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Damage of left temporal lobe resulting in conversion of speech to Sutra, a Buddhist prayer stored in the right hemisphere

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The present study describes a case of a right-handed 74-year-old woman with a brain tumor who showed conversion of speech to Sutra, a Buddhist prayer, which was stored in the right hemisphere according to the Wada test. After surgery, relative improvement in the speech disorder was observed, and frequency of speech production of simple normal words with normal phonology increased. These observations indicate that damage to left temporal lobe resulted in conversion of speech to Sutra, and that Sutra was stored in this patient’s right hemisphere.

Keywords: Right hemisphere; Sutra.

INTRODUCTION

The localization of various language functions in the human brain has been delineated by new non-invasive diagnostic modalities, such as fMRI and diffusion tensor imaging (DTI) combined with neurological evaluation. These studies have characterized the different roles of the left and right hemisphere for speech production and comprehension. For example, lexicon and semantics of words and sentences are mainly stored in left hemisphere, and damage to the left temporal or frontal lobe can result in several types of aphasia, including Wernicke’s and Broca’s aphasia of the English language (Anderson et al., 1992; Binder et al., 1995; Hagoort, 1993). By contrast, the production and perception of prosody of speech is mainly related to right hemispheric function (Ross & Monnot, 2008; Weintraub, Mesulam, & Kramer, 1981).

Sutra is a Japanese Buddhism’s prayer derived from Sanskrit. This prayer was translated to Kanji mimicking the sound of Sanskrit, and therefore does not contain semantic meaning. This contrasts with English Christian prayers that convey both religious feeling and semantic meaning. Of note, Sutra does not have song-like properties. The present study describes a case of a patient with damage to the left temporal lobe, which resulted in conversion of speech production to Sutra, a Buddhist religious prayer, which was stored in this patient’s right hemisphere.
METHODS

Patient

A 74-year-old native Japanese-speaking female, with a 3-year history of brain tumor presented for evaluation. Magnetic resonance imaging (MRI) demonstrated a brain tumor (anaplastic oligoastrocytoma) and enhancement within the left temporal region (Figure 1). The Wada test under propofol anesthesia was performed in July 2006. The Wada test consists of an injection of 5–6 mg propofol into one of the internal carotid arteries to shut down language and/or memory function in that hemisphere. Then, the name, birthday, place and occupation of the patient were asked. Therefore, any function that remains is controlled by the contralateral hemisphere. During that test, injection of propofol into the left carotid artery induced speech production of Sutra, a prayer of Buddhism, namely ‘nam myoho ren gekyo’, instead of aphasia, while injection of propofol into the right carotid artery induced normal speech production, namely, a correct answer to the questions regarding name and address. This demonstrated that the left hemisphere was dominant and that Sutra was stored in right hemisphere. The patient underwent awake surgery in July 2009 for resection of the brain tumor, the details of which have been described previously (Shinoura et al., 2005). Since the tumor had invaded the medial left temporal lobe, we checked for any change in ability to repeat words and ability to perform conscious/voluntary motor tasks during awake surgery. Before surgery, her aphasia had worsened as the brain tumor grew and invaded the left inferior to superior temporal lobe (Figure 1B). She was unable to comprehend nearly all spoken or written words, and her speech consisted of Sutra. After surgery, her aphasia improved slightly, and frequency of production of normal words with normal phonology increased while frequency of Sutra decreased.

Neuropsychological testing

The Japanese Standard Language Test of Aphasia (SLTA) was performed to measure language ability (Mimura et al., 1998). Auditory comprehension, repetition, object naming, and reading were assessed using this test.

RESULTS

Neuropsychological findings

When we first performed SLTA and the Wada test in September 2006, auditory word comprehension (7/10), object naming (2/4), repetition (10/10) and reading (7/10) were relatively preserved, indicating that the patient did not suffer from any type of aphasia. In June 2009, SLTA conducted before and after surgery demonstrated that auditory word comprehension and reading abilities were almost completely impaired. Further, repetition (2/10) was markedly impaired both before and after surgery, indicating that this patient had total aphasia. However, she seemed to understand some spoken words, such as greetings, and in free talking spoke...
not only jargon, but also normal words and Sutra with normal phonology before surgery. It is important to note that this was observed during free talking, while the results of SLTA indicated that she suffered from total aphasia. In addition, the frequency of conversion of Sutra from speech had decreased and the frequency of speech production of simple normal words with normal phonology had increased after surgery when compared with before surgery. Before and after surgery, simulation of humming was relatively intact.

**DISCUSSION**

The present study described a case of a patient with left superior to inferior temporal lobe damage due to tumor invasion. This damage induced conversion of speech to Sutra, which was demonstrated to be stored in right hemisphere by the Wada test. This patient had total aphasia, as she could not read, write, and comprehend auditory words according to SLTA. However, she sometimes spoke simple normal words with normal phonology during free talking. Global aphasia is often accompanied by preservation of phonologically intact stereotypes or perseverative language. Since Sutra is a stereotypic word, this phenomenon might agree with this case.

Speech production has been reported to be involved in a bihemispheric network including the superior middle and posterior temporal lobe as well as the inferior frontal lobe and the primary sensory cortex (Dhanjal, Handunnetthi, Patel, & Wise, 2008; Ozdemir, Norton, & Schlaug, 2006). Regarding hemispheric specialization, speech is lateralized to the left temporal lobe, whereas singing is lateralized to the right temporal lobe, supporting the fluency-evoking effects of singing in aphasia (Callan et al., 2006; Jeffries, Fritz, & Braun, 2003; Ozdemir et al., 2006). This hemispheric specialization is demonstrated by both alphabetic languages and Japanese words (Imai-zumi, Mori, Kiritani, Hosoi, & Tonoike, 1998). In this patient, conversion of speech to Sutra indicates that speech production is involved in a bihemispheric network, since the attempt to produce speech resulted in production of Sutra, which is stored in right hemisphere. In addition, simulation of humming, which is also lateralized to the right hemisphere, was relatively intact in this patient, (Ozdemir et al., 2006). These observations suggest that normal speech production takes place in the left hemisphere, while Sutra production takes place in the right hemisphere.

The region of the right hemisphere involved in Sutra has not yet been characterized. Since Sutra originated from the ancient Sanskrit and was translated to Kanji mimicking the sound of Sanskrit, Japanese Buddhists usually read Sutra without realizing its semantics. When speaking Sutra, Buddhists report feeling calm and happy, which is possibly closely related to religious feeling associated with this prayer. In temporal lobe epilepsy, ecstatic religious experience is predominantly localized to the right temporal lesion (Devinsky & Lai, 2008). Ictal kissing and religious speech, and ictal ‘sign of the cross’ maneuvers are observed in right temporal lobe epilepsy (Lin et al., 2009; Ozkara, Sary, Hanoglu, Aydogdu, & Ozyurt, 2004). By contrast, the right ventrolateral prefrontal cortex is engaged in religious belief and can relieve the perception of pain (Wiech et al., 2008). Since the right temporal lobe is deeply involved in religious feeling, production of Sutra in this patient may be related to activation of the right temporal lobe due to its religious nature. Sutra represents religious feelings rather than language semantics to Japanese Buddhists, which may explain why Sutra is stored in the right hemisphere in contrast to normal speech or Christian prayers.

In conclusion, damage to the left temporal lobe resulted in conversion of speech to Sutra, which is stored in the right hemisphere. This suggests that religious feeling is deeply related to right hemisphere.

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