DIFFUSION TENSOR IMAGING IN PATIENTS WITH ALZHEIMER'S DISEASE AND MILD COGNITIVE IMPAIRMENT

S. Fall[1], S. El Sankari[2], R. Bouzerar[1], B. Perin[3], M-E. Meyer[4], and O. Baledent[1]
[1]Imaging and Biophysics, University Hospital, Amiens, Picardie, France, [2]Institute of Neuroscience, Cliniques Universitaires Saint-Luc, Brussels, Belgium, [3]Neurology, University Hospital, Amiens, Picardie, France, [4]Nuclear Medicine, University Hospital, Amiens, Picardie, France

Introduction

The inferior fronto-occipital fasciculus (IFO) connects a wide associative network localized in frontal regions and posterior temporal areas which are involved in semantic processing. Semantic memory is altered in Alzheimer's disease (AD) and Mild Cognitive Impairment (MCI) is often a preclinical stage of AD. The aim of this study was to evaluate potential IFO alterations in AD using DTI.

Material and methods

We investigated twelve patients (5 women and 7 men, 80.6 ± 6.9 years old) with MCI and fifteen patients (12 women and 3 men, 79.8 ± 4.3 years old) with AD.

Images were acquired on 3T MR scanner. DTI parameters were TR = 9000 ms, TE = 80 ms, field of view = 28 x 28 cm, slice thickness = 3 mm, number of averages = 2, number of slices = 32, matrix = 128 x 128, number of diffusion gradient directions = 12, b = 1000 sec/mm^2. The diffusion-weighted images were processed using DTI-Studio software. The regions of interest were bilaterally positioned in the DTI cartography in the temporal regions as presented in figure 1.

Within each group, left and right IFO were compared (Wilcoxon test) in terms of Longitudinal diffusivity (λ_1), Radial diffusivity ($(\lambda_2+\lambda_3)/2$), Fractional anisotropy (FA) and Apparent diffusion coefficient (ADC).

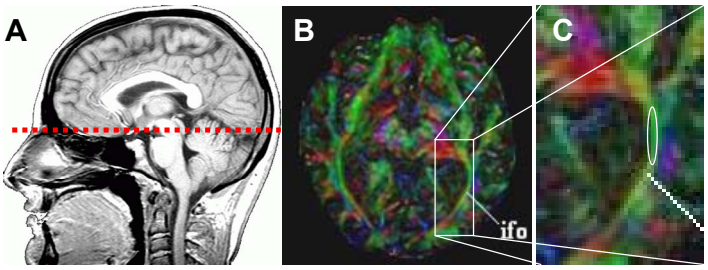

Figure 1
A: Location of DTI slice
B: Color map
C: ROI position on IFO

Results

Table1 and table2 summarize the statistical analysis results. No significant difference between MCI and AD was found. Means of longitudinal and radial diffusivities, FA, ADC were significantly higher on the right than on the left side for the AD group. Within the MCI group, only FA and radial diffusivity were higher on the right side.

The Differences between the two lobes concerning longitudinal and radial diffusivities and ADC values were more important in patients with AD than in patients with MCI. The differences were nearly 2 times greater within the AD group. While, the FA differences between the two lobes were similar in both populations (tables 1-2)

Conclusion

The results have revealed regional differences between the two temporal lobes in both MCI and AD groups. These white matter abnormalities might involve functional asymmetry. Therefore, our observations support the fact that the patients with AD rely more on right-sided posterior areas, which are metabolically less severely affected than their left-sided counterparts as previously revealed in the literature by PET imaging.

Although most imaging studies were focused on the primary alterations of grey matter in AD, our results suggest that the regional WM abnormalities may be an important component in the early pathophysiological aspects of AD.

Table1: Longitudinal and radial diffusivities, * $p < 0.05$.

	λ_1			$(\lambda_2+\lambda_3)/2$		
	Left	Right	*p*	Left	Right	*p*
MCI (*n* = 12)	1.46 ± 0.16	1.61 ± 0.16	0.038*	0.70 ± 0.08	0.73 ± 0.05	0.905
AD (*n* =15)	1.36 ± 0.17	1.67 ± 0.23	0.000*	0.64 ± 0.08	0.76 ± 0.18	0.016*

Table2: Fractional anisotropy and Apparent diffusion coefficient, * $p < 0.05$.

	FA			ADC		
	Left	Right	*p*	Left	Right	*p*
MCI (*n* = 12)	0.43 ± 0.07	0.48 ± 0.05	0.038*	0.95 ± 0.09	1.02 ± 0.07	0.074
AD (*n*=15)	0.46 ± 0.08	0.51 ± 0.10	0.027*	0.88 ± 0.09	1.06 ± 0.20	0.005*

Reference: Hirono et al., 2001. Neuronal substrates for semantic memory: a positron emission tomography study in Alzheimer's disease. Dement Geriatr Cogn Disord 12, 15-21.