Review Article

My Approach to a Standardized Assessment of the Tricuspid Valve: A Contemporary Analysis

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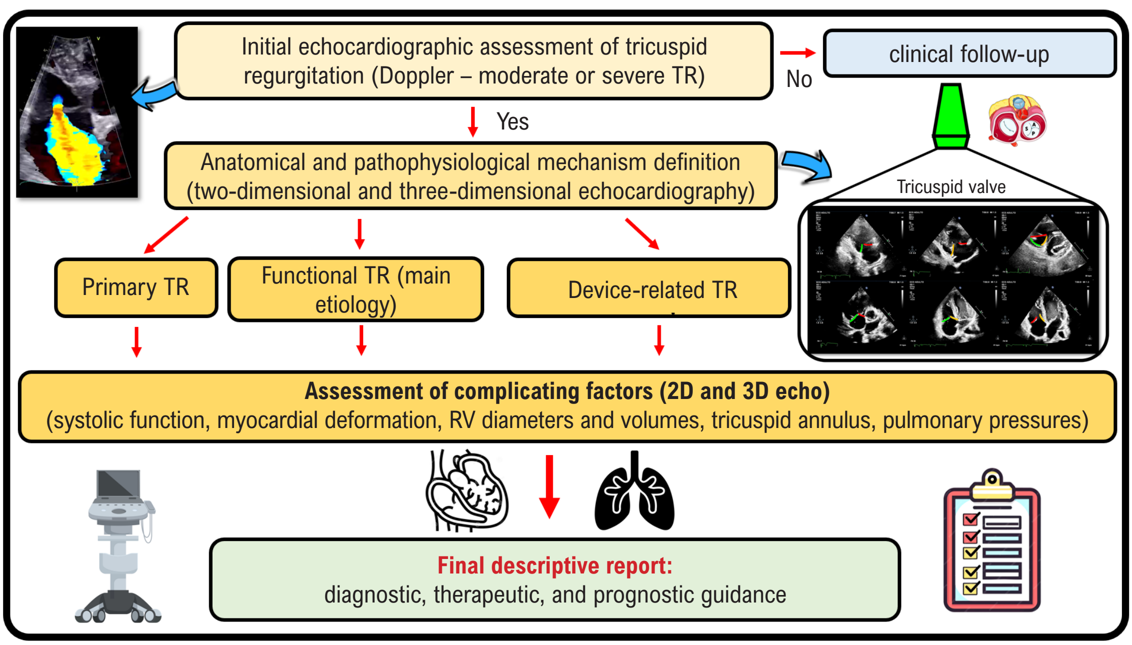
Central Illustration: My Approach to a Standardized Assessment of the Tricuspid Valve: A Contemporary Analysis



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Abstract

Tricuspid regurgitation (TR) remains one of the most frequent valvular diseases encountered in echocardiographic practice. Mild cases generally do not require further investigation or specific treatment. Moderate and severe valvular disease, however, require more detailed anatomical and etiological assessment to better understand the underlying pathophysiological mechanism.

Two-dimensional echocardiographic analysis is the initial examination of choice and should be performed in a standardized manner, with individual identification of the leaflets using the main transthoracic echocardiographic windows. The description of complementary parameters – such as right ventricular (RV) systolic function, myocardial deformation assessed by longitudinal strain, right-sided chamber diameters and volumes, and estimation of pulmonary pressures – guides the clinician regarding potential therapeutic strategies and provides relevant prognostic information.

In this context, the 2025 European Society of Cardiology (ESC) guideline reinforces the importance of a standardized and comprehensive evaluation of the tricuspid valve and its hemodynamic repercussions. Most of this assessment can be performed using widely available two-dimensional transthoracic echocardiography.

Keywords

Tricuspid Valve; Tricuspid Valve Insufficiency; Pulmonary Hypertension.

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Introduction

The tricuspid valve (TV) is an important cardiac structure in echocardiographic evaluation, especially in conditions such as functional tricuspid regurgitation, pulmonary hypertension, and right ventricular dysfunction, where detailed analysis can influence therapeutic decisions. The tricuspid valve complex is an integrated anatomic-functional unit composed of valve leaflets, chordae tendineae, papillary muscles, and the valvular annulus, dynamically interacting with the right ventricle (RV), right atrium (RA), and pulmonary circulation. This integration contributes to hemodynamic function by ensuring unidirectional flow during the cardiac cycle and preventing regurgitation that would impair systolic efficiency.[1]

General Anatomy and Leaflet Structure

The TV is the most apical cardiac valve, positioned between the RA and the RV, with the largest orifice among the atrioventricular valves (typically 7–9 cm² in healthy adults, according to echocardiographic assessment). Its septal insertion is usually ≤10 mm more apical than the mitral valve plane, a classic echocardiographic finding that aids in anatomical characterization. The leaflets are asymmetrical and show numerical variability, with approximately 54% of cases presenting three cusps and 46% subdivided into the other types (two, four and five cusps). They are identified as anterior (or anterosuperior), septal, and posterior (or inferior/mural):

- **Anterior cusp:** The largest and most mobile, extending from the anterior infundibular region of the RV to the inferolateral wall, contributing to broad coaptation during diastole, essential for valve function.
- **Septal Cusp:** The smallest and least mobile, anchored to the interventricular septum, with a more apical insertion, relevant in the evaluation of dysfunctions associated with ventricular alterations.
- **Posterior Cusp:** Located along the posterior margin of the tricuspid annulus, extending between the septal leaflet and the RV free wall, playing a stabilizing role during ventricular contractions.

Coaptation occurs at the annular plane or slightly below it (with a coaptation height of 5–10 mm), functioning as a reserve mechanism in moderate annular dilation, as emphasized in tricuspid regurgitation assessment guidelines. Three-dimensional echocardiography is recommended to map these dynamics and identify pathological changes – such as tethering or dilation – that impair valvular competence.[2]

The Annulus as a Dynamic Structure

The tricuspid annulus has a non-planar geometry, with an oval saddle-shaped configuration (similar to the letter "D"), and dynamic dimensions that respond to preload and the cardiac cycle: approximately 10–15% shortening in diameters and 15–25% reduction in area during systole in healthy individuals. This annular contractility, which can be assessed by echocardiography, may be characterized in greater detail using three-dimensional (3D) techniques when available, contributing to the understanding of leaflet coaptation and the forces exerted on the subvalvular apparatus. Pathological measurements include a diastolic diameter ≥ 40 mm or ≥ 21 mm/m², preferably obtained in the apical four-chamber (4C) view, with body-surface-area indexing for prognostic purposes and intervention planning.

Subvalvular Apparatus: Chordae Tendineae and Papillary Muscles

The subvalvular apparatus consists of chordae tendineae that are less distensible than those of the mitral valve, arranged in a fan-shaped distribution, and three papillary muscle groups: anterior and posterior (well defined and anchored to the RV free wall) and septal. These structures anchor the cusps, preventing prolapse or eversion during systole, and are particularly sensitive to RV dilation, which may lead to tethering and functional regurgitation.

Epidemiology and Clinical Impact

Tricuspid regurgitation (TR) is a relatively common echocardiographic finding in the general population, with higher prevalence in women and in older patients. Mild TR is, in most cases, a benign condition that does not require further investigation. Significant TR is defined when regurgitation is ≥ moderate in severity and has an age- and sex-adjusted estimated prevalence of 0.55%, with a gradual increase associated with aging (4% in individuals ≥ 75 years).[2] Similar to mitral regurgitation, this condition should be interpreted along a continuous spectrum of severity, in which greater regurgitation correlates with higher risk of death and cardiovascular complications, independent of comorbidities, ventricular function, and pulmonary pressures.

Only 8-10% of patients with TR present clear anatomical abnormalities of the tricuspid valve complex (primary TR). These may result from various conditions such as infectious endocarditis, rheumatic disease, carcinoid syndrome, congenital anomalies (Ebstein anomaly), thoracic radiation, myxomatous disease, as well as trauma or iatrogenic valvular injury (e.g., endomyocardial biopsy). TR related to cardiac implantable electronic devices (CIEDs) represents a distinct entity requiring specific diagnostic and management approaches. In patients with CIEDs, diagnostic efforts should aim to determine whether the lead is the cause of TR (CIED-related TR) or merely incidental (CIED-associated TR).

In patients with secondary TR, the tricuspid valve leaflets are structurally normal, and regurgitation is caused by annular dilation and/or leaflet tethering due to right atrial (RA) dilation and/or right ventricular (RV) dilation and dysfunction. Based on key morphological and hemodynamic characteristics, two phenotypes of secondary TR have been proposed:

- **Atrial secondary TR**: primarily due to atrial fibrillation and characterized by the absence of significant leaflet tethering, but with marked dilation of the right atrium (RA) and annulus, along with preserved right ventricular (RV) size/function, pulmonary pressure, and left ventricular (LV) function.
- **Ventricular secondary TR:** caused by annular dilation and leaflet restriction as a consequence of left-sided ventricular or valvular disease (post-capillary pulmonary hypertension), pre-capillary pulmonary hypertension, or primary RV cardiomyopathy/ischemia (also after left-sided valve surgery).

In advanced stages of the disease, these two phenotypes may no longer be distinguishable; therefore, early characterization is essential for determining prognosis. Currently, there is no evidence of a direct impact on patient management; thus, current recommendations for intervention primarily consider primary versus secondary TR.

Diagnostic Evaluation Focused on Severity and Prognostic Aspects

A comprehensive transthoracic echocardiographic examination of the tricuspid valve requires a methodical approach to correctly identify the associated pathology. In two-dimensional echocardiography, it is not possible to visualize all three leaflets simultaneously, and there is considerable variability regarding which leaflets appear in each acquired image.

In the parasternal RV inflow view, the anterior leaflet always appears in the proximal field. In the distal field, the leaflet may be either the septal or the posterior one, depending on the transducer angulation.

In the short-axis view, the leaflet adjacent to the aortic valve generally corresponds to either the septal or the anterior leaflet, whereas the leaflet adjacent to the RV free wall is usually the posterior leaflet.

In the apical four-chamber view, the septal leaflet is positioned along the ventricular septum. The leaflet related to the free wall may be either the anterior or the posterior one, depending on the transducer angulation: when the aorta is visualized, it is the anterior leaflet; when the coronary sinus is seen, it is the posterior leaflet.

Figure 1 illustrates the main echocardiographic windows used in the two-dimensional assessment of the tricuspid valve, with identification of the corresponding leaflets visualized.

Compared with transthoracic echocardiography (TTE), transesophageal echocardiography is generally more limited in obtaining ideal windows for severity quantification due to the acquisition of off-axis imaging planes and the greater distance between the probe and the tricuspid valve.

Three-dimensional echocardiography provides unique views of the TV, allowing simultaneous visualization of all three or more leaflets and the entire annulus. Adding color Doppler to a full-volume acquisition not only makes it possible to analyze the mechanism and locate the TR jet, but also to quantify the size of the effective regurgitant orifice (ERO).[4]

Assessment of the right heart chambers

The RV is usually dilated in the presence of hemodynamically significant TR. Septal position produces a D-shaped LV, more evident in diastole (a pattern of RV volume overload). When TR is related to pulmonary hypertension, there is septal flattening throughout the

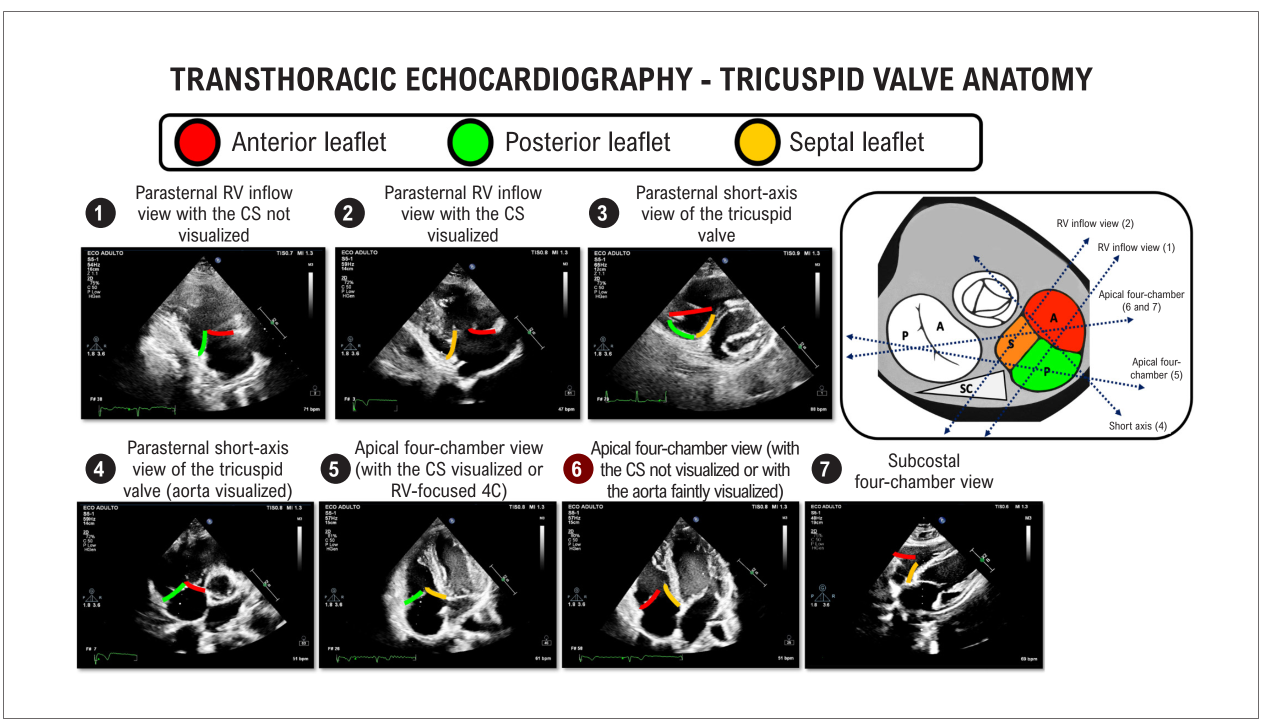

Figure 1 – *Two-dimensional transthoracic echocardiographic assessment of the tricuspid valve. Images 1, 2, 3, 4, 5, 6, and 7 demonstrate the main echocardiographic windows used for tricuspid valve evaluation and the corresponding leaflets visualized in a patient with normal anatomy. Anatomical variations should be considered, particularly in the parasternal short-axis and apical four-chamber views. Although not shown above, the apical two-chamber RV view generally displays the anterior and posterior leaflets of the tricuspid valve; RV: right ventricular; CS: coronary sinus; S: septal; A: anterior; P: posterior; adapted from Hungerford et al.*[3]

entire cardiac cycle, reflecting both diastolic and systolic RV overload (a pattern of RV pressure overload).

Parameters of RV systolic function are important for monitoring the effects of chronic primary TR and detecting deterioration of RV cardiac function. Assessing RV systolic function is challenging in this context because these parameters are load-dependent. A tricuspid annular plane systolic excursion (TAPSE) <1.7 cm and a right ventricular fractional area change (FAC) <35% are suggestive of RV dysfunction, although tricuspid annular excursion in particular may yield false-positive and false-negative results. In the presence of a valve with normal anatomy, abnormal RV function is more likely to be the cause rather than the consequence of TR. Significant chronic TR also leads to enlargement of the right atrium and the inferior vena cava. Finally, right atrial enlargement in patients with permanent atrial fibrillation and concomitant tricuspid annular dilation (>35 mm) may result in secondary tricuspid regurgitation of atrial etiology.[3]

Echocardiographic assessment of TR severity

1. Color-flow imaging

Color Doppler assessment of TR severity involves a critical analysis of the jet components: jet area, *vena contracta* (VC), and the flow convergence zone, with each of these components described below.

Jet area: Jet area is one of the color Doppler parameters used to evaluate the severity of regurgitation. However, there may be considerable overlap in jet areas among patients with mild versus moderate TR. In addition, eccentric regurgitant jets that impinge on the atrial wall appear smaller than centrally directed jets with a similar regurgitant volume. In general, a color Doppler jet area >10 cm^2 is consistent with severe TR; however, because several hemodynamic and anatomical factors affect the appearance of a central jet, jet area is often considered only a semiquantitative parameter. In cases of massive TR with lack of tricuspid leaflet coaptation, TR velocity may be so low that no aliasing occurs, making jet area calculation inaccurate.

Vena contracta: Visualization of the VC is technically less demanding than the PISA method and can be used semiquantitatively or qualitatively. When obtained from the apical four-chamber view and the parasternal RV inflow view, a VC width >0.7 cm identifies severe TR and is a marker of worse prognosis (Nyquist limit between 50–70 cm/s). Three-dimensional color Doppler can be used to measure both VC area and width. When comparing 2D and 3D color Doppler VC measurements, the maximum VC diameter is often larger on 3D Doppler imaging. The 3D VC area correlates well with the effective regurgitant orifice area (EROA). Based on currently available data, a VC area >0.4 cm^2 is a reasonable cutoff value for determining severe TR.

Flow convergence: The proximal flow convergence method is applicable to TR, but there is less experience with it than with MR. The PISA method for TR is subject to all the limitations seen in its application to MR. In particular, contour flattening as blood approaches the orifice may be exaggerated in TR, since the peak velocity is generally lower than in MR, resulting in underestimation of the regurgitant flow. Because the regurgitant orifice is often noncircular in TR, the standard PISA approach leads to additional underestimation. The 2D PISA method underestimates the effective regurgitant orifice area compared with 3D PISA and with the 3D VC area.[4]

2. Regurgitant volume

In theory, TR volume can be calculated by subtracting the flow across a non-regurgitant valve from the forward flow across the tricuspid annulus. However, this approach is rarely used in clinical practice, partly due to the difficulty in accurately estimating the shape of the tricuspid annulus (which is not circular) and the lack of uniformity in the site where velocity is measured across the annulus.

The optimal cutoff value for defining severe TR is still not well established. A comparative study in patients with significant mitral regurgitation (MR) and TR found that, for the same EROA obtained using the 2D PISA method (0.4 cm^2), the regurgitant volume cutoff values differed between TR (45 mL/beat) and MR (60 mL/beat). This difference is a direct consequence of the typically lower velocity of TR compared with MR, suggesting that, in clinical practice, different regurgitant volume thresholds need to be used, although a similar grading scheme may be applied for EROA.[4]

3. Pulsed and Continuous-Wave Doppler

It is important to note that TR jet velocity is not related to the regurgitant flow volume. In fact, very severe TR is often associated with a low jet velocity, with near equalization of RV and right atrial systolic pressures. Similar to MR, the continuous-wave Doppler characteristics of the TR jet that help assess regurgitation severity include signal intensity and the contour of the velocity curve. In severe TR, a dense spectral envelope is observed. A triangular jet contour with an early peak in maximum velocity indicates elevated right atrial pressure and a prominent regurgitant pressure wave (V wave) in the right atrium. It should be noted that this pattern may also be present in patients with milder degrees of TR who have markedly elevated right atrial pressure (reduced right atrial compliance).

Pulsed-wave Doppler evaluation of the hepatic veins helps corroborate the assessment of TR severity. As TR severity increases, the normally dominant systolic forward wave becomes less prominent. In severe TR, systolic flow reversal occurs. However, hepatic vein flow patterns are also influenced by right atrial and right ventricular compliance, respiration, preload, pacemaker rhythms, complete heart block, and atrial fibrillation/flutter. Systolic flow reversal is a specific sign of severe TR, provided that the modulating conditions mentioned above are considered during interpretation.[4]

Integrative approach to the assessment of tricuspid regurgitation (TR)

The ideal approach to evaluating TR severity is to integrate multiple parameters of tricuspid regurgitation, avoiding reliance on a single measurement. It is also important to distinguish between the regurgitant volume and its hemodynamic consequences, particularly when considering acute versus chronic regurgitation.

If qualitative or semiquantitative parameters fall within the intermediate range between mild and severe, the TR severity is more likely to be moderate. Accurate quantification of TR severity is more challenging than in aortic or mitral valve disease. In cases where TTE provides limited assessment of regurgitation, when there is significant internal inconsistency, or when findings are discordant with the clinical presentation, additional evaluation using other imaging modalities may be necessary to more precisely assess the mechanism and severity of TR.[4]

Although the more recent classification proposed by Hahn et al.[1] in 2017 includes the categories of massive and torrential TR, this article will maintain the classification proposed by the American Society of Echocardiography (ASE) in its latest guideline, which divides severity into mild, moderate, and severe, in order to facilitate identification and reporting in outpatient echocardiography studies. Table 1 describes the main parameters used to grade the severity of TR.

Guideline Update

State of the Art in Tricuspid Valve Assessment in 2026

What's New in the 2025 European Society of Cardiology (ESC/EACTS) Guideline

Organization of Intervention and Reference Centers / "Heart Team"

The 2025 guideline reinforces the central role of the Heart Team and specialized reference centers with expertise in

Table 1 – Structural, qualitative, semiquantitative, and quantitative parameters for determining the severity of tricuspid regurgitation according to the recommendations of the American Society of Echocardiography (ASE)

ASSESSMENT OF CHRONIC TRICUSPID REGURGITATION SEVERITY - ECHOCARDIOGRAPHY			
PARAMETERS	**MILD**	**MODERATE**	**IMPORTANT**
STRUCTURAL			
Morphology of the tricuspid valve	Normal or slightly abnormal leaflets	Slightly abnormal leaflets	Severe valvular lesions (flail leaflet, severe retraction, large perforation)
RV and LV size	Usually normal	Normal or mild dilation	Dilated chambers *RV and RA size may remain within the "normal" range in patients with acute severe TR
Inferior vena cava diameter	IVC ≤ 20 mm	IVC between 21 and 25 mm	IVC > 25 mm
QUALITATIVE DOPPLER			
Jet area	Small, narrow, and central	Moderate and central	Large or eccentric jet with Coanda effect
Convergence zone	Not visible, transient, or small	Intermediate size and duration	Large PISA throughout systole
Continuous wave Doppler	Weak/partial/parabolic	Dense, parabolic or triangular	Dense, often triangular CW Doppler signal
SEMIQUANTITATIVE PARAMETERS			
Jet area (cm^2)	Not defined	Not defined	> 10 cm^2
Vena contracta width (cm)	< 0.3 cm	0.3 - 0.69 cm	≥ 0.7 cm
PISA radius	≤ 0.5 cm	0.6 - 0.9 cm	> 0.9 cm
Hepatic vein flow	Systolic-dominant	Systolic attenuation	Systolic flow reversal
Tricuspid inflow	Dominant A-wave	Variable	E-wave > 1.0 m/s
QUANTITATIVE			
EROA (cm^2)	< 0.20 cm^2	0.20 - 0.39 cm^2	≥ 0.40 cm^2
Regurgitant volume (PISA)	< 30 mL	30 - 44 mL	≥ 45 mL

TR: tricuspid regurgitation; RA: right atrial; RV: right ventricular; IVC: inferior vena cava; PISA: proximal isovelocity surface area; EROA: effective regurgitant orifice area.[4]

valvular heart disease to determine the optimal timing and modality of intervention, standardizing care pathways and prioritizing early evaluation. The official document and its supporting materials emphasize shared decision-making and practical decision pathways, with a focus on more concise and operational recommendations.

Advances in Imaging and Quantification

The 2025 European guideline consolidates 3D echocardiography, cardiac computed tomography, and cardiac magnetic resonance as key components in the screening and evaluation of valvular heart disease, assigning these modalities a more clearly defined role than in the 2021 guideline within the integrated cardiovascular imaging assessment. For the tricuspid valve, the update maintains the classic criteria for TR quantification (qualitative, semiquantitative, and quantitative), without changes to reference values (Figure 2). However, the new document reinforces a more contextualized interpretation of these parameters, integrating them with measurements of the tricuspid valve complex obtained through 3D assessment (annulus, gap, coaptation height, and tethering), as well as functional metrics of the RV – such as global and free-wall strain – which now contribute to severity grading and to defining the optimal therapeutic strategy.[5]

Functional Stratification of the RV and Tricuspid Valve Remodeling

The guideline now places greater emphasis on the consequences of TR by integrating RV function and remodeling, as well as tricuspid annular dilation and dynamics, into the decision-making process. In 2025, functional stratification of the right ventricle is based primarily on conventional echocardiographic parameters such as TAPSE and RV S′, and can be refined by additional measures, including right ventricular ejection fraction by three-dimensional echocardiography (3D RVEF), RV strain, and three-dimensional anatomical assessment of the annulus and tricuspid apparatus when appropriate, to help determine the optimal timing and strategy for intervention. Figure 3 summarizes this framework, highlighting the integration between valvular mechanism parameters and conventional TR quantification.

In Figure 4, the main echocardiographic images are shown based on this sequential analysis, integrating two-dimensional acquisitions, color Doppler, and three-dimensional anatomical and volumetric assessment of the RV. This approach allows for a more holistic understanding of the mechanisms underlying TR as well as its hemodynamic repercussions.

Criteria for Tricuspid Valve Intervention

The update maintains the principle of earlier intervention in significant TR, especially when associated with left-sided valve disease, and reinforces the importance of concomitant treatment in these scenarios. The 2025 document adopts an organizational logic similar to that applied to the aortic and mitral valves, consolidating the role of the Heart Team as the central decision-making body for the tricuspid valve as well. As with left-sided valvular disease, management is now guided by multimodality imaging assessment and interdisciplinary discussion in reference centers, which determine the timing and modality of intervention—surgical or transcatheter—in an individualized, risk-based manner.

Specific considerations: sex, multimorbidity, combined valve disease

The 2025 guideline emphasizes patient-centered evaluation, incorporating sex, comorbidities, and combined

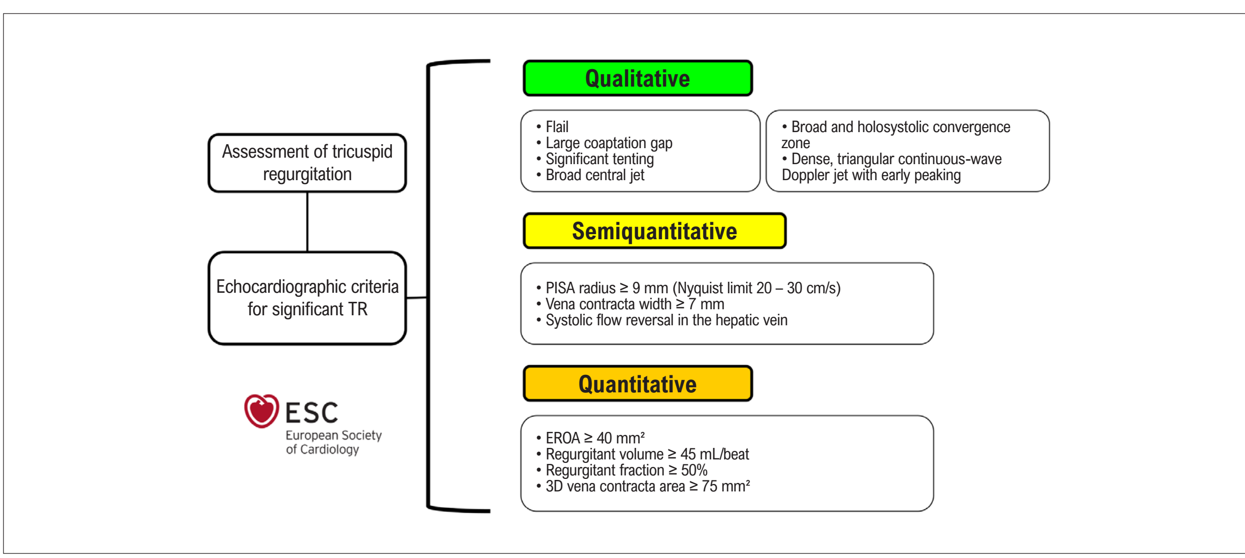

Figure 2 – *Structural, qualitative, semiquantitative, and quantitative parameters for determining the severity of tricuspid regurgitation according to the recommendations of the 2025 European Society of Cardiology guideline. "TR": tricuspid regurgitation; "PISA": proximal isovelocity surface area; EROA: effective regurgitant orifice area.*[2]

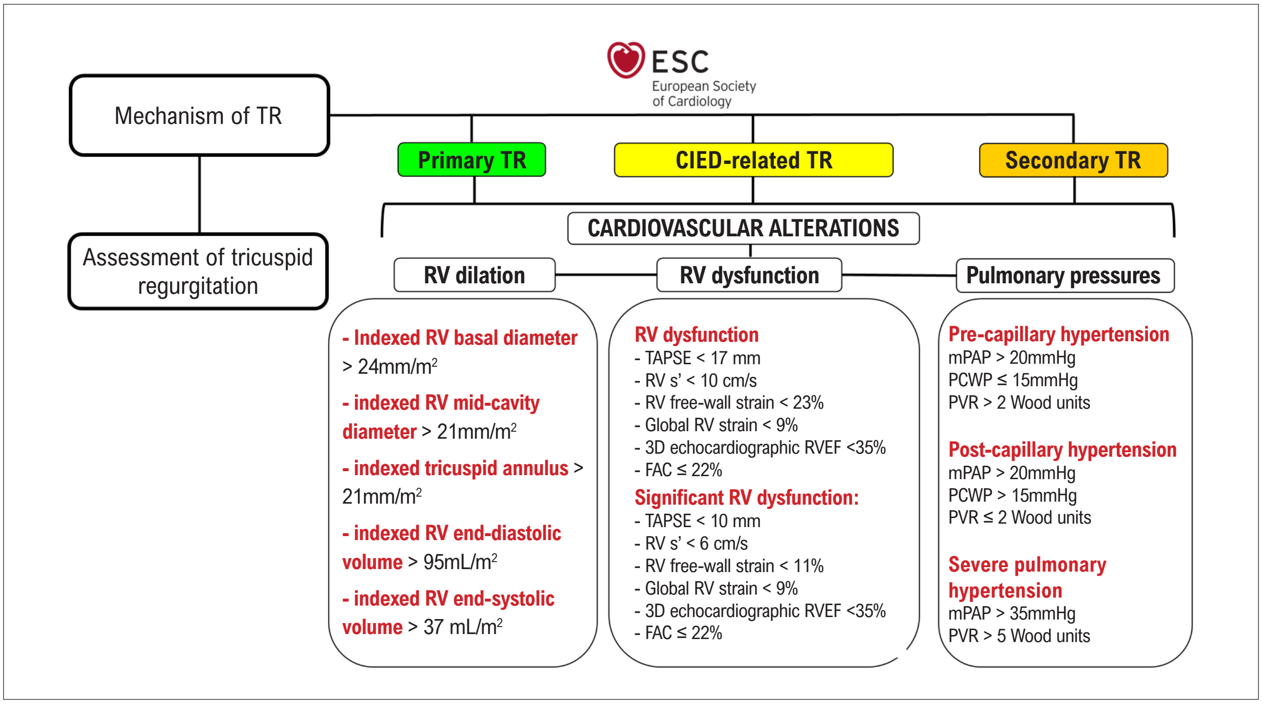

Figure 3 – *Additional integrated analysis complementing the quantification of TR severity, highlighting the main prognostic factors associated with worse cardiovascular outcomes according to the 2025 European Society of Cardiology guideline. "TR": tricuspid regurgitation; "RV": right ventricle; "TAPSE": tricuspid annular plane systolic excursion; "RVEF": right ventricular ejection fraction; "FAC": fractional area change; mPAP: mean pulmonary artery pressure; "PCWP": pulmonary capillary wedge pressure; "PVR": pulmonary vascular resistance; "CIED": cardiac implantable electronic device.*[2]

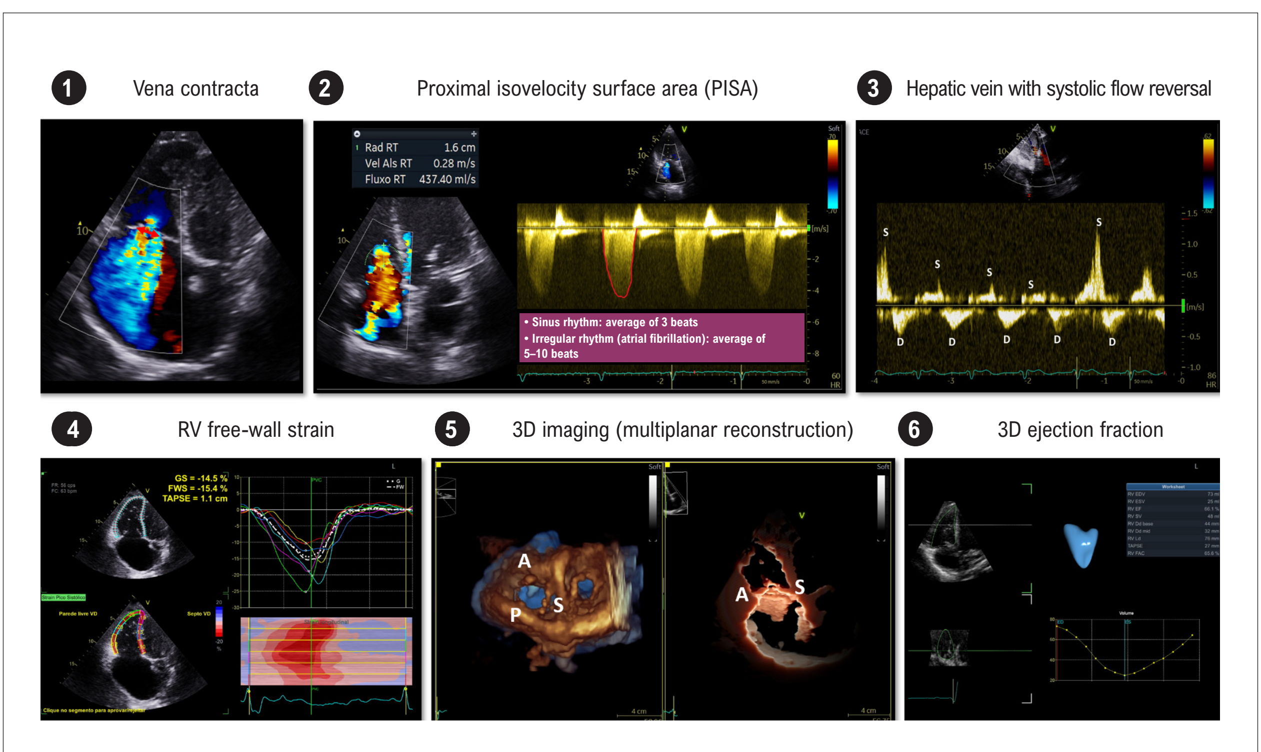

Figure 4 – *Fundamental two-dimensional and three-dimensional echocardiographic images for anatomical assessment, quantification, and prognostic analysis in patients with significant tricuspid regurgitation; "S": septal leaflet; "A": anterior leaflet; "P": posterior leaflet; "RV": right ventricle*

valvular disease into the decision-making process. In the context of TR, this means weighing frailty, RV dysfunction, pulmonary hypertension, and involvement of left-sided valves to determine the appropriate timing and modality of intervention, with referral to high-volume centers when a transcatheter approach is feasible.

Impacts on the tricuspid valve and practical recommendations

The 2025 ESC/EACTS guideline consolidates the understanding that TR should be approached with the same rigor applied to left-sided valvular disease. This repositioning has direct implications for clinical practice by reinforcing the central role of echocardiography in early disease detection, functional stratification of the right ventricle, and determination of the appropriate timing for intervention.

From an echocardiographic standpoint, assessment remains grounded in systematic two-dimensional analysis and conventional Doppler parameters, which are widely available and essential for the initial characterization of tricuspid regurgitation severity, mechanism, and hemodynamic impact. In this context, integration with additional anatomical and functional measurements allows for progressive refinement of diagnostic reasoning. Three-dimensional (3D) echocardiography, when available, serves as a complementary tool, contributing to a more detailed characterization of tricuspid annular geometry, coaptation patterns, and leaflet tethering.

Functional parameters of the right ventricle – such as TAPSE, tricuspid annular systolic velocity, three-dimensional right ventricular ejection fraction (3D RVEF), and global longitudinal strain – should be interpreted in an integrated manner, considering load-dependent limitations and the clinical context. This combined approach supports a more robust evaluation, particularly in scenarios where therapeutic decision-making requires greater anatomical or functional precision, as illustrated in the central figure of the article.

In clinical practice, this conceptual evolution translates into three main developments.

First, earlier detection of structural and functional abnormalities, in which identification of significant annular dilation or early right ventricular dysfunction justifies more frequent reassessment and timely referral for Heart Team discussion.

Second, a clearer definition of the optimal timing for intervention, particularly in patients with significant tricuspid regurgitation associated with left-sided valve disease, favoring concomitant treatment and reducing progression to advanced stages of right ventricular remodeling. Third, the gradual incorporation of transcatheter therapies, considered in selected scenarios – especially in patients with high surgical risk or with favorable anatomy better characterized by advanced imaging modalities.

In the daily routine of the echocardiography laboratory, this approach implies valuing a well-executed and standardized two-dimensional evaluation, using three-dimensional echocardiography as a complementary tool whenever pertinent, and monitoring right ventricular function parameters with the same regularity applied to left-sided valvular diseases. This set of principles supports a more consistent, accessible practice aligned with contemporary recommendations, enabling individualized decisions grounded in multidisciplinary teams.

Trends and Future Perspectives

Advances in tricuspid valve assessment are expected to focus on the integration of emerging technologies that enhance diagnostic precision and the ability to dynamically characterize cardiac remodeling. The incorporation of artificial intelligence algorithms into echocardiography and tomography routines should enable automatic anatomical segmentation, more stable measurements of the tricuspid annulus, and refined three-dimensional analysis of coaptation, favoring interpretations that are less examiner-dependent and more comparable across institutions.

In the therapeutic context, continuous development of devices for transcatheter repair or replacement of the tricuspid valve is observed, with greater suitability for the anatomical spectrum of primary and secondary regurgitation. As these devices achieve technological maturity and wider availability in specialized centers, decision-making is expected to incorporate more objective metrics of right ventricular function, extent of tethering, and annular geometry, expanding the ability to select interventions with greater physiological precision.

The progressive understanding of tricuspid regurgitation phenotypes, particularly the atrial phenotype, enables more informative categorizations of the hemodynamic behavior of the valvopathy and of the mechanisms of structural progression. This differentiation tends to improve management strategies that consider not only the severity of regurgitation but also the trajectory of right atrial and ventricular remodeling.

Finally, the field is moving toward models that integrate clinical data, biomarkers, two-dimensional and three-dimensional echocardiographic parameters, and machine learning–derived variables, with the potential to generate predictive platforms capable of estimating disease progression and functional impact in the medium and long term. These approaches favor a more anticipatory view of the pathophysiological process, with therapeutic choices based on quantitative projections and individualized risk stratification.

Conclusion

Transthoracic echocardiography remains the primary imaging modality for assessing the etiology, mechanism, and severity of tricuspid valve disease. A comprehensive evaluation requires integrating data from multiple echocardiographic windows and modalities, which may include three-dimensional transthoracic and transesophageal imaging, as well as complementary examinations such as cardiac CT and cardiac MRI.

New guidelines, such as the most recent European Society of Cardiology publication, provide direction for a systematic and standardized assessment of imaging findings, taking into account the patient's clinical context, the structural disease affecting the tricuspid valve complex, and the impact on related chambers such as the right ventricle.

The rapid expansion of tricuspid interventional cardiology has renewed interest in the detailed evaluation of this valve and reaffirms echocardiography—particularly its structural analysis—as the cornerstone of clinical decision-making. This approach enables more appropriate selection of patients who are likely to benefit from intervention.

Author Contributions

Conception and design of the research and writing of the manuscript: Silva HAGP, Souza AC; critical revision of the manuscript for intellectual content: Silva HAGP, Souza AC, Beck A.

Potential Conflict of Interest

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Study Association

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Ethics Approval and Consent to Participate

This article does not contain any studies with human participants or animals performed by any of the authors.

Use of Artificial Intelligence

The authors did not use any artificial intelligence tools in the development of this work.

Availability of Research Data

The underlying content of the research text is contained within the manuscript.

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