

Cerebral blood flow and cerebrovascular reactivity in Parkinson's disease: Relationship with severity of motor symptoms

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Background

Parkinson's disease (PD) is a progressive neurodegenerative disorder that mainly affects motor function.¹ Neurovascular unit (NVU) disruption has been hypothesized to play a role in neurodegenerative mechanisms in PD.² However, its relationship with the development and progression of the disease is still unclear.² The aims of this study were to assess cerebral blood flow (CBF) and cerebrovascular reactivity (CVR) in mild to moderate stages of PD, and their correlations with the severity of motor symptoms.

Methods

Arterial spin labeling (ASL) MRI was acquired for twenty-eight PD patients (66.6±8.6 years, 22 males, median [IQR] H&Y=1.5 [1-1.9], median [IQR] MoCA=22.9 [20-24.9]) and thirty-two age- and sex-matched healthy controls (HC, 63.1±8.1 years, 20 males) to derive CBF maps. A subgroup of thirteen PD patients and thirteen HC was also scanned at hypercapnia to compute CVR. Median CBF and CVR were computed within cortical and subcortical regions of the motor network (precentral gyrus, postcentral gyrus, supplementary motor area, striatum, pallidum, thalamus, red nucleus, substantia nigra and subthalamic nucleus). PD-vs-HC differences were tested for both CBF and CVR, and the correlation between them and the severity of PD motor symptoms (quantified with UPDRS III) was assessed. Multiple comparisons were corrected using the false discovery rate (FDR) method.

Results

No significant CBF/CVR differences were found between PD and HC. Positive significant ($p_{FDR}<0.05$) CBF-UPDRS III correlation was observed in the precentral gyrus ($\rho=0.633$, $p_{FDR}=0.001$), postcentral gyrus ($\rho=0.673$, $p_{FDR}<0.001$), supplementary motor area ($\rho=0.543$, $p_{FDR}=0.003$), corpus striatum ($\rho=0.493$, $p_{FDR}=0.015$), pallidum ($\rho=0.447$, $p_{FDR}=0.023$), thalamus ($\rho=0.648$, $p_{FDR}=0.002$), red nucleus ($\rho=0.555$, $p_{FDR}=0.009$) and substantia nigra ($\rho=0.485$, $p_{FDR}=0.015$). Significant negative CVR-UPDRS III correlation was found in the striatum ($\rho=-0.720$, $p_{FDR}=0.048$).

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Conclusions

These results suggest that there might be a neurovascular involvement in the motor network at the mild to moderate stages of PD. CBF and CVR assessment provides indirect non-invasive information about NVU integrity and may be used as imaging markers for PD longitudinal evaluation.

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