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EDITORIAL COMMENT

The Predictive Value of Right Ventricle to Pulmonary Artery Coupling in Valvular Heart Disease

Three Valves, One Sign

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Within the past decades, the development of transcatheter interventions for valvular heart disease (VHD) has made considerable progress. The recently published ESC/EACTS guidelines for the management of valvular heart disease further strengthened the role of transcatheter aortic valve replacement, as well as mitral and tricuspid valve repair and replacement, as important pillars in the treatment of VHD.[1] With increasing application of transcatheter therapies in clinical practice, patient selection and optimized outcome prediction came into scientific focus. In this context, right ventricular (RV) function has emerged as a critical prognostic determinant in patients with both right- and left-sided VHD.[2] The RV assumes a complex pathophysiological role between the systemic venous circulation and the pulmonary vasculature. The concept of RV-to-pulmonary artery (RVPA) coupling (RVPAc) integrates RV function with its afterload and has consistently demonstrated superior predictive value for clinical outcomes compared with the assessment of RV function alone.[3,4] A large number of studies and registry analyses have proposed different cutoff values for defining RVPA uncoupling across various cohorts.[5-7] The most common formula to calculate RVPAc is to divide tricuspid annular plane systolic excursion (TAPSE) by systolic pulmonary artery pressure (sPAP). However, the heterogeneity of available thresholds has complicated their translation into everyday clinical practice.

In this issue of *JACC: Cardiovascular Interventions*, Androshchuk et al[8] provide a concise and well-structured overview of the available literature on RVPAc in patients undergoing transcatheter valve interventions. The study is based on a thorough and seemingly comprehensive literature search, which was independently verified by 2 reviewers.

Based on the current evidence, the investigators identified a threshold of 0.51 mm/mm Hg for patients with aortic stenosis (AS), 0.33 mm/mm Hg for those with severe mitral regurgitation (MR), and 0.44 mm/mm Hg in the presence of tricuspid regurgitation (TR) to be associated with significantly reduced survival. Cutoffs for the prediction of a composite secondary endpoint comprising major adverse cardiovascular events, including all-cause mortality, were only slightly different from those for mortality prediction. As the investigators correctly point out, the TAPSE/sPAP ratio, used as a surrogate for RVPAc, has several inherent limitations. TAPSE, as a measure of RV function, represents a purely 1-dimensional functional parameter and is of limited value, particularly after cardiac surgery or in the presence of RV volume overload as can be observed in the setting of severe TR.[4]

The identified cutoff for MR is lower compared with the one that has been calculated for patients with AS. As the investigators further note, this is

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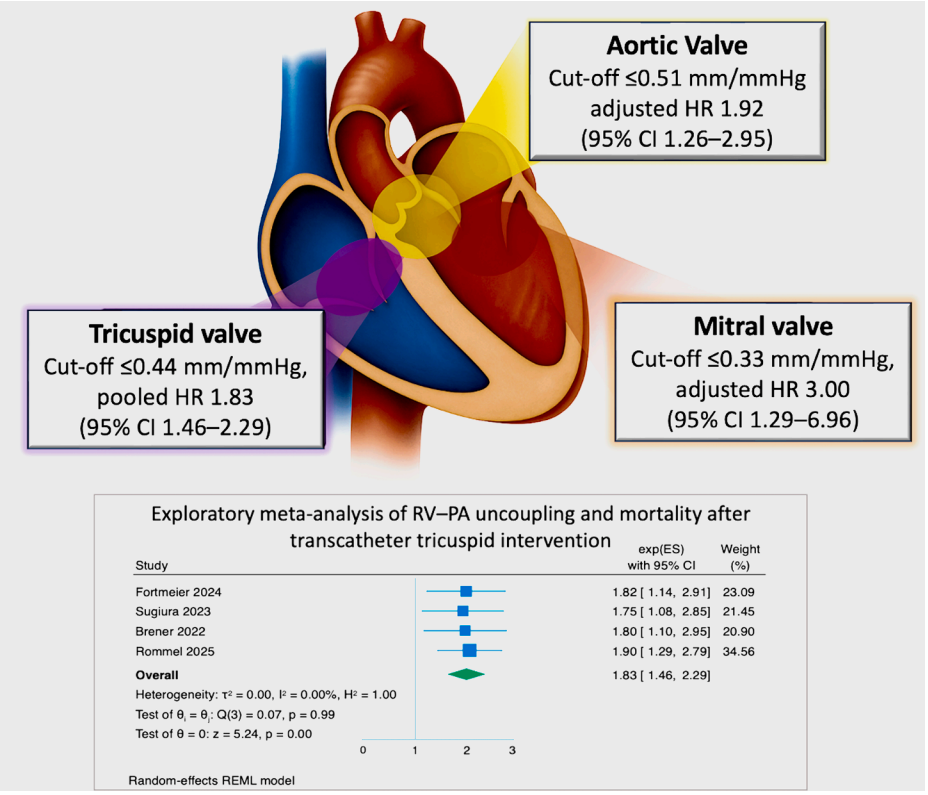
FIGURE 1 Valve-Specific RV-PA Coupling Thresholds and Mortality Risk



Valve-specific right ventricle-to-pulmonary artery (RV-PA) coupling thresholds and mortality risk across valve interventions are shown. The aortic and mitral cutoffs are derived from Androshchuk et al,[8] whereas the tricuspid estimate originates from the present exploratory meta-analysis of transcatheter tricuspid interventions, showing a pooled HR of 1.83 (95% CI: 1.46-2.29) with no heterogeneity ($I^2 = 0\%$).

likely related to the direct pathophysiological impact of mitral valve disease on pulmonary pressures. As previously hypothesized by Généreux et al,[9] long-standing aortic stenosis can also trigger a series of pathophysiological changes that ultimately affect the pulmonary circulation and RV function. However, compared with patients with severe MR, this relationship is less immediate.[10]

For patients with MR and AS, the investigators provide further quantitative meta-analyses of pooled effect estimates across the studies. Due to the limited number of studies in patients with TR, no such statistically robust models could be established in this population. In addition to the smaller number of available studies compared with AS and MR, quantifying RVPAc in the presence of severe TR is complicated by technical limitations. In patients with TR, echocardiographic estimation of sPAP frequently yields falsely low values, leading to discrepancies between invasively and echocardiographically derived coupling indices.[11,12] This underestimation is primarily driven by the rapid pressure equalization between right atrium and right ventricle in the presence of a large coaptation defect.[13] Nonetheless, RVPAc remains an important prognostic marker even in patients with severe tricuspid regurgitation. In a large registry study, Rommel et al[6] demonstrated that in an intermediate RVPAc range (0.32 to 0.46 mm/mm Hg), tricuspid valve transcatheter edge-to-edge repair was associated with superior 1-year survival compared with medical therapy alone, whereas survival rates were comparable in patients with coupling values above or below this range.[6] An exploratory quantitative synthesis restricted to interventional tricuspid cohorts confirmed the consistency of the prognostic signal

reported by Androshchuk et al[8] (pooled HR: 1.83; 95% CI: 1.46-2.29; $I^2 = 0$), supporting the reproducibility of the association between RV-PA uncoupling and mortality after tricuspid intervention (**Figure 1**).[11-13]

In the section on the diagnosis and management of severe TR in the 2025 ESC/EACTS guidelines, RVPAc is now mentioned for the first time as a parameter for risk stratification, although prospective validation is still pending.[1] Of note, the majority of the studies analyzed enrolled patients who underwent interventional treatment of VHD. This is ultimately due to the limited number of corresponding studies in surgical or medical treatment settings, which, to some extent, restricts the generalizability of the findings beyond patients undergoing transcatheter interventions.

In summary, RVPAc has emerged as an important outcome predictor in VHD. By pooling currently available evidence, Androshchuk et al[8] provide unified thresholds for RVPAc in patients with severe AS, MR, and TR, especially in the setting of interventional treatment.

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