RIGHT VENTRICULAR GEOMETRIC SHORTENING IN PULMONARY ARTERIAL HYPERTENSION: FOLLOW-UP IN SURVIVORS AND NON-SURVIVORS

J. T. Marcus[1], G. J. Mauritz[2], T. Kind[2], M. van de Veerdonk[2], N. Westerhof[2], and A. Vonk-Noordegraaf[2]
[1]*Physics & Medical Technology, VU University Medical Center, Amsterdam, Netherlands,* [2]*Pulmonary Diseases, VU University Medical Center, Amsterdam, Netherlands*

Rationale Many studies have focused on describing RV dysfunction in patients with Pulmonary Arterial Hypertension (PAH), but few have addressed the deterioration of RV function over time. It is important to recognize those patients who are prone to develop RV failure and early mortality, in order to put those on a lung transplantation list. As yet, for clinical follow-up, longitudinal RV shortening is used as a practical RV functional measure [1].

Objectives Our aim is to study the changes of right ventricular (RV) geometric shortening in surviving and non-surviving PAH patients, in order to characterize the non-survivors in an early stage.

Methods We reviewed 42 consecutive PAH patients who underwent right heart catheterization and cardiac MRI at baseline and 1-year follow-up before 2006. Based on the survival after baseline, patients were classified into two groups: survivors (26 patients) who survived more than 5 years, and non-survivors (16 patients) who died between 1 and 5 years. MRI was performed using a 1.5 T Siemens Sonata MRI system (Siemens Medical Solutions, Germany), equipped with a 6-element phased-array coil. ECG-gated cine imaging was performed during breath-holds, using a balanced steady-state free precession pulse sequence. Four-chamber cine images were used to quantify RV longitudinal shortening (apex-base distance change), RV transverse shortening (septum to free wall distance change as shown in fig 1 [2]), and RV fractional area change (RVFAC) between end-diastole and end-systole. A stack of parallel short-axis cine images was used for calculating RV ejection fraction.

Results At baseline, pulmonary artery pressure and pulmonary vascular resistance were <u>not</u> different between survivors and non-survivors. However, at baseline, RV longitudinal shortening, transverse shortening, and RVFAC were smaller in the non-survivors than in the survivors ($p < 0.05$). Longitudinal shortening did not change any more between baseline and 1 year follow-up in both patients groups ($p = 0.48$). Transverse shortening and RVFAC remained the same in the survivors. By contrast, in the non-survivors, transverse shortening decreased from 5 ± 5 mm to -1 ± 5 mm ($p < 0.01$), and RVFAC decreased from 24 ± 10 % to 17 ± 10 % ($p < 0.001$) at 1 year follow-up (fig 2A). This decrease in RVFAC was associated with a decrease in RV ejection fraction (RV EF, fig 2B).

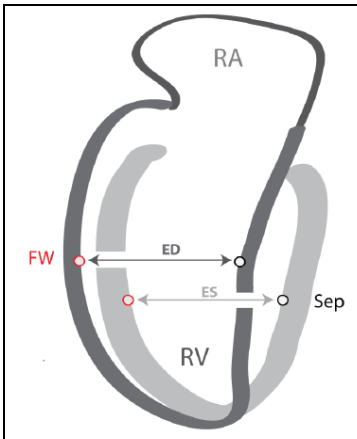

Fig 1. RV transverse shortening, defined as the distance change between RV free wall (FW) and septum (Sep) between end-diastole (ED) and end-systole (ES).

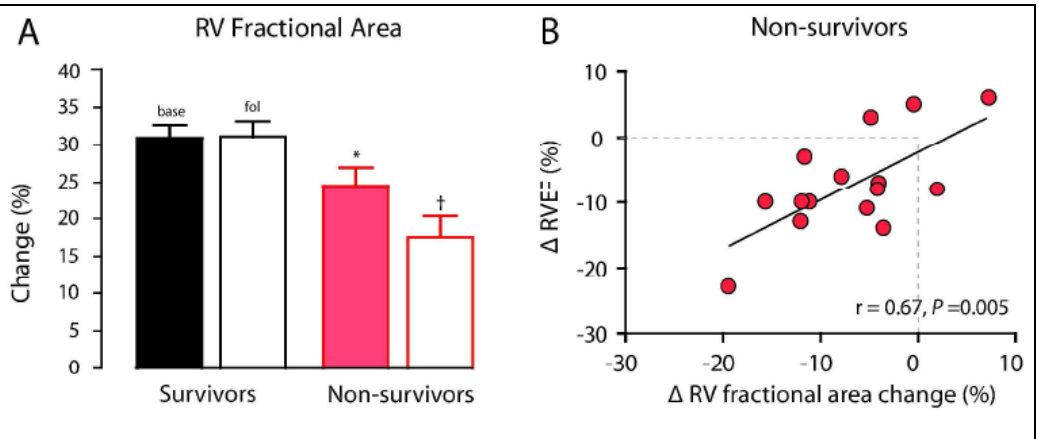

Fig 2. Bar plots showing the averaged RV fractional area change (RVFAC) (**A**) of s*urvivors* (black bars) and *non-survivors* (red bars) for baseline (filled bars) and follow-up (open bars). For the *non-survivors* the decrease in RVFAC correlated with the decrease in RVEF at follow-up (**B**).
(*) = P <0.05 compared to baseline *survivors*;
(†) = P<0.001 compared to baseline *non-survivors*

Conclusions Non-surviving PAH patients are characterized by a continued decline in RV transverse shortening and in RVFAC, while RV longitudinal shortening remains the same. This underscores the importance of measuring RV transverse shortening and RVFAC by MRI, for the follow-up of patients in clinical practice.

References

[1] Forfia PR, Fisher MR, Mathai SC et al. Tricuspid annular displacement predicts survival in pulmonary hypertension. *Am J Respir Crit Care Med* 2006; 174(9):1034-1041.
[2] Kind T, Mauritz GJ, Marcus JT et al. Right ventricular ejection fraction is better reflected by transverse rather than longitudinal wall motion in pulmonary hypertension. *J Cardiovasc Magn Reson 2009*;12:35.