Non-targeted effects of photon and particle irradiation and the interaction with the immune system.

Abstract: Ionizing irradiation is an important clinical approach to treat solid tumors. Modern radiation technologies aim to selectively kill tumor cells and protect the surrounding normal tissue. The standard paradigm for radiation effects in cellular systems involves damage of the DNA including DNA double-strand breaks, which are considered as most effective in destroying tumor cells. Due to their enhanced physical and radiobiological properties, high-linear energy transfer radiation qualities are of special interest in tumor therapy. Future radiation therapy strategies aim to utilize carbon ions to effectively treat highly aggressive tumors. More recently, evidence is emerging for non-DNA targeted effects of radiation, including mutations, chromosomal aberrations, and changes in gene expression, which can occur in cells that were not directly exposed to radiation. Radiation oncologists are only gradually beginning to appreciate the clinical relevance of radiation-induced bystander effects, genomic instability, and abscopal effects. Since these effects are sensed by the immune system, a combination of immunotherapy and irradiation presents a new therapeutic opportunity in the future.