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Meeting abstract

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159 3D Submillimeter isotropic resolution superficial femoral artery wall MRI using SPACE at 3.0 T

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Introduction

Peripheral artery disease (PAD), affecting approximately 12 million people in the US, is a condition that causes poor circulation in the legs. Magnetic resonance imaging could be used for the noninvasive assessment of atherosclerotic plaque burden in the peripheral circulation. Typically 2D dark blood turbo spin-echo (TSE) techniques are used for arterial wall imaging. Time-of-flight dark-blood preparation schemes typically used in these techniques necessitate 2D cross-sectional imaging, which requires prolonged imaging time to cover a large region of interest in the leg. Variable-flip-angle TSE (SPACE) has been introduced as a dark blood technique for 3D arterial wall imaging [1,2].

Purpose

To evaluate the potential of this technique in assessing atherosclerotic diseases of superficial femoral artery (SFA) at 3.0 T.

Methods

Imaging

5 healthy volunteers and 5 patients (ankle-brachial index: 0.3–0.7) underwent MR scans on a 3.0 T scanner (Tim Trio, Siemens, Erlangen, Germany) using a body phased array coil. SPACE scan was then performed. Imaging parameters were as follows: 1) for volunteers, coronal acquisition with both SFAs covered, TR/TE = 1500/198 ms, average = 2, slice thickness = 0.70 mm, (phase/slice) FOV = 380 × 380 mm, turbo factor = 49, resolution 0.7 × 0. 7 × 0.7 mm^3, TA = 10 min; 2) for patients, sagittal acquisition with only low-ABI SFA covered, TR/TE = 1500/206 ms, average = 2, slice thickness = 0.70 mm, FOV = 380 × 190 mm, turbo factor = 83, resolution 0.7 × 0.7 × 0.7 mm^3, TA = 7.5 min. Single-slice 2D DIR T1, T2 and PD-weighted imaging were performed with resolution of 0.5 × 0.5 × 3 mm^3.

Analysis

The 2D axial slice corresponding to the 2D T2-weighted TSE image was obtained from SPACE by multi-planar reconstruction (MPR). For volunteers, each pair of 2D axial slices of 3D SPACE and 2D TSE around the SFA bifurcation was analyzed using ImageJ (version 1.37 v, NIH, USA) to measure signals of vessel wall, lumen and air. For patients, the plaque region was analyzed using the aforementioned approach. Lumen SNRs efficiency (SNR_{eff}) and wall-lumen CNRs efficiency (CNR_{eff}) were compared between the two scans, and student t-test was used for statistics.

Results

Sample images obtained from a volunteer are shown in Figure 1. SFA of a PDA patient is shown in Figure 2. 3D MPR of whole SFA contains extensive plaque burden obtained with SPACE and the corresponding axial images of vessel wall showing luminal narrowing are also shown in Fig. 2. Volunteer study showed that SPACE achieved

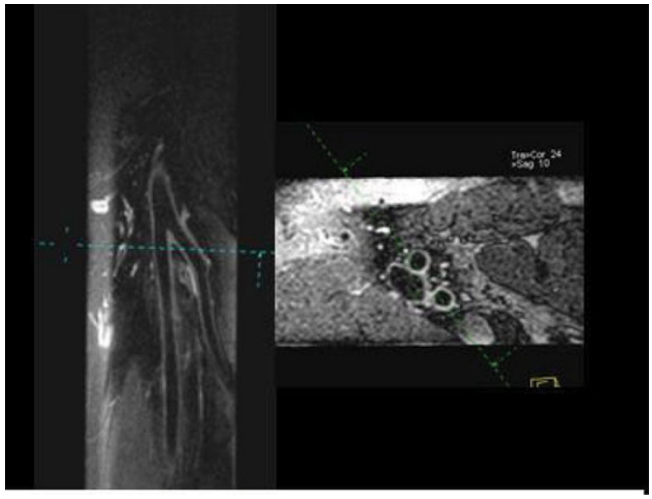

Figure 1
SPACE images showed plaque in any angle which is not capable of being accomplished with 2D TSE. With more time efficient as compared to 2D TSE, SPACE allows an adequate spatial coverage of superficial femoral artery with a high resolution. Healthy volunteer. Left: longitudinal view of the bifurcation of femoral artery into SFA and superficial and deep branches aquired using SPACE. Right: cross-sectional images of the arterial wall by MRI. Both images show very clear vessel wall and lumen.

comparable lumen SNR_{eff} and wall-lumen CNR_{eff} with 2D TSE (lumen SNR_{eff}: 193.47 ± 10.23 vs. 7.65 ± 0.97, $p < 0.001$, wall-lumen CNR_{eff} 215.52 ± 13.25 vs. 12.41 ± 4.37, respectively, $p < 0.001$). A major advantage of 3D is much shorter imaging time to cover the same area (380 mm).

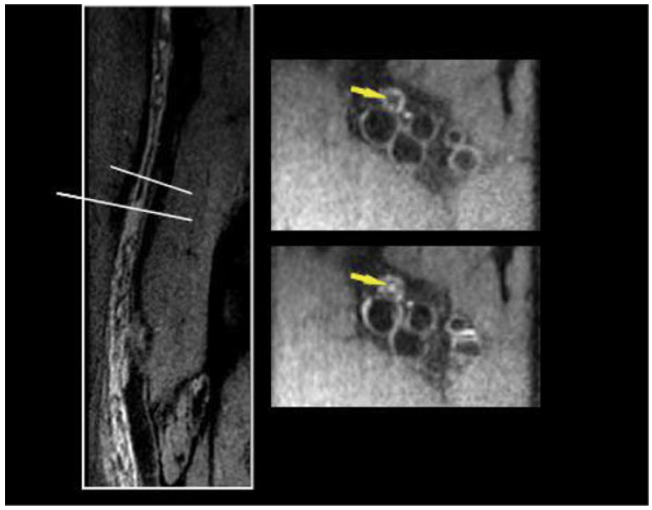

Figure 2
Left: MPR of SPACE shows a longitudinal view of superficial femoral artery with extensive plaques. Right: cross-sectional MPR images of the arterial wall by MRI. Both images show the plaques of wall and lumen.

Conclusion

The results showed that 3D vessel wall imaging of the SFA with the SPACE technique is feasible. In patients, isotropic-resolution SPACE images, with the aid of MPR, showed plaque in any angle which is not capable of being accomplished with 2D TSE. In addition, SPACE imaging was more time efficient as compared to 2D TSE, allowing for an adequate spatial coverage of SFA with a high resolution.

References

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