Abstract ID: 19336  Title: Gold Nanoparticle Modify Density of Ionizations Inside Cells Submitted to Radiation Therapy: Microscopic Track Analysis of Secondary Electrons Using Monte Carlo

Purpose: Study density of ionization in cells containing gold nanoparticles (AuNP) submitted to Radiation Therapy.

Methods:Spherical gold nanoparticles with diameters ranging 0-100nm were considered evenly distributed inside a 20µm cubic cell, maintaining the gold concentration of 0.01%, with constant number of gold atoms inside the cell. Monte Carlo simulations were performed using PENELOPE code considering event-by-event transport of secondary electrons with minimum energy of 1keV. Simulated clinical energy spectrum of 250kV and 6MV x-rays;Co-60 and Ir-192 γ-ray sources obtained at each corresponding build-up depths were considered. Density of ionization inside the cell was evaluated counting delta electrons created either in AuNP or cell, excluding electrons attenuated inside the nanoparticles. The dose enhancement resultant from interaction of electrons with few micrometers range was quantified by the factor µDEF as the ratio of doses inside the cell with and without AuNP.

Results:Maps of ionization density were obtained at the central plane of the cell illustrating ionizations around and between AuNP. The density of ionization increases in cell medium as the AuNP diameter enlarges, being higher to larger nanoparticles for all energies studied. The total dose deposited in the cell is affected by the fraction of electrons consumed in the nanoparticles, resulting in size-dependence for µDEF. The µDEFs for 250kV are 1.68 to 20nm, 1.83 to 60nm and 1.72 to 100nm; µDEFs for 6MV are 1.14 to 20nm, 1.38 to 60nm and 1.20 to 100nm, therefore presenting an optimum nanoparticle size for clinical applications in Radiation Therapy.

Conclusions:The µDEF describes dose enhancements founded on the effective density of ionizations inside cell medium containing AuNP, considering real electron tracks close to metallic interfaces. The profile of ionizations describes electron spectra of electrons with intracellular range considering dynamics of creation and consumption, hence being directly proportional to potential applicability of AuNP in Radiation Therapy.

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