Prediction of Cognitive Change Based on Hemispheric Cortical Surface Maps of FDDNP

Protas, H. D.; Huang, S-C; Kepe, V.; Ercoli, L.; Thompson, P.; Small, G.W.; Barrio, J.R.

Objectives:
Hemispheric Cortical Surface Maps (HCSM) of FDDNP give good visualization of beta amyloid plaque (BA) and neurofibillary tangle (NFT) distribution in the brain. To assess how well the distribution pattern predicts cognitive decline, we examined the feasibility and reliability of using a statistical method to predict a subject's MMSE based on their regional cortical FDDNP uptake pattern.

Methods:
We applied movement correction to dynamic FDDNP PET data from 23 subjects that have Mini Mental State Examination (MMSE) scores. Logan graphical plots were used, with the cerebellum as reference region, to generate the Distribution Volume Ratio (DVR) image of FDDNP. Early summed FDDNP images were computed. A HCSM for each subject was extracted from the MRI in ICBM space. The same transformations were applied to the DVR and summed FDDNP images to put them in the same cortical space. ROIs were drawn directly on the average HCSM. Linear regression was used to find the rate of change of FDDNP vs MMSE for each HCSM ROI. The models were then used jointly to predict MMSE from a set of ROI values for each subject. Cross validation was used to show the reliability of the estimate.

Results:
Use of all ROI values of DVR to predict MMSE gave a sample standard deviation (SD) of 2.3 that was comparable to using the global DVR alone. With a stepwise approach, we found that the SD can be reduced to 1.7 by using only DVR values from prefrontal, medial and lateral temporal, parietal regions plus the summed FDDNP values in posterior cingulate.

Conclusions:
HCSM of FDDNP can provide not only good visualization of brain cortical distribution of BA and NFT, but also reliable estimates of subjects' MMSE, when proper statistical estimation is employed.

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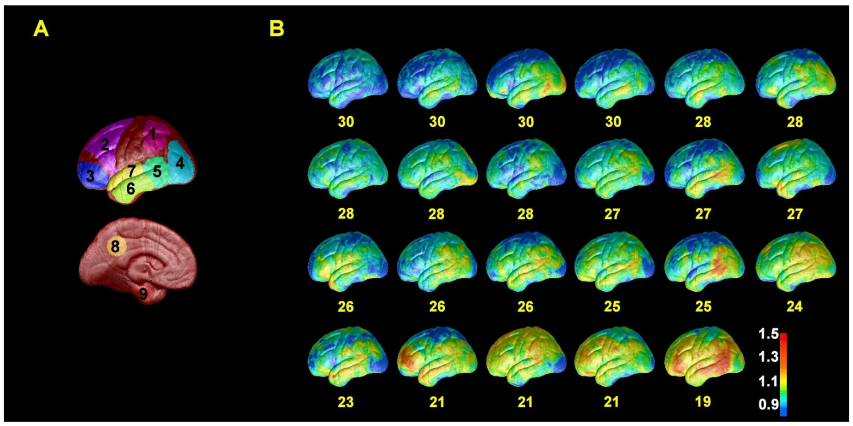

Prediction of MMSE scores based on regression analysis.
A. ROIs used in the study. The left hemisphere is shown only, but these ROIs are used on the right hemisphere as well. B. Order of cortical surface maps determined by regression between FDDNP PET and 30-MMSE score for parietal, lateral temporal, medial temporal, prefrontal from the DVR image and posterior cingulate of early summed FDDNP image. The estimated MMSE are shown under the cortical surfaces.

Subjects	30-MMSE (true)	30-MMSE (est)
1	3	2
2	0	2
3	3	6
4	1	0
5	1	3
6	1	4
7	0	0
8	2	5
9	1	2
10	1	0
11	3	5
12	3	2
13	4	3
14	2	0
15	1	3
16	4	2
17	10	9
18	5	4
19	6	4
20	7	9
21	6	7
22	7	9
23	11	11

Table of cross validation study that shows the estimated 30-MMSE for each of the subjects. The standard deviation of the cross validation calculated between the estimated 30-MMSE and the true 30-MMSE value is 1.7