ARTERIAL SPIN LABELING IN THE IDENTIFICATION OF ABNORMAL PERFUSION PATTERNS IN EARLY, DRUG-NAÏVE PARKINSON'S DISEASE

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Aim: To identify cerebral blood flow (CBF) perfusion patterns derived from Arterial Spin Labeling (ASL) MRI to distinguish recently diagnosed, drug-naïve Parkinson’s disease (PD) patients from healthy controls as a potential early biomarker in PD.

Methods: Pseudo Continuous ASL was used on a 3T GE HDx scanner with a 3D fast spin echo spiral sequence to investigate CBF perfusion with TE = 1.8s, TR = 9.2s, and a total time of 8 minutes 4s. Eight drug-naïve Parkinson’s patients (mean age: 64.4 ± 11 years) and 16 controls (mean age: 70.8 ± 8 years) completed neuropsychological tests of global mental status (Mini Mental State Examination (MMSE) and Montreal Cognitive Assessment), motor assessment (Hoehn & Yahr (H&Y), UPDRS) and MRI scans. Each CBF map was normalized to the Montreal National Institute (MNI) template using SPM5. Principal Component Analysis (PCA) of all the datasets (PD and controls) resulted in a set of characteristic perfusion covariance patterns represented as principal component images. The expression of the first principal component in each individual was used to examine differences between the two groups, as well as correlations with neuropsychological scores and disease severity.

Results: A t-test of the expression of the principal component in each individual successfully distinguished between patients and controls (t23 = -2.30, p = 0.03; figure 1a). The identified covariance pattern was characterized by hypoperfusion in PD versus controls in the bilateral posterior parietal-occipital region, extending anteriorly to include precentral and postcentral gyri and middle frontal gyrus. Hypoperfusion also occurred in the posterior medial cortex (principally precuneus) and left middle temporal lobe (figure 1b). The decrease in the expression of this pattern in PD did not significantly correlate with neuropsychological tests or measures of disease severity (MMSE vs. Principal component1 (PC_1): r2 = 0.006, p = 0.71; H&Y vs. PC_1: r2 = 0.36, p = 0.11).

Discussion: The pattern of hypoperfusion evident in PD cases provides a new finding that may be indicative of early disease status. This pattern appears to be independent of both motor severity and cognition. However, the limited range of scores on cognition, reflecting non-advanced age and short disease duration, suggests the need to reassess this network in a larger sample of patients showing a wider spectrum of motor and non-motor impairments. Radiotracer studies by others suggest separate motor and cognitive PD-related metabolic/perfusion patterns in advanced PD; at this early disease stage, we identified subtle changes in perfusion using ASL.

Conclusion: This study demonstrated that a group of drug-naïve PD patients differed significantly from controls by showing reduced expression of an underlying perfusion network free from drug/treatment related influences. The expression of this ASL derived perfusion pattern offers a potential early biomarker in PD that may also have value in presymptomatic individuals at risk of developing PD.