

CLINICAL IMAGE

Amide Proton Transfer Imaging of Cavernous Malformation in the Cavernous Sinus

Manisha Bohara, Kiyohisa Kamimura, Masanori Nakajo, Tomohide Yoneyama,
and Takashi Yoshiura*

Keywords: *amide proton transfer imaging, cavernous malformation, chemical exchange saturation transfer*

Amide proton transfer (APT) imaging is an emerging molecular MRI technique based on chemical exchange saturation transfer where the imaging contrast is generated by endogenous mobile proteins and peptides. Previous studies have shown that APT signal increases with increasing malignancy grade of gliomas, hypothetically reflecting abundant cytosolic protein due to high cellularity. Cavernous malformation is rare, highly vascular benign lesion that has very low cellularity. Here, we report a cavernous malformation that showed markedly high APT signal.

A 70-year-old woman presented with left facial discomfort and progressive loss of vision in the left eye for 6 months. Magnetic resonance imaging was performed using a 3T scanner (Ingenia 3.0T; Philips Healthcare, Best, The Netherlands) equipped with dual-source parallel radiofrequency transmission system and a 15-channel head coil for signal reception, which revealed a left cavernous sinus mass with hypointensity on T_1 -weighted imaging, marked hyperintensity on T_2 -weighted imaging, and strong homogenous enhancement after contrast injection (Fig. 1).

Amide proton transfer imaging based on two-dimensional single slice single-shot turbo spin-echo technique was performed: TR, 4550ms; TE, 4.8ms; flip angle 90° ; turbo factor 128; number of signal averaging, 1; FOV, 230×230 mm²; imaging matrix, 128×128 (reconstructed in 256×256); slice thickness, 5 mm. A quasi-continuous saturation pulse with an amplitude of 2 μ T and a duration of 2 s (40×50 ms, sin c -Gaussian elements) was applied at 27 offset frequencies including 24 ranging from +6 to -6 ppm with a step of 0.5 ppm and 2 at ± 9.6 ppm as well as one far off-resonance

frequency (-1560 ppm) for signal normalization. During postprocessing, the B_0 field inhomogeneity was corrected on a voxel-by-voxel basis using a separately obtained map of B_0 . The APT images were obtained by calculating the magnetization transfer ratio asymmetry (MTR_{asym}) between ± 3.5 ppm using the B_0 -corrected MT-spectrum:

$$MTR_{\text{asym}}(3.5 \text{ ppm}) = (S_{-3.5 \text{ ppm}} - S_{3.5 \text{ ppm}}) / S_0 \times 100 (\%),$$

where $S_{\pm 3.5 \text{ ppm}}$ and S_0 represent signal intensities at ± 3.5 ppm and -1560 ppm, respectively. The intratumoral APT signal (MTR_{asym} at 3.5 Vppm) was 6.9%, which is substantially higher than that in the contralateral normal-appearing tissue (0.8%) (Fig. 2) and also, par or even higher than the values previously reported for glioblastomas (typically, 4–5%). The mass was partially resected. Histopathological examination revealed a cavernous malformation.

We speculate that the high APT signal in the cavernous malformation is attributable to the blood filling multiple dilated vascular channels in the lesion, which contains various

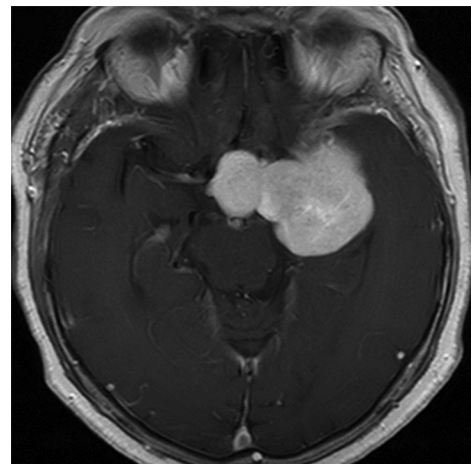


Fig. 1 Axial T_1 -weighted gadolinium-enhanced MR image reveals a dumbbell-like mass with strong and homogenous enhancement in the left cavernous sinus.

Department of Radiology, Graduate School of Medical and Dental Sciences, Kagoshima University, 8-35-1 Sakuragaoka, Kagoshima, Kagoshima 890-8544, Japan

*Corresponding author, Phone: +81-99-275-5417, Fax: +81-99-265-1106, E-mail: yoshiura@m3.kufm.kagoshima-u.ac.jp

©2018 Japanese Society for Magnetic Resonance in Medicine

This work is licensed under a Creative Commons Attribution-NonCommercial-NoDerivatives International License.

Received: October 16, 2017 | Accepted: February 7, 2018

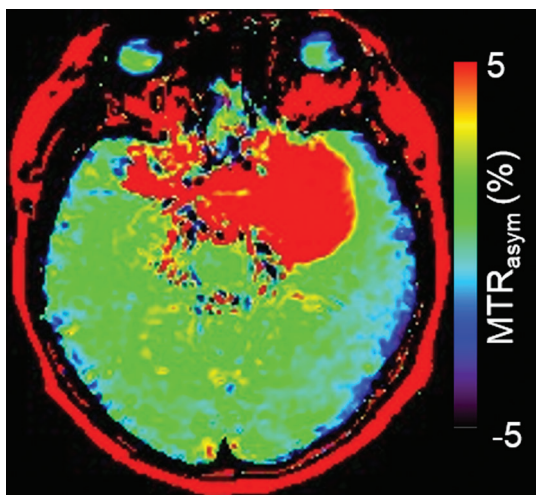


Fig. 2 The amide proton transfer (APT) image shows markedly high APT signal (mean, 6.9%) in the lesion. The mean APT signal in the contralateral normal appearing white matter is 0.8%.

proteins and peptides like albumin.¹ Using a 3T clinical scanner, Zheng et al. reported that porcine whole blood samples showed large MTR_{asym} up to almost 10%, peaking around

3 ppm.² Jeong et al. have shown that a high APT signal can be seen in acute hemorrhage.³ The markedly high APT signal may help differentiate cavernous malformation from other tumors in this location, such as neurinoma and meningioma. Moreover, our case suggests that, in addition to cytosolic proteins and acute hemorrhage, blood in tumor vessels may be a major source of the APT signal in hypervascular tumors.

Conflicts of Interest

The authors declare that they have no conflicts of interest.

References

1. Dula AN, Arlinghaus LR, Dortch RD, et al. Amide proton transfer imaging of the breast at 3T: establishing reproducibility and possible feasibility assessing chemotherapy response. *Magn Reson Med* 2013; 70:216–224.
2. Zheng S, van der Bom IM, Zu Z, Lin G, Zhao Y, Gounis MJ. Chemical exchange saturation transfer effect in blood. *Magn Reson Med* 2014; 71:1082–1092.
3. Jeong HK, Han K, Zhou J, et al. Characterizing amide proton transfer imaging in haemorrhage brain lesions using 3T MRI. *Eur Radiol* 2017; 27:1577–1584.