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Title page

Disrupted Amplitude of Low-frequency Fluctuations and Causal Connectivity in Parkinson's Disease with Apathy

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Highlights

- Non-invasive rs-fMRI was used to investigate changes of brain regions in PD with apathy.
- We combined GCA with ALFF approaches to analyze rs-fMRI data.
- A positive feedback from thalamus to damaged SFG may contribute to PD-related apathy.

Abstract

Apathy is a common non-motor symptom in Parkinson's disease (PD). We aimed to explore its associated neural substrates changes via amplitude of low-frequency fluctuations (ALFF) and granger causality analysis (GCA). Resting-state functional magnetic resonance imaging (rs-fMRI) scans were performed in 20 PD patients with apathy (PD-A), 22 PD patients without apathy (PD-NA) and 19 healthy volunteers. GCA, a new method exploring direction from one brain region to another, was based on brain regions showing alterations of neural activity as seeds, which were examined utilizing ALFF approach. The relationships between ALFF or GCA and apathetic symptoms were also assessed. Relative to PD-NA group, PD-A group indicated decreased ALFF in left orbital middle frontal gyrus and bilateral superior frontal gyrus (SFG). Only ALFF values in right SFG were negatively correlated with Apathy Scale (AS) scores. Then GCA with the seed of right SFG showed a positive feedback from right thalamus to ipsilateral SFG, which was positively correlated with AS scores. In conclusion, dysfunction in SFG and a positive feedback from thalamus to ipsilateral SFG contributed to presence of PD-related apathy, providing a new perspective for future studies on apathy in PD.

Keywords: Parkinson's disease; Apathy; Neural substrates; Amplitude of low-frequency fluctuations (ALFF); Granger causality analysis (GCA)

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