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Meeting abstract

2109 Long segment carotid artery black blood visualization by simultaneous double-stack acquisition with diffusion preparation

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Introduction

The increasing understanding of atherosclerosis as an important risk factor for the development of acute ischemic events like ischemic stroke has stimulated increasing interest in non-invasive assessment of the structure, composition and burden of plaque depositions in the carotid artery wall. This requires the coverage of larger volumes, which, the often applied 2D dual inversion recovery (DIR) techniques are not able to deliver. However 3D protocols, because of the prolonged scan time, can lead to severe motion artifacts, e.g. from swallowing and the DIR black blood effect is prone to fail in the larger volumes due to saturation effects.

Purpose

The purpose of this work was to develop a time efficient and robust 3D black blood technique to visualize large segments of the carotid arteries, centered on the location of the bifurcations, which are of special clinical interest for the assessment of atherosclerosis.

Methods

Carotid artery wall imaging was performed in 5 patients with suspected atherosclerotic disease. All imaging was performed on a 3 T Whole Body Scanner (Achieva, Philips Medical Systems, Netherlands) equipped with a high performance gradient system capable of a maximum gradient amplitude for imaging of 40 mT m^{-1} using a maximum slew rate of 200 T m^{-1} s^{-1}. All data was acquired with a dedicated two times two-element carotid artery coil sized 120 × 50 mm (Philips Research Europe) with one two-element coil located on either side of the neck. A 3D diffusion prepared, fat suppressed, segmented spoiled gradient echo dual stack sequence was developed (TE/TR 2.1/4.7 ms, TR per segment 1 s, acq. duration 188 ms, Flip 20°, FOV 150 × 30 × 200 mm, Resolution 1 mm isotropic, parallel imaging factor 2 in AP direction, acquisition time 295 s). As reported previously by Koktzoglou [1], suppression of blood signal was accomplished by a motion sensitizing

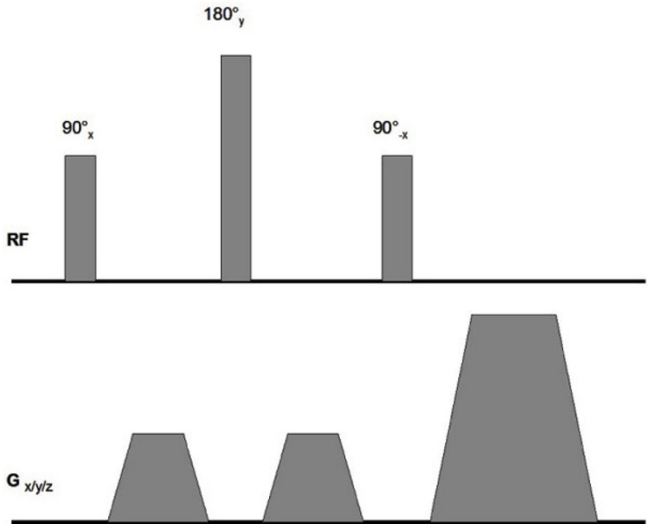

Figure 1
Diffusion prepulse.

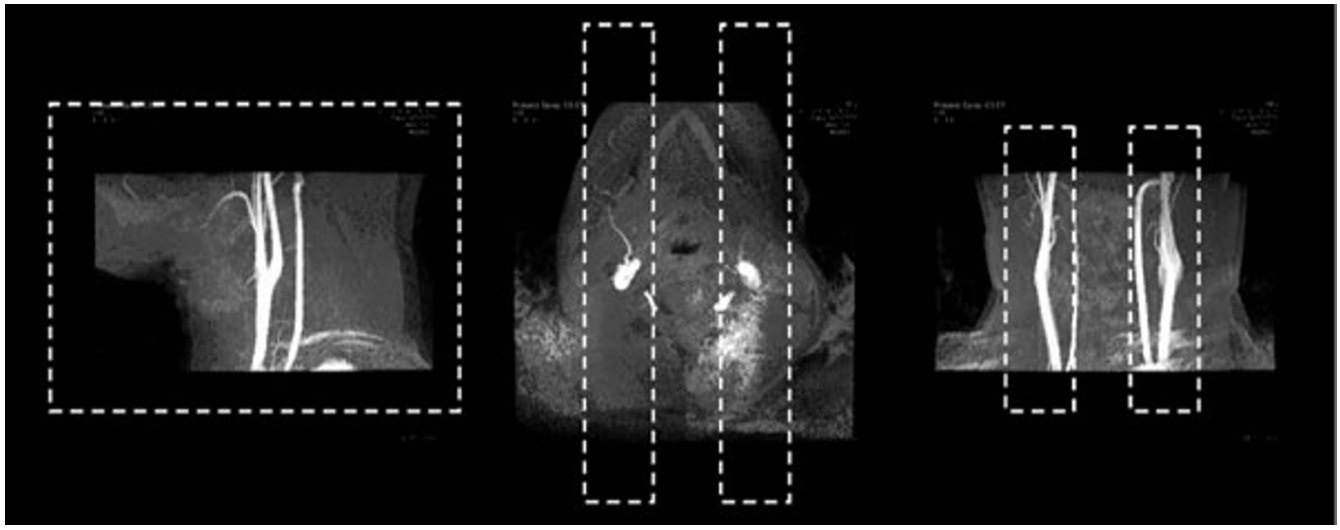

Figure 2
Planning schema for dual stack carotid imaging.

diffusion spin preparation. The preparation comprised a $90°_{x}$-$180°_{y}$-$90°_{-x}$-driven equilibrium technique with integrated magnetic field gradients for dephasing the spins of moving blood. Suppression of residual transversal magnetization was achieved by subsequently applied spoiler gradients (Figure 1). The duration of the preparation was 21.5 ms with a cumulated B-value in all three directions of 17.1 s mm^{-2} applying a 15 mT m^{-1} gradient amplitude for 4.5 ms. The preparation was applied once prior to the acquisition of each k-space segment. The simultaneous dual sagittal stack approach, which, compared to the single coronal stack approach, does not prolong the scan time, was chosen to diminish possible motion artifacts from swallowing. Figure 2 visualizes the planning of the scan geometry. The pharynx is left out of the acquisition and not excited, thus the peril of motion artifacts is greatly reduced.

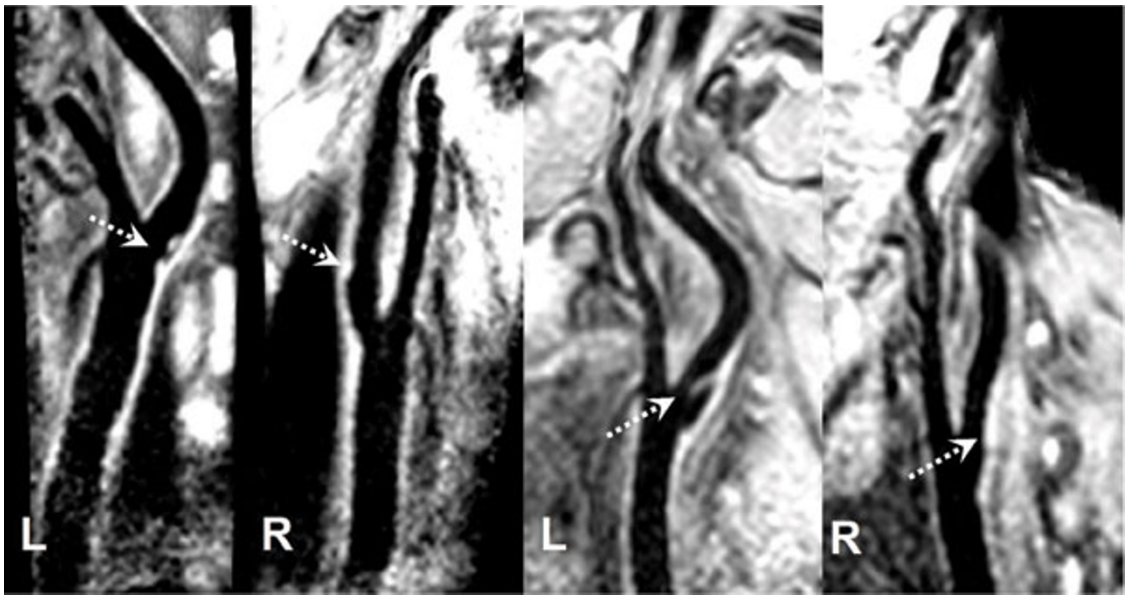

Figure 3
Reformatted images of the carotid arteries of 2 patients with lesions (see arrows).

Results

Figure 3 summarizes the obtainable image quality and coverage of the suggested technique. The carotid artery bifurcations of two patients with plaque lesions (see arrows) are shown as reformatted images. After reformatting, the vessel wall could be clearly depicted over a range of about 15 cm in either patient.

Conclusion

With the suggested dual-stack technique in combination with diffusion prepared black-blood imaging, high quality dark blood imaging of the carotid arteries over a large range appears feasible. This might enable fast overview scans for assessment of the plaque burden in atherosclerotic patients.

References

1. Koktzoglou I, Li D: **Diffusion-prepared segmented steady-state free precession: Application to 3D black-blood cardiovascular magnetic resonance of the thoracic aorta and carotid artery walls.** *J Cardiovasc Magn Reson* 2007, **9(1):**33-42.