A standardized [18F]-FDG-PET template for spatial normalization in statistical parametric mapping of dementia.

Abstract:
[18F]-fluorodeoxyglucose (FDG) Positron Emission Tomography (PET) is a widely used diagnostic tool that can detect and quantify pathophysiology, as assessed through changes in cerebral glucose metabolism. [18F]-FDG PET scans can be analyzed using voxel-based statistical methods such as Statistical Parametric Mapping (SPM) that provide statistical maps of brain abnormalities in single patients. In order to perform SPM, a "spatial normalization" of an individual's PET scan is required to match a reference PET template. The PET template currently used for SPM normalization is based on [15O]-H2O images and does not resemble either the specific metabolic features of [18F]-FDG brain scans or the specific morphological characteristics of individual brains affected by neurodegeneration. Thus, our aim was to create a new [18F]-FDG PET aging and dementia-specific template for spatial normalization, based on images derived from both age-matched controls and patients. We hypothesized that this template would
increase spatial normalization accuracy and thereby preserve crucial information for research and diagnostic purposes. We investigated the statistical sensitivity and registration accuracy of normalization procedures based on the standard and new template-at the single-subject and group level-independently for subjects with Mild Cognitive Impairment (MCI), probable Alzheimer's Disease (AD), Frontotemporal lobar degeneration (FTLD) and dementia with Lewy bodies (DLB). We found a significant statistical effect of the population-specific FDG template-based normalisation in key anatomical regions for each dementia subtype, suggesting that spatial normalization with the new template provides more accurate estimates of metabolic abnormalities for single-subject and group analysis, and therefore, a more effective diagnostic measure.

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