AbstractID: 13432 Title: Characterization of ADC and T2 responses of tumor tissue to radiation with histological investigation

Purpose: To characterize the temporal, dose, and oxygenation dependence of apparent diffusion coefficient (ADC) and transverse relaxation time (T2) responses of tumor tissue after treatment with ionizing radiation, in the context of histology and observed volume changes.

Methods: Human glioblastoma multiforme (GBM) tumors were grown subcutaneously in mice. Multiple groups treated with 200 kVp x-rays and two unirradiated control groups were formed (n=6 per group). Single fraction groups received doses ranging from 50 cGy to 800 cGy. Fractionated deliveries were 800 cGy in 1, 2 or 3 fractions and fractions were separated by 24 or 72 hours. Oxygenation dependence was investigated with 800 cGy in a single fraction with a ligature in place to deplete the tumor's oxygen supply. Images were acquired on a 9.4 T MR system at multiple time points before and after treatment. Quantitative ADC and T2 maps were produced from each image set.

Results: A dose dependent ADC increase was observed in irradiated tumor tissue. Maximum response was observed 7 days post-treatment. Tumor T2 was maximum 3 days after treatment and had fallen below baseline by 14 days after treatment. Fractionation did not affect amplitude of ADC response, but delayed the time at which maximum ADC occurred and the time for T2 to fall below baseline. Hypoxic tissues showed reduced ADC response after treatment.

Preliminary pathology results show ADC response correlated with reduced tumor growth rate and reduced mitotic cell count. Early increases in ADC and T2 were associated with early-stage necrosis and edema. Later responses were associated with evolving necrosis and extracellular macromolecule accumulation.

Conclusion: These results further the understanding of ADC and T2 responses and their development as biomarkers of treatment response.