



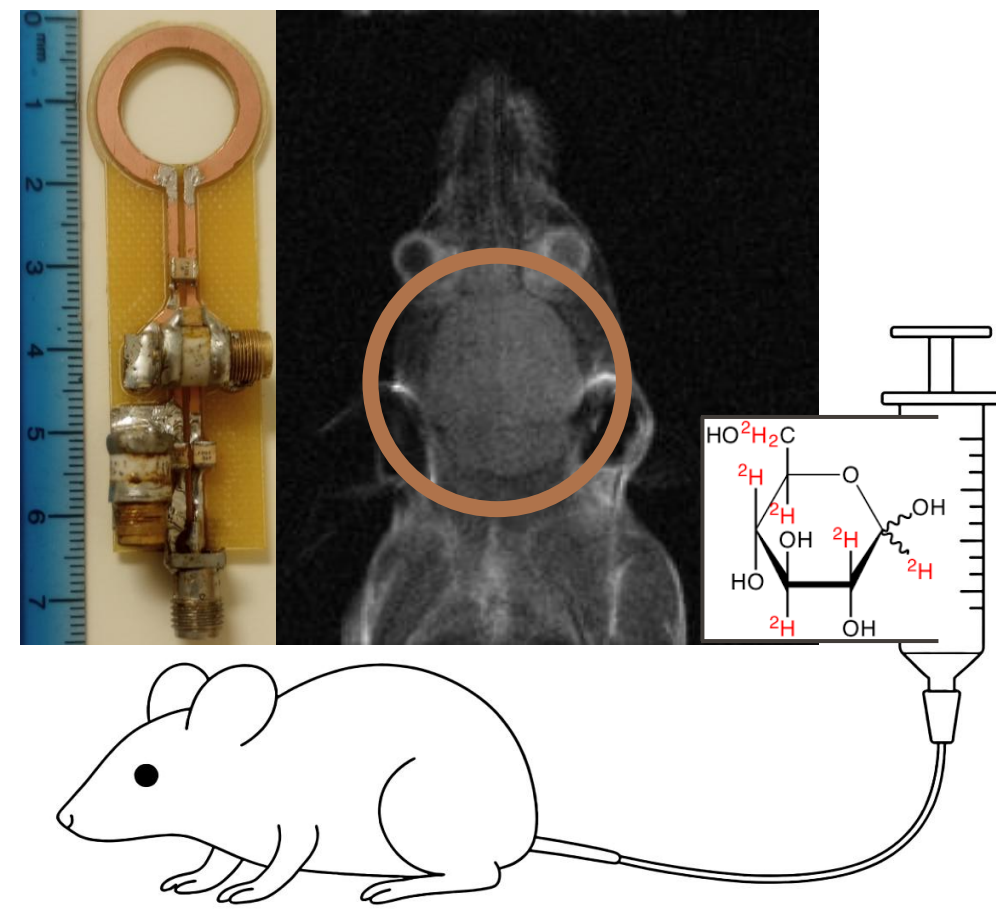
Quantitative HDO production from glucose-d7 for monitoring tumor metabolism

Ryan Boyce, Donghang Cheng, Vidya Gopalakrishnan, Matthew Merritt, James Bankson

Department of Imaging Physics, The University of Texas MD Anderson Cancer Center, Houston TX

Cancer
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Deuterium MR Spectroscopy

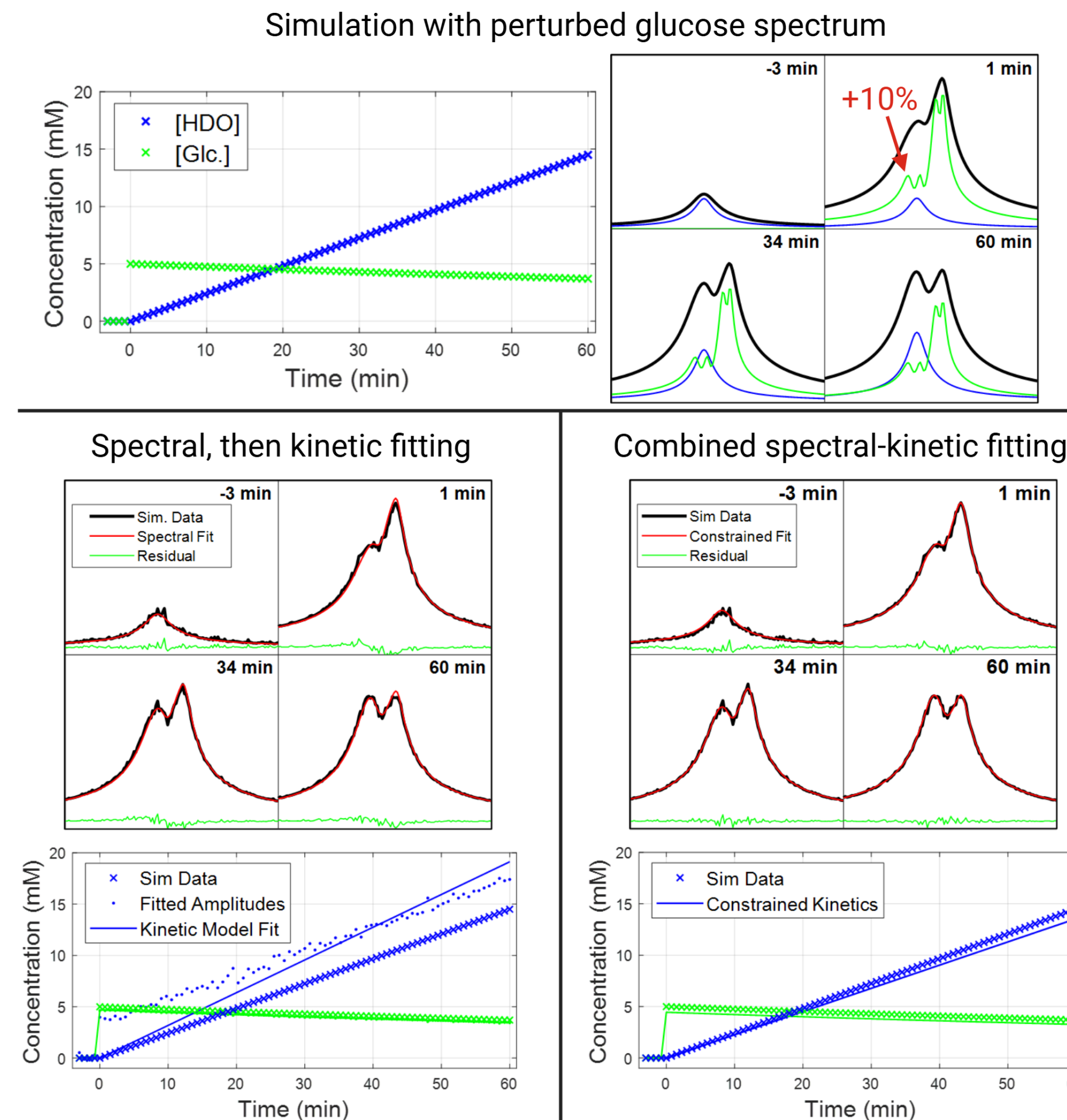
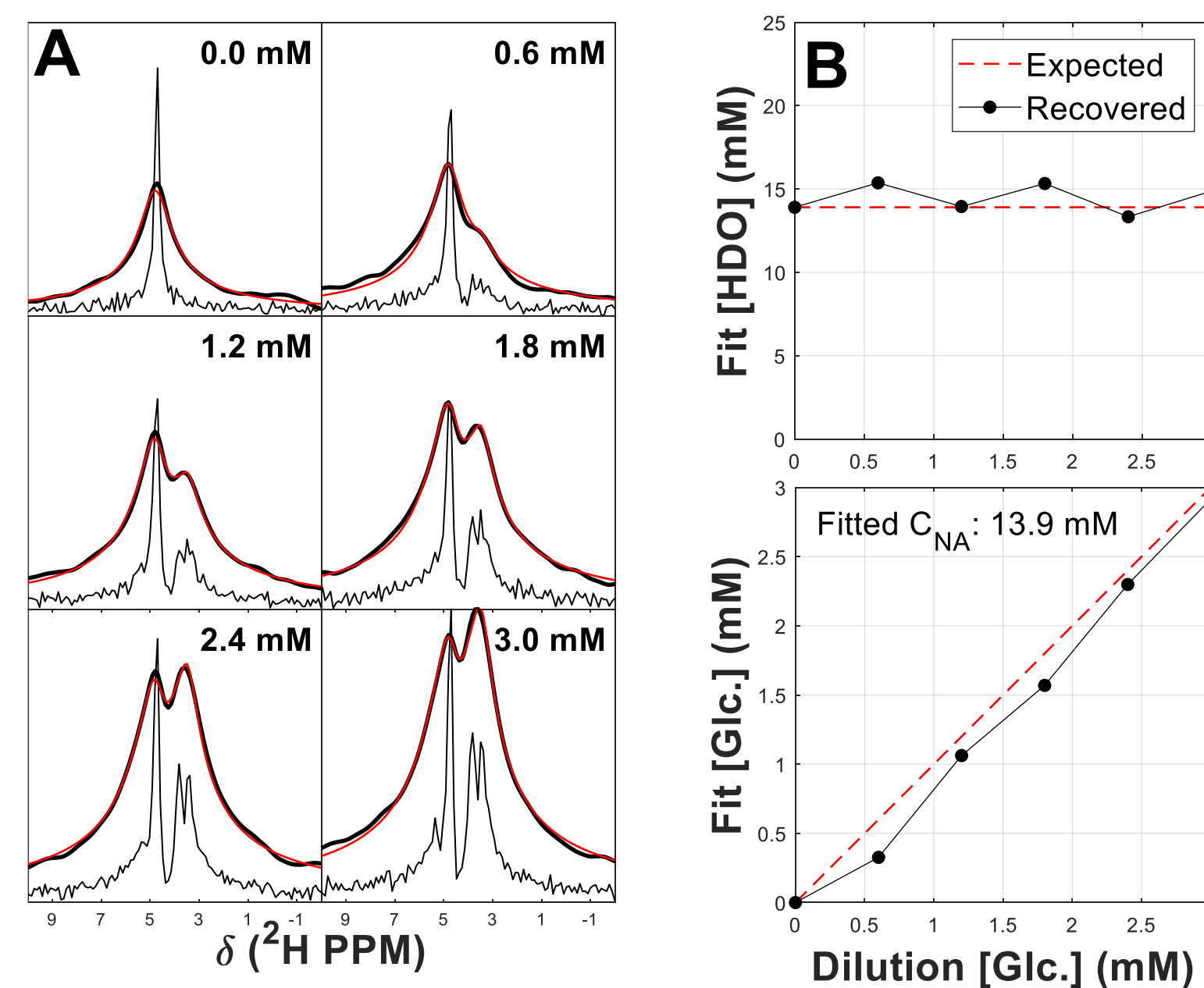


Deuterium spectroscopy using glucose-d2 is a rising star of metabolic imaging which can quantify lactate production from injected glucose.^{1,2} HDO production from glucose-d7 is a potential surrogate of tumor metabolism³ and provides much better dynamic signal contrast than lactate production from glucose-d2, however it remains an under-explored alternative in the field of deuterium metabolic imaging.

This work seeks to extend the quantitative methods developed for glucose-d2 to HDO production from glucose-d7 as a potential avenue for improving metabolic monitoring using deuterium MR.

Quantifying Concentration

- Known glucose-d7 was serially diluted
- Amplitudes normalized by T_1 weighting⁴ and compared to natural abundance ^2H in water (C_{NA}) to find concentration

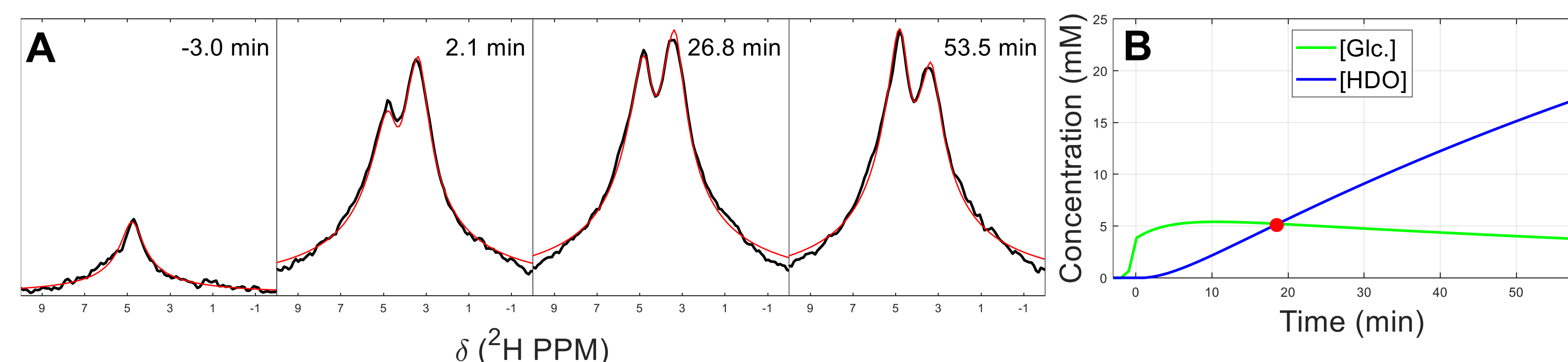


Pharmacokinetic Model

- Modified extended Toft's Model to include metabolism
- Model selected from a suite of more complete kinetic models⁵

$$\begin{aligned}\frac{\partial}{\partial t} [Glc_{iv}] &= -\mu [Glc_{iv}] \\ \frac{\partial}{\partial t} [Glc_{ev}] &= \frac{k_{ve}}{v_e} [Glc_{iv}] - \left(\frac{k_{ve}}{v_e} + k_{glyc} \right) [Glc_{ev}] \\ \frac{\partial}{\partial t} [HDO] &= 4k_{glyc} [Glc_{ev}]\end{aligned}$$

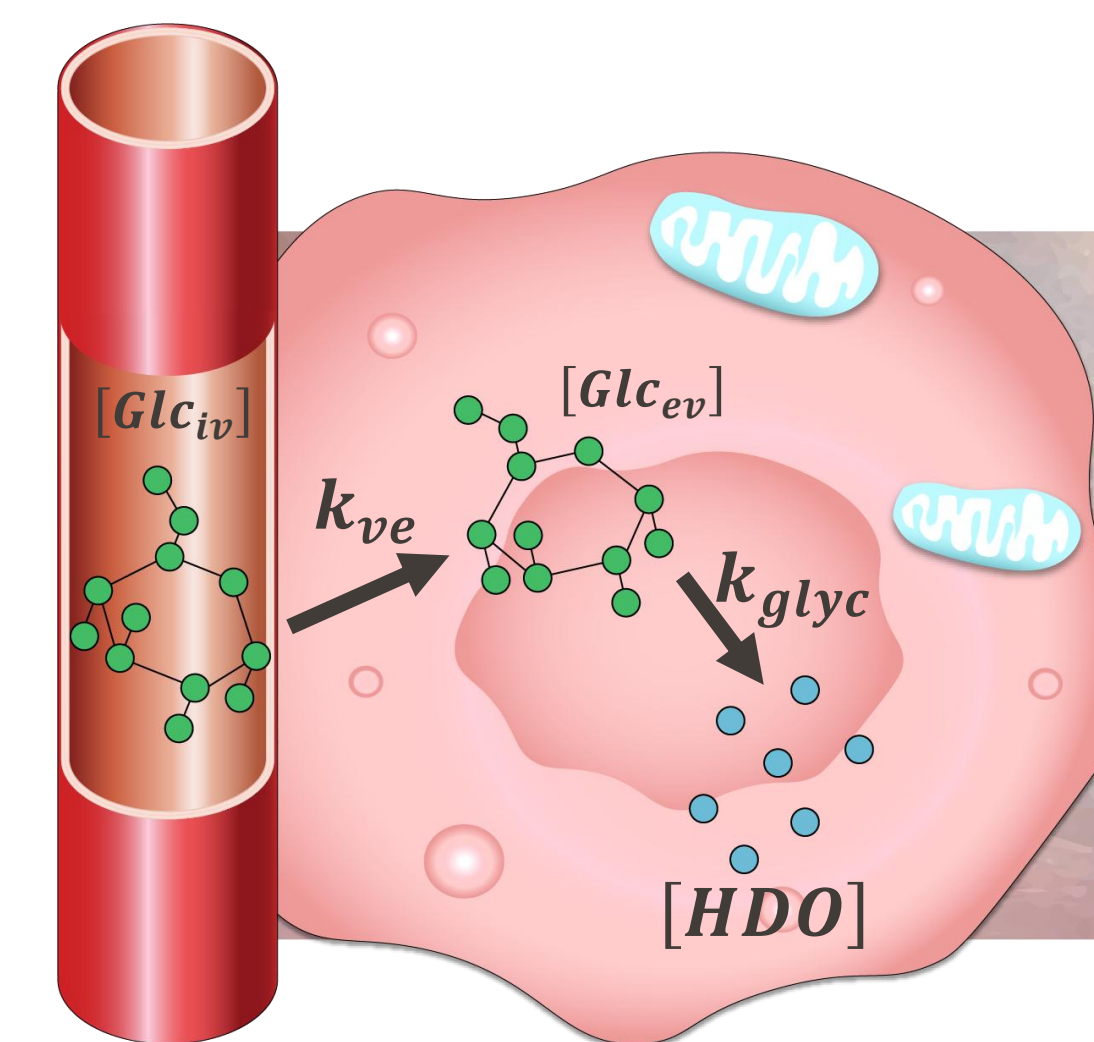
In Vivo Results – no artifact!



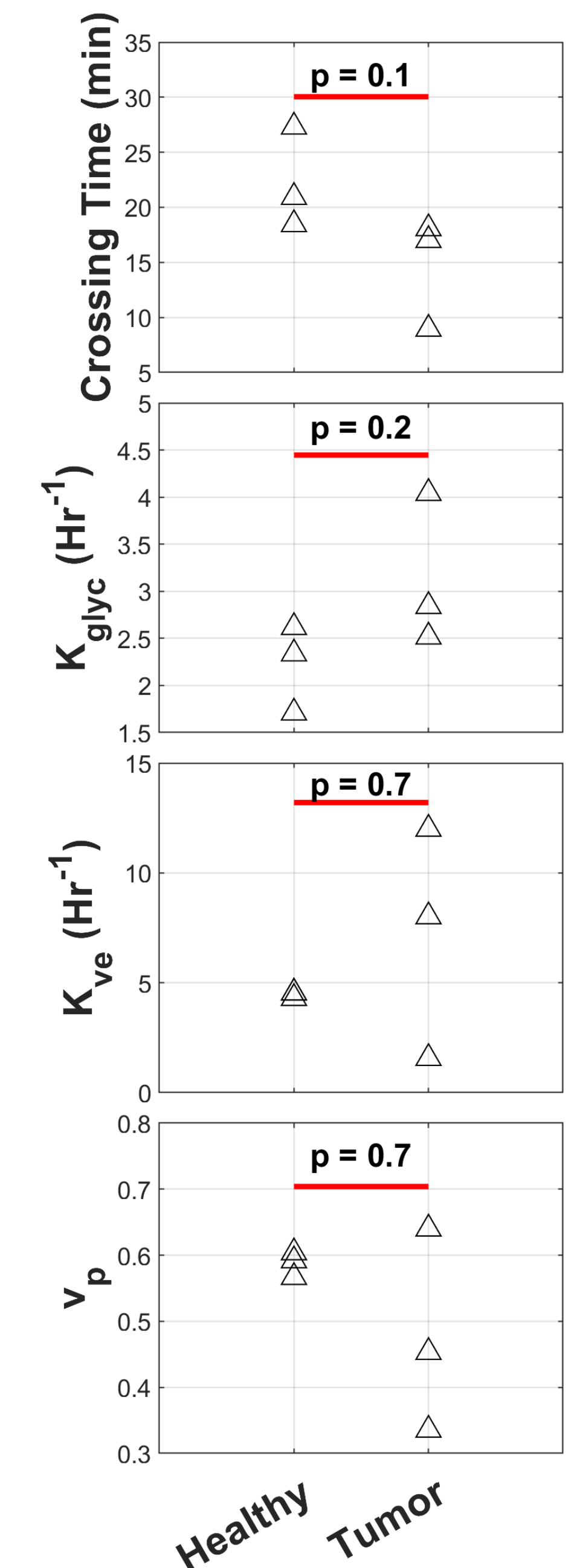
Spectral Overlap

The first analysis of in vivo data demonstrated a large spike artifact in reconstructed HDO concentration immediately following injection of glucose-d7.

- 1) Simulated “ground truth” series of dynamic spectra with a slightly perturbed spectral model.
- 2) Fitting each spectrum independently, then fitting a kinetic model to spectra amplitudes recapitulated the HDO spike.
- 3) Combining spectral and kinetic models and fitting all parameters removed spike artifact and resulted in much less error between assumed and estimated kinetics.



Potential Tumor Indicators



- Differences in mean metabolic speeds
- Not enough data for significance with Wilcoxon Rank Sum

Conclusions

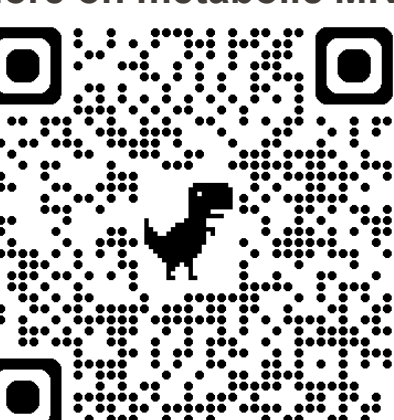
We have established a pipeline for quantifying dynamic spectroscopy from the metabolism of glucose-d7 and proposed several potential metabolic contrasts for spectroscopic imaging.

Further experiments with more animals are required to demonstrate differences in the proposed parameters between healthy models and tumor-bearing models.

References

- 1) Lu et al., *J Cereb Blood Flow Metab.* 2017
- 2) De Feyter et al., *Sci Adv.* 2018
- 3) Chang et al., *Sci Adv.* 2025
- 4) Li et al., *PNAS Nexus.* 2025
- 5) Seidemo et al., *J Cereb Blood Flow Metab.* 2025

More on metabolic MRI



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