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)). $T_1$s 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 LCMoModel 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.
Results and Discussions:

T₁ was estimated for 16 metabolites in the rat brain at 9.4T and 14.1T and for most metabolites the T₁ 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 T₁ obtained were within ~15% of those obtained with progressive saturation. The T₁ 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 T₁ similar to that of Cho. Macromolecule T₁ was 0.66±0.07s@14.1T and 0.51±0.07s@9.4T. These results indicate that at 14.1T the T₁ relaxation time corrections are likely to be similar. We can conclude that the potentially increased T₁s of metabolites are of minimal importance for sensitivity considerations when increasing B₀ beyond 11.7T.

References:
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