Amide proton transfer in detecting intracerebral hemorrhage

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Target audience: Radiologists and scientists who are interested in Amide Proton Transfer MRI.

Purpose: We aimed to explore the value of non-invasive APT in early detecting intracerebral hemorrhage (ICH) at different stages by comparing it to susceptibility-weighted imaging (SWI), the most sensitive tool for detecting ICH.

Methods: Routine MRI, SWI and APT imaging were performed in 39 patients with ICH at different stages on a 3.0 T MR system (Magnetom Trio Tim, Siemens AG, Erlangen, Germany) using a 12-channel head coil. The APT imaging protocol was: TR/TE = 3200/2.87 ms, FA = 10 degree, slice thickness = 5 mm, matrix = 128×128, FOV = 256×256 mm^2. RF pulses with a power of 3.0 μT and offsets ranging from -5 to +5 ppm with a step of 0.5 ppm were used for the saturation protocol. APT-weighted images were reconstructed using a magnetization-transfer-ratio asymmetry at offsets of ± 3.5 ppm with respect to the water resonance. The MRI findings were evaluated, the signal values of SWI and APT in the hemorrhage lesions were measured and compared with the contralateral normal brain tissues. Paired-sample t-test was used for statistical evaluation.

Results: SWI showed hypointense in 15 cases and heterogeneous signal intensity in the other 14 cases. However, all the ICH lesions were hyperintense on the APT-weighted images. Both the mean values of APT and SWI were higher in the hemorrhagic lesions than in the contralateral normal brain tissues ($P<0.01$).

Discussion and Conclusion: Amide Proton Transfer (APT) is a kind of chemical-exchange-dependent saturation transfer (CEST) imaging which can detect peptides and endogenous mobile proteins[1,2,3]. Early detection of ICH is critical for the therapy. Routine MR imaging has limitation in detecting ICH because of the various signal intensities at the different stages. SWI is more sensitive than conventional MRI in detecting ICH. But SWI shows heterogeneous signal intensity in half of the cases with ICH because of the T2 and T1 properties in SWI. As APT can detect endogenous mobile proteins and peptides, the ICH which contains many hemoglobins always shows hyperintensity on APT. In this way, APT imaging is sensitive to detect ICH and may provide a new MRI tool as a routine imaging technique for early detecting ICH.

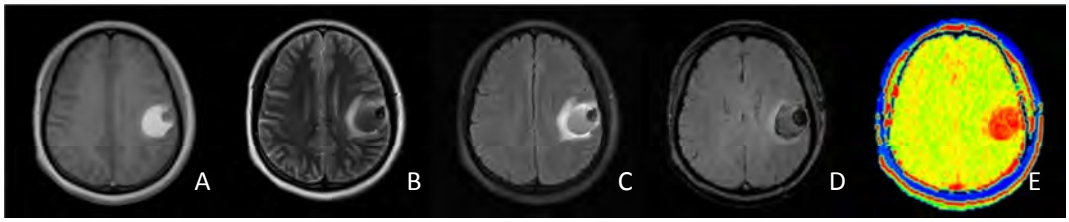

Figure 1. A 24-year-old female with cerebral hemorrhage in the left temporal lobe. The center of lesion shows hyper- and iso-intensity on T1w image (A), iso- and hypo-intensity on T2w image (B), iso- and hypo-intensity on FLAIR (C) and heterogeneous signal intensity on susceptibility-weighted image (D). The APT color map (E) demonstrates the lesion is hyperintense.

References : (1) Benjamin Schmitt et al. Magn Reson Med, 65(2011)1620-1629; (2) Zhou et al. Nat. Med. 9(2003)1085. (3) Zhou et al. J Magn Reson Imaging. 11(2013)1119-28. Supported by grant from NSFC 81271565 and 31470047.