

**Specialty Area: Quantitative Imaging and Modeling**

**Speaker Name:** Kathleen M. Schmainda, Ph.D.  
[kathleen@mcw.edu](mailto:kathleen@mcw.edu)

**Highlights:**

- Dynamic susceptibility contrast (DSC) MRI is the most common advanced imaging method used for the evaluation of brain perfusion abnormalities.
- Contrast agent extravasation or “leakage effects” alter the DSC signal in ways that are influenced by the choice of image acquisition and post-processing methods.
- A more complete understanding of these influences has resulted in a growing consensus regarding best approaches.
- Despite the challenges associated with acquiring and post-processing the DSC MRI data it has become a very robust technique with many potentially powerful clinical applications.

**Talk Title:** Modeling Dynamic Susceptibility Contrast in Brain Tumors

**Target Audience:** Clinicians and scientists who use and develop dynamic susceptibility contrast (DSC) MRI perfusion methods to evaluate brain pathologies such as brain tumors.

**Objectives:** Participants should learn how to design and interpret DSC MRI studies for the evaluation of brain tumors.

**Purpose:** To illustrate how the DSC signal is affected by the choice of imaging parameters and tissue conditions, which together with the choice of post-processing methods can influence the final perfusion parameter maps. A thorough understanding of these issues should enable more accurate use and interpretation of the perfusion parameter maps, as well as providing topics in need of further exploration.

**Methods:** Collection of DSC data during the bolus injection of a gadolinium (Gd)-based contrast agent has become the most common way to assess brain perfusion abnormalities. From this data image maps of cerebral blood volume (CBV) and cerebral blood flow (CBF) are most often created. However, the DSC signal profile can be altered by a disrupted blood brain barrier (BBB), from which contrast agent extravasates or “leaks”. The extent and appearance of this “leakage effect” on the DSC signal depends on the choice of image acquisition parameters and contrast agent dosing [1]. Examples of these differences will be shown. In addition, various post-processing methods have been developed to create the final perfusion parameter maps, but each handles the leakage effect differently. The most common post-processing methods will be described, example results shown and the advantages and disadvantages of each discussed.

**Results:** Several studies have been performed to address the influence of DSC image settings on both the normal DSC curve and curves affected by contrast agent leakage [2-7]. For best signal to noise a minimum of 30 seconds of pre-contrast DSC signal should be collected. Contrast agent leakage can be apparent as either a T1 or T2/T2\* dominant effect, depending on the tissue condition, image acquisition parameters and contrast-agent dosing protocol [1, 8]. When leakage is present, a loading dose of contrast agent along with post-processing correction of leakage has been shown to be effective [1]. Dual-echo methods also hold much promise for creation of perfusion maps using just a single dose of Gd contrast agent, and intrinsically correcting for T1 leakage effects [1, 9, 10].

**Discussion:** A consensus regarding best approaches for brain tumor perfusion imaging is being reached. With an improved understanding of the various factors affecting this measurement more emphasis can be given to proving the many relevant uses of these

techniques, such as guiding biopsies [11], predicting response to and evaluating therapies [12, 13] by, for example, distinguishing treatment effects from residual or recurrent tumor [14].

Conclusion: DSC perfusion imaging has become a well-understood technology that is proving to be a robust approach for the evaluation of brain tumors and other brain pathologies.

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