

Innovations at the Crossroads: Nanotechnology and Radiotherapy Opportunities

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Extended Abstract

Radiotherapy remains a cornerstone in the treatment of many cancers. Despite advancements in dose delivery techniques, the escalation of radiation doses to improve tumor control is often limited by the risk of toxicity to adjacent healthy tissues. Consequently, strategies to locally enhance radiation dose within tumor sites are critically needed to optimize treatment efficacy.

Recent developments in nanotechnology offer promising avenues to address this challenge. Nanoparticles such as gold, silver, or hafnium oxide can act as radiosensitizers, amplifying the local radiation dose within tumors. Gold nanoparticles, in particular, are widely studied for their high atomic number, which enhances radiation absorption and produces localized secondary electrons that damage cancer cells. Additionally, nanoparticles can function as targeted delivery vehicles for radiosensitizing agents, further improving therapeutic outcomes.

I will discuss the therapeutic potential of nanoparticle-based radiosensitizers, focusing on their tumor-targeting capabilities and underlying mechanisms of sensitization. I will present preclinical data supporting application of nanotechnology in radiotherapy and examine the current status of clinical translation efforts. Overall, nanotechnology holds promise for making radiotherapy more effective, personalized, and safer, contributing to improved clinical outcomes for cancer patients.