CONTRAST-ENHANCED MRA WITH GRASP OUTPERFORMS THE CONVENTIONAL TWIST IN AORTIC DISEASES PATIENTS COHORT

Camilla G. Calastra(1), Fabian Haupt (1), Adrian T. Huber (1), Elena Kleban (1), Hendrik von Tengg-Kobligk (1), Bernd Jung (1)

1. Department of Diagnostic, Interventional and Pediatric Radiology, University Hospital of Bern, Switzerland

Introduction

Gadolinum based contrast-enhanced time-resolved magnetic resonance angiography (CE-MRA) techniques depict the anatomy and dynamics of complex vascular structures [1]. This is desirable to reduce the number of invasive procedures with their inherent radiation exposure on patients. TWIST (Time-resolved angiography With Interleaved Stochastic Trajectories) sequence is commonly used to perform a CE-MRA, it is based on Cartesian acquisition and sharing of k-space data between neighbouring time frames [2]. This trajectory is prone to motion-related image artefacts, which may result in spatial blurring of vessels. A recently introduced time-resolved 3D acquisition technique is GRASP (Golden-angle radial sparse parallel MRI) sequence, combining compressed sensing, parallel imaging, and golden-angle radial sampling and is less sensitive to motion compared to Cartesian acquisition types [3]. The use of GRASP for CE-MRA has not been reported yet. The aim of this patient study is the qualitative and quantitative comparison between TWIST and GRASP on a cohort of patients with aortic diseases.

Methods

N=30 patients (60.87±16.11 y.o., 7 females) with various chronic aortic diseases underwent a clinical examination on a 1.5T scanner (Magnetom SolaFit, Siemens) including a TWIST and a GRASP sequence. For the qualitative assessment, a radiologist assessed overall image quality, contrast, vessel sharpness and image artefacts on a 4-points Likert scale (1=excellent, 4=non-diagnostic). For the quantitative assessment, full width at half maximum (FWHM), temporal signal-to-noise ratio (tSNR) and signal to noise ratio (SNR) [4] were calculated from normalized signal intensity time courses in regions of interest (ROIs) at three aorta levels (see Figure 1). Vessel sharpness (vs) was calculated from intensity profiles at the same aorta levels [5].

Discussion

The GRASP sequence provided a superior overall image quality index, resulting from the qualitative scores of soft tissue contrast, sharpness and vascular contrast level – despite an increased artifact level compared to TWIST (Figure 2). The level of streaking artifacts increases with the level of undersampling. However, most streaking artifacts appeared in the periphery of the field-of-view (FOV) and the images remained of diagnostic value in the aortic regions. The improved vessel sharpness for all ROIs in GRASP is assumed to result from the higher in-plane resolution and from reduced sensitivity of the radial trajectory to respiratory motion. The higher levels of tSNR in GRASP data (also visible in smoother signal-time-courses in Figure 1) are likely linked to the smaller temporal footprint (temporal resolution). In TWIST, k-space lines are taken from a wider time range to reconstruct a single time frame resulting in a temporal footprint three times higher than temporal resolution (based on k-space center A=25% and sampling density of k-space periphery B=33%) [2]. Contrary, the FWHM was lower for TWIST in all locations indicating the weighting of the k-space center for the image contrast in TWIST (scan time for A~1s).

Conclusion

GRASP outperformed TWIST in temporal SNR, SNR, vessel sharpness and reduction in image blurring; streaking artefacts were clearly visible, but did not affect the diagnostic image quality. Including GRASP in the clinical protocols may improve diagnosis of aortic diseases patients.
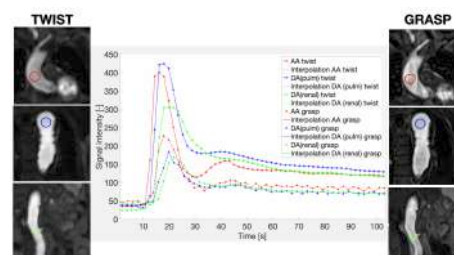

Figure 1: *Signal intensity over time for ascending aorta (AA, red) and descending aorta (DA_pulm, blue) at the level of pulmonary trunk and descending aorta at the level of infrarenal arteries (DA_renal, green) for TWIST and GRASP.*

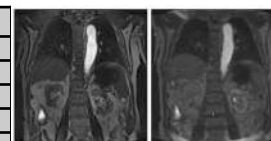|	GRASP	TWIST
vascular contrast	1.46±0.52	1.66±0.44
vascular sharpness	1.5±0.77	2.10±0.75
image artefacts	2.63±0.66	2.23±0.48
overall image quality	1.5±0.65	1.87±0.57
soft tissue contrast	2.6±0.60	2.8±0.51

Figure 2: (left) *Qualitative assessment presented as mean ± standard deviatio; **(right)** overall image quality comparison between GRASP (left) and TWIST (right).*

References

1. Grist TM et al. J Magn Reson Imaging, 36:1273-86, 2012.
2. Laub G et al. MAGNETOM Flash, 3;92-95, 2006.
3. Feng L et al. Magn Reson Med 72:707-17, 2014.
4. Goerner FL et al. Med Phys, 38(9): 5049–5057, 2011.
5. Larson AC et al. Magn Reson Med 53:159-168, 2005.
6. Robson PM et al. Magn. Reson. Med. 60:895-907, 2008.
7. Velikina JV et al. Man. Reson Med 70: 1263-1273, 2012.