Name(s)
Sumanth Gurram; David Wu

Project Number
38126

Project Title
Low-Frequency Electromagnetic Fields Decrease Cancer Cell Viability for Potential Cancer Therapy

Abstract

Objectives/Goals
With drug delivery, expense, efficacy and side effects becoming problematic in cancer therapy, more directed, low-cost and effective therapy is needed. A potential candidate for such therapy is the use of low-frequency electromagnetic fields (EMFs), which are ubiquitous in the modern world and are a widely debated topic in public health. We aimed to develop a low-cost EMF-exposure system that would reduce cancer cell viability in vitro by aiming 60 Hz 2 mT EMFs at colorectal and neuroblastoma cancer cell lines, showing potential for therapeutic development.

Methods/Materials
We constructed an inexpensive 20-inch tall, 168-turn solenoid to generate 60 Hz EMFs up to 2 mT in strength. 96-well experimental and control plates containing cells lines HCT116, SH-SY5Y, and RAW macrophages in monoculture and coculture were created and exposed to EMFs 12 hours at a time for up to 5 days. Following exposures, Propidium iodide Assay and MTS Assay were conducted to quantify reduced cell viability in addition to qualitative observations under the microscope. Propidium iodide binds to fragments of DNA from dead cells and an absorbance reading is taken. The presence of NAD(P)H-dependent dehydrogenase enzymes in viable cells reduces the MTS reagent resulting in a colored compound with an absorbance maximum at 490 nm.

Results
After two days of 12-hour-daily exposures, the exposed well plate showed a 65-94 percent decrease in cell viability and proliferation as quantified by the MTS Assay when compared to the unexposed plates. After 4-5 days of exposure, the exposed plate cells numbered significantly less, were deformed and non-adherent. MTS assay revealed a dramatic difference between the exposed and unexposed with the exposed having little to no cell metabolic activity at 90-100 percent decreases in viability and proliferation.

Conclusions/Discussion
Our EMF device and exposure system has significantly reduced cancer cell viability and proliferation in vitro for both neuroblastoma and colorectal cancer. We plan to test exposures on non-cancerous cell lines and also optimize exposure intensity and duration for reduced cancer cell viability. Overall, our results point to potentially using EMFs in cancer therapy. EMF-based treatment represents a potentially low-cost, directed and effective way of treating cancer in the future.

Summary Statement
This project demonstrates the adverse effects that low-frequency EMFs have on cancer cell viability and proliferation, which presents EMFs as a potential candidate for cancer therapy.

Help Received
Dr. Salvesen at Sanford Burnham Prebys Research Institute provided us with the cell lines, culture materials, and training. The idea and plans for executing this project were developed independently. We carried out the experiments and analyzed the data ourselves under the appropriate supervision in the lab.