

Oxygen Extraction Fraction using Quantitative BOLD and Cerebral Blood Flow during Vasodilation

ISMRM-ESMRMB & ISMRT 31st Annual Meeting

ABSTRACT 4095

10 May 2022

Linh N. N. Le¹, Gregory J. Wheeler¹, Alique M. Momjian¹, Corinne A. Donnay², Nicholas P. Blockley³, Audrey P. Fan^{1,2}

¹Department of Biomedical Engineering, University of California, Davis, CA, United States

²Department of Neurology, University of California, Davis, CA, United States

³University of Nottingham, England, United Kingdom



Declaration of Financial Interests or Relationships

Speaker Name: Linh Le

I have no financial interests or relationships to disclose with regard to the subject matter of this presentation.

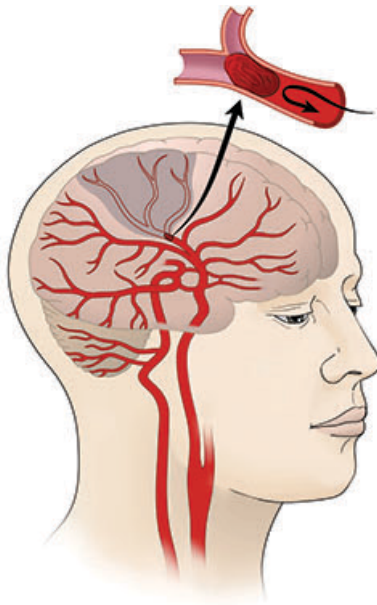


Oxygen Extraction Fraction

The brain uses ~20% of available oxygen for normal function

OEF: measurement of oxygen consumed by metabolism

- Altered during disease and activities



CBF = *Cerebral Blood Flow*

OEF = *Oxygen Extraction Fraction*

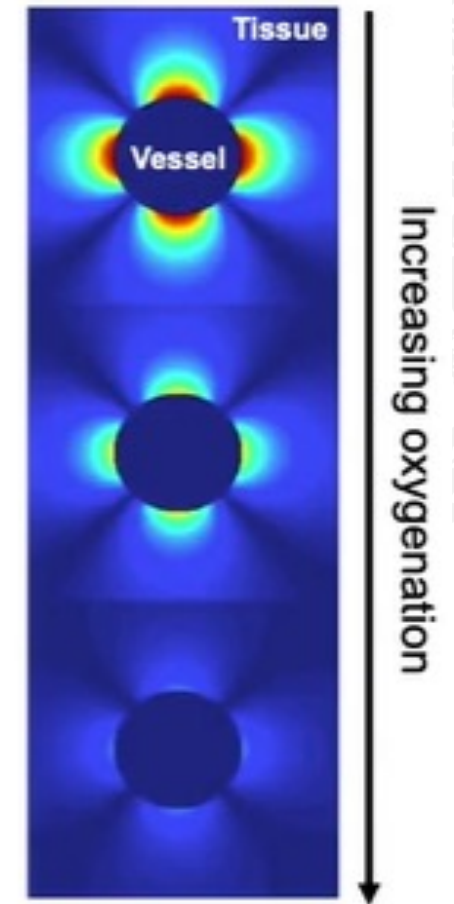
Introduction

Quantitative BOLD (qBOLD)

- Non-invasive
- $R2'$ weighted measurements
- Asymmetric spin echo pulse sequence (ASE)

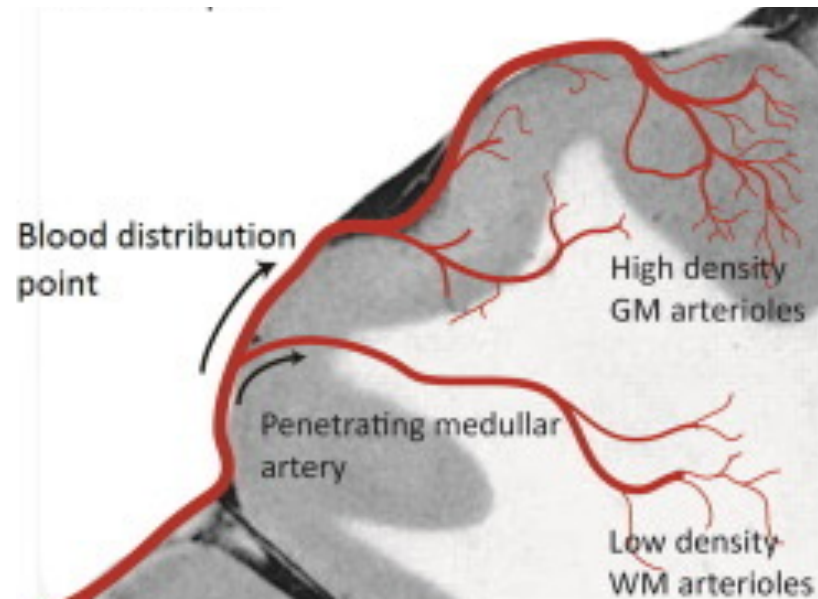
→ Tissue hemodynamic parameters

- Deoxygenated blood volume (DBV)
- Oxygen extraction Fraction (OEF)



Objective

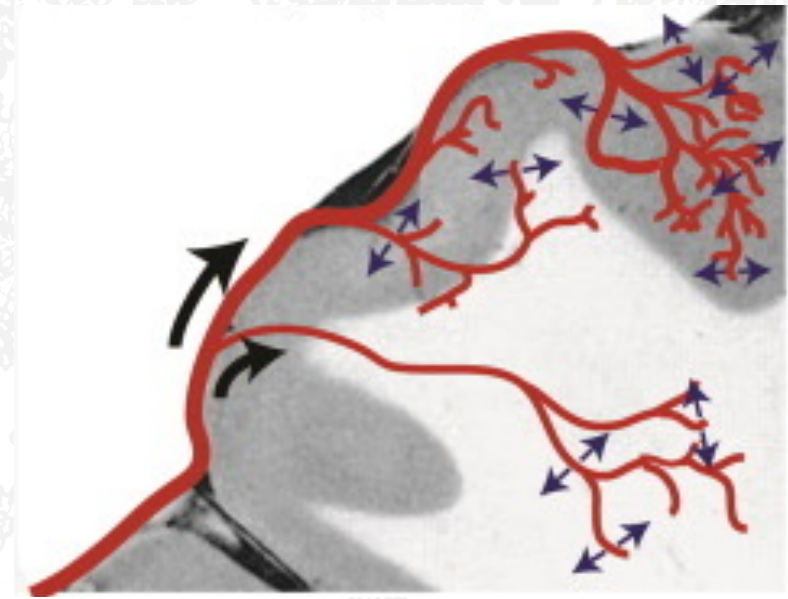
PRE ACZ: OEF, CBF



Vasodilation



POST ACZ: OEF, CBF

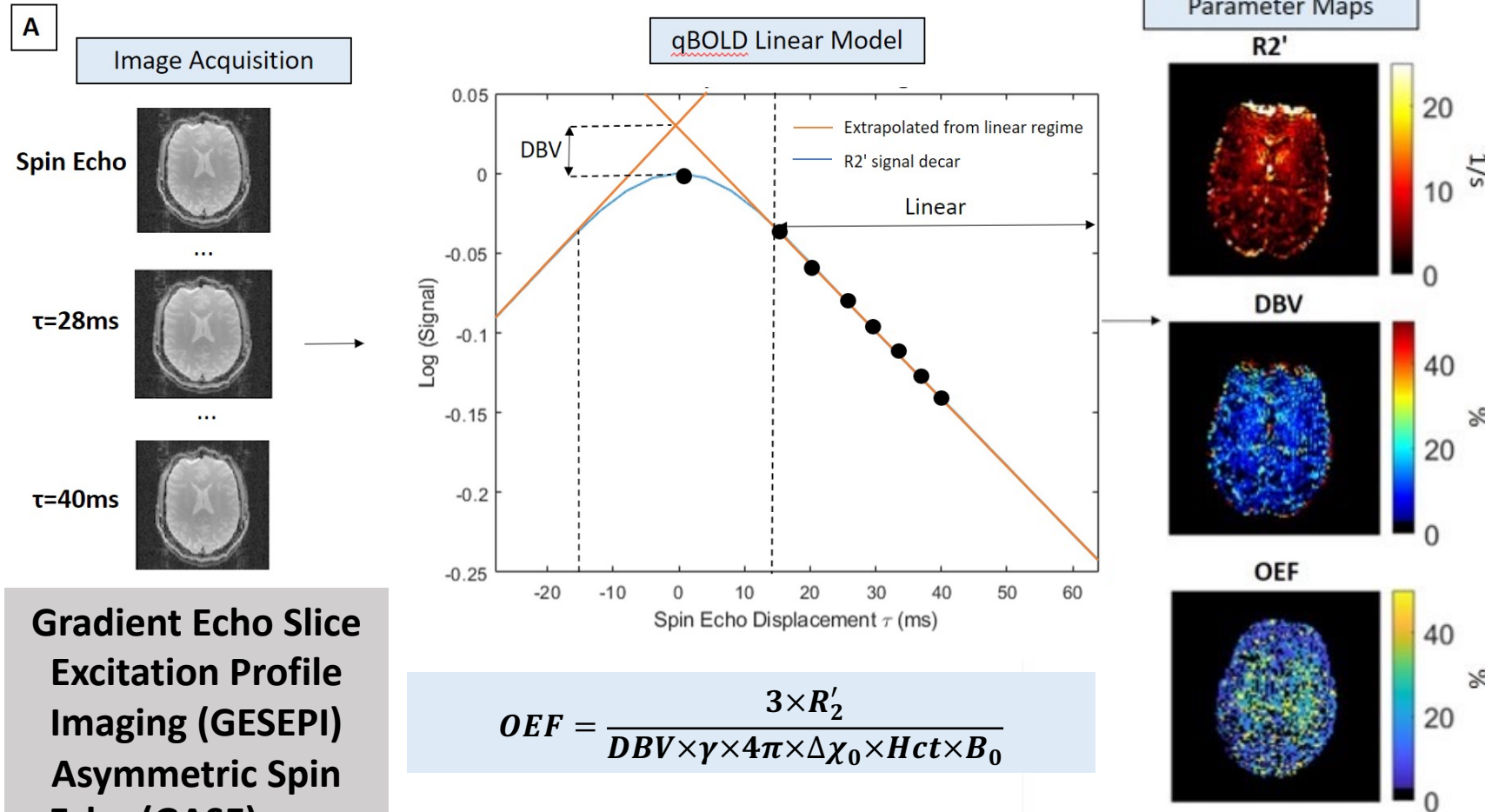


ACZ = Acetazolamide
(dose of 15mg/kg)

Hypothesis

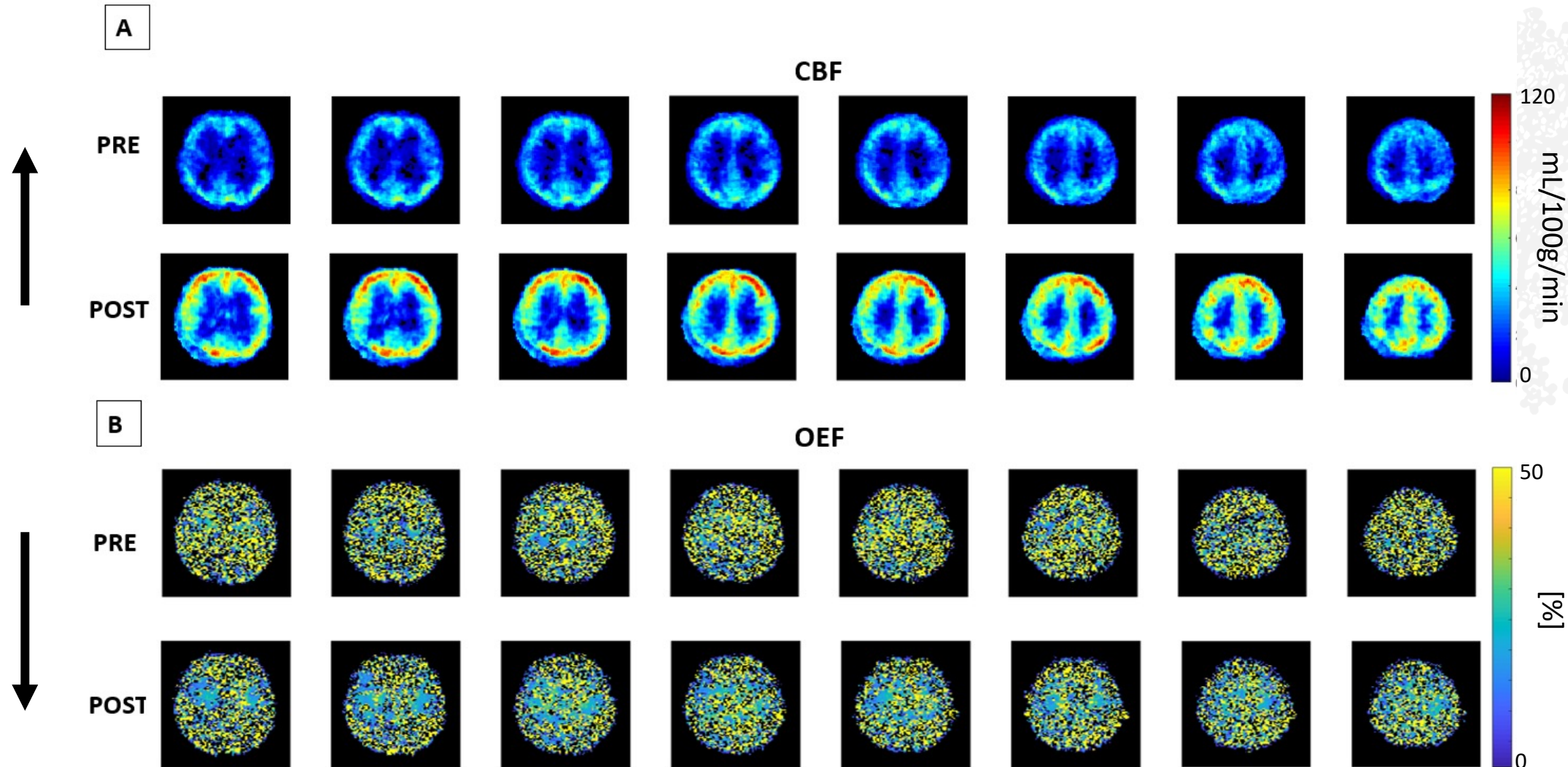
↑ in CBF in brain tissue → ↓ in OEF

Schematic of qBOLD linear model explaining the transverse MR signal decay in microvessels

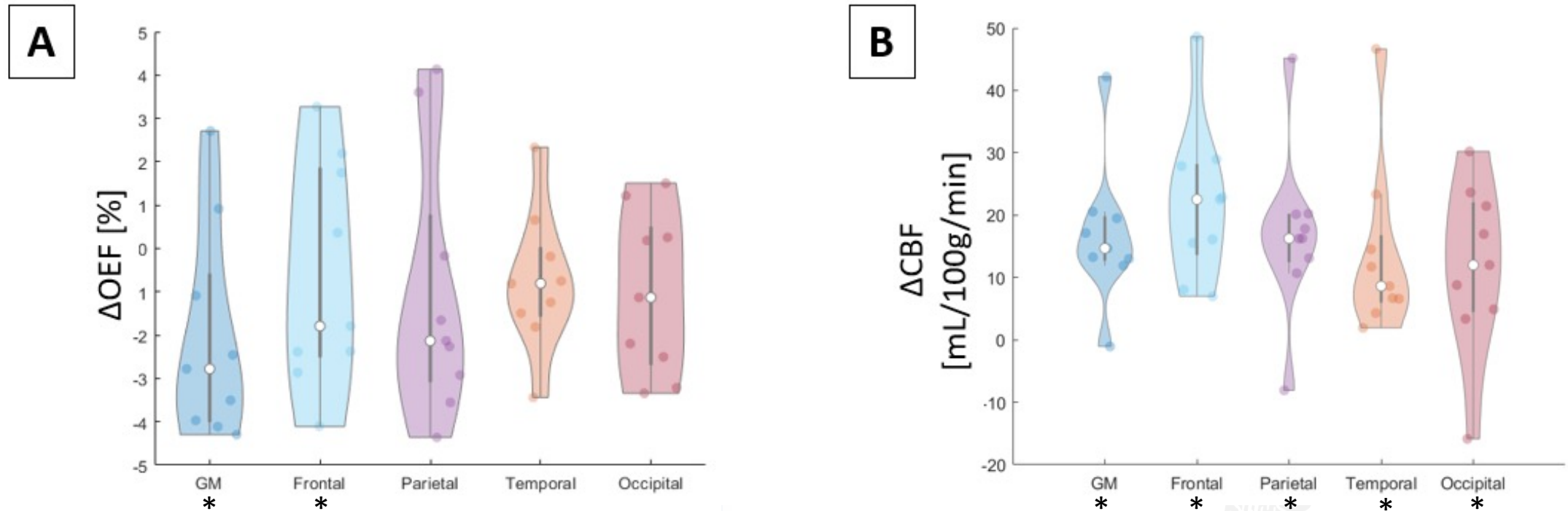


- 9 healthy subjects
 - (47±13 years, 7 female)
- 3T scanner (MAGNETOM Skyra, Siemens Healthineers, Erlangen, Germany)
 - 32-channel head coil
- CBF: multi-delay arterial spin labeling ASL
- T1-weighted: define ROIs

Cerebral blood flow (CBF) maps and oxygen extraction fraction (OEF) across all subjects



Change in OEF and CBF in response to acetazolamide for each region

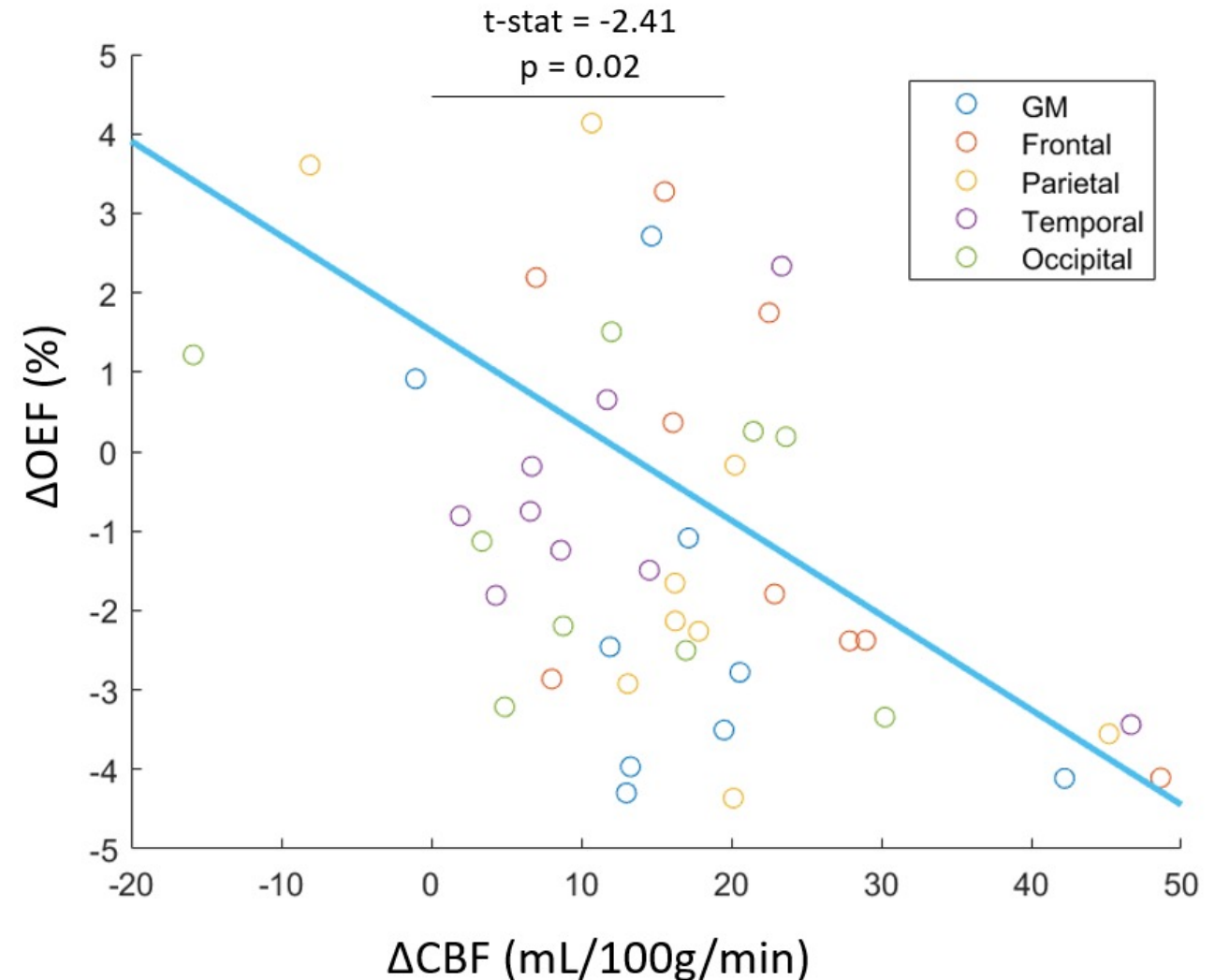


- Pairwise t-test between pre and post vasodilation with Bonferroni correction
 - * $p < 0.01$ after correction

Correlation between ΔOEF and ΔCBF

- Linear mixed-effect model
- Across all ROIs and subjects

ΔOEF was *inversely correlated* with ΔCBF during vasodilation



Conclusion

Quantitative BOLD technique effectively evaluates the tissue hemodynamic parameters (e.g. OEF), and its response to a vasodilation challenge in a reliable manner with induced tissue perfusion changes

Acknowledgement



Professor Nick P. Blockley



Professor Audrey P. Fan



This study was supported by NIH R00-NS102884

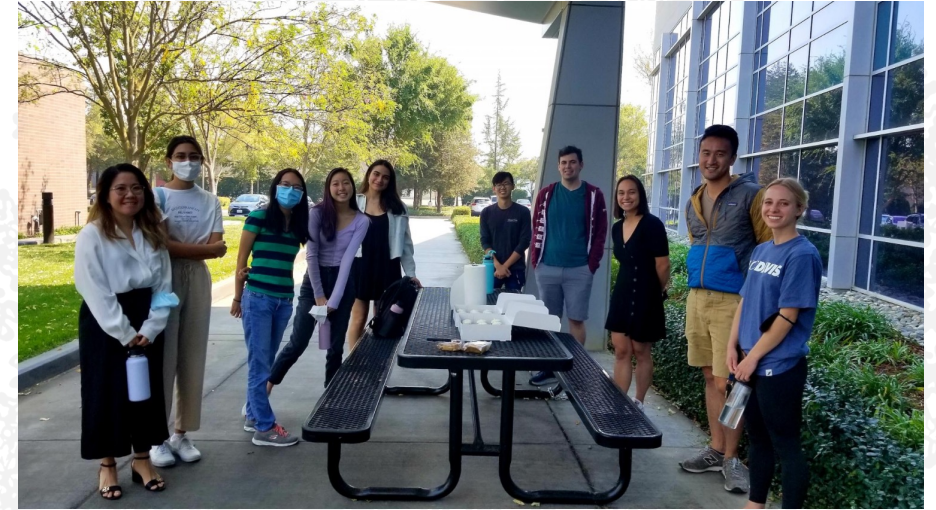
Special thanks to

UC Davis FAN Lab

Corinne Alison Donnay (UC Davis)

Emily Holy (UC Davis)

Gregory Wheeler (UC Davis)



FAN Lab

