

グローバル COE 特別セミナー

疾患生命工学センター

生物物理学セミナー

(平成 19 年度)

演者: Arthur Konnerth 博士

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演題: Dendritic calcium signals and synaptic plasticity
in cortical neurons

日時: 平成 19 年 9 月 13 日 (木) 13:30-14:30

場所: 医学系研究科 教育研究棟 13階 1304B 号室(第 7 セミナー室)

要旨:

Work from various laboratories identified the presence of local dendritic spikes in cortical and hippocampal neurons. In a study that started a few years ago in our laboratory (Holthoff et al., J. Physiol., 2004), we established a new and simple experimental procedure for the generation of dendritic spikes in layer 5 pyramidal neurons in mouse cortical slices by local synaptic stimulation. We showed that these synaptically-evoked local dendritic spikes initiate a fast calcium transient in a small spino-dendritic compartment. The dendritic spikes require the activation of NMDA receptors and involve also the activation of voltage-gated calcium channels. Our results indicated that a single of these dendritic spikes is sufficient to induce LTD (long-term depression) (Holthoff et al., J. Physiol., 2004). A surprising new finding is that the co-incident activation of synaptically-induced local dendritic spikes and back-propagating action potentials produces LTP (long-term potentiation). Even a single pairing event is sufficient for LTP induction, provided that the interval the somatic action potential occurs within a brief time window (of about 50 ms) after the induction of the local dendritic spike. This critical time window is characterized by a supralinear increase in the amplitude of the intradendritic calcium transient. Taken together, our results reveal a new form of rapidly-induced bidirectional synaptic plasticity. We demonstrate that the direction of plasticity, LTP or LTD, depends essentially on the peak calcium level reached in the active spines. We propose that this instantly-induced form of synaptic plasticity underlie the rapid acquisition of information in cortical circuits.

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