Water Statics and Dynamics in Tissue

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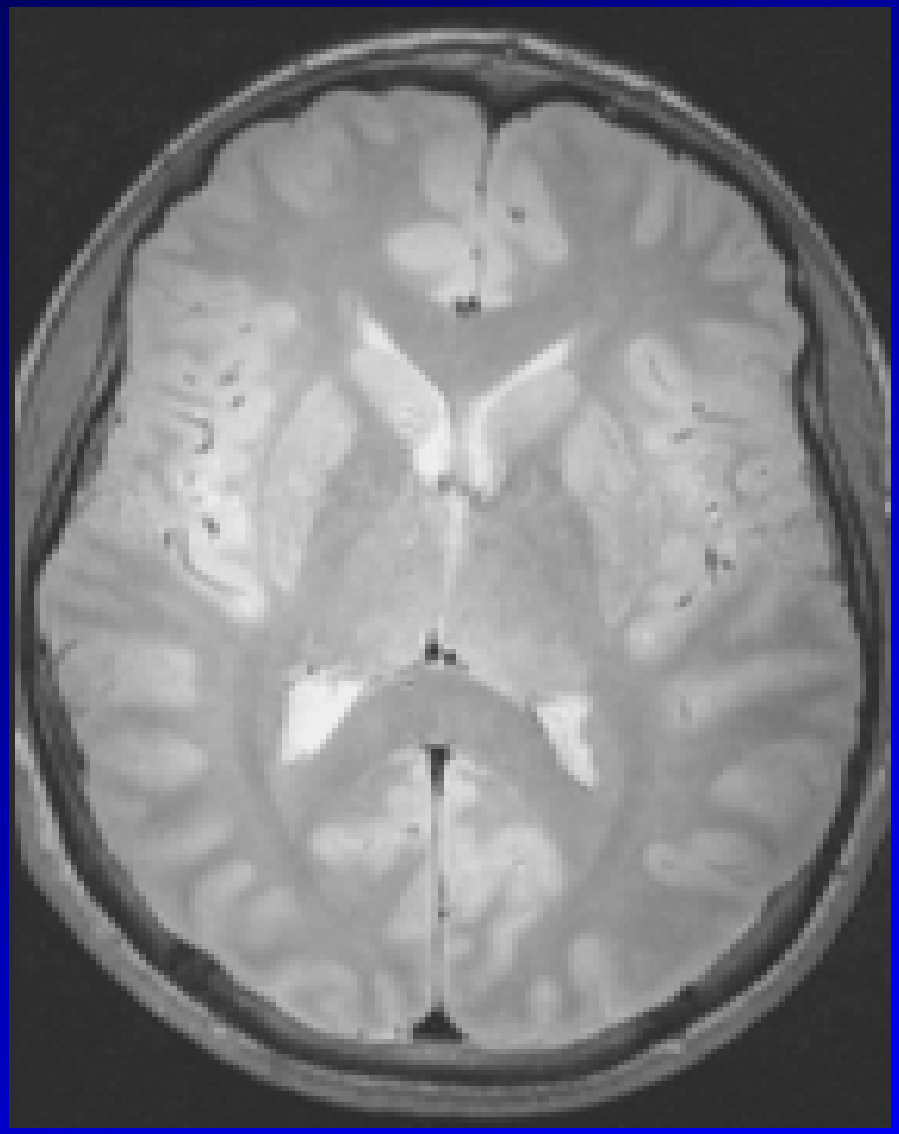
MR $^{1}H_2O$ Measurements /4T

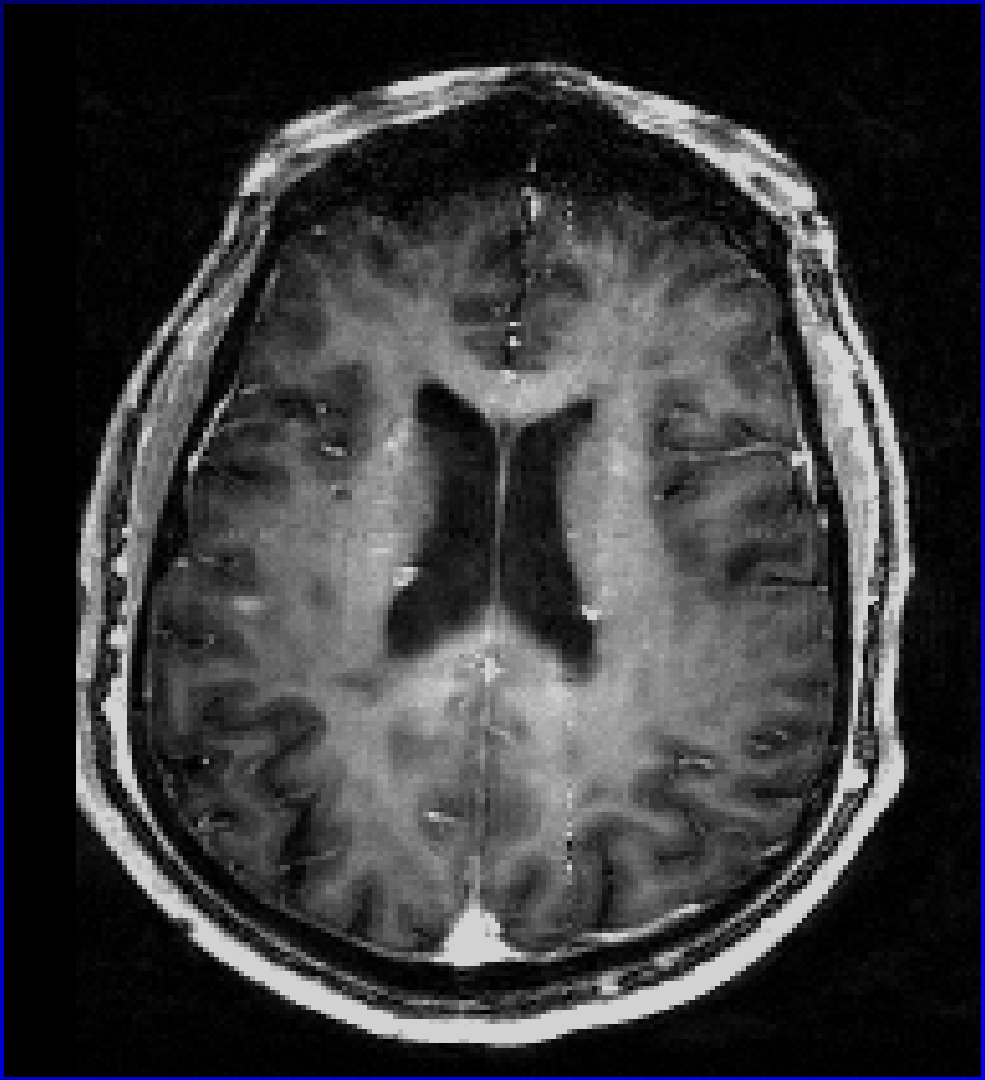


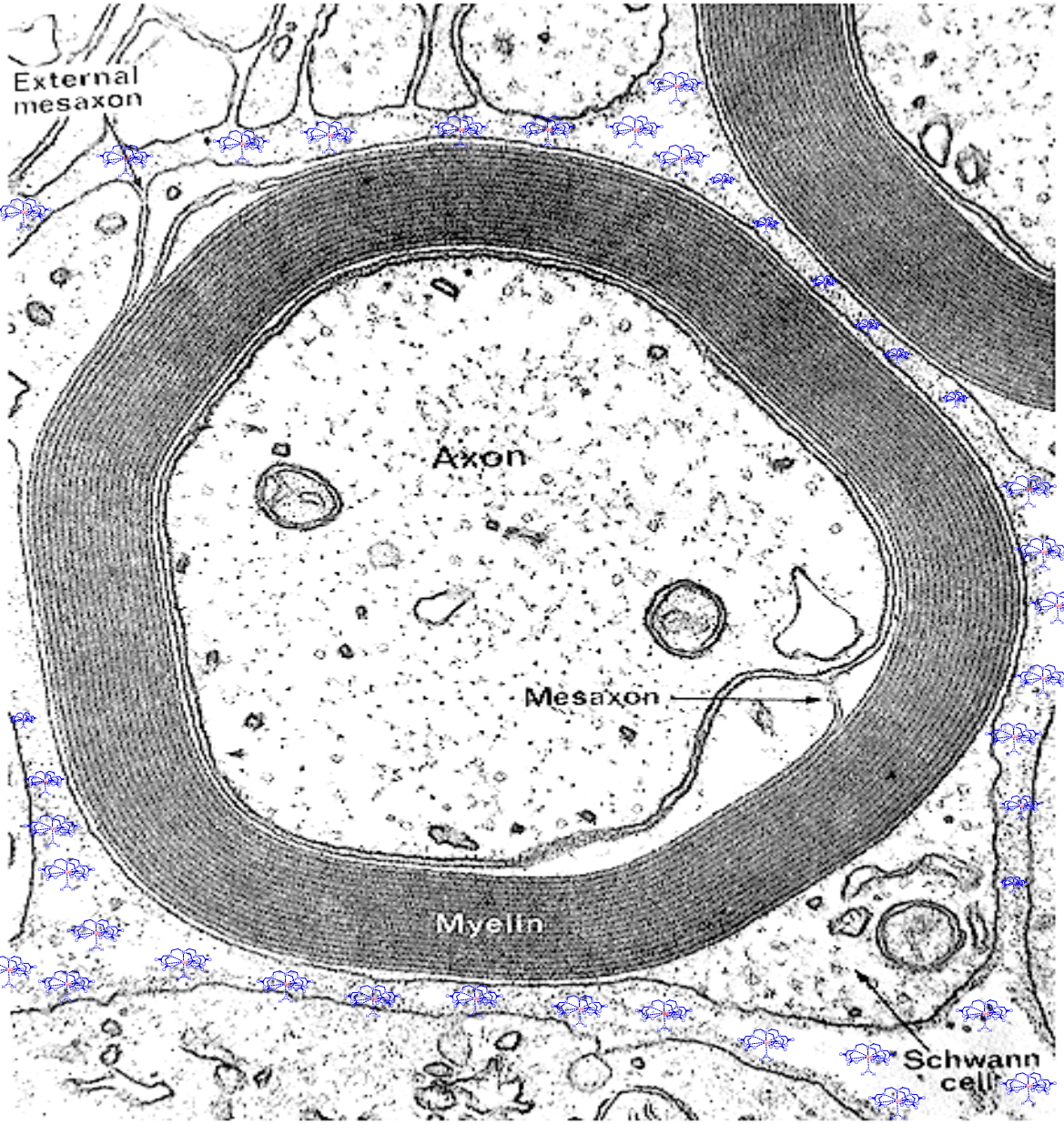
Intensity related to water concentration

But no information on how that water is distributed

For example, what fraction is intracellular? Vascular?

T_1-weighted (MDEFT) Post-CR



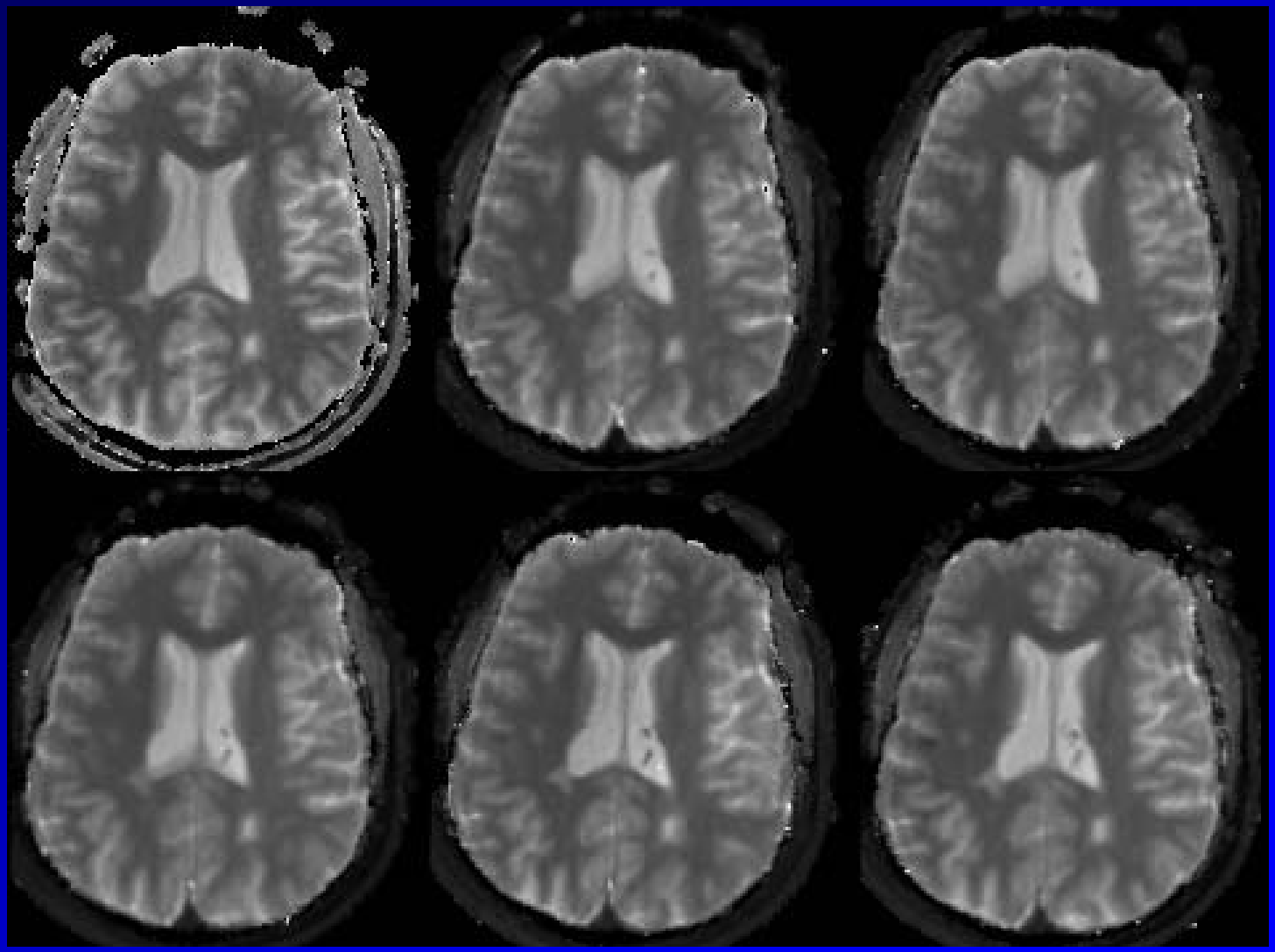

External
mesaxon
Axon
Mesaxon
Myelin
Schwann
cell

Methods

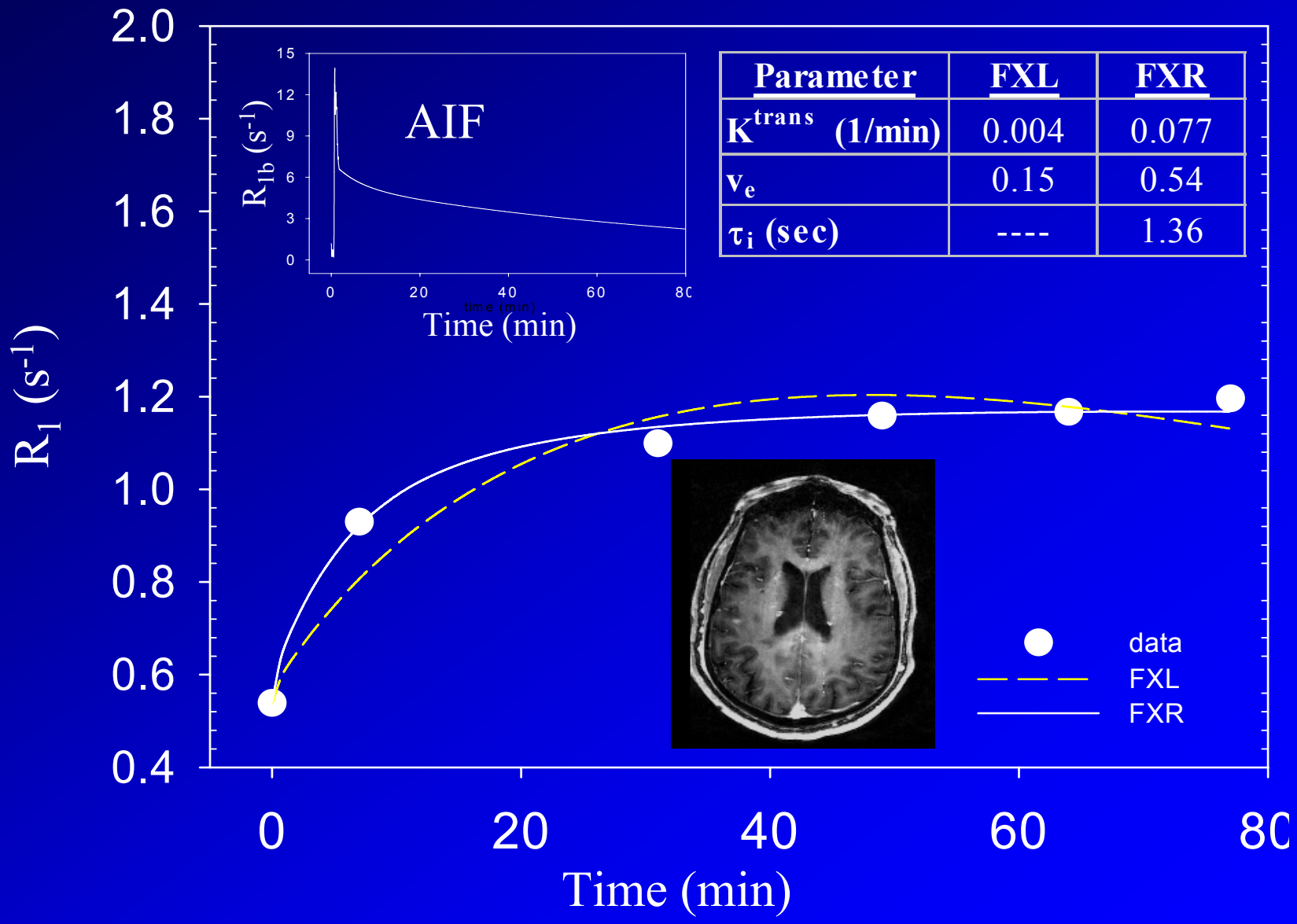
- 4 T Varian/Siemens instrument
- Multi-echo GRE used for T_2* measurement
  - 16 echoes (1.5 ms - 32 ms); 2.5 s temporal resolution
  - 10 mm slice; 3 mm in-plane resolution
- T_1 w/TAPIR (Zaitsev, Steinhoff, Shah. MRM 2003)
  - 16 inversion times, 26 slices, 3 mm thick, 1 mm in-plane resolution, 6 measurements: 1 pre-CR, 5 post-CR
- 0.3 mmol/kg gadoteridol (injected at ≥ 2.5 mL/s)

- BOLERO Pharmacokinetic modeling

T_1 Maps Pre- & Post CR

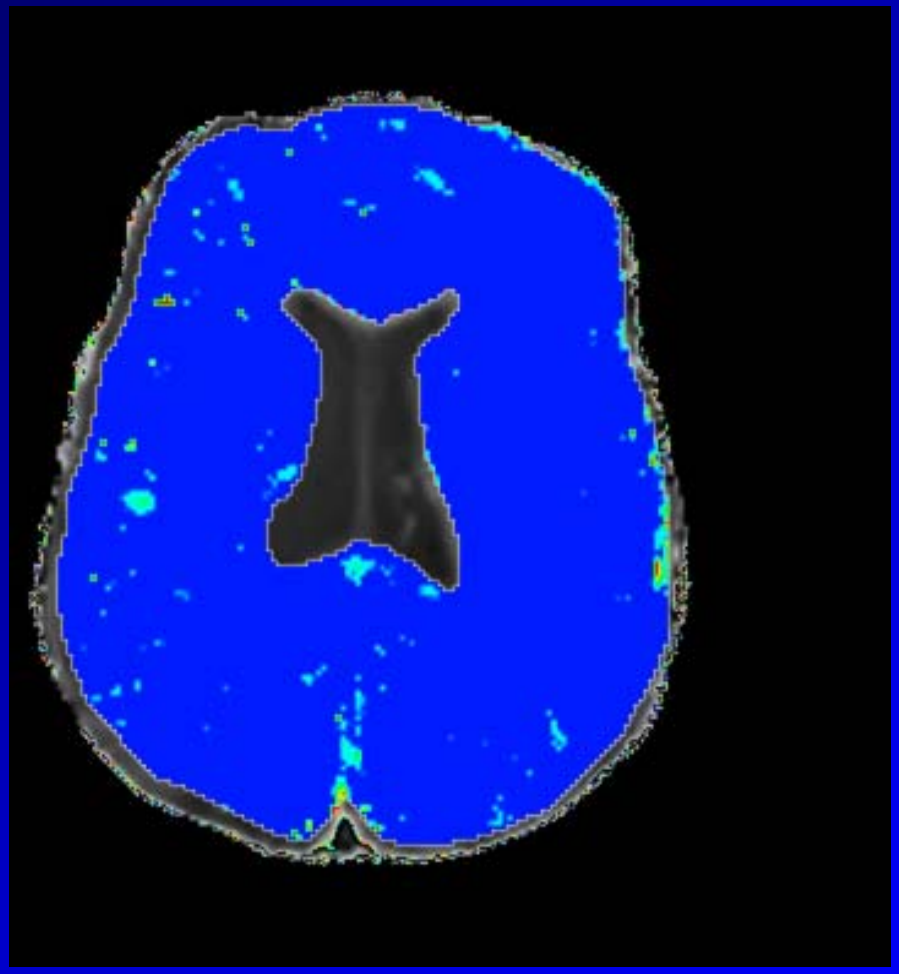


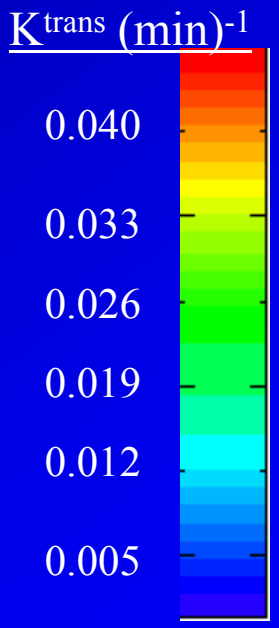
MS Lesion ROI Data



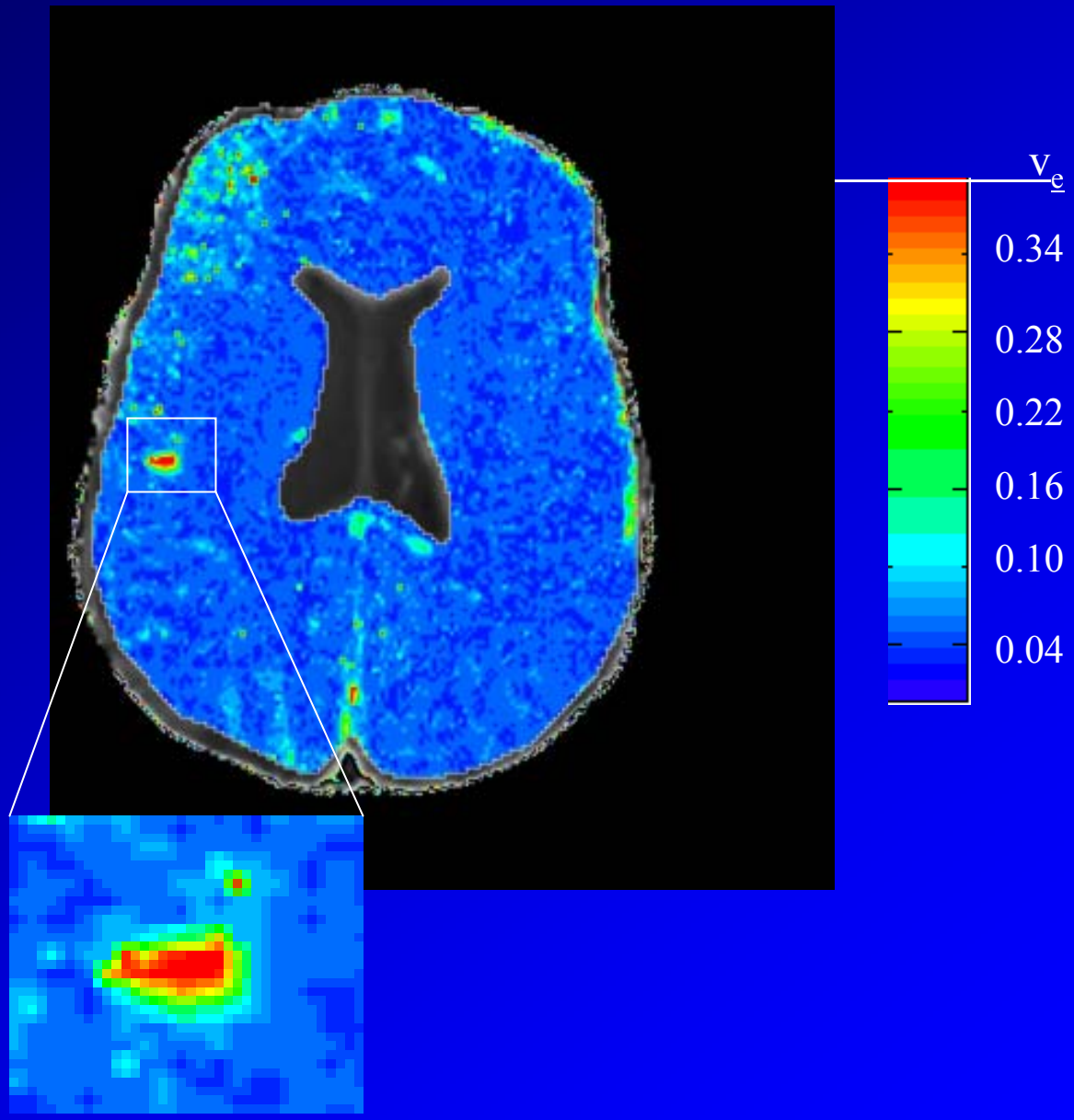
Parameter	FXL	FXR
K^{trans} (1/min)	0.004	0.077
v_e	0.15	0.54
τ_i (sec)	----	1.36

Plasma-tissue Transfer Constant (K^{trans})

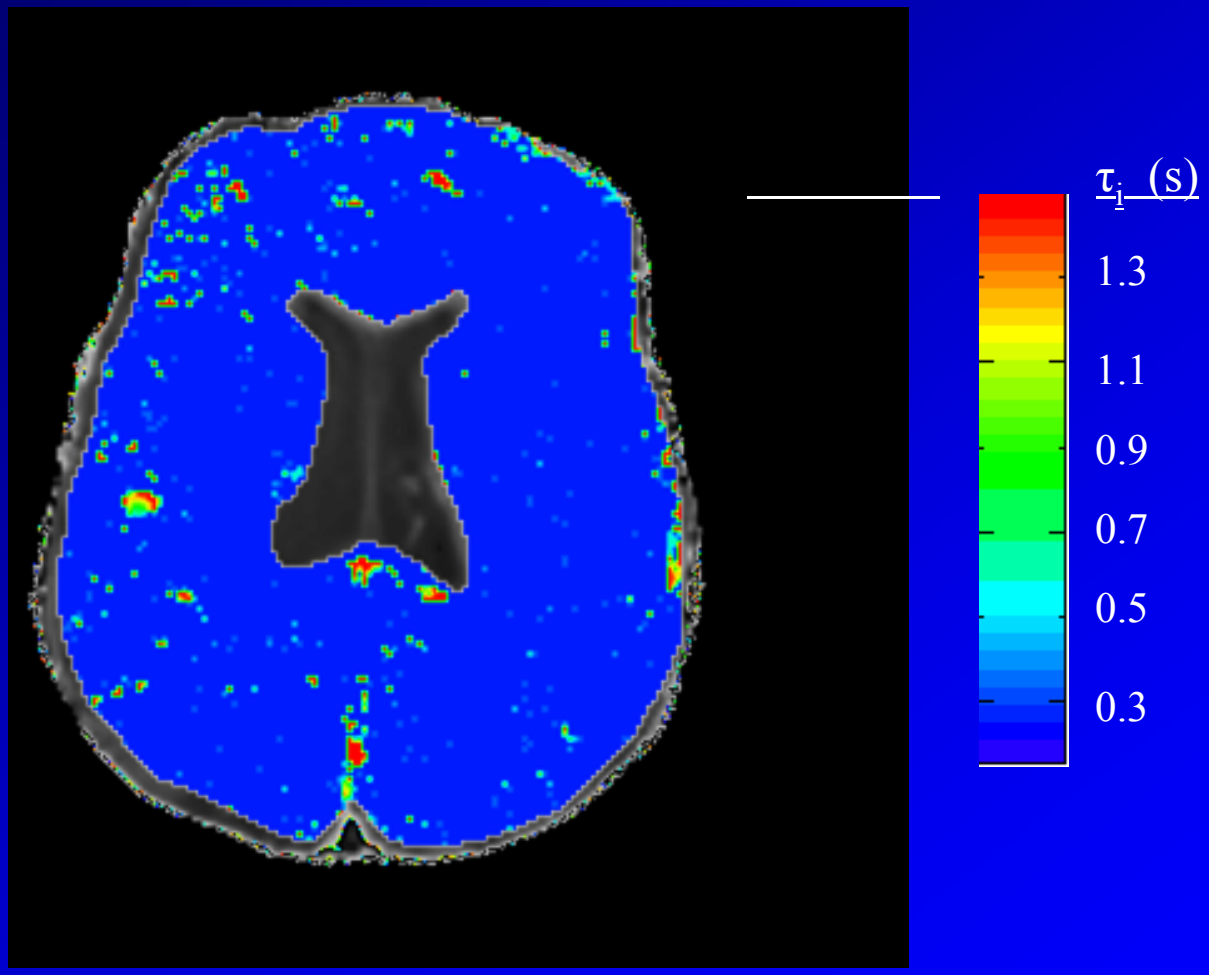




Extracellular Volume Fraction (v_e)



Intracellular Water Lifetime (τ_i)



Summary

- Applications: Lesion/tissue characterization
  - tumor staging, edema classification & quantification
- Limitations
  - Mixed measure of blood flow and extraction fraction
  - Model stability, completeness
- Future directions
  - Additional data collection to improve modeling

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