Purpose: To assess the tumor response to radiation in transgenic mouse model of prostatic adenocarcinoma (TRAMP) by hyperpolarized MR spectroscopic imaging (MRSI) of [1–13C]pyruvate.

Methods: The TRAMP mouse model used in this study develops an autochthonous tumor in the prostate at the onset of puberty. The progression of tumors was volumetrically monitored by T2-weighted MRI at 7 T. Four mice with tumor volumes of 400–1500 mm3 underwent hyperpolarized 13C MRSI at 3 T. Two of them received fractionated X-ray radiation (200 kV, 20 mA, 1.21 cGy/s, 1 mm Cu HVL) doses of 10 and 20 Gy to the tumors, followed by the 13C MRSI at the fourth day of postirradiation. Dynamic 13C MRSI was performed following an intravenous bolus injection of 300 μL of 80 mM hyperpolarized [1–13C]pyruvate to obtain the transient fate of 13C-labeled metabolites in a 3D volume encompassing the tumor with a nominal spatial resolution of 2.7×2.7×3 mm3. The average time-resolved signal intensities of pyruvate and its downstream products lactate and alanine were measured in the tumors from reconstructed metabolic images. Metabolic response was characterized in terms of lactate/pyruvate ratio and apparent rate constant of pyruvate-to-lactate conversion, kpl, by fitting data to a two-site exchange model.

Results: Based on MRI volumetry, the TRAMP tumors exponentially grew with doubling time of 7±3 d and shrank in response to radiation by 50% in volume within 4±1 d. The untreated tumors that grew to larger volumes over a similar postirradiation period exhibited increased lactate/pyruvate ratio and kpl compared to the treated tumors. Alanine was in noise levels and hence not considered for analysis.

Conclusions: Preliminary data indicate the feasibility of utilizing hyperpolarized 13C MRSI to assess therapeutic response of prostate cancer to radiation in TRAMP mice. Further investigations are underway to obtain additional data.

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