EGR1 Protein: A Key Factor in Cellular Homeostasis?

Cellular homeostasis is an essential process ensuring cells' proper functioning and survival in changing environmental conditions. It involves the dynamic regulation of various intracellular parameters, such as pH, ion concentration, and metabolic activity, to maintain a stable internal environment. This balance is achieved through a complex interplay of signaling pathways, transcription factors, and feedback mechanisms.

The project aims to investigate the function of the EGR1 protein in maintaining cellular homeostasis under stress caused by factors such as excessive cell hypertrophy, anticancer drugs, and reactive oxygen species. Research tasks focus on examining the structure and function of the nucleolus, a non-membrane cell organelle located in the cell nucleus. The main function of the nucleolus is to produce ribosomes, other cellular organelles that conduct protein synthesis in the cell. The process of ribosome formation itself is quite complicated and requires precision in carrying out individual components of this process in time and space. The ribosome consists of 80 proteins and four ribosomal RNA (rRNA) strands. Proteins are produced in the cytoplasm and must be imported through the cell nucleus into the nucleolus. On the other hand, rRNA is synthesized in the nucleoli themselves. Both of these processes must be coordinated so that a ribosome (its two subunits) can finally be formed in the nucleolus, which are then exported to the cytoplasm, where they can perform their function.

Our preliminary research has shown that the EGR1 protein can regulate this process. Primarily due to its location in the nucleolus. We were able to make this type of discovery by using a particular kind of microscope and fluorescence technique, as well as by using specific antibodies that recognize the EGR1 protein and have fluorescent markers. The microscope allowed us to visualize the protein in the nucleolus because we could directly observe the fluorescent marker corresponding to the site of protein recognition in the cell, i.e. in this case, the nucleolus. Moreover, the production of the EGR1 protein is tightly controlled in the cell, especially when the cell is under stress, which may be induced by anticancer drugs that are intended to kill the cell. To protect itself, the cell activates many processes to eliminate the stressor by pumping it out of the cell (resistance based on transmembrane pumps located in the cell membrane and actively pumping drugs out of the cell).

EGR1 protein is an important transcription factor that plays a key role in gene activation, cell differentiation, and mitogenesis. EGR1 has also been identified as a tumor suppressor gene, highlighting its importance in cancer biology. Research aimed at understanding the mechanisms of action of EGR1 may contribute to improving clinical outcomes and discovering new therapeutic targets. Understanding these processes will increase our knowledge about the functioning of the nucleolus, ribosome maturation, and the mechanisms of how the cell manages to maintain these processes in unfavorable conditions, and may even contribute to developing new anticancer therapies and deepen knowledge about basic biological processes.