

# Preliminary Investigation of Placental [1-<sup>13</sup>C]Pyruvate Metabolism Correlated with Placental Efficiency in Guinea Pigs

178

Lindsay E. Morris<sup>1</sup>, Lanette J. Friesen-Waldner<sup>1</sup>, Timothy RH. Regnault<sup>2,3,4</sup>, Charles A. McKenzie<sup>1,4</sup>

<sup>1</sup>Medical Biophysics Western University, <sup>2</sup>Physiology and Pharmacology Western University, <sup>3</sup>Obstetrics and Gynaecology Western University, London, ON, <sup>4</sup>Division of Maternal, Fetal and Newborn Health, Children's Health Research Institute, London, ON

## Introduction

- Placental efficiency (PE) is often defined as the ratio of fetal volume to placental volume. A low PE indicates poor placental function, or placental insufficiency, and is associated with immediate and long-term adverse effects for the fetus.
- Hyperpolarized <sup>13</sup>C-pyruvate magnetic resonance imaging (MRI) is a metabolic imaging method that enables the visualization of substrates during key reactions in vivo (1).
- This preliminary work aimed to correlate placental [1-<sup>13</sup>C]pyruvate metabolism with PE in a guinea pig model near-term. We hypothesize that inefficient placental function may be associated with altered placental metabolism.

## Methods

- Twenty two pregnant sows underwent an MRI exam (~60 ± 1 days gestation, full term ~ 68 days) that acquired T<sub>1</sub>-weighted (T<sub>1</sub>-w) and hyperpolarized [1-<sup>13</sup>C]pyruvate metabolic images (2, 3). Due to technical issues, only thirteen sows have metabolic images.
- T<sub>1</sub>-w images were manually segmented in 3D Slicer to obtain 41 fetal and placental volumes (litter size: 1-5).
- The mean signal intensities of [1-<sup>13</sup>C]pyruvate and its metabolites (lactate (LAC), alanine (ALA), and bicarbonate (BIC)) were measured in the placental volumes as a function of time.
- The metabolic conversion rates were estimated using the area under the curve (AUC) method (4).
- The PE data were correlated with the metabolic conversion rates using a linear mixed model (LMM) controlled by the maternal sow.

## Conclusion

- We did not observe a significant correlation between PE and the rates of conversion of pyruvate to its metabolites.
- There is not a strong correlation between placental pyruvate placental metabolism and placental efficiency.

## Results

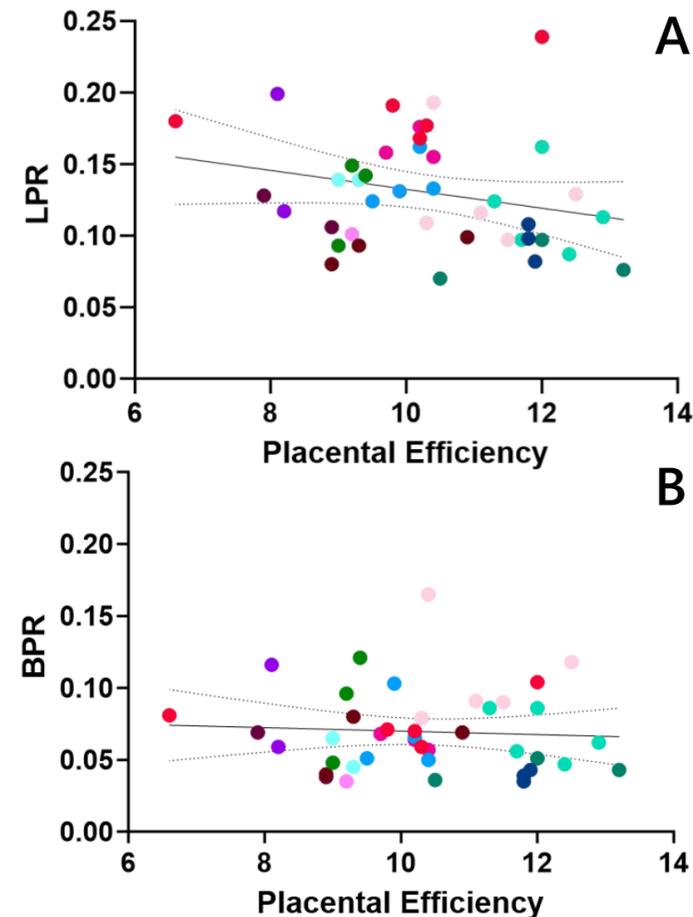


Figure 1: There were no significant ( $p > 0.05$ ) correlations between the PE and AUC ratios for LAC (A) and BIC (B). Circles with the same colour are fetuses from the same maternal sow. The metabolite ALA was not included due to low signal to noise in the placenta.

## References

- [1] Ardenkjaer-Larsen JH, et al. *PNAS USA* 2003
- [2] Friesen-Waldner LJ, et al. *J. Magn. Reson. Imaging* 2016
- [3] Smith LM, et al. *Magn. Reson. Med.* 2020
- [4] Larson PEZ, et al. *NMR Biomed.* 2018

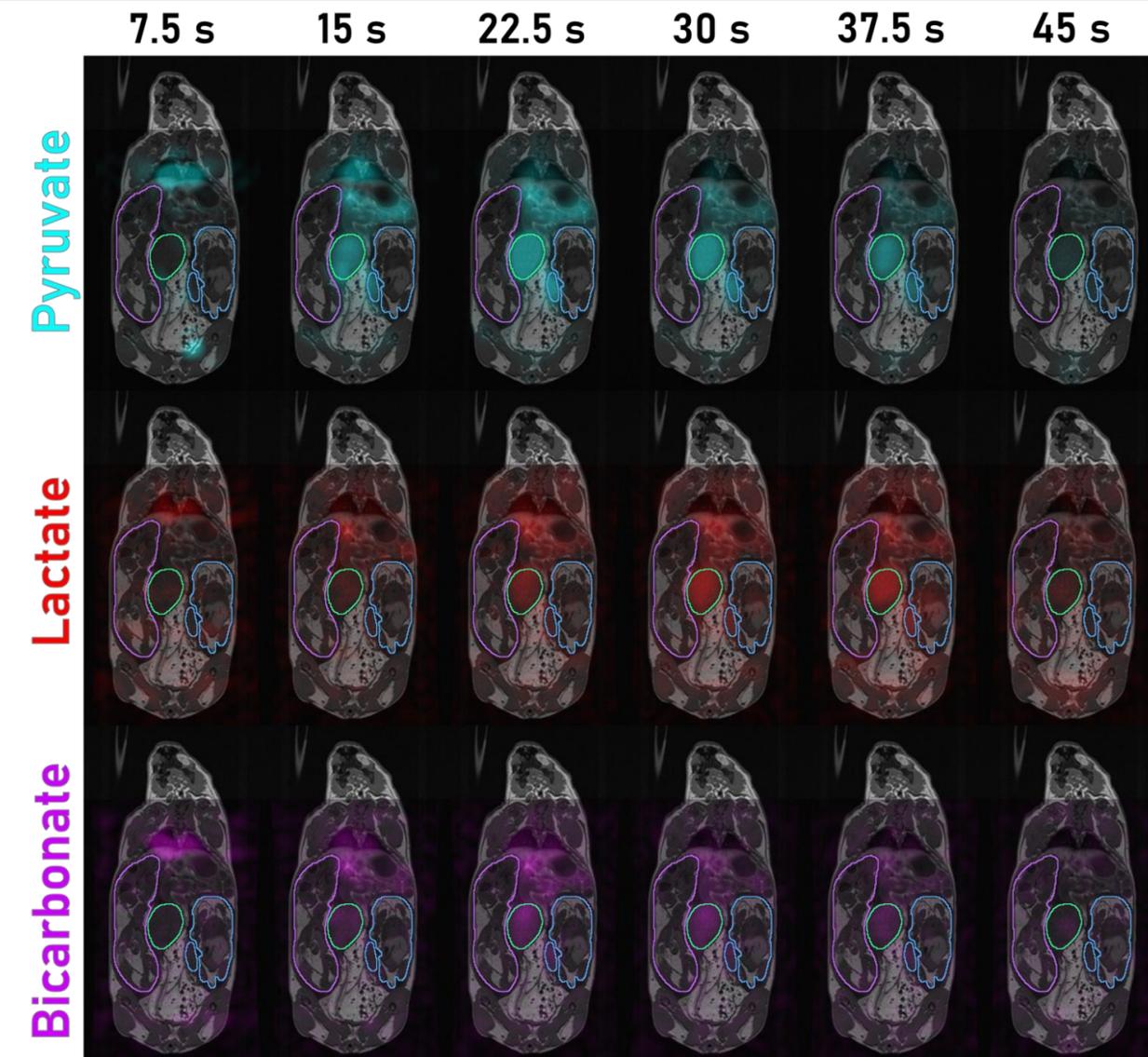


Figure 2: 61 day pregnant sow with three fetuses. T<sub>1</sub>-weighted image with first 6 of 7 timepoints of metabolic images (pyruvate: cyan, lactate: red, bicarbonate: purple) overlaid to observe signal intensity over time. In this image slice, one fetus (far left, contoured in purple), one placenta (middle, contoured in blue), one fetus and matching placenta are visible (far right, contoured in pink). The pyruvate images and the metabolite images are windowed and leveled identically.