The pulmonary blood volume variation decreases after experimentally induced myocardial infarction in pigs – a novel quantitative MRI-based measure of preload?

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BACKGROUND: The assessment of heart failure currently lacks diagnostically useful quantitative non-invasive measures of preload. Therefore, the aim of this study was to use novel MRI methods to measure the changes in pulmonary blood volume (PBV) and the PBV variation (PBVV) throughout the cardiac cycle, in experimental heart failure.

METHODS: 5 pigs were studied before and after myocardial infarction induced by 40 minutes of LAD balloon occlusion and reperfusion. PBV was calculated as the product of cardiac output determined by velocity encoded MRI (Philips Intera 1.5T) in the pulmonary artery, and the pulmonary transit time determined as the time for a 1 ml intravenously administered contrast bolus (gadopentetate dimeglumine, 0.5 mmol/ml) to pass from the pulmonary trunk to the left atrium during real time MR imaging at 10 images/s. Furthermore, the blood flow in the pulmonary artery and the pulmonary veins were measured using velocity encoded MRI. The difference in arterial and venous pulmonary flow during the cycle was integrated in order to calculate the PBVV.

RESULTS: Stroke volume, ejection fraction, PBV and PBVV before and after experimentally induced heart failure were (mean±SEM [%change]) 39±1 ml vs. 23±2 ml [-42%] ($p<0.05$), 55±2% vs. 40±2% [-28%] ($p<0.05$), 202±12 ml vs. 209±19 ml [+6%] ($p=0.69$), and 30±3 ml vs.12±1 ml [-57%] ($p<0.05$), respectively.

CONCLUSIONS: Following the induction of infarction and heart failure, stroke volume, ejection fraction and PBVV, but not PBV, decreased significantly. The greatest percentage change was seen in PBVV, indicating that it may be the most sensitive measure of heart failure. Further studies are needed to assess the utility of PBVV as a quantitative non-invasive measure of heart failure.