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Research Interests

Multicellular Systems Biology, Aging, Disease model, Tissue clearing, 3D imaging

Education

2002	Medical doctor, Faculty of Medicine, Kyushu University
2007	Doctor of Medicine, Graduate School of Medicine, Kyushu University

Professional Career

2006 - 2010	Post-doc, Medical Institute of Bioregulation, Kyushu University
2010 - 2013	Post-doc (JSPS PD/RIKEN SPR), RIKEN CDB
2013 - present	Faculty staff (2019- associate prof.), Graduate School of Medicine, The University of Tokyo

Scientific Activities

2002 -2010	Research on cell cycle/cell activity states and their molecular mechanisms
2010 - present	Development of cell-omics and high-throughput genetics technology

Honors

2017	The Young Scientists' Prize of The Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology
2019	Selected award of PRESTO "Single-cell" area, Japan Science and Technology Agency

Publications

1. Susaki EA et al., "Versatile whole-organ/body staining based on electrolyte-gel properties of biological tissues", Nature Communications 11 (2020) 1982.
2. Susaki EA and Ueda HR. "Whole-body and Whole-Organ Clearing and Imaging Techniques with Single-Cell Resolution: Toward Organism-Level Systems Biology in Mammals", Cell Chemical Biology 23 (2016) 137-157.
3. Susaki EA et al., "Whole-Brain Imaging with Single-Cell Resolution Using Chemical Cocktails and Computational Analysis", Cell 157 (2014) 726-739.

CUBIC-HistoVIsion: a versatile three-dimensional whole-organ/body staining and imaging based on electrolyte-gel properties of biological tissue

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The recent development of various tissue clearing and three-dimensional (3D) imaging methods, including our CUBIC pipeline [1-2], allowed the comprehensive observation of the whole organ/body with cellular resolution or more. However, in the long history of histology, whole-organ/body 3D staining and imaging have been challenging due to the difficulty of adequate penetration of stains and antibodies. Even a small dye occasionally exhibits resistance to penetration, implying a complex physicochemical environment in the staining system.

In this presentation, we will introduce a versatile whole-organ/body staining and imaging protocol named CUBIC-HistoVIsion [3]. To dissect the complex physicochemical environment, we first conducted a precise characterization of biological tissue as an electrolyte gel. Then, we experimentally evaluated a broad range of 3D staining conditions by using a simplified tissue-mimicking artificial electrolyte gel. The combination of essential conditions allowed a bottom-up design of efficient 3D staining protocol which could uniformly label adult whole mouse brains, an adult marmoset hemisphere, a ~1 cm3 tissue block of adult human postmortem cerebellum, and an infant whole marmoset body with dozens of antibodies and cell-impermeant nucleic acid stains. We also demonstrate that our protocol enabled structural and functional neural circuit identification and analysis with Rabies virus tracing and whole-brain c-Fos immunostaining. The CUBIC-HistoVIsion offers advanced opportunities for organ- and organism-scale histological analysis of multicellular systems in the brain and body.

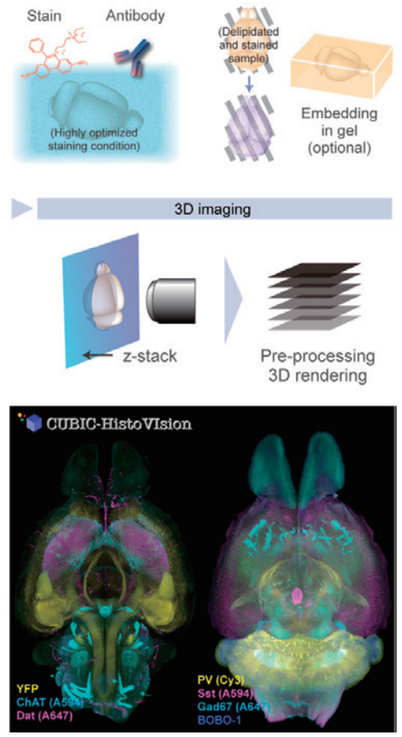

Fig. 1 Overview of CUBIC-HistoVIsion and representative 3D imaging data of whole mouse brains.

References

[1] Susaki et al. Cell 157: 726-739 (2014)
[2] Susaki et al. Nature Protocols 10: 1709-1727 (2015)
[3] Susaki et al. Nature Communications 11: 1982 (2020)