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Navigating Upstream and Downstream: Unleashing the Prognostic Potential of RVFWLS/PASP Ratio in Severe Tricuspid Regurgitation

Corentin BOURG¹, Elizabeth CURTIS¹, Erwan DONAL¹

1- Department of Cardiology, University of Rennes, CHU Rennes, Inserm, LTSI - UMR 1099, F-35000 Rennes, France.

Corresponding author:

Erwan DONAL

Cardiology, CHU Rennes,
Rennes, Bretagne, France;
erwan.donal@chu-rennes.fr

The right ventricle caught our eye

The right ventricle (RV) has been the neglected sibling of the left ventricle (LV) for many years. While the LV has historically garnered most of the attention and research focus, in recent years there is a growing recognition of the pivotal role played by the right ventricle, and the interaction with tricuspid regurgitation (TR). (1) This valvular disease is no longer considered benign and holds significant prognostic and quality of life implications for patients.

In recognition of this, the management of tricuspid regurgitation, has emerged as an important area of investigation. The regurgitant flow imposes a hemodynamic burden on the right ventricle, leading to increased wall stress, volume overload, and altered contractile dynamics. These changes can result in RV dilation, impaired systolic and diastolic function, and ultimately, right heart failure. (2)

As researchers delve further into the pathophysiological mechanisms of tricuspid regurgitation (TR), a greater understanding of the intricate interplay among tricuspid valve dysfunction and right ventricular function is emerging. The concept of “coupling” of RV function to pulmonary pressures to describe the adaptation and subsequent dysfunction of the RV has been described and appears to be a promising tool in risk stratification.

Recognizing the prognostic significance of TR and its impact on the right ventricle has prompted a paradigm shift in clinical management. Cardiologists are now emphasizing the importance of early detection, accurate assessment, and tailored treatment strategies for severe TR, with the goal of preserving right ventricular function and improving long-term outcomes. (3)

Recent advances in non-invasive imaging techniques have provided powerful tools to assess RV morphology, function and severity of TR. (4)

What happens upstream?

The right atrium also plays a crucial role in the pathophysiology of TR. The right atrium can either be the cause of the valvular regurgitation, or atrial dysfunction can be a result of the chronic volume and pressure loading. This leads to remodeling and changes in atrial mechanics, including alterations in strain patterns.

Right atrial strain, measured through speckle tracking imaging, provides valuable insights into atrial function and can serve as an additional marker of disease severity and prognosis when right atrial strain is decreased in patients with TR. (5)

Understanding the importance of right atrial strain in the presence of tricuspid regurgitation allows for a more comprehensive evaluation of the overall right heart function. By incorporating this parameter alongside RV function and pulmonary artery pressures, clinicians can obtain a more nuanced understanding of the hemodynamic burden, mechanism of TR and disease staging.

Go downstream and don't stop profiling!

We know that the right ventricle is more sensitive to afterload than the left ventricle (6) and the available markers can be limited in conditions that amplify this sensitivity. Thus, the coupling between the right ventricle and pulmonary artery (RV-PA coupling) is an emerging, simple, and non-invasive tool that reflects the degree right ventricular adaptation and holds prognostic significance for patients.

The combination of tricuspid annular plane systolic excursion (TAPSE) and pulmonary artery systolic pressure (PASP), representing the afterload, has already demonstrated its value in refining patient prognostic classification. A low coupling ratio has been associated with worse outcomes in conditions such as heart failure, cardiac surgery or patients with isolated tricuspid regurgitation. (7,8)

The use of speckle tracking of the right ventricular has allowed for earlier detection of right ventricular dysfunction and can help reclassify the assessment of RV function when compared to traditional measures alone. (9)

Combining the concepts of speckle tracking and coupling, Ancona et al. aimed to unravel the intricate interplay between right ventricular free wall longitudinal strain, pulmonary artery systolic pressures, and their impact on clinical outcomes. (10) The findings by Ancona *et al.* offered valuable insights into the upstream drivers of prognosis. (10) Patients with low coupling ratios of strain vs PASP (RVFWLS/PASP ratio < 0.34 %/mmHg) demonstrated a significant association with baseline clinical RV heart failure. Univariate and multivariate analyses confirmed its strong correlation with all-cause mortality. Coupling ratios using strain were more sensitive than the coupling ratios defined by TAPSE, affirming its potential as a powerful prognostic marker in severe TR

The survival analysis revealed that individuals with RVFWLS $> 14\%$ and RVFWLS/PASP > 0.26 %/mmHg exhibited the most favorable survival outcomes at the 24-month follow-up. This observation underscores the importance of a comprehensive assessment of the right heart.

While using free wall strain to assess right heart function and its adaptation using coupling is an exciting complimentary tool, it primarily measures the longitudinal component of RV deformation. This does not cover the radial contraction which is also an important determinate of RV function. The other disadvantage of free wall strain is that it ignores the septal components.

The 3D RV ejection fraction encompasses the longitudinal, radial and septal components, and could improve the assessment of the right heart function and should be investigated as a coupling measure to improve the predictive value of this concept.

Conclusion

The prognostic potential of the RVFWLS/PASP ratio in severe tricuspid regurgitation is a promising tool in risk stratification. By including an upstream and downstream assessment when analysing the right heart, we gain valuable insights and improve our assessment. This innovative approach proposed by Ancona *et al.* refines our identification of high-risk patients and tailoring their management accordingly.

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