

Acquisition of velocity-encoded CMR is feasible in presence of contrast agent, but delineation for strain is difficult

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INTRODUCTION: Quantitative assessment of blood flow and cardiac function is of importance for diagnosis and evaluation of treatment. Blood flow and regional myocardial function such as strain and myocardial displacement can be measured using phase-contrast cardiac magnetic resonance imaging (PC-CMR). Since a gadolinium-based contrast agent often is utilized in the same CMR session for acquisition of myocardial infarct size, it is of importance to know whether presence of contrast agent has impact on quantification using PC-CMR data, subsequent to e.g. altered SNR and/or additional phase effects owing to the contrast agent administration. We sought to determine whether the presence of contrast agent affects measurements of blood flow in the aorta, and myocardial displacement of the left ventricle in humans.

METHODS AND MATERIAL: In 17 patients (14 men, median age 62 years, range 41–73) with a first-time myocardial infarction, velocity data was acquired for aortic flow and regional myocardial long-axis function during free breathing in 33 and 37 samples pre and post contrast agent administration (0.2mmol/kg Gd-DOTA), by PC-CMR using a 1.5 T Philips Intera CV scanner. Spatial resolution and v_{enc} was $1.4 \times 1.4 \times 6 \text{ mm}^3$ and 2.0m/s and $1.6 \times 1.6 \times 8 \text{ mm}^3$ and 0.2m/s for aortic flow and for regional myocardial function, respectively. The software Segment was used for aortic flow evaluation, and a recently developed and validated automated method in MatLab for analysis of regional myocardial function. For comparison pre and post contrast agent, cardiac output was calculated as mean velocity multiplied by ROI area over the cardiac cycle, multiplied by heart rate, and for regional myocardial function myocardial displacement was calculated pixelwise at end systole by integration of velocity with respect to time.

RESULTS: The difference in cardiac output pre and post contrast agent was -0.04 ± 0.52 l/min (Figure 1A). Linear regression for myocardial displacement (MD) showed $MD_{postCA} = 0.95MD_{preCA} + 0.04$ ($r=0.97$), and MD_{postCA} was 0.1 ± 0.5 mm shorter than MD_{preCA} (Figure 1B). Magnitude image contrast for regional myocardial function was visually lower in the post contrast agent images (Figure 1C).

CONCLUSIONS: Acquisition of aortic flow is feasible both in the absence and presence of contrast agent. This implies that the total examination time can be reduced when assessing both viability and quantitative flow using CMR, since flow can be assessed after contrast agent administration. Even though data for regional myocardial function is assessable both in the absence and presence of contrast agent, delineation of the myocardium after contrast agent administration may be difficult due to the lower image contrast. Acquisition of regional myocardial function using PC-CMR should therefore currently be performed pre contrast agent administration.

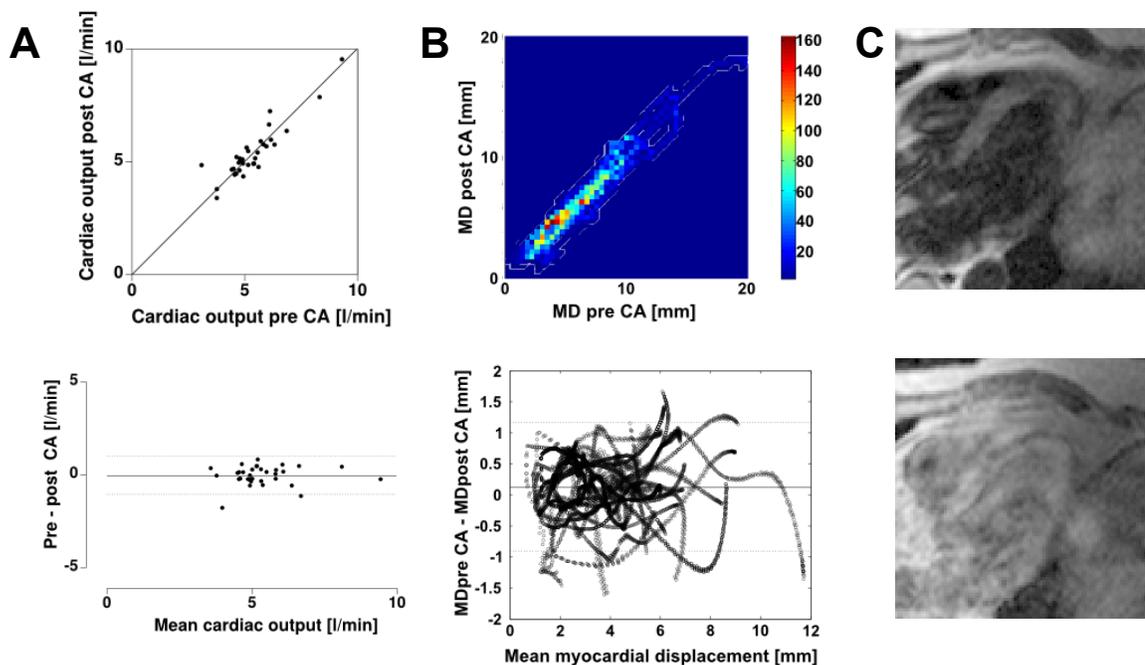


Figure 1. A) Agreement (top) of cardiac output between pre and post contrast agent acquisitions. Bland-Altman plot (bottom) showing differences between pre and post contrast agent acquisitions (mean and ± 2 SD indicated). B) Corresponding data and analysis for myocardial displacement shown as a 2D histogram and Bland-Altman plot. The Bland-Altman plot complex view is related to the amount of data. C) Magnitude images for regional myocardial function pre (top) and post (bottom) contrast agent administration. CA=contrast agent; MD=myocardial displacement.