7T MRI demonstrates diffuse iron deposition in the putamen and caudate nucleus in CADASIL

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Background Cerebral autosomal dominant arteriopathy with subcortical infarcts and leukoencephalopathy (CADASIL) is a hereditary form of small vessel disease, caused by mutations in the *NOTCH3* gene.[1] Cerebral microbleeds can be visualized in up to 40% of patients with MRI scanners at standard field strengths.[2] However, these scanners have a limited sensitivity in detecting more subtle cerebral damage associated with iron deposition. The aim of this study is to quantify focal and diffuse iron deposition in CADASIL, performing 7 Tesla MRI.

Methods Twenty-five *NOTCH3* mutation carriers and 15 healthy controls were examined using high resolution susceptibility-weighted imaging on a 7 Tesla whole body MRI scanner. The scan protocol consisted of 3D T1-weighted, 3D turbo spin-echo and 3D T2*-weighted whole-brain scans, as well as a high-resolution multi-slice T2*-weighted scan over a limited field-of-view (TR/TE/FA = 720ms / 21 ms / 45°, slice thickness 1.0 mm with a 0.1 mm interslice gap, 20 slices, 240 x 180 mm field of view, 1000 x 750 matrix size - resulting in a nominal resolution of 0.24 x 0.24 x 1 mm).MRI scans were screened for the presence of focal and diffuse areas of decreased signal intensity on the T_2*-weighted scans. Areas of decreased signal intensity were compared between mutation carriers and controls using mean signal intensity measurements in affected brain regions.

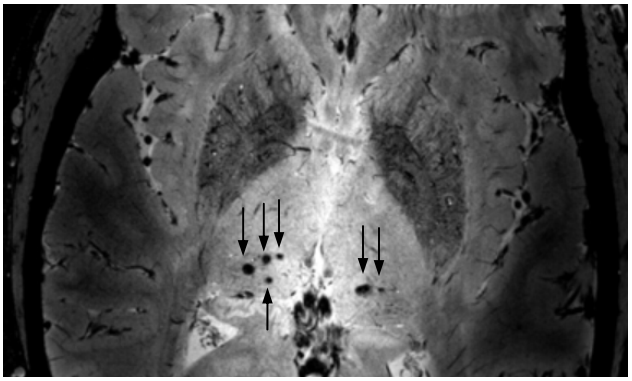

Figure 1. T2*-weighted gradient echo scan showing focal areas of signal loss bilaterally in the thalamus in a 35 year old CADASIL patient.

Results *Diffuse* areas of decreased signal intensity were found in mutation carriers. Compared to healthy controls, mutation carriers had significantly lower signal intensity in the putamen ($p = 0.005$) and caudate nucleus ($p = 0.0007$). Signal intensities in the globus pallidus and thalamus did not differ between mutation carriers and controls. *Focal* areas of decreased signal intensity were found in 36% of mutation carriers and in none of the healthy controls. These areas were predominantly (66%) located in the thalamus. Other locations included the subcortical and deep white matter. There were no highly localized cortical areas of hypointensity visible on the T_2*-weighted images.

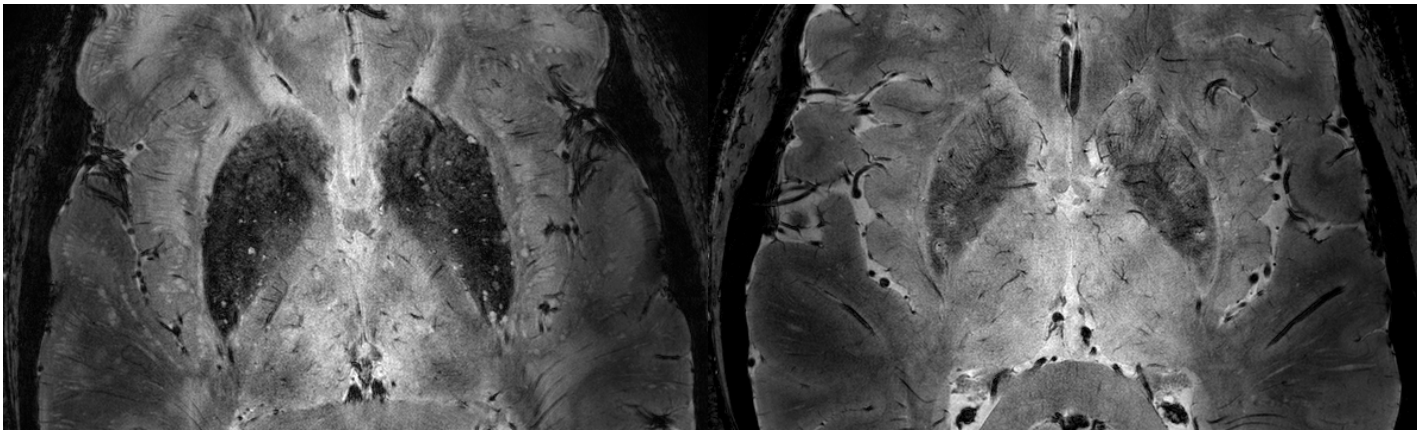

Figure 2. T2*-weighted gradient echo scans of a 60 years old CADASIL patient (left) a 60 years control subject (right), demonstrating increased iron accumulation in the putamen and caudate nucleus of the CADASIL patient

Conclusions 7 Tesla MRI reveals increased areas of hypointensity in the putamen and caudate nucleus of CADASIL patients, that is likely caused by increased diffuse iron accumulation. Focal areas of decreased signal intensity were also found in 36% of CADASIL patients, in a pattern consistent with microbleeds.

References

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2. Lesnik Oberstein SA, van den Boom R, Van Buchem MA et al. Cerebral microbleeds in CADASIL. Neurology. 2001; 57:1066-1070