

# First Pass Inversion Recovery TrueFISP for Detection of Intracardiac Vascular Abnormalities

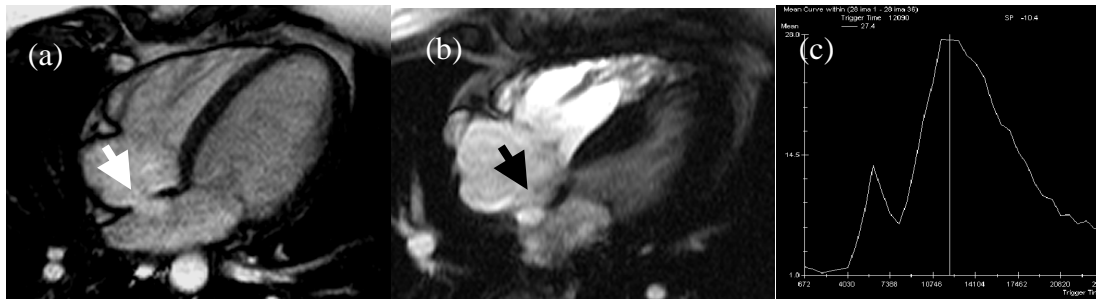
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**INTRODUCTION:** Intracardiac vascular abnormalities, such as shunts and aneurysms, are a significant cause of morbidity and mortality. The multiplanar capabilities of MRI make it particularly useful for evaluating these conditions. First pass imaging of the heart during the passage of a tight bolus of contrast is generally required in order to accurately detect and characterize these lesions. First pass imaging with MRI is typically utilized for assessment of myocardial perfusion [1]. In this setting, magnetization-prepared low spatial resolution images are acquired in order to maximize coverage of the heart within a limited time-frame of 1 heartbeat. In order to detect small intracardiac vascular defects, higher spatial resolution is required, however temporal resolution must be adequate so that small changes in flow can be detected. TrueFISP [2], because of its short repetition time, can acquire an image with relatively high spatial resolution within a single heartbeat. If each image is ECG-triggered, then temporal resolution is determined by the heart rate but should still be sufficient to detect dynamic changes in flow. An inversion recovery pulse can be used to null the resting blood signal.

**PURPOSE:** To evaluate first pass inversion recovery TrueFISP for detection of intracardiac vascular abnormalities.

**MATERIALS AND METHODS:** 22 patients with suspected intracardiac vascular abnormality were evaluated using a 1.5T Siemens Sonata. All patients had correlative echocardiography or cardiac catheterization. Initial functional imaging of the heart was carried out in short and long axis orientations using cine TrueFISP (TR/TE 3.0/1.5; flip angle 70°). First-pass imaging was then carried out during rapid injection of 6cc Gadolinium-DTPA at 6cc/sec via an 18G intravenous cannula. Single-shot TrueFISP [3] (TR/TE: 3.2/1.6; flip angle 55°) was used for first pass imaging and an inversion recovery pre-pulse (TI 300msec) 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<sup>2</sup>. The acquisition time was approximately 450 msec per image and ECG-triggering was used so that 1 image was acquired per heartbeat. A trigger delay was utilized to ensure that image acquisition occurred during diastole. The acquisition was started 2-3 seconds before the injection to provide sufficient time to reach the steady state and satisfactory blood nulling. The first pass images were reviewed by 2 observers and the presence of any intracardiac vascular abnormality was noted. For patients with intracardiac shunts, the direction of flow was noted. Regions of interest were placed over each cardiac chamber and time-intensity curves were generated for each patient.



- (a) Long axis cine TrueFISP showing defect (arrow) in interatrial septum consistent with atrial septal defect (ASD)
- (b) First pass IR TrueFISP image shows early flow of contrast across an ASD indicating the presence of a right to left shunt (arrow).
- (c) Time-intensity curve with region of interest placed in left atrium shows an early smaller peak consistent with right to left shunt and a later larger peak secondary to normal antegrade flow from the pulmonary veins

**RESULTS:** 13 patients had normal studies and 9 patients had intracardiac vascular abnormalities (3 ASD, 1 VSD, 3 surgical shunts post Mustard repair, 1 atrioventricular pseudoaneurysm, 1 coronary artery aneurysm). First-pass IR TrueFISP accurately detected all of the abnormalities (100% sensitivity and specificity). Direction of flow could accurately be determined in all of the shunt cases (6 right to left and 1 left to right). Time-intensity curves demonstrated clear separation of the left and right circulations in all normal patients. There was an early peak in intensity in either the right or left side of the heart in all shunt cases.

**CONCLUSION:** First pass single-shot inversion recovery TrueFISP is accurate in detecting intracardiac vascular abnormalities where anatomic detail and flow dynamics are essential for complete characterization. This technique can be a useful adjunct to cine and phase-contrast MR for evaluation of intracardiac vascular lesions.

## References:

1. Eichenberger et al. J Magn Reson Imaging 1994. 4: 425-431
2. Carr et al. Radiology 2001. 219: 828-834
3. Carr et al. ISMRM 2003