

Poster presentation

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Arrhythmia insensitive inversion recovery preparation (IR-prep) with real-time adaptive inversion delay (TI):phantom validation

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Introduction

Typically an ECG-gated 2D IR turbo-field-echo (TFE) sequence is used for myocardial viability imaging. This IR-TFE sequence is robust if every RR-interval matches the entered heart-rate, and if steady-state longitudinal magnetization (Mz) reached before the first shot remains the same throughout the acquisition. In real-world, the RR-intervals are variable and this variability can introduce substantial amount of artifacts in the resulting image (See Figure 1A, 1B). We hypothesize that it is feasible to reduce the artifacts resulting from variations in the RR interval. The paper describes the method, as well as tests the theoretical predictions in a phantom model.

Purpose

Unlike saturation recovery (SR) preparation, IR-prep is sensitive to cardiac arrhythmias. The purpose of this paper is to describe an arrhythmia insensitive IR-prep method that is suitable for clinical applications such as myocardial viability imaging.

Materials and methods

All experiments were performed on a 1.5 T MR scanner (Philips Healthcare), and a patch was created with the following changes. The TI necessary to null the signal from a specific tissue is given by: $TI = \ln(2/(1+\exp(-RR/T1))) * T1$. The TI for each shot of the IR-TFE shot was adaptively adjusted in real-time based on the record of the most recent RR interval.

Phantom study

An agarose gel phantom mimicking the LV cavity and the surrounding was designed, and imaged using an IR-TFE sequence with the following parameters: TR/TE/ α = 5.1/2.5/15° ms; Voxel-size: 1.6*1.6*8 mm; TFE factor = 14; BW/pixel = 309 Hz. Total scan duration: 18 RR intervals. Arrhythmias mimicking clinical reality were generated using a software driven ECG synthesizer.

Results

Representative IR-TFE images acquired without any arrhythmias and with arrhythmias without adaptive TI correction, and with adaptive TI correction are shown in Figure (1C, D and 1E - left to right). Note the substantial reduction in the ghosting artifacts in the image with adaptive TI correction. The myocardial-to-blood CNR was 73% lower without adaptive TI correction than with TI correction. The ghost artifact intensities dropped by 180% with adaptive TI correction when compared with intensities measured without adaptive TI.

Conclusion

The results from the study show that it is feasible to diminish artifacts arising from arrhythmias in an IR-TFE sequence by adaptively adjusting the TI in real-time based on the most recent RR interval. The elimination of these artifacts can improve the myocardial-to-blood CNR as well as decrease artifact intensity.

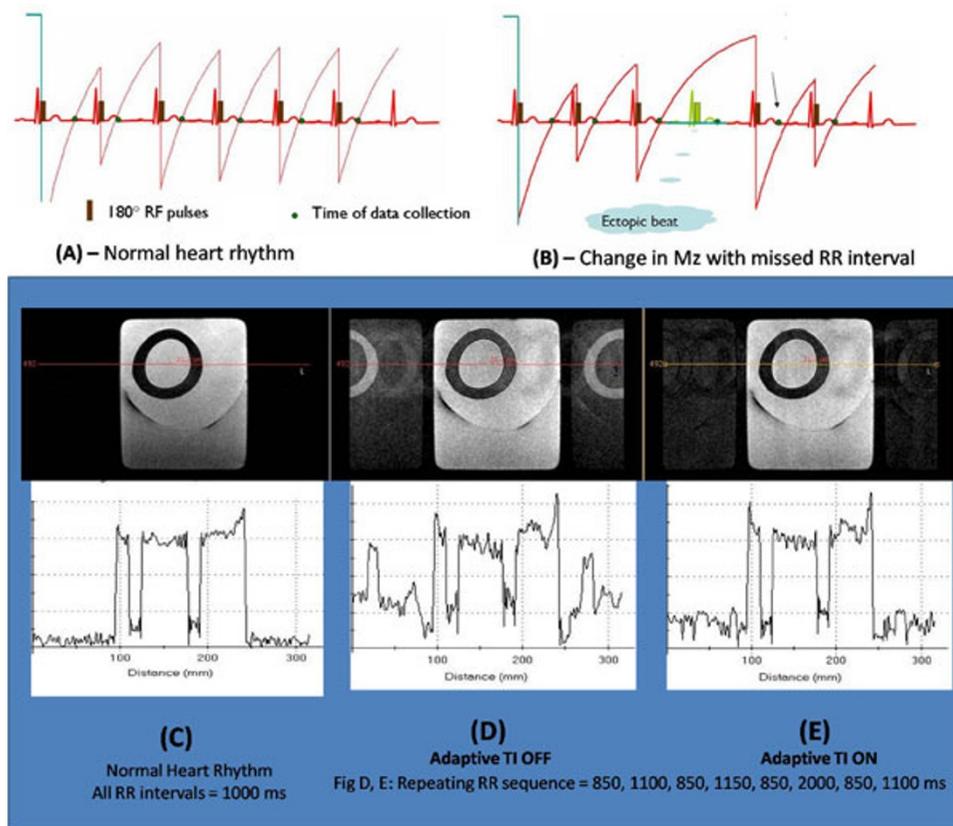


Figure 1

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