DANDRITE
Danish Research Institute of Translational Neuroscience
Nordic EMBL Partnership for Molecular Medicine

AARHUS UNIVERSITY

Virtual DANDRITE Lecture

Monday 15 August 2022

16.00 – 17.00 (CEST)

Online via Zoom

Please find Zoom link via the Outlook calendar invitation. If you have not received this, please write an e-mail to Astrid: asmu@dandrite.au.dk

Vladyslav Vyazovskiy

Professor at the Department of Physiology, Anatomy and Genetics, University of Oxford, United Kingdom.

Local and global aspects of sleep regulation

Sleep has been found in all animal species carefully studied to date; yet, the biological function of sleep remains unclear. Sleep can be defined on at least two distinct levels: the behaviour of the whole organism and the spatiotemporal patterns of neuronal activity in the brain. Upon falling asleep, cortical networks alternate between periods of generalized population firing and periods of relative silence. This pattern of neuronal activity gives rise to electroencephalogram (EEG) oscillations at a frequency of approximately 1-4 Hz, which are termed slow waves. Contrary to the widely-held notion, waking and sleep are not global, mutually exclusive states, and research over the last decades has revealed that spontaneous brain activity during sleep can be locally modulated. For example, slow wave activity (SWA) is more intense in frontal compared to more posterior areas, especially in early sleep or after sleep deprivation, and regional differences are apparent at the level of individual sleep slow waves. Although the alternation of periods of increased neuronal activity and silence is usually correlated across cortical regions and individual neurons, up-states can sometimes be seen in one region of the cortex while another region is in a down-state, with these states often spreading as travelling waves. Sleep deprivation is associated with increased low-frequency EEG activity during waking in both animals and humans, and recordings in rodents suggested that this EEG pattern reflects local neuronal OFF periods in the neocortex. Although the role of subcortical neuromodulatory areas in generating and maintaining sleep and wakefulness is well established, the possibility remains that the neocortex is also involved in sleep regulation. Consistent with this hypothesis, we observed a marked increase in the amount of wakefulness and a diminished increase in SWA after sleep deprivation in transgenic mice, in which a subset of pyramidal cells in cortical layer 5 is functionally silenced by removal of the t-SNARE protein SNAP25. These notions suggest that sleep need accumulates at the level of local cortical networks, which are directly implicated in global sleep regulation.