



Prognostic significance of right ventricular-pulmonary artery coupling in patients undergoing tricuspid valve surgery

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Background: The accurate evaluation of right ventricular function and its response to correction of tricuspid valve pathology are challenging. This retrospective study evaluated the predictive value of right ventricular-pulmonary arterial (RV-PA) coupling in patients undergoing isolated or combined tricuspid and mitral valve surgery.

Methods: Patients at Massachusetts General Hospital who underwent isolated tricuspid or combined tricuspid and mitral valve surgery between January 2013 and June 2024 with available preoperative transthoracic echocardiography images were included. The RV-PA coupling ratio was calculated by dividing the tricuspid annular plane systolic excursion (TAPSE) by PA systolic pressure. The optimal cut-off value for this ratio was determined using the maximal log-rank test. The primary outcome was mid-term survival, while secondary outcomes included in-hospital mortality, intensive care unit (ICU) stay duration, hospital stay, and prolonged postoperative inotrope use.

Results: A total of 264 patients were followed for a median of 23 months (interquartile range, 7.0–48.0 months). The optimal RV-PA coupling ratio linked to mortality was 0.339 mm/mmHg. Patients with an RV-PA coupling ratio of ≤ 0.339 mm/mmHg had significantly higher all-cause mortality (25.5% vs. 10.0%; $P < 0.002$), longer median ICU stay (4.0 vs. 3.0 days; $P < 0.001$), longer median hospital stay (11.5 vs. 9.0 days; $P = 0.002$), increased need for inotropic support (45.7% vs. 21.8%; $P < 0.001$), and higher in-hospital mortality (10.6% vs. 2.9%). In multivariable Cox regression analysis, an RV-PA coupling ratio > 0.339 mm/mmHg was linked to a reduced risk of all-cause mortality (hazard ratio 0.09, $P = 0.003$). TAPSE and RV free-wall strain showed no association with mortality.

Conclusions: Echocardiography-derived RV-PA coupling is a robust, independent predictor of adverse outcomes in patients undergoing tricuspid valve surgery, particularly in those undergoing combined procedures. It captures a critical dimension of RV physiology not fully appreciated by standard measures and may serve as a powerful tool in surgical risk stratification and patient selection.

Keywords: Tricuspid valve surgery; right ventricular-pulmonary arterial coupling (RV-PA coupling); right ventricle; tricuspid regurgitation



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Introduction

The tricuspid valve, often referred to as the “forgotten valve”, has been gaining increasing attention with the emergence of new treatment strategies. Despite surgical and medical improvements, perioperative morbidity and mortality remain significant (1). Particularly, the accurate preoperative assessment of right ventricular (RV) function and its response to the correction of tricuspid pathology and associated changes in flow and pressure is challenging. Unlike the left ventricle, the RV function is highly load dependent, making conventional indices of RV function, such as tricuspid annular plane systolic excursion (TAPSE), less reliable (2-4).

A promising parameter in this context is right ventricular-pulmonary artery (RV-PA) coupling, which quantifies the efficiency of RV systolic function relative to its afterload. Conceptually, RV-PA coupling reflects the matching of contractile performance to vascular load, and is typically assessed invasively by the ratio of end-systolic to arterial elastance (E_{es}/E_a) (5). However, noninvasive surrogates—such as the ratio of TAPSE to pulmonary artery systolic pressure (PASP)—have shown clinical utility and strong prognostic value in various cardiac populations, including those with pulmonary hypertension, valvular disease, heart failure, and transcatheter valve interventions (5-10). Physiological values of echocardiographically-assessed RV-PA coupling have been described in the range of 0.5–0.7 mm/mmHg (11).

Despite its theoretical and practical appeal, the role of RV-PA coupling in the context of tricuspid valve surgery remains poorly defined. This gap is particularly relevant as RV dysfunction and uncoupling have been shown to predict morbidity and mortality independently (10,12). The prognostic value of RV-PA coupling in patients undergoing tricuspid valve surgery has not been evaluated.

In this study, we aimed to investigate the prognostic utility of RV-PA coupling in patients undergoing tricuspid valve surgery. We hypothesize that impaired RV-PA coupling is associated with worse clinical outcomes and may serve as a more sensitive predictor of RV function than conventional echocardiographic markers.

Methods

Ethical approval

This study was approved by the local ethics committee. Being a retrospective study, informed consent from individual patients was waived (IRB: 2022P001627; approved: 9/13/2022).

Study design and definitions

The institutional database, which includes all patients undergoing cardiac surgery, was queried for patients who underwent either isolated tricuspid valve surgery or combined with left-sided valve surgery from January 2013 to June 2024. Most patients had undergone combined surgery for left-sided and right-sided valvular pathology. Given the retrospective observational design of the study, no sample size calculations were performed. For our analysis, all patients age 18 years or older, with adequate baseline transthoracic echocardiographic images for RV strain function measurements and valve assessment, were included in this study. Patients who underwent surgery for congenital pathologies were excluded from the study. Right ventricular free wall strain (RVFWS) analysis was performed using 2D speckle-tracking imaging software (TomTec, Chicago, IL, USA). All measurements were retrospectively performed using a semiautomated tracing of endocardial borders in the apical four-chamber view and border tracings were visually assessed and adjusted for adequate tracing. Tricuspid regurgitation severity was graded with a combination of semiquantitative (measuring the vena contracta) and qualitative (by assessing color flow Doppler signal) parameters in preoperative echocardiograms (13). For our primary analysis, RV-PA coupling (unit: mm/mmHg) was characterized by the ratio of TAPSE and echocardiographically estimated PA systolic pressure. TAPSE was measured using the M-mode tracings obtained in the apical 4-chamber position. The PASP was measured using the peak TR gradient calculated from the transvalvular velocity and an assumed right atrial pressure of 5 mmHg was added to the calculated value (11). The right atrial pressure was assumed to be 5 mmHg in all patients to ensure consistency of PASP calculation, due to the unreliable estimation of right atrial pressures. In addition, we calculated RV-PA coupling by dividing RVFWS by the peak gradient TR gradients to compare strain-based RV-PA coupling (unit: %/mmHg) as a postoperative predictor in an observational analysis.

Study outcomes

The primary study outcome was mid-term survival. Secondary study outcomes were in-hospital mortality, intensive care unit (ICU) stay, hospital length of stay (LOS), and prolonged inotropic support (longer than 24 hours postoperatively).

Table 1 Baseline patient characteristics

Variables	Overall (N=264)	RV-PA \leq 0.339 (N=94)	RV-PA $>$ 0.339 (N=170)	P value
Age (years)	67.37 [13.45]	67.73 [13.23]	67.16 [13.61]	0.743
Male gender	120 (45.5)	41 (43.6)	79 (46.5)	0.751
Weight (kg)	76.15 [18.53]	74.94 [18.45]	76.81 [18.60]	0.434
Height (m)	1.68 [0.10]	1.67 [0.11]	1.68 [0.10]	0.712
BMI (kg/m ²)	27.02 [5.97]	26.72 [6.04]	27.18 [5.95]	0.553
NYHA class \geq 3	100 (37.9)	39 (41.5)	61 (35.9)	0.278
STS score (%)	4.97 [4.47]	5.62 [4.01]	4.65 [4.67]	0.349
Diabetes mellitus	60 (22.7)	34 (36.2)	26 (15.3)	<0.001
Previous myocardial infarction	38 (14.4)	18 (19.1)	20 (11.8)	0.146
Chronic kidney disease	85 (32.4)	37 (39.4)	48 (28.6)	0.202
GFR (mL/min)	62.99 [24.80]	55.60 [25.64]	67.0 [23.46]	<0.001
Dialysis	18 (6.8)	10 (10.6)	8 (4.7)	0.115
PM/ICD	100 (37.9)	39 (41.5)	61 (35.9)	0.443
AST (U/L)	41.16 [95.43]	34.40 [36.81]	44.89 [115.70]	0.394
ALT (U/L)	34.64 [113.19]	27.33 [39.32]	38.68 [137.98]	0.436
Total bilirubin (mg/dL)	0.98 [1.07]	0.97 [0.70]	0.98 [1.23]	0.929
Direct bilirubin (mg/dL)	0.57 [1.23]	0.39 [0.42]	0.68 [1.54]	0.231
INR	1.45 [0.66]	1.47 [0.53]	1.44 [0.72]	0.706
Sodium (mg)	138.62 [3.87]	138.16 [4.40]	138.87 [3.53]	0.153
Atrial fibrillation	228 (86.4)	81 (86.2)	147 (86.5)	0.99

Data are presented as mean [SD] or n (%). ALT, alanine aminotransferase; AST, aspartate aminotransferase; BMI, body mass index; ICD, implantable cardioverter defibrillator; INR, international normalized ratio; GFR, glomerular filtration rate; NYHA, New York Heart Association; PA, pulmonary artery; PM, pacemaker; RV, right ventricle; SD, standard deviation; STS, Society of Thoracic Surgeons.

Statistical analysis

Categorical variables were expressed as frequencies and percentages and compared using the chi-squared or Fisher's exact test. Continuous normally distributed variables were expressed as mean and standard deviation, and non-normally distributed variables as median and interquartile range (IQR) and were compared by Student's t-test or Mann-Whitney U test. For all analyses, P values <0.05 were considered statistically significant.

A maximally selected rank statistics analysis was performed to detect the optimal cut-off value for RV-PA coupling for mortality risk stratification. The study cohort was divided into two groups based on this optimal value. Survival analysis was performed using the Kaplan-Meier method and differences were analyzed using the log-rank test. A Cox proportional hazards analysis including TAPSE, RVFWS and RV-PA ratio adjusted for left ventricular ejection fraction (LVEF), atrial fibrillation, diabetes and

glomerular filtration rate (GFR) was performed, analyzing the relationship between RV function parameters and mortality. To compare the prognostic accuracy of RV-PA coupling indices as predictors of mortality [RVFWS/systolic pulmonary artery pressure (sPAP) *vs.* TAPSE/sPAP], we used time-dependent receiver operating characteristic (ROC) analysis at 12 months. The area under the curve (AUC) was estimated using the timeROC package in R. To assess the difference in AUCs between the two predictors, we performed nonparametric bootstrap resampling with 1,000 iterations. In each iteration, paired AUCs were calculated on bootstrap samples, and the distribution of AUC differences was used to estimate the 95% confidence interval and P value. Additionally, we analyzed time-dependent AUC values to compare the discriminative performance at varying time points. All analyses were performed using R statistical Software (v.4.4.1; R Core Team 2025; packages: ggplot2, maxstat, rms, survival, tableone).

Results

Patient characteristics

A total of 264 patients were included in our analysis, with a

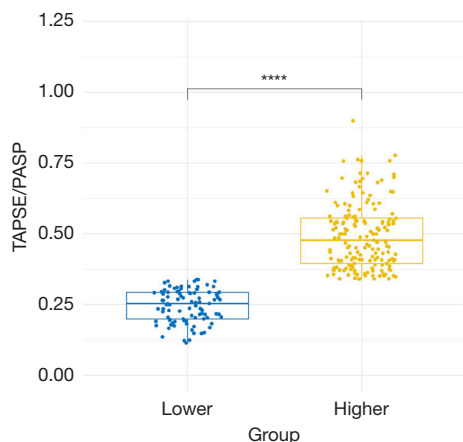


Figure 1 Boxplot of the distribution of RV-PA coupling, measured by the TAPSE/PASP ratio, stratified by a calculated optimal cutoff value of 0.339 mm/mmHg. Two groups were defined: “Lower” (blue) and “Higher” (yellow) TAPSE/PASP based on this threshold. ****, $P < 0.0001$. PASP, pulmonary artery systolic pressure; RV-PA, right ventricular-pulmonary artery; TAPSE, tricuspid annular plane systolic excursion.

mean age of 67.4 ± 13.5 years, and 64.5% ($n=144$) were female. The baseline patient characteristics are shown in *Table 1*. The majority of patients had preoperative atrial fibrillation (86.4%, $n=228$) and the mean STS risk score was 4.97%.

The patient cohort was stratified into two groups based on our calculated optimal RV-PA cut-off value of 0.339 mm/mmHg. The distribution of RV-PA ratios is illustrated in *Figure 1*, with a median ratio of 0.25 mm/mmHg (IQR, 0.20–0.29 mm/mmHg) in the lower group and a median ratio of 0.48 mm/mmHg (IQR, 0.40–0.56 mm/mmHg) in the higher coupling group. The rate of diabetes (36.2%, $n=34$ vs. 15.3%, $n=26$, $P < 0.001$) was higher in the lower RV-PA group, and GFR (55.6 ± 25.6 vs. 67.0 ± 23.5 mL/min, $P < 0.001$) was lower. Other baseline characteristics were comparable between the two groups.

Echocardiographic measurements and perioperative details

Preoperative echocardiographic measurements are shown in *Table 2*. The mean LVEF was 61.3% with no difference between the groups. RV function parameters were impaired in the lower RV-PA group in comparison to the higher RV-PA group (TAPSE: 15.3 ± 3.6 vs. 20.7 ± 4.3 mm, $P < 0.001$; RVFWS: $-19.1\% \pm 9\%$ vs. $-21.5\% \pm 5.7\%$, $P < 0.001$). The PASP was significantly higher in the lower RV-PA group

Table 2 Baseline echocardiographic measurements

Variables	Overall (N=264)	RV-PA ≤ 0.339 (N=94)	RV-PA > 0.339 (N=170)	P value
LVEF (%)	61.26 [11.68]	61.14 [11.82]	61.33 [11.63]	0.899
TR grade \geq moderate	248 (93.9)	92 (97.9)	156 (91.8)	0.022
TAPSE (mm)	18.78 [4.84]	15.30 [3.61]	20.71 [4.34]	< 0.001
PASP (mmHg)	50.68 [15.78]	64.22 [14.92]	43.19 [10.32]	< 0.001
TAPSE/PASP (mm/mmHg)	0.41 [0.17]	0.25 [0.06]	0.50 [0.13]	< 0.001
TR vena contracta (mm)	7.8 [2.6]	8.0 [2.2]	7.7 [2.8]	0.372
TV annular diameter (mm)	38.43 [7.27]	37.82 [7.22]	38.74 [7.30]	0.35
RV basal diameter (mm)	46.83 [9.00]	45.69 [9.54]	47.44 [8.67]	0.154
RVFWSL (%)	-20.76 [6.98]	-19.10 [9.00]	-21.51 [5.72]	0.027
RV4CSL (%)	-16.83 [4.15]	-14.96 [3.22]	-17.67 [4.25]	< 0.001
MR degree \geq moderate	195 (73.9)	68 (72.3)	127 (74.7)	0.134

Data are presented as mean [SD] or n (%). LVEF, left ventricular ejection fraction; MR, mitral regurgitation; PA, pulmonary artery; PASP, pulmonary artery systolic pressure; RV, right ventricle; RV4CSL, right ventricular global four-chamber longitudinal strain; RVFWSL, right ventricular free wall longitudinal strain; SD, standard deviation; TAPSE, tricuspid annular plane systolic excursion; TR, tricuspid regurgitation; TV, tricuspid valve.

Table 3 Perioperative outcomes

Variables	Overall (N=264)	RV-PA ≤ 0.339 (N=94)	RV-PA > 0.339 (N=170)	P value
Tricuspid valve repair	252 (95.5)	92 (97.9)	160 (94.1)	0.274
Mitral valve replacement	141 (53.4)	68 (72.3)	73 (42.9)	<0.001
Mitral valve repair	93 (35.2)	22 (23.4)	71 (41.8)	0.004
Left atrial appendage occlusion	133 (50.4)	44 (46.8)	89 (52.4)	0.463
LA ablation	103 (39.0)	29 (30.9)	74 (43.5)	0.059
CABG	39 (14.8)	16 (17.0)	23 (13.5)	0.559
AVR	44 (16.7)	19 (20.2)	25 (14.7)	0.4
New onset atrial fibrillation	25 (9.5)	9 (9.6)	16 (9.4)	0.99
Postoperative stroke	3 (1.1)	2 (2.2)	1 (0.6)	0.594

Data are presented as n (%). AVR, aortic valve replacement; CABG, coronary artery bypass grafting; LA, left atrium; PA, pulmonary artery; RV, right ventricle.

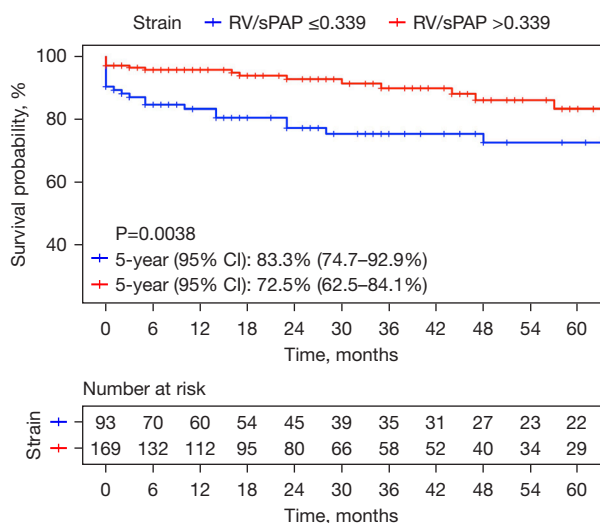


Figure 2 Kaplan-Meier survival curves for all-cause mortality stratified by RV-PA coupling defined as TAPSE/PASP ratio. CI, confidence interval; PA, pulmonary artery; PASP, pulmonary artery systolic pressure; RV, right ventricular; sPAP, systolic pulmonary artery pressure; TAPSE, tricuspid annular plane systolic excursion.

(64.2 ± 14.9 vs. 43.2 ± 10.3 mmHg). Overall, 93.9% (n=248) of patients had at least moderate TR, with a slightly higher number in the lower RV-PA group. However, there was no difference in mean vena contracta between both groups (8.0 ± 2.2 vs. 7.7 ± 2.8 mm, $P=0.37$). The perioperative details are summarized in *Table 3*. The majority of patients underwent tricuspid valve repair (95.5%, n=252) with no difference between the two groups. There was a higher rate

of mitral valve repair in the higher RV-PA group compared to the lower RV-PA group (41.8% vs. 23.4%, $P=0.004$).

Survival analysis and in-hospital outcomes

The overall all-cause mortality was higher in the lower RV-PA group compared to the higher RV-PA group (25.5% vs. 10.0%; $P<0.002$). The median follow-up was 23 months (IQR, 7–48 months). The Kaplan-Meier analysis showed significantly lower survival rates in patients with lower RV-PA coupling compared to those with higher RV-PA coupling (72.5% vs. 83.3%, log-rank $P=0.0038$) (*Figure 2*). In-hospital mortality (10.6%, n=10 vs. 2.9%, n=5, $P<0.001$), ICU stay [4 (IQR, 3–8) vs. 3 (IQR, 1.25–5) days, $P<0.001$], hospital stay (11.5 (IQR, 8–17) vs. 9 (IQR, 7–13) days, $P<0.001$) and postoperative prolonged need for pressors (45.7%, n=43 vs. 21.8%, n=37, $P<0.001$) was higher in the lower RV-PA coupling group.

We constructed multiple multivariable Cox regression models using different echocardiography-based RV function parameters to assess the association with mortality. All models were adjusted for LVEF, preoperative atrial fibrillation, diabetes and GFR. The covariates were selected based on prior clinical knowledge.

Higher TAPSE-based RV-PA coupling [hazard ratio (HR): 0.09, 95% confidence interval (CI): 0.008–0.95, $P=0.04$] and RV-strain-based RV-PA coupling (HR: 0.08, 95% CI: 0.015–0.47, $P=0.005$) showed decreased risk of mortality. In contrast, the isolated RV function parameters TAPSE (HR: 0.96, 95% CI: 0.96–1.04, $P=0.31$) and

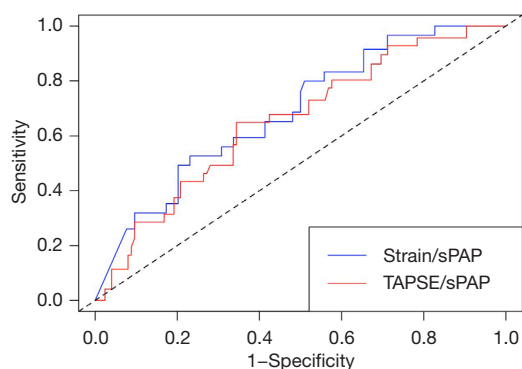


Figure 3 Time dependent AUC for 12-month survival comparing strain based and TAPSE based RV-PA coupling. AUC, area under the curve; PA, pulmonary artery; RV, right ventricular; sPAP, systolic pulmonary artery pressure; TAPSE, tricuspid annular plane systolic excursion.

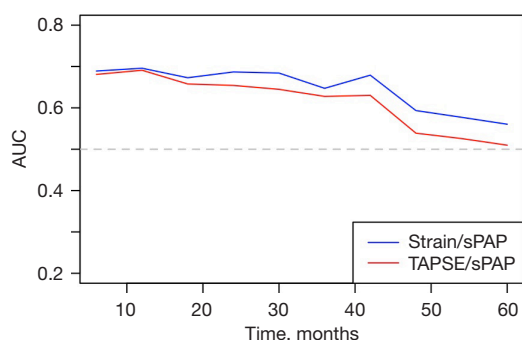


Figure 4 Time dependent AUC for strain and TAPSE based RV-PA coupling. AUC, area under the curve; PA, pulmonary artery; RV, right ventricular; sPAP, systolic pulmonary artery pressure; TAPSE, tricuspid annular plane systolic excursion.

RVFWS (HR: 0.96, 95% CI: 0.96–1.12, $P=0.34$) showed no association with mortality. In all models, higher GFR was significantly associated with decreased mortality (HR: 0.98, 95% CI: 0.96–0.99, $P<0.05$).

To compare the TAPSE-based and RV strain-based models, we performed a time-dependent ROC analysis. The optimal cut-off value for RVFWS/TAPSE was $-0.490\%/mmHg$. The time-dependent AUC at 12 months was 0.695 for the strain-based RV-PA and 0.690 for the TAPSE-based RV-PA, indicating comparable discriminatory performance between both parameters (Figure 3). The difference in AUC between the two parameters was small and statistically insignificant, verified by bootstrap resampling (mean $\Delta AUC = 0.004$, 95% CI: -0.11 to

0.12, $P=0.97$). The discriminatory performance of both parameters remained stable for up to 36 months of survival and then decreased (Figure 4).

Discussion

This study demonstrates that impaired preoperative RV-PA coupling, assessed by the ratio of TAPSE and PASP, is an independent predictor of postoperative morbidity and mid-term mortality in patients undergoing isolated or combined tricuspid valve surgery. Patients with lower RV-PA coupling ratios had significantly lower 5-year survival, higher in-hospital mortality, required prolonged inotropic support, and had longer intensive care and hospital stays. These findings underscore the importance of RV-PA coupling as a non-invasive, easily accessible metric that offers superior prognostic value to isolated RV function parameters. In a sub-analysis, the RVFWS-based RV-PA coupling assessment showed comparable discriminatory value for risk prediction in our study cohort. However, TAPSE/PASP and RVFWS/PASP represent distinct surrogates of RV-PA coupling derived from different physiological assumptions and are not interchangeable.

RV-PA coupling serves as a surrogate for the interplay between RV contractility and pulmonary arterial afterload. In contrast to conventional RV functional parameters, such as TAPSE, RV fractional change, or RV-PA coupling, it integrates the measurement of RV functional reserve against its afterload. Higher RV-PA coupling ratios indicate a higher afterload reserve and preserved RV contractility. In the setting of tricuspid regurgitation, the RV is exposed to chronic volume overload, often with preserved TAPSE and RV dimensions (14). The correction of the tricuspid pathology leads to a decrease in volume overload and can improve RV performance (15,16). However, predicting the ability of the RV to recover after tricuspid valve surgery is challenging and RV-PA coupling could be a valuable clinical parameter for the assessment of RV recovery.

The association between RV-PA uncoupling and adverse outcomes has previously been established in various patient populations. Tello *et al.* showed in patients with pulmonary hypertension that patients with a TAPSE/PASP <0.31 mm/mmHg had a significantly worse prognosis compared to a higher TAPSE/PASP ratio (5). In the field of transcatheter valve therapies, studies by Brener *et al.* have shown an association between RV-PA ratios and mortality in patients undergoing mitral valve transcatheter therapy for secondary mitral regurgitation and patients undergoing

tricuspid transcatheter therapy in the TriValve registry, with an optimal cut-off value in the TriValve registry of 0.406 mm/mmHg (8,9). Chehab *et al.* analyzed the predictive value of the TAPSE/PASP ratio in patients undergoing mitral valve surgery and identified that a ratio ≤ 0.35 is an independent predictor of all-cause mortality and prolonged hospital stay (17).

In an analysis of patients with secondary tricuspid regurgitation, Fortuni *et al.* (10) showed that a lower TAPSE/PASP ratio is associated with a higher hazard of all-cause mortality. In their cohort, a TAPSE/PASP ratio of 0.31 mm/mmHg was a suitable threshold for risk stratification. Our study verifies the previously published findings of the association between TAPSE/PASP ratios and all-cause mortality and expands the findings to the field of tricuspid valve surgery. Our optimal cut-off value of 0.339 aligns with other published thresholds. However, a generally applicable cut-off value for all patients has not yet been established and varies between 0.3 and 0.4 mm/mmHg (11).

The association of RV dysfunction with adverse outcomes in TV surgery has previously been established and was consequently implemented in risk assessment, as in the TRI-SCORE (18-20). The RV dysfunction assessment in these studies is performed using either TAPSE, doppler tissue imaging peak systolic annular velocity (S'), or by visual assessment. Our findings suggest that RV-PA coupling is a more sensitive and specific prognostic marker in this patient population and should be considered as an additional parameter in preoperative risk assessment. The routine clinical implementation could direct patients to therapy earlier before RV dysfunction develops, or identify patients who require more aggressive treatment of RV dysfunction, or could benefit from staged interventions or transcatheter therapies. Ultimately, it could add accuracy in patient risk prognostication and help inform patients. Future studies are required to analyze the added value of RV-PA coupling to existing risk scores.

Limitations

The present study, being retrospective, is susceptible to all the inherent weaknesses of such analyses. Unmeasured differences between the two groups could introduce bias and influence our results. In 56 patients, insufficient images for echocardiographic analysis were available and had to be excluded. The echocardiography-based measurement of PASP approximates the exact values and becomes challenging in higher degrees of TR. Due

to the missing invasive PASP values, we were unable to cross-validate our echocardiographic findings. The right atrial pressure was assumed to be 5 mmHg in all patients which may underestimate true PASP. This limitation may affect absolute PASP and RV-PA coupling values. The majority of patients had left-sided valvular pathology in addition to tricuspid regurgitation, which leads to a limited generalizability in the setting of isolated surgical TVR. Although our findings align with previously published results in other cohorts, the generalizability of our results may be limited due to the single-center study setting at an academic institution. External validation in a separate cohort should be performed to verify our findings.

Conclusions

Echocardiography-derived RV-PA coupling is a robust, independent predictor of adverse outcomes in patients undergoing tricuspid valve surgery, particularly in those undergoing combined procedures. It captures a critical dimension of RV physiology not fully appreciated by standard measures and may serve as a powerful tool in surgical risk stratification and patient selection.

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Footnote

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Conflicts of Interest: The authors have no conflicts of interest to declare.

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References

1. Zack CJ, Fender EA, Chandrashekar P, et al. National

- Trends and Outcomes in Isolated Tricuspid Valve Surgery. *J Am Coll Cardiol* 2017;70:2953-60.
2. Rudski LG, Lai WW, Afilalo J, et al. Guidelines for the echocardiographic assessment of the right heart in adults: a report from the American Society of Echocardiography endorsed by the European Association of Echocardiography, a registered branch of the European Society of Cardiology, and the Canadian Society of Echocardiography. *J Am Soc Echocardiogr* 2010;23:685-788.
 3. Haddad F, Hunt SA, Rosenthal DN, et al. Right ventricular function in cardiovascular disease, part I: Anatomy, physiology, aging, and functional assessment of the right ventricle. *Circulation* 2008;117:1436-48.
 4. Sanz J, Sánchez-Quintana D, Bossone E, et al. Anatomy, Function, and Dysfunction of the Right Ventricle: JACC State-of-the-Art Review. *J Am Coll Cardiol* 2019;73:1463-82.
 5. Tello K, Wan J, Dalmer A, et al. Validation of the Tricuspid Annular Plane Systolic Excursion/Systolic Pulmonary Artery Pressure Ratio for the Assessment of Right Ventricular-Arterial Coupling in Severe Pulmonary Hypertension. *Circ Cardiovasc Imaging* 2019;12:e009047.
 6. Bok Y, Kim JY, Park JH. Prognostic Role of Right Ventricular-Pulmonary Artery Coupling Assessed by TAPSE/PASP Ratio in Patients With Acute Heart Failure. *J Cardiovasc Imaging* 2023;31:200-6.
 7. Shechter A, Vaturi M, Kaewkes D, et al. Prognostic Value of Baseline Tricuspid Annular Plane Systolic Excursion to Pulmonary Artery Systolic Pressure Ratio in Mitral Transcatheter Edge-to-Edge Repair. *J Am Soc Echocardiogr* 2023;36:391-401.e19.
 8. Brener MI, Lurz P, Hausleiter J, et al. Right Ventricular-Pulmonary Arterial Coupling and Afterload Reserve in Patients Undergoing Transcatheter Tricuspid Valve Repair. *J Am Coll Cardiol* 2022;79:448-61.
 9. Brener MI, Grayburn P, Lindenfeld J, et al. Right Ventricular-Pulmonary Arterial Coupling in Patients With HF Secondary MR: Analysis From the COAPT Trial. *JACC Cardiovasc Interv* 2021;14:2231-42.
 10. Fortuni F, Butcher SC, Dietz MF, et al. Right Ventricular-Pulmonary Arterial Coupling in Secondary Tricuspid Regurgitation. *Am J Cardiol* 2021;148:138-45.
 11. Mukherjee M, Rudski LG, Addetia K, et al. Guidelines for the Echocardiographic Assessment of the Right Heart in Adults and Special Considerations in Pulmonary Hypertension: Recommendations from the American Society of Echocardiography. *J Am Soc Echocardiogr* 2025;38:141-86.
 12. Dietz MF, Prihadi EA, van der Bijl P, et al. Prognostic Implications of Right Ventricular Remodeling and Function in Patients With Significant Secondary Tricuspid Regurgitation. *Circulation* 2019;140:836-45.
 13. Zoghbi WA, Adams D, Bonow RO, et al. Recommendations for Noninvasive Evaluation of Native Valvular Regurgitation: A Report from the American Society of Echocardiography Developed in Collaboration with the Society for Cardiovascular Magnetic Resonance. *J Am Soc Echocardiogr* 2017;30:303-71.
 14. Hahn RT, Waxman AB, Denti P, et al. Anatomic Relationship of the Complex Tricuspid Valve, Right Ventricle, and Pulmonary Vasculature: A Review. *JAMA Cardiol* 2019;4:478-87.
 15. Kim HK, Kim YJ, Park EA, et al. Assessment of haemodynamic effects of surgical correction for severe functional tricuspid regurgitation: cardiac magnetic resonance imaging study. *Eur Heart J* 2010;31:1520-8.
 16. Rommel KP, Besler C, Noack T, et al. Physiological and Clinical Consequences of Right Ventricular Volume Overload Reduction After Transcatheter Treatment for Tricuspid Regurgitation. *JACC Cardiovasc Interv* 2019;12:1423-34.
 17. Chehab O, Long E, Androshchuk V, et al. Right ventricular to pulmonary arterial coupling as a predictor of survival in patients undergoing mitral valve surgery for mitral regurgitation. *Eur J Cardiothorac Surg* 2024;66:ezae421.
 18. Algarni KD, Arafat A, Algarni AD, et al. Degree of right ventricular dysfunction dictates outcomes after tricuspid valve repair concomitant with left-side valve surgery. *Gen Thorac Cardiovasc Surg* 2021;69:911-8.
 19. Dreyfus J, Audureau E, Bohbot Y, et al. TRI-SCORE: a new risk score for in-hospital mortality prediction after isolated tricuspid valve surgery. *Eur Heart J* 2022;43:654-62.
 20. Subbotina I, Girdauskas E, Bernhardt AM, et al. Comparison of Outcomes of Tricuspid Valve Surgery in Patients with Reduced and Normal Right Ventricular Function. *Thorac Cardiovasc Surg* 2017;65:617-25.

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