## 29

# Cortical surface-based statistical analysis of brain PET images

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**Purpose:** Precise and focal analysis of brain PET using voxel-based statistical mapping is limited due to the innate low spatial resolution of PET images which causes partial volume effect as well as due to the low precision of the image registration. In this study, we propose a cortical surface-based method for the precise analysis of brain PET images in combination with MRI. **Methods:** $^{18}$F-FDG brain PET images were acquired using GE ADVANCE PET scanner in 3D mode. 3D T1-weighted axial MR images were acquired from Philips Intera 1.5T scanner with slice thickness 1.5 mm and FOV=22 cm. The first step of analysis, we segmented gray and white matter from the structural T1 images using Freesurfer (MGH, Harvard Medical School) which extract the white matter surface using a deformable surface model. The cortical surface was further parcellated automatically into 85 anatomically relevant brain sub-regions. The second step, we developed a method for registering PET images to MRI in combination with a mutual information algorithm to maximize total metabolic activity within the gray matter band. Partial volume correction of PET image was conducted utilizing the extracted gray matter. The third step, we calculated mean cortical activity along the path from the white matter surface to the gray matter surface. The cortical activity was represented on the spatially normalized surface which statistical evaluation of cortical activity was conducted with. **Results:** We evaluated the surface-based representation of PET images and the registration of PET and MRI utilizing cortical parcellation. The preliminary results showed that our method is very promising in the analysis of subtle cortical activity difference. **Conclusion:** We proposed a novel surface-based approach of brain PET analysis using high resolution MRI. Cortical Surface-based method was very efficient in the precise representation of brain activity, correction of partial volume effect as well as better spatial normalization.

## 30

# Relationship between Salivary Cortisol Levels and Regional Cerebral Glucose Metabolism in Nondemented Elderly Subjects

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**Purpose:** Cortisol is a primary stress hormone for flight-or-fight response in human. Increased levels of cortisol have been associated with memory and learning impairments. However, little is known about the role of cortisol on brain/cognitive functions in older adults. We compared regional cerebral glucose metabolism between elderly subjects with high and low cortisol levels using FDG PET. **Methods:** Salivary cortisol levels were measured four times during a day, and an average of the four measurements was used as the standard cortisol level for the analyses. From a population of 120 nondemented elderly subjects, 19 (mean age, 70.1±4.9 y; 2 males and 17 females) were identified as the high (> mean + 1 SD of the total population) cortisol subjects (mean cortisol, 0.69±0.09 μg/dL), while 14 (mean age, 67.2±4.5 y; all females) as the low (< mean 1 SD) cortisol (mean cortisol, 0.27±0.03 μg/dL). A voxel-wise comparison of FDG PET images from the high and low cortisol subjects was performed using SPM99. **Results:** When compared with the low cortisol group, the high cortisol group had significant hypometabolism in the right middle temporal gyrus, left precuneus, right parahippocampal gyrus, right inferior temporal and superior temporal gyri ($P < 0.01$ uncorrected, $k = 100$). There was no significant increase of glucose metabolism in the high cortisol group compared with the low cortisol group ($P < 0.01$ uncorrected, $k = 100$). **Conclusion:** The high cortisol elderly subjects had hypometabolism in the parahippocampal and temporal gyri and precuneus, regions involved in memory and other cognitive functions. This may represent the preclinical metabolic correlates of forthcoming cognitive dysfunction associated with stress in the elderly. Longitudinal studies of brain metabolism and cognitive function are warranted.