

Impaired CMR-derived rapid semi-automated right atrial longitudinal strain is associated with decompensated hemodynamics in pulmonary arterial hypertension

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The transition of right ventricle (RV) from a compensated to decompensated state contributes to survival in pulmonary arterial hypertension (PAH). However, little is known about the significance of right atrial (RA) dysfunction on disease progression in PAH. We present a rapid assessable strain parameter that requires the automatic tracking of only 3 anatomical reference points – thus avoiding the segment contour tracking near the insertion of the anterior leaflet into the tricuspid annulus (Fig. 1). The calculation of RA longitudinal strain (ϵ) at any time point (t) in the cardiac cycle from the time of minimal RA volume (time 0) is based on the Lagrange strain formula as follows: $\epsilon(t) = (L(t) - L_0) \times 100/L_0$. Three phasic strain measurements are derived (**Fig. 1**).

The RSA method was applied in a group of 80 PAH patients, including 58 with hemodynamically compensated RV function (PAH-C) and 22 with decompensated RV function (PAH-D), and 80 age- and gender-matched normal controls. In PAH compared to controls, significantly reduced RA strains and SRs were observed. Among PAH patients, PAH-D had significantly impaired RA strains and SRs compared to PAH-C. RA total strain and passive strain were the best parameters for differentiating PAH-D from PAH-C. Reduced RA strains were significantly associated with higher risk of clinical worsening in PAH. RA passive strain was the best predictor of a composite adverse event endpoint (Harrell's C-statistic, 0.75; hazard ratio, 0.84; $P=0.019$) compared to other conventional RA and RV functional measurements. RA strain parameters investigated, which are highly reproducible and readily obtainable from post-processing of standard 4-chamber cine CMR images, are promising candidate indices for non-invasive detection of RA dysfunction, RV decompensation and monitoring of disease progression in PAH patients.

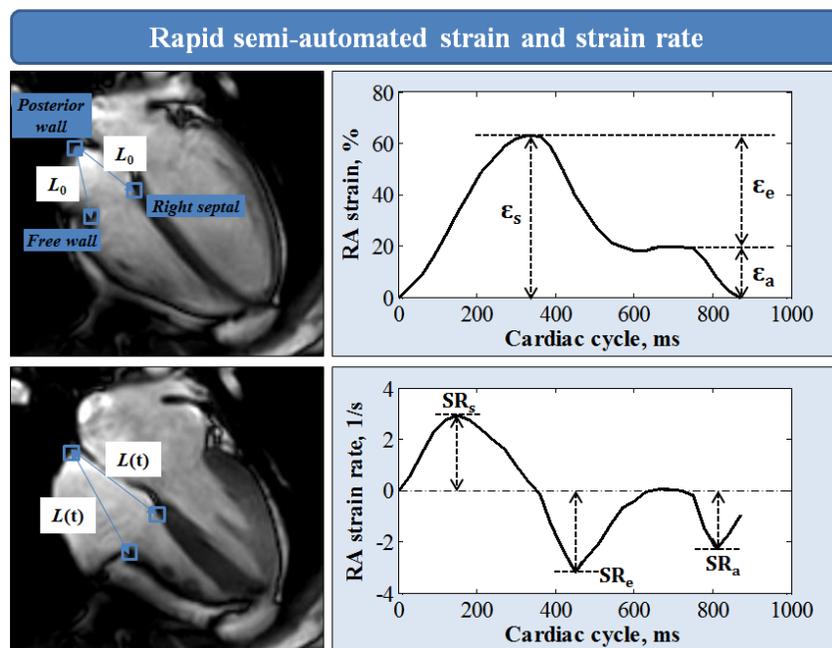


Figure 1. Rapid semi-automated right atrial strain and strain rate measurement in 4-chamber view. L denotes the distance between the right atrioventricular junction (right septal and free wall) and a user-defined point at the mid posterior right atrial wall on standard cardiovascular magnetic resonance 4-chamber view. Rapid semi-automated strain was derived from time variation of distance L . Total strain (ϵ_s) and strain rate (SR_s) correspond to reservoir function. Passive strain (ϵ_e) and strain rate (SR_e) correspond to conduit function. Active strain (ϵ_a) and strain rate (SR_a) correspond to booster pump function.