BRAIN FDG-PET IN MCI: A RETROSPECTIVE LONGITUDINAL STUDY

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Background and Objective

Brain metabolism alteration represents one of the earlier neuroimaging biomarkers of dementia. This study aimed to disentangle different brain FDG-PET patterns in Mild Cognitive Impairment on the base of the longitudinal clinical progression.

Subjects & Methods

Seventy-four MCI patients underwent brain F^{18}-FDG-PET and clinical and neuropsychological follow-up for about three years (mean 33 months). Using voxel-based analysis, FDG-PET scans at baseline were statistically compared between patients who convert to Alzheimer's type Dementia (MCI-AD) or to Fronto-Temporal Dementia (MCI-FTD) and a matched group of healthy controls. Based on different clinical course, MCI-AD and MCI-FTD were compared separately with stable MCI (MCI-MCI).

Within this sample of MCI individuals, 28 patients (17 men, 11 women; mean age 65.75 years, standard deviation 9.67; mean education 10.53, standard deviation 4.23; mean MMSE 26/30, standard deviation 2.63) remained stable in their diagnosis of MCI (called MCI-MCI group), while 46 of them (19 men, 27 women; mean age 69.45 years, standard deviation 9.94; mean education 8.39, standard deviation 3.98; mean MMSE score 24.76/30, standard deviation 2.14) developed dementia. Of this group 33 evolved toward the Alzheimer's type Dementia (called MCI-AD group) and 13 evolved toward different variants of Frontotemporal Dementia (called MCI-FTD group; 6 bvFTD, 4 nfPPA, 2 svPPA, 1 FTD-parkinsonism). PET images were analysed using SPM5 on Matlab 7.01.

Results

Compared with healthy controls, MCI-AD exhibited hypometabolism in the left cingulate gyrus, cuneus, posterior cingulate and superior parietal lobule, whereas MCI-FTD showed hypometabolism bilaterally in the caudate nucleus, superior and inferior frontal gyrus, anterior cingulate cortex and left insula. Compared with Stable MCI, MCI-AD had hypometabolism in the left middle and inferior temporal gyri and a relative increased metabolism in the bilateral postcentral gyri, right precentral gyrus, insula and left lentiform nuclei, whereas MCI-FTD showed hypometabolism in the right inferior, middle, superior frontal gyri and inferior, middle and superior temporal gyri.

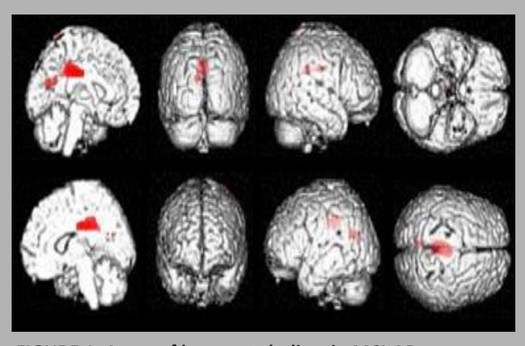

FIGURE 1. Areas of hypometabolism in MCI-AD vs controls ($p < 0.05$ FWE)

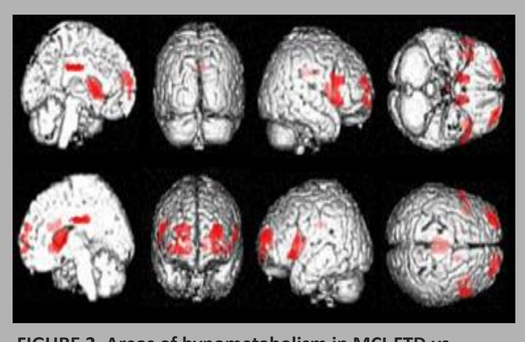

FIGURE 2. Areas of hypometabolism in MCI-FTD vs controls ($p < 0.0001$)

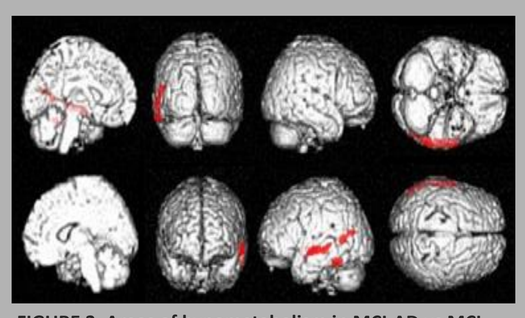

FIGURE 3. Areas of hypometabolism in MCI-AD vs MCI-MCI ($p < 0,005$)

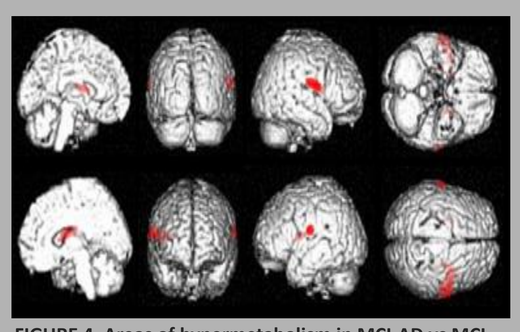

FIGURE 4. Areas of hypermetabolism in MCI-AD vs MCI-MCI ($p < 0,005$)

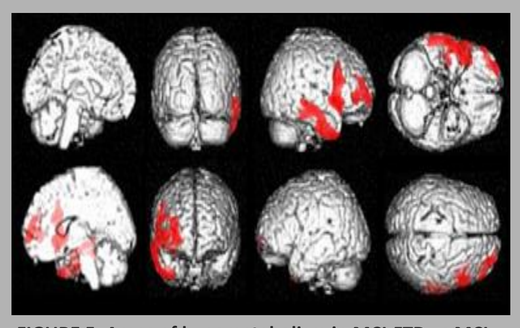

FIGURE 5. Areas of hypometabolism in MCI-FTD vs MCI-MCI ($p < 0.001$)

Type of study	retrospective
Years	2009-2014
Original sample	195 patients with cognitive disorders
Definitive sample	74 MCI (Petersen et al. 2001)
Subtypes	29 a-MCI, 27 md-MCI, 18 em-MCI
Age	68.05 *SD 9.94*
Gender	38 F, 36 M
Education	9.2 *SD 4.18*

Brain area	Left/Right	Brodmann area (BA)	Z value at local maximum	Talairach coordinates x y z
MCI-AD vs controls				
Hypometabolism				
Cingulate gyrus	L	31	6.94	-1 -33 30
Cuneus	L	18	5.30	-9 -69 16
Posterior cingulate	L	23	5.22	-6 -58 19
Superior parietal lobule	L	7	5.30	-33 -56 65
MCI-FTD vs controls				
Hypometabolism				
Caudate nucleus	L R		4.87 4.72	-12 8 3 14 12 1
Superior frontal gyrus	L R	10 10	4.59 4.13	-32 55 16 20 59 17
Cingulate gyrus	R L	23 23	4.53 4.20	8 -28 31 -4 -24 31
Inferior frontal gyrus	R L L	45 44 47	4.47 4.46 4.03	53 15 20 -55 12 12 -48 17 -1
Insula	L	13	4.11	-34 17 -1
MCI-AD vs MCI-MCI				
Hypometabolism				
Middle temporal gyrus	L	21 39	5.22 4.70	-61 -16 -4 -55 -56 8
Inferior temporal gyrus	L	20	4.97	-59 -47 -14
Hypermetabolism				
Precentral gyrus	R	6	5.36	53 -1 17
Postcentral gyrus	R L	43 43	5.30 5.11	63 -5 17 -63 -15 17
Insula	R	13	5.06	42 3 15
Lentiform nucleus (Putamen)	L		4.80	-22 -3 13
MCI-FTD vs MCI-MCI				
Hypometabolism				
Inferior frontal gyrus	R R	9 47	4.14 3.89	51 17 21 40 19 -3
Middle frontal gyrus	R	10	4.00	32 58 3
Superior frontal gyrus	R	10	3.63	32 53 16
Inferior temporal gyrus	R	20	3.82	51 -4 -35
Middle temporal gyrus	R	21	3.79	50 4 -36
Superior temporal gyrus	R R	22 38	3.69 3.87	55 10 -0 40 12 -38

TABLE 2. Brain areas of significant differences between groups

Conclusions

FDG-PET imaging, supported by a voxel-based analysis, is a very good tool in dementia diagnosis and might improve diagnostic and prognostic confidence in MCI condition. Among MCI patients, compensatory mechanisms and relative hypermetabolic patterns shown by FDG-PET are not yet fully understood and explored. Increase metabolism especially in subcortical areas could be specific of an evolution towards AD and not to other types of dementia, such as FTD. Further studies are required to better understand whether hypermetabolism might also play a direct role in the progression from MCI to AD and in the spread of amyloid pathology.

References

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