentation Preference (Complete): Oral preferred

YIA & Survey (Complete):

***Agree**: Yes

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