**Myocardial BOLD Imaging using Flow Compensated 2D Cine bSSFP**

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**Introduction:** Robust image quality is critical for reliable detection and evaluation of myocardial oxygenation changes with blood-oxygen-level-dependent (BOLD) imaging. Recently, balanced Steady-State Free Precession (bSSFP) methods have been employed to overcome image quality limitations associated with myocardial BOLD methods. However, the long TRs required for optimal BOLD contrast can lead to unwanted flow/motion artifacts, ultimately compromising image quality. In this work we evaluate the utility of 2D first-order motion compensation scheme to minimize flow/motion artifacts in cardiac phase-resolved bSSFP BOLD imaging.

**Methods:** Animal Preparation & Imaging: Six dogs were studied in an Espree System (1.5T, Siemens Medical Solutions, Erlangen) using first-order flow/motion-compensated bSSFP method (sequence diagram shown in Figure 1) over the whole left ventricle. Basal, mid-ventricular, and apical cine images were acquired with three different approaches: (A) TR = 3.5ms (conventional cine); (B) TR = 6.2 ms (long TR without compensation); and (C) TR = 6.2 ms (long TR with flow/motion compensation). Preliminary myocardial BOLD studies were performed on animals (n=2) with controllable LCX stenosis to evaluate the benefits of flow compensation. Studies were performed under rest and adenosine stress in the absence or presence of severe stenosis (greater than 80% narrowing). Other scan parameters were: spatial resolution = 1.2x1.2x5; TR=3.1ms; and flip-angle=70°. Data Analysis: Three experts used (i) Ghost artifacts (GA), an impression of artifacts observed within the image; and (ii) myocardial inhomogeneity (MI), a measure of the signal homogeneity within the left-ventricular myocardium, to evaluate myocardial signal characteristics. One-way ANOVA was employed to evaluate whether there were any differences in the indices with various approaches. Statistical significance was set at p<0.05.

**Results:** Mean scores for the 3 approaches assessed over the various positions along the left ventricle of all animals are summarized in Figure 2. The scores for Approach (B) were significantly higher than Approaches A and C (p<0.01). For TR=6.2ms, GA and MI increased when moving from the apex to base. There was no statistical difference in the scores for Approaches (A) and (C). Figure 3 shows a representative set of late-systolic and late-diastolic mid-ventricular images obtained from a canine model with severe LCX stenosis under adenosine stress. Results showed remarkable reduction in image artifacts, permitting the visualization of signal loss in the LCX territories over the entire cardiac cycle in the presence of LCX stenosis.

**Conclusions:** First-order flow/motion compensation strategy employed in this study provided significant improvement in image quality compared to the standard long TR SSFP BOLD approach without flow compensation. It was also observed that the imaging artifacts observed in the flow-compensated long TR acquisitions were not significantly different when compared to the conventional (short TR) cine bSSFP imaging that is routinely employed in the assessment of cardiac function. In addition, the proposed strategy allowed for the visualization of the hypointense LCX territories in stress images with LCX stenosis throughout the cardiac cycle. We anticipate the proposed method may enable a more reliable means for detecting and evaluating BOLD signal changes due to coronary artery stenosis.