

FUNDING PROGRAM FOR NEXT GENERATION WORLD-LEADING RESEARCHERS

Project Title: Technology-based systems pharmacology towards brain diseases

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1. Background of research

It has been becoming difficult to develop new medicines, in particular for diseases in the central nervous system. The brain is a complex system that performs high-order information processing, unlike many other tissues. Therefore, understanding the brain function requires specific experimental strategies that are optimized for the brain tissue, in addition to conventional approaches.

2. Research objectives

I have been involved in the field of pharmacology for nearly 20 years since I was a undergraduate student. Based on this long experience, I will propose a new research field “systems pharmacology” for the brain, aiming to obtain a new and effective interpretation of the brain function. By digesting complicated knowledge on the brain function and brain pathology into understandable levels, I will answer two following questions:

- i) How do biological structures and physiological mechanisms denature under pathological conditions?
- ii) What strategies can be taken to prevent or recover from such degeneration?

3. Research characteristics (incl. originality and creativity)

The brain consists of not only neuronal cells, but also glial cells and blood vessels, and thus studying neuronal function along, which has been conducted in many neuroscience researches, is not enough. By making the best use of state-of-the-art techniques for functional optical imaging of neuronal, glial, and vascular networks, I will elucidate the brain function in terms of the dynamic interaction among these networks.

4. Anticipated effects and future applications of research

This research project, aimed to integrate the behaviors of neurons, glia, and vessels, is expected to offer novel points of biological view for brain diseases and drug designs. Through new tools and perspectives, I hope to contribute to pharmaceutical sciences and eventually to human health and to the reduction of medical costs in the national budget.

Toward the brain “trinity” model

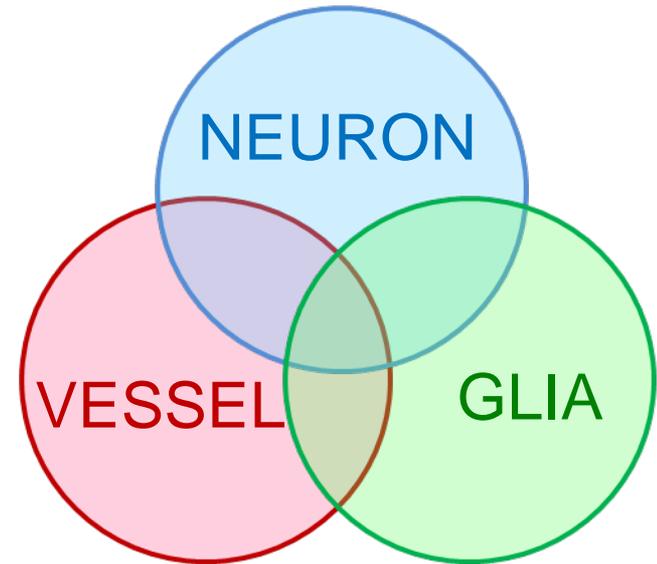
Step 1 Studying individual dynamics of three factors, *i.e.*, neurons, glia, vessels

Step 2 Studying their responses to external perturbations

Step 3 Studying the interactions among three factors and constructing the brain “trinity” model

Step 4 Identifying the pathologic alterations in the brain trinity model under disease states

Step 5 Studying how drugs act on the brain trinity model



structure *versus* function
time *versus* space