

# CHINESE MEDICAL SCIENCES JOURNAL

## CASE REPORT

### Hyperperfusion of Multiple Sclerosis Plaques Characterized by 3D FSE Arterial Spin Labelling

Zhi-ye Chen and Lin Ma\*

Department of Radiology, Chinese People's Liberation Army General Hospital, Beijing 100853, China

**Key words:** multiple sclerosis; arterial spin labelling; perfusion; magnetic resonance imaging

Chin Med Sci J 2014; 29(3):194-196

**M**ULTIPLE sclerosis (MS) is a common inflammatory demyelinating disorder of central nervous system, and the disease burden could be well evaluated by conventional magnetic resonance imaging (MRI),<sup>1</sup> including T2-weighted, fluid-attenuated inversion recovery, and postcontrast T1-weighted sequences.<sup>2</sup> We investigated the perfusion state of MS plaques using brain perfusion imaging in a 12-year-old boy with MS.

#### CASE DESCRIPTION

A 12-year-old boy came to us from the local hospital owing to bilateral impaired vision and lower extremity weakness for 6 months. The patient received MRI scan at the local hospital, and was diagnosed as MS. After the patient received steroid therapy, he achieved remission. MS recurred twice after the first symptom onset. The patient suffered from bilateral lower extremity weakness 5 days ago. Therefore, the patient was admitted to our hospital and MRI (GE Healthcare, Milwaukee, WI, USA) was performed.

Conventional MRI findings demonstrated that the lesions were mainly located in the bilateral paraventricle

white matter, which showed hyperintensity on T2-weighted imaging and hypointensity on T1-weighted imaging (Figs. 1A-E). The lesions presented hyperintensity on diffusion weighted imaging (Figs. 1F-G) and hypointensity on apparent diffusion coefficient map (Fig. 1H), and showed no enhancement on post-contrast images (Figs. 1I-J). Susceptibility weighted imaging demonstrated decreased medullary veins (Figs. 2A-B). Proton magnetic resonance spectroscopy revealed decreased N-acetyl aspartate peak (2.02 ppm) and increased choline peak (3.2 ppm), and inverted double peak of lactate (1.33 ppm) (Figs. 2C-D). Three dimensional fast-spin echo arterial spin labelling (3D FSE ASL) revealed the lesions with evidently increased cerebral blood flow (Figs. 3A-B). Dynamic susceptibility contrast (DSC) enhanced perfusion MRI further detected increased cerebral blood flow (Fig. 3C) and cerebral blood volume (Fig. 3D), and the lesion also showed shortened mean transit time (Fig. 3E) and time to peak (Fig. 3F).

#### DISCUSSION

In this case, all the lesions showed no enhancement, which could be considered as chronic MS plaques. Previous studies reported vascular dysfunction in MS, which supported the hypothesis that MS may be associated with chronic cerebrospinal venous insufficiency.<sup>3, 4</sup> The disorder had a significant relationship with hypoperfusion in the brain parenchyma.<sup>4</sup> And susceptibility weighted imaging demonstrated



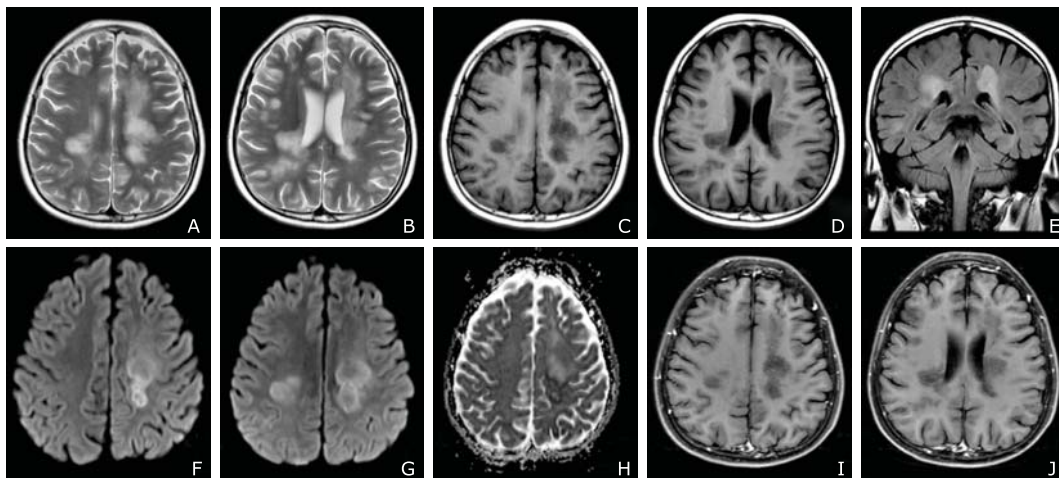


**Figure 1.** Bilateral paraventricular lesions were observed on 3T magnetic resonance images.

A and B. axial T2-weighted imaging (6656/105); C and D. axial T1-weighted imaging (1750/23); E. T2-fluid-attenuated inversion recovery (FLAIR) (8500/166); F-G. diffusion weighted imaging ( $b=1000 \text{ s/mm}^2$ ); H. apparent diffusion coefficient map; I-J. gadolinium-enhanced T1-FLAIR (1903/26).

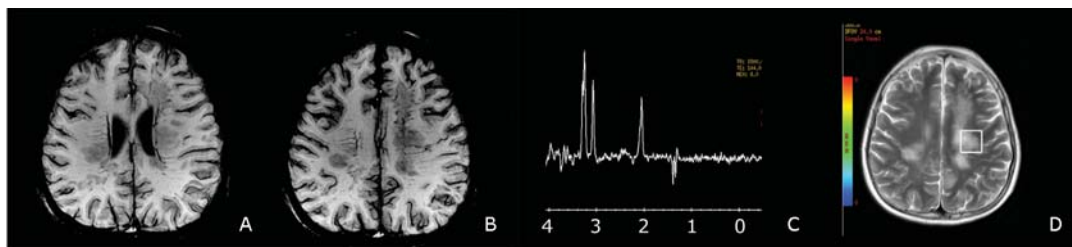


**Figure 2.** Susceptibility weighted imaging (A and B, 34/4.6-301.1) and proton magnetic resonance spectroscopy (C and D, echo time=144 ms) results obtained from 3T magnetic resonance systems.

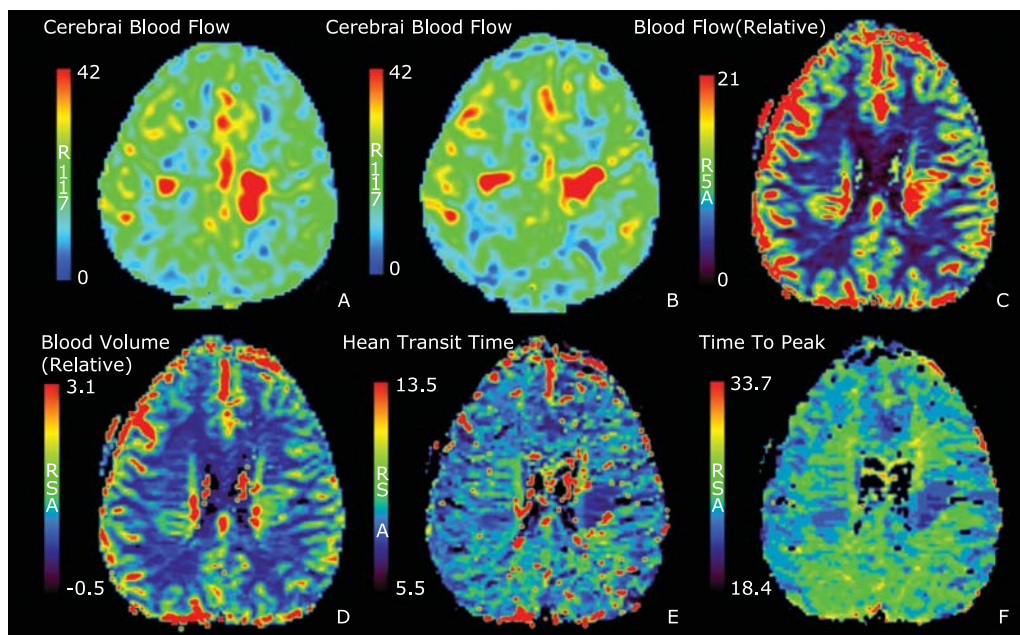


**Figure 3.** Three dimensional fast-spin echo arterial spin labelling and dynamic susceptibility contrast (DSC) enhancement perfusion magnetic resonance imaging.

A and B. cerebral blood flow images of arterial spin labelling (4632/11); C. relative cerebral blood flow (DSC); D. relative cerebral blood volume (DSC); E. mean transit time (DSC); F. time to peak (DSC).

decreased medullary veins in this case, which may be associated with chronic cerebrospinal venous insufficiency. Several studies demonstrated that acute MS plaques showed hyperperfusion and chronic MS plaques showed hypoperfusion,<sup>4-7</sup> and these changes were detectable not only prior to the blood-brain barrier breakdown, but also prior to increase in the apparent diffusion coefficient.<sup>8</sup> Therefore, MR perfusion evaluation could early reveal the pathophysiological features of MS plaques.

For the further evaluation of the MS plaques, MR perfusions were performed. 3D FSE ASL was a new non-enhancement perfusion sequence on MR750 3.0T, which was a reliable and reproducible cerebral perfusion measurement technique.<sup>9</sup> In this case, the chronic plaques did show evident hyperperfusion, which was not consistent with the previous studies.<sup>4-7</sup> Further DSC enhanced perfusion MRI demonstrated hyperperfusion on cerebral blood flow and cerebral blood volume images, and shortened mean transit time and time to peak, which confirmed that 3D FSE ASL could characterize the pathophysiological condition of MS plaque. 3D FSE ASL was a non-invasive MR perfusion assessment compared with DSC enhancement perfusion MRI, and could provide a quantitative measurement of cerebral blood flow.

The application of 3D FSE ASL in this case demonstrated that 3D FSE ASL could successfully evaluate the perfusion state of MS plaque, and have a good feasibility in the clinical practice.

## REFERENCES

1. Riley C, Azevedo C, Bailey M, et al. Clinical applications of imaging disease burden in multiple sclerosis: MRI and advanced imaging techniques. *Expert Rev Neurother* 2012; 12: 323-33.
2. Bakshi R, Thompson AJ, Rocca MA, et al. MRI in multiple sclerosis: Current status and future prospects. *Lancet Neurol* 2008; 7: 615-25.
3. D'Haeseleer M, Cambron M, Vanopdenbosch L, et al. Vascular aspects of multiple sclerosis. *Lancet Neurol* 2011; 10: 657-66.
4. Zamboni P, Menegatti E, Weinstock-Guttman B, et al. Hypoperfusion of brain parenchyma is associated with the severity of chronic cerebrospinal venous insufficiency in patients with multiple sclerosis: A cross-sectional preliminary report. *BMC Med* 2011; 9: 22.
5. Ingrisch M, Sourbron S, Morhard D, et al. Quantification of perfusion and permeability in multiple sclerosis: Dynamic contrast-enhanced MRI in 3D at 3T. *Invest Radiol* 2012; 47: 252-8.
6. Ge Y, Law M, Johnson G, et al. Dynamic susceptibility contrast perfusion MR imaging of multiple sclerosis lesions: Characterizing hemodynamic impairment and inflammatory activity. *AJNR Am J Neuroradiol* 2005; 26: 1539-47.
7. Haselhorst R, Kappos L, Bilecen D, et al. Dynamic susceptibility contrast MR imaging of plaque development in multiple sclerosis: Application of an extended blood-brain barrier leakage correction. *J Magn Reson Imaging* 2000; 11: 495-505.
8. Wuerfel J, Bellmann-Strobl J, Brunecker P, et al. Changes in cerebral perfusion precede plaque formation in multiple sclerosis: A longitudinal perfusion MRI study. *Brain* 2004; 127: 111-9.
9. Parkes LM, Rashid W, Chard DT, et al. Normal cerebral perfusion measurements using arterial spin labeling: Reproducibility, stability, and age and gender effects. *Magn Reson Med* 2004; 51: 736-43.