AbstractID: 3732 Title: Estimation of tumor dose enhancement due to gold nanoparticles during typical radiation treatments: A preliminary Monte Carlo study

Purpose: To computationally demonstrate possible tumor dose enhancement due to the use of gold nanoparticles and to provide quantitative estimates of this tumor dose enhancement during typical radiation treatments.

Method and Materials: This investigation was conducted with several phantom test cases that simulated typical radiation treatments using orthovoltage x-rays, high energy photon beams from linear accelerators, and gamma rays from a brachytherapy source. Specifically, possible dose enhancement within a tumor loaded with gold nanoparticles was calculated by Monte Carlo calculations when the phantoms were irradiated by 140 kVp x-rays, 4 and 6 MV photon beams, and ^{192}Ir gamma rays. Based on published mice studies, the current study considered three levels of gold concentration within the tumor: 7, 18, and 30 mg Au / g tumor. The Monte Carlo calculations were performed with the BEAMnrc/DOSXYZnrc code system for the external beam cases and with the MCNP5 code for the ^{192}Ir cases, respectively.

Results: The dose enhancement over the entire tumor volume considered for the 140 kVp x-ray case can be at least a factor of 2 at an achievable gold concentration of 7 mg Au /g tumor. The tumor dose enhancement for the cases involving the 4 and 6 MV photon beams ranged from about 18% to 60%, depending on the amount of gold within the tumor and photon beam qualities. For the ^{192}Ir cases, the dose enhancement within the tumor region ranged from 5% to 31%, depending on radial distance and gold concentration level.

Conclusion: The tumor dose can be enhanced significantly by using gold nanoparticles during typical radiation treatments, assuming that the findings from previous mice studies would be applicable in humans.

Conflict of Interest: This investigation was supported in part by PHS Grant No. CA 10953 awarded by the National Cancer Institute, Department of Health and Human Services.