NYCU-Tohoku Online Seminar for Neuroscience

Organized by :
National Yang Ming Chiao Tung University, College of Medicine,
Tohoku University, Graduate School of Medicine

Endorsed by :
Tohoku University Neuro Global International Joint Graduate program,
Tohoku University Brain Science Center

Date

Wednesday, April 16, 2025 17:00 – 18:35 JST

1st Speaker

Ko Matsui, Ph.D.

Professor, Tohoku University Graduate School of Life Sciences

Title

Cerebellar glial control of memory and behavior

2nd Speaker

Yu-Chieh Jill Kao, Ph.D.

Assistant Professor, Department of Biomedical Imaging and Radiological Sciences, National Yang Ming Chiao Tung University

Title

Quantitative MRI Reveals Impact-dependent Alteration in Structural and Functional Outcome Following Repetitive Mild Traumatic Brain Injury in Rats

Registration
https://forms.gle/GKjG6GhdYBAUkecE8

Program

17:00 Opening Remarks (10mim)
17:10 Lecture by **Ko Matsui, Ph.D,** (35min)
17:45 Q&A (5min)
17:50 Lecture by **Yu-Chieh Jill Kao, Ph.D.** (35min)
18:25 Q &A (5min)
18:30 Closing Remarks (5min)

【脳科学セミナーシリーズEx, 先進脳科学セミナーシリーズEx】【[Advanced] brain science seminar series Ex】1 point
【医学系研究科・医学履修課程】国際交流セミナー【Medical Science Doctoral Course】 International Interchange Seminar 1 attendance
【生命科学研究科・単位認定セミナー】【Credit-granted seminar】2 points

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Speaker：**Ko Matsui, Ph.D.**

Title： Cerebellar glial control of memory and behavior

Abstract:
Glial cells in the brain occupy nearly as much volume as neurons; however, they were once thought to merely fill the gaps between neurons. Recent research has shown that glial cells participate in information processing in the brain, albeit in a manner distinct from that of neurons. We have discovered that cerebellar memory formation during a motor learning task in mice involves two parallel processes. One occurs during training, referred to as online learning, while the other takes place during the resting period, known as offline learning. Online learning can be enhanced or suppressed by manipulating the activity of cerebellar Bergmann glial cells. Furthermore, we demonstrated that Bergmann glial cells actively 'eat' neighboring neuronal elements in healthy living brain tissue. This synaptic pruning by glial cells contributes to the consolidation of offline learning. Recently, increasing attention has been given to the role of the cerebellum in non-motor functions such as social cognition and aggression. We propose that theta-band cerebellar neuronal activity is modulated by Bergmann glial cell activity, suggesting that cerebellar glial cells play a role in regulating aggression in mice. Overall, cerebellar glial cells have been shown to be key regulators of both memory and behavior.

Reference:
Asano Y, Sasaki D, Ikoma Y, Matsui K* (2024) Glial tone of aggression. Neuroscience Research, 202: 39-51.
Beppu K, Kubo N, Matsui K* (2021) Glial amplification of synaptic signals. Journal of Physiology, 599: 2085-2102.
Kanaya T, Ito R, Morizawa YM, Sasaki D, Yamao H, Ishikane H, Hiraoka Y, Tanaka K, Matsui K* (2023) Glial modulation of the parallel memory formation. Glia, 71: 2401-2417.
Morizawa YM, Matsumoto M, Nakashima Y, Endo N, Aida T, Ishikane H, Beppu K, Moritoh S, Inada H, Osumi N, Shigetomi E, Koizumi S, Yang G, Hirai H, Tanaka K, Tanaka KF, Ohno N, Fukazawa Y, Matsui K* (2022) Synaptic pruning through glial synapse engulfment upon motor learning. Nature Neuroscience, 25: 1458-1469.

Profile:
Field of interest: Brain physiology
- Glia-neuron interactions in the regulating of meta-information
- Optogenetic deciphering of brain information coding
- Electrophysiological analysis of cellular interactions

Dr. Ko Matsui is a professor at the Super-network Brain Physiology Laboratory, Graduate School of Life Sciences, Tohoku University, Japan. He earned his Ph.D. in 2001 from the University of Tokyo under the supervision of Professor Masao Tachibana, studying patch-clamp recordings from retinal cells to understand the characteristics of synaptic transmission in early visual information processing. From 2001 to 2006, he worked as a postdoctoral researcher in Professor Craig E. Jahr's laboratory at the Vollum Institute (Portland, OR), where he discovered ectopic vesicle release from glial cells in the cerebellum, demonstrating ultrafast information transmission between glia and neurons. From 2006 to 2012, he was an Assistant Professor at the National Institute for Physiological Sciences in Professor Ryuichi Shigemoto's laboratory, where he combined ultrastructural studies on the nanometer-scale distribution of postsynaptic receptors with millisecond-scale electrophysiological recordings of synaptic transmission. From 2013 to 2017, he served as an Associate Professor at the Graduate School of Medicine, before joining the Graduate School of Life Sciences at Tohoku University in 2017. Recently, using primarily fiber photometry, he has been investigating how circuits formed between neurons, glial cells, and the peripheral nervous system integrate to generate cognitive functions from physical processes.

Speaker：**Yu-Chieh Jill Kao, Ph.D.**

Title: Quantitative MRI Reveals Impact-dependent Alteration in Structural and Functional Outcome Following Repetitive Mild Traumatic Brain Injury in Rats

Abstract:
Mild traumatic brain injury (mTBI) accounts for the largest portion of brain injury and becomes the significant risk factor of the later-on neurodegeneration. However, mTBI is always viewed as a silent epidemic since the negative findings in routine neuroimaging in the early phase. We have established an animal model of mTBI, closed-head injury (CHI) model, with negative tissue loss but significant behavioral deficit replicating the radiological pattern of patients suffered from uncomplicated mTBI. Translational and multi-parametric MRI including structural, diffusion and functional MRI were performed to measure the macro- and micro-structural integrity and to probe functional reorganization of neuronal network after mTBI. Measurable and dynamic changes in microstructure, cortical volume, brain connectivity, behavior, and histopathology after mTBI were reported. The changes in MRI features depend on the impact site, number of injuries and inter-injury intervals, suggesting that impact parameters play important role in determining the severity of repetitive mTBI. After repetitive mTBI, sustained microstructural injury may last up to 90 days, which was reveled by tensor scalar measurements, including L and q values, from DTI MRI. The current work bridges cross-sectional evidence from human subjects and pathologic studies using animal models with a multi-time point, longitudinal and translational research paradigm.

Reference:
Cheng C, Lu CF, Hsieh BY, Huang SH, Kao YC*. Anisotropy component of diffusion tensor imaging reveals long-term neuroinflammation following repetitive mild traumatic brain injury in rats. Eur Radiol. Exp. 2024. 8:82
Kao YC, Lui Y, Lu CF, Chen HL, Hsieh BY, Chen CY*. Behavioral and structural effects of single and repeated closed-head injury. Am J Neuroradiol. 2019. 40(4):601–08
Kuo PH, Tang TH, Huang SH, Hsieh BY, Lu CF, Kao YC*. An Uncomplicated Mild Traumatic Brain Injury Model Evidenced by Magnetic Resonance Imaging. Journal of Visual Experiments. Accepted 2025

Profile:
Field of interest: Neuroimage
- Small Animal MRI
- Animal models of Neurological Disorders
- Neurovascular function in brain injuries

Dr. Jill Kao is an assistant professor at Department of Biomedical Imaging and Radioligcal Sciences at National Yang Ming Chiao Tung University in Taiwan. She was trained as an electrophysiologist during my PhD and joined University of North Carolina (UNC) at Chapel Hill as a Postdoctoral Fellow engaging animal functional MRI research. She moved back to Taiwan in 2014 and supported to optimize multi-model and translational MRI techniques in multiple preclinical scanners. Her own laboratory, the laboratory of preclinical brain imaging (PBI Lab), was established at NYCU in mid 2020 and aims to probe the functional and metabolic changes along disease progression using the most advanced MR technique in preclinical models. With the close collaboration with physicians and continuous dialogue with clinical experts, PBI lab intends to tackle translational questions and explore tentative image biomarkers in mild traumatic brain injury, ischemic or hemorrhagic stroke, ischemic hypoxia and etc. Together with the clinical-relevant animal models, multi-parametric MRI, and quantitative image analysis, PBI lab is currently on the path carrying out leading research in the field of translational neuroimaging.