GlucoCEST Imaging of the Maternal-Fetal Interface in a Mouse Model at 21.1 T

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Introduction

Glucose-based chemical exchange saturation transfer (GlucoCEST) utilizes unlabeled, endogenous D-glucose as an MRI contrast agent by magnetization transfers between hydroxyl groups and water. Although GlucoCEST has been used previously in tumor applications [1], this study investigates the use of GlucoCEST in maternal-fetal glucose uptake and metabolism at 21.1 T. Glucose phantom data was used to optimize saturation offset for D-glucose and an *in vivo* pregnant mouse model was used to investigate detection within the placenta and fetus.

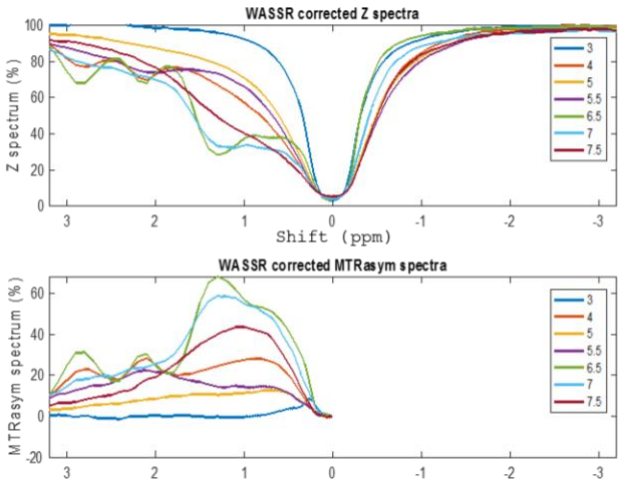

Fig.1 WASSR-corrected Z-spectra and MTR asymmetry plots for pH (3 - 7.5) phantom with 400-mM D-glucose

Experimental

Phantom and Animal Model: GlucoCEST contrast was investigated utilizing phantoms with varying pH (3-7.5). For *in vivo* studies, CD-1 (Envigo Corp) mice were imaged on days 15-17 of gestation under isoflurane. Animals were administered an *in situ* intravenous injection of 2-M, 4-mg D-glucose/g body wt. after baseline scans.

MRI Protocol: All MRI experiments were performed with the 21.1-T ultra-wide bore magnet at the NHMFL. GlucoCEST measurements and WASSR acquisitions were based on single slice, fast spin-echo (FSE) images with 80x80 matrices, FOV=3.2x3.2 cm, TR=2.5-4 s and TE=11.3-23 ms. Acquisition time was ~20 min per complete Z-spectrum. The magnetization transfer ratio (MTR) was calculated according to $MTR(\Delta\omega) = \left|\frac{S(-\Delta\omega)-S(+\Delta\omega)}{S_0}\right|$ with S_0 set to a reference image.

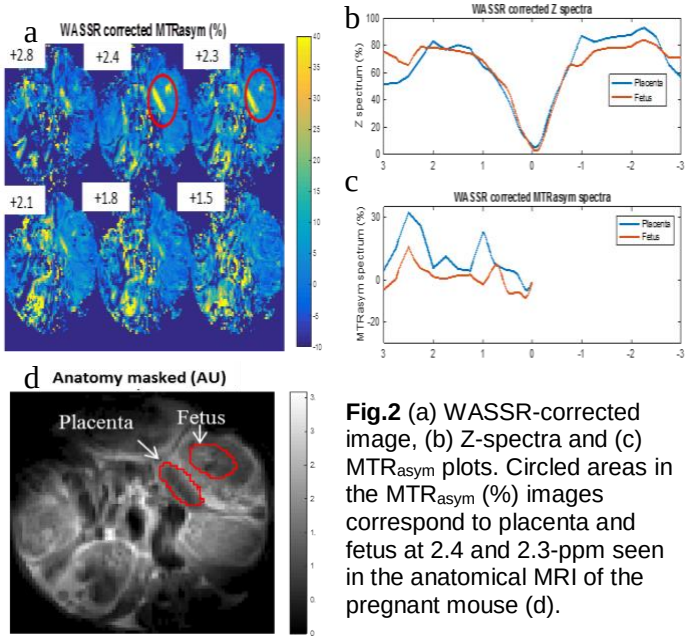

Fig.2 (a) WASSR-corrected image, (b) Z-spectra and (c) MTR_{asym} plots. Circled areas in the MTR_{asym} (%) images correspond to placenta and fetus at 2.4 and 2.3-ppm seen in the anatomical MRI of the pregnant mouse (d).

Results and Discussion

Fig.1 shows WASSR-corrected Z-spectra of glucose phantom with pH titrations and MTR_{asym} plots showing percent contrast. Typical exchangeable offsets for D-glucose are evident at 1.2, 2.2, and 2.8 ppm at pH 6.5 [1] with ~60% contrast at 1.2-ppm for pH 7. **Fig.2** shows GlucoCEST MTR_{asym} plots and images following IV glucose infusion (2-25 min) with corresponding anatomical location in the placenta and fetus. 30% CEST contrast is achieved at 2.4 ppm within the placenta. Data demonstrates the ability to monitor glucose metabolism using WASSR-correction at 21.1 T with increased contrast compared to lower fields [2].

Acknowledgements

This work was performed at the NHMFL, supported by NSF DMR-1157490 and the State of Florida. Support also provided by the NHMFL UCGP (#5093 to SCG), NHMFL VSP and Minerva Project 712277 (to LF), NIH R01-HD086323 (to MN), Kimmel Institute for Magnetic Resonance and Perlman Family Foundation (to LF).

References

[1] Chan, K.W.Y., *et al.*, Magn. Reson. Med., **68**, 1764-73 (2012).

[2] Walker-Samuel, S., *et al*., Nat. Med., **19**, 1067-72 (2013).