

Present Cardiac MRI protocols do not reliably measure ventricular volumes due to variations in breathing technique

Introduction: Cardiac MRI (CMR) is the gold standard for right ventricular (RV) volumetric assessment. CMR protocols use breath holds to obtain clear images. Acceptable error and prolonged acquisition sequences add difficulty to quantification of left ventricular (LV) and RV volumetric changes during respiration.

Hypothesis: CMR measured ventricular volumes differ with free breathing and breath hold techniques.

Methods: Non-sedated two ventricular physiology patients enrolled while undergoing clinical CMR studies. All data was derived from a single mid-papillary, short axis slice. Baseline was averaged from 2 free breathing cine acquisitions. Then a breath hold was performed and multiple cine acquisitions were obtained to the limit of the patient's ability. Patients performed both end inspiration and end expiration maneuvers. Endocardial borders were measured to calculate volumes. Patients served as their own controls so volumetrics were reported as percent change from baseline. Differences were deemed statistically significant for $p < 0.05$ with a 95% confidence interval.

Results: Of the 69 patients (13-87 years) enrolled, 50 completed the protocol and 47 had usable images. RV end diastolic volumes (EDV) increased throughout inspiratory breath holds. In contrast, RV EDV initially decreased then recovered during expiratory breath holds. LV EDV decreased over time with inspiratory breath holds and did not change significantly during expiratory breath holds. Stroke volumes followed EDV patterns. (Figure 1).

Conclusions: Both breathing technique and length of breath hold significantly alter ventricular volumetrics in CMR studies. These findings are consistent with expected physiologic changes in venous return during the respiratory cycle. Adjustments need to be made when comparing CMR studies with differing breathing techniques.

