Multiscale Ca^{2+} imaging for brain function analysis

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Central nervous system has a hierarchical organization from neurons to huge complex network, and each hierarchy can process and can hold the information. However, analysis of the neuronal signal from every hierarchy of the brain is not easy. To resolve this issue, we are developing the multiscale Ca^{2+} imaging methods that enable the multi-scale analysis of the brain functions. For in vivo whole brain activity analysis, we selected the quantitative activation-induced manganese-enhanced MRI (qAIM-MRI) method. qAIM-MRI is based on the use of Mn^{2+} as a surrogate marker of Ca^{2+} influx. Mn^{2+} shortens the longitudinal relaxation time (T_1) of H^+. Therefore, qAIM-MRI can measure the history of the neuronal activities non-invasively. For in vivo local circuit imaging with single cell resolution, we have developed ultra-thin florescence endoscope imaging system. This endoscope can record the multicellular neuronal activities from deep brain region. To reveal the cellular and molecular mechanisms for exhibiting brain function, in vitro experiments is needed. Thus, we conduct fluorescent imaging study on the brain slice preparations. These three imaging methods can be applied to the same individual and can be combined with behavioral and biochemical studies. At present, we apply individual techniques of multiscale imaging to the some model mice. I will show the concept of the multi-scale imaging and some data at the conference.