Motor associations of iron deposition in patients with Parkinson's disease


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Introduction

- Loss of dopaminergic neurons in the substantia nigra (SN) is associated with an increase in neuronal iron.
- Low molecular weight iron can cause oxidative damage to proteins, lipids and DNA for which there is ample evidence in Parkinson's disease (PD).
- Susceptibility weighted imaging (SWI) is a high-resolution MR-based imaging technique for quantifying iron depositions in vivo.
- We hypothesised that SWI may be a robust biomarker for clinical characterization of PD, and we sought to investigate the clinical associations of iron depositions in SN.

Objectives

To determine whether Susceptibility Weighted Imaging of Substantia Nigra could be a feasible cross-sectional clinical biomarker in Parkinson Disease (PD).

Methods

- Forty-two patients with PD and 8 healthy volunteers were studied with SWI imaging from Transneuro research project (‘An imaging study to assess structural and functional connectivity in a longitudinal study of patients with Parkinson’s disease’, 10/H0805/723) (Table 1).
- Phase images were obtained from 3T high resolution gradient-echo SWI sequence on a 3T MRI (Siemens Trio, Germany) with 32 channel head coil. Phase, magnitude and combined SWI images were acquired although only phase data were analysed.
- Analysis of high-pass filtered phase shift data was performed using SPIN (MRI institute for Biomedical Research, Detroit) software.
- Bilateral manual delineation of SN was performed according anatomic structures on high-pass filtered phase images (Fig 1).
- Analysis of bilateral shift values averaged and transformed to Radians was performed in addition to total number of pixels.
- For analysis of high iron deposition percentage, threshold consisting in mean plus 2 standard deviations from SN of the healthy control group was calculated.

Results

- PD patients had higher phase shift values (p<0.001) and iron deposition percentage (p<0.001) in the SN bilaterally, compared to healthy controls.
- The SN contralateral to the most symptomatic side, showed higher phase values (p<0.001) and iron deposition percentage (p<0.01) compared to the less-affected side.

Conclusions

- SWI is a feasible imaging method for analysis of susceptibility changes of iron deposition in SN with average phase shifts and high iron deposition percentage calculations.
- PD patients show higher levels of deposits of iron in SN compared to age- and gender-matched healthy controls.
- Increased iron levels in SN are associated with prolonged disease and increased motor disability.

References


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