In Vivo Quantitative MT Imaging Using Selective Inversion Recovery

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Synopsis

Magnetization transfer (MT) imaging methods tend to either be non-quantitative, take too long to be clinically useful, or make unwarrented assumptions. We here demonstrate single slice *in vivo* selective inversion recovery (SIR) imaging to produce quantitative MT (qMT) maps of human brain at 3T. The acquistion time under optimal conditions remains to be determined, but the current results were acquired in 20 minutes. Minimal assumptions are required to map the pool size ratio and MT rates.

Introduction

Recently, qMT imaging has received increased interest, especially in relation to assessing white matter pathologies such as demyelination. qMT measures may provide more specific indicators of demyelination than the widely employed MT ratio (MTR) method. MT ratios are only semi-quantitative because they are functions of several sample and acquisition parameters. qMT imaging, on the other hand, can quantify a fundamental sample parameter, such as the ratio of the sizes of the free liquid and macromolecular proton pools or the exchange rate between them. Up to now, most *in vivo* qMT imaging techniques have been based on pulsed saturation of the macromolecular pool at several rf powers and frequency offsets. These methods tend to either make very strong assumptions about spin saturation or they require long acquisition times and complicated data analysis. In distinction, transient methods such as selective inversion recovery (SIR) can quantify the pool size ratio and MT rates using only low power inversion pulses and with weak assumptions about the MT rate and macromolecular T_2 value.

Methods

We implemented a fast spin echo version of SIR imaging on a 3T GE human system. Images were acquired from a 6mm slice, with 128x128 resolution, NEX = 2, predelay = 5s, 25 different inversion times between 5.6ms and 8s, and a fast spin echo readout with 32 echoes. The resulting data show a biexponential recovery. Assuming that the fast MT rate (k_{mf}) is much faster than the relaxation rates (R_{1f} and R_{1m}), that the pool size ratio (p_m/p_f) << 1, and that the macromolecular T_2 value is one the order of 10's of μs, then the pool size ratio and MT rates can be determined [1].

Results

Figure 1 illustrates the results from a single volunteer. Note the higher pool size ratio in the white matter, likely due to the increased myelin content. Some areas in the ventricles are misfitting because cerebral spinal fluid (CSF) has no MT component and therefore has a single exponential recovery. If desired, such areas could be removed by editing on the basis of the R_1 values. These results demonstrate the feasibility of *in vivo* human SIR imaging to quantify MT. Further experimental and simulation studies are required to optimize the method.

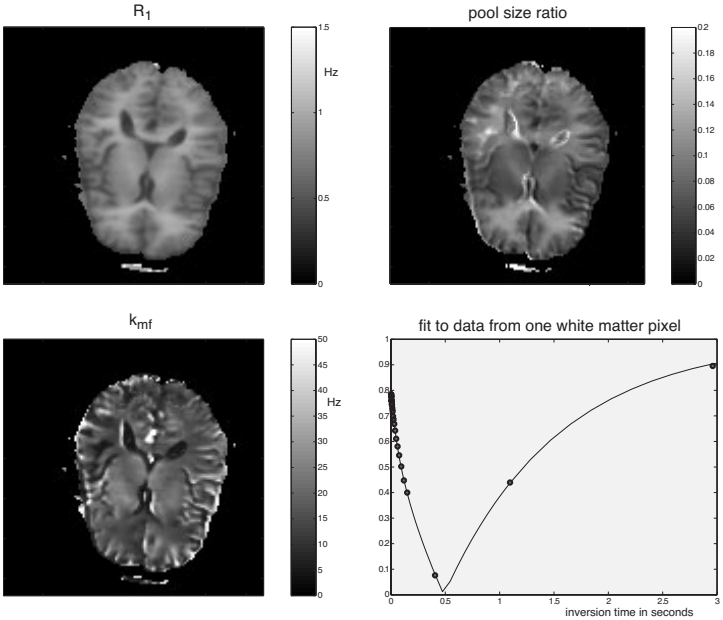

Figure 1: SIR imaging of a normal human volunteer. Each pixel was fit to the absolute value of a biexponential recovery to quantify the relaxation rate R_1, the pool size ratio p_m/p_f and the MT rate constant k_{mf} (and k_{fm}, not shown).

1. Gochberg, D.F. and J.C. Gore, *Quantitative imaging of magnetization transfer using an inversion recovery sequence.* Magn Reson Med, 2003. **49**(3): p. 501-505.