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Meeting abstract

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2117 High-resolution 3D free-breathing coronary MR angiography using wideband SSFP at 3 Tesla

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Introduction

Steady-state free precession (SSFP) imaging at 3 T can be used to generate coronary artery images with substantially higher signal to noise ratio (SNR) and blood-myocardium contrast to noise ratio (CNR) compared to 1.5 T, but is limited by potentially severe off-resonance artifacts [1]. The need for a short TR (to avoid banding) limits the spatial resolution to > 1 mm using conventional gradients, making it difficult to achieve the sub-millimeter resolution needed for accurately evaluating coronary artery stenoses.

Wideband SSFP uses two alternating repetition times to increase the band spacing in the steady-state frequency response, with a modest sacrifice in SNR [2]. It can suppress off-resonance related artifacts in cardiac imaging for a given spatial resolution. We demonstrate the application of wideband SSFP to 3D free-breathing coronary artery imaging at 3 T, and compare results with conventional SSFP at 3 T.

Methods

Experiments were performed on a Signa Excite HD 3 T scanner (GE Healthcare, Waukesha, WI) with gradients capable of 40 mT/m amplitude and 150 mT/m/ms slew

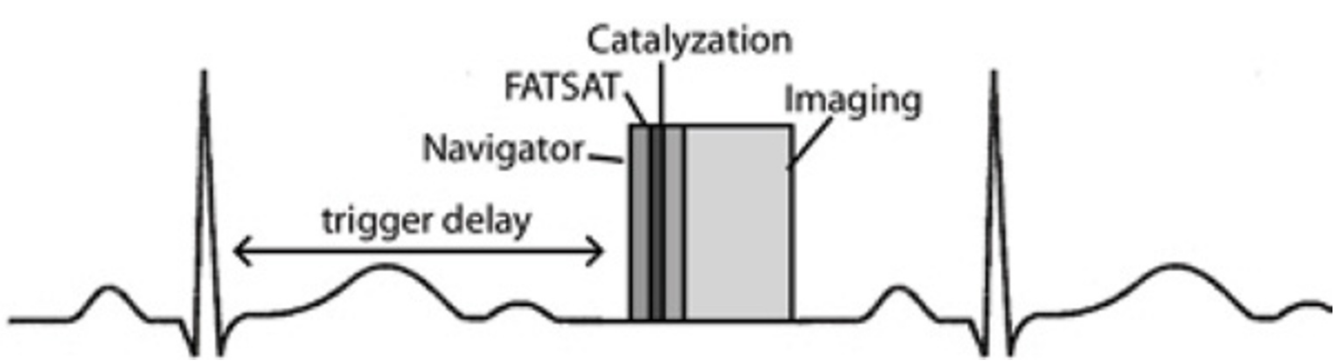

Figure 1

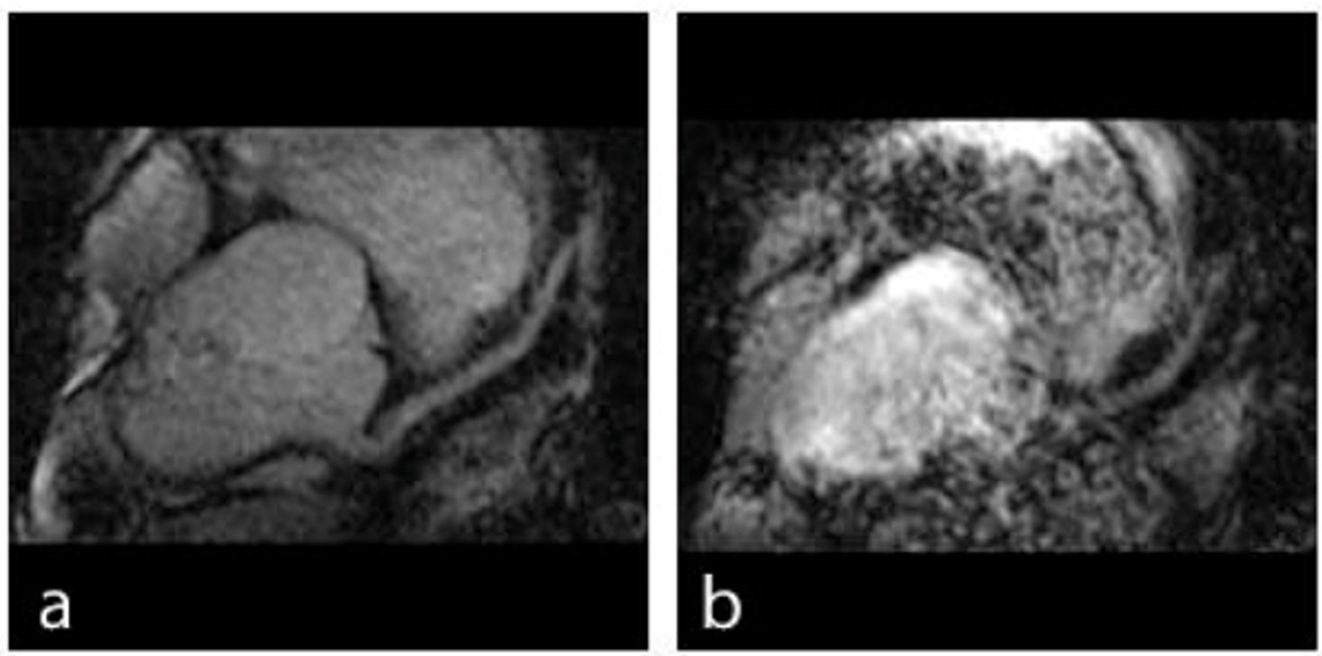

Figure 2
We demonstrate sub-millimeter resolution 3D SSFP coronary artery imaging at 3 Tesla using the wideband SSFP technique. Images of the LMCA and proximal LAD were obtained with 0.68 × 1.0 × 1.0 mm resolution and without the banding artifacts experienced by conventional SSFP.

rate, using an 8-channel phased-array cardiac coil. Three healthy volunteers were scanned after providing informed consent. Navigator-gated sequences, illustrated in Figure 1, were used to image the LMCA and proximal LAD in mid-diastole. A conventional cylindrical navigator (4.3 ms excitation), is followed by a spectrally-selective fat saturation pulse, and a Kaiser-Bessel RF ramp to quickly align magnetization with the steady-state. 3DFT image acquisition used a segmented interleaved sequential phase-encoding order. Imaging parameters were: FOV = 26 × 26 × 1.8 cm^3, resolution = 0.68 × 1.0 × 1.0 mm^3, flip angle = 55°, TR/TRs = 3.9/2.4 ms for wideband SSFP and TR = 3.9 ms for conventional SSFP. 3D image reformation was performed off-line.

Results and discussion

Figure 2 shows 3-D reformatted LAD images from one volunteer. A resolution of 0.68 × 1.0 × 1.0 mm^3 was achieved at 3 T with a wideband SSFP sequence in 5 minutes (Figure 2a). Figure 2b shows a conventional SSFP image with the same spatial resolution and TR (3.9 ms), where banding artifacts obstruct the assessment of vessels of interest. Wideband SSFP with TR/TRs = 3.9/2.4 ms is expected to have a 24% wider null-to-null spacing (~317 Hz) compared to SSFP and this increased bandwidth removes the off-resonance artifacts from the region of interest.

Summary

We have demonstrated wideband SSFP in free-breathing 3D coronary artery MR imaging at 3 T. A spatial resolution of 0.68 × 1.0 × 1.0 mm^3 was achieved without the banding artifacts experienced by conventional SSFP with excellent coronary artery imaging.

References

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