ADNI Alzheimer's Disease Neuroimaging Initiative

University of Utah PET Image Analysis Methods

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Summary

The focus of The University of Utah component of the PET Imaging Core is on the individual image analysis and processing of molecular imaging data using 3-dimensional stereotactic surface projections (3D-SSP) computed by Neurostat, developed by Satoshi Minoshima [Minoshima et al., 1995]. We submit 7 numeric summary values. We compute the averaged uptake values in 18F-FDG, 18F-AV45 and 11C-PIB images, for regions that are typically relevant to Alzheimer's Disease: pons, frontal and association cortices. In order to convey the extent of hypometabolism from FDG scans, we compare each subject to an elderly control population and compute the number of significantly hypometabolic pixels. We compute the sum of the significantly hypometabolic pixels from FDG scans, in order to communicate both the extent and severity of the subject's hypometabolism.

Method

PET scans downloaded from LONI are from the post-processed group 4 images, i.e. coregistered and averaged frames, standardized mage orientation and voxel size, and uniform resolution smoothed to 8mm. Neurostat aligns the brain images along the AC-PC line and non-linearly warps the image into standard Talairach space. Longitudinal scans are co-registered to the baseline scan and a multi-step nomalization is used to create a mean template that reduces the variability between subject visits. A peak pixel template is created from the mean template and applied to intra-subject serial scans to produce SSP maps. The SSP images are used to calculate values from pre-defined brain regions for FDG and amyloid images. FDG metabolic values are compared pixel-wise to values from a reference set of cognitively normal individuals to create SSP Z-score maps showing the statistical significance of regional cerebral glucose hypometabolism. The numeric summary values we submit are: *i*) average regional pons value (AVEPONS), *ii*) average regional association cortex value (AVEASSOC), consisting of both lateral and medial surfaces from frontal, temporal and parietal cortices, *iii*) average regional frontal cortex (lateral and medial) value (AVEFRONT), *iv*) number of hypometabolic FDG pixels with Z-scores greater than or equal to 2 standard deviations from normal (2SDSIGPXL), *v*) and the number of hypometabolic FDG pixels with Z-scores greater than or equal to 3 standard deviations from normal (3SDSIGPXL), *vi)* sum of FDG Z-scores greater than or equal to 2 standard deviations (SUMZ2) and *vii*) sum of FDG Z-scores greater than or equal to 3 standard deviations (SUMZ3).

FDG-PET Analysis

Regional values of glucose uptake are computed and normalized to the averaged pons value. Individual scans are compared to our control population (N=27) of elderly normals, (NORM27HR4_4 , 14 men, 13 women, mean age 69.6 ± 7.7).

Amyloid (AV45, PIB) PET Analysis

Amyloid images are co-registered to the corresponding FDG-PET scan with the closest date. Using the FDG transforms, amyloid images are warped into Talairach space. Reference templates generated from the FDG scans are used to create the 3D-SSP maps for amyloid uptake images. Regional values of amyloid uptake are computed and normalized to the averaged cerebellar value.

References

1. Minoshima S, Frey KA, Koeppe RA, Foster NL, Kuhl DE. A diagnostic approach in Alzheimer's disease using three-dimensional stereotactic surface projections of fluorine-18-FDG PET. J Nucl Med 1995;36:1238-48.

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