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Road-map to use of gold nanoparticles in cancer radiotherapy

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Radiotherapy is used to treat more than 50% of the cancer patients. Improving the therapeutic ratio, either by reducing the impact of side effects or enhancing the treatment effectiveness locally, is a major goal of current cancer radiotherapy. One of the ways to improve the local radiation dose while minimizing damage to healthy surrounding tissue is to introduction of high Z materials such as gold nanoparticles (GNPs) as radiation dose enhancers. They enhance radiation damage by producing a shower of secondary electrons when exposed to X-ray beams. Radiation dose enhancement properties due to GNPs is dependent on their localization within cells, due to the short range of these electrons. The exact magnitude of the sensitization depends on a number of factors, including GNP size, beam energy, and total dose. However, there has been limited translation of GNP-mediated radiosensitization to a clinical setting. One of the key challenges in this area is the wide range of experimental systems that have been investigated, spanning a range of particle sizes, shapes and preparations. Hence, mechanisms of uptake and radiosensitization have remained difficult to clearly identify. This has resulted in a significant barrier to the identification of optimal GNP formulations which strike a balance among their radiosensitizing properties, their specificity to the tumors, their biocompatibility, and their imageability in vivo. In this talk, I will review the current state of knowledge in each of the areas concerning the use of GNPs as radiosensitizers, and outlines the steps which will be required to advance GNP-enhanced radiation therapy from their current preclinical setting to clinical trials in the near future.

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