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The Role of the Cytoskeleton in Cell Membrane Activities

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In the cell membrane there are many processes that interact with the cytoskeleton in order to carry out its process. One of the processes that are affected by the cytoskeleton that is closely by is diffusion rate of particles across the membrane. The purpose of this review to present the readers with evidence from previous studies and scientific implications that have been made by other authors that the cytoskeleton has a specific role in cell membrane activity. Authors Potma, Jaqaman and Thorsten all show that diffusion rate is influenced by the cytoskeleton. Thorsten described how they were able to track single molecule tracking to view how the molecules would diffuse across the plasma membrane. Each author indicated that the cytoskeleton slowed the diffusion rates. This is important because the audience can learn how protein diffusion rate across membranes is relevant and can be regulated.

Introduction

The interaction of cellular structures and molecules happens in a very particular way. When describing processes such as protein diffusion for particles entering and exiting the cells; a mechanical presentation would be an appropriate illustration. There have been many studies to my knowledge and beyond to try and figure specific details how particles are diffused across a cellular membrane. Researchers have done a large number of different studies to try and understand the machinery of cellular process. Techniques such as single particle tracking, various forms of microscopy and spectroscopy were performed in order to examine such interactions with clarity. Concise techniques were crucial in order to yield useable results. Thorsten explains the results received indicated that the translational diffusion rate of RBCs, red blood cells, was faster when passing through a membrane without the cytoskeleton intact. The density of the network of filaments that made up the cytoskeleton had to be noted in order to understand why this was occurring when observing the pressure field. The pressure field is observed when the

long-chain proteins exert a pressure on the fluid membrane. (Thorsten 819) Khuloud discusses how the cytoskeleton can have an influence one of two ways: One is that molecules are affected directly and/or indirectly by the cytoskeleton is because it can generate barriers that hinder diffusion rates. The single particle tracking technique revealed that the diffusion rate was less when cytoskeleton was present. Another was through the hop-diffusion model, it was revealed that the cytoplasmic tails of the proteins were getting caught in the cytoskeleton filaments. Potma talks about the actin that makes up the majority of the cytoskeleton which determines shape and density of the filaments. These shapes formed can regulate the rate of the proteins being diffused. This was able to be determined through photobleaching fluorescence recovery. Each study indicated the questions about how much are diffusion rates interdependent with the cytoskeleton in the membrane. More studies would allow more in depth data that could help solidify the answer to this relationship.

Recent Progress

Current studies show that some diffusion rates of particles are directly related to actin in the filament network in the cytoskeleton. In eukaryotic cells, actin is found at high

concentrations in the cytoskeleton. (Potma 1) The density of the filamentous network will allow certain shaped particles diffuse more readily than others. Green fluorescence protein (GFP) mobility is limited by actin. (Potma 6) The studies also indicate other factors diffuse across the membranes, such as organization of the membrane, osmotic conditions, environmental conditions etc. Khuloud suggests that receptor signaling changes the organization of the filamentous network which affects any processes thereafter. Receptor-mediated signaling in immunoreceptors is one case where the cytoskeleton structure. (Khuloud 515).

Discussion

In each of the article the question of the relationship with the cytoskeleton in the membrane and cellular processes such as diffusion is still largely at bay. Since the cellular membrane is a highly complex structure to simply address there must be further studies to relate the relationships of the individual structures that partake in the diffusion process in particle transport must be done. The researchers discuss that this is important because the structure affects the membrane signaling that goes on between different protein structures. There are a large number of factors, within the cell and outside, that contribute to the way and rate of how particles diffuse across the membrane. Activation, signaling and transporting dynamics are influenced by the organization made by the cytoskeleton structure. Efficient particle transport is crucial for the survival of cells and multicellular organisms to be able to properly develop and function.

References

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