

Within lesion differences in quantitative MRI parameters predict contrast enhancement in multiple sclerosis

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Target audience: (neuro)radiologists and physicists interested in innovative MR imaging

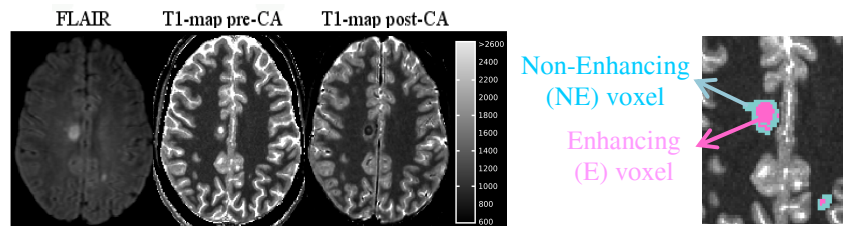
Purpose

Quantitative (q) MR parameter T1 relaxation time (T1), proton density (PD) and magnetization transfer ratio (MTR) are influenced by structural tissue damages and extracellular water content. Cerebral extracellular water depends on extracellular matrix and the integrity of the blood brain barrier (BBB), both of them representing typical changes in lesions of multiple sclerosis (MS). We postulate that (1) the extent of BBB damage is objectively measurable by relative shortening of T1 upon standardized application of contrast agent (CA); (2) lesional qMR parameters differ depending from the presence of BBB damage.

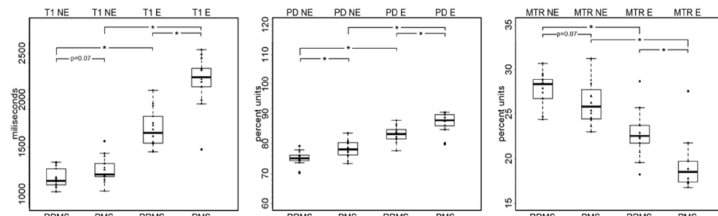
Methods

In 17 patients with relapsing-remitting MS (RRMS, EDSS 1-3.5), 15 patients with progressive MS (PMS, EDSS 3-8.5) and 17 controls T1, PD and MTR were measured at 3T and T1-mapping was repeated exactly 7 min. after CA administration. Pre-contrast T1, PD and MTR were compared in enhancing (E) and non-enhancing (NE) lesional voxels, NAWM and grey matter.

Manually drawn MS-lesions (3D-FLAIR) were labeled as enhancing if post-CA T1-shortening was > 2 SD above the mean T1-shortening in the normal appearing white matter (NAWM).



Results



Pre-CA T1, PD and MTR differed significantly between enhancing and non-enhancing lesions in RRMS and PMS patients (all $p < 0.01$).

PD values of NAWM, E-voxel and NE-voxel significantly differed between RRMS and PMS.

Pre-CA T1 and MTR of grey matter significantly differed between RRMS and PMS but only MTR of grey matter differed between RRMS and controls.

Discussion

BBB damage in MS lesions is objectively measurable by relative T1-shortening upon standardized CA application. BBB damage seems to be measurable without CA by PD, T1 and MTR provided that subtypes (RRMS versus PMS) are considered. Higher cerebral PD values may be a sensitive indicator for an advanced tissue damage in MS lesions and in NAWM, whereas MTR is the most sensitive parameter for a damage of the grey matter in MS patients.

Conclusion

In contrast to the operator-dependant conventional MRI qMRI objectively measure damage of brain tissue and of BBB.

Reference: Volz S, Nöth U, Deichmann R. Correction of systematic errors in quantitative proton density mapping. *Magn Reson Med.* 2012 Jul;68(1):74-85