

Status and Update of the DCE and DSC-MRI Biomarker Committees

Interested in joining/participating? Please contact us at QIBA@rsna.org

Challenges & Opportunities

Need for Test-Retest Data:

- Defines QIBA claims
- Paucity of published test-retest data (< 20 of 6157 articles in DCE-MRI literature search)
- Please submit & publish test-retest data (consider open-source opportunities)
- “Quantitative Imaging Biomarkers Alliance (QIBA) Recommendations for Improved Precision of DWI and DCE-MRI Derived Biomarkers in Multicenter Oncology Trials” [Dave et al. - in press JMIR 2018]



Gadolinium-based contrast agent (GBCA) accumulation

- Trace amounts of GBCA may stay in the body long-term
- To date, the only known adverse health effect related to GBCA retention is a rare condition called nephrogenic systemic fibrosis (NSF) that occurs in a small subgroup of patients with pre-existing kidney failure
- However, do not avoid or defer clinically necessary GBCA MRI scans
- <https://www.fda.gov/Drugs/DrugSafety/ucm589213.htm>

Other Current Challenges/Opportunities:

- No standard, validated analysis software available
- An open source standard would help generate consensus among vendors and users
- A validated flow phantom would facilitate the development and standardization of software, algorithm and sequences

DCE-MRI (Co-Chairs: Caroline Chung – MDACC, Hendrik Laue – Fraunhofer MEVIS)

Status report / profile update

The QIBA Profile (Dynamic Contrast-Enhanced Magnetic Resonance Imaging) DCE-MRI Profile addresses the standardization of sequences, algorithms and software used for evaluating DCE-MRI data. Version 2.0 of the DCE-MRI Profile aims to address parallel imaging and DCE-MRI using a 3.0 T magnet. The main quantitative biomarker evaluated within the DCE-MRI Profile is K^{trans} , which reflects perfusion and permeability. The Profile is currently in the internal review stage.



Preliminary Claims for K^{trans} for two different tumor types:

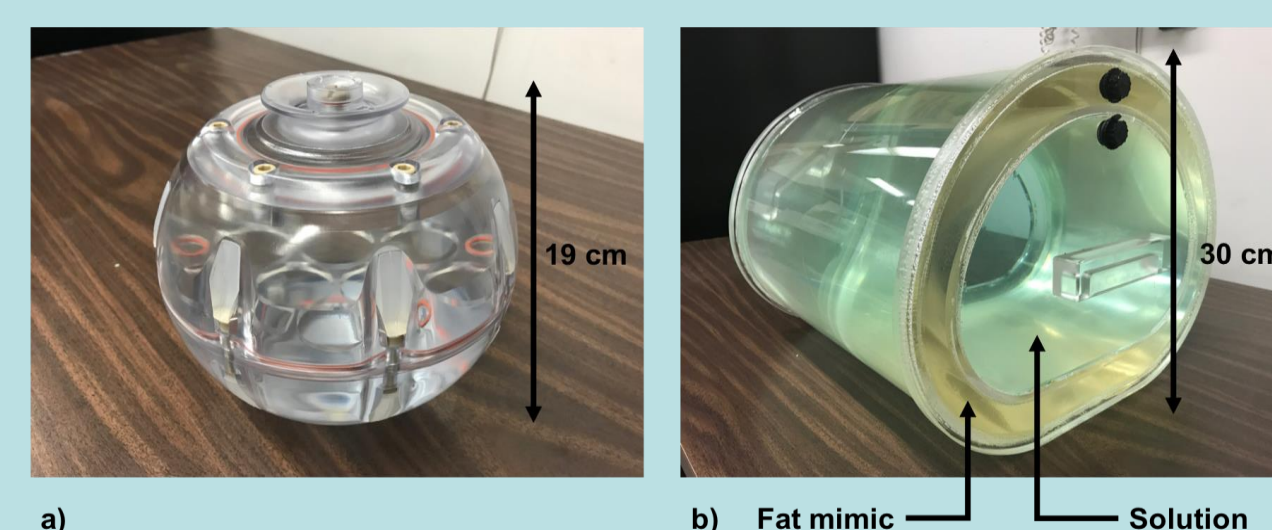
Claim 2a: A measured change of K^{trans} in brain tumors (glioblastoma multiforme, GBM) of 21.33% or larger indicates that a true change has occurred with 95% confidence.

Claim 2b: A measured change of K^{trans} in prostate tumors of 50.7% or larger indicates that a true change has occurred with 95% confidence [Alonzi et al, 2010; Jackson et al, 2003].

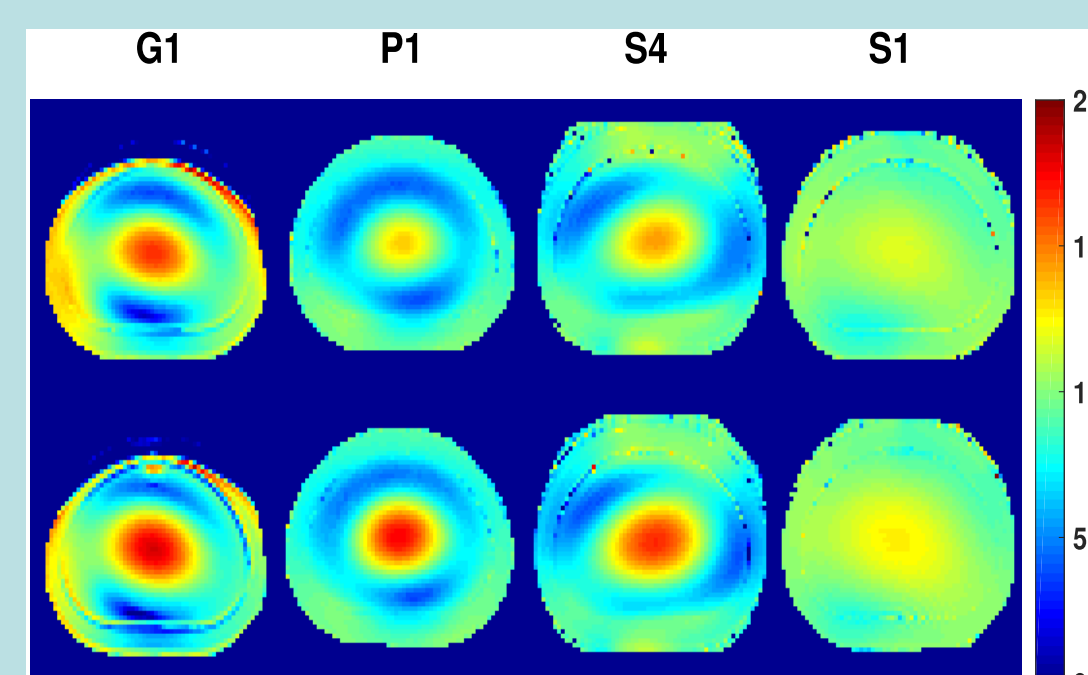
Claim definitions for prostate and brain are based on test-retest data. The claims will be updated with new, soon-to-be-published data.

Groundwork Project

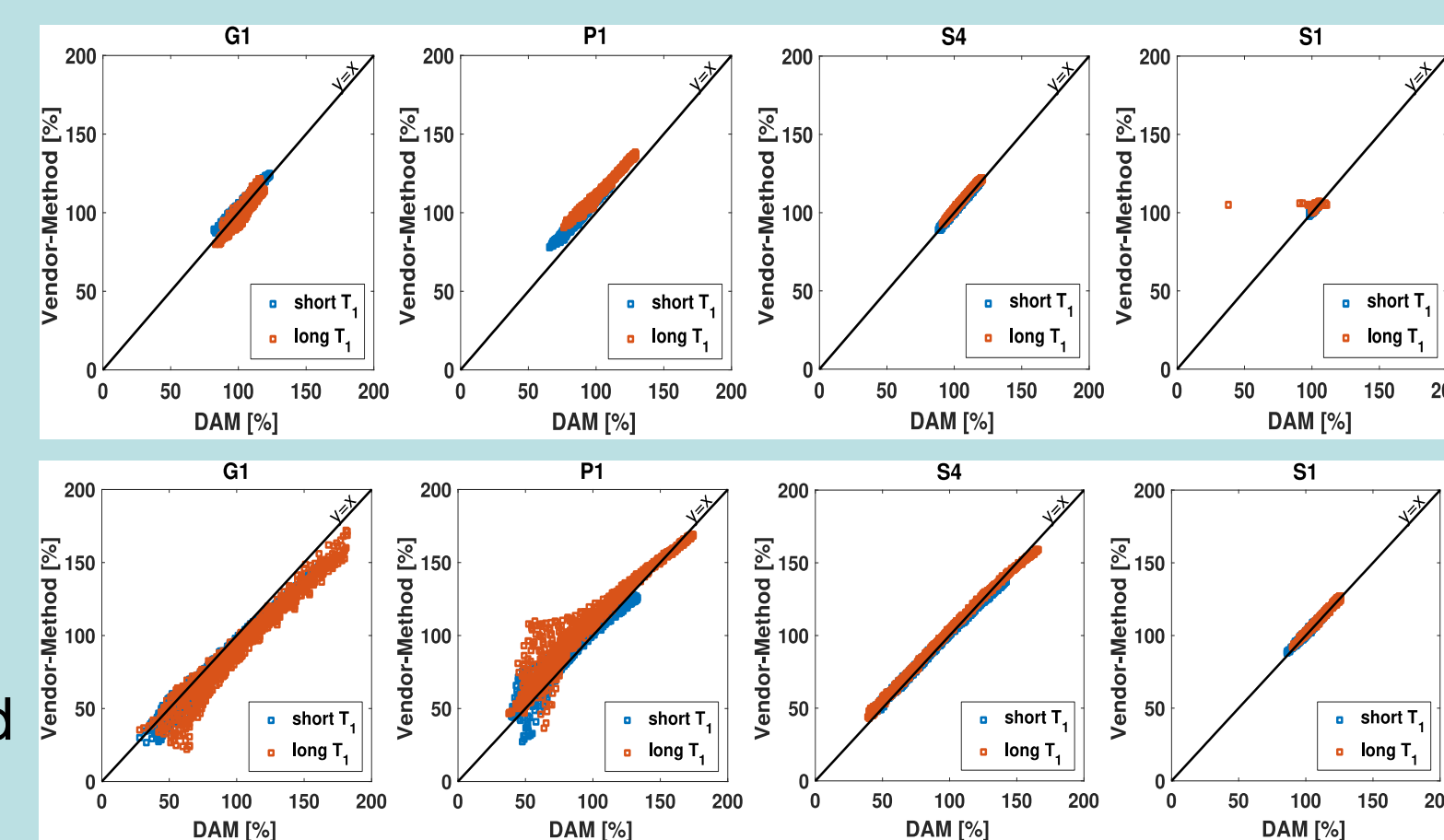
B_1^+ Calibration Groundwork Project (PI: Krishna Nayak)



Left: Images of the (a) head and (b) body B_1 phantoms



Lefts: B_1^+ maps acquired with the double angle method (DAM) for the short (top) and long T_1 torso phantoms (bottom) for different scanners (left to right). S_1 is a 1.5T.



Top: Correlation plots for head (top) and torso phantoms (bottom) for DAM and vendor method. All methods show good agreement with DAM for head, two methods show deviation in the torso phantom.

Motivation

Radio Frequency field variations at higher field strength result in error of local tissue T_1 measurements and signal-to-concentration conversion. This project estimates those errors and compares fast B_1^+ mapping sequences.

Conclusion

B_1^+ inhomogeneity impact DCE parameter estimation. B_1^+ mapping sequences allow accurate determination of B_1^+ inhomogeneity to correct for this source of error. [Nayak, et al. – in review]

DSC-MRI (Co-Chairs: Brad Erickson – Mayo Clinic, Ona Wu – MGH)

Status report / profile update

This QIBA Profile (Dynamic-Susceptibility-Contrast Magnetic Resonance Imaging) DSC-MRI addresses tissue-normalized first-pass area-under-the contrast-agent concentration curve (AUC-TN) which is often used as a biomarker of brain tumor progression or response to treatment. The Profile address the technical performance standards for tissue-normalized first-pass area-under-the gadolinium concentration curve (AUC-TN).



Preliminary Claims

Claim 1: A true change in Area Under the Curve-Tissue Normalized (AUC-TN) in enhancing tumor tissue has occurred with 95% confidence if the measured change is 86% or more.

This claim holds when: The region of interest is measured in enhancing brain tumor tissue as identified on the difference of T_1 -weighted images

Claim 2: A true change in Area Under the Curve-Tissue Normalized (AUC-TN) in normal brain tissue has occurred with 95% confidence if the measured change is 111% or more.

Groundwork Projects

DSC DRO Generator (PI: Brad Erickson)

DSC MRI image simulation
A web-based tool for creating DSC Digital Reference Objects

The purpose of this project is to provide a web-based interface to several software packages that create DSC simulations. Three modes are available for creating images that create simulated DSC perfusion data which can be used for creating simulated images.

The software takes the signal profiles for each tissue type in a 3D anthropomorphic head model to produce the 4D data set simulating a perfusion acquisition.

The following models are available:

- BNF DRO
- Bernhardt MB, Stieve AM, Bell LC, Bissman J, Clarke CD. A Population-Based Digital Reference Object (DRO) for Optimizing Dynamic Susceptibility Contrast (DSC)-MRF Methods for Clinical Trials. Tomography: a journal for imaging research. 2017 Mar;3(1):47.
- MGH COIN
- Wu Q, Obergruber L, Weisskopf R, Rosen T, Rosen B, and Sorensen A.G. 2003. Tissue arterial timing-insensitive technique for estimating flow in MRF perfusion-weighted imaging using singular value decomposition with a block-circulant decomposition matrix. Magnetic resonance in medicine. 50(1), pp.164-174. Wu Q, Obergruber L, Kimohno K, Schwann CH, O'Donnell J, Schaefer PK, Rosen BR, Weisskopf RL, Sorensen AG. Effects of tracer arrival time on flow estimates in MRF perfusion-weighted imaging. Magnetic resonance in medicine. 2003 Oct 1;50(6):658-64.
- RL MAYO
- Korffes P, Aliev TL, Kim ZS, Carter RE, Hu S, Erickson BJ. Dynamic Susceptibility Contrast-MRF Quantification Software Tool: Development and Evaluation. Tomography: a journal for imaging research. 2016 Dec;2(4):448.

Please select one of the following models

Available Models: Select

Not compatible with iExplorer

Acknowledgment

This work was funded by:

Create Synthetic DSC images using computer models.

DSC Phantom (PI: Ona Wu)

DSC Phantom: Topping off to remove bubbles.

Round robin results: (A) Phantom A datasets. (B) Phantom B datasets.

Plot of measured ΔR_2^* using rotated DSC vials for Phantom A..