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

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

Quantitative Imaging Biomarkers Alliance — RSNA

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 JMRI 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:

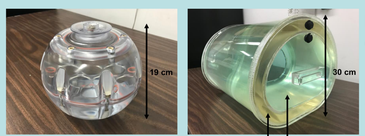
Claim 2a: A measured change of K^{trans} in brain tumors (glioblastoma multiforme, GBM) of 21.33% or larger indicates that a true change has occurred with 95% confidence.

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].

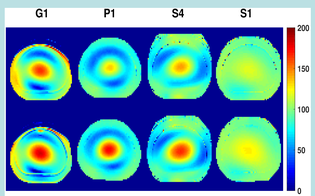
Claim definitions for prostate and brain are based on test-retest data. The claims will be updated with new, soon-to-be-published data.

Groundwork Project

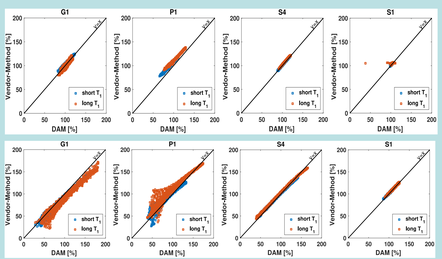
B_1^+ Calibration Groundwork Project (PI: Krishna Nayak)



Left: Images of the (a) head and (b) body B1 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

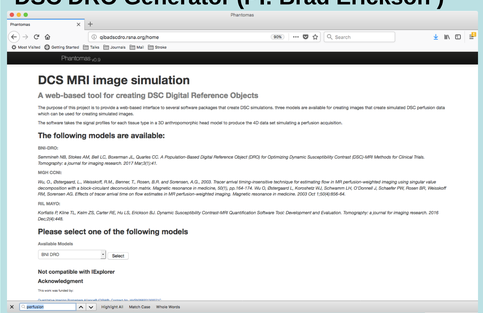
Claim 1: A true change in Area Under the Curve-Tissue Normalized (AUC-TN) in enhancing tumor tissue has occurred with 95% confidence if the measured change is 86% or more.

This claim holds when: The region of interest is measured in enhancing brain tumor tissue as identified on the difference of T1-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.

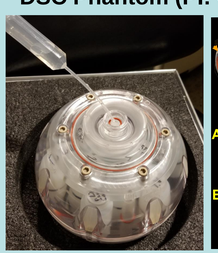
Groundwork Projects

DSC DRO Generator (PI: Brad Erickson)

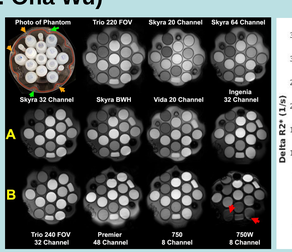


Create Synthetic DSC images using computer models.

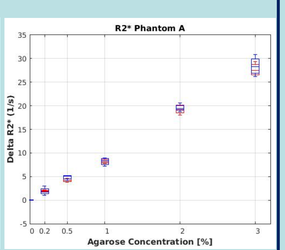
DSC Phantom (PI: Ona Wu)



DSC Phantom: Topping off to remove bubbles.



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



Plot of measured ΔR2* using rotated DSC vials for Phantom A..

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