Delayed Contrast-enhanced Imaging of Left Ventricular Myocardial Scarring Using Single-shot Inversion Recovery (IR) TrueFISP

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Synopsis

Segmented IR TurboFLASH is typically used for assessment of left ventricular viability but has long acquisition times, resulting in respiratory motion artifact in susceptible patients. IR single-shot TrueFISP is an alternative faster technique, making it less susceptible to motion. Delayed post-contrast imaging was carried out in 22 patients using both techniques. Single-shot IR TrueFISP identified 94% of hyperenhancing regions detected with segmented IR TurboFLASH. Conspicuity of abnormality and image quality were slightly higher with IR TurboFLASH. IR TrueFISP is an accurate alternative method for detecting myocardial scarring and may be particularly useful in patients that cannot hold their breath.

Introduction

Determination of left ventricular viability is important in patients with myocardial infarction in order to predict if they will respond to surgical or endovascular revascularization. MR assessment of left ventricular viability has typically been carried out with segmented inversion recovery (IR) TurboFLASH [1, 2]. Acquisition times are usually of the order of 10 – 15 seconds, which may result in respiratory motion artifact in patients who cannot hold their breath.

TrueFISP is a steady-state pulse sequence, which is routinely utilized as a segmented k space acquisition, for functional cine MRI of the heart [3]. TrueFISP can also be implemented as a single-shot technique [4], with an inversion recovery pre-pulse to null signal from normal myocardium. As a result, it may be useful for detecting hyperenhanced foci in myocardial scars. Single-shot IR TrueFISP has the advantage of much shorter acquisition times, making it potentially insensitive to respiratory motion artifact.

Purpose

To compare single-shot IR TrueFISP with segmented IR TurboFLASH in the assessment of left ventricular myocardial scarring.

Methods

22 patients with suspected coronary artery disease underwent assessment of left ventricular viability on a 1.5T Siemens Sonata. Initial functional imaging of the heart was carried in the short axis plane using cine TrueFISP (TR/TE 3.0/1.5; flip angle 70^0). Gadolinium-DTPA (0.1mmol/kg) was then injected via an 18G intravenous cannula. Approximately 10 minutes post contrast injection, 6 mm thick short and long axis images of the entire left ventricular myocardium were obtained using segmented IR TurboFLASH (TR/TE: 8.0/4.0; flip angle 25^0; TI 250-350msec). 23 lines / segment were acquired in each R-R interval. 6 mm thick short and long axis images were then obtained using single-shot IR TrueFISP (TR/TE: 3.2/1.6; flip angle 55^0; TI 250-350msec). 2-3 averages, without breath-holding, were acquired to increase signal to noise. Both sequences were triggered to alternate R waves of the cardiac cycle.

2 experienced observers evaluated each image independently. Short axis images were divided into 8 equidistant, 45^0 segments. Long axis images were divided into 4 segments. The presence of focal areas of left ventricular myocardial hyperenhancement was noted. Conspicuity of enhancement and overall image quality were scored qualitatively (scale: 1-5). The acquisition time was noted for both sequences.

Fig 1 (a): Short axis IR TurboFLASH showing subendocardial infarct in septal wall (arrow)

Fig 1 (b): Short axis IR TrueFISP also showing subendocardial infarct in septal wall (arrow). Conspicuity of abnormality and image quality are similar to IR TurboFLASH.

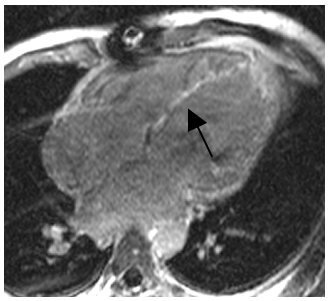

Fig 2 (a): Long axis IR TurboFLASH showing diffuse infarction of septal and lateral walls (arrow). Image is degraded by respiratory motion artifact

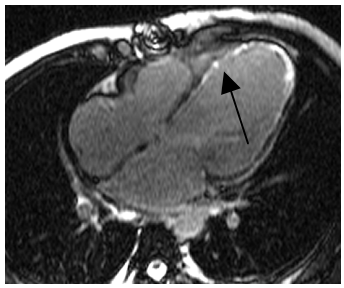

Fig 2 (b): Long axis IR TrueFISP showing diffuse infarction of septal and lateral walls (arrow). Myocardial enhancement is more conspicuous. There is no respiratory motion artifact.

Results

The average acquisition time for IR TrueFISP was 6.2 seconds and for segmented IR turboFLASH was 11.1 seconds. Single-shot IR TrueFISP identified 94% of the hyperenhancing regions detected with segmented IR TurboFLASH. Conspicuity of the abnormality was 3.9 with segmented IR turboFLASH and 3.5 with single-shot IR TrueFISP. Overall image quality was 4.1 with IR TurboFLASH and 3.6 with IR TrueFISP. Motion artifacts were more problematical with segmented IR TurboFLASH.

Discussion

Single-shot IR TrueFISP is accurate in detecting focal areas of left ventricular hyperenhancement and is quicker than segmented IR TurboFLASH. This alternative approach to assessment of left ventricular myocardial scarring may be of particular value in patients who cannot hold their breath.

References

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