Electroporation-based treatment for Triple-negative breast cancer

Purdue University and Institute for Cancer Research, Jan 2021- Present

Abstract: Human cells and proteins are bio-dielectric systems. The cell membranes are less permeable to external molecules such as chemo drugs, making them less effective when treated. However, we can use high-intensity, short-duration electric pulses (EP) to open up temporary pores in the cell membrane, which enhances drug uptake. This aspect can be used to treat triple-negative breast cancer (TNBC), the most aggressive and lethal subset of breast cancer, and to better understand the intracellular alternation in biological processes in the presence of an electric field.

Our approach involves the following steps to treat triple-negative breast cancer:

- Optimizing the electrical parameters, such as electrical field intensity, number of pulses, and pulse width, along with dosage for Metformin and Metformin + Cisplatin combination.
- Building a 3D scaffold that mimics the tissue structure to create an *in vitro* cancer drug testing platform under various electroporation conditions.
- Studying intracellular alteration with the application of electric pulses using cell toxicity/viability assay, metabolite (Reactive Oxygen Species-ROS, Glucose, Lactate), proteomics, and other cell biology assays.
- Analyzing proteomics data to assess upregulated, downregulated, and unique sets of protein/genes to discover the metabolic signaling pathways and mechanism of action for TNBC proliferation upon application of electric pulse coupled with Metformin and Metformin + Cisplatin using label-free quantitative (LFQ) proteomics.

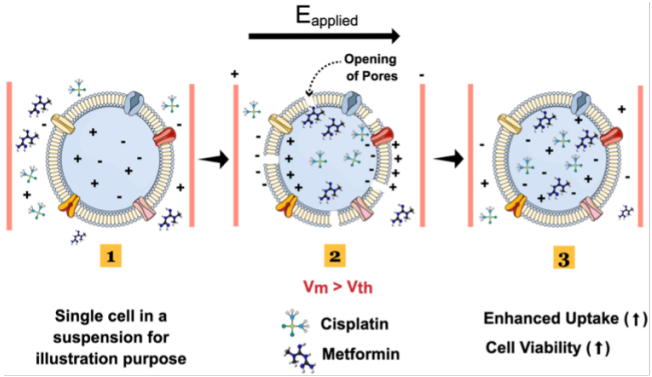

Figure 1: Electroporation technique and delivery of proposed drug in the presence of an electric field

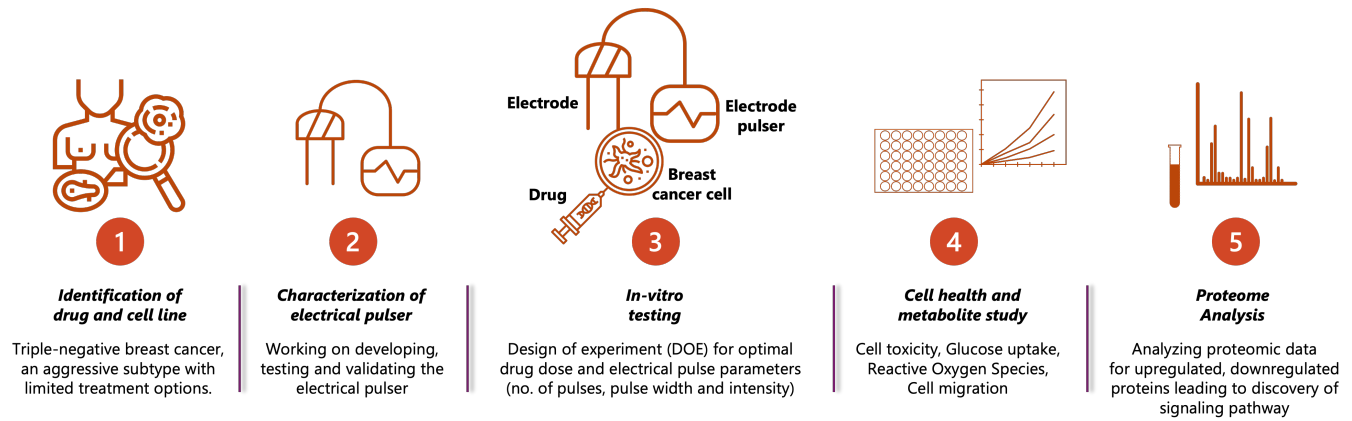

Figure 2: Overview of a multistep experimental approach for the treatment of triple-negative breast cancer: From drug and cell line identification to signaling pathway using Proteome analysis

Skills:

Wet Lab/Bench	Lab Instruments	Electron Microscopy
Mammalian cell culture	Light microscope	Fix
Plate-based assays	Cell counter	Embed
Cytotoxicity	pH meter	Stain
Reactive oxygen species	Oscilloscope	Section
Glucose assay	Electroporator BTX 830	Prepare grid
Lactate assay	EVOS fluorescence microscopy	Staining
Sample preparation (Proteomics)	Scanning electron microscope	
Colony forming assay	UV/Vis spectrophotometry	
ELISA	Gel electrophoresis	
Transfection	Confocal microscope	
Inoculation		

Bioinformatics	Data Analysis	General Laboratory
DAVID 2021	Design of experiment (DOE)	Media preparation
STRING 11.0	Statistical analysis	Precision weighing
GOrilla	Tableau	Class II BSC
GeneCodis	Origin/GraphPad	Sterile technique
Cytoscape	ImageJ	Lyophilization
Heatmapper	Programming (C, Python)	Centrifuge
Venny	Grant writing	Incubators

Certifications:

- Data Classification and Handling Educational Resources Annual CertificationData Classification and Handling Educational Resources Annual Certification, D2L
- Responsible Conduct of Research (RCR) Training - Faculty, Postdoctoral, and Graduate Students, CITI Program
- Biosafety for Principal Investigators, Lab Personnel, and IBC MembersBiosafety for Principal Investigators, Lab Personnel, and IBC Members, CITI Program
- Group 2. Social Behavioral Research Investigators and Key Personnel, CITI Program