EFFICACY OF NANOFORMULATION-ENHANCED PHOTODYNAMIC THERAPY EXCITED BY RADIATION IN HEAD AND NECK CANCER CELLS

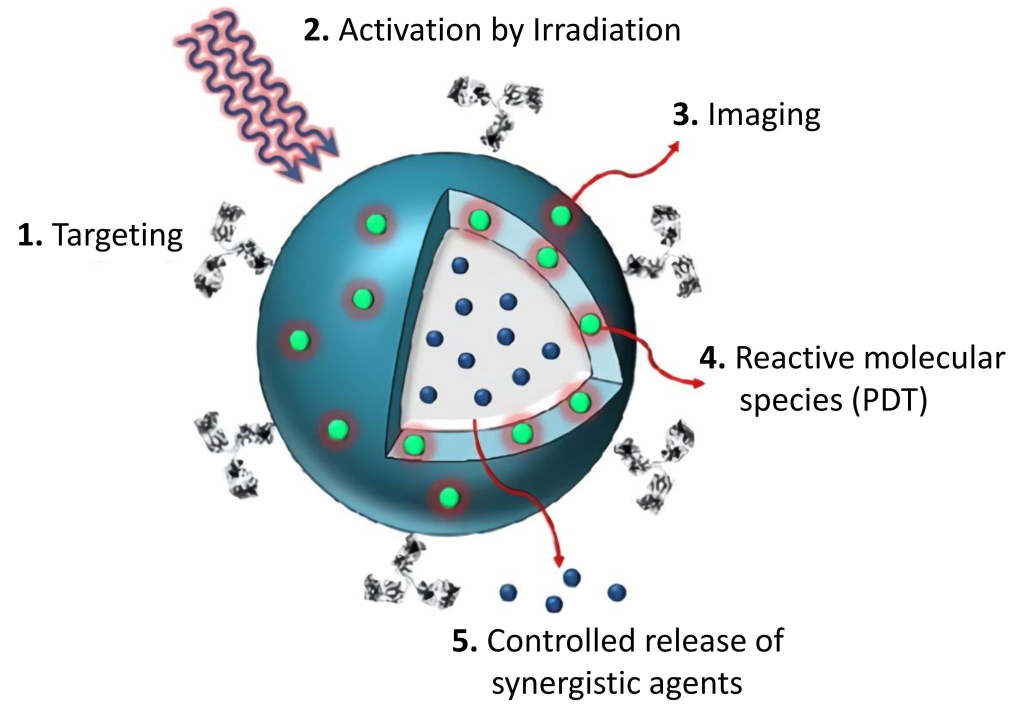
John Squire[1,2], Girgis Obaid[1], Debabrata Saha[2]

[1] Department of Bioengineering, The University of Texas at Dallas

[2] Department of Radiation Oncology, The University of Texas Southwestern Medical Center

BACKGROUND

- More than 870,000 patients worldwide are diagnosed with head and neck cancer with over 440,000 new deaths each year [1].
- Radiotherapy is one of the front-line treatment modalities for head and neck cancer.
- One of the biggest challenges in radiotherapy is the development of tumor radiation resistance.
- Photodynamic therapy (PDT) is an alternative cancer treatment method that utilizes light and a photosensitizer molecule, but treatment can become complex for deeply-seated tumors [2].
- Ionizing radiation used for radiotherapy can overcome the depth limitation of PDT and can activate photosensitizer molecules.
- Generation of reactive oxygen species (ROS) is the main mechanism of cancer cell killing for PDT and radiation-activated PDT.
- Several nanoformulations are used to entrap photosensitizer molecules and enhance PDT efficacy.



Idealized general structure of a PDT nanoformulation [3]

PURPOSE

- In this study, we aimed to lower the cytotoxic dose threshold of x-ray and γ-ray irradiation in AT-84 mouse head and neck cancer cells through the usage of nanoformulations to enhance outcomes of radiotherapy.
- We hypothesized that the approach of combining radiotherapy with deep tissue PDT using nanoformulations will produce an effective solution for targeting and eliminating head and neck cancer cells while reducing the necessary level of radiation exposure of a patient.

METHODS

Irradiation Techniques

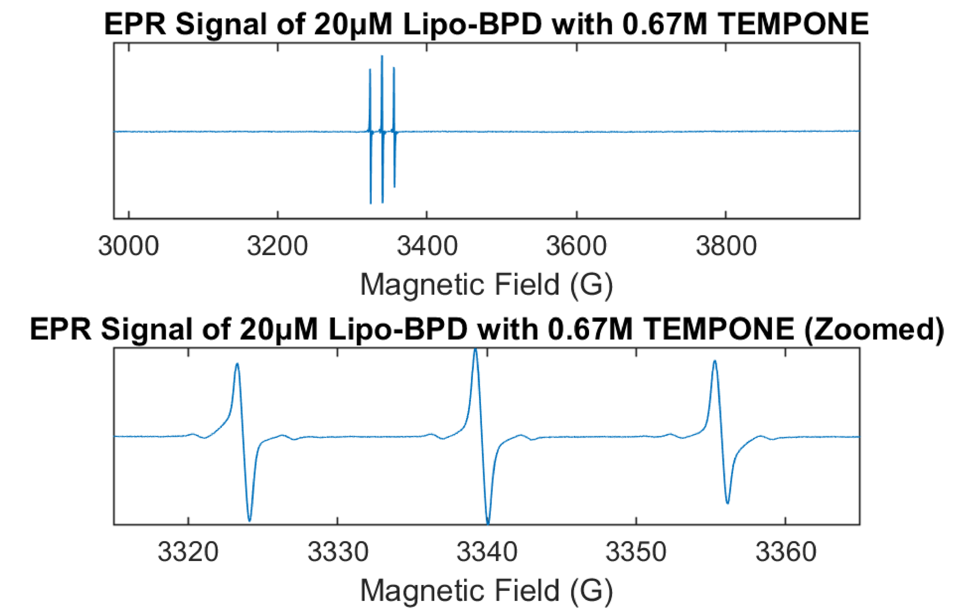
- X-ray: Precision X-Rad 320 X-ray irradiator
- γ-ray: J. L. Shepherd and Associates Mark 1-68 Cs-137 γ-ray irradiator

ROS Generation Measurements

- Anthracene-9,10-dipropionic Acid (ADPA)
- Spin Trapping for EPR spectroscopy

Cell Survival Measurements

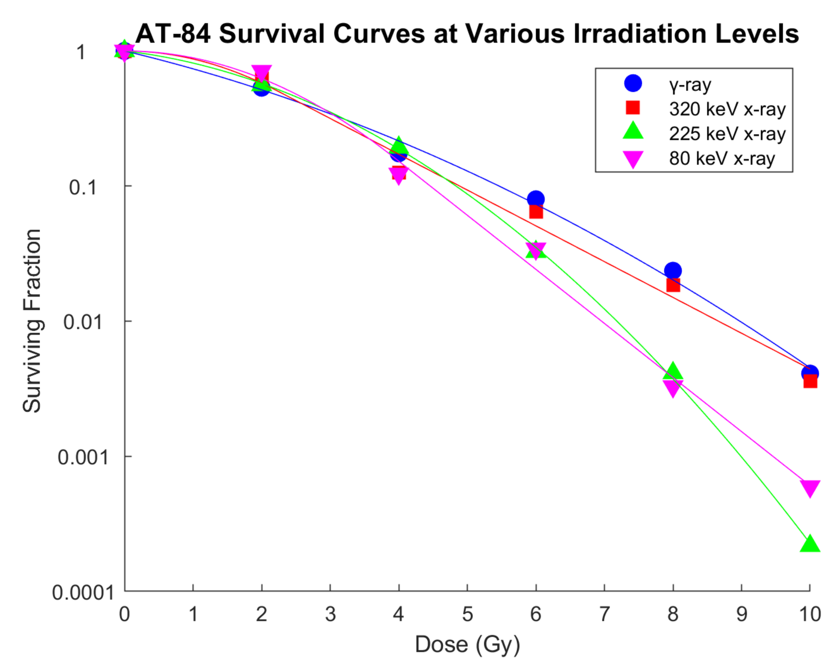
- MTT Assay
- Colony Formation Assay (CFA)



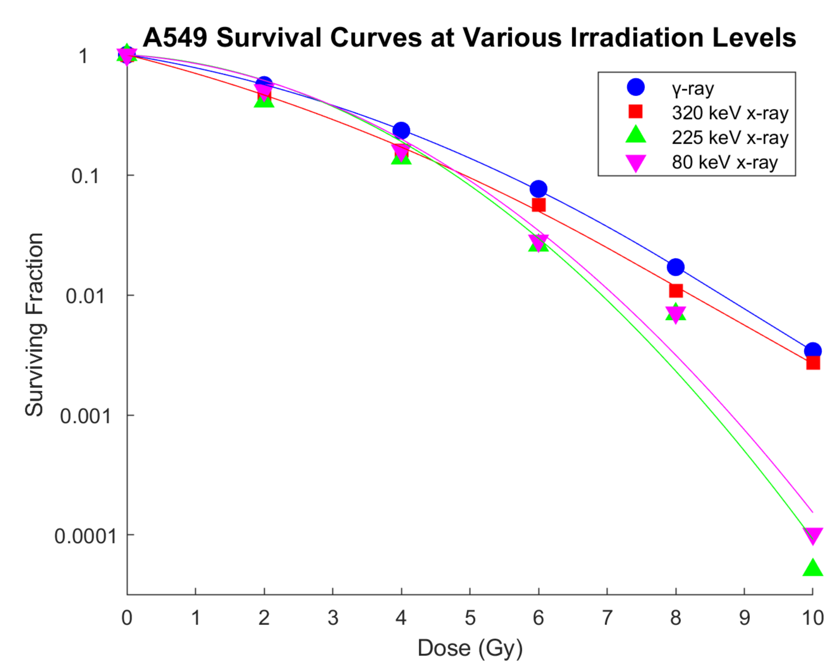
Spin adduct signals from the spin trapping method of detecting ROS (the peaks indicate presence of ROS)

The x-ray irradiator (left) and the γ-ray irradiator (right) used

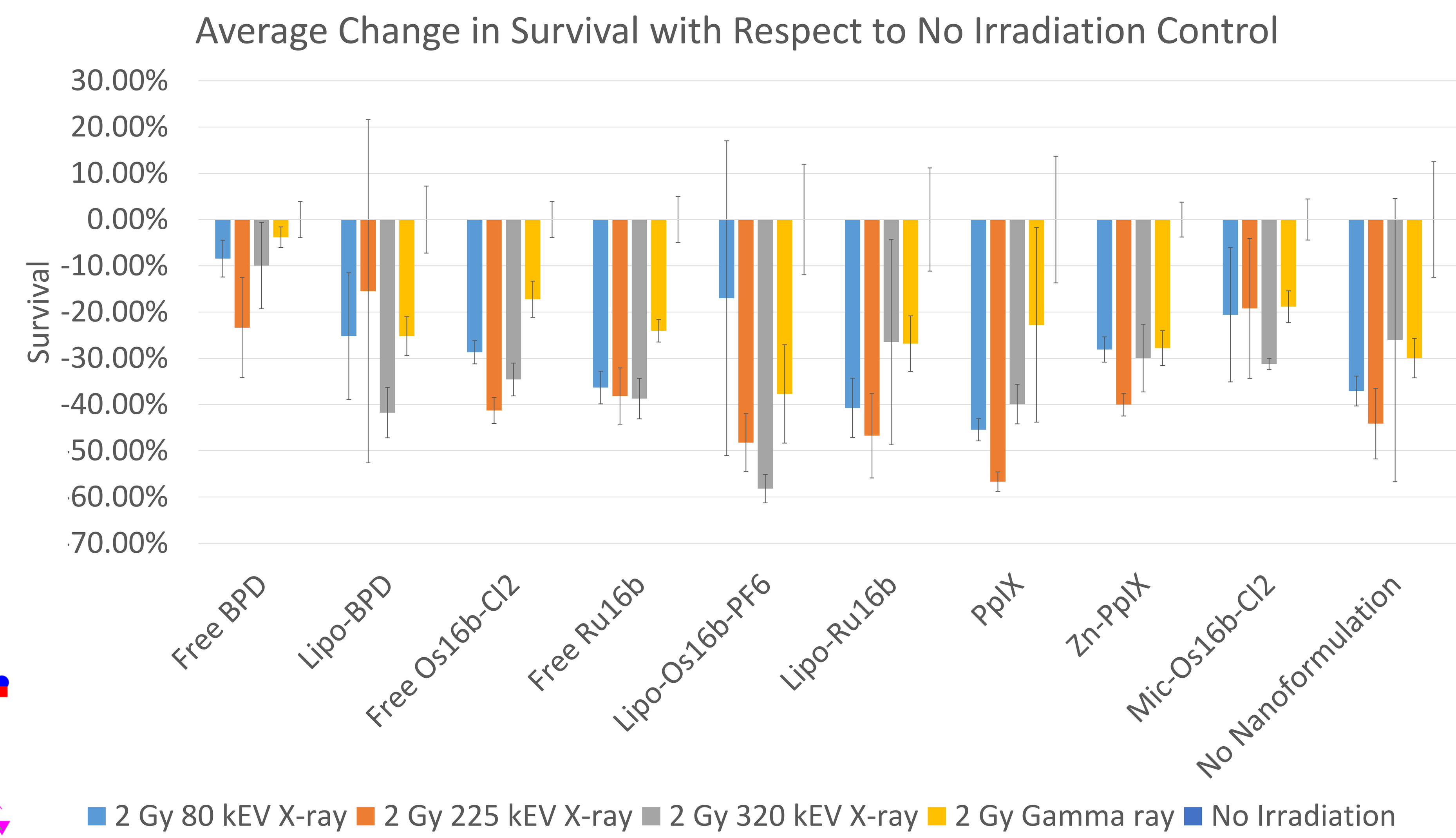
RESULTS



AT-84 survival curves generated from CFAs at various irradiation levels (left)



A549 survival curves generated from CFAs at various irradiation levels (right)



Change in AT-84 survival when exposed to combined nanoformulation and irradiation treatment measured by MTT assay as compared to unirradiated AT-84 cells

CONCLUSION

- The nanoformulations explored have the potential to utilize x-ray and γ-ray irradiation to reduce the viability of AT-84 cells. More experimentation is needed to further characterize their efficacy, such as utilizing new nanoformulations and other cell lines.
- Using the CFA technique rather than an MTT assay might provide more insightful results of clonogenicity.
- Spin trapping appears to be a viable method for measurement of ROS generated by the excitation of nanoformulations using ionizing radiation.

CONTACT

John Squire
jsquire@utdallas.edu
https://personal.utdallas.edu/~jsquire

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