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Field:
Biology/Life Science

Session Topic:
Optogenetics: Manifold Applications

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1. Introduction

We spend almost one third of our life time just to sleep. Sleep/wakefulness cycle is a very intriguing physiological phenomenon. We fall asleep at least once per day. After sleeping for a while, we can wake up naturally. However, the mechanism regulating sleep/wakefulness cycle has not been completely understood so far, while it appears to be regulated by neurons in the hypothalamus.

Orexin, also called hypocretin is a neuropeptide recently identified as a natural ligand for orphan G protein coupled receptor[1]. Orexin-producing neurons (orexin neurons) are located specifically in the hypothalamus but project their efferents throughout the brain. Intriguingly, the mice lacking prepro-orexin gene showed behavioral characteristics similar to human sleep disorder "Narcolepsy", that is a fragmentation of sleep/wakefulness and sudden muscle weakness. Human clinical studies also showed that orexin neurons are specifically ablated in the narcoleptic patient's brain. These results suggest that the orexin neurons play a critical role in the regulation of sleep/wakefulness. Previous studies using electrophysiological *in vitro* techniques have identified potential neuronal pathways or networks connecting orexin neurons with other neurons which are known to be involved in sleep/ wakefulness regulation[2,3]. However, it will be essential to analyze living animals for the purpose of elucidating how these neuronal networks regulate sleep/wakefulness, a physiological phenomenon only observed in living animals. To address this, we incorporated recently developed technique "optogenetics"[4], which allows us to control neuron activity by illuminating light locally in the brain. In this symposium, I will discuss physiological importance of the activity of orexin neurons in the maintenance of arousal using optogenetics.

References

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