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FOCUS ON TRICUSPID AND MITRAL VALVES

ORIGINAL RESEARCH: STRUCTURAL

TRIVALVE Score

A Risk Score for Mortality/Hospitalization Prediction in Patients Undergoing Transcatheter Tricuspid Valve Intervention

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ABSTRACT

BACKGROUND Transcatheter tricuspid valve intervention (TTVI) has been increasingly adopted in recent years for the treatment of patients with tricuspid regurgitation (TR). However, no dedicated risk stratification has been established for patients undergoing TTVI.

OBJECTIVES The aim of the present study was to propose a dedicated risk score for patients affected by severe TR undergoing TTVI.

METHODS The score was derived from the TRIVALVE (International Multisite Transcatheter Tricuspid Valve Therapies Registry; NCT03416166) registry, according to data availability. A stepwise model approach was used on predictor variables to develop a scoring system for predicting 12-month mortality or rehospitalization using multivariable logistic regression. Internal discrimination, calibration, and validation were assessed using receiver-operating characteristic curve analysis and bootstrapping with 1,000 resamples.

RESULTS A total of 483 patients were included in the study, with an overall 12-month mortality or rehospitalization rate of 19% (n = 94). The final risk score, ranging from 0 to 4.5, included the following 5 parameters (adjusted for age and gender): 1) atrial fibrillation at baseline; 2) glomerular filtration rate <30 mL/min; 3) elevated gamma-glutamyl transferase/bilirubin levels; 4) signs of right heart failure; and 5) left ventricular ejection fraction <50%. The bias-corrected area under the receiver-operating characteristic curve was 68% (95% CI: 62%-75%). A cutoff value of 2.5 demonstrated sensitivity of 65.4% and specificity of 60.5% for the outcome.

CONCLUSIONS The present study proposes a dedicated risk score for patients undergoing TTVI, providing an additional and simple tool for heart teams to select the best therapy for patients affected by severe TR.
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Tricuspid regurgitation (TR) is a highly prevalent heart valve disease: recent data showed that the total prevalence of moderate or severe TR is 0.6%, very close to that of severe aortic stenosis.[1] In addition, multiple studies have demonstrated that patients with TR are burdened by poor quality of life and high mortality.[2-5] Nonetheless, TR (especially if isolated and in the older population) is still undertreated by surgeons because of its high perioperative mortality (7%-17%), which might be explained by late referral and multiple comorbidities.[6] Recent registries indicate improved outcomes of surgery, suggesting an important role of a surgical strategy with proper patient selection.[7] However, surgical treatment is still performed mainly during left-sided heart valve interventions, whereas isolated TR is more frequently left untreated or referred for percutaneous intervention. To better stratify the in-hospital mortality risk of patients undergoing surgery for isolated TR, a risk score providing an important tool for heart teams to select the best therapy for patients affected by isolated TR has recently been proposed.[8] However, although several percutaneous technologies have been developed in recent years, and as this risk score is extrapolated from patients who underwent surgery, the performance of the TRI-SCORE in patients undergoing percutaneous procedures was lower.[9,10]

Against this background, the aim of the present study was to propose a dedicated risk score for patients undergoing percutaneous treatment of TR on the basis of the population enrolled in the TRIVALVE (International Multisite Transcatheter Tricuspid Valve Therapies Registry) registry, which represents the first and among the biggest registries worldwide including patients undergoing percutaneous interventions for TR correction.

METHODS

STUDY DESIGN. The TRIVALVE international registry is a multicenter registry including data on patients with symptomatic, at least severe TR undergoing transcatheter tricuspid valve intervention (TTVI) with multiple devices.

The registry includes the following devices: MitraClip and TriClip (Abbott Cardiovascular); Trialign, Cardioband, Forma, and Pascal (Edwards Lifesciences); TriCinch (4Tech); TricValve (P&F Products + Features); Tricento (NVT); and NaviGate (NaviGate Cardiac Structures). The specific distribution of each device within this registry is outlined in **Figure 1**.

All patients included in the study were enrolled between 2016 and 2022, with the latest follow-up updated in January 2024. A total of 21 centers from Europe, the United States, and Canada contributed to the registry.

All patients enrolled in the registry were discussed by the local multidisciplinary heart team. Clinical and

ABBREVIATIONS AND ACRONYMS

AF = atrial fibrillation

AUC = area under the receiver-operating characteristic curve

EuroSCORE = European System for Cardiac Operative Risk Evaluation

GFR = glomerular filtration rate

GGT = gamma-glutamyl transferase

HF = heart failure

LVEF = left ventricular ejection fraction

ROC = receiver-operating characteristic

RV = right ventricle/ventricular

STS = Society of Thoracic Surgeons

TR = tricuspid regurgitation

TTVI = transcatheter tricuspid valve intervention

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The authors attest they are in compliance with human studies committees and animal welfare regulations of the authors' institutions and Food and Drug Administration guidelines, including patient consent where appropriate. For more information, visit the Author Center.

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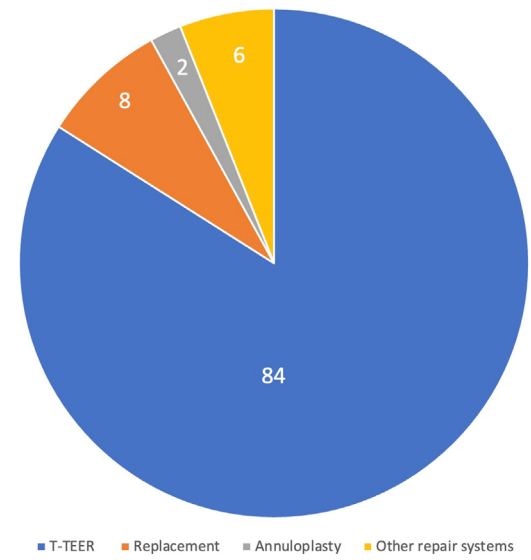
FIGURE 1 Distribution With Percentages of Devices and Techniques Within the Registry



Transcatheter tricuspid edge-to-edge repair (T-TEER) includes MitraClip, TriClip, and Pascal devices. Replacement includes both orthotopic and heterotopic devices, and other repair systems include Trialign, TriCinch, and Forma.

echocardiographic data were self-reported and collected at baseline and at follow-up. Grading of TR severity was based on the integration of semi-quantitative and quantitative measures, as described by the American Society of Echocardiography guidelines as well as the European Association of Cardiovascular Imaging guidelines.[11,12]

Elevated gamma-glutamyl transferase (GGT) and bilirubin levels were defined when greater than the local laboratory thresholds. High doses of diuretic agents were defined as a daily dose of furosemide ≥125 mg. The conversion chart adopted for diuretic dose was as follows: furosemide 40 mg = torasemide 10 mg = bumetanide 1 mg. Atrial secondary TR was defined by the presence of atrial fibrillation (AF), left ventricular ejection fraction (LVEF) >50%, and systolic pulmonary arterial pressure <50 mm Hg. Right ventricular (RV) dysfunction was defined as tricuspid annular plane systolic excursion <17 mm. Signs of right heart failure (HF) included pitting edema (any grade) and/or ascites.

Among a total of 639 subjects in the full registry, 156 patients with missing data on survival and/or rehospitalization were excluded from the present study, and only patients with complete data for prognostic evaluation were included. All variables had <15% missing data, and only elevated GGT or bilirubin had 19% missing data and systolic pulmonary artery pressure 46% missing data.

All necessary ethical oversight was secured. The study was conducted in line with the Declaration of Helsinki, and the local ethics committees approved the investigation. The TRIVALVE registry is registered at ClinicalTrials.gov (NCT03416166).

STATISTICAL ANALYSIS. Continuous variables are presented as mean ± SD or median (Q1-Q3), according to variable distribution. Categorical variables are presented as numbers and percentages of total. The Shapiro-Wilk test was used to test the normality of distributions. Continuous variables were evaluated using a parametric test (Student's *t*-test) or a nonparametric test (the Mann-Whitney *U* test), as appropriate. Categorical variables were evaluated using the chi-square test or Fisher exact test, as appropriate.

The group with mortality or rehospitalization in the first 12 months was compared with the group with no mortality or hospitalization >12 months to identify through univariate analysis the variables with *P* values <0.10 for the construction of multiple logistic models. All variables included in the analysis were dichotomous on the basis of clinically meaningful values to simplify the scoring system. Subsequently, we selected, in addition to gender and age (<75 and ≥75 years) as adjustment variables, the variables that produced the best fitting model for the studied outcome.

Adjusted ORs and their 95% CIs were obtained from multiple logistic regression models, and the best fitting model was used to create a risk score (mortality and rehospitalization <12 months). The coefficients resulting from the multiple logistic regression analysis were used to assign points for score construction (approximate values).

The cutoff value in the score that provided the best discrimination between the 2 groups was calculated by means of the receiver-operating characteristic (ROC) curve analysis, using the point closest to the (0,1) corner method. To evaluate the performance of the system, the sensitivity, specificity, and area under the ROC curve (AUC) were calculated. The study adhered to TRIPOD+AI guidelines.

Model discrimination was assessed using the AUC, with 95% CIs calculated using DeLong's method. Calibration was evaluated through the construction

TABLE 1 Baseline Characteristics of Study Population: Univariate and Multivariate Analyses in Patients With and Without Death or Rehospitalization at 12 Months

	Overall (N = 483)	No Death/Rehospitalization (n = 389)	Death/Rehospitalization (n = 94)	Univariate	Multivariate
Age >75 y	333 (69)	267 (69)	66 (70)	0.77	0.28
Female	279 (58)	229 (59)	50 (53)	0.32	0.99
ASTR	154 (36)	125 (37)	29 (33)	0.52	
Pre-AMI	86 (18)	70 (18)	16 (17)	0.89	
Pre-LH intervention	145 (30)	116 (30)	29 (31)	0.85	
Atrial fibrillation	110 (23)	98 (25)	12 (13)	0.011	0.010
CIED	119 (25)	91 (24)	28 (30)	0.20	
Pre-PAD	71 (15)	49 (13)	22 (24)	0.009	
Pre-COPD	109 (23)	89 (23)	20 (21)	0.74	
GFR <30 mL/min	107 (22)	75 (19)	32 (34)	0.002	0.011
Elevated GGT/bilirubin	367 (94)	281 (72)	86 (91)	0.074	0.053
Diabetes	135 (28)	105 (27)	30 (32)	0.35	
NYHA functional class IV	130 (27)	93 (24)	37 (39)	0.003	
Signs of right HF	102 (23)	68 (17)	34 (36)	<0.0001	0.005
Admission right HF	299 (69)	228 (66)	71 (84)	0.002	
High-dose diuretic agents	85 (18)	59 (15)	26 (28)	0.003	
Dilated LV	238 (58)	188 (48)	50 (53)	0.78	
LVEF <50%	161 (34)	119 (30)	42 (44)	0.009	0.039
MR 3/4+	152 (32)	117 (30)	35 (37)	0.17	
TR 5/6+	93 (19)	78 (20)	15 (16)	0.252	
TAPSE <17 mm	234 (54)	179 (46)	55 (59)	0.020	
sPAP >50 mm Hg	58 (12)	43 (11)	15 (16)	0.19	
Residual TR <2+	367 (79)	305 (83)	62 (66)	<0.0001	

Values are n (%).

AMI = acute myocardial infarction; ASTR = atrial secondary tricuspid regurgitation; CIED = cardiac implantable electronic device; COPD = chronic obstructive pulmonary disease; GFR = glomerular filtration rate; GGT = gamma-glutamyl transferase; HF = heart failure; LH = left heart; LV = left ventricle; LVEF = left ventricular ejection fraction; MR = mitral regurgitation; PAD = peripheral artery disease; sPAP = systolic pulmonary artery pressure; TAPSE = tricuspid annular plane systolic excursion.

of calibration curves to measure the concordance between observed and predicted probabilities of death or rehospitalization within a 12-month period. Internal validation was performed using 1,000 bootstrap resamples, yielding bias-corrected AUC estimates accompanied by 95% CIs calculated using the bias-corrected and accelerated bootstrap interval. Additionally, we evaluated the predictive performance, measured using the AUC, of the TRIVALVE score compared with other scoring systems and to each single variable using DeLong's test. Finally, calibration curves were used to estimate and adjust for the degree of optimism present in both model discrimination and calibration.

A 2-tailed *P* value <0.05 was established as the level of statistical significance. All statistical analyses and graphing were performed using SPSS version 25.0 (IBM), Stata version 18.0 (StataCorp), and R version 4.3.2 (R Foundation for Statistical Computing) for Windows.

RESULTS

STUDY POPULATION. Baseline characteristics of the study population (n = 483) are presented in Table 1. More than two-thirds were ≥75 years of age, with women accounting for 58% of patients. Most of the patients undergoing TTVI (77%) showed AF and elevated GGT or bilirubin (76%). Of note, most patients had already been hospitalized for right HF symptoms (62%). RV dysfunction was observed in almost one-half of patients.

Overall mortality or rehospitalization at 12 months (n = 94) was 19% (median follow-up time 6 months; Q1-Q3: 2-12 months) (Central Illustration C).

PREDICTIVE MODEL DEVELOPMENT AND SCORING. All variables associated with mortality or rehospitalization at 12 months in the univariate analysis are presented in Table 1. A total of 11 variables were significant at univariate analysis: AF at baseline,

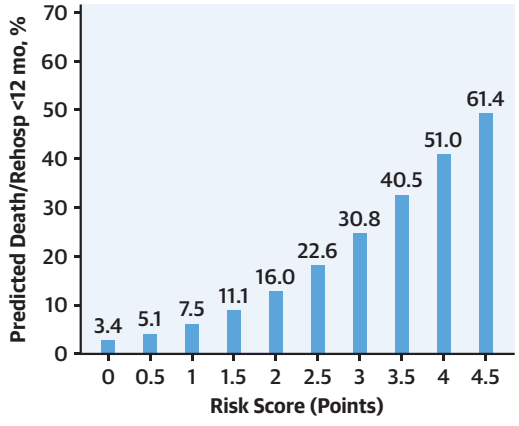
CENTRAL ILLUSTRATION Proposed Risk Score for TTVI Patients

A Dedicated Risk Score for Patients With Severe TR Undergoing TTVI

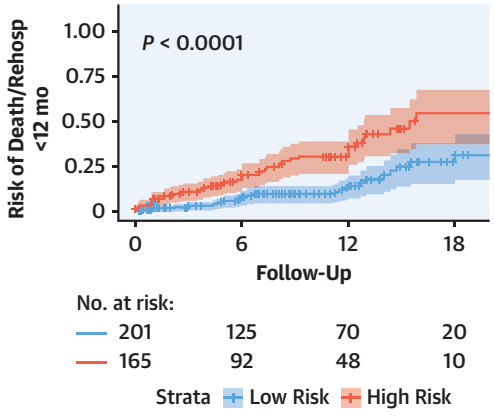
A TRIVALVE Score

Parameter	Points
Atrial fibrillation	1
GFR <30 ml/min	1
Elevated GGT or bilirubin	1
Signs of right HF	1
LVEF <50%	0.5

B Predicted 12-Month Death/Rehospitalization According to Risk Score



C Survival According to Risk Score Category



- The proposed dedicated risk score for patients with severe TR undergoing TTVI predicts 12-month death/rehospitalization with bias-corrected AUC of 68%
- The cut-off value of 2.5 showed sensitivity of 65.4% and specificity of 60.5%
- The TRIVALVE score is a simple tool to help the Heart Team select best treatment for patients with severe TR

Russo G, et al. JACC Cardiovasc Interv. 2024;17(18):2170-2179.

(A) TRIVALVE score including the 5 parameters and the correspondent points. (B) Predicted 12-month mortality or rehospitalization (rehosp) rate according to the final risk score model. (C) Survival curves according to risk score category (cutoff value 2.5). AUC = area under the receiver-operating characteristic curve; GFR = glomerular filtration rate; GGT = gamma-glutamyl transferase; HF = heart failure; LVEF = left ventricular ejection fraction; Rehosp = rehospitalization; TR = tricuspid regurgitation; TRIVALVE = International Multisite Transcatheter Tricuspid Valve Therapies Registry; TTVI = transcatheter tricuspid valve intervention.

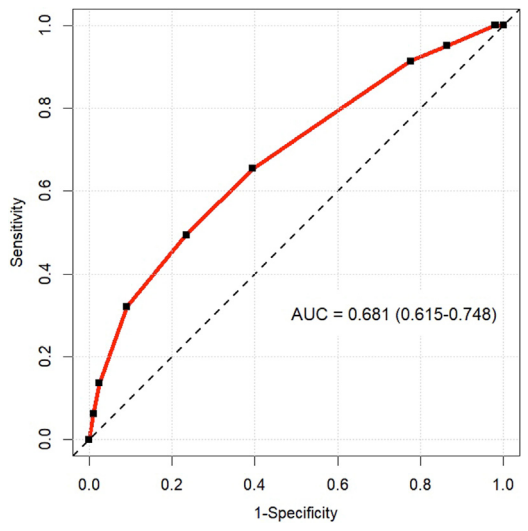
peripheral artery disease, glomerular filtration rate (GFR) <30 mL/min, elevated GGT or bilirubin, NYHA functional class IV, signs of right HF, prior admission for right HF, administration of high doses of diuretic agents, LVEF <50%, RV dysfunction, and residual TR ≤2+. All variables with *P* values <0.10 and clinical relevance were included in the multivariate analysis. After stepwise multivariate analysis, 5 variables were selected: 1) AF at baseline; 2) GFR <30 mL/min; 3) elevated GGT or bilirubin; 4) signs of right HF; and 5) LVEF <50% (Central Illustration A). In addition, age and gender were added to the model only as

TABLE 2 Predicted vs Observed Mortality According to Risk Score Values

Score	n	Predicted Mortality, %	Observed Mortality, %
0.0	5	3.4	0.0
0.5	1	5.1	0.0
1.0	37	7.5	10.8
1.5	28	11.1	10.7
2.0	130	16.0	16.2
2.5	59	22.6	22.0
3.0	55	30.8	25.5
3.5	34	40.5	44.1
4.0	10	51.0	60.0
4.5	8	61.4	62.5

adjustment variables. In the final simplified scoring system, 1 point was attributed to the variables with beta coefficients between 0.77 and 1.22 and 0.5 points to those with beta coefficients closer to 0.5 (0.59) (Table 2). Analysis of the ROC curve was performed to identify a possible cutoff value to discriminate the 2 groups and predict patients with greater risk for mortality or rehospitalization in the first year of follow-up (after the TTVI procedure). Although the AUC was <70%, a cutoff value of 2.5 showed sensitivity of 65.4% and specificity of 60.5% for the outcome. Moreover, a score ≥2.0 showed high sensitivity (>90%) and a score ≥3.5 high specificity (>90%).

FIGURE 2 Receiver-Operating Characteristic Curves From the Final Multivariate Risk Score Model



AUC = area under the receiver-operating characteristic curve.

PREDICTIVE MODEL VALIDATION AND CALIBRATION. The observed and predicted rates of death or rehospitalization within 12 months, as per the risk score model, ranged from 0.0% to 62.5% and from 3.4% to 61.4%, respectively, for scores ranging from 0 to 4.5. These rates exhibited an exponential increase as the score increased (Table 2, Central Illustration B).

The final simplified risk score model demonstrated fair discrimination performance, with an apparent AUC of 0.681 (95% CI: 0.615-0.748) and a bias-corrected AUC of 0.681 (95% CI: 0.613-0.746) from internal validation (Figure 2). In addition, the TRIVALVE score was compared with other scoring systems, including the TRI-SCORE, European System for Cardiac Operative Risk Evaluation (EuroSCORE) II, TR impact on outcomes score, and Society of Thoracic Surgeons (STS) score, with AUCs of 0.652 (95% CI: 0.590-0.715; $P = 0.31$), 0.566 (95% CI: 0.505-0.626; $P = 0.001$), 0.614 (95% CI: 0.552-0.677; $P = 0.10$), and 0.611 (95% CI: 0.545-0.677; $P = 0.044$), respectively (Figure 3). The AUC of the final model outperformed that of each single predictive variable (Supplemental Figures 1 and 2).

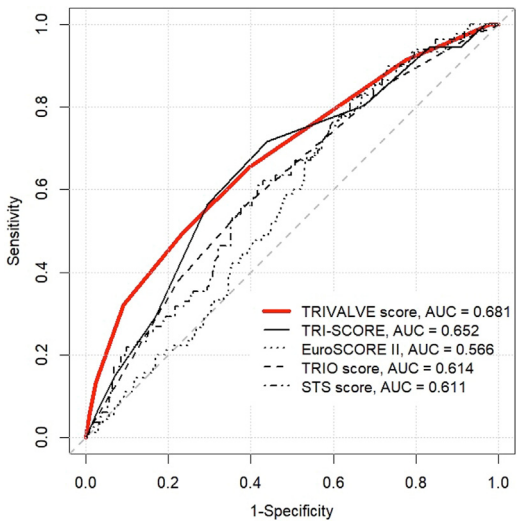
Calibration of the risk score model was deemed appropriate, as indicated by calibration curves showing favorable agreement between actual and predicted probabilities of death or rehospitalization within 12 months, both apparent and bias corrected, across all probabilities. However, a slight underestimation of the model was observed for probabilities falling between 40% and 60% (Figures 4 and 5).

DISCUSSION

We propose a dedicated risk score to predict 12-month mortality or hospitalization in patients affected by severe TR undergoing TTVI. On the basis of a large cohort from the TRIVALVE registry, the score includes 5 parameters: 1 electrocardiographic (AF), 1 clinical (right-sided HF signs), 2 laboratory (elevated GGT or bilirubin and GFR <30 mL/min), and 1 echocardiographic (LVEF <50%). The score showed fair discrimination and calibration.

To achieve good outcomes, patient selection and timing of intervention represent big challenges for all heart valve disease, but they are even more complex in tricuspid valve disease because of late onset or recognition of symptoms, late referral, and imperfect knowledge of TR natural history.[13] For the same reasons, surgery carries high mortality risk and,

FIGURE 3 Receiver-Operating Characteristic Curves Comparing Different Risk Score Models

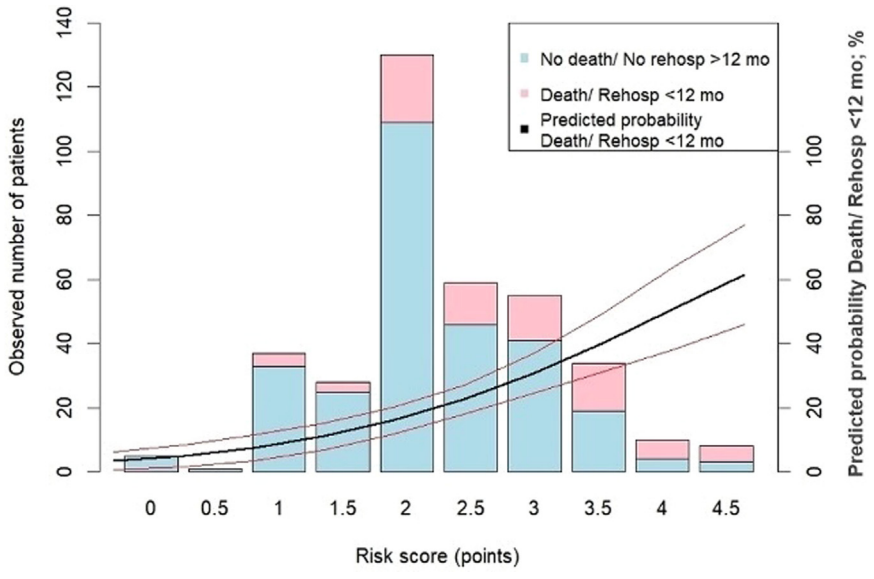


AUC = area under the receiver-operating characteristic curve; EuroSCORE = European System for Cardiac Operative Risk Evaluation; STS = Society of Thoracic Surgeons; TRIO = tricuspid regurgitation impact on outcomes; TRIVALVE = International Multisite Transcatheter Tricuspid Valve Therapies Registry.

consequently, is seldom performed in patients with isolated TR. Although a number of risk scores have been used to assess outcomes for patients with significant TR who are medically treated or surgically managed, specific scores to assess the risk of patients treated with transcatheter therapies are required.[14-19] In particular, the TRI-SCORE was recently introduced to better stratify patients undergoing isolated tricuspid valve surgery. However, when applied to a large real-world population undergoing TTVI, it showed some limitations.[10] Thus, the TRIVALVE score represents the first dedicated tool for patients with indications for percutaneous treatment. It may help address 2 important issues: 1) to understand who may benefit from percutaneous therapies, even if procedural risk is low (patient selection); and 2) to help the heart team decide on the optimal timing of intervention. In fact, for those patients with indications for a "watch and wait" strategy, the 5 parameters included in the present risk score might help understand when the clinical conditions are worsening and avoiding "too late" interventions (timing of intervention).

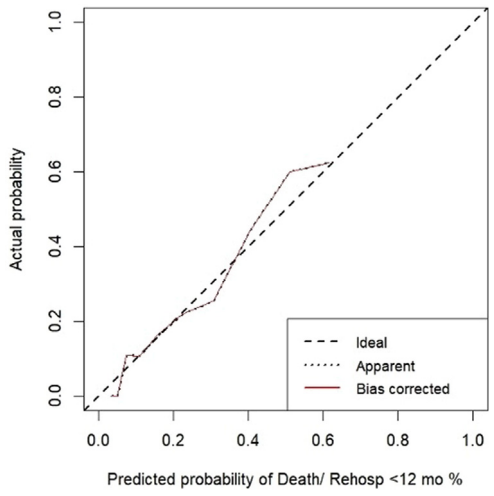
Our study confirms the negative role of some factors, such as GFR <30 mL/min and LVEF <50%, usually also present in other risk scores (eg, EuroSCORE II, TRI-SCORE). Similarly to the TRI-SCORE,

FIGURE 4 Calibration of the Final Multivariate Risk Score Model: Scores vs Probability of 12-Month Mortality or Rehospitalization



Rehosp = rehospitalization.

FIGURE 5 **Calibration of the Final Multivariate Risk Score Model: Predicted vs Actual Probability of 12-Month Mortality or Rehospitalization**



Rehosp = rehospitalization.

the TRIVALVE score also includes elevated GGT or bilirubin and ascites or peripheral edema as laboratory and clinical signs of right HF, respectively. Of note, this score includes baseline rhythm, with AF affecting long-term prognosis compared with sinus rhythm. Recent data on the relationship between AF and TR suggest that permanent AF may induce significant TR in one-third of patients, in turn affecting prognosis.[20,21] Indeed, the concept of "atrial failure" or "myopathy" has been introduced only recently, with AF representing one of the most important markers of atrial disease and one of the key features in most definitions of atrial functional TR.[22,23]

Taken together, all parameters included in the score describe an advanced stage of TR and right HF.[24] Consequently, the presence of such variables might suggest that the benefits of TTVI might be limited. Furthermore, specific considerations might be valuable for patients with cardiac implantable electronic device–related TR to guide therapeutic strategies.[25,26]

In addition to the TRI-SCORE, another score has been recently proposed for the prediction of 1-year mortality in patients affected by secondary isolated secondary TR.[27] The score includes 12 variables. Despite the differences between the 2 scores, some similarities, such as chronic kidney disease and RV function, are present. Some others are different but might be interpreted as 2 sides of the same coin: thrombocytopenia, international normalized ratio >1.5, and low albumin levels might indicate liver and spleen dysfunction similarly to elevated GGT or bilirubin elevation and ascites. The score is extrapolated from a wide population (>8,000 patients) and has a similar discriminatory ability (C statistic = 0.71), although it is based on a population receiving medical therapy and might be more difficult to apply clinically given the 12 variables.

Finally, the ROC curves of the available scores (TRI-SCORE, TR impact on outcomes score, EuroSCORE II, and STS score) displayed in **Figure 3** suggest that: 1) a dedicated risk score for TR can better stratify patients compared with general operative risk scores (EuroSCORE II and STS score); and 2) the TRIVALVE score performs slightly better than the TRI-SCORE in patients undergoing TTVI. The low value of the C statistic indicates a fair discriminatory ability: compared with the TRI-SCORE, the lower C statistic suggests that patients undergoing TTVI are probably more heterogeneous than those selected for isolated TR surgery and often several comorbidities, possibly because of too late referral. Therefore, a reasonable approach might consider both the TRI-SCORE and the TRIVALVE score to better characterize candidates for intervention for severe TR.

In general, although the present score represents the only one built from patients undergoing percutaneous interventions and is user friendly, we believe that all the scores (TRIVALVE, TRI-SCORE, and the score of Wang et al) should be taken into consideration by the heart team, bearing in mind their different backgrounds and purposes.[14,27] The TRIVALVE score represents a useful tool for the decision making regarding patients deemed high risk for surgery (high TRI-SCORE), with poor prognosis if left on medical therapy (high Wang score), and with good anatomical and clinical characteristics for percutaneous therapies (low TRIVALVE score).

STUDY LIMITATIONS. First, the sample size was small, and there were some missing data, although the TRIVALVE registry is among the largest available of patients with severe TR undergoing TTVI. Consequently, external validation was not performed, and this might represent a future step to further confirm our findings.

Second, the study has the intrinsic limitations of a retrospective and multicenter registry, although it describes real-life conditions. Third, data from

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participating centers were self-reported without core laboratory assessment.

Fourth, this registry includes different TTVI devices, some of which are no longer available (eg, Forma, Trialign, and TriCinch), although edge-to-edge technology represents most procedures. Fifth, data on race/ethnicity were not included in the registry, and consequently, these variables could not be analyzed.

Sixth, the mean follow-up duration was relatively short. Moreover, minor elevations of liver enzymes might be frequently found in elderly patients. However, to standardize the results, the same definition of the TRI-SCORE was used.

Finally, patients with concomitant mitral regurgitation were included in the analysis, and this might have affected the outcomes. However, 1) mitral regurgitation was included in the univariate analysis, with no statistical significance observed; and 2) this "inclusive" approach is more representative of a real-life population.

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Dr Russo has received a fellowship training grant from the European Association of Percutaneous Cardiovascular Interventions, sponsored by Edwards Lifesciences. Dr Adamo has received personal fees from Abbott Vascular, Medtronic, and Novartis. Dr Hahn has received speaker fees from Abbott Structural, Baylis Medical, Edwards Lifesciences, and Philips Healthcare; has institutional consulting contracts for which she receives no direct compensation with Abbott Structural, Boston Scientific, Edwards Lifesciences, Medtronic, and Novartis; has stock options with NaviGate; and is chief scientific officer for the Echocardiography Core Laboratory at the Cardiovascular Research Foundation for multiple industry-sponsored trials, for which she receives no direct industry compensation. Dr Andreas is a proctor, consultant, and speaker for Edwards Lifesciences, Abbott, Medtronic, Boston Scientific, and Zoll; and has received institutional research grants from Edwards Lifesciences, Abbott, Medtronic, and LSI Solutions. Dr Denti has received speaker honoraria from Abbott and Edwards Lifesciences. Dr Estevez-Loureiro is a consultant for Abbott Vascular, Boston Scientific, and Edwards Lifesciences. Dr Nickenig has received honoraria for lectures or advisory board membership from Abbott, Boston Scientific, Edwards Lifesciences, and Medtronic. Dr Schofer is a consultant for Edwards Lifesciences. Dr Sievert has received study honoraria to the institution, travel expenses, and consulting fees from 4tech Cardio, Abbott, Ablative Solutions, Adona Medical, Akura Medical, Ancora Heart, Append Medical, Axon, Bavaria Medizin Technologie, Bioventrix, Boston Scientific, Cardiac Dimensions, Cardiac Success, Cardimed, Cardionovum, CeloNova Biosciences, Contego, Coramaze, CroiValve, CSL Behring, CVRx, Dinova, Edwards Lifesciences, EndoBar, Endologix, EndoMatic, Esperion Therapeutics, Hangzhou Nuomao Medtech, Holistick Medical, InterShunt Technologies, Intervene, K2, Laminar, Life Tech Care, Magenta, Maquet Getinge Group, Metavention, Mitralix, Mokita, Neurotronic, NXT Biomedical, Occlutech, Recor, Renal Guard, Shifamed, Terumo, Trisol, Vascular Dynamics, Vectorious Medtech, Venus, Venock, Vivasure Medical, Vvital Biomed, and WhiteSwell. Dr Tang has served as a physician proctor for Medtronic; has served as a consultant for Medtronic, Abbott Structural Heart, and NeoChord; has served on the transcatheter aortic valve replacement advisory board for Abbott Structural Heart; and has served on the physician advisory board for JenaValve. Dr von Bardeleben has served for trials and as a principal investigator for Abbott, Edwards Lifesciences, and Medtronic. Dr Windecker has received research, travel, or educational grants to the institution from Abbott, Abiomed, Amgen, AstraZeneca, Bayer, Biotronik, Boehringer Ingelheim, Boston Scientific, Bristol Myers Squibb, Cardinal Health, Cardiovalve, CorFlow Therapeutics, CSL Behring, Daiichi-Sankyo, Edwards Lifesciences, Guerbet, Infraredx, Janssen-Cilag, Johnson & Johnson, Medicure, Medtronic, Merck Sharp & Dohme, Miracor Medical, Novartis, Novo Nordisk, Organon, OrPha Suisse, Pfizer, Polares, Regeneron, Sanofi, Servier, Sinomed, Terumo, Vifor, and V-Wave; has served as an advisory board member and/or a member of the steering or executive groups of trials funded by Abbott, Abiomed, Amgen, AstraZeneca, Bayer, Boston Scientific, Biotronik, Bristol Myers Squibb, Edwards Lifesciences, Janssen, MedAlliance, Medtronic, Novartis, Polares, Recardio, Sinomed, Terumo, V-Wave, and Xeltis, with payments to the institution but no personal payments; and is a member of the steering or executive committee groups of several investigator-initiated trials that receive funding from industry, without impact on his personal remuneration. Dr Enriquez-Sarano is a consultant for Edwards Lifesciences, ChemImage, Cryolife, and HighLife. Dr Maisano is a consultant for Abbott Vascular, Medtronic, Edwards Lifesciences, Perifect, Xeltis, Transseptal Solutions, Magenta, and Cardiovalve; has received grant support from Abbott Vascular, Medtronic, Edwards Lifesciences, Biotronik, Boston Scientific, NVT, and Terumo; has received royalties from Edwards Lifesciences and 4Tech; and is a cofounder and shareholder of Transseptal Solutions, 4Tech, Cardiovalve, Magenta, Perifect, Coregard and SwissVortex. Dr Taramasso has received consultancy fees from Abbott Vascular, Edwards Lifesciences, 4Tech, Boston Scientific, CoreMedic, Mitraltech, and SwissVortex (outside the submitted work). All other authors have reported that they have no relationships relevant to the contents of this paper to disclose.

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PERSPECTIVES

WHAT IS KNOWN? TTVI is being increasingly selected for the treatment of patients with TR although the right candidates and timing of interventions have not been established yet.

WHAT IS NEW? The present score is the first dedicated score for patients undergoing percutaneous interventions for TR and represents a useful tool for the characterization of patients affected by TR.

WHAT IS NEXT? Larger studies are needed to validate our findings and to further define the best candidates for TTVI and the right timing of intervention.

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APPENDIX For supplemental figures, please see the online version of this paper.