

AbstractID: 3986 Title: Initial Monte Carlo Analysis of the Dosimetric Effects of Gold Nanoparticle Radiosensitizers

Purpose: Monte Carlo simulations have been undertaken to quantify the dosimetry of tumors that have absorbed nanoparticle gold as radiosensitizers and irradiated with various radiotherapy modalities.

Method and Materials: EGSnrcMP and BEAMnrcMP, well known and documented Monte Carlo Photon Transport simulation codes are used for therapy simulations. Previous measurements of uptake ratio's provide a basis for generating new radiation interaction cross sections for use in radiation transport simulations. Cross sections generated by the simulation software are checked against cross sections generated using the NIST (National Institute of Standards and Technology) Standard Reference Database 8 (XGAM) and found to agree to within about 0.5%. 250 kVp, and 6 MV and Ir-192 HDR spectra provided with the EGS package were used as sources. Tumors containing 0.5% to 5% Au by weight (the balance made up by water) and sized from 0.5 to 3 cm were simulated at various depths and compared to pure water. The effects of normal tissue absorption of gold in media surrounding the tumor were also investigated.

Results: As expected, 250 kVp orthovoltage units showed the largest benefit from nanoparticles. A 50% absorption increase in tumors absorbing 1.5% Au by weight. Ir-192 therapy beams available from High Dose Rate Brachytherapy units treating 1.5% and 5% nanoparticle gold by weight showed a 13% and 38% increase in dose absorption rate for tumors 1cm from the source. 6MV photon beams treating a 3cm tumor at 10cm depth showed a modest 5% improvement. Surrounding media absorption of gold nanoparticles shifts both target and surrounding tissue absorption rates higher, but does not significantly change their relative absorption rates.

Conclusion: These simulations suggest gold nanoparticles in some modalities are worth investigating as radiosensitizers. Initial research should focus on HDR modalities first.

Conflict of Interest (only if applicable):