NONISCHEMIC APPLICATIONS OF FIRST PASS CARDIAC IMAGING

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Introduction: First pass cardiac imaging has been established as a robust technique in the MRI evaluation of myocardial ischemia. Dynamic TrueFISP images (Figure 1) are typically used to identify regions of compromised perfusion. However, TrueFISP provides potential utility beyond that of perfusion imaging. Inversion magnetization preparatory pulse is applied for T1 weighting (Fig 1). With this technique, off resonance frequency shifts due to field inhomogeneities and flow can lead to image artifacts. This can impair interpretation of perfusion studies. However, the images generated with this technique provide superior SNR and spatial resolution, desirable in the evaluation of cardiac pathology. Performed in conjunction with MR angiography, this serves as a complimentary method to identify and characterize entities such as masses, shunts and vascular anomalies (Fig 2).

Materials and Methods: Studies were performed using a 1.5T Siemens Avanto. Initial functional imaging of the heart was conducted in short and long axis orientations using cine TrueFISP (TR/TE 3.0/1.5; flip angle 70 degrees). First pass imaging was then performed during rapid injection of 6cc Gadolinium-DPTA at 6cc/sec via an 18G intravenous cannula. Single shot TrueFISP (TR/TE: 4.4/1.5; flip angle 60%) was used for first pass imaging and an inversion recovery pre-pulse (T1 300ms) was used for magnetization preparation of blood and myocardium. A 180 x 256 matrix size was used yielding pixel sizes of 2.0 x 1.4 mm squared. The acquisition time was approximately 450ms per image and ECG triggering was used so that one image was acquired per heartbeat. A trigger delay was utilized to ensure that image acquisition occurred during diastole. The acquisition was initiated two to three seconds before the injection to provide sufficient time to reach steady state and satisfactory blood nulling.

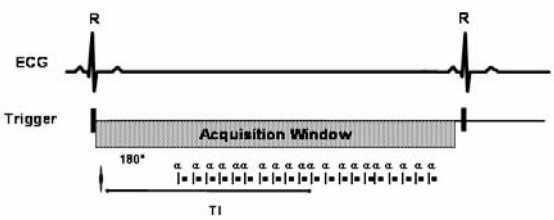

Figure 1: The Pulse sequence for inversion recovery prepared TrueFISP technique.

Results/Discussion:

Figure 2 shows representative images of an ostium secundum defect with associated left to right shunt: (a) shows a sagittal precontrast TrueFISP image of the heart. In (b), initial passage of contrast opacifies the right atrium in an identical plane. Nonopacified blood in the left atrium is shunted across the interatrial septum, seen as a low signal jet within the opacified chamber (red arrow). In (c), a late phase image demonstrates opacification of bilateral atria with a high signal contrast jet traveling in a similar direction (red arrow) across the defect.

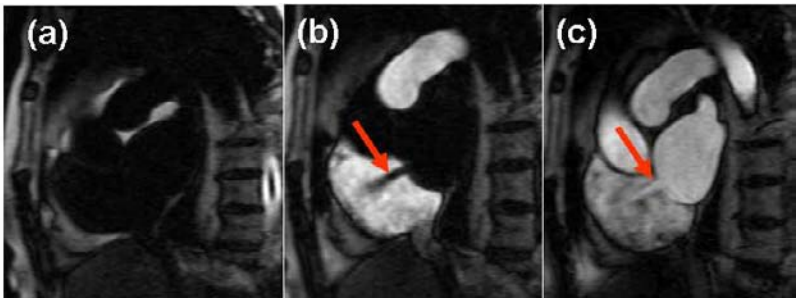

Figure 2: TrueFISP imaging of an ostium secundum defect.

Intracardiac abnormalities, including intracardiac shunts, aneurysms and masses are a significant cause of morbidity and mortality. Traditionally, cardiac catheterization and echocardiography have served as the gold standard imaging modalities for detecting and characterizing these lesions. However, both modalities possess potential disadvantages. Cardiac MRI provides high spatial and temporal resolution for the anatomical and functional diagnosis of acquired and congenital heart disease. The application of an inversion prepared TrueFISP first pass technique can be utilized to detect intracardiac abnormalities and fully characterize these lesions without subjecting the patient to an invasive procedure with its inherent risks. Furthermore, the use of this technique provides a comprehensive imaging alternative without sacrificing image quality.

References:

[1] Pinto, C, et al, JVIR 2006. [2] Pinto et al ISMRM 2004.