Description for the general public

The goal of the proposed project is to develop a new three-dimensional (3D) culture model of breast and female reproductive tract cancers (gynecological cancers) under laboratory conditions with the usage of the perfusion microbioanalytical systems. Moreover, the influence of vascularization on therapeutic effect of the selected anticancer therapies will be analyzed.

According to the statistical data, cancers beside cardiac diseases are the most common cause of death all over the world. Cancers of breast and female reproductive tract (called gynecologic cancers) are the most common cancers in women. This group includes cervical, endometrial, fallopian tube, ovarian, vaginal and vulvar cancers. They represent nearly 40% of women cancers and they cause high women mortality. Surgical removal of the tumor and chemotherapy are the most commonly used treatments. However, these methods are invasive and not always effective. Cancers of breast and female reproductive tract are characterized by high hormone-dependency and chemoresistance, therefore in this cases hormone therapy can be used. This method is less cytotoxicity and causes fewer side effects than chemotherapy. In addition, to increase the efficacy of the treatment of this type of cancer, photodynamic therapy (PDT), radiotherapy or their combination can be utilized.

In response to the important social problem, which are female gynecologic cancers, we propose the research on the development of a new culture model, which will mimic spatial arrangement of the cancer cells. In the process of tumor cell growth, both tumor cells and non-malignant cells are involved in the development of tumor tissue, and they are creating layer of stroma. Non-malignant (normal) cells ensure the integrity of the tumor, nourish it and stimulate division of tumor cells. Moreover, vascularization is an important element of tumor. Therefore, the proposed culture model will consist of both normal and cancer cells, creating heterogeneous multilayer culture.

In our research the microanalytical devices, called *Lab-on-a-chip* systems will be used. Such microsystems can function as an integrated micro-laboratory on a chip. They are good tools to develop new research methodology, because application of such systems allows to perform investigation in real time with minimal impact of external factors on the experiments. Such microlaboratory contains microstructures for cell culture and flow of reagents, what enables mimic *in vivo* microenvrinoment. Additional structural elements of the microsystems will be biocompatible materials (*e.g.* porous membranes) - specific scaffolds for cellular multilayers as well as electrodes for automating analytical measurements.

The developed microsystem with multilayered heterogeneous and vascularized culture of cancer cells will be applied for investigation of toxicity of drugs used to treat gynecological cancers. This will allow to compare the effectiveness of chemo and hormonal therapy based on cell culture mimicking growth of tumor in live organisms. In the future, this may influence the selection of the key factors for effective treatment of gynecologic cancers.

The scientific area of the proposed project can be placed at the interface between chemistry, biology, medical diagnostics and microtechnology. The obtained results of this interdisciplinary project will be a crucial for development of non-invasive and efficient methods of diagnostics, visualization and therapies of gynecologic cancers as well as development innovative methods for drug delivering. In the future, the developed new 3D cancer model can be a basis of the laboratory research that contributes to early tumor screening in patients samples.