Multimodal MRI-PET data-driven pipeline for the discrimination of prodromal Alzheimer's Disease

Federico Nemmi(1), Pierre Payoux(1,2), Jérémie Pariente(1,3), Patrice Péran(1),

(1)ToNIC – UMR1214 Inserm/Universitè Paul Sabatier, Toulouse, France; (2) Department of Nuclear Medicine, Centre Hospitalier Universitaire de Toulouse, Toulouse, France (3) Neurology Department, , Centre Hospitalier Universitaire de Toulouse, Toulouse, France

Introduction: Combining multimodal neuroimaging and machine-learning is becoming one of the most useful tool for discriminating between healthy (HC) and pathological subjects. We recently developed a fully data-driven pipeline for diagnostic based on multimodal MRI imaging (Nemmi et al., 2019, Neuroimage:Clinical; Nemmi et al., 2019, Human Brain Mapping). In this study we used a well-characterized dataset of prodromal Alzheimer's Disease (AD) patients and HC with a multimodal MRI and PET protocol to expand our pipeline to PET.

Methods: Our pipeline includes a series of features selection (variance threshold, relieff, correlation-based subset selection) and reduction (spatial clustering) steps coupled with support-vector machine for discrimination. It is able to estimate the discriminant power for each modality, together with the most discriminant clusters (signature) and the predicted labels. We included 21 AD and 22 HC with available T1-weighted (grey matter volume, GMV), Diffusion Weighted Images (fractional anisotropy, FA, and mean diffusivity, MD), FDG-PET and AV45-PET and submitted their images to the pipeline using both a vowel-wise and an atlas-based approach. We validated the pipeline using a 10-times repeated 10-fold cross-validation.

Results: The pipeline reached and accuracy of .78. When using a vowel-wise approach we observed that GMV and AV45 were the most discriminant modalities being selected in 90% of the folds. When using an atlas-based approach AV45 and FDG were the most discriminant modalities (~90% of the folds). For all modalities, the signature was coherent with the known pathophysiology of AD, with GMV in the medial temporal lobe, FDG in the medial temporal and frontal lobe and AV45 in lateral and medial parietal cortices.

Conclusion: This study extended our pipeline to PET as well as extending it to atlas-based analyses. We have shown that AV45 is consistently the most discriminant modality even in a sample of prodromal AD.