UNIVERSITY of MARYLAND SCHOOL OF MEDICINE

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Education and Training

M.Sc. in Elementary Particle Physics, Warsaw University, Warsaw, Poland.

Ph.D. in Nuclear Engineering, University of Maryland, College Park MD

Post-doc in Radiation Biology & Medical Physics, University of Maryland School of Medicine, Baltimore MD

Biosketch

Dr. Balcer-Kubiczek research goal is to leverage her expertise in the field of radiation biology and physics for translation into the realm of cancer biology and therapy. Her research interests cover a number of areas relevant to clinical use of photon or proton radiation, radio-frequency hyperthermia and combined therapy. She also teaches the Radiobiology course in the department of Radiation Oncology that focuses on integration of radiobiology and radiation physics into clinical practice.

Dr. Balcer-Kubiczek joined the Eugene Robinson' s group at the University of Maryland Department of Radiation Oncology as a Ph.D. graduate student in nuclear engineering at the University of Maryland College Park with Master' s degree in elementary particle physics from University of Warsaw (Poland). Her graduate and early post-graduate work focused on neutron radiation carcinogenesis at the cellular and molecular levels. In risk assessment studies, we utilized cell-based neoplastic transformation assays to obtain quantitative dose response on rates of neoplastic conversion for cyclotron- and fission reactor-produced neutrons. We focused on the effects of high doses of low- and high-LET ionizing radiation (relating to radiation therapy) and the effects of low dose rates (relating to medical, space, environmental, and occupational exposures). Our neutron radiobiology research has current relevance to radiation oncology because secondary neutrons are unwanted byproduct in proton radiotherapy (and to the lesser extent in megavoltage photon radiotherapy). The neutron doses resulting from proton interactions in the body are small but irreductible. In addition, neutrons about 20 times more biologically effective than photons and thus even small doses have a high potential for carcinogenesis. Consequently, exposure due to low doses of secondary neutrons may present a significant risk for developing a secondary primary cancer later in the patient lifetime.

The Balcer-Kubiczek research progressed to investigating the molecular mechanisms involved in the multistage nature of radiation carcinogenesis. Since human exposure to environmental agents frequently involves more than one agent, the emphasis had been on the effects induced by a combination of environmental carcinogens with non-ionizing or ionizing radiation identification. Under generous funding from NCI, NIEHS and NASA we were the first to develop research tools for generation molecular profiles capable of distinguishing between different exposures conditions. Microarray transcriptome data for cells exposed to ionizing radiations (X-rays, neutrons, HZE particles) revealed the latent gene expression signature in surviving cells linked to the hallmarks of cancer: resisting cell death, evading growth suppression, sustaining proliferative signaling, and genome destabilization. In contrast to physical and chemical carcinogenes, no association was seen between low-level exposure to electromagnitic fieds and cancer-related end points. This result is important because everyone is exposed to a complex mix of weak electric and magnetic fields, both at home and at work, from the generation and transmission of electricity, domestic appliances, personal electronic devices and industrial or medical equipment, to telecommunications and broadcasting.

The main effect of high levels of electromagnetic field exposures is heating of body tissue. The medical manupulation of body temperature for treatment of cancer has a long and fascinating history in the department of Radiation Oncology. In fact, the research by Professor Eugene Robinson first demonstrated the highly quantifiable cell killing by microwave hyperthermia. The improved ability to control and measure thermal dose in a patient, in combination with a more complete recognition of the underlying biologic contribution of hyperthermia in radiosensitization, is curretly driving a vigorous research effort in the Translational Rediation Sciences Division aimed at clinical trials testing benefit of hyperthermia for enhancing radiation therapy with protons.

Research/Clinical Keywords

Radiation carcinogenesis, biological effects of neutrons and protons, health hazards of non-ionizing radiations, low dose/low dose-rate of radiation physics and biology, biologically and pharmacologically augmented radiation therapy.

Highlighted Publications

E.K. Balcer-kubiczek, G.H. Harrison, X.F. Zhang, et al. Rodent cell transformation and immediate early gene expression following 60-Hz magnetic field exposure. Environ Health

Perspect 104:1188-1198, 1996.

E.K. Balcer-Kubiczek, X.F. Zhang, G.H. Harrison, et al. Delayed expression of hpS2 and prologed expression of CIP1/WAF1/SD1 in human tumor cells irradiated with X rays, fission neutrons, or 1 GeV/n Fe-ions. Int J Radiat Biol 75:529-541, 1999.

E.K. Balcer-Kubiczek, M. Attarpour, J.Z. Wang, W.F. Regine. The effect of docetaxel (Taxotere) on human gastric cancer cells exhibiting low-dose radiation hypersernsitivity. Clin Med Oncol 2: 301-311. 2008.

R. Karan, P. DasSarma, E.K. Balcer-Kubiczek, et al. Bioengineering radioresistance by overproduction of RPA, a mammalian-type single-stranded DNA-binding protein, in halophilic archaeon. Appl Microbiol Biotech 98: 1737-1747, 2014.

E.K. Balcer-Kubiczek. The role of apoptotic machinery in radiation carcinogenesis (Invited paper). Crit Rev Oncog. Special Issue: Cell Death in Cancer. 2016 in press.

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