AbstractID: 8842 Title: Computed Tomography Imaging to Quantify Iodine Distribution in IUdR-labeled DNA

Purpose: Treatment planning for X-ray Activated Auger electron radiotherapy requires CT data sets correlated to the distribution of preloaded high Z radiosensitizer molecules in cellular DNA. The study's aim was to evaluate a polychromatic microCT scanner and a synchrotron monochromatic CT system for their ability to measure the spatial distribution of iodine incorporated in DNA.

Method and Materials: The Skyscan 1074 microCT system produces images at 20-40 kVp with a 736×512 element CCD camera. CT images were acquired at 40 kVp and 1000 μA. The synchrotron produces a tunable (6-35 keV) monochromatic beam with a beam profile of 0.1×2.8 cm^2 and a 1.5k×1k CCD camera with focusing lenses to obtain CT images with pixel sizes of 4.5-9.0 μm. CT images were acquired above (33.8 keV) and below (32.5 keV) iodine's K-edge binding energy of 33.169 keV. Phantoms were constructed from acrylic for the benchtop microCT system or glass micro-hematocrit capillary tubes for the synchrotron based monochromatic CT system. Iodine contrast agent (Reno-30) was diluted with distilled-deionized water in concentrations 0.05-25 mg I ml^{-1}.

Results: Results from the microCT system and the synchrotron K-edge subtraction data were fit using linear regression. The fit parameters for the Skyscan and CAMD (33.8 keV) data were CT# =2.39 + 29.7×[I] with χ_v^2=0.282 and CT# =6.80 + 82.74×[I] with χ_v^2=1.37 respectively. The fit parameters for the K-edge subtraction were $[I]_{meas}$= -0.00968 + 0.677×$[I]_{known}$ with χ_v^2=1.61.

Conclusions: Noise limited the microCT's accuracy at low iodine concentrations. K-edge subtraction using monochromatic x-rays is promising but the glass capillary tubes have proved too attenuating for test measurements. Measurement of 0.06 mg I ml^{-1} (corresponding to 18% thymidine replacement) appeared feasible. The imaging methods are being applied to studying Chinese hamster ovary cells containing iododeoxyuridine-labeled DNA to verify the magnitude and distribution of iodine incorporation in cell samples.