Design of a SAR compatible, 3T qMTI protocol

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Introduction: Typical magnetization transfer (MT) techniques use a pair of sequences, with and without the MT pulse, and an MT Ratio (MTR) is calculated. This ratio is sensitive to the macromolecular content but it also depends on the T1 relaxation properties of the tissue. Quantitative Magnetization Transfer Imaging (qMTI) [1-3] removes this drawback, by measuring and accounting for the T1 relaxation effect. However, at higher magnetic fields, due to the quadratic increase with B0 in RF power deposited by the MT pulse, the specific absorption rate (SAR) becomes an important limitation. We demonstrate the design of a 3T qMTI protocol, using interleaved MT acquisitions, that is compatible with the First Level SAR limit, for subjects with a body mass as low as 50kg.

Methods: The qMTI protocol was implemented on a 3T General Electric whole body scanner using a head and neck HDNV 8-ch coil. First level SAR was enabled at the beginning of the scan. The parameters for the MT acquisitions were 256x224, FOV=36cm, PhaseFOV=.56, slice thickness 3mm, 50 slices (discard 4), TR=38ms, for a scan time of 4:03min. After the 3-Plane Localizer and calibration sequence, the MT sequences are played in an interleaved fashion as follows. MT 3kHz/700 (MT pulse off-resonance/flip angle) is played first, followed by MT OFF, MT 9kHz/600, MT 6kHz/500, T1 mapping dual-flip angle sequence [4] (optimized for TR=20ms) with a flip angle FA=27 (2:10), T1 map FA=5 (2:10), MT 6kHz/700, B1 mapping sequence B1 120/240 (1:30), B1 60/120 (1:30), MT 9kHz/700, B0 mapping sequence (2:30), MT 12kHz/700. The Auto Prescan for the first MT sequence is done with the MT pulse turned off to maximize signal. Before MT sequences interleaved with B1, T1 or B0 mapping, Auto Prescan with MT turned off was done again. Alternatively, Manual Prescan can be used if the parameters (R1/R2/TG/AX and Shim values) from the first Auto Prescan were recorded and reused.

Results: Data was reconstructed to produce bound pool fraction and cross relaxation maps for the entire brain using separately the 6 MT points, 4 MT points (3,6,9,12kHz/700 flip angle sets) and 2 MT points (3,9kHz/700 flip sets) [5,6]. The bound pool map results for one slice for the 4point and 2point method are shown in Figure 1.

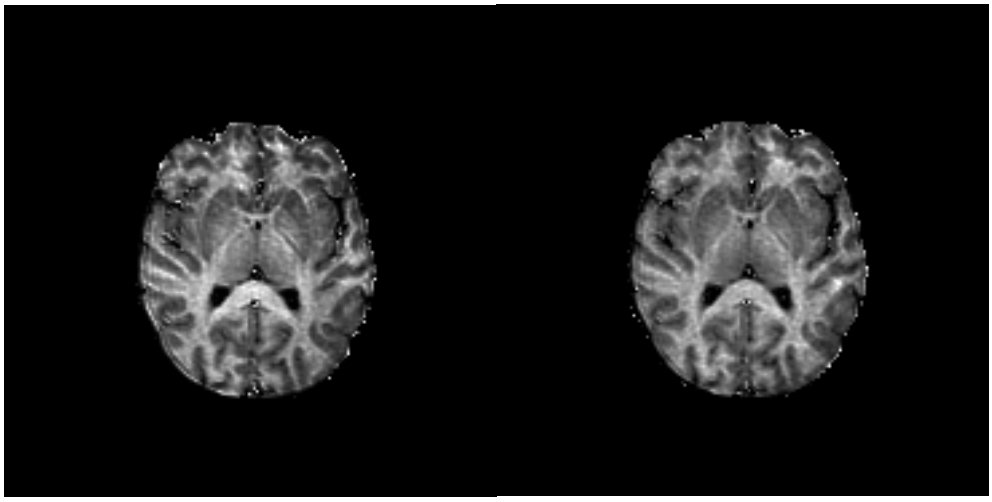

Fig 1: *Bound pool fraction maps for a 3T acquisition for a normal control subject, using the 2point (left) and 4 point(right) method.*

Conclusions: We implemented a qMTI protocol at 3T. Despite challenging SAR limitations, high-resolution qMT imaging is feasible using First Level SAR for patients with a mass as low as 50kg. Furthermore, the shorter (15-20 minutes) 2point MT method could be included in a number of clinical protocols.

References: [1] Sled et al. MRM **46** ’01 [2] Henkelman et al., MRM **29**, ’93 [3] Portnoy et al., MRM **58** ’07. [4] Deoni et al.., MRM, **49**, 515, ’03. [5] Yarnykh MRM **47,** ‘02 [6] Yarnykh, ISMR Proc. ’07