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

DANDRITE Topical Seminar

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From 13:15-14:00

Aud. 6, 3rd floor, building 1170
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Visualization of result of calcium influx through low-voltage activated calcium channels

Calcium ions play one of the main roles in cell's life. They can be second messengers in signal transduction pathways, maintain potential difference across excitable cell membranes, control calcium-activated potassium channels and activate neurotransmitter release. And in all activities one of the most important things is local concentration of calcium ion: where it will be increased, how much and for how long.

For managing the Calcium concentration there are several intracellular mechanisms. Calcium concentration can be controlled by storage function of organelles like mitochondria and the endoplasmic reticulum; calcium-binding proteins like calmodulin and ion exchangers. All these mechanism are deeply involved in maintenance of cytoplasmic calcium ion concentration as well as in formatting of local calcium microdomains. Calcium concentration domains are localized sites of high calcium ion concentration in cell's cytoplasm that can be found around the intracellular calcium channels as a result of their opening. It is a spatial domain where concentration can increase up to hundreds of micromoles. And they can be visualized by using special calcium indicators like Fluo-3 or Fluo-4 or calcium-activated photoprotein aequorin using fluorescence microscopy technique. T-type calcium channels are low-voltage activated calcium channels that open during membrane depolarization and aid in mediating calcium influx into cells after an action potential or depolarization signal. They can be activated by negative membrane potentials of about -55 mV and have small single channel conductance. However these channels have fast voltage-dependent inactivation compared to that of other calcium channels. T-type calcium channels are present in many neuronal cells within the central nervous system where they help to provide stronger and quicker depolarization and allow for more frequent depolarization events. T-type channel is important for the repetitive firing of action potentials in cells with rhythmic firing patterns such as neurons in the thalamus of the brain and cardiac muscle cells where it contributes to the rhythmic beating of the heart. Pharmacological evidence of T-type calcium channels suggest that they play a key role in diseases such as absence epilepsy, diabetes, and several forms of cancer. But the main question in all these processes associated with calcium ions, was spatial and temporal features of calcium domains. In an attempt to measure increase of spatial intracellular calcium concentration we used two techniques at the same time: whole cell patch clamp recording and calcium-dependent indicator Fluo-3 for fluorescence microscopy. In addition we used some image post-processing technique and simple mathematical model for understanding diffusion of calcium ion near the channel.

Our result give us a chance to say that in neurons of lateral dorsal nucleus of thalamus of rat, as result of activity T-type calcium channels, there could be regions of high calcium concentration that are spatially separated. We saw two different type of fluorescent signal that indicate non uniform channel distribution which might be related to local functions of group of channels and dendritic plasticity.

Host: Group Leader Duda Kvitsiani, DANDRITE