Alzheimer's disease-related hypometabolic convergence index

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Summary

We previously developed a global index summarizing voxel-wise information into a single measurement referred to as the hypometabolic convergence index (HCI). HCI characterizes the extent to which the pattern and magnitude of hypometabolism in a person's fluorodeoxyglucose positron emission tomography (FDG PET) image corresponds to that in patients with the clinical diagnosis of Alzheimer's dementia. We now calculated HCI for 796 new scans available (out of a total of 2865) from the ADNI LONI website for us to download. We examined HCI correlations with cognitive measures and clinical ratings, and HCI changes over time in the AD, MCI, eMCI and healthy control groups.

Method

So far, we downloaded 2865 FDG PET scans from 343 cognitively normal subjects, 13 SMC, 305 eMCI, 411 MCI and 216 patients with AD, including the 796 new ones for the current HCI estimations. SPM8 and our in-house developed routine were used to compute HCI. Using HCI from ALL scans we have, the associations between HCI with cognitive measures and clinical ratings were examined as well as the HCI changes over 12, 24, 36 and 48 months for each diagnostic group.

Image Processing Steps and Names and Versions of Software used

All images downloaded from LONI (http://adni.loni.ucla.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 R2009b (Mathworks, Natwick, MA). The in-house developed procedure was used to calculate the HCI for each of the new scans. For detailed description about HCI computation, please see reference [1] listed below.

Results

Pooling all data together (across subject groups and time points) and as summarized below in the table, we found significant correlation of HCI with ADAS-total, MMSE, sum of boxes, AVLT-delay 30min and AVLT-total. HCI changes over time are biggest in AD patients for visits where FDG-PET data available, lowest for HC while HCI values for MCI are intermediate (details will be described separately).

	Overall	normal	eMCI	MCI	AD
ADAS-Total	r=0.561 p=9.47e-99 N=1179	r=0.009 p=0.872 N=300	r=0.230 p=5.31e-5 N=302	r=0.341 p=2.34e-11 N=363	r=0.417 p=2.16e-10 N=214
Sum of Boxes	r=0.529 p=2.24e-86 N=1187	r=0.013 p=0.828 N=301	r=0.136 p=0.018 N=305	r=0.214 p=3.75e-5 N=365	r=0.259 p=1.15e-4 N=216
MMSE	r=0.504 p=2.50e-77 N=1187	r=0.093 p=0.109 N=301	r=0.025 p=0.668 N=305	r=0.232 p=7.74e-6 N=365	r=0.229 p=0.001 N=216
AVLT-Delay 30'	r=0.328 p=6.34e-31 N=1180	r=0.038 p=0.509 N=300	r=0.041 p=0.472 N=303	r=0.178 p=0.001 N=363	r=0.095 p=0.165 N=214
AVLT-Delay Total	r=0.362 p=1.01e-37 N=1179	r=0.077 p=0.181 N=300	r=0.048 p=0.406 N=303	r=0.167 p=0.001 N=362	r=0.109 p=0.112 N=214

Conclusion

As a single index, HCI can be used to examine group difference crosssectionally and longitudinally. Its associations with various cognitive measures and clinical ratings provided evidence of its relevance to AD. Additional studies are needed to further improve its statistical powers.

Version Information

This is the first document submitted from Banner Alzheimer Institute regarding Hypometabolic Convergence Index (HCI) of FDG PET image analysis for all subjects in ADNI (1/GO/2).

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 17.0	06 August 2013

References

1. K. Chen, N. Ayutyanont, J. B. Langbaum, A. S. Fleisher, C. Reschke, W. Lee, X. Liu, D. Bandy, G. E. Alexander, P. M. Thompson, L. Shaw, J. Q. Trojanowski, C. R. Jack, Jr., S. M. Landau, N. L. Foster, D. J. Harvey, M. W. Weiner, R. A. Koeppe, W. J. Jagust, and E. M. Reiman, "Characterizing Alzheimer's disease using a hypometabolic convergence index," *Neuroimage.*, vol. 56, no. 1, pp. 52-60, May 2011.

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