In-Vitro Electrical Pulse Stimulation of MCF-7 Breast Cancer

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One of the first documented uses of electrical pulse stimulation (EPS) within cell culture was published in 1976 by Shainberg & Burstein using platinum wire electrodes to study the effects of EPS on acetylcholine receptor regulation in chick muscle cells. Following this pioneering study, the utilization of EPS has been predominantly used to study the physiological, cellular, and molecular responses of excitable cells such as nerve and muscle. Our current study looks into the effects of EPS on breast cancer cells (MCF7s), based on previous work on muscle cancer cells. In-vitro EPS was applied at 6, 8 and 10 Volts for 4-hour bouts over a 24-hour period. Protein analyses were performed following 1 and 2 days of EPS. Preliminary data indicates that when subjected to EPS, MCF7 cells consequently stopped growing and died. Results indicate that cell death does not occur during or immediately after EPS but over the span of 24-48 hours following cessation of EPS. This suggests that the response is a programmed response initiated by EPS and not just a random event. Preliminary data also suggests that cell death may be independent of apoptosis and mediated through macro autophagy, a process whereby the cell excessively engulfs cellular contents leading to cell death. We hypothesize that this cellular response to EPS is mediated by altered ion homeostasis, specifically Ca$^{2+}$. This is based on the body of literature on the effects of EPS on muscle and nerve cells. This study aims to characterize the response of MCF7 cells to EPS and build on a working model of cell cycle arrest, autophagy, and cell death mediated by calcium signaling through G1/S phase signaling proteins. Ultimately, by stressing cancer cells with EPS, we can learn more about potential novel modes to induce mechanisms of proliferative failure.