AbstractID: 9493 Title: Quantitative in vivo Measurements of Treatment Response in Murine Tumors using Diffusion-Weighted Magnetic Resonance Imaging

Purpose:

Post-irradiation changes in tissue structure can lend insight into how a tumor is responding to therapy. Here, diffusion-weighted magnetic resonance imaging (DW-MRI), which observes Brownian motion within a tissue sample, was used to quantify changes in the diffusion properties of irradiated tumors *in vivo*.

Method and Materials:

MCa-29 mammary carcinoma was grown in the hind legs of C_3Hk/fam mice. Tumors were grown to a diameter of 8mm, treated with 20Gy of ^{137}Cs gamma-rays (mean energy = 662keV), and imaged with DW-MRI. After this initial scan, half the mice were sacrificed and the tumors excised for histological analysis. The remaining animals were re-scanned three days later before being sacrificed for histological analysis.

Diffusion data were collected on a 4.7T Bruker Biospin scanner (Billerica, MA) and analyzed using a two-compartment model, representing MR signal as originating from a slow-diffusing component, often associated with intracellular space, and a fast-diffusing component, often associated with extracellular space. The analysis yielded rates of diffusion for the slow- and fast-diffusing components and the volume fraction occupied by slow-diffusing component, or cellular space (CVF).

Results:

Between imaging sessions the mean rates of diffusion in the slow- and fast-diffusing components increased 96% ($p=0.03$) and 62% ($p=0.30$), respectively. The DW-MRI-based CVF remained approximately unchanged ($CVF=0.40\pm0.04$ versus $CVF=0.43\pm0.08$, $p=0.88$). This did not correlate with the histology-based CVF measurements which, during the same time period, decreased significantly from 0.76 ± 0.03 to 0.56 ± 0.01 ($p<0.001$).

Conclusion:

Although there was disagreement between the CVF measurements made by DW-MRI and histology, a qualitative analysis indicated regional increases in tumor homogeneity after treatment. Also, the rates of diffusion of both tissue components increased after radiation treatment, suggesting decreased structural organization in the tumor, a finding supported by histology. Thus, DW-MRI has potential as a non-invasive *in vivo* method of observing structural changes in irradiated tissues.