【Grant-in-Aid for Transformative Research Areas（A）】

Section Ⅲ

Title of Project： Glia decoding: deciphering information critical for brain-body interactions

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【Purpose of the Research Project】

The internal state of an animal changes continuously in response to the environment. The internal condition of the animal body also affects brain functions. Traditionally the sensory organs have been taken as the main route of interaction between the nervous system and the environment. However, recent studies proposed that glial cells play a central role in the interaction between the brain and peripheral tissue as a bidirectional interface. Internal conditions of the body are presented to the brain via the glial interface. Reciprocally, glial cells transmit signals of the brain status to the peripheral organs and tissues. The development of new methods for decoding the signals in glial cells (glia decoding) will help a full understanding of brain-body interactions.

This research program achieves comprehensive decoding of glial cell functions by recruiting researchers with new analytical methods or interest in peripheral organs. To this end, we set three goals as follows:

(1) Understand the information processing between glia and neural circuits, with particular reference to the dynamics of metabolic, cardiovascular, and immunological responses.

(2) Clarify the various interaction mechanisms between the environment, internal body state, and brain function, especially those operating via the glia-derived signals.

(3) Develop methods of decoding glial cell state, function, and intercellular signaling (glia decoding), which facilitate the understanding of signal integration in the brain-body interactions.

These approaches will clarify the functional correlation between brain and body, leading to a new research field beyond the current brain science.

【Content of the Research Project】

We set the following three research aims in this program.

(A01) Brain functions based on the integration of glia and neural network.

The research topics include glial regulation of developing neural circuits, energy consumption and metabolic processes regulated by glia and blood vessels, and intercellular signaling between glia and other cell types visualized by FRET biosensor. These experiments will clarify the functional integration of glia and neural networks.

(A02) Regulation of the brain-body interaction by glia.

Information of noxious stimuli in the peripheral tissue is transmitted to the brain via multiple pathways. In this context, mechanisms other than the fast signal transmission through the classical peripheral sensory system are likely to be operated. The possible involvement of glial and immune cells in this process is explored.

(A03) Comprehensive analysis and manipulation of glia-mediated brain-body interactions.

New methods that enable comprehensive decoding and manipulation of glial functions in the whole brain will be developed. New replacement technology of glial cells in the entire brain will be tested. Also, new tissue-clearing technology for the imaging of total glial cells in the brain will be applied to the analysis of glial functions. We try to identify the possible roles of long-range cellular communications via exosomes in the brain-body interactions.

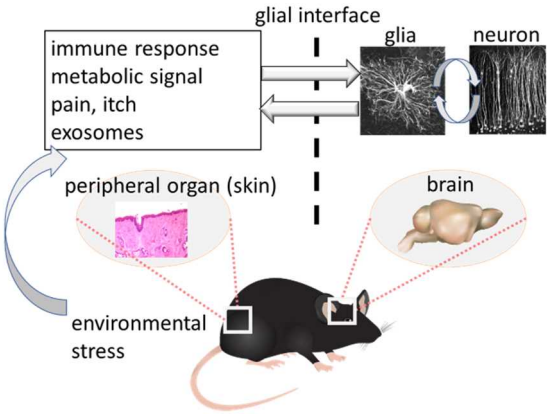

Figure 1. Glial interface regulates brain-body interactions

【Expected Research Achievements and Scientific Significance】

Neural circuit study is supported by large brain projects in the US and EU. It is necessary to establish systematic research programs in the study of glia and brain-body interaction. The new research program will discover multiple functions of glia at the interface between brain and peripheral organs, together with the development of cutting-edge technologies for the deciphering of "glial code." The data produced in this program will expand the glial research field beyond the current neuroscience. Moreover, this research program will help identify the core pathology of neurological and psychiatric disorders.

【Key Words】

Brain-body interaction: mechanism of homeostasis and integrated function of the whole body through the elaborate interaction of the peripheral organs and the brain.

【Term of Project】 FY2020-2024

【Budget Allocation】 1,222,400Thousand Yen

【Homepage Address and Other Contact Information】

http://gliadecode.com /