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Case report

Out-of-body experience in the anterior insular cortex during the intracranial electrodes stimulation in an epileptic child

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ABSTRACT

The authors present a case of an out-of- body experience (OBE) that occurred in a child with intractable epilepsy when stimulating the anterior insular cortex (AIC) by intracranial electrodes. After destroying several sites precisely located at the left AIC by radiofrequency thermocoagulation, the patient's seizures disappeared, and the OBE could not be reproduced when repeatedly stimulating these sites. To our knowledge, it has never been reported that an OBE occurred in the AIC. We analyze the mechanism of an OBE mostly appearing in temporo-parietal junction (TPJ) and propose two perspectives for a possible mechanism involving the AIC causing the OBE.

1. Introduction

OBE is characterized by an individual, who seems to be awake, seeing his corporeal body and the world from a location outside the physical body. A majority of researchers consider that the brain lesion of the temporo-parietal junction (TPJ), or this area's dysfunction, is associated with OBE. In this report, we will share a case of an epileptic child who was stimulated to experience an OBE using stereotactic electroencephalograph (SEEG) at electrode sites that were located in anterior insular cortex (AIC). Then, we discuss the possible mechanism by which the AIC causes the OBE.

2. Case report

The patient is a 17-year-old, right-handed girl who first had seizure onset when she was 7 years old with symptoms of loss of consciousness and limb spasm. Gradually, the epileptic symptoms included loss of consciousness, the right arm elevating and left arm's automatism followed by right arm's tonic-clonic movement, and secondary generalized tonic-clonic seizures lasting for 1–2 min during sleep. Her illness worsened as the seizure frequency increased from once per month to 3–4 times per day. Multiple antiepileptic medications are limited to those seizures. Her results of neuropsychological and neurological examinations were normal. The brain MRI was normal and magnetoencephalography (MEG) revealed some abnormal interictal activities in the left AIC (Fig. 1). PET-MRI revealed the hypometabolism located in the superior part of the AIC (Fig. 1). Long-term video electroencephalograph (EEG) recordings manifested that most sharp waves and spikes were recorded in the left frontal and temporal lobes in the interictal EEG. The sharp waves in the left temporal lobe and low voltage fast activities in the left frontal lobe could be observed during the ictal phases (Fig. 1).

Seven stereotactic intracranial electrodes were implanted in the brain. (Fig. 2). The background activities at electrodes A and E were active where we could see interictal epileptiform discharges. Continuous spikes on the left AIC were recorded during the ictal period (Fig. 2). Intracranial electrode stimulation was conducted to map the important functional area of cortex. Bipolar stimulation was chosen and the parameters were used as follows: 50 Hz, pulse width 0.2 ms, duration 3 s, intensity increased gradually from 0.5 to 6 mA. During the stimulation procedure, the OBE occurred at 0.5 mA at 4 electrode sites and at 0.4 mA at 4 electrode sites, which are located in the AIC (Fig. 2). The girl surprisedly said that she saw herself elevating to the left upper side 2 m high under the ceiling without any vestibular sensations like floating, flying, rotation and vertigo. She felt the virtual body was real herself and saw her own body entirely lying in bed being electrode stimulated by the doctor and nurses walking around in the sickroom. During the whole stimulation procedure, the patient is completely conscious. The phenomena could be reproduced after repeating stimulation using the same parameters without the existence of afterdischarge.

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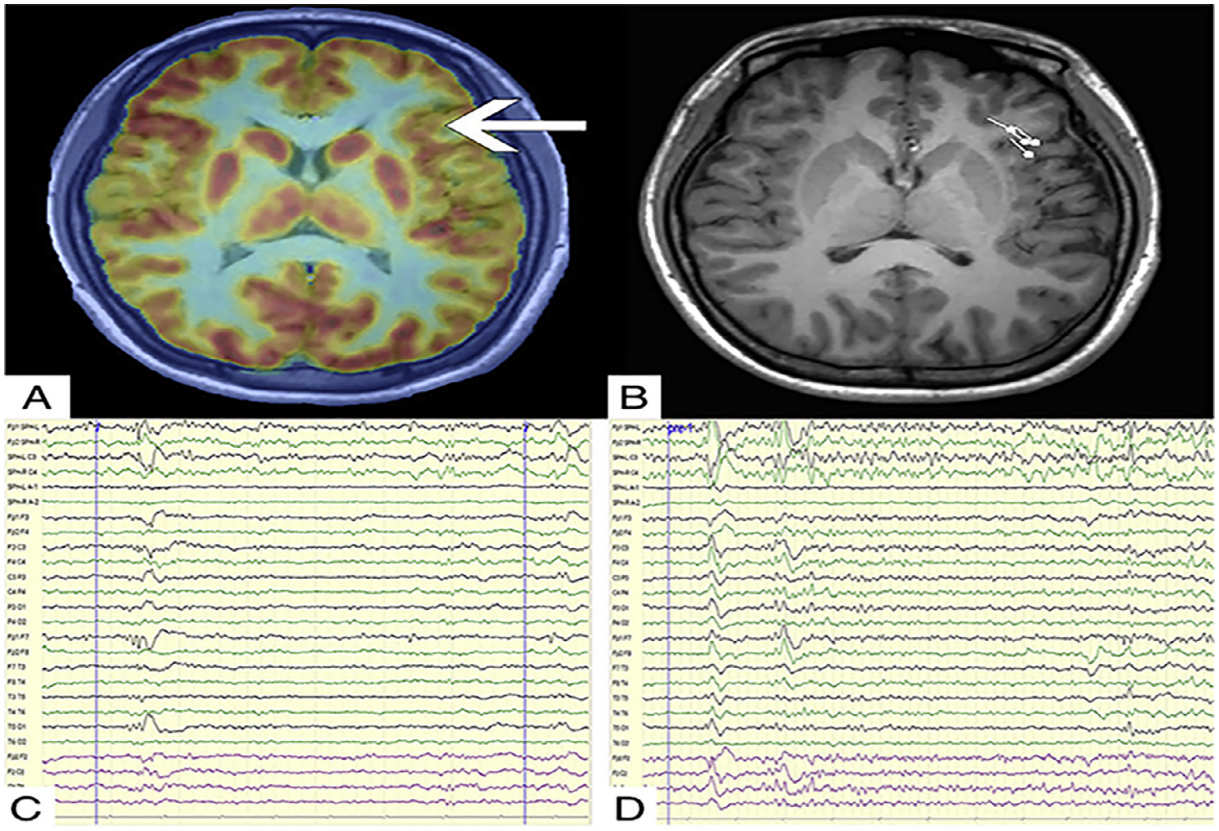

Fig. 1. A: PET-MRI: Hypometabolism in the AIC (arrow). B: MEG: A few abnormal interictal activities in the left AIC. C: Scalp interictal EEG: Most sharp waves and spikes in the left frontal and temporal lobes. D: Scalp ictal EEG: Sharp waves in the left temporal lobe and low voltage fast activities in the left frontal lobe.

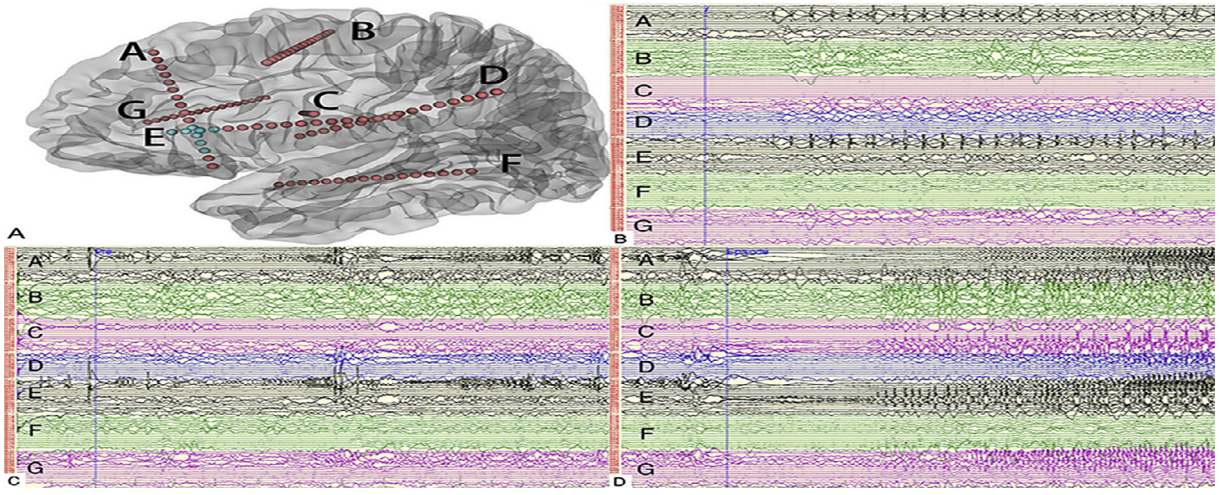

Fig. 2. A: Intracranial electrodes stereogram: Electrodes' orientation is displayed as follows: Electrode A: from left middle frontal gyrus to AIC. Electrode B: from left posterior frontal lobe to supplementary motor area. Electrode C: from Broca area to insular operculum. Electrode D: from left inferior parietal lobe to middle area of insula. Electrode E: from left inferior parietal lobe to AIC. Electrode F: from left posterior temporal lobe to hippocampus. Electrode G: from posterior area of right inferior frontal gyrus to orbitofrontal cortex. The OBE occurred at blue dots during the stimulation procedure. B: Intracranial interictal EEG: The background activities at electrodes A and E are active where we can see interictal epileptiform discharges. C and D: Intracranial ictal EEG: Continuous spikes on the left AIC during the ictal period.

Ultimately, eight sites at electrodes A and E, which precisely located at the left AIC, were destroyed by radiofrequency (RF) thermocoagulation using Cosman RF Lesion Generator (RFG-1A) (Fig. 3). Lesions were performed by using a 6 W power, applied for 30–60 s. The Spike wave rhythm in electrodes A and E essentially disappeared after the operation (Fig. 3). The girl has now been seizure free at a follow-up time of 5 months. Electrode sites which could cause the OBE were stimulated repeatedly until the OBE disappeared.

3. Discussion

Individuals experiencing an OBE have a second own-body from an elevated location and have a sensation of disembodiment, usually with some vestibular sensations such as rotation, elevation, and floating. Most scientists accepted that an OBE is related to the disintegration of multisensory signals such as visual, tactile, somatosensory and proprioceptive information, especially the vestibular information which is controlled by the TPJ and its

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