

DTI and MTI Parameters Correlate in Periventricular White Matter Hyperintensities in Old Age

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Introduction: Regions of diffuse periventricular white matter hyperintensities (PVWMH) are a common finding on T₂-weighted MRI scans of older subjects, but their aetiology remains unclear. The aim of this study was to characterize differences in water diffusion and magnetization transfer MRI parameters between macroscopically normal-appearing white matter (NAWM) and PVWMH in a cohort of normal older subjects.

Methods: Twenty-nine, non-demented, 83-year-olds underwent structural, diffusion tensor and magnetization transfer MRI using a previously described MRI protocol [1]. Using small square (25 voxels, volume 110 mm³) ROI, mean diffusivity (<D>), fractional anisotropy (FA), and magnetization transfer ratio (MTR) were measured in both NAWM and PVWMH in frontal and parieto-occipital white matter, and centrum semiovale. Non-parametric tests were used to determine if these MRI parameters were significantly different between tissue types (Mann-Whitney U test), and whether there were any correlations between the water diffusion parameters and MTR (Spearman's ρ).

Results: For all three regions, PVWMH had greater <D> than NAWM, while FA and MTR were significantly reduced compared with normal tissue ($p < 0.01$). For PVWMH, MTR was significantly correlated with <D> and FA in all three regions (see Figure 1 and Table 1). Conversely, there were no significant correlations between MTR and either water diffusion parameter in NAWM (see Table 1).

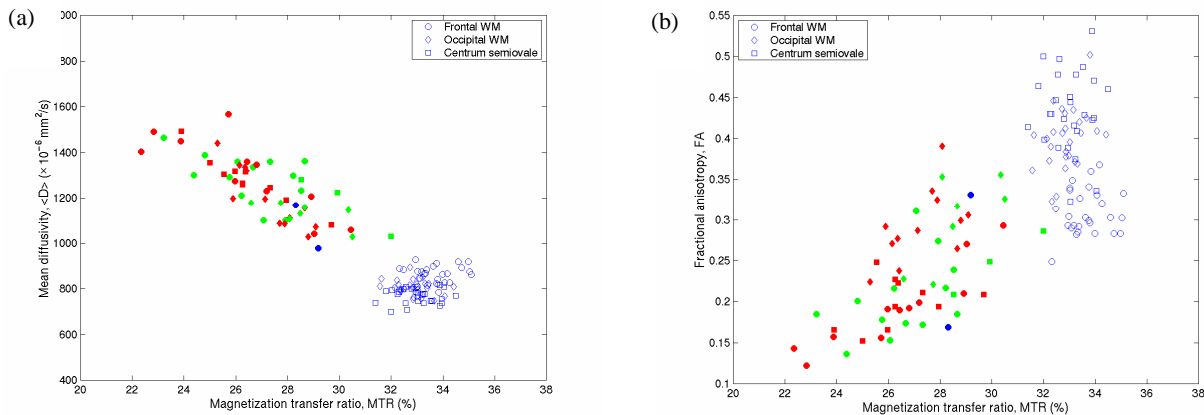


Figure 1: Scatter plot of MTR versus (a) <D> and (b) FA for NAWM (open symbols) and PVWMH (closed symbols). Each symbol represents data from one subject for the indicated region. For measurements in PVWMH, the symbols are coloured blue, green and red to indicate Fazekas scores of 1, 2 and 3 respectively.

	Frontal white matter		Parieto-occipital white matter		Centrum Semiovale	
	NAWM (N = 27)	PVWMH (N = 26)	NAWM (N = 27)	PVWMH (N = 19)	NAWM (N = 27)	PVWMH (N = 13)
<D>	0.03	-0.75**	-0.14	-0.80**	-0.08	-0.86**
FA	0.09	0.70**	0.32	0.58**	-0.04	0.61*

Table 1: Correlations (Spearman's ρ and p value) between MTR and water diffusion parameters for NAWM and PVWMH in frontal and parieto-occipital white matter, and centrum semiovale. Bold type indicates a significant correlation at the $p < 0.05$ (*) and $p < 0.01$ (**) level.

Discussion: This is the first study to measure simultaneously DTI and MTI parameters in age-related periventricular white matter hyperintensities and surrounding normal-appearing white matter. These data indicate that in normal white matter, characterized by structurally coherent cell membranes, the degree of water molecule diffusion and myelination are held within relatively tight limits. However, within PVWMH, MTR correlates strongly with water diffusion parameters probably because of the pathologically associated neuronal loss, demyelination and gliosis. Furthermore, the above MRI findings are consistent with confluent PVWMH being characterized by vasogenic oedema, although it is not possible to determine whether they are ischaemic or otherwise in origin. Nevertheless, these data provide further support for the view that PVWMH should not be considered benign.

References

[1]. Deary I, Bastin ME, Pattie A, Clayden JD, et al. White matter integrity and cognition in childhood and old age. Neurology 2006;66:505-512.

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