An Introduction to the International Journal of Particle Therapy’s Special Issue on Charged Particle Radiobiology

Marcelo E. Vazquez, MD, PhD
Associate Professor, Loma Linda University Medical Center, James Slater MD Proton Treatment and Research Center, CA, USA

Advances in medical physics and technology have dramatically improved the targeting, precision, and quality of particle therapy treatments. We are also beginning to recognize that radiobiology has the potential to provide breakthroughs in radiation oncology, and that exploiting the quantitative and qualitative differences in the biological responses of charged particles and photons can be of decisive benefit to the patient.

An understanding of charged particle radiobiology, therefore, is critical to optimizing charged particle radiotherapy. Although the physical properties of charged particle radiobiology are reasonably well-understood, its biological properties, particularly the complex biological responses that take place during particle therapy treatment, have been underexplored and underexploited. In the lab, clinic, and beyond, photon and particle radiotherapy require a paradigm shift to include biological interventions tailored to radiation-related phenomena. Modern radiobiology is gradually evolving to incorporate such complex biological responses to radiation, thereby providing new paradigms with direct translational impact.

Advances in radiation biology can help guide the appropriate implementation of charged particle therapy based on preclinical and clinical research aimed at understanding, optimizing, and personalizing the potential advantages of particle therapy alone or in combination with chemo- and immunotherapies. Such advantages to charged particle therapy will include the use of radiogenomics, biomarkers, and molecular imaging to help identify patients for charged particle clinical trials.

Given the current state of charged particle radiobiology, IJPT associate editors determined that a special issue focused on the basic radiobiological mechanisms and translational implications of particle therapy could not be timelier.

The goal of this special issue is to provide an overview of several topics in basic and translational radiobiology, including molecular, cellular, and tissue effects; differences in the biological effects of photons, protons, and heavy-ions, their RBE uncertainties, and modeling; personalized, precision medicine; biomarkers and molecular imaging; radiogenomics; radioimmunotherapy; and combined treatments and the use of charged particle irradiation for functional disorders. It is our hope that this special issue will increase the awareness and interest in charged particle radiobiology and attract additional work in this critical field.

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