A length and offset varied saturation (LOVARS) CEST MRI: A new tool in early detecting both intracerebral hemorrhage and infarct

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Target audience: Scientists and clinicians who are interested in CEST and stroke imaging.

Purpose To explore the capability of LOVARS chemical exchange-dependent saturation transfer (CEST) imaging in early detecting intracerebral hemorrhage (ICH) and infarct.

Methods: 23 patients with ICH and 26 patients with infarct were examined using LOVARS MRI at a 3.0 T MR scanner (Magnetom Tim Trio, Siemens AG, Erlangen, Germany) with a 12-ch head coil (slice thickness = 5 mm, TE/TR = 2.87/1620 ms, FA = 12 degree, FOV = 256 × 256 mm^2, matrix = 128 × 128). 2 frequency offsets were used for pre-saturation with 2 or 5 RF pulses of 2.0 µT (each of 100 ms length with 100 ms intervals), and the phase images were calculated by FFT of the three cycles of LOVARS unites (12 images in total). The qualitative and quantitative analyses were performed in the lesions, and the ratios of the signal of lesion to contralateral normal-appearing white matter were calculated and compared between the two groups.

Results: The ICH showed a consistently hyperintense LOVARS signal whereas the infarct showed hypointense signal compared to the contralateral brain tissue, respectively. Quantitative analysis demonstrated a significant difference between the two groups ($p < 0.05$).

Discussion and Conclusion: LOVARS is a kind of CEST imaging which can detect endogenous mobile proteins and peptides[1,2,3]. Early detection and separation of ICH and infarct is critical for the opposite therapy strategyies. Our preliminary results suggest that LOVARS can identify and separate ICH and infarct at the early stage by demonstrating opposite LOVARS signals. Therefore the non-invasive LOVARS has the potential to save time for the diagnosis of early stroke and may improve stroke patient care.
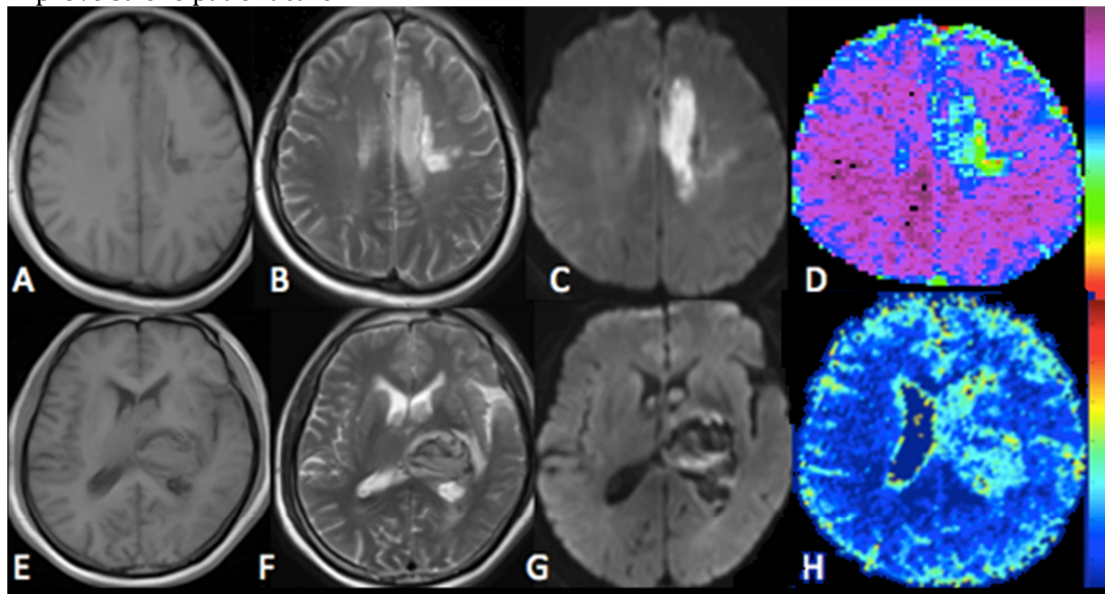

Figure1. Case 1: Acute infarct (A, B, C, D). The infarct shows hypointensity on T1w image (A), hyperintensity on T2w image (B), hyperintensity on DWI (C) and hypointensity on LOVARS phase map (D); Case 2: Hyperacute ICH (E, F, G, H). The hemorrhage shows hypo- to isointensity on T1w image (E), heterogeneous hyperintensity on T2w image (F), heterogeneous signal intensity on DWI (G) and hyperintensity on LOVARS phase map (H).

Reference: (1)Zhou et al. Nat. Med. 9(2003)1085. (2) Song et al. MRM 68(2012)1074. (3) Sun et al. JCBFM 27(2007)1129.