Applicability of real time imaging for assessing left-ventricular function in patients with acute ST elevation myocardial infarction at 3T.

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Target audience: This work targets the clinical cardiac MR community (i.e. researchers and physicians).

Purpose. Cardiovascular Magnetic Resonance (CMR) is the gold standard to assess injury in patients with acute myocardial infarction (MI). However, successful scanning in acutely ill patients may be challenging due to arrhythmias and difficulty in breath-holding. Thanks to recent developments, new fast free-breathing and free-gating real time sequences for functional imaging have become available, including through-time radial GRAPPA.[1] We aimed to assess the feasibility real time functional imaging using this method in patients with acute ST elevation MI, and to compare LV function values to those obtained with conventional cine imaging.

Methods. Seven ST elevation myocardial infarction (STEMI) patients underwent 3T CMR (Siemens Verio), 24 hours post primary percutaneous coronary intervention (PPCI). The CMR protocol included acquisition of matching 9-11 short axis slices covering the entire left ventricle (LV) using both conventional (Cartesian) retrospectively gated SSFP ('*CONV*') (TE/TR_{seg}=1.47/46.5ms, voxel size: 1.6x 1.6 x8 mm, temporal resolution – 16 segments per RR interval) and a radial real time ('*RT*') bSSFP imaging (TE/TR_{phase}=1.58/50.6ms, FOV – 30x30cm, 128 readout points, 16 projections per image, 80 phases, oversampling factor 2). 16 fully sampled calibration data sets (128 projections) were acquired prior to the *RT* acquisition for calculating the coil weights. Image reconstruction was performed offline in Matlab using the through-time radial GRAPPA[1] reconstruction with all 16 calibration frames and a segment size of 8x4 (read x projection), followed by exporting the images into DICOM. Left-ventricular volumes and ejection fraction were assessed in CMR42.

Results. Acquisition of LV datasets using both sequences was successful in all patients. Representative images are shown in Fig.1. All patients were in sinus rhythm (heart rate = 74 ± 18 bpm). The duration of the acquisitions was 5-8 mins vs 2 mins 50 secs using *CONV* SSFP vs *RT* (including calibration scans), respectively. LVEF was 52 ± 14% vs 52 ± 13%, *CONV* vs *RT* (p=0.9). LV volumes were as follows: EDV – 165 ± 39 mL vs. 154 ± 30 mL (p=0.6); ESV – 87±31 mL vs. 78 ±27 mL (p=0.6); SV =79±14 mL vs. 76±22 mL (p=0.8), *RT* vs. *CONV* cine, respectively. Bland-Altman analysis of LVEF, which is shown in Fig 2, shows excellent agreement between both methods with a negligible bias of 0.8%.

Fig. 1: Representative RT *(left) and* CONV *(right) cine images (diastolic frame).*

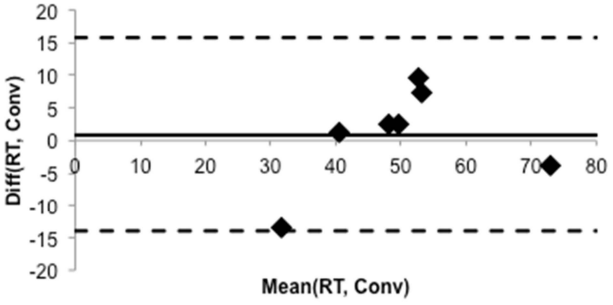

Fig. 2: Bland-Altman plot for LVEF. The bias was 0.8% (solid line), and the dashed lined indicate the confidence interval (i.e. ±1.96 SD).

Discussion. *RT* imaging for assessment of LV function in patients with acute STEMI is feasible, providing time saving by allowing for shorter scan protocols. Importantly, it overcomes limitations due to poor breath-holding required for *CONV* imaging, commonly observed in this patient group. Importantly, LV volumes and EF's were comparable between both acquisitions.

Conclusion: Real time imaging with through-time radial GRAPPA and only 16 calibration data sets allows for an accurate and rapid assessment of LV function, and may become a valuable tool for clinical applications in acutely ill (STEMI) patients. Future work aims to provide further time saving, and to extend the application to arrhythmic patients.

References: .1. Seiberlich N, Ehses P, Duerk J, Gilkeson R, Griswold M. Improved radial GRAPPA calibration for real-time free-breathing cardiac imaging. Magn Reson Med 2011;65:492-505.

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