SELECTIVITY OF NON-THERMAL ATMOSPHERIC PRESSURE MICROSECOND PULSED DIELECTRIC BARRIER DISCHARGE PLASMA INDUCED APOPTOSIS IN MALIGNANT CELLS OVER NORMAL CELLS

Sameer Kalghatgi, Ekaterina Cerchar, Jane Azizkhan-Clifford, Alexander Fridman and Gary Friedman
Drexel University, 3141 Chestnut St
Philadelphia, PA 19104 USA

Initiation of apoptosis is an important issue in cancer treatment as cancer cells frequently have acquired the ability to block apoptosis and thus are more resistant to chemotherapeutic drugs. The non-functioning of a tumor-suppressor gene that facilitates apoptosis, or the over expression of an anti-apoptotic protein are both important pathways in cancer development. Many anti cancer therapies are aimed at modulating these factors with various bioactive agents as well as radiation in an attempt to target components of the apoptotic pathway. However, many of these approaches remain in preclinical development due to either low efficacy or tumor drug resistance. Non-thermal atmospheric pressure plasma is being widely developed for various clinical applications ranging from wound healing to cancer therapy and may prove to be a novel clinical tool for cancer treatment.

We have shown earlier that reactive oxygen species generated by non-thermal dielectric barrier discharge (DBD) plasma in the medium surrounding the cells induce DNA damage in mammalian cells [1]. Although non-thermal plasma primarily produces reactive oxygen species (ROS) extracellularly we hypothesize that it can induce apoptosis in malignant cells similar to ionizing radiation which primarily produces ROS intracellularly. Previously, we have also demonstrated that non-thermal DBD plasma induces apoptosis in malignant cells [2]. Targeted and selective destruction of cancer cells are desirable for many reasons, including limiting systemic side effects and preventing damage to nearby healthy tissue. We demonstrate in this work the selectivity of the induction of apoptosis in transformed malignant epithelial cells over normal epithelial cells in vitro by exposure to non-thermal plasma. We also show that malignant cells are more susceptible to non-thermal plasma than normal cells. Thus, unlike ionizing radiation which damages healthy tissue surrounding the malignant tissue, non-thermal plasma, due to its non-penetrating nature may provide a safer means to induce selective apoptosis in malignant tissue with precise control of treatment area and depth

References:

[1] Kalghatgi S, et. al. 2009 Proc. 17th IEEE Pulsed Power Conference, Washington DC, pp 1133 – 1138
[2] Fridman G. et. al. 2007 Plasma Chemistry and Plasma Processing, 27, 2, pp 163-176.