

Shift in relative contribution of longitudinal and radial motion to global right ventricular function in heart transplant patients

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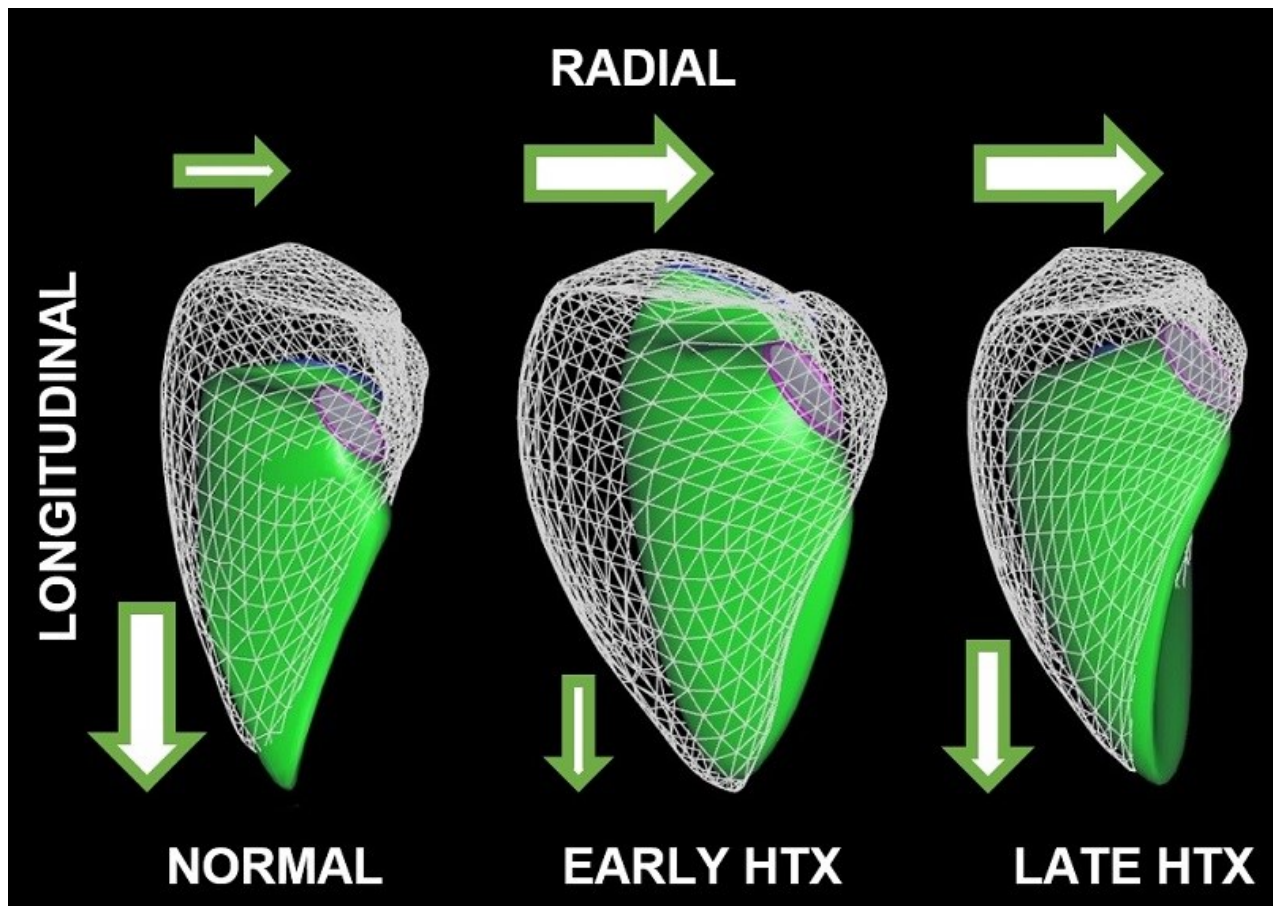
Longitudinal shortening is considered to be the most important motion determining right ventricular (RV) function. However, the radial direction ("bellows" effect) can gain particular importance in certain conditions.

Our aim was to quantify the longitudinal and the radial components of RV performance using three-dimensional (3D) echocardiography in patients after heart transplantation (HTX) and assess their relative contribution to RV function in time.

Fifty-one ambulatory HTX patients (median of 226 days after HTX) and 35 age- and gender matched healthy volunteers were enrolled. Fifteen HTX patients also completed one-year follow up. Beyond conventional echocardiographic protocol, full volume datasets were acquired using multi-beat reconstruction from 4 or 6 cardiac cycles. Using dedicated software for RV 3D and speckle-tracking analysis (4D RV-Function 2), 3D beutel model was created and exported volume-by-volume throughout the cardiac cycle. Beside end-diastolic volume (EDV) and total ejection fraction (TEF), we quantified longitudinal (LEF) and radial ejection fraction (REF) by decomposing the motion of each vertex of the reconstructed 3D beutel model along three orthogonal axes and omitting the other two directions.

EDV was higher, TEF was mildly decreased in HTX patients compared to controls (HTX vs. control; EDV: 96±27 vs. 80±26mL, TEF: 47±7 vs. 51±4%, both $p<0.01$). In normal subjects, TEF was mainly determined by longitudinal motion (LEF $\beta=0.64$, REF $\beta=0.54$, $R^2=0.52$, $p<0.001$), however, in HTX patients the radial motion became far dominant (LEF $\beta=0.49$, REF $\beta=0.84$, $R^2=0.87$, $p<0.001$). After one-year follow up, EDV and TEF did not change significantly (EDV: 96±27 to 101±21mL, TEF: 47±7 to 52±9%, both NS). Notably, longitudinal function improved in time (LEF: 12±4 to 15±5%, TAPSE: 14±3 to 17±3mm, free wall longitudinal strain: -19±6 to -26±5%, all $p<0.05$). Nevertheless, radial function remained dominant (LEF $\beta=0.48$, REF $\beta=0.66$, $R^2=0.65$, $p<0.001$). TAPSE and free wall longitudinal strain correlated with the time elapsed after HTX ($r=0.57$ and $r=-0.48$, respectively, both $p<0.001$).

Our software allows to quantify longitudinal and radial motion of the RV separately using 3D analysis. Current results confirm the empirical phenomenon on the superiority of radial motion in determining RV function in HTX patients. In time, longitudinal function may recover, however, radial motion remains dominant.



Relative contribution to RV function