

Cold Plasma Selectivity and Application for Cancer Therapy

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Plasma is an ionized gas that is typically generated in high-temperature laboratory conditions. Recent progress in atmospheric plasmas led to the creation of cold plasmas with ion temperature close to room temperature. We have demonstrated the efficacy of cold plasma in a pre-clinical model of various cancer types (lung, bladder, and skin) [1]. Both *in-vitro* and *in-vivo* studies revealed that cold plasmas selectively kill cancer cells. We showed that: (a) cold plasma application selectively eradicates cancer cells *in vitro* without damaging normal cells. For instance a strong selective effect was observed; the resulting 60–70% of SW900 cancer cells were detached from the plate in the zone treated with plasma, whereas no detachment was observed in the treated zone for the normal NHBE cells under the same treatment conditions. (b) Significantly reduced tumor size *in vivo*. Cold plasma treatment led to tumor ablation with neighbouring tumors unaffected. These experiments were performed on more than 10 mice with the same outcome. We found that tumors of about 5mm in diameter were ablated after 2 min of single time plasma treatment. The two best known cold plasma effects, plasma-induced apoptosis and the decrease of cell migration velocity can have important implications in cancer treatment by localizing the affected area of the tissue and by decreasing metastatic development. In addition, cold plasma treatment has affected the cell cycle of cancer cells. In particular, cold plasma induces a 2-fold increase in cells at the G2/M checkpoint in both papilloma and carcinoma cells at ~24 hours after treatment, while normal epithelial cells (WTK) did not show significant differences. It was shown that reactive oxygen species metabolism and oxidative stress responsive genes are deregulated. We investigated the production of reactive oxygen species (ROS) with cold plasma treatment as a potential mechanism for the tumor ablation observed.

References

[1]. M. Keidar, R. Walk, A. Shashurin, P. Srinivasan, A. Sandler, S. Dasgupta, R. Ravi, R. Guerrero-Preston, B. Trink, Cold plasma selectivity and the possibility of a paradigm shift in cancer therapy, *British Journal of Cancer*, Vol. 105, No. 1295-1301, 2011