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Original Research Article

A comparative analysis of the accuracy of cardiac surgery risk scores in tricuspid valve procedures undertaken in the Republic of Georgia

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ABSTRACT

Background: Tricuspid valve (TV) surgeries present significant challenges marked by elevated risk and mortality rates. Despite the application of established risk scores like ACEF-II, EuroSCORE-II, and Hannan EL et al's risk stratification (HRS), their accuracy in predicting mortality rates for these procedures in a third-world setting remains under-researched. This study sought to assess the predictive performance and overall accuracy of these risk scores in the context of TV surgeries performed in the Republic of Georgia.
Methods: A cohort of 63 patients who underwent TV procedures was retrospectively analyzed. ACEF-II, EuroSCORE-II, and HRS were applied and run through statistical analysis to assess their predictive capabilities.
Results: ACEF-II demonstrated an accuracy rate of 58.7%, an area under the curve (AUC) of 0.819, and an expected-to-observed mortality ratio of 0.16. EuroSCORE-II exhibited an accuracy rate of 61.9%, an AUC of 0.866, and an expected-to-observed mortality ratio of 0.17. The HRS demonstrated an accuracy rate of 65.1%, an AUC of 0.882, and an expected-to-observed mortality ratio of 0.35.
Conclusion: While the risk scores show promise, our study highlights their limitations in accurately predicting mortality rates of TV surgeries by *underestimating* them and emphasizes the need for refinement or the development of risk scores tailored specifically to TV procedures in third-world countries.

Keywords: Tricuspid valve, Cardiac surgery, Risk scores, Risk assessment

INTRODUCTION

Tricuspid valve (TV) surgery is acknowledged as a challenging and high-risk procedure associated with high mortality rates. The right-sided position of the tricuspid valve makes it inherently more challenging to access compared to left-sided valves, requiring specialized surgical skills and techniques. Additionally, tricuspid valve surgeries are often performed alongside left-sided valve procedures, which complicates the surgical scenario. The complexity of these procedures is further increased by the restrictive surgical indications for isolated tricuspid valve interventions, which are typically only considered when the disease is severe or in conjunction with left-sided valve issues, resulting in a higher threshold for intervention.[1]

Prior to tricuspid valve surgeries, several risk scoring systems are employed to estimate the potential mortality and overall risk associated with the procedure. These scores, designed to guide clinical decision-making and patient counseling, incorporate a variety of patient-specific variables to predict surgical outcomes. However, despite their widespread use, the accuracy of these scores in the context of tricuspid valve surgeries remains questionable. Existing scores often overlook critical

variables, resulting in an underestimation of mortality risks associated with these procedures. Recognizing this gap, our study aims to assess established scoring systems, such as the age, creatinine, and ejection fraction-II (ACEF-II) score, the European system for cardiac preoperative risk evaluation-II (EuroSCORE-II), and Hannan EL et al's risk stratification for valve surgery (HRS) in a third-world setting.[2-4] ACEF-II incorporates patient age, serum creatinine, hematocrit levels, left ventricular ejection fraction, and the urgency of surgery. EuroSCORE-II, a widely used risk score in cardiac surgery, considers various patient-specific factors such as age, gender, comorbidities, and procedural details to predict the likelihood of mortality. HRS encompasses age, body surface area, type of valve surgery, numerous preoperative variables, and previous cardiac surgery. Despite these scores' effectiveness in general cardiac procedures, their applicability to tricuspid valve surgeries in a third-world context may be limited due to the omission of factors specific to the complexities of these procedures, potentially resulting in less accurate mortality predictions in this specific setting.

We hypothesize that the scoring systems underestimate the mortality rates for patients undergoing TV surgeries in third-world countries. Despite facing limitations such as restricted access to records from a single Heart Disease Center and a small patient cohort, our study highlights the inadequacy of these scores in the context of TV surgeries in third-world nations like the Republic of Georgia. These findings emphasize the urgent need to refine existing scoring systems or develop novel ones tailored to the unique challenges presented by tricuspid valve interventions in these regions.

The objective of this study was to evaluate the predictive accuracy of established cardiac surgery risk scores - ACEF-II, EuroSCORE-II, and HRS in the context of tricuspid valve procedures performed in the Republic of Georgia. Given the unique challenges posed by tricuspid valve surgeries, particularly in a third-world setting with limited resources and access to care, this study aimed to assess whether these scoring systems accurately predict in-hospital and 30-day mortality rates. By analyzing patient outcomes and comparing them with the predicted mortality rates provided by these scores, the study sought to identify potential gaps in the current risk assessment models and to explore the need for refinement or development of scoring systems that better reflect the complexities of tricuspid valve surgeries in such settings.

METHODS

Study design

All adult patients (ages>18) who underwent tricuspid valve procedures (repair or replacement) during a 10-year period (2014–2023) in the participating heart disease center were enrolled in the registry for retrospective analysis. No exclusions were made for concomitant valve surgery, coronary surgery, atrial fibrillation surgery, or surgery for congenital lesions. Ethical clearance for this study was granted by the Biomedical Research Ethics Committee of Tbilisi State Medical University.

Retrospective analysis utilized deidentified patient records sourced from the registries of the participating Heart Disease Center. Examined records pertained to patients undergoing TV procedures, ranging from annuloplasty alone to valve reconstruction with or without annuloplasty, or valve replacement. Patient preoperative risk assessment encompassed comorbid diseases, operative status, and the specific procedure performed. The focal points of interest included exploring risk-adjusted associations between patient-level factors present on admission and the outcomes of operative mortality and composite major morbidity. Composite major morbidity encompassed postoperative extracorporeal membranous oxygenation or intra-aortic balloon pump use, deep sternal wound infection, postoperative stroke, perioperative myocardial infarction, pneumonia, prolonged mechanical ventilation, renal failure, hemodialysis, or reoperation.

Statistical analysis

Descriptive statistics, involving metrics such as mean, median, standard deviation, and interquartile ranges, were deployed to concisely summarize essential parameters, providing a clear overview of central tendencies and variations within the patient cohort. Screening tests, including Sensitivity, Specificity, Positive Predictive Value, Negative Predictive Value, and Accuracy Rate, were systematically executed to assess the predictive efficacy of these scoring systems. The Chi-Square test was utilized to ascertain associations between variables, providing a statistical framework to identify potential relationships among categorical variables within the dataset. Additionally, the receiver operating characteristic (ROC) curve was generated to visualize the discriminatory abilities of the scoring systems. The area under the curve (AUC), calculated from the ROC curves, quantified the models' overall discriminative performance, offering a sturdy measure of their sensitivity and specificity trade-offs. It could vary between 0.5 (lowest accuracy) and 1.0 (highest accuracy). Expected mortality rates, determined by the scoring systems, were compared against the actual observed mortality rates, and subsequently, expected-to-observed mortality ratios were calculated. A value of 1.0 indicated optimal prediction, with a value less than 1.0 signifying an underestimation of the risk score, and a value greater than 1.0 indicated an overestimating effect.

30-day mortality is defined as the rate of death occurring up to the 30th postoperative day after the surgical procedure. In-hospital mortality is defined as any death occurring before discharge from the hospital at any time interval. Post-discharge mortality is defined as death occurring after the patient has been discharged from the

hospital within a specified follow-up period of 10 years. In our study population, in-hospital and 30-day mortality rates were equal.

The entire statistical analysis was conducted using the statistical package for the Social Sciences (SPSS) version 24.0. A significance threshold of $p<0.05$ was applied, ensuring that observed associations and findings were deemed statistically significant if the probability of their occurrence by random chance was less than 5%.

Risk score calculations

Risk scores were calculated using specific tools for each system. The EUROSCORE-II was calculated using the official website.[5] The ACEF-II score was determined using the calculator available at MDCalc.[6] For HRS, calculations were performed according to the paper published by Hannan EL et al.[4] These tools and methods ensured that each patient's risk was assessed accurately and consistently based on the established criteria for each scoring system.

RESULTS

Patient demographic

In this study that encompassed a cohort of 63 patients, the demographic profile revealed a diverse array of characteristics among the participants. The gender distribution reflected 36 females (57%) and 27 males (43%) (Figure 1). The mean age of the cohort was 53±13 (range 18-72) years. Cardiopulmonary comorbidities were notable, with 6 patients (9.5%) presenting with chronic obstructive pulmonary disease (COPD). Hemodynamic instability was observed in 33 patients (52.4%), and 4 patients (6.3%) had a recent history of myocardial infarction. Endocarditis was identified in 7 patients (11.1%), while 3 patients (4.8%) were undergoing dialysis (Table 1). Diabetes mellitus type II was present in 7 patients (11.1%), and pulmonary hypertension, ranging from mild to severe, was noted in 41 patients (65.1%) (Figure 2). Functional status, assessed by the New York Heart Association (NYHA) classification, indicated that 8 patients (12.7%) were categorized as NYHA II, 39 patients (61.9%) as NYHA III, and 7 patients (11.1%) as NYHA IV. Ascites was present in 4 patients (6.3%), and 31 patients (49.2%) were prescribed Furosemide. Right ventricular dysfunction was prevalent, affecting 45 patients (71.4%). A history of previous stroke was reported in 4 patients (6.3%), and 29 patients (46%) were hypertensive. Tricuspid valve disease, including nonrheumatic tricuspid valve insufficiency or congenital malformation, was identified in 37 patients (58.7%).

In the context of surgical preparation and urgency, preoperative intra-aortic balloon pump support was employed in 3 patients (4.8%), 3 patients (4.8%) underwent emergent surgery, while the majority, comprising 60 patients (95.2%), underwent elective surgery. Regarding the nature of tricuspid valve interventions, 3 patients (4.8%) received mechanical prosthetic replacements, while the remaining 60 underwent tricuspid valve repair. Among the repair procedures, annuloplasty using a prosthetic ring was performed in 50 patients (79.4%), annuloplasty using suture in 9 patients (14.3%), and other forms of annuloplasty for valve insufficiency in 1 patient (1.6%).

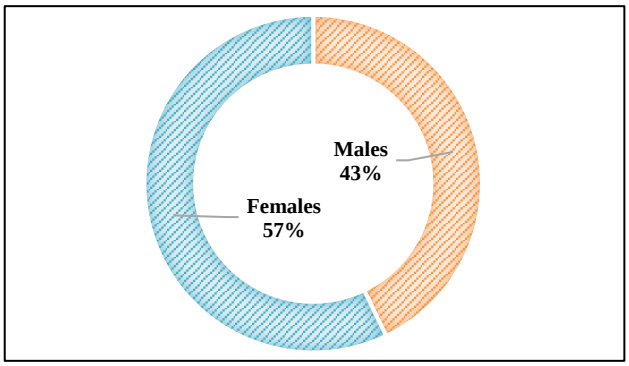

Figure 1: Patient demographic.

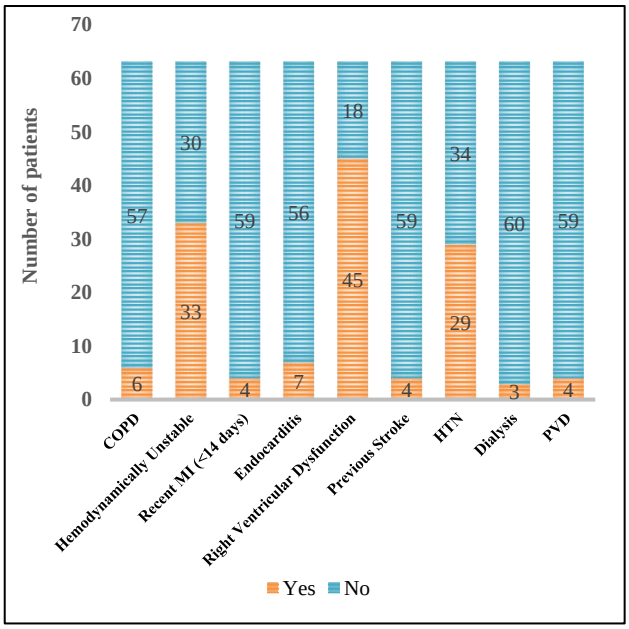

Figure 2: Patient morbidity.

COPD - Chronic Obstructive Pulmonary Disease; MI - Myocardial Infarction; PVD - Peripheral Vascular Disease; HTN - Hypertension.

In-hospital/30-day/post-discharge mortality

In our study cohort of 63 patients undergoing tricuspid valve procedures, both in-hospital and 30-day mortality rates were identical, totaling 9 subjects and yielding an overall observed mortality rate of 14.3%. Post-discharge mortality amounted to 8 patients (12.7%). The causes of mortality exhibited a spectrum, encompassing shock, cardiomyopathy, septicemia, acute kidney insufficiency, stroke, stupor, and thrombosis on the surgically intervened valve. Septicemia emerged as the predominant

known cause of overall mortality, accounting for 6 patients (35.3%), followed by shock in 3 patients (17.6%). Additionally, cardiomyopathy and stroke/stupor were observed in 2 patients (11.8%) each. The remaining 4 patients died from other causes, or the specific reason for their deaths could not be determined (Figure 4).

Table 1: Observed clinical variables.

		Frequency	%
COPD	N	57	90.5
	Y	6	9.5
Hemodynamically unstable	N	30	47.6
	Y	33	52.4
Recent MI (<14 days)	N	59	93.7
	Y	4	6.3
Endocarditis	N	56	88.9
	Y	7	11.1
Right ventricular dysfunction	N	18	28.6
	Y	45	71.4
Previous stroke	N	59	93.6
	Y	4	6.3
HTN	N	34	54.0
	Y	29	46.0
Dialysis	N	60	95.2
	Y	3	4.8
PVD	N	59	93.6
	Y	4	6.3

COPD - Chronic obstructive pulmonary disease; MI - Myocardial Infarction; HTN - Hypertension; PVD - Peripheral Vascular Disease.

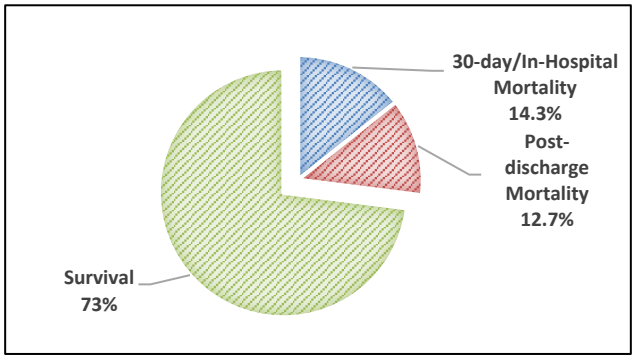

Figure 3: Observed mortality rates.

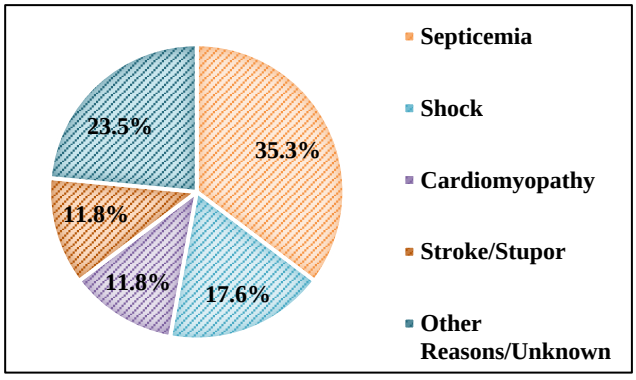

Figure 4: Causes of mortality.

Risk score assessment

The predicted mortality rates by the scoring systems were calculated to be 2.3% by ACEF-II, 2.46% by EUROSCORE-II, and 5% by HRS. Comparing these predicted mortality rates to the observed in-hospital/30-day mortality rates (14.3%), the corresponding expected-to-observed mortality ratios were ACEF-II: 0.16, EUROSCORE-II: 0.17, and HRS: 0.35. These ratios, being less than 1, indicate an *underestimation* of mortality risk by the respective scoring systems.

The discriminative ability of the scoring systems, as indicated by the AUC revealed values of 0.819 for ACEF-II, 0.866 for EUROSCORE-II, and 0.882 for HRS (Figure 5). These AUC values signify the models' capacity to distinguish between patients who experienced mortality and those who did not, with higher values indicating greater discriminatory accuracy.

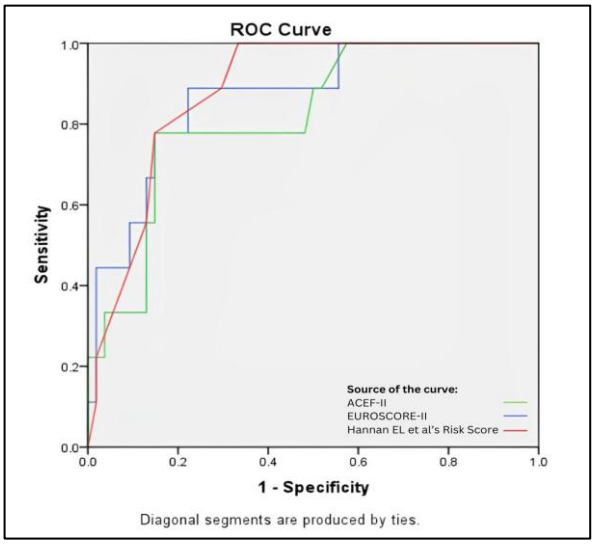

Figure 5: ROC curves for all patients (n=63).

ACEF-II score (green line), EuroSCORE II (blue line), and Hannan EL et al's Risk Score (red line); ROC- Receiver Operating Characteristic curve; ACEF-II -Age, Creatinine, and Ejection Fraction Score -II; EuroSCORE II -European System for Cardiac Operative Risk Evaluation II.

Table 2: ACEF-II mortality.

Variables		Mortality		
		Yes*	No	Total
>Median (>2.30)	Count	7	24	31
	%	77.8	44.4	49.2
<Median (<2.30)	Count	2	30	32
	%	22.2	55.6	50.8
Total	Count	9	54	63
	%	100.0	100.0	100.0

*Sensitivity=77.8%, Specificity=55.6%, Positive predictive value=22.6%, Negative predictive value=93.8%, Accuracy rate=58.7%

Furthermore, for ACEF-II (Table 2), the sensitivity stood at 77.8%, specificity at 55.6%, positive predictive value at 22.6%, negative predictive value at 93.8%, and an

overall accuracy rate of 58.7%. In the case of EUROSCORE-II (Table 3), the sensitivity reached 88.9%, specificity at 57.4%, positive predictive value at 25.8%, negative predictive value at 96.9%, and an accuracy rate of 61.9%. Lastly, HRS (Table 4) demonstrated a sensitivity of 100%, specificity of 59.3%, positive predictive value of 29%, negative predictive value of 100%, and an accuracy rate of 65.1%. These findings underscore the variability in the predictive performance of each scoring system, emphasizing the need for a more refined approach to risk assessment in the context of tricuspid valve surgeries.

Table 3: EuroScore-II mortality.

Variables		Mortality		
		Yes*	No	Total
>Median (>2.46)	Count	8	23	31
	%	88.9	42.6	49.2
<Median (<2.46)	Count	1	31	32
	%	11.1	57.4	50.8
Total	Count	9	54	63
	%	100	100	100

*Sensitivity=88.9%, Specificity=57.4%, Positive predictive value=25.80%, Negative predictive value=96.90%, Accuracy rate=61.9%

Table 4: Hannan EL et al's risk stratification score mortality.

Variables		Mortality		
		Yes*	No	Total
>Median (> 5.00)	Count	9	22	31
	%	100	40.7	49.2
<Median (<5.00)	Count	0	32	32
	%	0	59.3	50.8
Total	Count	9	54	63
	%	100	100	100

*Sensitivity=100%, Specificity=59.3%, Positive predictive value=29.0%, Negative predictive value = 100%, Accuracy rate=65.1%

DISCUSSION

While the tricuspid valve was traditionally labeled the "forgotten valve" for an extended period, there has been a notable surge in awareness and accurate diagnosis of tricuspid disease in recent times. This shift has significantly altered the perspective of the global cardiovascular community, turning the spotlight onto this once-overlooked topic and sparking vigorous research, debate, and discussion.

Tricuspid valve surgery is acknowledged in existing literature as a challenging and high-risk endeavor, necessitating careful consideration and specialized expertise due to its inherent complexities. Various studies emphasize the intricate nature of tricuspid valve procedures, highlighting the increased surgical difficulties associated with the right-sided positioning of the valve. According to Vassileva et al, surgical interventions involving the tricuspid valve are inherently more demanding than those targeting left-sided valves, often requiring a higher threshold for standalone procedures. Furthermore, studies such as that by Braun et al, underscore the elevated risk-benefit considerations in tricuspid valve surgeries, pointing to the unique challenges posed by the right heart anatomy.[1,7] The location of the tricuspid valve on the right side of the heart introduces procedural complexities, influencing clinicians to prioritize interventions on the left side where access and surgical techniques are comparatively more straightforward.

Approximately 1.6 million patients in the United States are impacted by moderate to severetricuspid regurgitation (TR).[8] Among individual swith significant TR, the majority concurrently present with other valvular diseases. The prevalence of moderate-to-severe TR is noted in 30% to 50% of patients with severe mitral regurgitation and 12% to 25% of those with severe aortic stenosis.[9-14] Alqahtani et al.'s study on TV surgery for TR found that out of 45,477 patients from 2003 to 2014, only 15% had isolated procedures, and 85% were concomitant with other cardiac surgeries. Regardless, both isolated TV replacement and repair showed high in-hospital mortality (10.9% and 8.1%, respectively), along with other complications, prolonged hospital stays, and substantial costs.[15]

The hospital mortality rate for tricuspid valve replacement varies from 14.5% to 48% based on existing literature.[16–23] In our investigation, the in-hospital mortality equaled 30-day mortality and stood at 14.3% (9 out of 63 cases) for the whole population. Following TV repair, mortality stood at 13.3% (8 out of 60 cases), whereas after tricuspid valve replacement, it was higher at 33.3% (1 out of 3 cases), representing similar findings as seen with the study conducted by Guenther et al.[24]

The EuroSCORE-II and ACEF-II are risk scores designed to predict both in-hospital mortality and 30-day mortality for cardiac surgery patients. EuroSCORE-II provides a comprehensive evaluation of patient-specific factors, while ACEF-II uses a simplified approach. Similarly, Hannan EL et al's risk stratification score, detailed in their 2013 paper, predicts in-hospital and 30-day mortality for patients undergoing valve and valve/coronary artery bypass graft surgery. These scoring systems aim to provide accurate mortality predictions to guide clinical decision-making.

In this current series, we present the outcomes of a cohort comprising 63 consecutive patients. The primary objective was to assess and compare the predictive accuracy of EuroSCORE-II, ACEF-II, and HRS scores concerning in-hospital and 30-day mortality in the context of TV surgeries performed in a third-world setting. The ROC analysis served as a pivotal component in our study, evaluating the discriminative performance of EuroSCORE-II, ACEF-II, and HRS in predicting

mortality outcomes. The AUC scores, representing the models' overall discriminatory abilities, were instrumental in quantifying their effectiveness. EuroSCORE-II exhibited an AUC of 0.866, ACEF-II demonstrated an AUC of 0.819, and HRS yielded an AUC of 0.882. These values, calculated from the ROC curves, provide a comprehensive measure of how well each scoring system distinguished between patients with different mortality outcomes. The higher AUC for HRS indicates superior discriminatory power in our cohort, while EuroSCORE-II and ACEF-II, though slightly lower, still exhibited substantial discriminative capacities.

Our study outcomes indicate that EuroSCORE-II, ACEF-II, and HRS possess a predictive value considered acceptable yet do not reach optimal levels in the context of tricuspid surgery in a third-world setting. We noted a significant trend where all scores consistently *underestimated* mortality rates across the entire population with expect-to-observed mortality ratios of ACEF-II: 0.16, EUROSCORE-II: 0.17, and HRS: 0.35. HRS appears to exhibit a relatively superior ability in predicting mortality compared to the other two scoring systems. This is further confirmed by the accuracy rates of 58.7% for ACEF-II, 61.9% for EuroSCORE-II, and 65.1% for HRS (Figure 6).

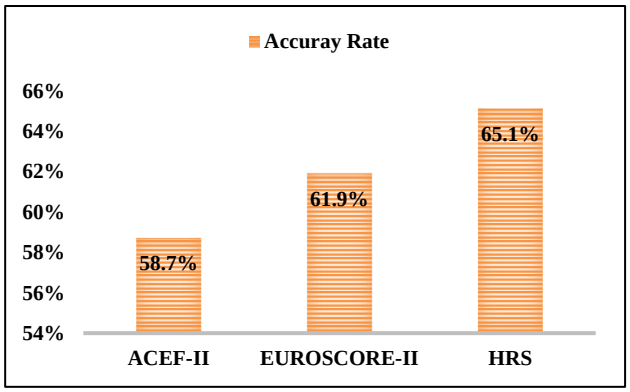

Figure 6: Accuracy rate of the scoring systems (%).
ACEF-II (58.7%), EUROSCORE-II (61.9%), HRS (65.1%); ACEF-II- Age, Creatinine, and Ejection Fraction; EUROSCORE-II- European System for Cardiac Operative Risk Evaluation; HRS - Hannan EL et al's Risk Stratification Score.

The interpretation of the results reveals varying strengths and weaknesses among the assessed risk scores for tricuspid valve surgeries. ACEF-II demonstrated a balanced negative predictive value (93.8%) and moderate sensitivity (77.8%), making it potentially suitable for ruling out adverse outcomes. EUROSCORE-II exhibited a higher sensitivity (88.9%) but a lower positive predictive value (25.80%), suggesting it might be more adept at correctly identifying positive cases but with a higher chance of false positives. Notably, HRS displayed perfect sensitivity (100%) but a relatively lower positive predictive value (29.0%). This indicates its robust ability to identify all true positive cases but with a higher likelihood of false positives.

In practical terms, if the emphasis is on correctly identifying cases with a lower risk of mortality, ACEF-II's higher negative predictive value and balanced sensitivity and specificity make it a viable choice. EUROSCORE-II, with its high sensitivity, might be preferable when the goal is to capture as many true positive cases as possible, even though it may result in a higher rate of false positives. The choice of the scoring system should be tailored to the specific objectives of risk assessment in tricuspid valve surgeries, balancing the priorities of sensitivity, specificity, positive predictive value, and negative predictive value based on the clinical context and the desired outcomes of the risk assessment.

While our study contributes valuable insights into the predictive accuracy of scoring systems in tricuspid valve procedures, certain limitations warrant consideration. The retrospective nature of the study and the reliance on a single-center cohort may limit the generalizability of our findings. Additionally, the influence of potential confounding factors, such as variations in surgical techniques and postoperative care protocols, should also be acknowledged. Furthermore, the study's geographic context in a third-world country introduces unique healthcare challenges that may impact the applicability of our results to different healthcare settings. These limitations highlight the need for cautious interpretation and underscore the importance of future studies incorporating diverse cohorts and addressing long-term outcomes to further refine risk stratification in tricuspid valve surgeries.

To the best of our knowledge, this is the first study that aimed to validate risk scores for tricuspid procedures in the Republic of Georgia. The observed mortality rates surpassing the predicted values in our study raise pertinent considerations, potentially linked to challenges often encountered in developing or third-world country healthcare settings, which may influence surgical outcomes. Tricuspid valve procedures in the Republic of Georgia are predominantly conducted in the capital city, Tbilisi, where only a limited number of specialized centers are equipped to perform these complex surgeries. This geographical concentration poses significant challenges for patients residing in rural areas, as access to these critical interventions is restricted. Furthermore, the overall number of tricuspid valve surgeries performed is exceptionally low, primarily due to a combination of factors, including inadequate diagnostic capabilities and the high costs associated with surgical procedures. Many patients may not receive timely diagnoses or appropriate referrals, leading to advanced disease stages at the time of presentation. Additionally, the financial burden of surgery can deter patients from seeking necessary care, resulting in delayed treatment and poorer outcomes. These challenges in a third-world setting might be reasons we speculate these scores underestimate the actual mortality rates. Future research should strive for larger sample sizes, involve multiple centers to enhance the robustness and applicability of the results, and

consider the broader healthcare landscape to provide a more comprehensive understanding.

CONCLUSIONS

Our study underscores the inherent challenges within widely utilized scoring systems when applied to tricuspid valve procedures in a third-world setting. The consistent *underestimation* of mortality rates prompts a critical examination of the impact of healthcare disparities, limited resources, and unique challenges prevalent in such contexts. The complexities of tricuspid surgeries in a third-world healthcare landscape, marked by delayed diagnosis, resource constraints, and socio-economic factors, potentially contribute to the observed discrepancies between predicted and observed mortality rates. This highlights the urgent need for refinement in risk stratification models, specifically tailored to the challenges posed by tricuspid procedures in resource-limited environments. Our findings emphasize the importance of acknowledging and addressing the intricacies of healthcare delivery in third-world countries when developing or adapting scoring systems, with the ultimate goal of enhancing predictive accuracy and optimizing patient outcomes in the realm of tricuspid valve surgeries.

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REFERENCES

1. Vassileva CM, Shabosky J, Boley T, Markwell S, Hazelrigg S. Tricuspid valve surgery: the past 10 years from the Nationwide Inpatient Sample (NIS) database. J Thorac Cardiovasc Surg. 2012;143(5):1043–9.
2. Ranucci M, Pistuddi V, Scolletta S, de Vincentiis C, Menicanti L. The ACEF II Risk Score for cardiac surgery: updated but still parsimonious. Eur Heart J. 2018;39(23):2183–9.
3. Nashef SAM, Roques F, Sharples LD, Nilsson J, Smith C, Goldstone AR, et al. EuroSCORE II†. Eur J Cardiothorac Surg. 2012;41(4):734–45.
4. Hannan EL, Racz M, Culliford AT, Lahey SJ, Wechsler A, Jordan D, et al. Risk score for predicting in-hospital/30-day mortality for patients undergoing valve and valve/coronary artery bypass graft surgery. Ann Thorac Surg. 2013;95(4):1282–90.
5. EuroScore Website-calculator. Available at: https://www.euroscore.org. Accessed on 28th July 2024.
6. ACEF II Risk score for cardiac surgery–MD Calc. Available at: https://www.mdcalc.com. Accessed on 28th July 2024.
7. Braun D, Orban M, Orban M, Hagl C, Massberg S, Nabauer M, et al. Transcatheter edge-to-edge repair for severe tricuspid regurgitation using the triple-orifice technique versus the bicuspidalization technique. JACC Cardiovasc Interv. 2018;11(17):1790–2.
8. Stuge O, Liddicoat J. Emerging opportunities for cardiac surgeons within structural heart disease. J Thorac Cardiovasc Surg. 2006;132(6):1258–61.
9. Schwartz LA, Rozenbaum Z, Ghantous E, Kramarz J, Biner S, Ghermezi M, et al. Impact of right ventricular dysfunction and tricuspid regurgitation on outcomes in patients undergoing transcatheter aortic valve replacement. J Am Soc Echocardiogr. 2017;30(1):36–46.
10. Barbanti M, Binder RK, Dvir D, Tan J, Freeman M, Thompson CR, et al. Prevalence and impact of preoperative moderate/severe tricuspid regurgitation on patients undergoing transcatheter aortic valve replacement. Catheter Cardiovasc Interv. 2015;85(4):677–84.
11. Nath J, Foster E, Heidenreich PA. Impact of tricuspid regurgitation on long-term survival. J Am Coll Cardiol. 2004;43(3):405–9.
12. Schueler R, Öztürk C, Sinning JM, Werner N, Welz A, Hammerstingl C, et al. Impact of baseline tricuspid regurgitation on long-term clinical outcomes and survival after interventional edge-to-edge repair for mitral regurgitation. Clin Res Cardiol. 2017;106(5):350–8.
13. Koelling TM, Aaronson KD, Cody RJ, Bach DS, Armstrong WF. Prognostic significance of mitral regurgitation and tricuspid regurgitation in patients with left ventricular systolic dysfunction. Am Heart J. 2002;144(3):524–9.
14. Lindman BR, Maniar HS, Jaber WA, Lerakis S, Mack MJ, Suri RM, et al. Effect of tricuspid regurgitation and the right heart on survival after

transcatheter aortic valve replacement. Circ Cardiovasc Interv. 2015;8(4):2073.
15. Alqahtani F, Berzingi CO, Aljohani S, Hijazi M, Al-Hallak A, Alkhouli M. Contemporary trends in the use and outcomes of surgical treatment of tricuspid regurgitation. J Am Heart Assoc. 2016;6(12):7597.
16. Rizzoli G, De Perini L, Bottio T, Minutolo G, Thiene G, Casarotto D. Prosthetic replacement of the tricuspid valve: biological or mechanical? Ann Thorac Surg. 1998;66(6):62-7.
17. Singh SK, Tang GHL, Maganti MD, Armstrong S, Williams WG, David TE, et al. Midterm outcomes of tricuspid valve repair versus replacement for organic tricuspid disease. Ann Thorac Surg. 2006;82(5):1735–41.
18. Ratnatunga CP, Edwards MB, Dore CJ, Taylor KM. Tricuspid valve replacement: UK Heart Valve Registry mid-term results comparing mechanical and biological prostheses. Ann Thorac Surg. 1998;66(6):1940–7.
19. Munro AI, Jamieson WR, Tyers GF, Germann E. Tricuspid valve replacement: porcine bioprostheses and mechanical prostheses. Ann Thorac Surg. 1995;60(2 Suppl):470-3.
20. McGrath LB, Gonzalez-Lavin L, Bailey BM, Grunkemeier GL, Fernandez J, Laub GW. Tricuspid valve operations in 530 patients. Twenty-five-year assessment of early and late phase events. J Thorac Cardiovasc Surg. 1990;99(1):124–33.
21. Van Nooten GJ, Caes FL, François KJ, Taeymans Y, Primo G, Wellens F, et al. The valve choice in tricuspid valve replacement: 25 years of experience. Eur J Cardiothorac Surg 1995;9(8):441-6.
22. Scully HE, Armstrong CS. Tricuspid valve replacement. Fifteen years of experience with mechanical prostheses and bioprostheses. J Thorac Cardiovasc Surg. 1995;109(6):1035–41.
23. Carpentier A, Deloche A, Hanania G, Forman J, Sellier P, Piwnica A, et al. Surgical management of acquired tricuspid valve disease. J Thorac Cardiovasc Surg. 1974;67(1):53–65.
24. Guenther T, Noebauer C, Mazzitelli D, Busch R, Tassani-Prell P, Lange R. Tricuspid valve surgery: a thirty-year assessment of early and late outcome. Eur J Cardiothorac Surg. 2008;34(2):402–9.

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