References

- 1 Nagashima K, Nakai S, Tanaka M, Kanosue K: Neuronal circuitries involved in thermoregulation. *Auton Neurosci* 2000;85:18–25.
- 2 Guyton AC: Body temperature, temperature regulation, and fever; in Guyton AC (ed): *Textbook of Medical Physiology*, ed 8. Philadelphia, WB Saunders, 1991, pp 797–808.
- 3 Di Pietro P, Debbia C, Paola Fondelli M: Pediatric hypothalamic lipoma with hypothermia. *Brain Dev* 2004;26:61–62.
- 4 White KD, Scoones DJ, Newman PK: Hypothermia in multiple sclerosis. *J Neurol Neurosurg Psychiatry* 1996;61:369–375.
- 5 Edwards S, Lennox G, Robson K, Whiteley A: Hypothermia due to hypothalamic involvement in multiple sclerosis. *J Neurol Neurosurg Psychiatry* 1996;61:419–420.
- 6 Gultekin SH, Rosenfeld MR, Voltz R, Eichen J, Posner JB, Dalmau J: Paraneoplastic limbic encephalitis: neurological symptoms, immunological findings and tumour association in 50 patients. *Brain* 2000;123:1481–1494.
- 7 Kusuhara T, Shoji H, Kaji M, Ayabe M, Hino H: Non-herpetic acute limbic encephalitis (in Japanese). *Rinsho Shinkeigaku* 1994;34:1083–1088.
- 8 Bien CG, Schulze-Bonhage A, Deckert M, Urbach H, Helmstaedter C, Grunwald T, Schaller C, Elger CE: Limbic encephalitis not associated with neoplasm as a cause of temporal lobe epilepsy. *Neurology* 2000;55:1823–1828.
- 9 Mori M, Kuwabara S, Yoshiyama M, Kanesaka T, Ogata T, Hattori T: Successful immune treatment for non-paraneoplastic limbic encephalitis. *J Neurol Sci* 2002;201:85–88.
- 10 Sener RN: MRI and diffusion MRI in nonparaneoplastic limbic encephalitis. *Comput Med Imaging Graph* 2002;26:339–342.
- 11 Watanabe Y, Shimizu Y, Ooi S, Tanaka K, Inuzuka T, Nakashima K: Steroid-responsive limbic encephalitis. *Intern Med* 2003;42:428–432.
- 12 Asaoka K, Shoji H, Nishizaka S, Ayabe M, Abe T, Ohori N, Ichiyama T, Eizuru Y: Non-herpetic acute limbic encephalitis: cerebrospinal fluid cytokines and magnetic resonance imaging findings. *Intern Med* 2004;43:42–48.

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Magnetic Resonance Tractography in a Patient with Alexia without Agraphia

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A 53-year-old right-handed man was admitted to our institution due to a language disturbance which had developed suddenly. His previous medical history was unremarkable until this event. At admission, blood pressure was 160/110 mm Hg with a regular pulse rate of 60 per minute. Neurological examination revealed him to be clearly oriented and alert, except for a mild language dysfunction. He could name, repeat, speak fluently and comprehend appropriately. However, he complained that he could not read the words or sentences, although he could write them. The confrontation test of visual fields revealed a full visual field. There was no motor weakness and sensory abnormalities. T₂-weighted and diffusion-weighted brain magnetic resonance imaging (MRI, Signa 3.0 T, GE, Milwaukee) demonstrated high signal intensity lesion in the subcortical white matter of the left temporal lobe (fig. 1). Also there were some scattered tiny lesions in the left temporal lobe. Brain magnetic resonance angiography showed a left middle cerebral artery branch occlusion. An MR tractography using diffusion tensor imaging (DTI) was performed according to the previously reported method [1]. DTI data were obtained with a *b* value of 1,000 s/mm². The seed points were placed at the bilateral upper occipital cortex with subcortical white matter at the axial plane. MR tractography showed disruption of the fiber tract that runs from the occipital lobe

Fig. 1. Brain MRI, with T₂-weighted (**a**) and diffusion-weighted images (**b**), shows an acute cerebral infarction in the left temporal subcortical white matter.

Fig. 2. **a, b** MR tractography shows interruption of the fiber tract between the bilateral occipital lobes and the left temporal lobe caused by the left temporal subcortical white matter infarction (arrow) when the seed points are placed at the bilateral upper occipital cortex and subcortical white matter. **c, d** Fiber tracts are decreased in the left hemisphere, which pass through the left temporal subcortical lesion, compared to the right hemisphere, when the seed points are placed at the lesion of the left temporal subcortical infarction and the symmetric region on the right side.

to the temporal lobe in the left hemisphere, due to an acute cerebral infarction (fig. 2a, b). When we used another seed point at the lesion of the left temporal subcortical infarction and the symmetric region on the right side, the fiber tracts were decreased on the left side, especially to the occipital and temporal lobes (fig. 2c, d). He was also diagnosed as having hypertension after repeated measurements of blood pressure during the admission. His language disturbance slowly recovered and 2 months after symptom onset, he had completely recovered from the reading problem.

Discussion

Alexia without agraphia is a classic disconnection syndrome first described by Déjérine in a patient with a lesion of the left occipital lobe and the splenium of the corpus callosum. It is often combined with signs of right homonymous hemianopia depending on the site of involvement. Since the first description, the crucial anatomic region which induces alexia without agraphia has been reported to be the paraventricular white matter of the left occipital lobe, which is capable of preventing bilateral visual stimuli perceived by the occipital lobes from being transferred to the left hemispheric language area via interhemispheric and intrahemispheric connections [2–4]. However, the interruption of this pathway has

not been demonstrated in vivo. MR tractography is a rapidly evolving technique in CNS imaging, which is based on DTI and enables us to visualize the white matter tract in vivo [5, 6]. This new technology may be useful in the diagnosis of various CNS disorders, such as congenital malformation, brain tumor and acute ischemic stroke, especially in those where the white matter tract system is involved [7–10].

In this case, we speculated that the acute cerebral infarction involving the left subcortical white matter of the temporal lobe might have caused the disconnection of pathways between the bilateral visual cortex and the left temporal language area, which resulted in alexia without agraphia. As we know, this is the first case that demonstrates in vivo the fiber tract disconnection in a patient with alexia without agraphia using MR tractography.

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References

- Masutani Y, Aoki S, Abe O, Hayashi N, Otomo K: MR diffusion tensor imaging: recent advance and new techniques for diffusion tensor visualization. *Eur J Radiol* 2003;46:53–66.
- Quint DJ, Gilmore JL: Alexia without agraphia. *Neuroradiology* 1992;34:210–214.
- Damasio AR, Damasio H: The anatomic basis of pure alexia. *Neurology* 1983;33:1573–1583.
- Leff AP, Crewes H, Plant GT, Scott SK, Kennard C, Wise RJ: The functional anatomy of single-word reading in patients with hemianopic and pure alexia. *Brain* 2001;124:510–521.
- Melhem ER, Mori S, Mukundan G, Kraut MA, Pomper MG, van Zijl PC: Diffusion tensor MR imaging of the brain and white matter tractography. *AJR Am J Roentgenol* 2002;178:3–16.
- Catani M, Howard RJ, Pajevic S, Jones DK: Virtual in vivo interactive dissection of white matter fasciculi in the human brain. *Neuroimage* 2002;17:77–94.
- Lee SK, Mori S, Kim DJ, Kim SY, Kim SY, Kim DI: Diffusion tensor MR imaging visualizes the altered hemispheric fiber connection in callosal dysgenesis. *AJNR Am J Neuroradiol* 2004;25:25–28.
- Mori S, Frederiksen K, van Zijl PC, Stieltjes B, Kraut MA, Solaiyappan M, Pomper MG: Brain white matter anatomy of tumor patients evaluated with diffusion tensor imaging. *Ann Neurol* 2002;51:377–380.
- Kunimatsu A, Aoki S, Masutani Y, Abe O, Mori H, Ohtomo K: Three-dimensional white matter tractography by diffusion tensor imaging in ischemic stroke involving the corticospinal tract. *Neuroradiology* 2003;45:532–535.
- Gillard JH, Papadakis NG, Martin K, Price CJ, Warburton EA, Antoun NM, Huang CL, Carpenter TA, Pickard JD: MR diffusion tensor imaging of white matter tract disruption in stroke at 3 T. *Br J Radiol* 2001;74:642–647.

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