The impact of cerebrovascular risk factors on brain tissue changes: A MTI study

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Introduction:

Due to the correlation of the magnetization transfer ratio (MTR) and the macromolecular density, this measure derived from conventional magnetization transfer imaging (MTI) is commonly used as a surrogate marker for myelin (1). In the first two decades of life, the MTR increases as a reflection of brain maturation and remains unchanged in the adult brain (2). As shown recently (3), in the ageing brain the MTR is negatively correlated with age and with the frequency of white matter hyperintensities (WMH). However, it is still unclear if this phenomenon reflects ageing per se or rather tissue changes due to the increasing impact of cerebrovascular risk factors. In this study we therefore wanted to explore if specific cerebrovascular risk factors may have an effect on changes of the brain tissue matrix as assessed by the MTR.

Methods:

The study cohort was drawn from the Austrian Stroke Prevention Study (ASPS), a prospective follow-up study to examine the frequency of WMH and cerebrovascular risk factors and their effects on cerebral morphology and function in the normal elderly (4,5), and consisted of 328 randomly selected subjects. They were 215 females with a mean age of 70.7 years (SD = 6.2 years) and 113 males with a mean age of 70.1 years (SD = 6.0 years). MRI was done on a 1.5T whole body scanner (Philips ACS Intera). Fluid attenuated inversion recovery MRI was used to delineate WMH and to define normal appearing brain tissue (NABT). MTI was performed using a spoiled 3D gradient echo sequence with and without a binomial saturation pulse. After brain extraction and lesion masking a MTR analysis was done in WMH and in NABT using histogram analysis. While the mean MTR value was taken from the WMH, the histogram peak position and the relative peak height were used for the global assessment of NABT. A large battery of possible risk factors was assessed including age, sex, arterial hypertension, diabetes, smoking, cardiac disease, body mass index, total cholesterol, and glycated hemoglobin. A multivariate regression model was used to study the impact of these factors on the global and lesional MTR.

Results:

Age, sex, arterial hypertension, and diabetes mellitus were the only factors that showed a significant effect ($p<0.05$) on the global MTR by the multivariate analysis. Age was the strongest predicator for global MTR reductions. While there was no difference between males and females in regard to the histogram peak position (Figure 1), males did show a stronger decrease of the peak height with increasing age than females (Figure 2). Regarding WMH, subjects with arterial hypertension had a significantly lower lesional MTR ($p<0.05$) than those with normal blood pressure after correction for age. Apart from age and hypertension no other factor had an effect on the lesional MTR.

Fig. 1.

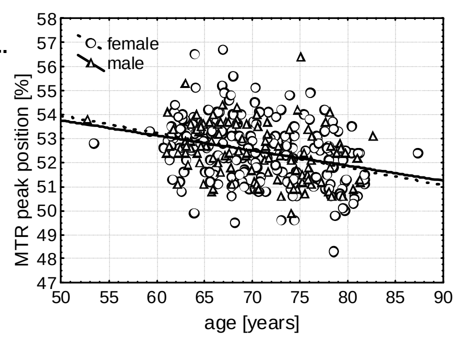
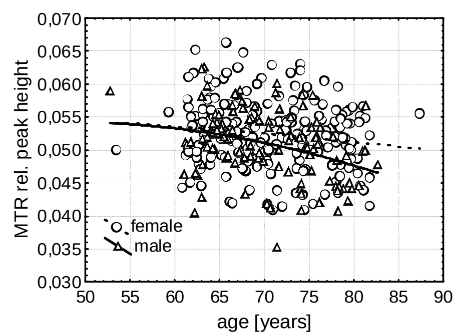


Fig.2.



Conclusion:

Changes of NABT as detectable with MTI seem to be predominantly related to the ageing process per se, while diabetes mellitus and hypertension may exert some additional minor effects. The link between lesional MTR and arterial hypertension underlines the impact of microangiopathy as an important underlying factor for WMH in the elderly.

References:

1) Schmierer K et al. Ann Neurol 2004;56:407.
2) Van Buchem M et al. Am J Neuroradiol 2001;22:762.
3) Fazekas F et al. Brain 2005;128:2926.
4) Schmidt R et al. Lancet 2003;361:2046.
5) Enzinger C et al. Neurology 2005;64:1704.