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Non-contrast enhanced pulmonary vein MRI with a spatially selective slab inversion preparation sequence

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Introduction

Non-contrast enhanced pulmonary vein (PV) MRI is an alternative to contrast-enhanced PV imaging for assessment of PV anatomy prior to and after PV isolation as a treatment for atrial fibrillation [1,2]. We propose a non-contrast enhanced three-dimensional (3D) free-breathing ECG-gated thin-slab spoiled gradient recalled echo (GRE) sequence with a slab-selective inversion for PV MRI.

Methods

A sagittal inversion slab was applied prior to data acquisition to suppress structures adjacent to the left atrium (LA) and PVs (Figure 1), thereby, improving the conspicuity of the PV and LA. Compared with other MR angiography methods using an inversion pulse, the proposed method does not require signal subtraction and the inversion slab is not parallel to the imaging slab. The feasibility of the proposed method was demonstrated in a cohort of healthy subjects. Typical imaging parameters were: TR/TE/α = 3 ms/1.4 ms/15°, TI = 500 ms, FOV = 300 × 400 × 60 mm^3, isotropic spatial resolution 1.8 × 1.8 × 1.8 mm^3 reconstructed to 0.9 × 0.9 × 0.9 mm^3, 60 mm sagittal inversion slab, ~550 ms trigger delay, 50 views per segment, low-high view order, no parallel imaging . The slab-selective inversion pulse was an adiabatic pulse of the hyperbolic-secant shape. A 2D spiral echo beam navigator echo was positioned on the right hemi-diaphragm. A spectrally selective fat saturation pulse was applied. The proposed imaging technique was performed on 5 healthy subjects using a series of inversion time (TI) and inversion

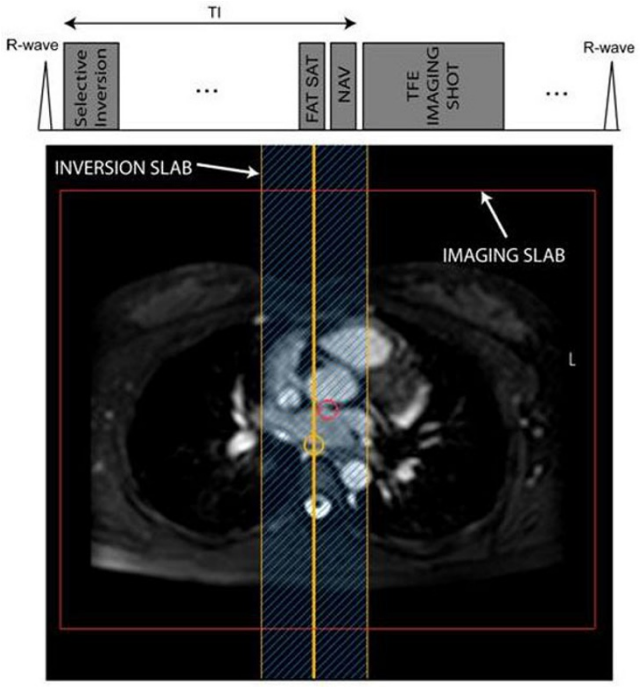

Figure 1
Sequence diagram (top) and illustration of imaging and inversion slab planning (bottom). A slab-selective inversion pulse is applied after the R-wave trigger, which is followed by an inversion time (TI) before imaging.

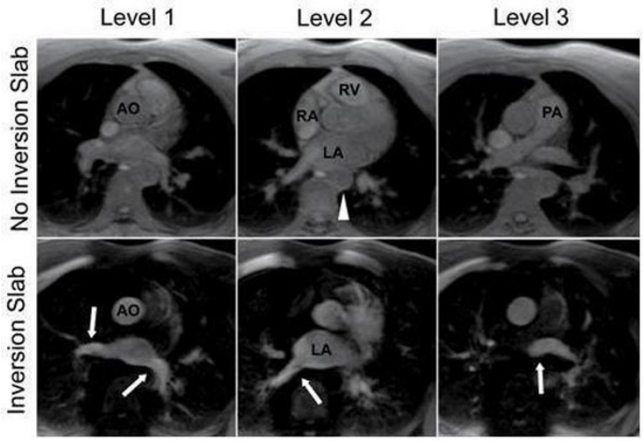

Figure 2
A compatison of images acquired on the same healthy subject using a 3D ECG-gated free-breathing GRE sequence without (top row) and with (bottom row) a sigittal selective inversion slab. The conspicuity and segmentation of the PVs (arrows) and LA was greatly improved.

slab thickness. The TIs and thickness corresponding to the best image quality and PV/LA conspicuity were chosen as the optimal TIs and thickness, respectively. The contrast-to-noise ratios (CNR) between the PVs/LA and the right atrium (RA), ascending aorta and pulmonary artery were measured and compared with conventional non-contrast imaging without inversion.

Results

The inversion slab thickness and TI were optimized to be 60 mm and 500 ms, respectively. Compared to the conventional GRE sequence without inversion, the proposed technique greatly increased the visual conspicuity of the PA and LA (Figure 2). The signal to noise ratios (SNR) of the PVs and the LA was similar with and without inversion ($p > 0.3$), while the signals from the pulmonary artery and the right atrium were greatly reduced using the proposed technique (Figure 3).

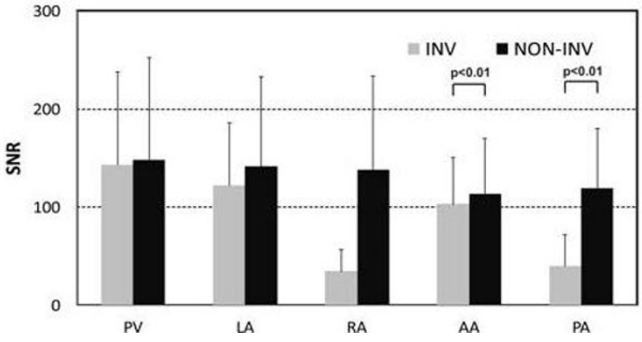

Figure 3
Relative SNR measures between the proposed (INV) and conventional (NON-INV) techniques. The proposed technique greatly suppresses RA and PA signal with minimal impact on PA and LA signal.

Conclusion

The proposed technique greatly enhances the conspicuity of the PVs and LA without significant loss of SNR.

References

1. Francois , *et al.*: *Radiology* 2009, **250(3):**932-939.
2. Krishnam , *et al.*: *Invest Radiol* 2009, **44(8):**447-453.