CALIFORNIA STATE SCIENCE FAIR
2016 PROJECT SUMMARY

Name(s)

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Project Number

36783

Project Title

Phasor-FLIM Analysis of Metabolic Effects of Caffeine and Cisplatin on a Triple-Negative Breast Cancer Cell Line

Abstract

Objectives/Goals

Caffeine and cisplatin's effects on NADH related energy production pathways within a breast cancer cell line.

Methods/Materials

Treated cells with different concentrations of caffeine, cisplatin, and a combined treatment of caffeine and cisplatin. Examined metabolism by measuring free and bound NADH in treated cells by using Fluorescence Lifetime Imaging Microscopy (FLIM). Acquired images with the ZEISS LSM 710 microscope. Analyzed images using the Phasor-FLIM technique with the Globals for Images program written by Dr. Enrico Gratton.

Results

Treatment with caffeine caused breast cancer cell energy production pathways to shift from primarily glycolysis towards more wild-type oxidative phosphorylation. Treatment with cisplatin also shifted cancer cell energy production pathway towards oxidative phosphorylation energy production. A combined treatment of caffeine and cisplatin induced cancer cells to shift towards wild-type metabolism as well, but the magnitude of the shift was similar to that of the cisplatin only treatment.

Conclusions/Discussion

Treating triple-negative breast cancer cells with caffeine induces anticancerous effects by inducing more oxidative phosphorylation. Although, according to literature, caffeine and cisplatin potentiate each other in lung and bone cancer cell treatment, the two do not when used on the triple negative breast cancer cell line studied. This experiment also shows that FLIM can be potentially used for targeted drug therapy screening in biopsied patient specimens to evaluate the efficacy of different drugs on individual tumor cells.

Summary Statement

I showed that caffeine is an effective drug in the treatment of invasive triple-negative breast cancer cells and that FLIM can be used for targeted drug therapy.

Help Received

Dr. Michelle Digman from the Laboratory for Fluorescence Dynamics at the University of California, Irvine mentored me while I completed my project. Ning Ma is a graduate student under Dr. Digman who also mentored me and helped with acclimating me to lab equipment and techniques.