# The use of nanotechnology in the study of the biological and biomechanical properties of cancer cells

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For years, the development of medicine has been driven by the development of sciences such as molecular biology and biophysics. An interdisciplinary approach is particularly important in the study and treatment of cancer - one of the most common causes of premature death in the world. Despite the increased efforts of the scientific community, effective methods of treating malignant neoplasms, such as glioblastoma, are still unknown. This tumor is located in the brain, thus its treatment using conventional methods does not bring satisfactory results. One of the causes of this phenomenon may be the high potential of glioblastoma cells to invade and migrate through adjacent tissue.

In-depth understanding of the invasion mechanisms may lead to the discovery of new molecular targets for therapy against this cancer. The first part of this dissertation is focused on determining the effect of miR-218-5p on the migration properties of glioblastoma cells. Parallel to molecular studies, biophysical analyzes including atomic force microscopy and single cell force spectroscopy were used to study the biomechanical properties of individual glioblastoma cells. The results of these studies indicate the complexity of the physical reaction of cells to changes in the level of miR-218-5p - an intracellular regulator of gene expression.

In the case of tumors developing within the central nervous system, treatment may not be effective due to the impossibility of surgical intervention in the brain, presence of the blood-brain barrier, or the neurotoxicity of used therapeuticals. In the second part of the work, the toxicity analysis of the hybrid nanomaterial composed of magnetite and polyethyleneimine was performed. Detailed characterization of the properties of such nanoparticles in terms of their cytotoxic properties is crucial for their potential use in therapeutic approaches, including its use to decrease the proliferation, migration and invasion of cancer cells.

The third part of this dissertation is related to the construction of new three-dimensional glioblastoma cell models. These types of models may in the future replace currently used two-dimensional cell models in the study of neoplastic invasion processes and be used to assess the effectiveness of new therapeutics with anti-invasive potential. The first proposed model is based on advanced organoid cultures derived directly from the tumor tissue and can be used to study the penetration of substances into the tumor and the interactions between tumor cells. The second proposed model is a modern assembloid culture that aims to replicate the interactions between glioblastoma cells and healthy brain tissue.