(OSS-II-10) Quantitative susceptibility mapping in human brain with normal aging

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Background: The spatial and temporal variations of iron deposits are important characteristics of aging in brain [1] and can be identified and measured using quantitative susceptibility mapping (QSM).[2] In this study, we use QSM to quantify susceptibility changes in the external and internal globus pallidus (GP), putamen, caudate nucleus (CN) and red nucleus (RN); five regions which have been previously suggested to change in aging.[3]

Methods: Data reported as meanąstandard deviation. Forty-seven, cognitively normal, individuals (age=51years ą15years) were imaged on a 3-T MR scanner and divided based on median age to form young (age<51years,n=23) and elderly (age≥51years,n=24) groups. Exclusion criteria included: a)history of neurological disorders, b)MR incompatibility, c)claustrophobia, and d)Montreal cognitive assessment composite score <27. Image acquisition parameters were multi-echo gradient-recalled sequence: TE_1=2.1 ms; ΔTE=2.4 ms; TR=22 ms; voxel-size =1mm^3; and acquisition matrix=256×256×128. Data underwent skull stripping,[4] 3D phase unwrapping and dipole fitting.[2] The magnetic field was calculated using phase data and the background field was removed using RESHARP technique.[5] A regularized deconvolution method was utilized to generate QSM data. The ICBM brain atlas was used to anatomically segment the QSM data. Two-tailed student t-tests were used to compare young and old groups. Regional magnetic susceptibility data were analyzed versus age using linear regression.

Results: External GP showed the highest magnetic susceptibility (270ppb ± 79ppb), followed by RN (268ppb ± 105ppb), internal GP (200ppb ± 82ppb), putamen (144ppb ± 53ppb), CN (143ppb ± 40ppb). Comparison between young and elderly groups showed that the elderly group had a higher average magnetic susceptibility in external GP (23.8%, p=0.011), internal GP (32.5%, p=0.022), and putamen (23.5%, p=0.048). A trend towards significance with aging was seen in the RN (20.1%, p=0.129). Changes in the CN were not significant (1.0%, p=0.949). Linear regression of susceptibility against age in all subjects showed positive slopes in external GP (1.75ppb/year, p=0.027), internal GP (1.64, p=0.037), putamen (1.04, p=0.050), RN (1.52, p=0.193) and CN (0.141, p=0.730).

Conclusions: Quantification and location of susceptibility variation using QSM characterizes iron deposition in deep nuclei with age may improve understanding of disease-related functional and cognitive decline without needing radioactive tracers, consistent with the aims of the MITNEC program.

References:

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