Magnetic Resonance Tractography in a Patient with Alexia without Agraphia

Kyung-Yul Lee\textsuperscript{a}, Young-Chul Choi\textsuperscript{a}, Tae-Sub Chung\textsuperscript{b}

\textsuperscript{a}Department of Neurology and Brain Research Institute and \textsuperscript{b}Department of Diagnostic Radiology, Yonsei University College of Medicine, Seoul, Korea

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. T\textsubscript{2}-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/mm\textsuperscript{2}. 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 to the left inferior temporal lobe.

\textbf{Fig. 1.} Brain MRI, with T\textsubscript{2}-weighted (\textbf{a}) and diffusion-weighted images (\textbf{b}), shows an acute cerebral infarction in the left temporal subcortical white matter.
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.

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.

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


Kyung-Yul Lee, MD, PhD, Department of Neurology
Yongdong Severance Hospital, Yonsei University College of Medicine
146-92 Dogok-dong, Kangnam-ku, Seoul (Korea)
Tel. +82 2 3497 3325, Fax +82 2 3462 5904
E-Mail kylee@yumc.yonsei.ac.kr