Differential alterations of metabolic connectivity between attentional networks and limbic networks are associated with visual hallucinations in Lewy Body Dementia (DLB): a FDG-PET/MRI study.

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Background

Recurrent complex visual hallucinations (VH) are common in dementia with Lewy Body (DLB). Resting state fMRI studies in DLB with VH have reported a functional imbalance between ventral attention, dorsal attention and default mode networks. Only one study has investigated metabolic connectivity in DLB with recurrent VH by means of PET-FDG.

Aim of Study

to explore connectivity changes of PET-FDG data acquired with a hybrid PET/MRI scanner in DLB patients with VH.

Methods

26 patients with a diagnosis of probable DLB (13 VH+ and 13 VH-; age: 72.3±6.09 yr, and 70.2±7.92 yr, respectively) and 18 controls subjects (CTRL)(mean age: 64,9±7,7 yr) were enrolled. Subjects were matched for age and sex. 3D-T1-MPRAGE MRI and a PET-FDG data were co-acquired for all subjects. T1-sequences were processed using Freesurfer standard pipeline, and the cortical surface was divided in 100 ROIs based on the functional atlas of Shaefer-Yeo that divides the brain cortical surface in 7 Networks. A partial volume correction was applied using PET-Surfer based on Symmetric Geometric Transfer Matrix (SGTM). The standardized uptake value (SUV) for each ROI, normalized with the cerebellum, was extracted. A first multivariate analysis of variance was done at the atlas-based network level. Graph analysis was performed using BrainGraph and the i-graph package-R to extract the following nodal parameters: clustering coefficient, strength degree, and characteristic path length. (Fig.1)

Results

At the network level, CTRL showed higher SUVr values for each network as compared to both DLB groups. SUVr values of the dorsal attention network were significantly lower in the VH+ group as compared to the VH-. The graph analysis showed, at atlas sub-networks, an increased of nodal strength in the ventral attentional and parietal networks, and a tendency of reduction dorsal attentional limbic network in VH+ with respect to VH-. At the nodal level, the VH+ group showed significant lower strength degree in the inferior parietal lobe (default network) and postcentral regions (dorsal attention network); and higher strength degree in the orbitofrontal cortex and temporal-pole (limbic), and inferior frontal cortex (ventral attention). The study of HUB shows that VH+ as compared to VH- loss of many posterior hubs in the ventral and dorsal attention networks, and gained more anterior hubs in the default mode, fronto-parietal and limbic networks. Hypometabolism of right temporo-parieto-occipital regions and a trend hypermetabolism are correlated with VHs severity(Fig. 2)

Conclusions

In DLB, glucose metabolism is diffusely decreased at the cortical level as compared to control subjects. The presence of visual hallucinations is associated with metabolic decrements/connectivity in parieto-occipital cortex, within the dorsal and ventral attention networks, and relatively higher metabolism/connectivity in the limbic system. The analysis of PET-FDG/MRI data using graph theory analysis may add information about in vivo network changes associated with genesis of visual hallucinations and may give us an instrument to better evaluate behavioral changes in neurodegenerative diseases.

Fig.1

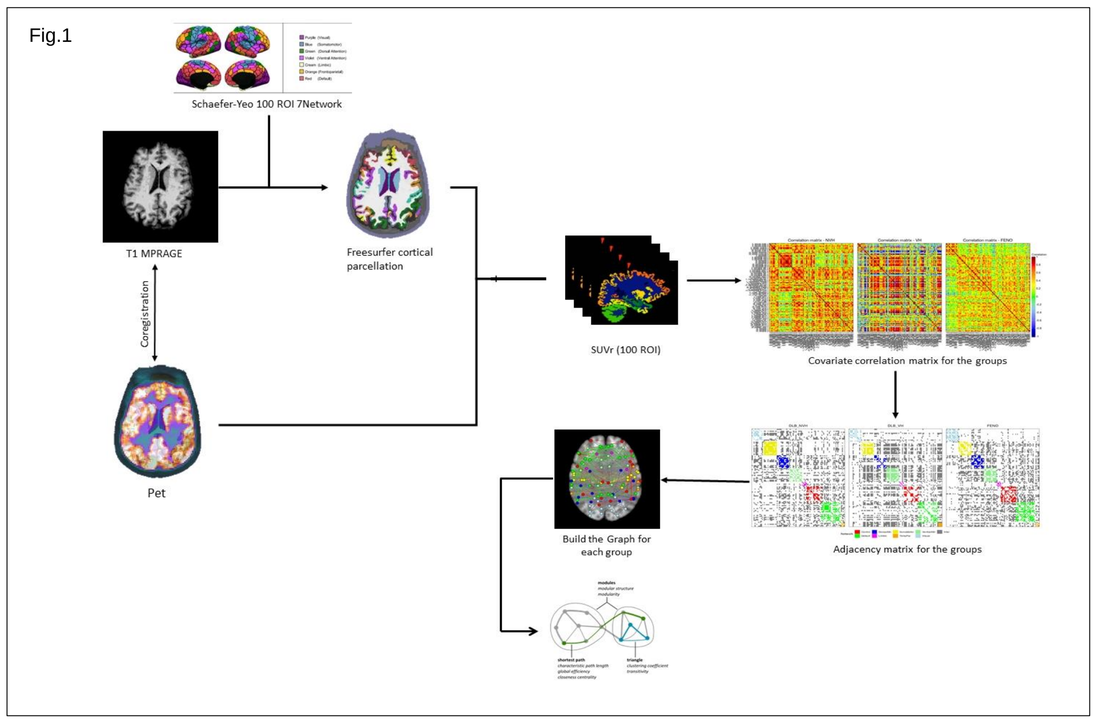

Fig.2