Cardiovascular diseases are a leading cause of death in developed countries, with myocardial infarction being the most common one. During infarction, ischaemic event occurs and functional cardiac cells – cardiomyocytes – are dying due to hypoxia. In the area of infarction, a scar tissue is formed, which lacks an ability to contract, which is necessary for normal heart function. Those irreversible changes cause a lot of suffering in affected individuals, as well as a decrease in their quality of life.

There is a hope for affected patients, with regenerative medicine being a potentially useful tool in the therapy of myocardial infarction, as it is based on stem cell transplantation into the damaged tissue. Stem cells possess the capacity to proliferate and differentiate into almost any cell type, which is why they may cause regeneration of infarcted tissue, and inhibit the process of scar formation. Some experimental therapies, both in animal models and human patients, were proved to be successful, despite low incorporation of transplanted cells into the target tissue. How is that possible? It is believed that paracrine factors may activate stem cells that reside in the heart, which may lead to observed regenerative effects. Those paracrine factors are cytokines and growth factors, as well as extracellular vesicles. Extracellular vesicles are small membrane structures that are responsible for cell-to-cell communication. They are secreted by almost any cell type and transport bioactive cargo, such as proteins or small nucleic acids, which may influence or even change the fate of acceptor cells.

Positive pro-regenerative effect of extracellular vesicles on acceptor cells was observed in both *in vitro* and *in vivo* studies in different tissue types, including kidney and heart. However we still don't know much about their impact on cardiac cells, as well as its exact mechanism of action. It is due to the fact, that cardiac cells possess very complex set of features, with presence of ion channels being the most distinctive one. Ion channels are responsible for formation of cardiac action potential, which causes contractile activity of cardiac muscle.

The main aim of this study was to optimize the parameters, which can be used for evaluation of cardiomyogenesis efficacy, based on changes in ion channels function and their gene expression. This model will also allow us to answer, if extracellular vesicles derived from pluripotent stem cells, may influence cardiomyogenesis, and thereby be a potential tool in regenerative medicine. Result of experiments proposed in this project, will lead to creation of simple yet precise method of cardiomyogenesis efficacy evaluation, which may help in future development of biology and medicine.

This innovative connection between two quite distant fields of science, electrophysiology and cell-to-cell communication, will help us to create a model to evaluate the level of cardiac differentiation, which may be used in research focused on development and regeneration of the heart and thus will influence modern biology and medicine.