Comprehensive 7T CEST applied to relapsing remitting multiple sclerosis patients

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Introduction For Multiple Sclerosis (MS), it is crucial to detect lesions and classify the MS-type as early as possible, in order to optimize treatment.[1,2] Interestingly, CEST MRI of rNOE[3] and Amine groups[4] has been shown to yield promising results in patients suffering from relapsing remitting multiple sclerosis (RRMS). As the recently published comprehensive 7T CEST approach[5] serves as a combined measurement of both mentioned and four other CEST effects, we are planning to shed light into the different CEST features of specific lesions, e.g. the differentiation of lesion types (active, passive, black hole etc.) using their CEST fingerprint.

Methods Data is acquired from four RRMS patients (subject acquisition ongoing), after written informed consent and under approval of the local ethics committee, at a MAGNETOM Terra.X 7 Tesla scanner (Siemens Healthcare GmbH, Erlangen, Germany) with an 32ch Rx and 8ch Tx head coil. Homogeneous pre-saturation was realized using the MIMOSA[6] scheme for the different pre-saturation schemes of 7T comprehensive CEST[5]. Image readout was a centric 3D snapshot GRE[7]. GRAPPA 2 was applied in the first phase encoding direction[8]. The evaluation of CEST data was done according to[5].

Results One exemplary slice of a female RRMS patient is shown in Figure 1. None of the depicted lesions was showing Gadolinium enhancement, as observed in clinical imaging with contrast agent at 3T two days prior to the 7T measurement. Different lesions show different features in the six CEST maps (**A**-**F**), while the Amine map (**E**) being most sensitive to WM lesions.

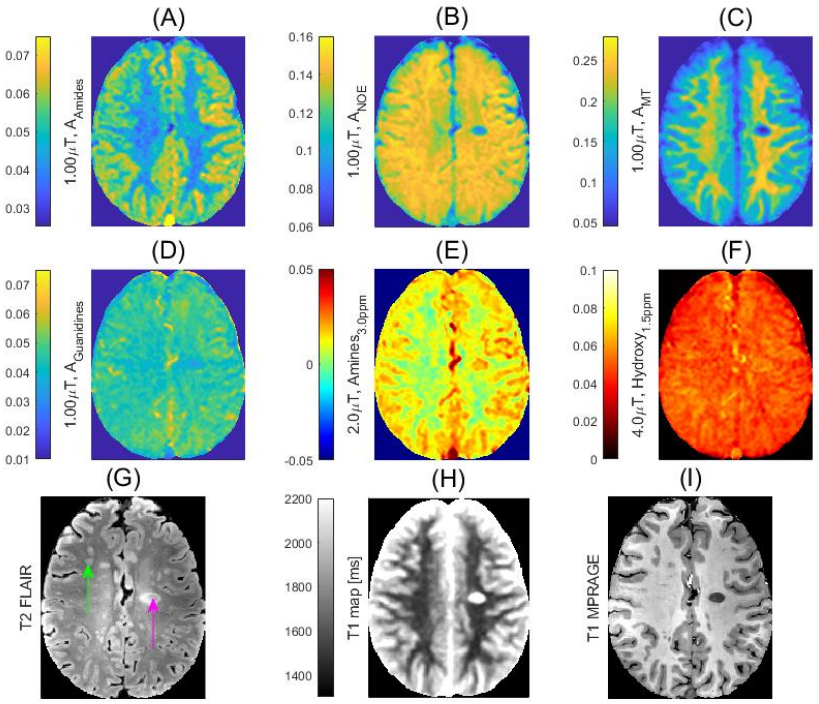

Figure 1: comprehensive 7T CEST images of a female 22y patient suffering from RRMS. CEST maps for Amides **A**, rNOE **B**, ssMT **C**, Guanidine **D**, Amine **E** and Hydroxyl **F** groups show different features for different lesions (s.a. green and pink arrow in the 3D FLAIR **G**), which are outlined by clinical imaging at 7T (**G-I**)

Discussion With the CEST experiment employed here, MS-Lesions (>3mm diameter) are detectable in CEST parameter maps. We already see, that different lesions (e.g. pink arrow vs. green arrow in the 3D FLAIR **G**) show contrasting patterns in the CEST images, e.g. hypointensity in rNOE **B** and hyperintensity in Amides **A** is not always as prominent. With further subject acquisition, we are aiming to confirm previous studies results, like reduced Amine GM values[4] or rNOE[3] in RRMS patients. With comprehensive 7T CEST we can study different exchange regimes at once, giving us access to more information of different molecule and metabolite processes. With the acquired data, it is possible to use neural network approaches for learning lesion types and predicting them in future RRMS patients.

Conclusion We applied the 7T comprehensive CEST approach[5] in RRMS patients and already saw promising features, e.g. for lesion classification. Further subject acquistion is estimated to soldify these preliminary results. With this project, we hope to gain a deeper insight into the metabolic information of RRMS, both locally and focally.

References

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