ADNI Alzheimer's Disease Neuroimaging Initiative

Trajectories of AD related cerebral glucose hypometabolism in individuals prior to their progression to MCI/dementia

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Summary

We introduced hypometabolic convergence index (HCI) and statistical region of interest (sROI) to characterize AD specific FDG-PET measured cerebral metabolic rates for glucose (CMRgl) reduction. HCI measures the degree of similarity, in terms of magnitude and spatial extents of reduced CMRgl in an individual comparing with that of a typical AD patient, and sROI tracks CMRgl alterations in brain regions associated with longitudinal change (Chen et al., 2010; Chen et al., 2011). In addition to our previous data uploads, we now completed HCI and sROI for total 3355 number of visits for total 1406 subjects.

Methods

Part 1, HCI and sROI values for each visit of each patent were computed as described in (Chen et al., 2010; Chen et al., 2011). We examined these global AD specific CMRgl indices HCI and sROI to characterize longitudinal changes 1) over 2.74 years in healthy individuals prior to their diagnosed cognitive impairment (NC-to-MCI progressors) in comparison to the non-progressors and 2) over 2.61 years in mild cognitive impairment (MCI) patients prior to their diagnosed dementia due to AD (MCI-to-AD progressors) in comparison to the patients with stable MCI. Our aim was to examine if the CMRgl decline is accelerated in the NC-MCI progressors and in MCI-AD progressors in contrast to, respectively, their non-progressing counterparts.

Part 2, Image Processing Steps and Names and Versions of Software used
All images downloaded from LONI (http://adni.loni.usc.edu/methods/pet-analysis/pre-processing/) were fully processed by LONI (Co-registered dynamic, Averaged, Standardized Image and Voxel Size, and Uniform Resolution). The images were then spatially normalized to the SPM template using SPM8 (Wellcome Trust Center for Neuroimaging, UCL, UK) in MATLAB R2013a (Mathworks, Natick, MA). The in-house developed procedures were used to calculate the HCI and sROI.

Results
For the study participants who were initially cognitively unimpaired, the NC-to-MCI progressors displayed an accelerated rate of change compared to the non-progressors in both sROI and HCI ($p=<0.001$ for both). Similarly, significant group differences of rate of changes were also found between MCI-to-AD progressor and stable MCI patients ($p<0.0001$ for both). For both sROI and HCI, MCI-to-AD progressor demonstrated a larger slope difference effect size (sROI: Cohen's d = 3.32, HCI: Cohen's d = 3.18) than NC-to-MCI progressors (sROI: Cohen's d = 1.97, HCI:

Cohen's d = 1.50). For the NC-to-MCI progressors, the age-onset was 3.85 years for sROI and 3.73 years for HCI prior to their MCI diagnosis. For MCI-to-AD progressors, the age of onset was 3.25 years and 3.41 years before their AD diagnosis separately for sROI and HCI.

Uploaded data:
We uploaded all HCI/sROI value included in our analysis.

Conclusions
Our results demonstrate that progressors and non-progressors embark on separate trajectories for cerebral metabolism several years before their clinical diagnosis demonstrating the feasibility of the use of FDG-PET technique in pre-clinical AD studies including prevention trials.

Version Information

This is the document submitted from Banner Alzheimer Institute regarding the HCI and sROI calculation for FDG-PET image analysis.

Dataset Information

This methods document applies to the following dataset(s) available from the ADNI repository:

Dataset Name	Date Submitted
Reiman/Chen Lab – HCI Analysis Version 20.0	9 Sep 2016
Reiman/Chen Lab – sROI Analysis Version 20.0	9 Sep 2016

About the Authors

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Reference List

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