THE IMPACT OF ELECTRIC FIELD-BASED ANTICANCER METHODS ON CELL VIABILITY WHEN 2D AND 3D CELL CULTURE MODELS ARE USED

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According to the World Health Organization, in 2020, 10 million people died from cancer. Therefore, there is a significant focus on improving treatment technologies and increasing the effectiveness of anticancer therapies in the scientific research field. One such technique is anticancer therapy involving the higher transfer of anticancer drugs to cancer cells affected by electric fields. This therapy is based on the process of electroporation, where the plasma membrane of a cell becomes temporarily permeable to hydrophilic molecules that normally cannot enter the cell. Electroporation occurs when an electric field increases the transmembrane potential of the affected cell to a poration threshold level. If the transmembrane potential is not too far from the threshold the reversible electroporation is obtained, hence cells do not die via necrosis. Nevertheless, the reversible electroporation is enough for anticancer drugs (e.g., bleomycin) to be delivered into the cell, leading to localized apoptotic cell death. This combination of applications to the cells to achieve cancer cell death is termed electrochemotherapy (ECT). Quite recently an alternative to bleomycin was proposed in ECT. Such alternative is Calcium ions that regulate many cellular functions, such as exocytosis, metabolism, gene expression, and the cell cycle. Apparently, once high enough concentrations of Calcium ions enter the cell with the help of electric fields the apoptotic cell death is triggered.

Another electric field-based method is irreversible electroporation (IE). The main difference is that if induced transmembrane potential greatly exceeds the electroporation threshold level, thus cells die due to the immense disruption of homeostasis. Alongside the ECT the IE is also considered as a good alternative to the conventional cancer treatment methods.

The majority of new anticancer therapy methods are being researched using a monolayer cell model (two-dimensional cell cultures). Unfortunately, such models often are too simplistic and do not permit observation of processes specific to more complex cancer tissue structures. This is why three-dimensional (3D) spheroid cell cultures are used. Such spheroids serve as an intermediate model between monolayer cell cultures and *in vivo* studies and can be an alternative to animal experiments. Although 3D cell cultures have been used more intensively in recent years, there are still too few studies to determine the effectiveness of electric field-based anticancer therapies. Therefore, the aim is to compare the impact of electric field-based anticancer methods on cell viability with 2D and 3D spheroid models.

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