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BIOMARKERS

POSTER PRESENTATION

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NEUROIMAGING

Quantitative multi-parameter mapping of locus coeruleus in aging and Alzheimer's disease

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Abstract

Background: The Locus Coeruleus (LC) is prominently affected by neuronal loss in the earliest stages of Alzheimer's disease (AD). Assessing LC integrity can serve as an important early biomarker for assessing AD progression. Neuromelanin (NM) accumulates in LC neurons and NM imaging has therefore been proposed as a means of imaging the LC. As signal intensity is taken as a proxy for cell density, a quantitative imaging approach of the LC, which is less variable across sites and time is desirable. The present study used a multi-parameter mapping (MPM) protocol optimized for LC imaging to compare weighted and quantitative maps in healthy younger, healthy older adults and individuals with AD.

Methods: Structural MRI data was acquired in a group of 26 healthy young adults, 26 healthy older adults and 26 individuals with Alzheimer's disease. Three sets of T1-weighted, MT-weighted, and PD-weighted images yielded quantitative maps (R1, MTsat, PD, and R2*) in each individual within one scan session. Qualitative and quantitative methods were used to assess weighted and quantitative maps for LC imaging across groups.

Results: Qualitatively, LC visibility was higher in weighted images. The LC was also apparent in R1 maps, but less clearly visible in MTsat and R2* maps (Figure 1). LC contrast ratio (with pons as reference), was reduced in Alzheimer's disease compared to younger adults as detected by MTw scans ($p = .001$) and to older adults as detected by T1w ($p<.001$), MTw ($p<.001$), and PDw scans ($p = .007$). No group differences were detected in quantitative maps, suggesting less sensitivity to pick up typical LC integrity reductions. PD maps could not be reliably estimated in the modified setup of the MPMs.

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Conclusion: Although among the quantitative maps LC was most visible in R1 images, our findings indicate that R1 maps capture the LC signal intensity less well as compared to non-quantitative LC imaging, as suggested by a qualitative assessment of LC visibility and inability to detect known group differences. Further research should improve sensitivity of quantitative maps for LC assessment by combining sequences capturing different aspects of LC tissue properties.

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Figure 1. A) Comparison of LC visibility in weighted images and quantitative maps (example participant); **B)** Summary of LC visibility in young, older adults and Alzheimer's disease using a line ROI. ROIs were assessed separately for left and right LC within manually drawn LC masks on individual T1w maps and centered around maximal intensity points. Shaded areas indicate variance between individuals within the group. Black dots indicate position of maximal signal intensity based on T1w maps. Note that PD maps could not be reliably estimated in the modified MPM setup.

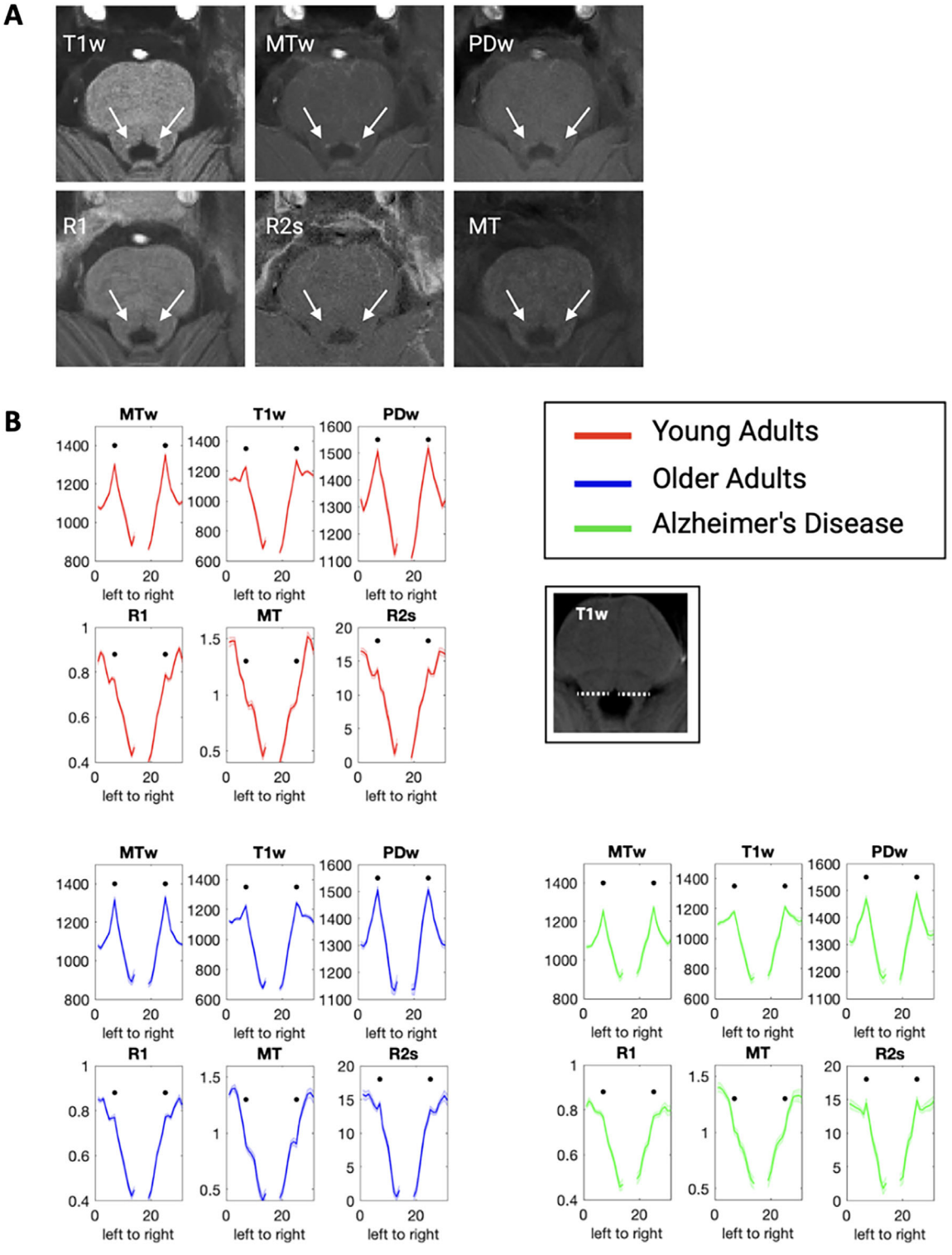

Figure 2. Summary of mean LC contrast ratio (CR), as calculated with pons as reference, across 3 set of weighted and quantitative maps.
** p <.01 *** p <.001