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Late diastolic radial motion is the main determinant of right ventricular filling in heart transplant recipients

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Late diastolic radial motion is the main determinant of right ventricular filling in heart transplant recipients

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Previous investigations confirmed the maintained, however, mechanically altered systolic function of the right ventricle (RV) in patients underwent heart transplantation (HTX). On the other hand, changes in RV diastolic function in this population may be of high clinical interest as well.

Our aim was to quantify the overall contribution of longitudinal and radial components of diastolic RV wall motion in HTX patients compared to healthy volunteers.

47 HTX recipients (median of 258 days after HTX) were enrolled in the study, and 29 age- and gender matched healthy volunteers (CTL) served as the control group. Full volume datasets of the RV were acquired and 3D beutel models were created and exported volume-by-volume. Beyond conventional echocardiographic parameters, such as RV end-diastolic volume (EDV), we have determined the early (E) and late (A) diastolic filling volumes as well. Using our custom method, we were able to decompose the motion of the RV along the three orthogonal axes and quantify the relative contribution of radial and longitudinal motion to the two phases of diastolic filling (E[rad], E[long], A[rad], A[long]) and also the overall contribution of these components (Dia[rad] and Dia[long]).

Compared to CTL, HTX patients have significantly higher EDV (HTX vs. CTL 96±28 vs. 79±26 mL, $p<0.01$). In the CTL group, the early diastolic filling volume was significantly higher, while in HTX patients the late diastolic filling was more dominant (E: 21±9 vs. 28±10 mL A: 20±12 vs. 11±5 mL, both $p<0.01$) suggesting impaired relaxation. The overall effect of longitudinal motion to diastolic filling is significantly lower in the HTX group, however, an increased radial contribution is present (Dia[long]: 10±8 vs. 14±4 mL; Dia[rad]: 23±8 vs. 17±7 mL, both $p<0.001$). Using multivariate analysis, in healthy volunteers the RV filling volume was mainly determined by E[rad] ($\beta=0.56$), E[long] ($\beta=0.45$) and A[long] ($\beta=0.34$), however, the late diastolic radial filling had a minor role (A[rad] $\beta=0.18$; overall $R^2=0.93$). In contrast to these findings, in HTX patients the late diastolic radial filling became far dominant (A[rad] $\beta=0.63$), followed by the other three components of RV filling (E[rad] $\beta=0.51$; E[long] $\beta=0.34$; A[long] $\beta=0.21$; overall $R^2=0.93$). Interestingly, all four parameters were independent predictors of diastolic filling volume in both study groups, referring to the separate physiological origin of these components.

Our findings suggest a remarkable functional shift in RV diastolic function in HTX recipients. While in healthy volunteers the longitudinal relaxation is superior, in HTX patients the late radial filling became dominant. Longitudinal and radial motion both in early and late diastole are independently predict the RV diastolic filling in HTX and in healthy as well, implying separate mechanisms behind these filling components.