

# Quantitative Cerebral Blood Flow Measurement in a Canine Stroke Model : Validation with Regional Blood Flow measurement Using Fluorescent Microspheres

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## Introduction

Dynamic susceptibility contrast (DSC) analysis using MR imaging has shown the potential to measure cerebral blood flow (CBF) with diagnosis of disease related with central nerve system. However it is known that DSC MR CBF values are relative, and many proposed quantification techniques break down in a setting of altered perfusion that results from a stroke. We report on validation of a quantitative MR perfusion technique [1] in an animal model of hyperacute stroke [2]. The bookend quantitative perfusion technique is based upon post-gadolinium T1 changes in the brain parenchyma and includes a novel algorithm to account for water exchange effects [3]. We present an initial result of validation of qCBF MR measurement, in a canine stroke model to compare with regional flow measurement using fluorescent microspheres deposition.

## Methods

**Acute stroke model:** MR imaging compatible canine model of acute stroke was created by catheter directed injection of blood clots into the middle cerebral artery [2]. After clot injection, occlusion of middle cerebral artery was confirmed with X-ray. The dog was moved to a 3.0 T scanner (Trio, Siemens Medical Solutions, Erlangen, Germany). MR Scanning was performed with injection of microspheres within 30 minutes after injection of a clot. Serial perfusion and diffusion scans were performed at 30 minute intervals.

**MR imaging:** For qCBF measurement, Bookend protocol, inversion recovery Lock-Locker echo planar imaging (EPI) images were acquired before and after perfusion weighted imaging (PWI). Our clinical perfusion protocol was adjusted to the body habitus of the dog. Both gradient echo (GE) and spin echo (SE) EPI were used for PWI [3]. Diffusion imaging was scanned to give information of stroke regions. Isotropic MPRAGE images were acquired to aid in image localization for perfusion and diffusion imaging and serve as a template allowing image registration for comparison between and MR quantitative CBF (qCBF) and microspheres derived cerebral blood flow.

### Flow measurement:

Microspheres with 2 mL of fluorescent 15  $\mu$ m diameter, total  $5 \times 10^6$  number of microspheres were injected into the proximal left atrium through the pigtail catheter. During the injection of microspheres, blood was collected for 2 minutes. Calculation of flow was performed based on the published study [4]. Voxel by voxel qCBF and qCBV maps were obtained from Bookend method [1,3]. Relative CBV and CBF maps from DSC analysis were calibrated with absolute CBV in a steady state measurement obtained by two T1 measurements before and after perfusion weighted imaging. 5 mm thickness of brain tissues were cut on  $1.5 \times 1.5$  cm<sup>2</sup> of grid for regional flow measurement and the same regions of interest were drawn on qCBF maps (See figure 2)

## Results/Conclusions

The results are shown in Figure 3. qCBF measurement using both GE-EPI and SE-EPI showed good correlation with regional absolute flow measurement using fluorescent microspheres. We validated quantitative MR perfusion measurement acquired in acute stroke model.

## Reference

1. Sakaie et al., *JMRI*, 2005.
2. Shaibani et al., *AJNR*, 2006.
3. Shin et al. *ISMRM*, 2006.
4. van Oosterhout et al., *AM J Physiol*, 1995

