

AbstractID: 10365 Title: Dependence of CHO Cell Survival on IUdR Uptake for 35-keV Photoactivated Auger Electron Therapy

Purpose: To characterize sensitization enhancement ratios (SER) obtainable using monochromatic x-ray activated Auger electron radiotherapy as a function of radiosensitizer concentration for a 35-keV x-ray beam and compare those results to measurements made using conventional 4 MV x-rays in order to separate effects due to dose enhancement from effects due to other (chemical) mechanisms.

Methods and Materials: IUdR was incorporated into CHO cell DNA through incubation in growth media containing 0, 5, 10, or 20 μM IUdR concentrations for 27 hours. Percent thymidine replacement was determined in separate tests using radiolabeled ^{125}I -IUdR. IUdR-loaded cells were irradiated to 1-8 Gy with 35 keV x-rays, generated at LSU's CAMD synchrotron, using a $2.8 \times 2.5\text{-cm}^2$ effective field size. Dose was determined from ionization chamber-measured dose rates ($\sim 18 \text{ cGy}\cdot\text{min}^{-1}$ at 100 mA) and verified with GAFCHROMIC[®] EBT film. 4 MV irradiations were performed using a Varian Clinac 21EX ($30 \times 30\text{-cm}^2$ field, 0.5-cm depth). Irradiated cells were incubated for 1 week, then fixed and stained with crystal violet. Colonies of 50 or more cells were scored as survivors. Survival fraction (SF) was plotted versus dose with results fit to a linear quadratic model. SER_{10} was calculated as the ratio of dose required to achieve 10% SF for cells without and with DNA-incorporated IUdR.

Results: SERs of 2.7 at 16.6 \pm 1.9% thymidine replacement (20 μM), 2.3 at 12.0 \pm 1.4% (10 μM), and 1.6 at 9.2 \pm 1.3% (5 μM) following 4-MV irradiations illustrate IUdR's effect as a chemical radiosensitizer. Following 35-keV irradiations, SERs of 4.3, 3.1, and 2.1 at 16.6%, 12.0%, and 9.2% replacement, respectively, indicate dose enhancement due to increased local DNA dose resulting from photoelectric interactions with DNA-incorporated iodine.

Conclusions: SER depends on percent thymidine replacement by IUdR. Compared to 4 MV x-rays, 35 keV photons produce an additional SER, linear with percent thymidine replacement.