Relative Area Change (RAC) Better Reflects Right Ventricular Ejection Fraction (RVEF) than Longitudinal or Transverse Functional Measurements in Pulmonary Hypertension Patients

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Introduction

Right ventricular ejection fraction (RVEF) may be better reflected by transverse than longitudinal right ventricular functional measurements using cardiac MRI [1]. Right ventricular relative area change (RAC) provides information of both longitudinal and transverse RV function, and hence may be a better marker of RVEF that can be calculated just as rapidly from ROI based measurements on the same 4 chamber image slice. This study in patients with pulmonary hypertension (PH) assesses the relation of RAC, transverse and longitudinal RV measurements with RVEF as calculated from multislice cine MRI.

Methods

206 patients who underwent cardiac MR and right heart catheterization within 48hrs were studied. Of the 206 patients studied 173 had PH as defined by mean pulmonary arterial pressure (mPAP) ≥ 25mmHg the remaining 33 were labelled as 'no PH'. MR imaging was performed on a 1.5T whole body scanner (GE HDx), 4 chamber and short axis (SA) cine images were acquired using a cardiac gated multi-slice steady state free precession sequence (20 images per cardiac cycle, slice thickness 8mm, FOV 48, matrix 256 x 256, BW 125 KHz/pixel, TR/TE 3.7/1.6 ms). RAC expressed as a percentage was calculated from the 4 chamber plane images using the following formula: RAC =[(Diastolic area-Systolic area)/Diastolic area]100. Longitudinal RV function was assessed using tricuspid annular plane systolic excursion (TAPSE) [2] and fractional tricuspid annulus apex distance change (fractional-TAAD). Transverse RV function was determined using change of the septum-free-wall distance (SFD) and fractional-SFD [1]. Global RV pump function was measured using right ventricle ejection fraction (RVEF) as calculated from the SA image stack. Linear regression was used to test the relations of these MR parameters with RVEF and an unpaired t-test was used for group comparisons.

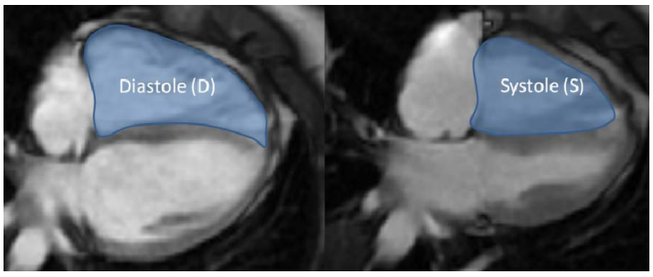
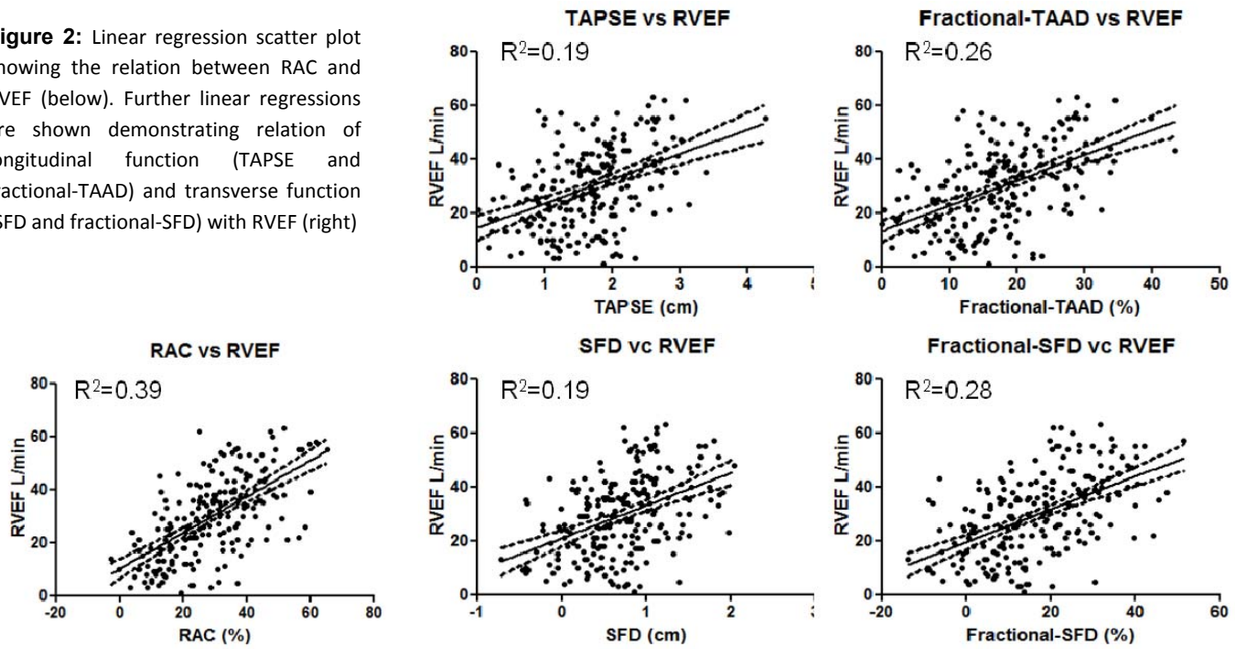


Figure 1: Images demonstrate calculation of percentage RV RAC using the end-diastole image (D) and end-systole image calculated from 100[(D-S)/D].

Results

Of the 206 patients studied 173 had PH as defined by mean pulmonary artery pressure ≥ 25mmHg the remaining 33 were labelled as 'no PH'. A significant relationship was demonstrated between RAC and RVEF (R^2=0.39, p=0.0001). TAPSE, SFD, fractional TAAD and fractional-SFD all had weaker relations with RVEF (R^2 =0.19, R^2=0.19, R^2=0.26, and R^2=0.28 respectively), all significant at p<0.0001. PH and 'no PH' patients had a mean RAC of 26.21±1.03 and 39.83±1.55 respectively, with PH patients having significantly lower RAC values than those with 'no PH' (p<0.0001).

Figure 2: Linear regression scatter plot showing the relation between RAC and RVEF (below). Further linear regressions are shown demonstrating relation of longitudinal function (TAPSE and fractional-TAAD) and transverse function (SFD and fractional-SFD) with RVEF (right)



Conclusion

RVEF is better reflected by RAC than longitudinal wall motion or transverse wall motion in patients with PH. We postulate this is because RAC assesses RV function in both the transverse and longitudinal directions. Transverse RV function showed a similar correlation to longitudinal function for predicting RVEF in our mixed cohort of PH patients.

References

1. Kind, T., et al., *Right ventricular ejection fraction is better reflected by transverse rather than longitudinal wall motion in pulmonary hypertension.* J Cardiovasc Magn Reson, 2010. 12: p. 35.
2. Forfia, P.R., et al., *Tricuspid annular displacement predicts survival in pulmonary hypertension.* Am J Respir Crit Care Med, 2006. 174(9): p. 1034-41.