Phase contrast MRI differentiates between brain lesions in Neuromyelitis optica and Multiple sclerosis – preliminary data from a 7T MRI study

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Introduction: Differentiating between seronegative Neuromyelitis optica (NMO) and multiple sclerosis (MS) with e.g. spinal predominance has remained challenging in clinical routine, but is of paramount clinical importance due to diametric therapeutic regimen. Small supratentorial white matter lesions suggestive for MS may also be observed on conventional low field MRI in NMO.[1] To address this shortcoming we studied the potential of high spatial resolution phase contrast MRI at 7 Tesla (T) which affords additional information on the tissue microstructure[2,3] and permits the differentiation between NMO and MS lesions.

Methods: Twelve patients with NMO spectrum disorders (NMOSD, mean±SD age 47±12 years, range 30-69 years) were investigated using ultrahigh field MRI (7T, Magnetom, Siemens, Erlangen, Germany) including T_2* weighted (T2*w, TE 25.0ms, TR 1820ms, spatial resolution (0.5x0.5x2)mm^3) and susceptibility weighted imaging (SWI, TE 14ms, TR 25ms, flip angle 12, spatial resolution (0.5x0.5x1.0 $mm)^3$), yielding magnitude as well as SWI-filtered phase. Twelve MS patients (mean±SD age 36±6 years, range 26-49 years) served as controls. Brain lesion morphology was analyzed by a trained investigator regarding e.g. iron deposits and rim-like phase alterations.

Results: In total, 149 NMO and 295 MS lesions could be detected on supratentorial T2*w images. We frequently observed either thin (36 of 295 lesions) or prominent (46 of 295 lesions) phase rims around MS lesions. Rim-like phase abnormalities were virtually absent around NMO lesions (3 of 149 lesions, $p<0.001$, figure 1). In addition, image characteristics suggestive for iron deposits within the center of brain lesions were nearly exclusively depicted in MS patients (28 of 295 lesions), but not in NMO lesions (1 of 149 lesions, $p<0.001$, figure 1). Thus central iron deposits or rim-like phase changes yielded a very high specificity (97%, CI 92%-99%) in differentiating MS from NMO lesions.

Conclusion: High spatial phase contrast MRI depicts unique morphological features in NMO and MS plaques. Phase contrast MRI can be used to afford imaging based distinction between brain parenchymal NMOSD and MS lesions which holds the promise to permit faster diagnosis and improved therapy guiding.

References: 1 Sinnecker et al Neurology 2012. 2 Yablonskiy et al. Proc Natl Acad Sci 2012. 3 Absinta et al. Ann Neurol 2013.

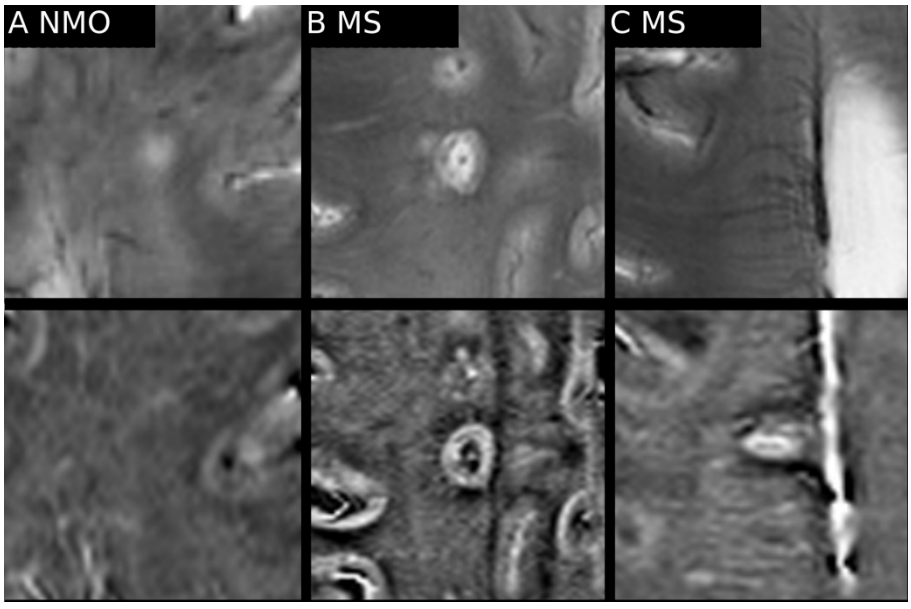

Figure 1. *Phase contrast MRI differentiates MS from NMO lesions.* The figures shows exemplary NMO (A) and MS (B, C) lesions. In MS, brain lesions are often characterized by rim-like phase abnormalities (B). Another group of MS lesions shows phase changes indicative for central iron deposits (C). Contrarily, phase abnormalities are not detectable in NMO lesions (A).