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Protection and sensitization of normal and tumor cells to proton radiation by cerium oxide nanoparticles

J. L. Shinpaugh*[1], B. Swartz*, C. Putnam-Evans†, S. Das‡, and S. Seal‡

* Department of Physics, East Carolina University, Greenville, North Carolina, USA
† Department of Biology, East Carolina University, Greenville, North Carolina, USA
‡Department of Mechanical, Materials and Aerospace Engineering, Advanced Materials Processing and Analysis Center, and Nanoscience Technology Center, University of Central Florida, Orlando, Florida, USA

Synopsis Cerium oxide nanoparticles are investigated as radioprotectors and radiosensitizers for normal (healthy) and tumor cells for charged particle radiation. Results are presented for cell survival and DNA damage for *in-vitro* irradiation of normal breast epithelial cells and prostate tumor cells by 1.5 – 3.0 MeV protons.

Radiation therapy is widely used in the treatment of cancer. Methods to protect healthy tissue while enhancing damage to tumor cells are continually being sought. Recently, cerium oxide (CeO_2) nanoparticles have been shown to act as a protectant for normal cells while sensitizing tumor cells to x-rays [1, 2]. Use of radioprotectors and radiosensitizers could clearly increase the efficacy of the treatment.

We have initiated experiments to investigate the potential use of ceria nanoparticles as protectors/sensitizers for proton and ion beam therapies. Ceria nanoparticles (CNPs) prepared at the UCF Nanoscience Technology Center were transferred to ECU. Normal breast epithelial cells and prostate tumor cells cultured in the cell culture facility at ECU were treated with the CNPs and irradiated with 1.5 – 3.0 MeV protons for doses of 1 – 8 Gray in the ECU Accelerator Laboratory. Cell viability was measured with the MTT assay after 24 and 48 hours post irradiation.

DNA damage was assessed using the TUNEL assay; typical results for are shown in figure 1 of a confocal image of normal cells irradiated with 3 MeV protons for a dose of 2.8 Gy. Blue fluorescence indicates the location of the cell nuclei, with the DNA damage indicated by red. The top image (A) is for cells untreated with the CNPs, and the bottom image (B) is for cells treated with 100 nM concentration of the CNPs 24 hours prior to irradiation. The greater extent of DNA damage (ratio of red to blue) is clearly observed in the untreated cells, indicating protection provided by the CNPs.

Mechanisms of radioprotection and radiosensitization by the CNPs will be discussed.

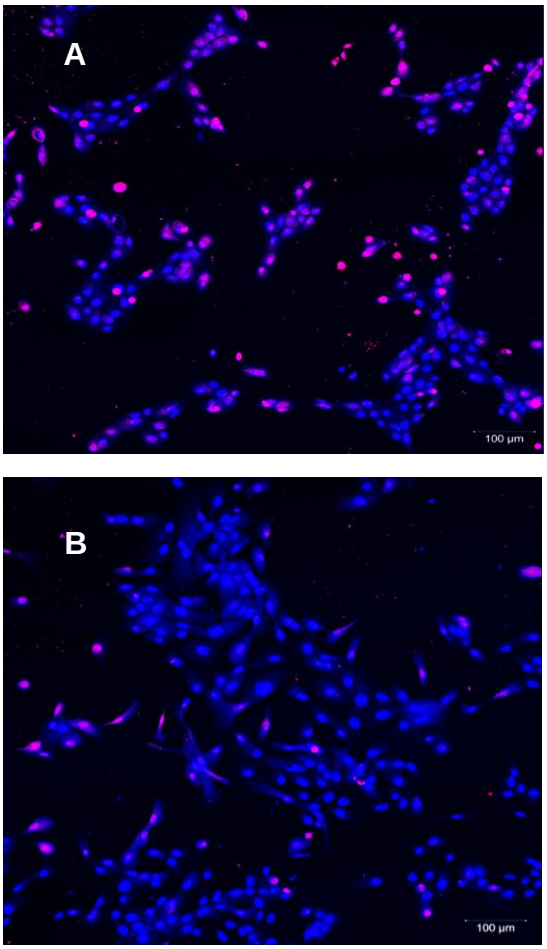

Figure 1. TUNEL assay showing DNA damage for untreated cells (A) and cells treated with ceria nanoparticles (B) following irradiation by 3 MeV protons. Cell nuclei are identified by blue fluorescence, with DNA damage labeled by a red fluorophore.

References

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[1] E-mail: shinpaughj@ecu.edu

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