News Release

Title：

Anterior insular cortex stimulation and its effects on emotion recognition

Key Points

- **○We assessed emotion processing in a series of patients who had undergone brain tumor resection in the insular lobe. We found that direct electrical stimulation over the anterior insular cortex during awake brain mapping enhanced anger recognition in these patients.**
- **○The sensitivity of anger recognition significantly deteriorated, while that of sadness improved, when emotional sensitivity was compared before and after surgery.**
- **○We showed that anger recognition is mainly associated with the left insula in a lesion symptom mapping study.**

Summary

This work is mainly from the team of Kazuya Motomura (Associated professor, Department of Neurosurgery) in Nagoya University Graduate School of Medicine (Dean: Kenji Kadomatsu) and Satoshi Umeda(Professor, Department of Psychology) and Yuri Terasawa (Associated professor, Department of Psychology) in Keio University (Dean: Yoshimitsu Matsuura).

To investigate the role of the insula in recognizing emotion, we performed direct electrical stimulation over the anterior insular cortex during awake surgery while simultaneously delivering an emotional sensitivity task. We registered 18 consecutive patients with brain tumors associated with the insular lobe, who were undergoing tumor resection. An emotional sensitivity task was employed to measure the patients' ability to recognize emotions from facial expressions before, during, and after awake surgery. Furthermore, we performed voxel-based lesion symptom mapping (VLSM) to identify the association between relevant brain lesions and emotion recognition.

When we performed direct electrical stimulation over the anterior insular cortex during awake surgery, the results showed that the ability to recognize anger was significantly enhanced with the presence of anterior insular stimulation ($p=0.02$). Comparing the performance in the emotional sensitivity task before and after surgery, the performance in the anger condition became worse ($p=0.002$) but became better in the sadness condition after surgery ($p=0.001$). In the case of anger recognition, lower scores in the correct response index were associated with lesions involving the left insula in the VLSM study.

Direct electrical stimulation over the anterior insular cortex enhanced anger recognition in patients with insular tumors. In contrast, accuracy of anger recognition was significantly reduced, and sadness was improved, when the performance of emotional sensitivity was compared pre- and post-surgery. Our findings suggest that the insular cortex is involved in changes in emotion recognition, including anger and sadness recognition by modulating arousal level that is closely connected with interoception.

The paper was published on the journal of Brain Structure and Function on June 5, 2019.

Research Background

Recent studies of the psychology of emotion suggest that integration of internal changes in bodily states and the interpretation of environmental information are the fundamental processes for recognizing emotion, and that the insular cortex is one of the critical regions housing this mechanism. Our previous functional magnetic resonance imaging (fMRI) studies support this hypothesis, and revealed that the right anterior insula cortex was commonly activated when the participants were aware of their own emotional and bodily states(Terasawa, et al., 2013a; Terasawa, et al., 2013b). In order to identify the role of insula in emotion processing, we performed direct electrical stimulation over the exposed anterior insular cortex during awake surgery using an emotional sensitivity task, which measured patients' ability to recognize emotions from facial expressions. This task was also performed before and after the removal of the insula in order to assess the functional role of selected insular regions. In addition, we sought to determine the correlated behavioral performance with regional distributions of brain damage using voxel-based lesion symptom mapping (Bates, et al., 2003).

Research Results

When we performed direct electrical stimulation over the anterior insular cortex during awake surgery, the results showed that the ability to recognize anger was significantly different depending on the presence or absence of anterior insular stimulation (p=0.02) (Figure. 1). Comparing the performance of emotional sensitivity at pre- and post-surgery, a t-test revealed significant difference in anger (p=0.002) and sadness (p=0.001) recognition (Figure. 2). Moreover, for anger recognition, lower scores of the correct response index in each emotion category were associated with lesions mainly involving the left middle insula in VLSM study.

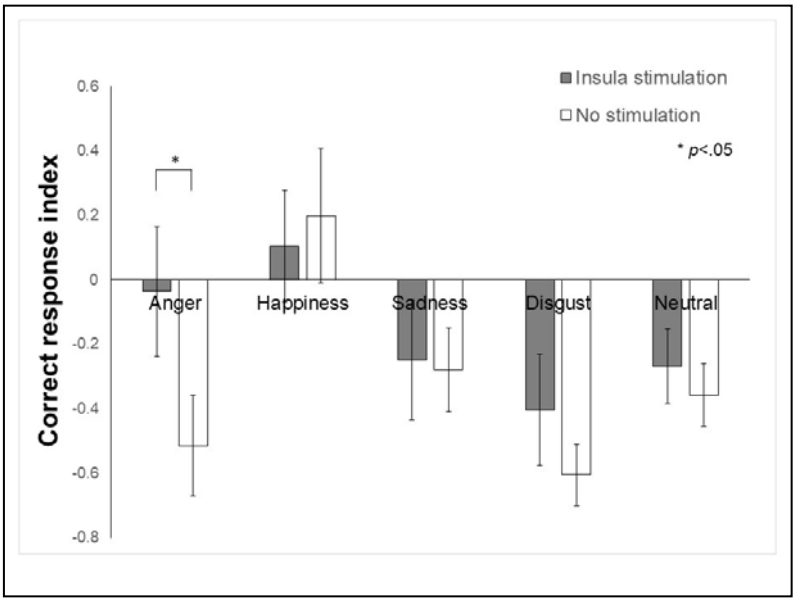

Figure 1. Performance in the emotional sensitivity task during awake surgery.

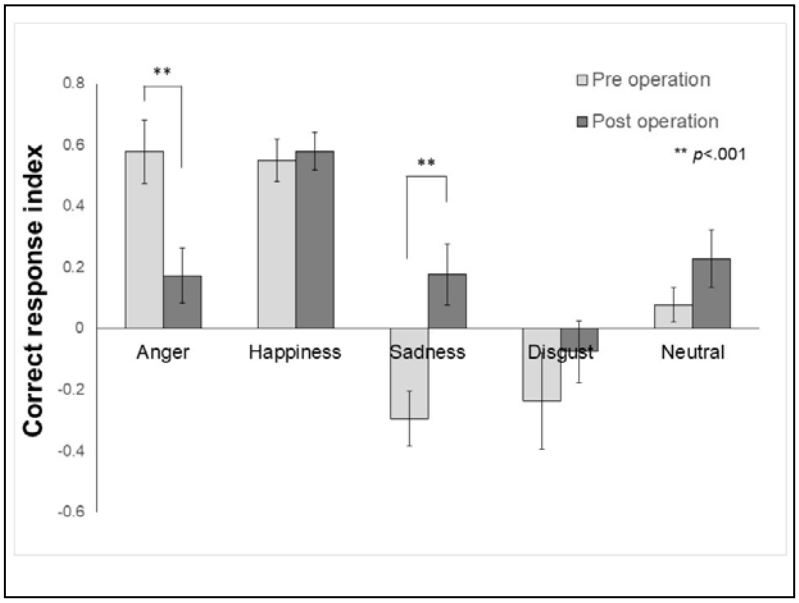

Figure 2. Changes in performance of emotional sensitivity before and after surgery

Research Summary and Future Perspective

Our findings suggest that insular cortex lesions are involved in changes related to emotion the recognition of emotions, including anger and sadness, and modulation of interoceptive processing underlies the changes. These findings highlight the need for prospective studies to assess emotion processing and establish a role for the insular lobe.

Publication

Kazuya Motomura, Yuri Terasawa, Atsushi Natsume, Kentaro Iijima, Lushun Chalise, Junko Sugiura, Hiroyasu Yamamoto, Kyohei Koyama, Toshihiko Wakabayashi, and Satoshi Umeda. Anterior insular cortex stimulation and its effects on emotion recognition. Brain Structure and Function, published online on June 5, 2019.
DOI: 10.1007/s00429-019-01895-9

Japanese ver.
https://www.med.nagoya-u.ac.jp/medical_E/research/pdf/Br_Stru_Fun_20190605en.pdf