



# **Dynamic Contrast-Enhanced MRI for Assessment of BBB:** *Challenges and New Opportunities*

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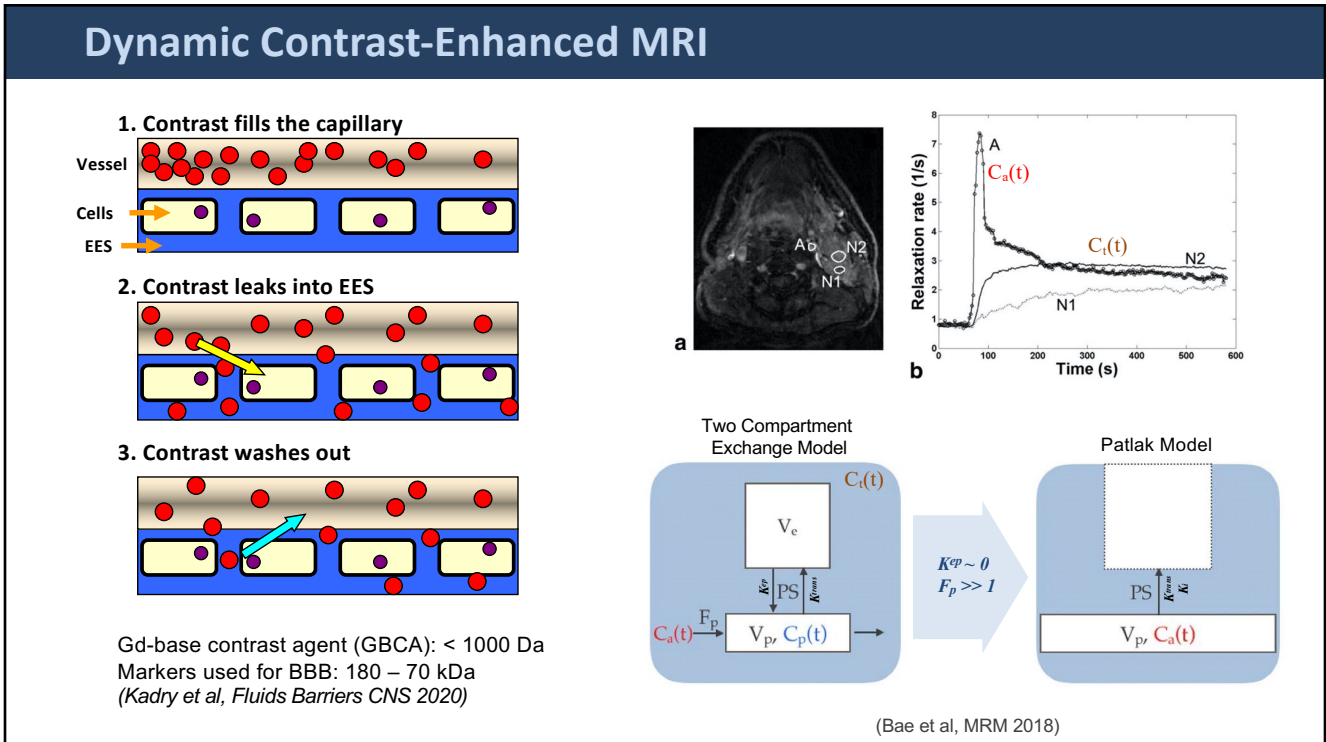
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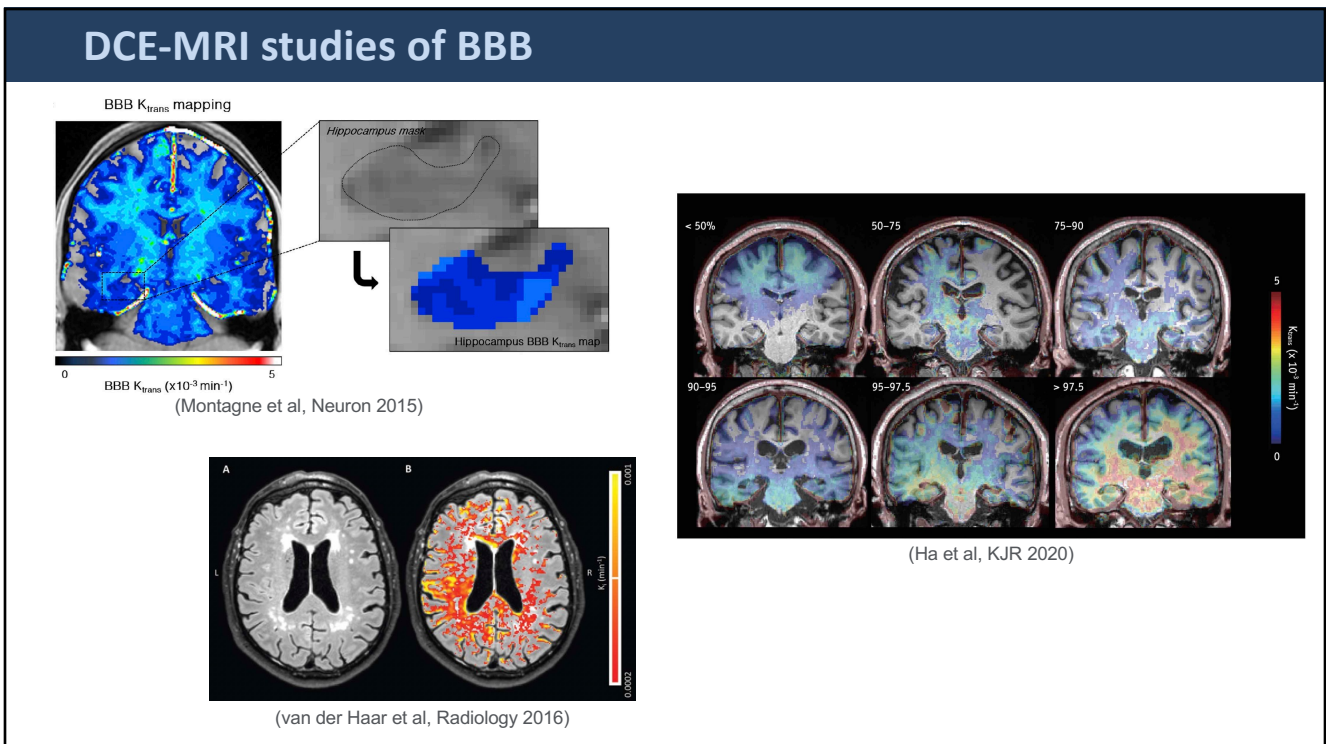
## **Contents:**

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2. Arterial Input Function
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## $K^{trans}$ (Volume transfer constant) in controls

Groups	Study	Controls $K^{trans}$ ( $\times 10^{-3} \text{ min}^{-1}$ )	
		WM	GM
Backes	(van de Haar et al., 2017)	0.070 $\pm$ 0.06	0.008 $\pm$ 0.076(CGM)
	(Zhang et al., 2017)	1.05 $\pm$ 0.05	1.49 $\pm$ 0.07(CGM), 1.11 $\pm$ 0.06(DGM)
	(van de Haar et al., 2016a)	0.070 $\pm$ 0.06	0.017 $\pm$ 0.08
	(van de Haar et al., 2016b)		0.18 $\pm$ 0.13
Zlokovic	(Barnes et al., 2016)	2.25 $\pm$ 0.25	3 $\pm$ 1
	(Montagne et al., 2015)	2.19 $\pm$ 0.18	0.81 $\pm$ 0.17(Thalamus)
Rosenberg	(Taheri et al., 2011a)	1.5 $\pm$ 0.5	
	(Taheri et al., 2011b)	1.8 $\pm$ 0.15	

WM, White Matter; GM, Gray Matter; CGM, Cortical Gray Matter; DGM, Deep Gray Matter

Raja et al, Neuropharmacology 2018; 134(Pt B):259-271

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## $K^{trans}$ (Volume transfer constant) in patients

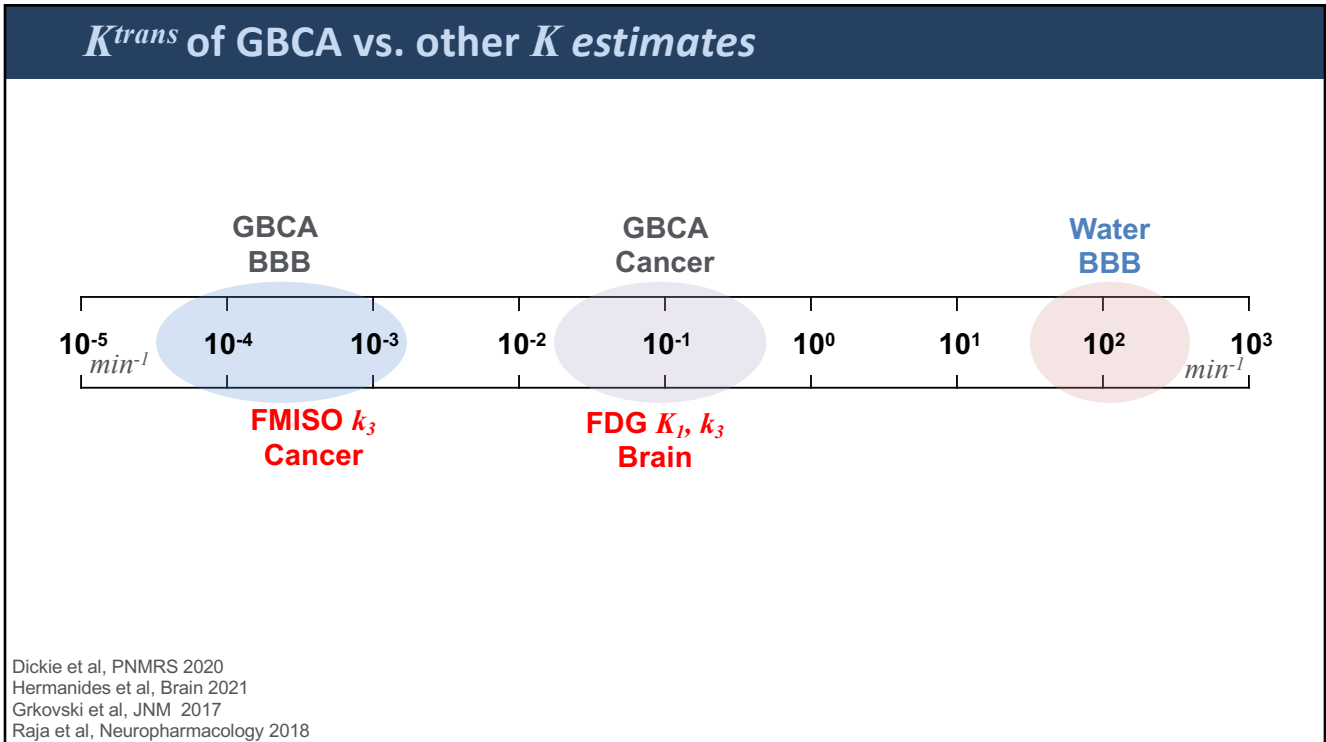
Groups	Study	Disease	Patients $K^{trans}$ ( $\times 10^{-3} \text{ min}^{-1}$ )			WMH
			NAWM	WM	GM	
Backes	(van de Haar et al., 2017)	early AD	0.075 $\pm$ 0.046		0.104 $\pm$ 0.124	
	(Zhang et al., 2017)	cSVD	0.97 $\pm$ 0.04		1.43 $\pm$ 0.05(CGM) 1.06 $\pm$ 0.04(DGM)	0.85 $\pm$ 0.03
	(van de Haar et al., 2016a)	early AD	0.065 $\pm$ 0.043	0.066 $\pm$ 0.04	0.089 $\pm$ 0.11	0.106 $\pm$ 0.11
	(Wong et al., 2017)	cSVD		1.3 $\pm$ 0.5	2.2 $\pm$ 0.7	
	(van de Haar et al., 2016b)	early AD			0.27 $\pm$ 0.14	
Wardlaw	(Munoz Maniega et al., 2017)	Mild stroke	0.224 $\pm$ 0.37			0.350 $\pm$ 0.48
	(Heye et al., 2016)	Mild stroke	0.296 $\pm$ 0.01		0.391 $\pm$ 0.012 (DGM)	0.396 $\pm$ 0.013
Zlokovic	(Montagne et al., 2015)	MCI		2.30 $\pm$ 0.36	0.89 $\pm$ 0.24*	
		MS		2.53 $\pm$ 0.27	0.80 $\pm$ 0.16*	
Rosenberg	(Taheri et al., 2011a)	SIVD				3 $\pm$ 2
		MI/LAC				2.5 $\pm$ 1
	(Taheri et al., 2011b)	VCI		2.4 $\pm$ 0.5		
		MS		2.3 $\pm$ 0.5		

\*, denotes thalamus regions

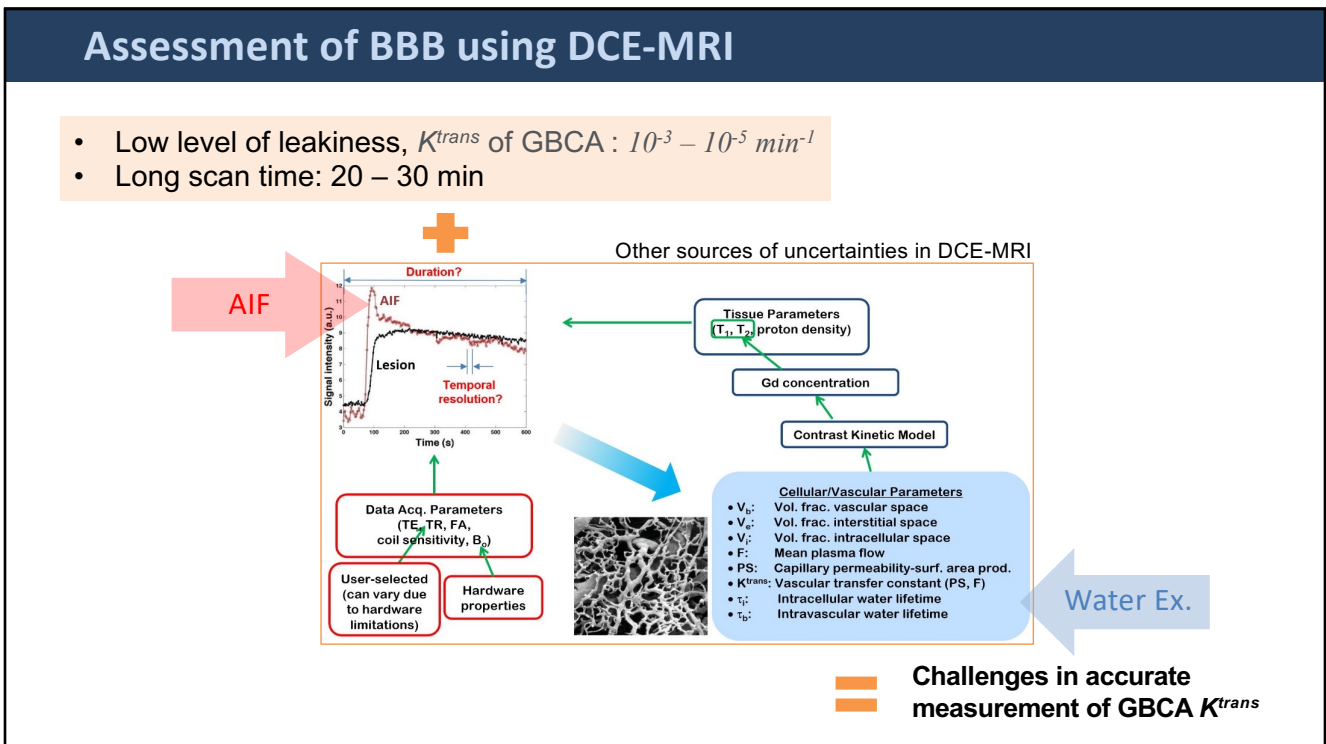
cSVD, Cerebral Small Vessel Disease; AD, Alzheimer's Disease; VCI, Vascular Cognitive Impairment; MCI, Mild Cognitive Impairment; MS, Multiple Sclerosis; WMH, White Matter Hyperintensities; WM, White Matter; GM, Gray Matter; NAWM, Normal Appearing White Matter; SIVD, Subcortical Ischemic Vascular Disease; MI/LAC, Multiple and Lacunar infarcts

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## Patlak Model in DCE-MRI of BBB

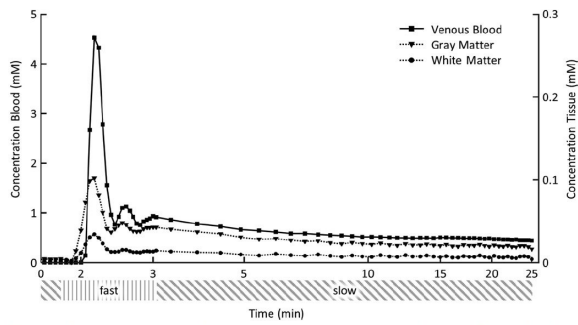
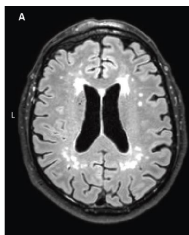
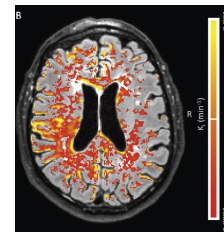
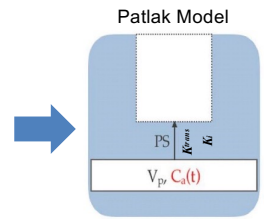
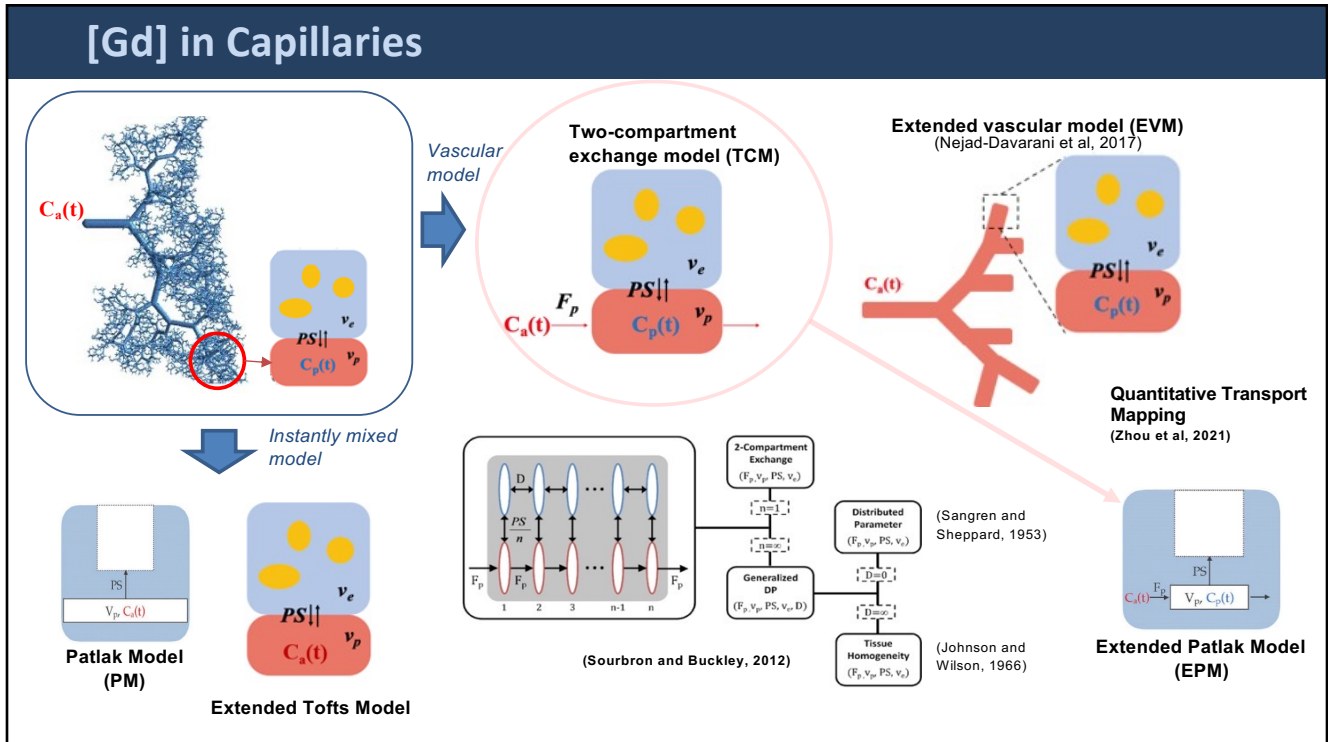


Figure 1: Graph shows example curves of contrast agent concentration in venous blood used as vascular input function and entire normal-appearing WM and the total gray matter (GM) (deep and cortex) of a single subject (75-year-old man). Time axis is on logarithmic scale to emphasize rapid changes during contrast agent arrival and initial recirculation (moment of injection  $\pm$  1 minute and 45 seconds). Below time axis is a bar depicting when fast and slow temporal resolution parts of the sequence were performed.

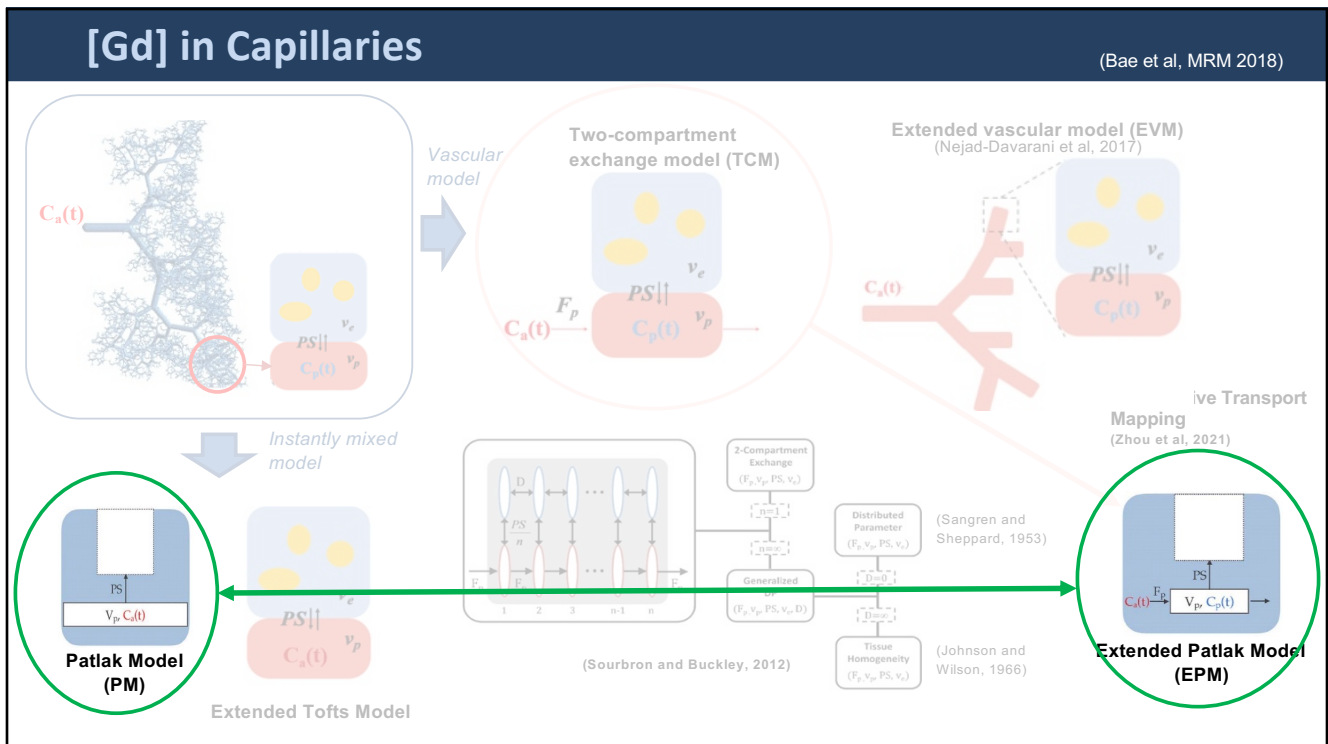


van der Haar et al, Radiology 2016; 281(2):527-535

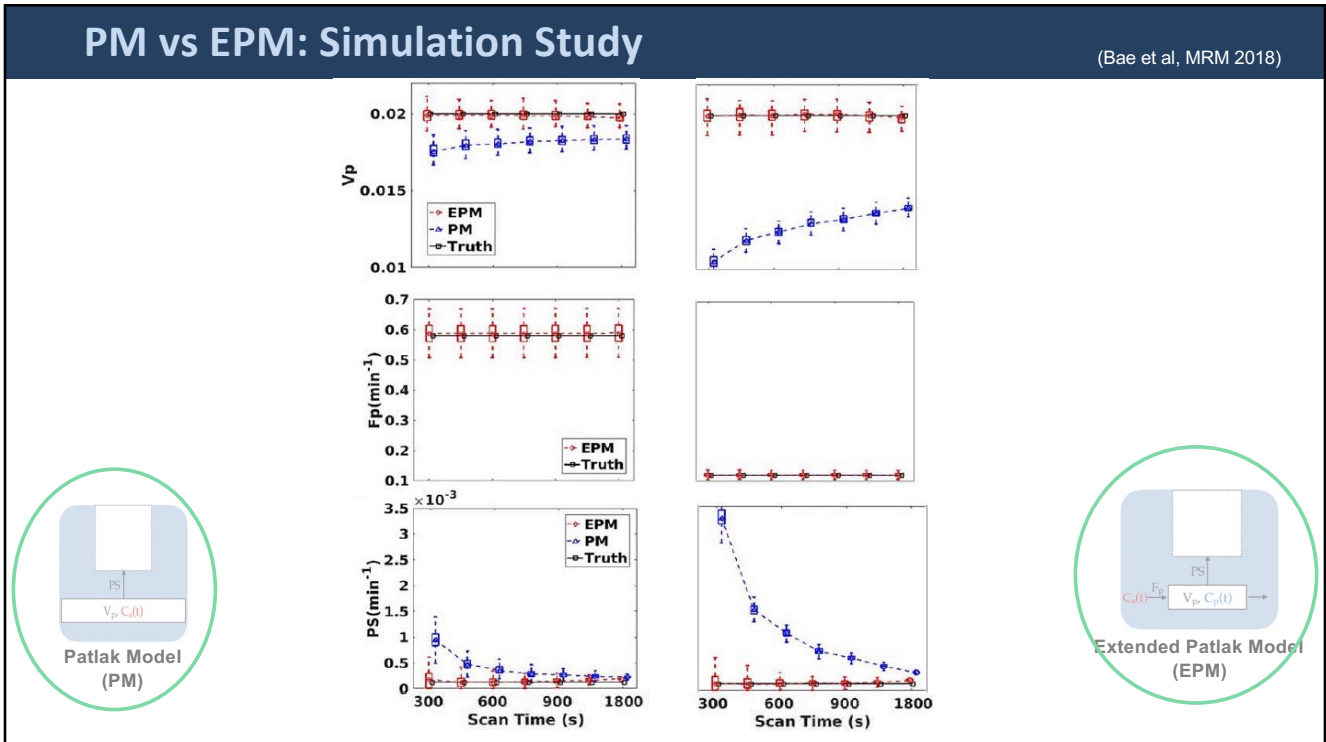
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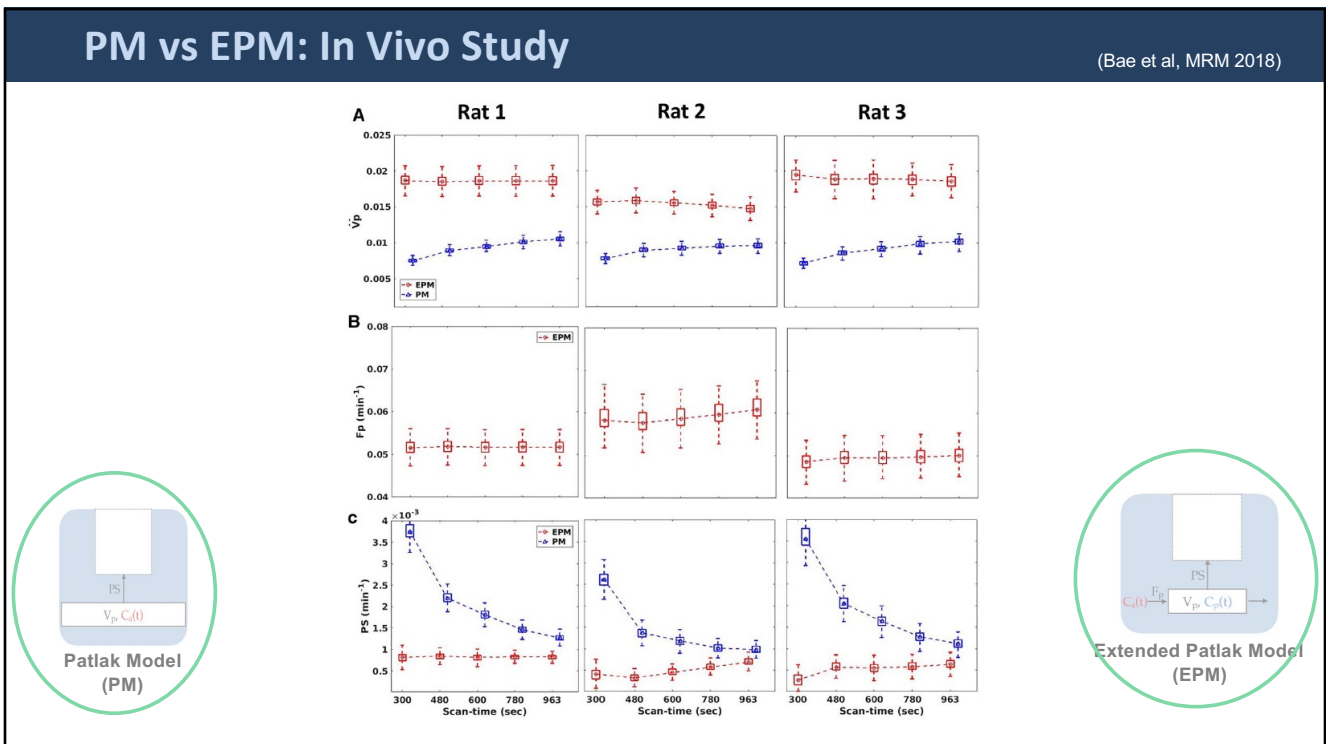
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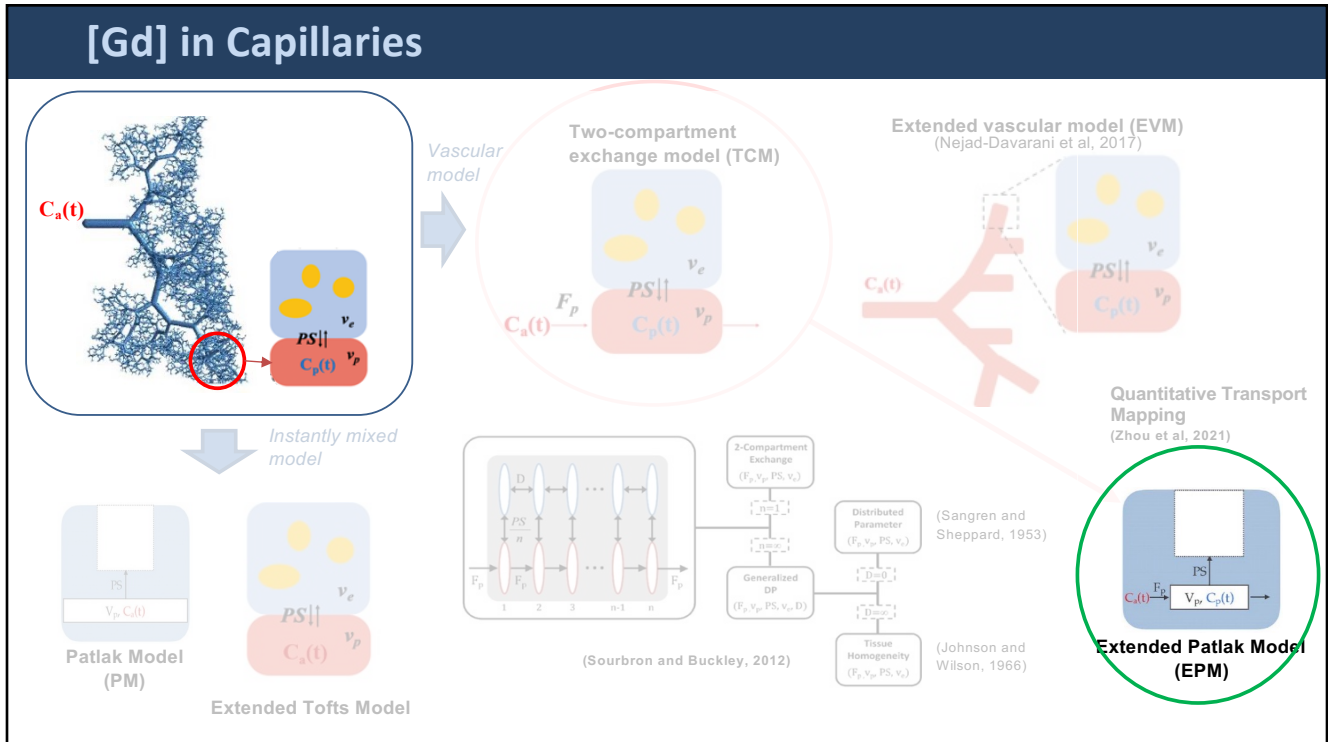
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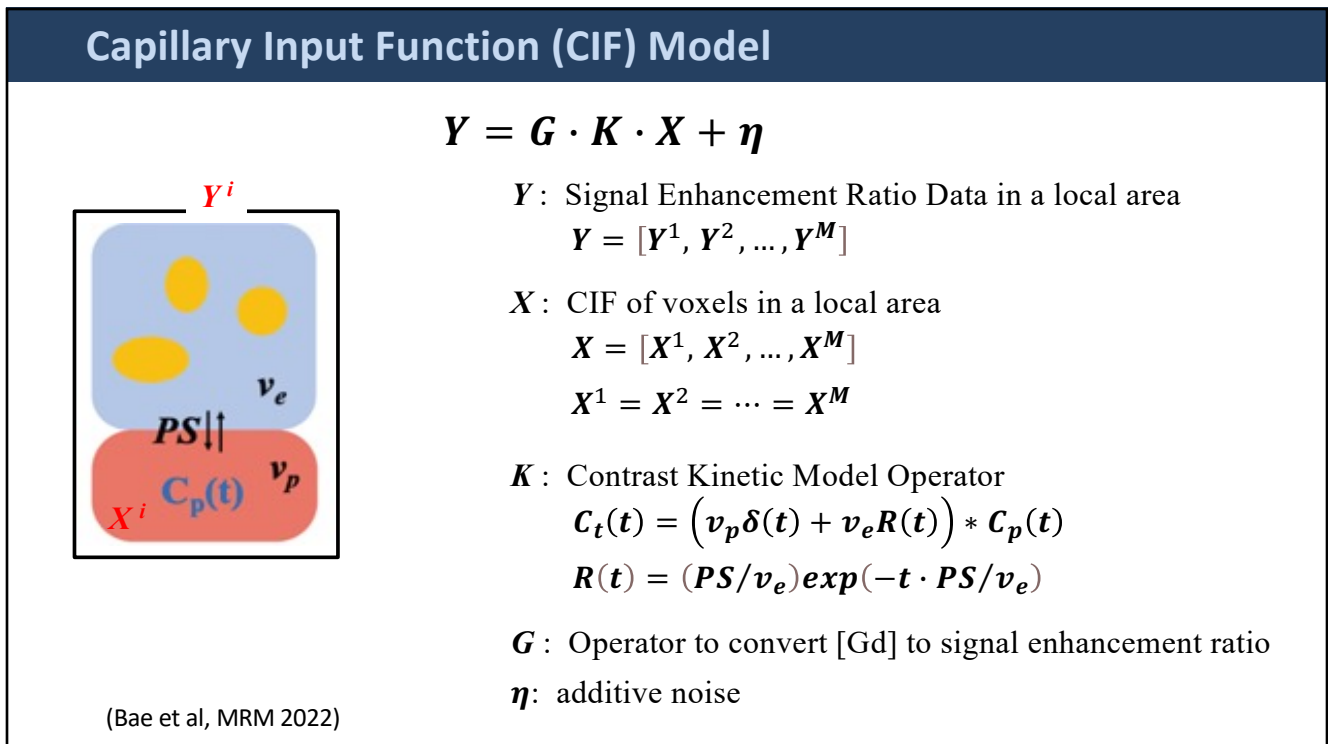
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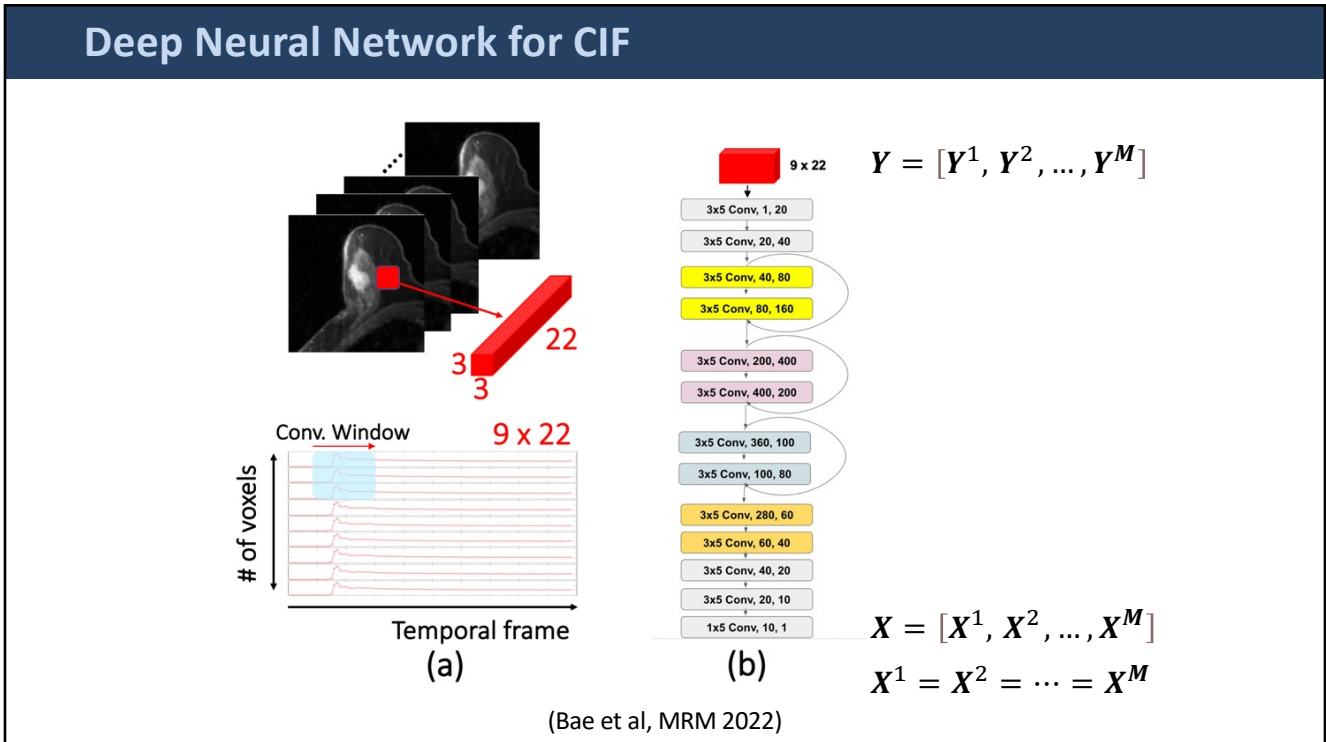


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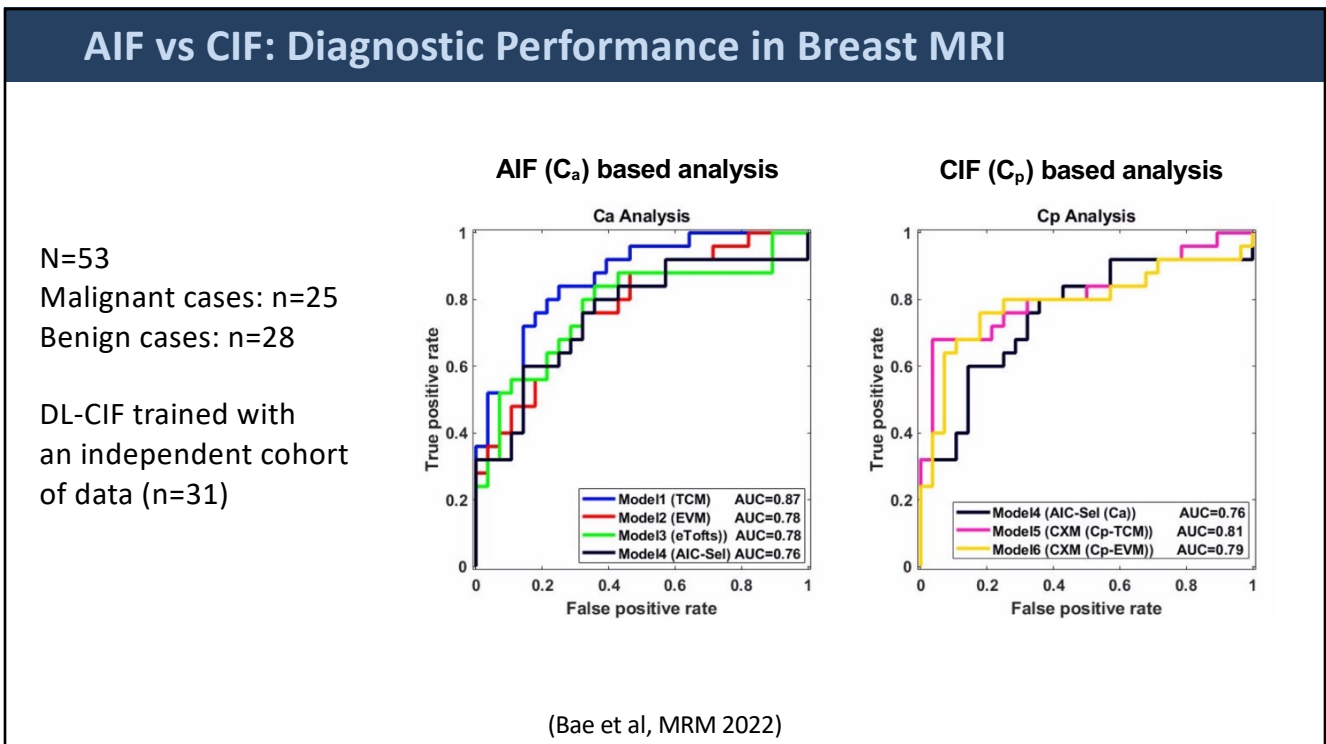


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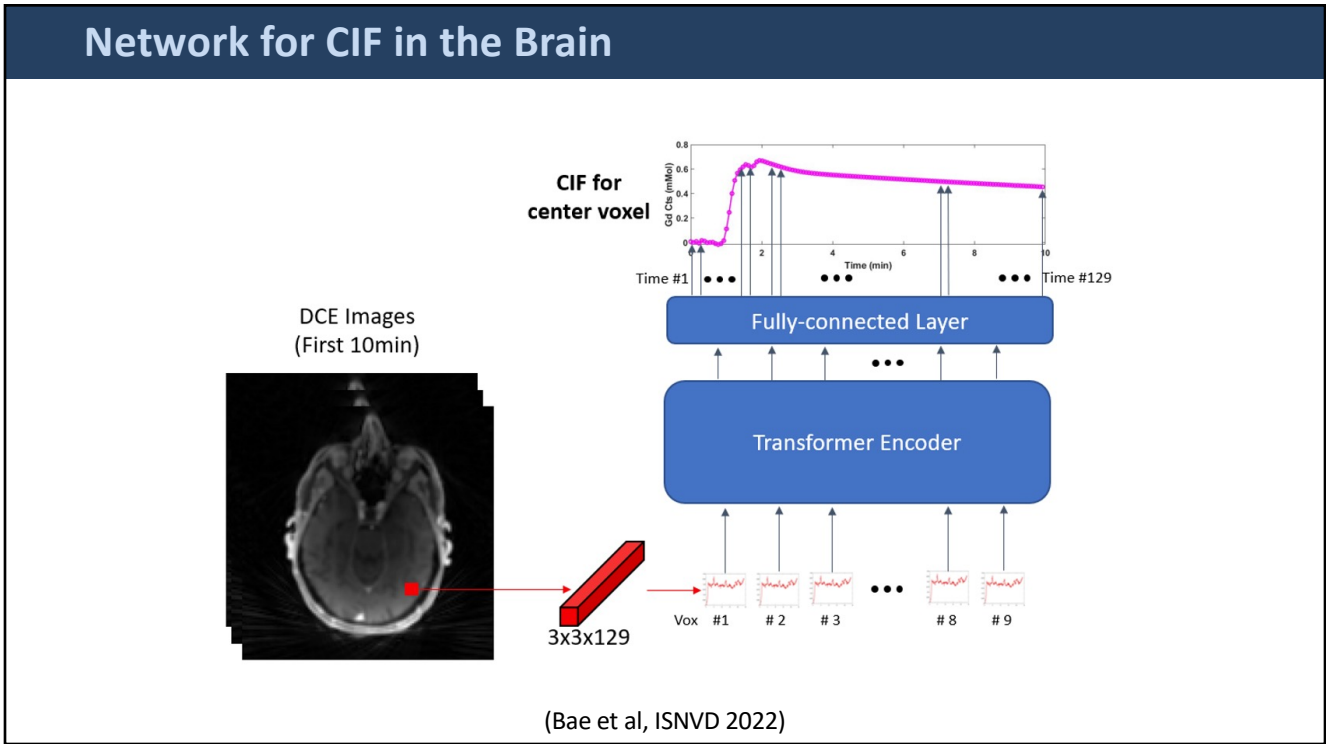




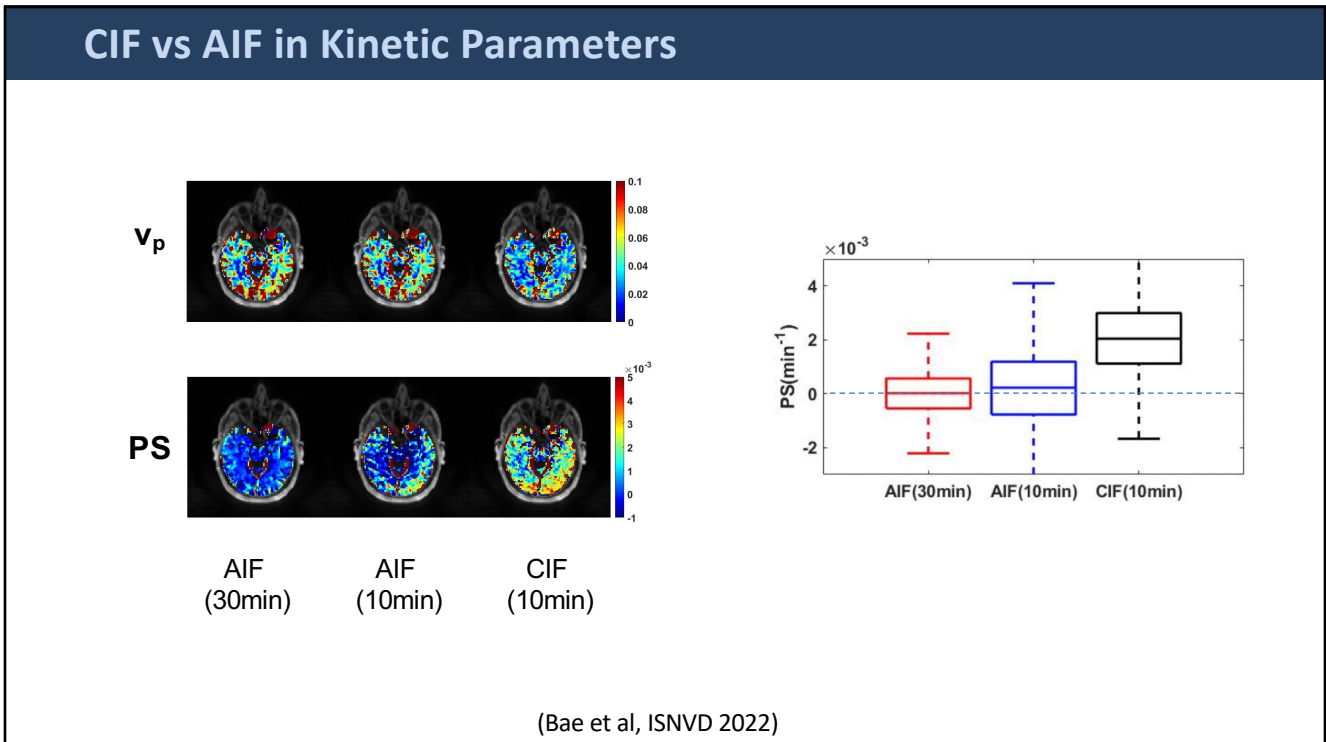
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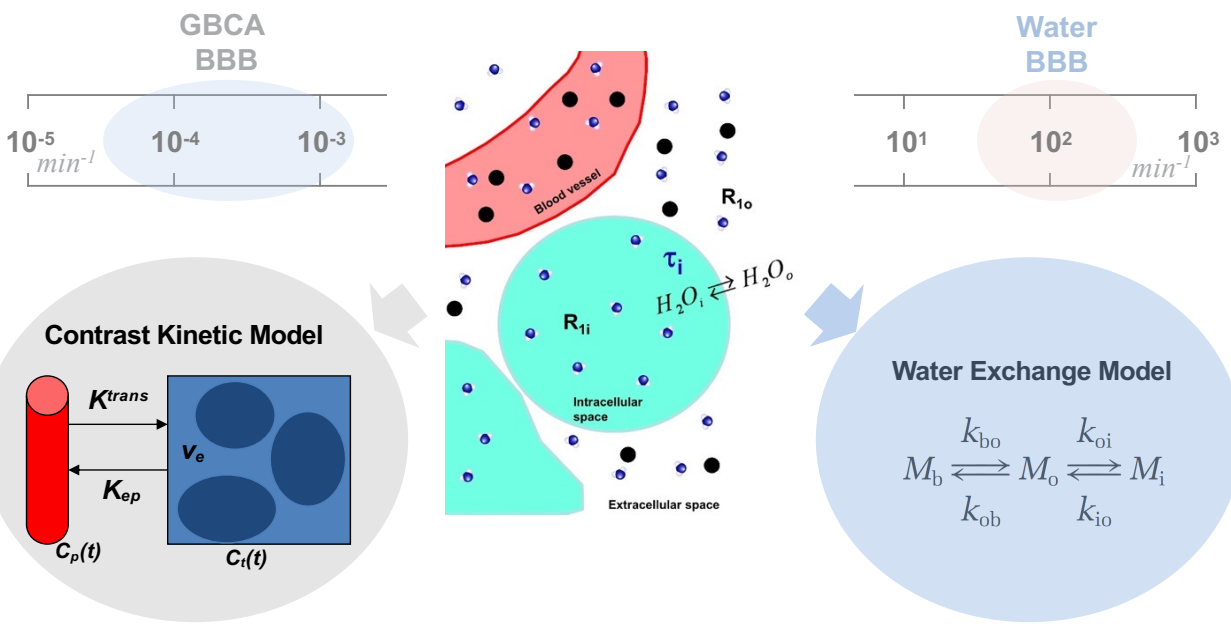
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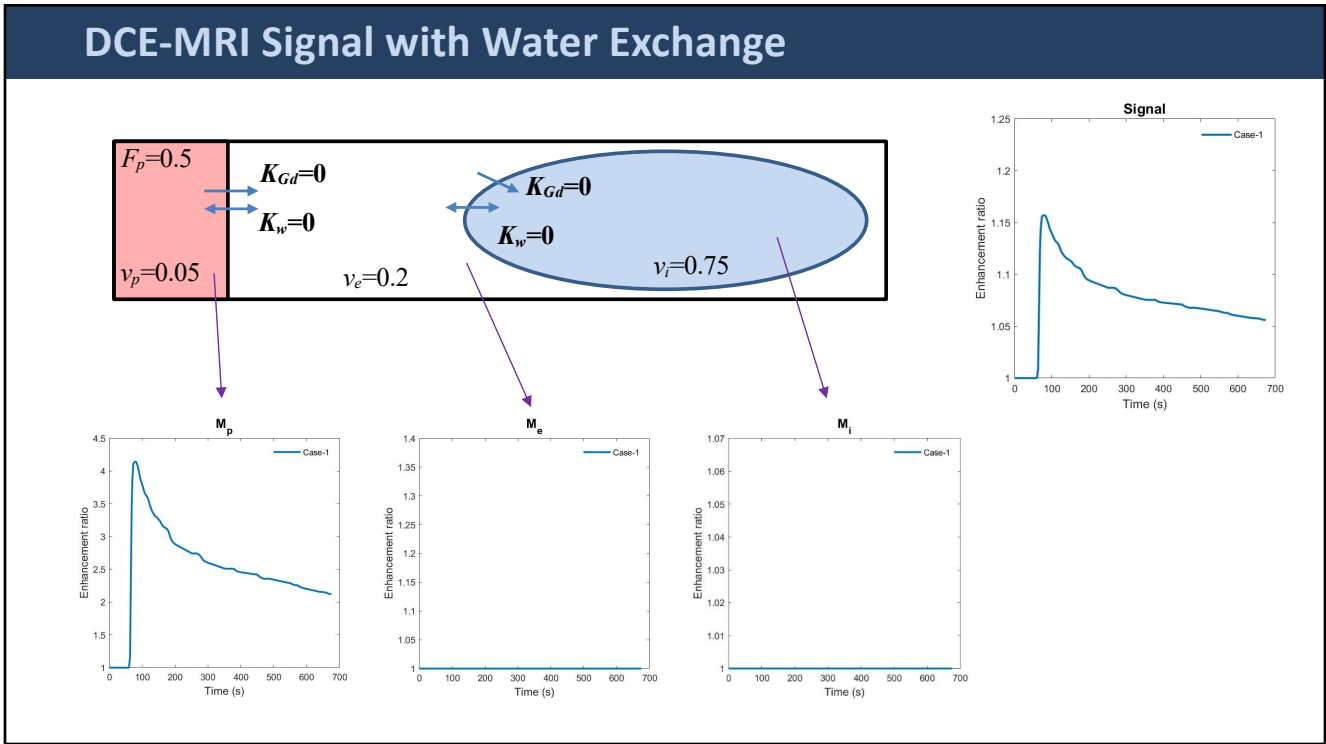
1. DCE-MRI for Assessment of BBB
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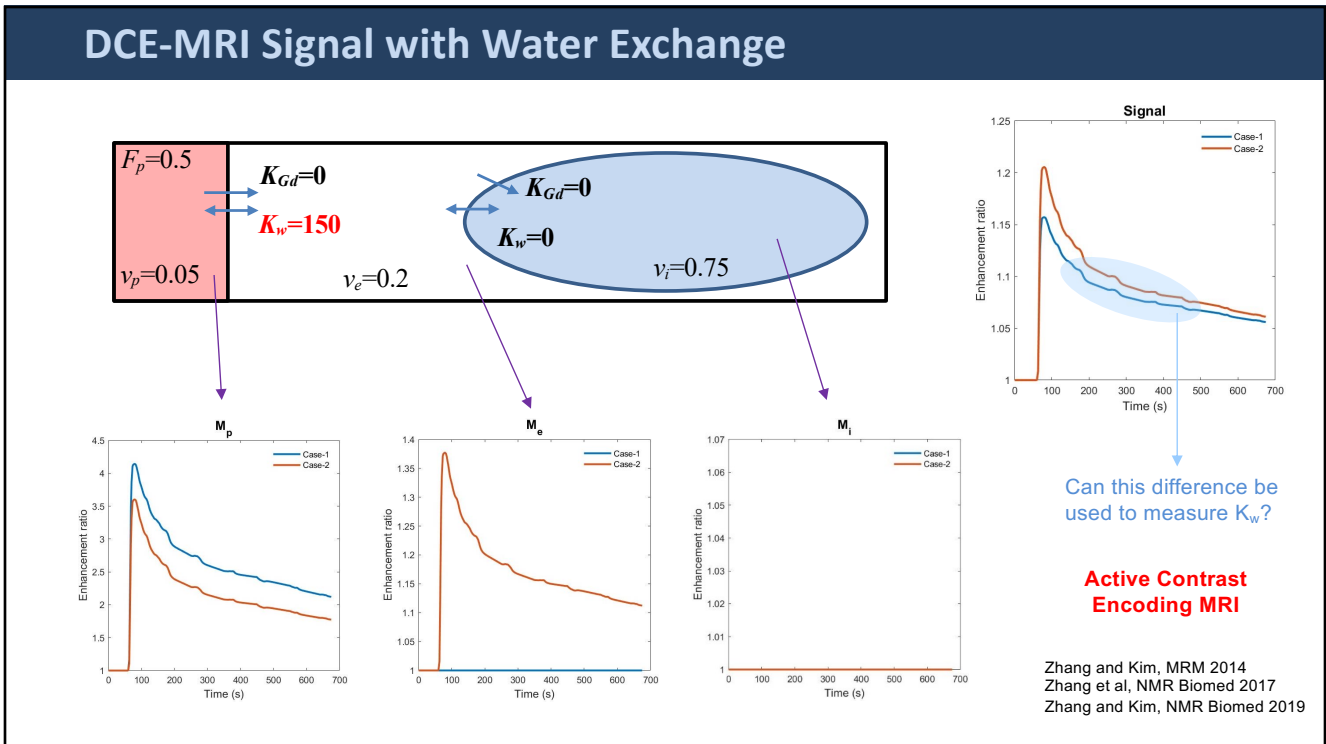
## Indirect measurement of [Gd] in DCE-MRI



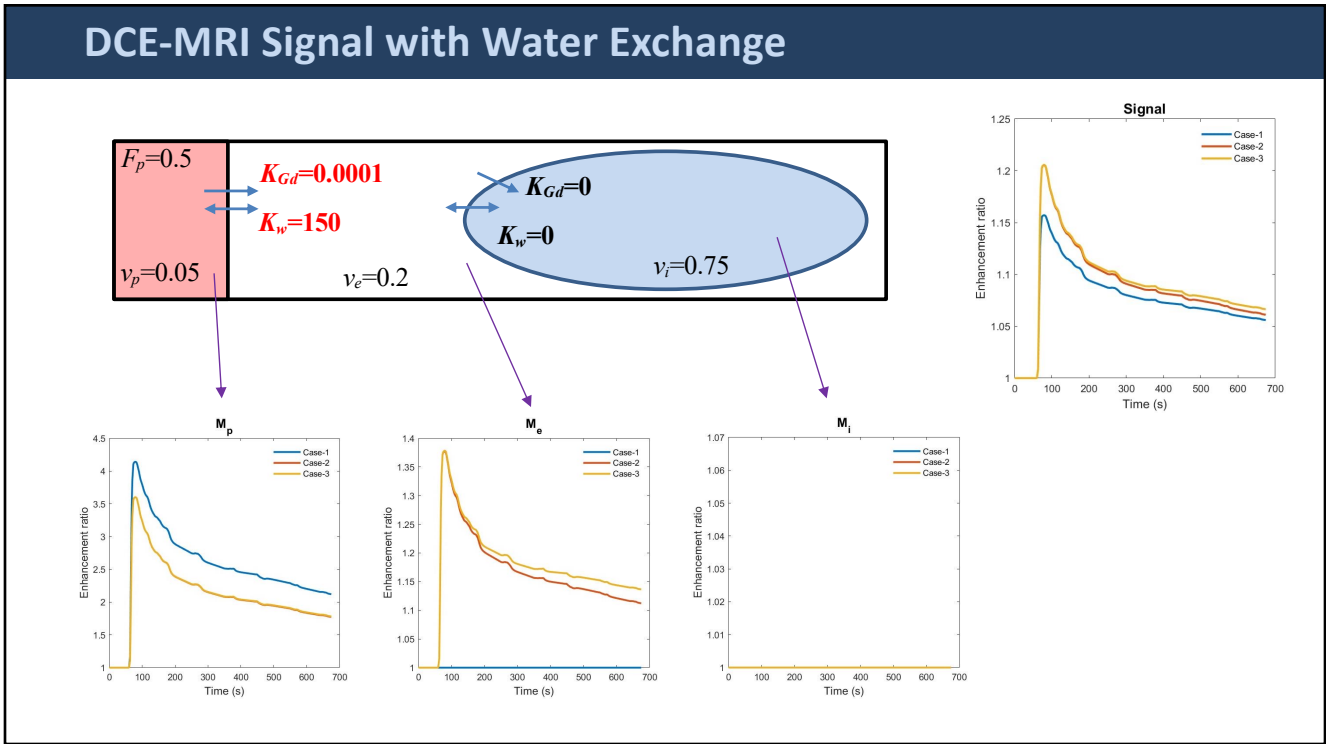
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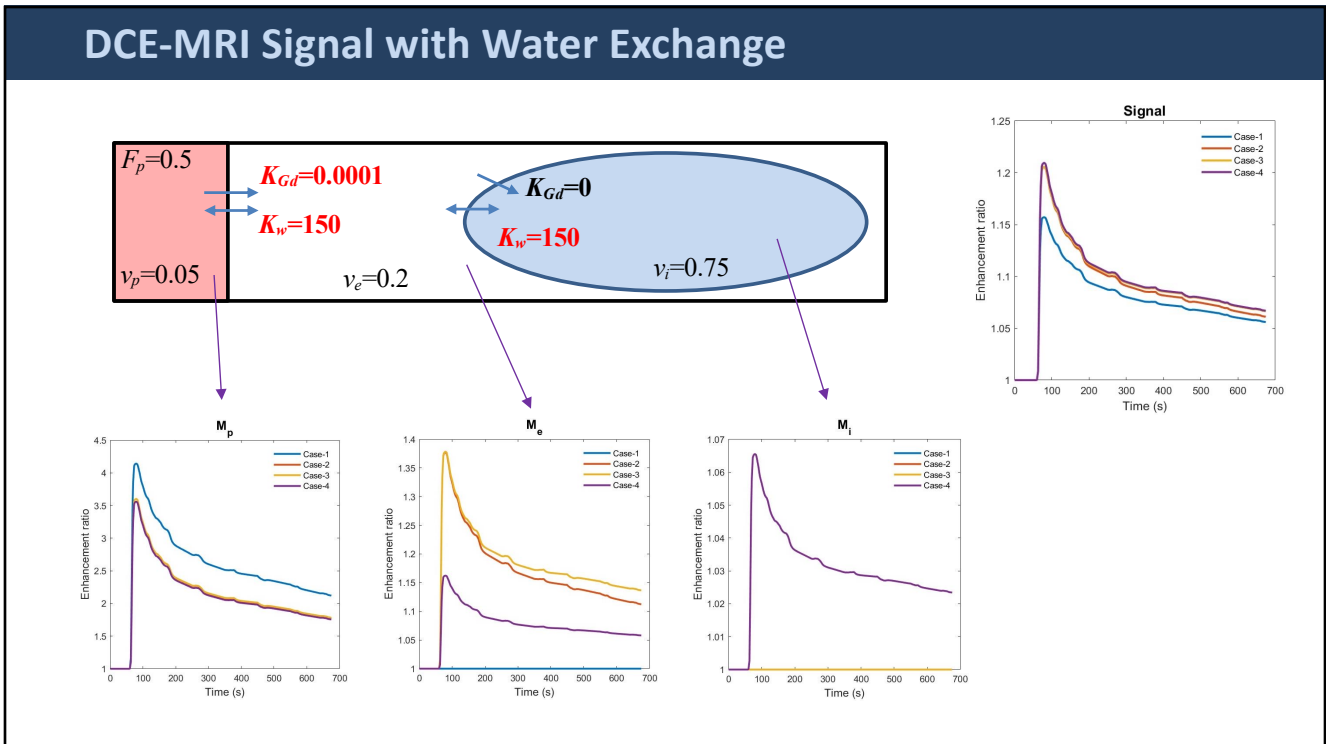
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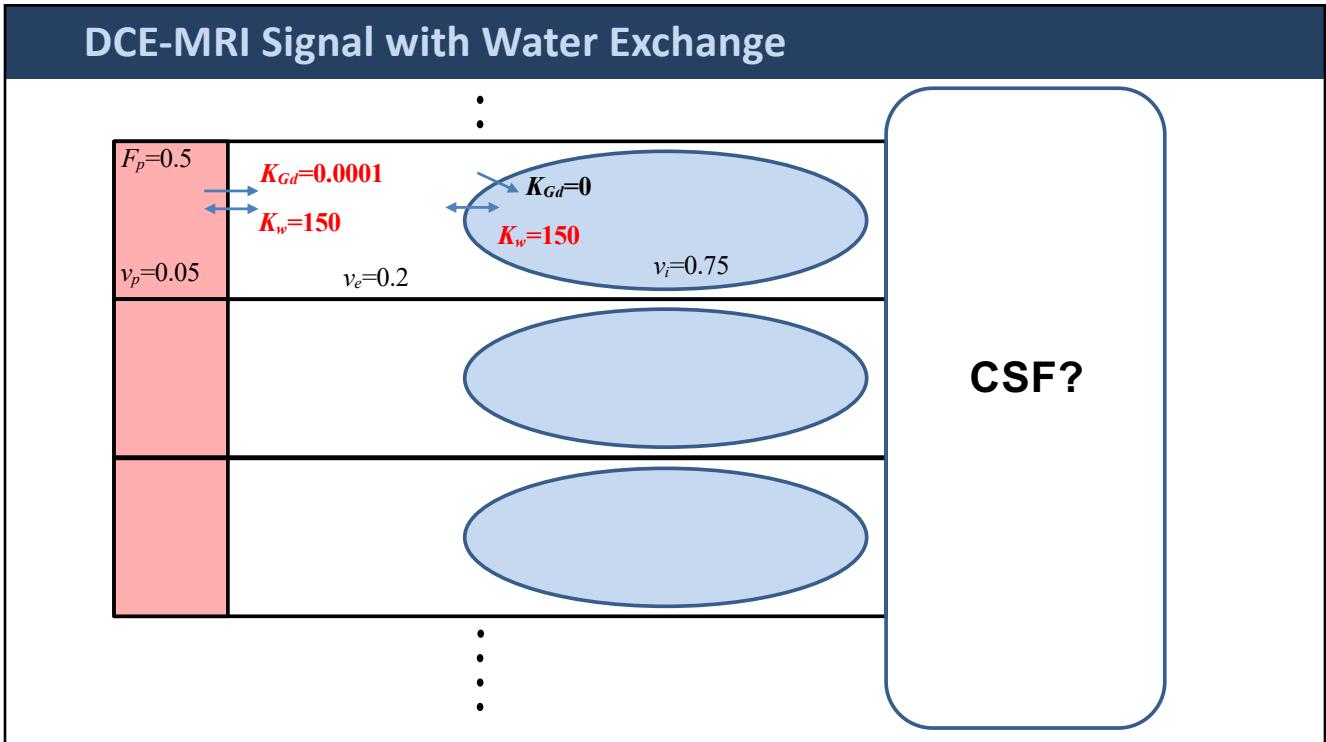
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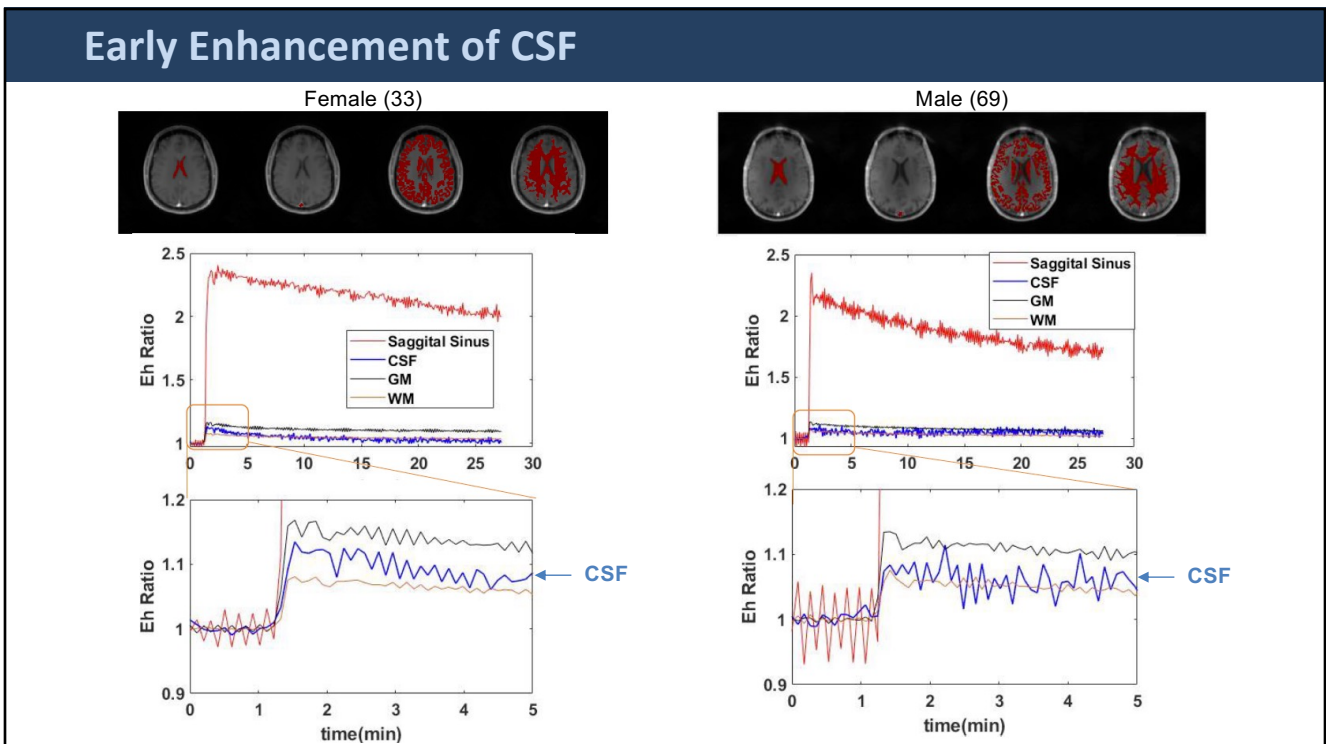
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**What we discussed...**

1. DCE-MRI for Assessment of BBB
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Low permeability of GBCA  
Long scan time

**Challenge:** Difficulty in measurement of CIF  
**Opportunity:** AI-based estimation of CIF

**Challenge:** Influence of WX on DCE-MRI signal  
**Opportunity:** Measurement of  $K_w$

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## ACKNOWLEDGEMENTS

**Kim Lab @ WCM:**  
Jin Zhang, PhD  
Eddy Solomon, PhD  
Ayesha Bharadwaj Das  
Sawwal Qayyum  
Suneeta Chaudhary, PhD  
Karl Kiser  
**Jonghyun (Joe) Bae**



**NYU School of Medicine**  
Yulin Ge, MD  
Arjun Masurkar, MD  
Dan Turnbull, PhD  
Jiangyang Zhang, PhD  
Youssef Zaim Wadghiri, PhD  
Steven Baete, PhD  
Henry Rusinek, PhD

**FA University Erlangen-Nuremberg**  
Florian Knoll, PhD  
Zhengguo Tan, PhD

**University of Liverpool**  
Harish Poptani, PhD

**Funding:**  
R01CA160620  
R01CA219964  
UH3CA228699  
AARG-17-533484

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