The Diffusion of Membrane Nanodomains with Specific Ganglioside Composition

Authors : Barbora Chmelova, Radek Sachl

Abstract : Gangliosides are amphipathic membrane lipids. Due to the composition of bulky oligosaccharide chains containing one or more sialic acids linked to the hydrophobic ceramide base, gangliosides are classified among glycosphingolipids. This unique structure induces a high self-aggregating tendency of gangliosides and, therefore, the formation of nanoscopic clusters called nanodomains. Gangliosides are preferentially present in an extracellular membrane leaflet of all human tissues and thus have an impact on a huge number of biological processes, such as intercellular communication, cell signalling, membrane trafficking, and regulation of receptor activity. Defects in their metabolism, impairment of proper ganglioside function, or changes in their organization lead to serious health conditions such as Alzheimer´s and Parkinson´s diseases, autoimmune diseases, tumour growth, etc. This work mainly focuses on ganglioside organization into nanodomains and their dynamics within the plasma membrane. Current research investigates static ganglioside nanodomains characterization; nevertheless, the information about their diffusion is missing. In our study, fluorescence correlation spectroscopy is implemented together with stimulated emission depletion (STED-FCS), which combines the diffraction-unlimited spatial resolution with high temporal resolution. By comparison of the experiments performed on model vesicles containing 4 % of either GM1, GM2, or GM3 and Monte Carlo simulations of diffusion on the plasma membrane, the description of ganglioside clustering, diffusion of nanodomains, and even diffusion of ganglioside molecules inside investigated nanodomains are described.
Keywords : gangliosides, nanodomains, STED-FCS, flourescence microscopy, membrane diffusion
Conference Title : ICBBMB 2023 : International Conference on Biochemistry, Biophysics and Molecular Biology
Conference Location : Prague, Czechia
Conference Dates : September 04-05, 2023