Role of Magnetization Transfer in mcDESPOT Results

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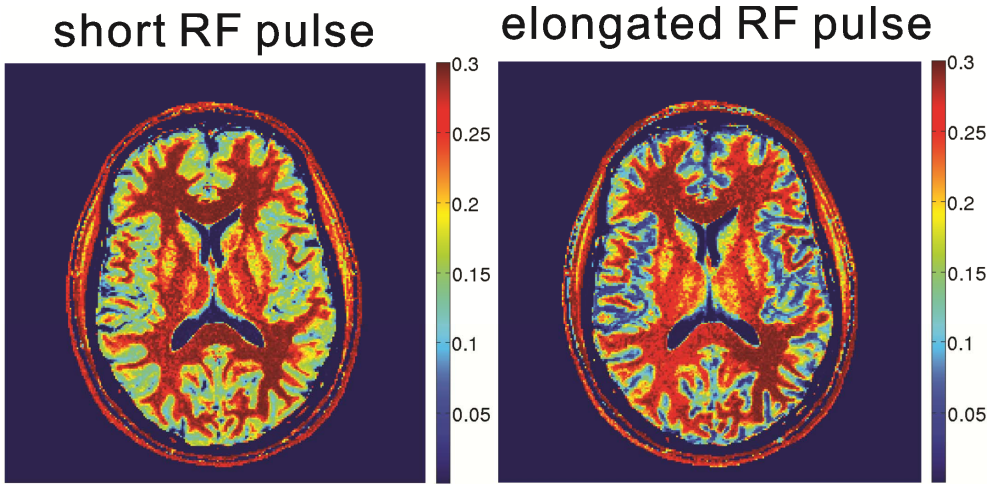
Target audience Those working with MR techniques for measuring myelin content.

Purpose Recently a steady-state approach entitled multicomponent driven equilibrium single pulse observation of T_1/T_2 (mcDESPOT) was employed for myelin water fraction mapping and applied in detecting demyelination in MS lesions and NAWM[1,2]. However, myelin water fractions (MWF) estimated by this method are significantly higher than MWF values derived from multi-spin echo T_2-decay curve approachs[3]. It has been suggested that magnetization transfer (MT), enhanced by the use of short, relatively high amplitude RF pulses in mcDESPOT[4], may influence the MWF maps. The goal of this study was to investigate the role of magnetization transfer in mcDESPOT results.

Methods All MR imaging experiments were performed on a 3.0T whole body MR scanner (Achieva 3.0T, Philips Medical Systems, Best, The Netherlands) using an eight-channel phased-array head coil for reception and the internal quadrature body coil for transmission. mcDESPOT measurements were acquired using (a) 'conventional' short (0.62ms for SPGR and 0.7ms for bSSFP) RF pulse durations and (b) longer (1.7ms for SPGR and 2.9ms for bSSFP), lower amplitude RF pulses, which should have yielded much lower MT effects. To further reduce the MT effect, the range of bSSFP flip angles was from 6° to 62° for (a) but limited to 6° to 30° for (b). Both acquisitions used the same FOV and voxel size. The images from (a) were analyzed by the conventional mcDESPOT method [1] and from (b) were analyzed using modified Bloch equations [5] with finite RF pulse correction. However, we analysed the data by searching the 6D uniform distribution space without fixing any T_1 or T_2 parameters.

Results We compared differences in transmit (B_1) magnetic field inhomogeneity, T_2 and T_1, and MWF for both methods. B_1 maps from both methods were qualitatively similar. The single component T_1 from (b) was around 30% higher than that of (a) and T_2 from (b) was 20% lower than that of (a) in grey matter. As shown in Figure, MWFs for white matter obtained from (b) were only slightly lower than that from (a), while MWFs for grey matter obtained from (b) were more than 50% lower than that from (a).



Representative axially-oriented slice through the myelin water fraction from mcDESPOT sequence acquired by (a) and (b).

Discussion MWF maps created from the mcDESPOT method with finite RF pulse correction were clearly different from the conventional mcDESPOT method. We should point out that for method (b), because the maximum flip angle of RF pulse was smaller in order to reduce the MT effect, only the early part of the mcDESPOT fitting curve was produced.

Conclusion In this work, the mcDESPOT method with both short and longer RF pulses was performed in order to investigate effect of MT on the MWF maps. We conclude that the MT effects did play a role in the estimated MWF from mcDESPOT. This effect was less marked in white matter, possibly because many white matter MWF values in mcDESPOT were limited by parameter constraints.

References

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