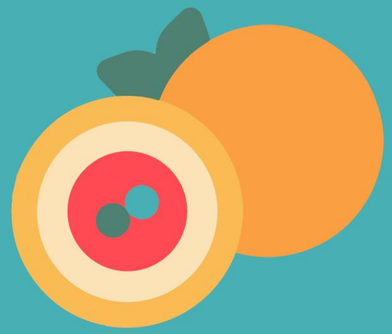
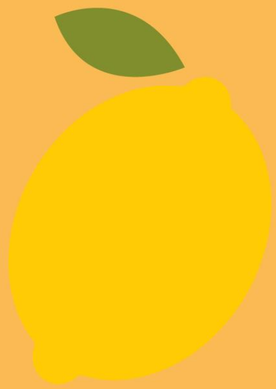
EUROVALVE

& STRUCTURAL CARDIOMYOPATHIES

NH PALERMO





SAVE THE DATE

OCTOBER 24&25,2024

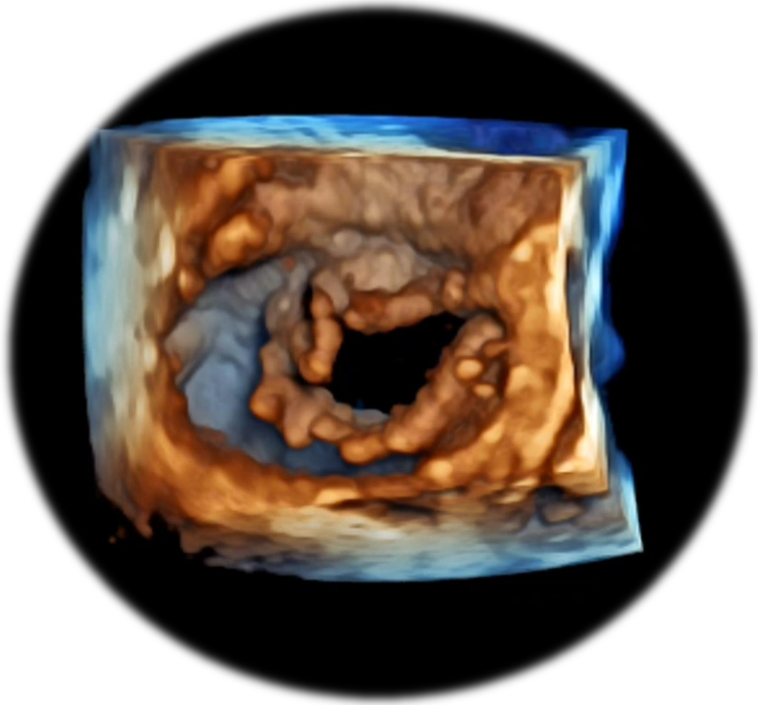
COURSE DIRECTORS

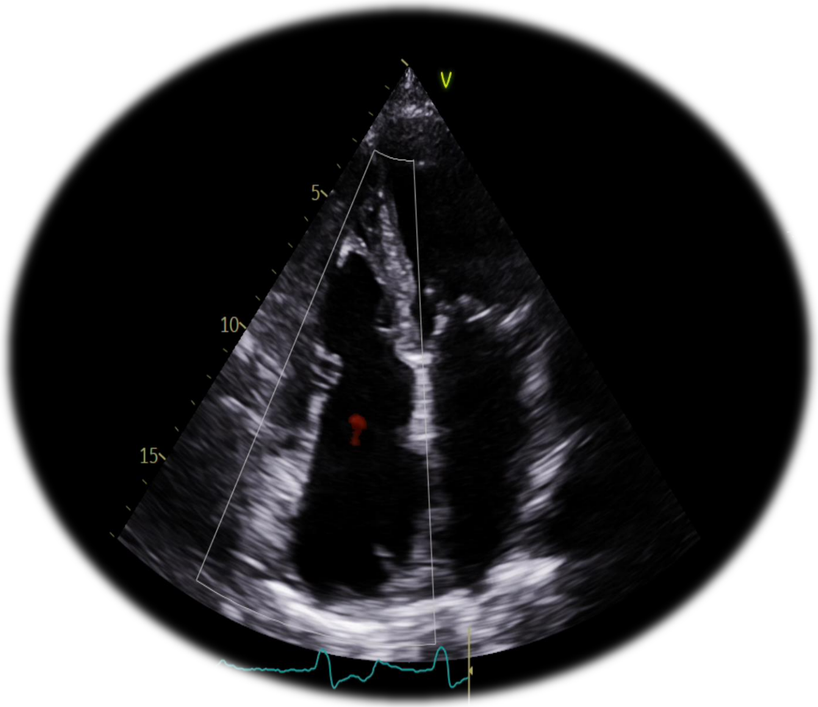
Patrizio Lancellotti, Belgium
Khalil Fattouch, Italy
Gilbert Habib, France
José Luis Zamorano, Spain
Philippe Pibarot, Canada
Mani Vannan, USA
Madalina Garbi, United Kingdom
Bernard Cosyns,Belgium

LOCAL HOST

Khalil Fattouch, Italy

IMPACT OF TREATMENT ON TRICUSPID REGURGITATION GRADING





Corrado Fiore MD, FASE, FEACVI
Head of Cardiology Department and EchoLab, Città di Lecce Hospital - GVM, Italy

@fiore_corrado

NO CONFLICTS OF INTEREST

ESC European Society of Cardiology

European Heart Journal (2019) **40**, 476–484
doi:10.1093/eurheartj/ehy641

META-ANALYSIS

Tricuspid regurgitation is associated with increased mortality independent of pulmonary pressures and right heart failure: a systematic review and meta-analysis

Nelson Wang[1], Jordan Fulcher[2,3], Nishan Abeysuriya[4], Michele McGrady[2], Ian Wilcox[1,2], David Celermajer[1,2], and Sean Lal[1,2]*

[1]Sydney Medical School, University of Sydney, Sydney, New South Wales, Australia; [2]Department of Cardiology, Royal Prince Alfred Hospital, Sydney, New South Wales, Australia; [3]NHMRC Clinical Trials Centre, University of Sydney, Sydney, New South Wales, Australia; and [4]University of Queensland, Brisbane, Queensland, Australia

Received 22 May 2018; revised 9 July 2018; editorial decision 20 September 2018; accepted 15 October 2018; online publish-ahead-of-print 22 October 2018

See page 485 for the editorial comment on this article (doi: 10.1093/eurheartj/ehy722)

Aims To undertake a systematic review and meta-analysis to determine the influence of tricuspid regurgitation (TR) severity on mortality.

Methods and results We performed a systematic search for studies reporting clinical outcomes of patients with TR. The primary endpoint was all-cause mortality and secondary endpoints were cardiac mortality and hospitalization for heart failure (HF). Overall risk ratios (RR) and 95% confidence intervals (CIs) were derived for each endpoint according to the severity of TR by meta-analysing the effect estimates of eligible studies. Seventy studies totalling 32 601 patients were included in the analysis, with a mean (±SD) follow-up of 3.2 ± 2.1 years. Moderate/severe TR was associated with a two-fold increased mortality risk compared to no/mild TR (RR 1.95, 95% CI 1.75–2.17). Moderate/severe TR remained associated with higher all-cause mortality among 13 studies which adjusted for systolic pulmonary arterial pressures (RR 1.85, 95% CI 1.44–2.39), and 15 studies, which adjusted for right ventricular (RV) dysfunction (RR 1.78, 95% CI 1.49–2.13). Moderate/severe TR was also associated with increased cardiac mortality (RR 2.56, 95% CI 1.84–3.55) and HF hospitalization (RR 1.73, 95% CI 1.14–2.62). Compared to patients with no TR, patients with mild, moderate, and severe TR had a progressively increased risk of all-cause mortality (RR 1.25, 1.61, and 3.44, respectively; $P < 0.001$ for trend).

Conclusions Moderate/severe TR is associated with an increased mortality risk, which appears to be independent of pulmonary pressures and RV dysfunction.

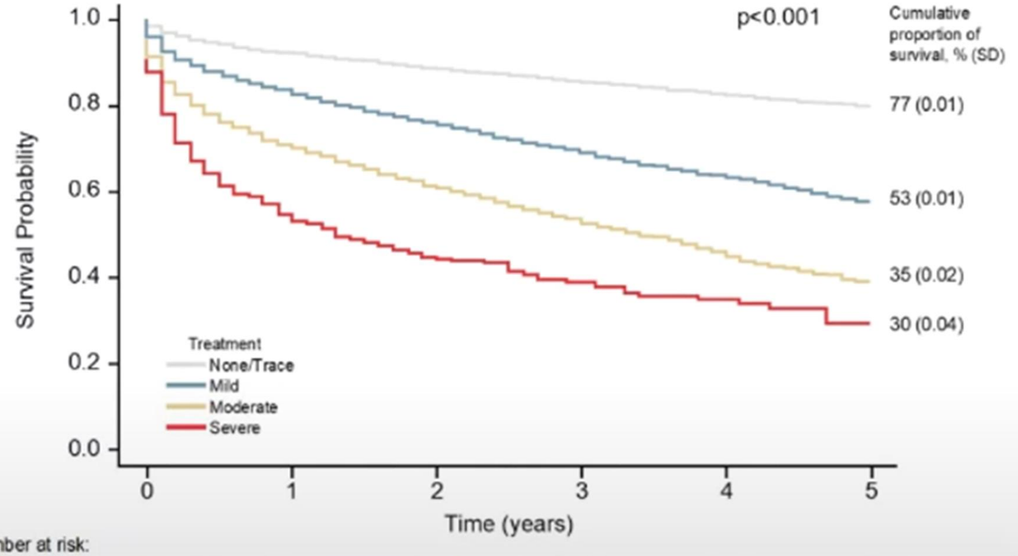
Tricuspid Regurgitation is not an 'INNOCENT BYSTANDER'

Tricuspid regurgitation and long-term clinical outcomes

At least moderate TR is independently associated with increased mortality

Survival-All Comers

The Kaplan-Meier survival curves of all patients according to TR grade

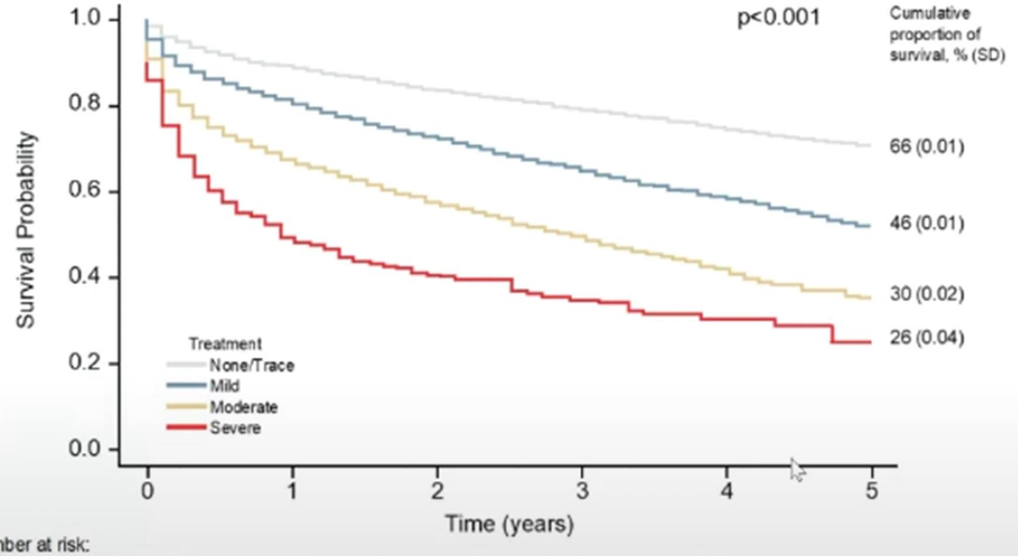


Number at risk:						
None/Trace	23045	20957	15985	11374	7183	2956
Mild	7297	6000	4455	2970	1750	805
Moderate	2682	1867	1230	764	432	177
Severe	281	152	101	65	42	14

Chorin E. et al. Eur Heart J CV Imaging. 2020 Feb 1;21(2):157-165.

Survival-Hospitalized

The Kaplan-Meier survival curves of hospitalized patients according to TR grade



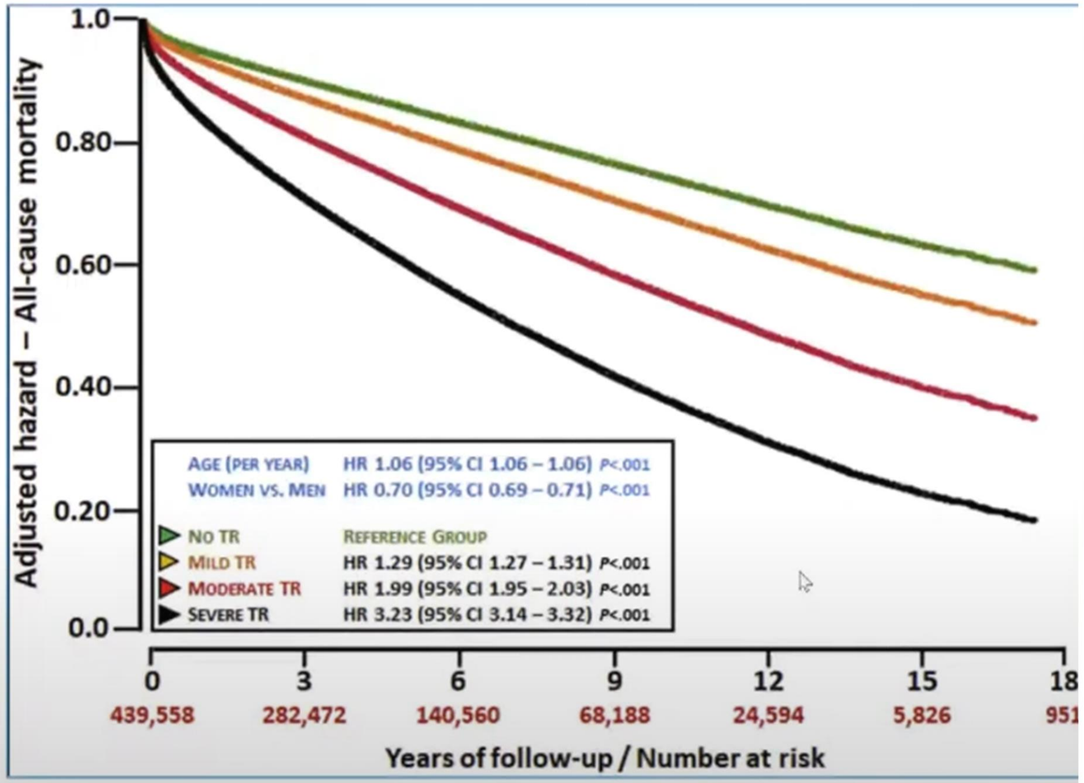
Number at risk:						
None/Trace	12345	10671	8063	5747	3627	1616
Mild	5554	4394	3281	2192	1277	610
Moderate	2157	1421	942	583	326	131
Severe	223	107	71	49	30	10

J Am Soc Echocardiogr. 2022 Aug;35(8):810-817. doi: 10.1016/j.echo.2022.04.003.
Epub 2022 Apr 12.

Adverse Prognostic Impact of Even Mild or Moderate Tricuspid Regurgitation: Insights from the National Echocardiography Database of Australia

Sophie Offen [1], David Playford [2], Geoff Strange [3], Simon Stewart [4], David S Celermajer [5]

- **TR severity was analyzed in 439,558 adults (mean age, 62.1 ± 17.8 years; 51.5% men) from 2000 to 2019, by 25 centers contributing to the National Echocardiography Database of Australia.**
- Long-term, all-cause mortality, according to TR severity and adjusted for age and sex.
  - Adjusted HR per grade increase in TR severity above None/Trace
    - ***Mild:*** **1.29 (95% CI, 1.27–1.31; *P* < .001)**
    - ***Moderate:*** **1.99 (95% CI, 1.95–2.03; *P* < .001)**
    - ***Severe:*** **3.23 (95% CI, 3.14–3.32; *P* < .001)**



Even in the presence of other cardiac disease, increasing grades of TR are independently associated with increasing risks of cardiovascular and all-cause mortality

JACC: CARDIOVASCULAR IMAGING
VOL. 13, NO. 8, 2020

PUBLISHED BY ELSEVIER

ORIGINAL RESEARCH

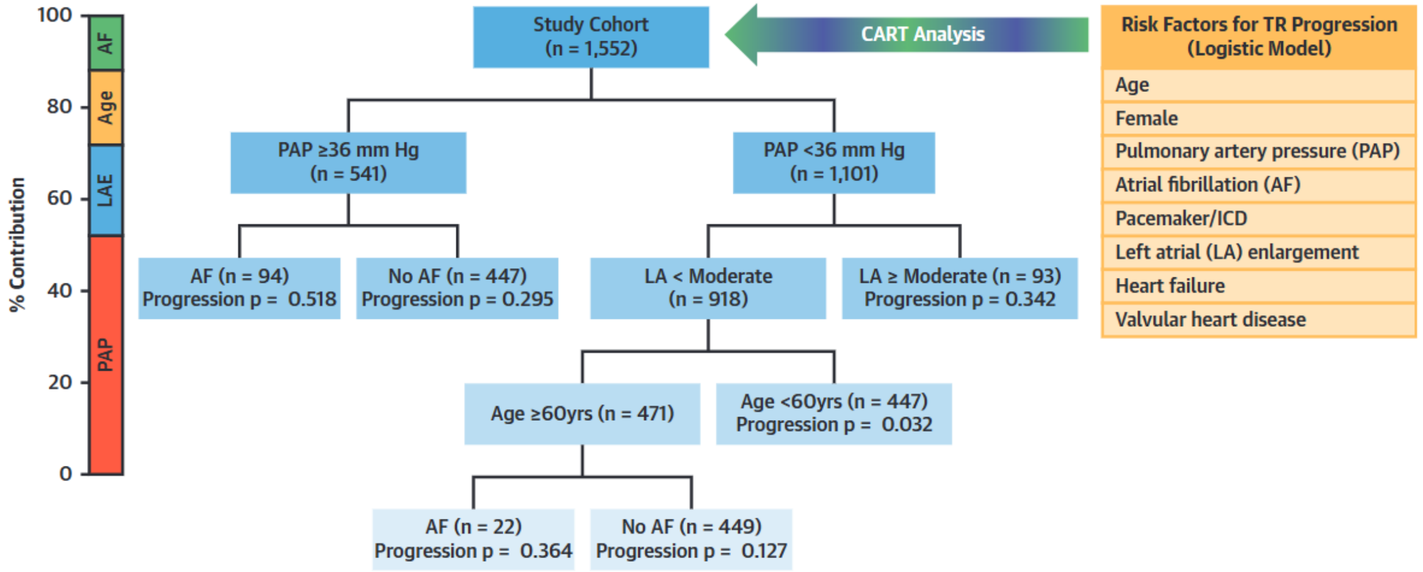
Risk Factors for the Development of Functional Tricuspid Regurgitation and Their Population-Attributable Fractions

Diab Mutlak, MD, Jawad Khalil, MD, Jonathan Lessick, MD, DSc, Izhak Kehat, MD, PhD, Yoram Agmon, MD, Doron Aronson, MD

Strongest predictors of TR progression:

- **PAP>36 mmHg**
- **LA enlargement**
- **Age >60y**
- **Atrial fibrillation**

CENTRAL ILLUSTRATION **Decision-Tree Model for Predicting TR Progression**



Risk Factors for TR Progression (Logistic Model)
Age
Female
Pulmonary artery pressure (PAP)
Atrial fibrillation (AF)
Pacemaker/ICD
Left atrial (LA) enlargement
Heart failure
Valvular heart disease

In absence of these 4 risk factors , progression occurs in 3% of patients

Mutlak, D. et al. J Am Coll Cardiol Img. 2020;13(8):1643-51.

JACC: CARDIOVASCULAR INTERVENTIONS
VOL. 16, NO. 2, 2023

PUBLISHED BY ELSEVIER

NEW RESEARCH PAPER

STRUCTURAL

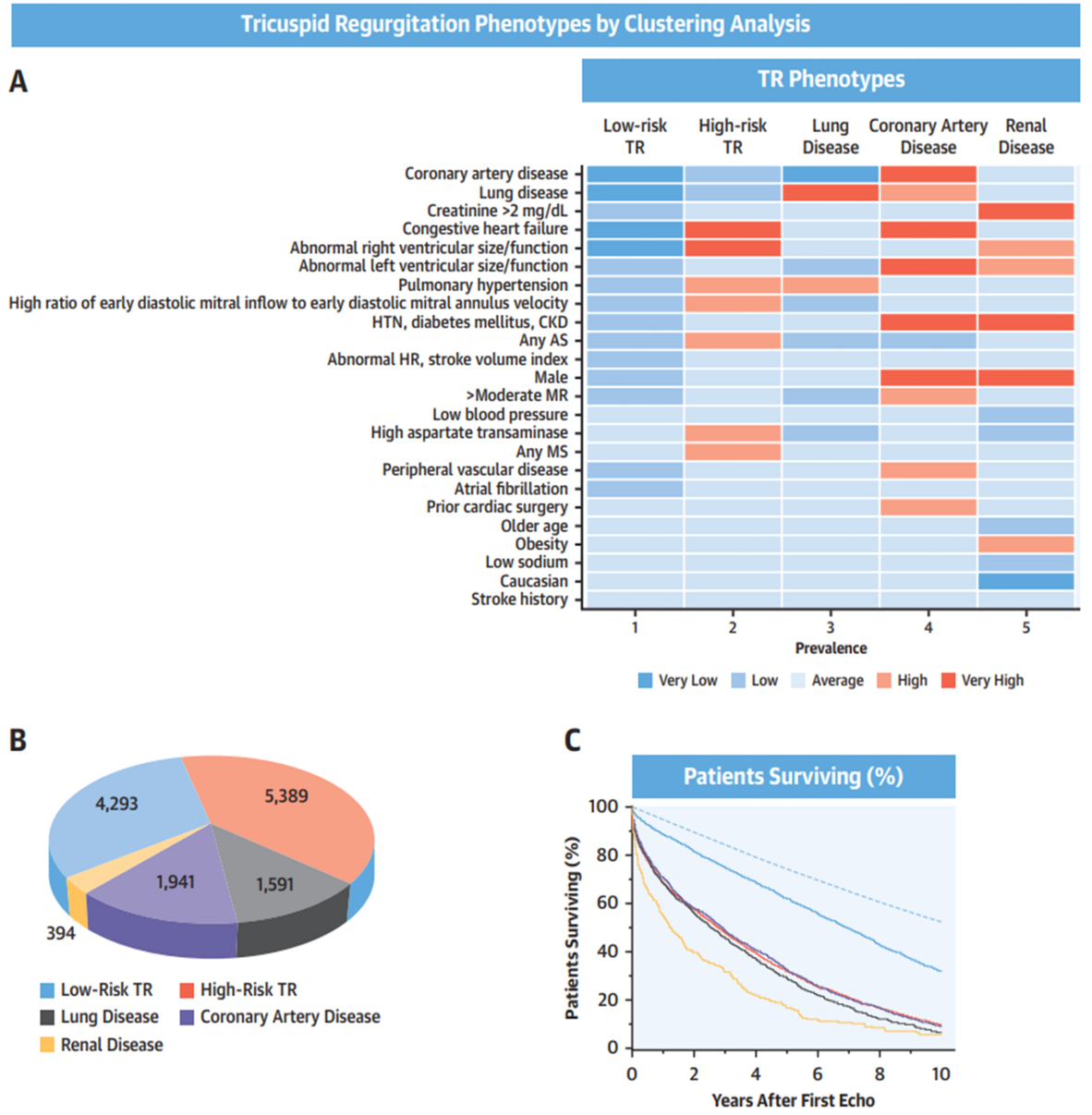
The 5 Phenotypes of Tricuspid Regurgitation

Insight From Cluster Analysis of Clinical and Echocardiographic Variables

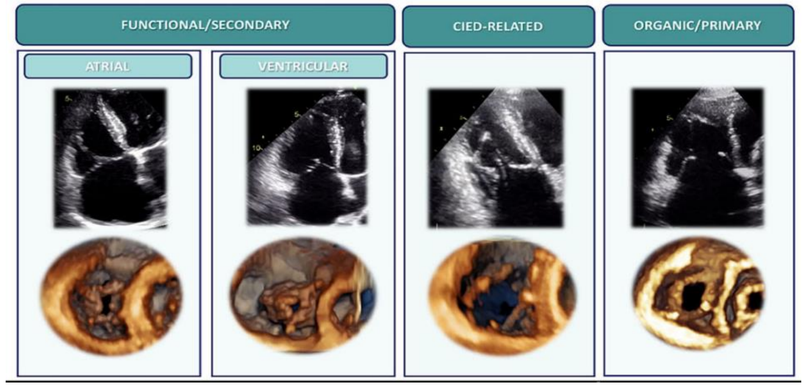
Vidhu Anand, MBBS,[a] Christopher G. Scott, MS,[b] Meredith C. Hyun,[b] Kyla Lara-Breitinger, MD,[a] Vuyisile T. Nkomo, MD, MPH,[a] Garvan C. Kane, MD, PhD,[a] Cristina Pislaru, MD,[a] Kathleen F. Kopecky, MD,[a] Phillip J. Schulte, PhD,[c] Sorin V. Pislaru, MD, PhD[a]

1. **LOW RISK TR** (few comorbidities and lesser severity of TR)
2. **HIGH RISK TR** (more severe TR, more comorbidities)
3. **TR associated with ischemic disease**
4. **TR associated with lung disease**
5. **TR associeted with chronic kidney disease**

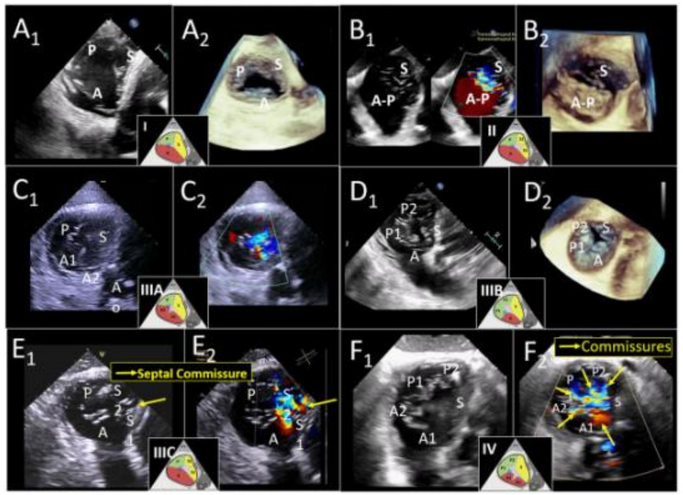
CENTRAL ILLUSTRATION Tricuspid Regurgitation Phenotypes and Survival



Anand V, et al. J Am Coll Cardiol Intv. 2023;16(2):156-165.



NOVEL TR CLASSIFICATION

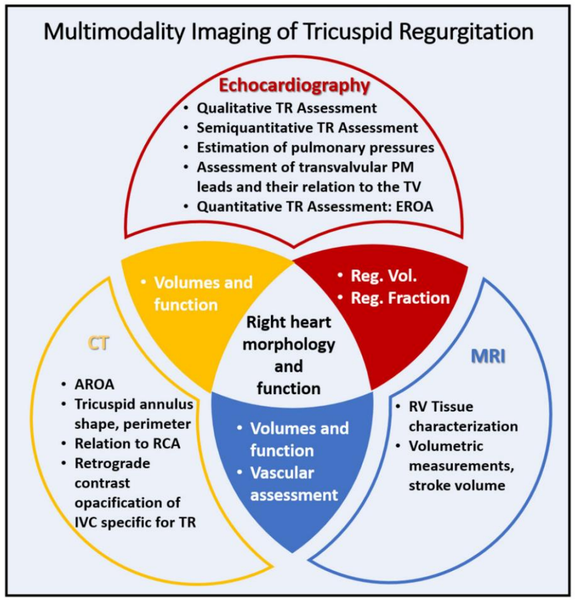


NOVEL TL NOMENCLATURE

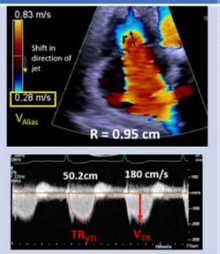
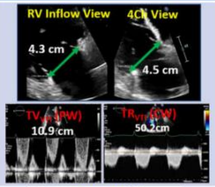
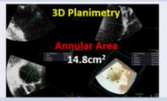
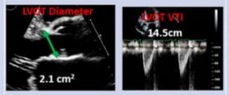
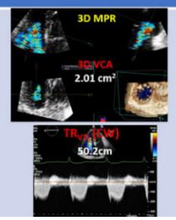
ESC European Society of Cardiology
European Heart Journal - Cardiovascular Imaging (2022) **23**, 913–929
https://doi.org/10.1093/ehjci/jeac009
REVIEW

Tricuspid regurgitation: recent advances in understanding pathophysiology, severity grading and outcome

Rebecca T. Hahn [1]*, Luigi P. Badano [2,3], Philipp E. Bartko [4], Denisa Muraru [2,3], Francesco Maisano [5], Jose L. Zamorano [6] and Erwan Donal [7]

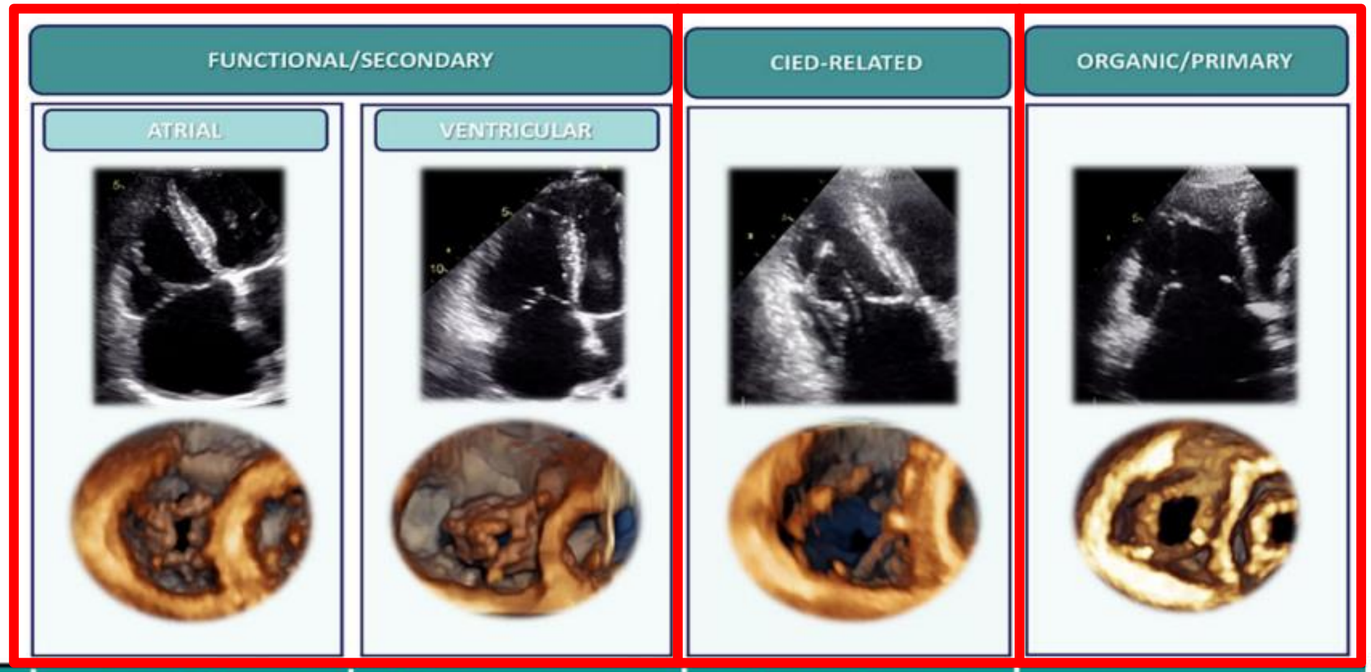


NOVEL TV IMAGING APPROACH

Proximal Isovelocity Surface Area	Measurements Required	Example	Calculation
Proximal Isovelocity Surface Area (PISA)	**Aliasing velocity (V_{Alias})** Color Doppler with baseline shift in the direction of regurgitant jet **Radius of PISA (r)** **TR peak velocity (V_{TR})** CW of the TR jet **TR velocity time integral (TR_{VTI})** CW of the TR jet		**PISA EROA:** $EROA = 2\pi r^2(V_{Alias}) \div V_{TR}$ **TR Regurgitation Volume** = EROA X TR_{VTI} EROA = (6.282 x 0.90 x 28cm/s) ÷ 180 cm/s = 0.88 cm^2 Reg Vol = 2.01cm^2 X 50.2cm = 100.9ml
Quantitative Doppler	**Measurements Required**	**Example**	**Calculation**
2D Method	**2D Diastolic $TV_{Annular}$ Area** RV Inflow and 4Ch TV annular diameters in mid diastole **TV velocity time integral (TV_{VTI})** PW Doppler sample volume at the annulus **TR velocity time integral (TR_{VTI})** CW of the TR jet		**TV Diastolic Stroke Volume** = $TV_{Annulus}$ Area X TV_{VTI} **TR Regurgitation Volume** = TV diastolic volume – Forward Stroke Volume **EROA** = RegVol ÷ TR_{VTI} **Example:** • TV Diastolic SV = (0.785 X 4.3cm X 4.5cm) X 10.9cm = 165.6ml • TR Reg Vol = 115.6ml • EROA = 115.6 ml ÷ 50.2cm = 2.30cm^2
3D Method	**Direct planimetry of the 3D Annular Area**		**Example:** 3D Annular Area = 14.8cm^2 TV Diastolic Area = 14.8 X 10.9cm = 161.3ml TR Reg Vol = 111.3ml EROA = 111.3 ÷ 50.2cm = 2.22cm^2
Forward Stroke Volume used to quantify RegVol	**LVOT Stroke Volume** LVOT Diameter LVOT PW Note: Forward Stroke Volume may be either the LV or RV stroke volume.		**Forward Stroke Volume** = $LVOT_{annulus}$ Area X $LVOT_{VTI}$ **Example:** LV SV = (0.785 X [2.1cm]²) x 14.5cm = 50.2ml
3D Color Doppler	**Measurements Required**	**Example**	**Calculation**
3D Vena Contracta Area (VCA)	**3D Color Doppler planimetry of the VCA** **TR velocity time integral (TR_{VTI})**		**EROA ≅ VCA** **TR Regurgitation Volume =** VCA X TR_{VTI} **Example:** 3D VCA = 2.01cm^2 Reg Vol = 2.01cm^2 X 50.2cm = 100.9ml

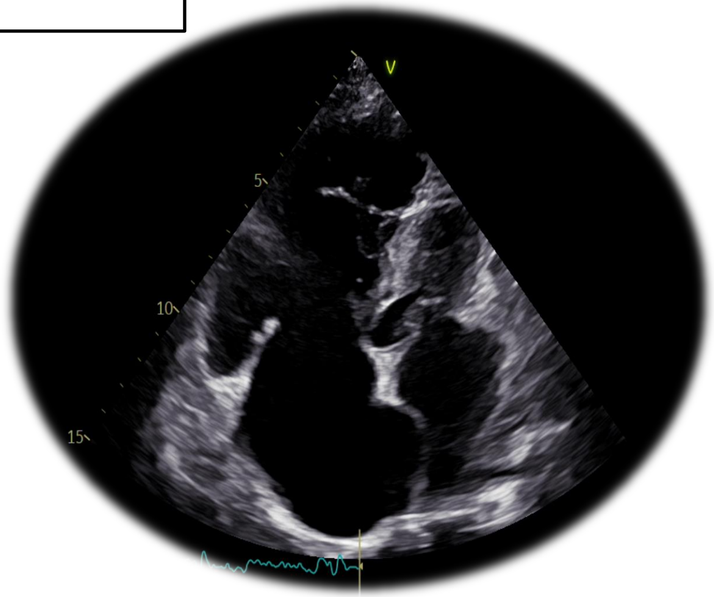
NOVEL TR QUANTIFICATION

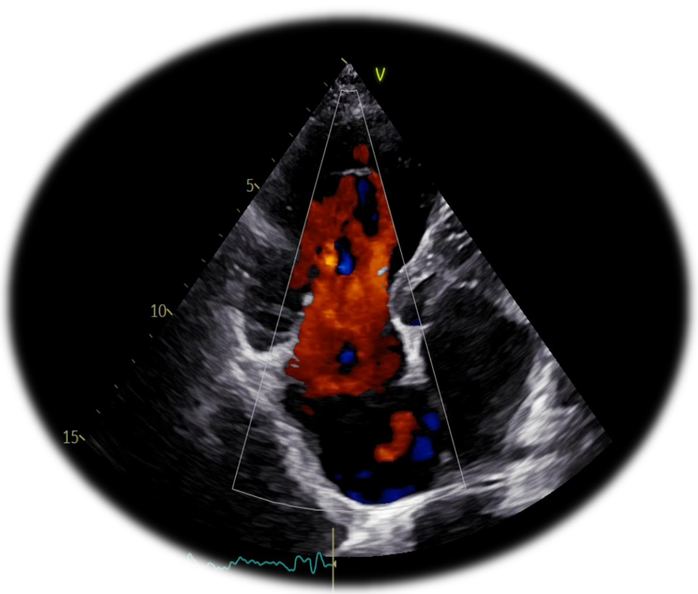
First question: what kind of mechanism are we dealing with?

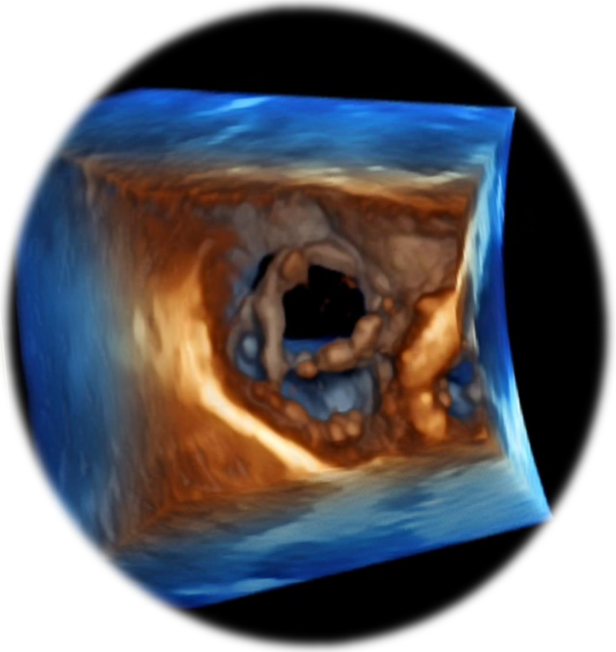


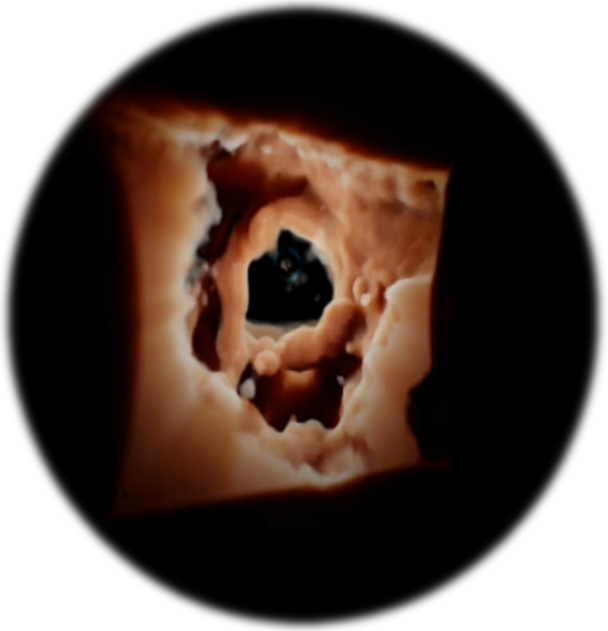
Parameter	Atrial FTR	Ventricular FTR	CIED-Related	Primary TR	
				Prolapse (I)	RHD (IIIA)
Leaflet Tethering	-	+++	++	-	-
Leaflet Restriction	-	Systole	Systole/Diastole	-	Diastole
RA/TA Dilatation	+++	++	+/-	++	++
RV Dilatation	+/-	+++	+/-	+/-	+/-
RV Dysfunction	+/-	+++	+/-	+/-	+/-

Structural abnormality of the tricuspid valve apparatus
Primary TR: ~10-15% of patients

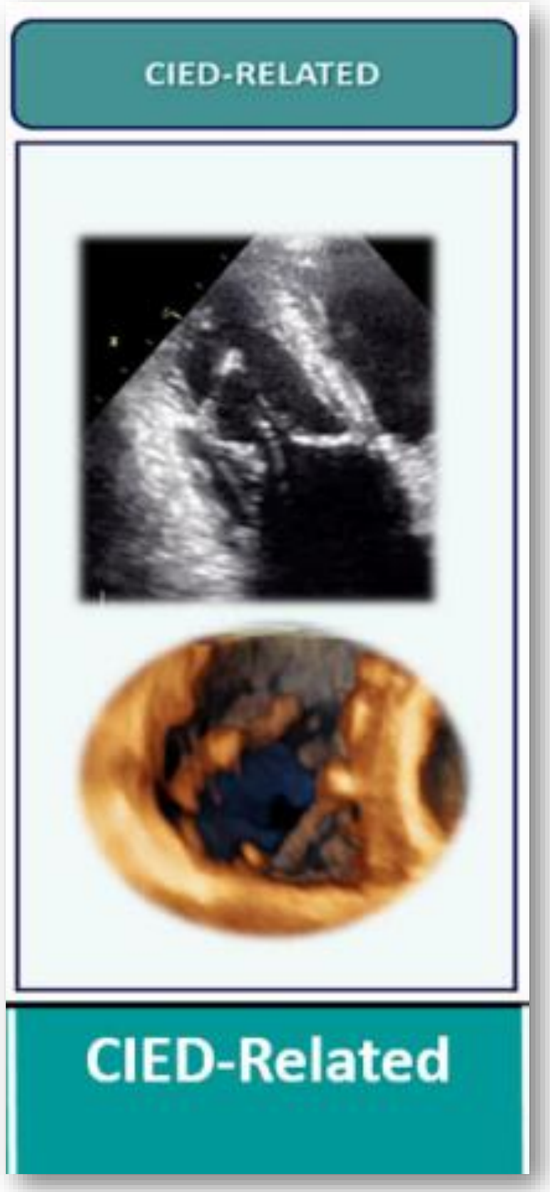


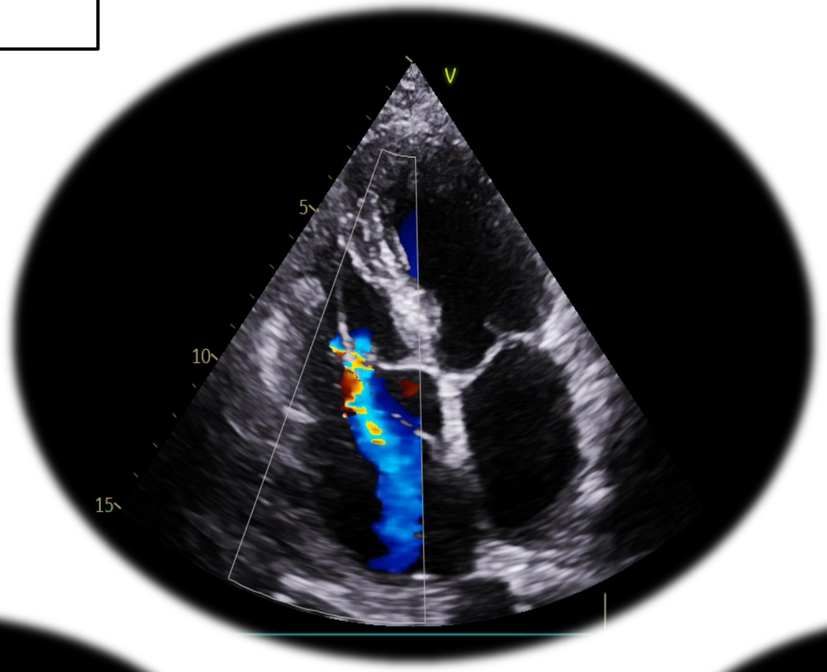


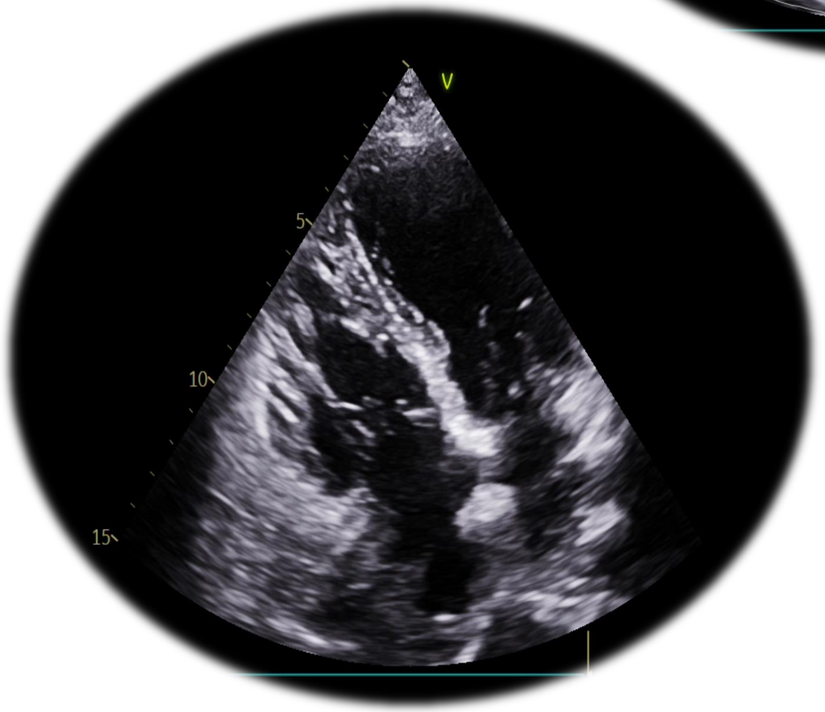


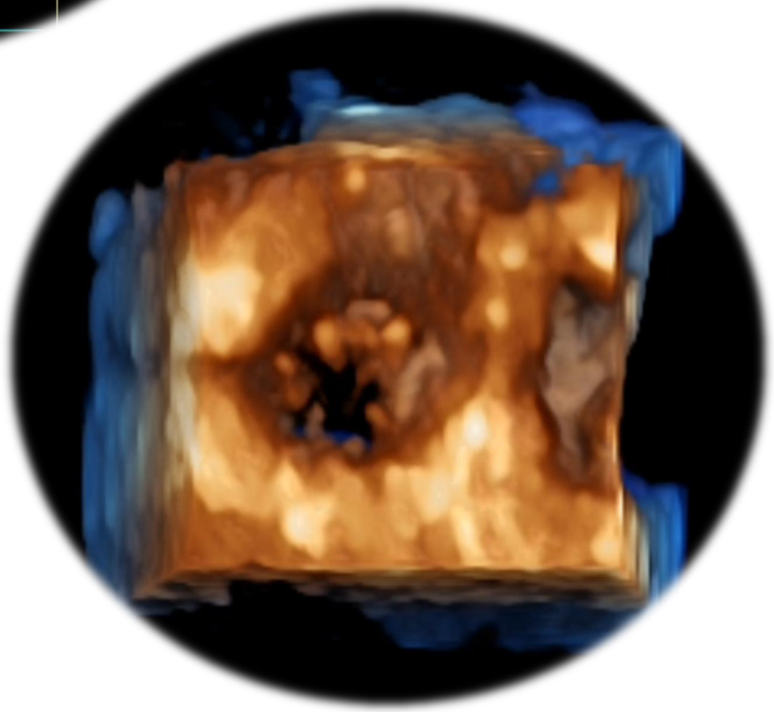


Cardiac implantable electronic device (CIED) induced TR (~ 5% of patients)

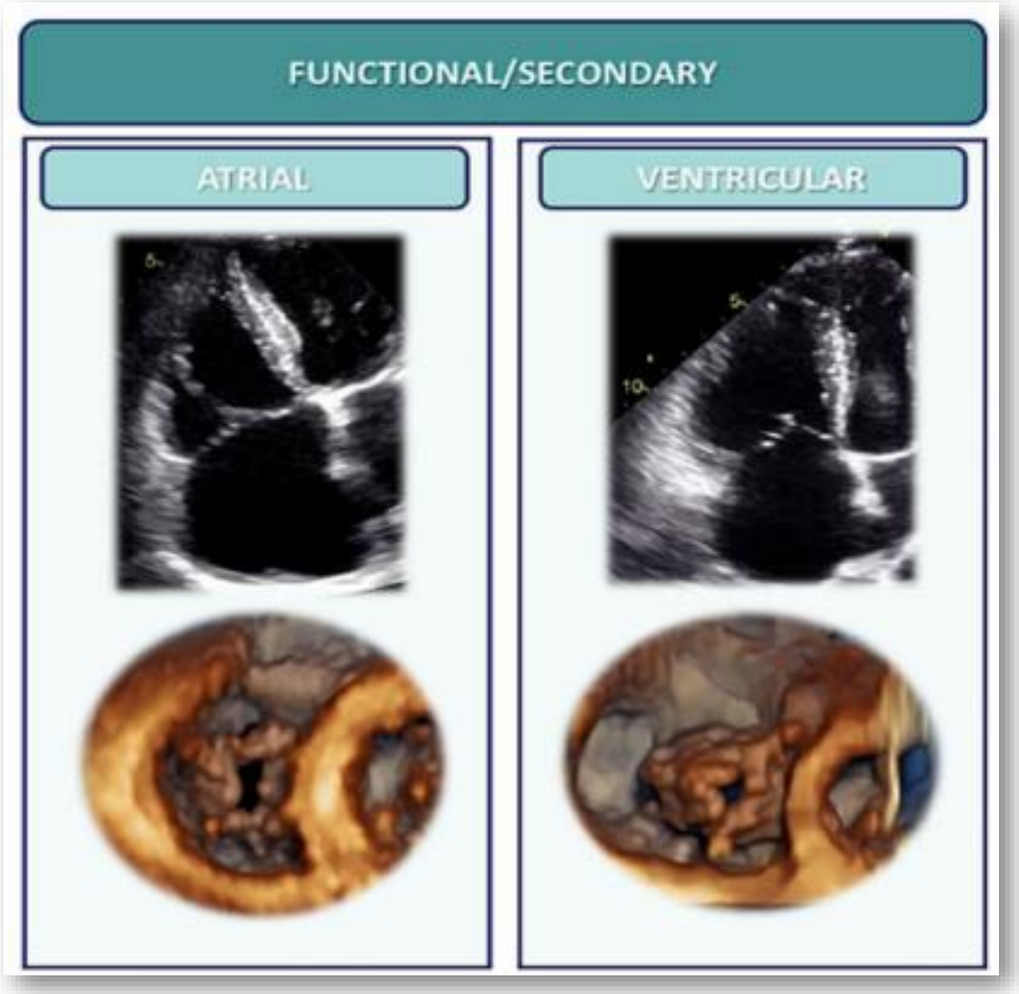


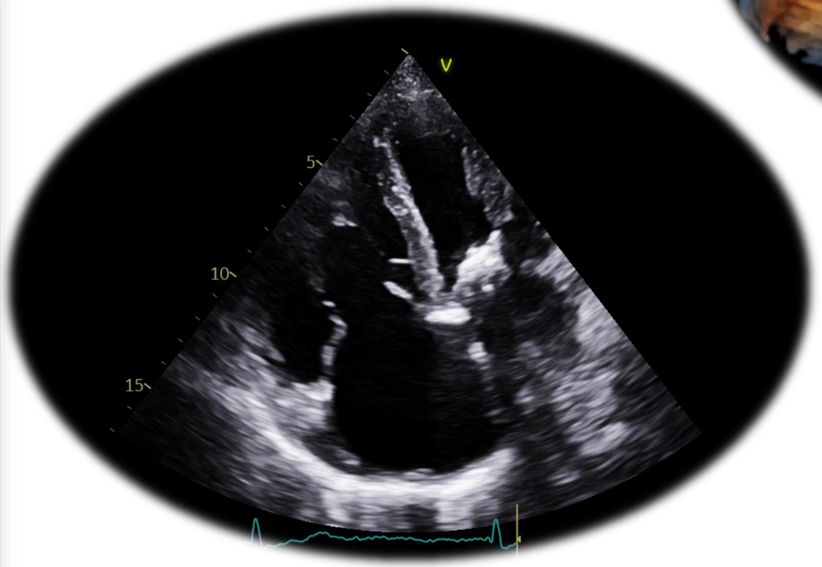


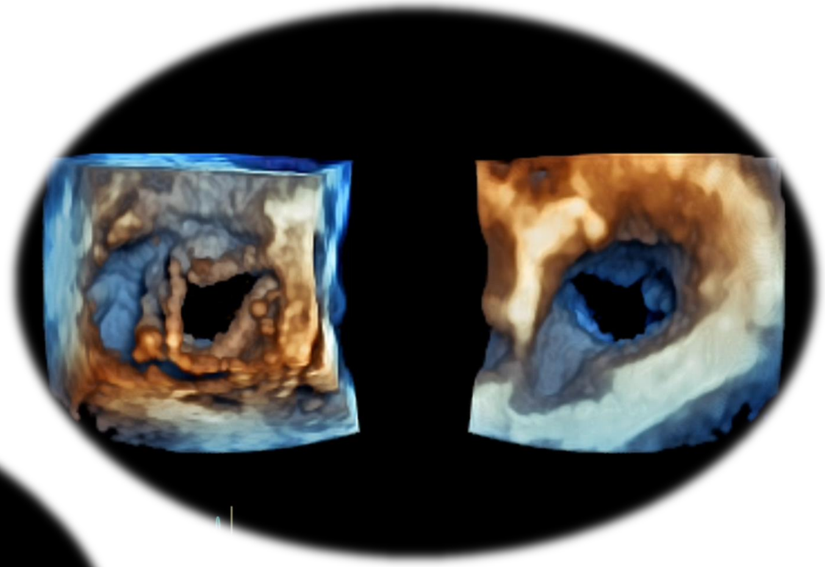


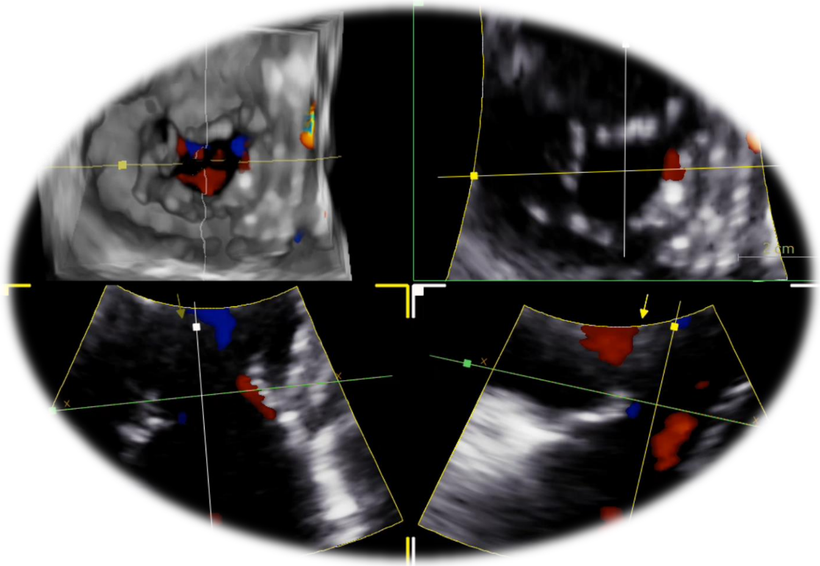


Morphological normal leaflets with annular dilatation and/or leaflet tethering.
Functional TR: ~ 80% of patients









JACC: CARDIOVASCULAR IMAGING
VOL. 12, NO. 3, 2019

PUBLISHED BY ELSEVIER

ORIGINAL RESEARCH

Burden of Tricuspid Regurgitation in Patients Diagnosed in the Community Setting

Yan Topilsky, MD,[a] Simon Maltais, MD,[b] Jose Medina Inojosa, MD,[c] Didem Oguz, MD,[c] Hector Michelena, MD,[c] Joseph Maalouf, MD,[c] Douglas W. Mahoney, MSc,[d] Maurice Enriquez-Sarano, MD[c]

FIGURE 3 Distribution Patterns of TR in the Community

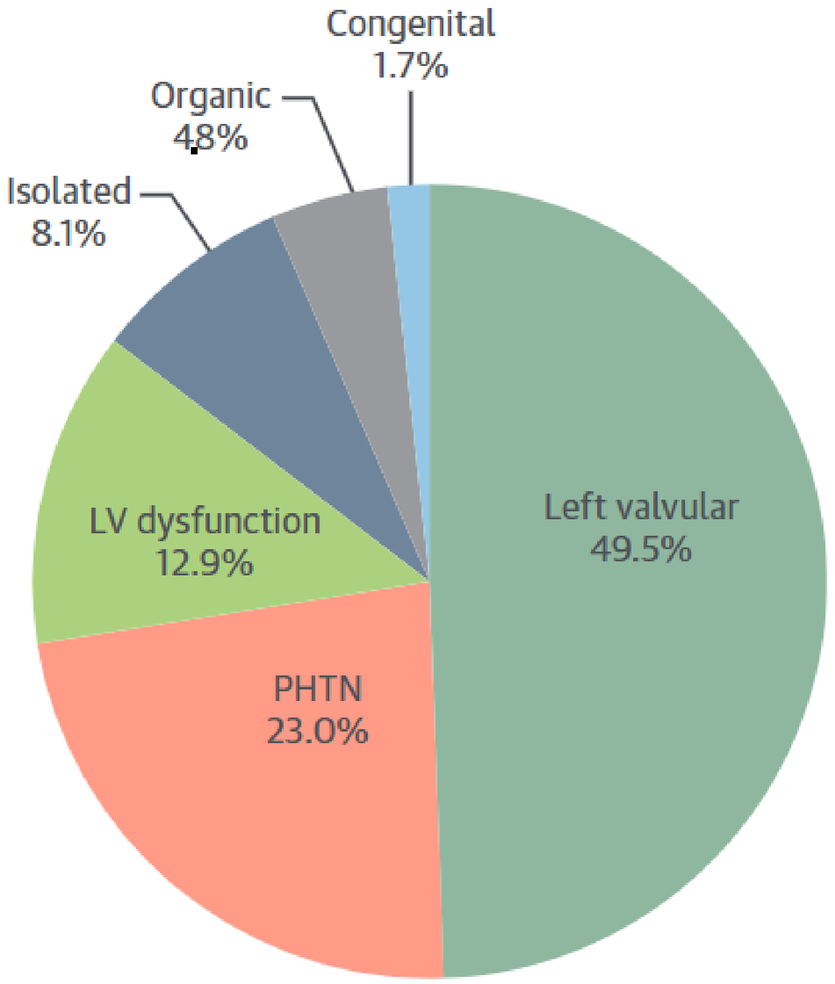
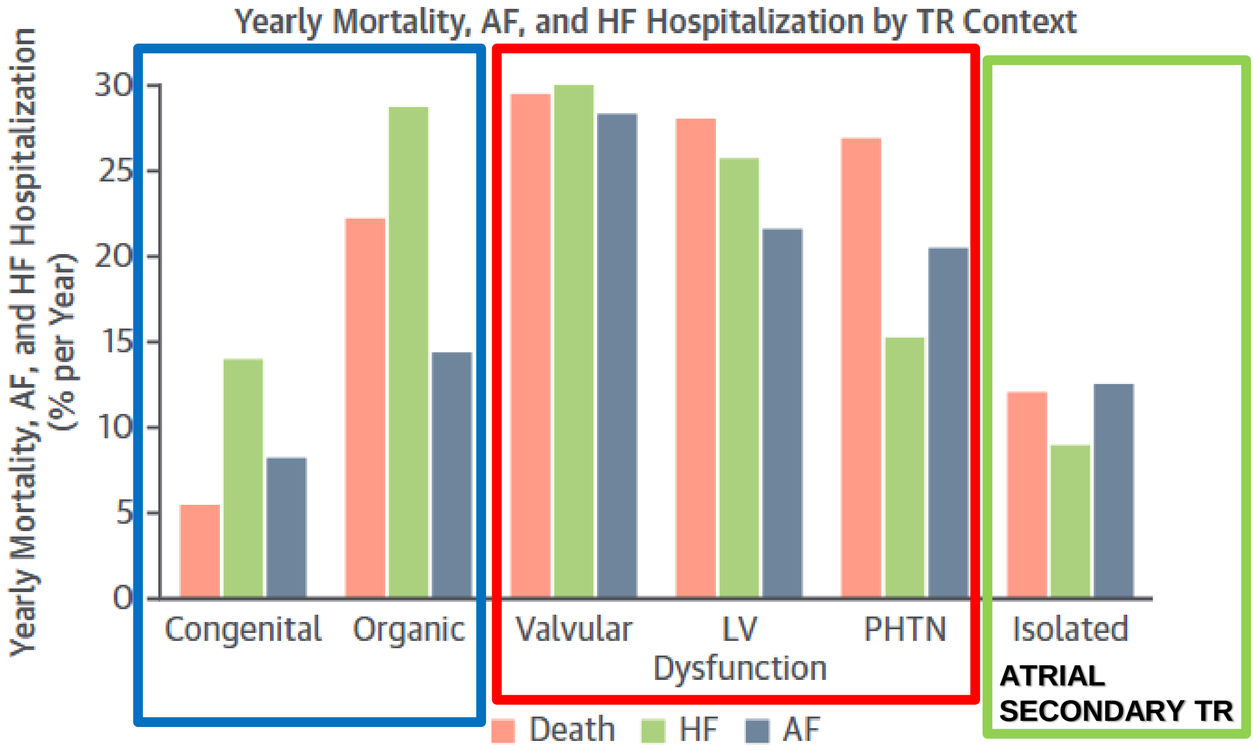


FIGURE 4 Linearized Yearly Mortality by TR Clinical Context



The atrial secondary tricuspid regurgitation is associated to more favorable outcome than the ventricular phenotype

Mara Gavazzoni[1,2], Francesca Heilbron[1], Luigi P. Badano[1,2]*, Noela Radu[2,3], Andrea Cascella[2], Michele Tomaselli[1,2], Francesco Perelli[2], Sergio Caravita[1,4], Claudia Baratto[1,2], Gianfranco Parati[1] and Denisa Muraru[1,2]

- ***A-STR Criteria (ACC/AHA Guidelines):***
  - ***Atrial fibrillation***
  - ***Left ventricular ejection fraction > 60%,***
  - ***Pulmonary artery systolic pressure (PASP) < 50 mmhg,***
  - ***No left-sided valve disease,***
  - ***Normal appearing tricuspid valve leaflets.***

- There was a 2.15-fold significantly higher risk of 1-year endpoint (death and HFH) for V-STR

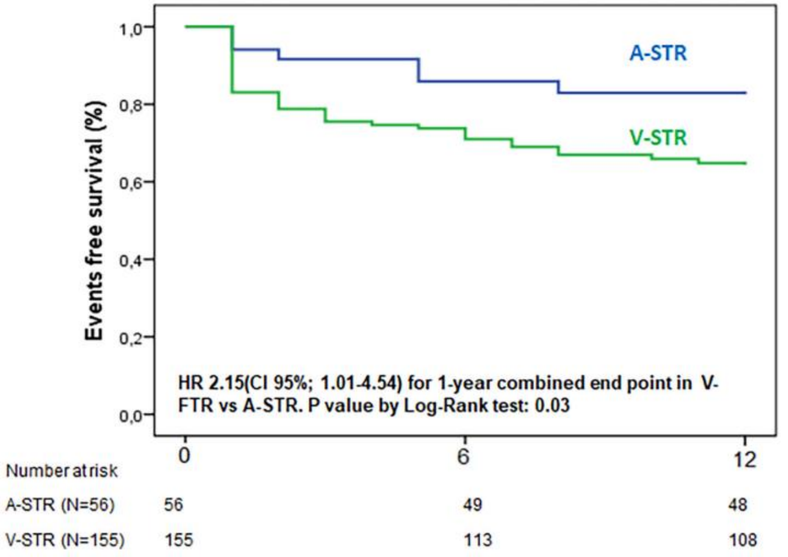


FIGURE 3
Kaplan-Meier curves for 1 year combined endpoint of all-cause death and hospitalization for heart failure. A-STR, atrial-secondary tricuspid regurgitation; HR, hazard Ratio; V-STR, ventricular secondary tricuspid regurgitation.

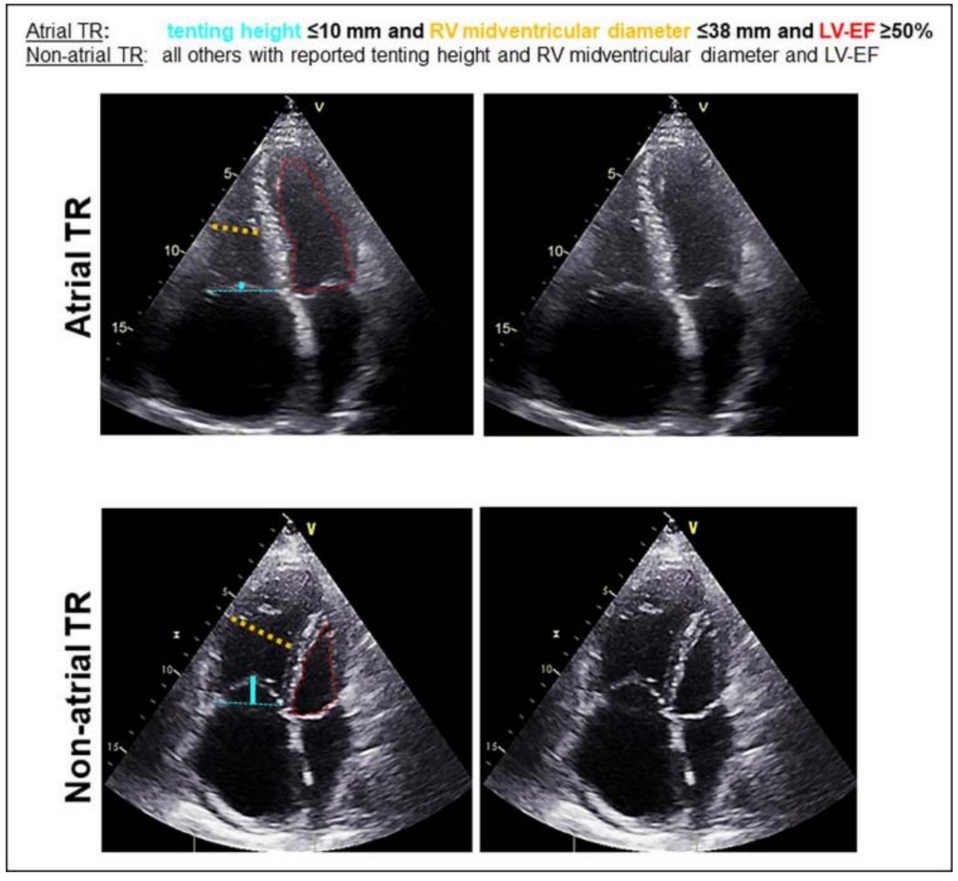
- **A-STR**
  - **TR severity (HR: 5.8, CI 95%: 1.4–25)**
- **V-STR**
  - **TR severity (HR 2.9, CI 95% 1.4–6.3)**
  - **RVEF (HR: 0.97, CI 95%: 0.94–0.99),**
  - **RVFWLS (HR: 0.93, CI 95%: 0.85–0.98)**

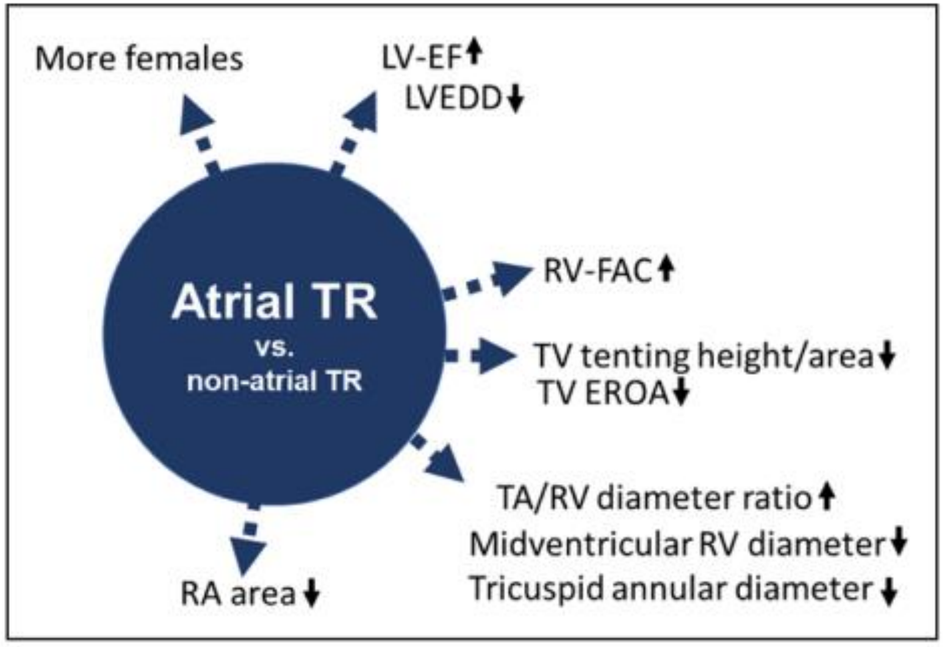
Circulation: Cardiovascular Interventions

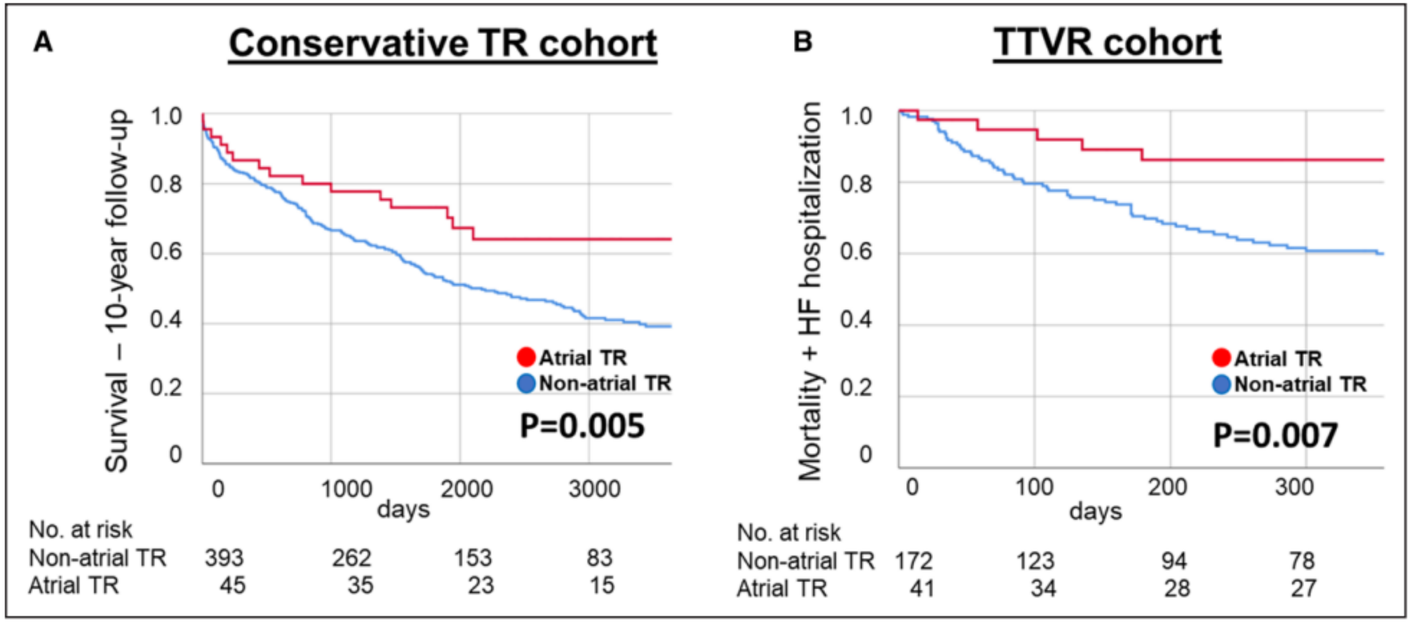
ORIGINAL ARTICLE

Atrial Functional Tricuspid Regurgitation: Novel Definition and Impact on Prognosis

Florian Schlotter, MD; Marlieke F. Dietz, MD; Lukas Stolz, MD; Karl-Patrik Kresoja, MD; Christian Besler, MD; Anna Sannino, MD, PhD; Karl-Philipp Rommel, MD; Matthias Unterhuber, MD; Maximilian von Roeder, MD; Victoria Delgado, MD; Holger Thiele, MD; Jörg Hausleiter, MD; Jeroen J. Bax, MD; Philipp Lurz, MD, PhD







Second question: how severe is the TR?

Table 15 **Grading the severity of TR**

TR Severity classes	Mild	Moderate	Severe
Qualitative parameters			
Tricuspid valve morphology	Normal or mildly abnormal leaflets	Moderately abnormal leaflets	Severe valve lesions/**flail/large coaptation defect//severe tenting**
Colour flow TR jet[a]	Small, narrow, central	Moderate central	**Large central jet** or eccentric wall impinging jet of variable size
Flow convergence zone	Not visible, transient or small	Intermediate in size and duration	**Large throughout systole**
CW signal of TR jet	Faint/partial/parabolic	Dense/parabolic, or triangular	**Dense/often triangular with early peaking** (peak <2 m/s in massive TR)
Semi-quantitative parameters			
Hepatic vein flow[b]	Systolic dominance	Systolic blunting	**Systolic flow reversal**
Tricuspid inflow	A-wave dominant	Variable	E wave dominant (≥1 m/s)[e]
PISA radius (mm)[c]	≤5	6-9	**>9**
VC width (mm)[a,d]	<3	3–6.9	**>7**
3D VC area or quantitative Doppler EROA (mm^2)			75–94
Quantitative parameters			
EROA (mm^2)	<20	20–39	≥40
R Vol (mL)	<30	30–44	≥ 45
RF (%)	≤15	16–49	≥50
CMR parameters			
RF (%)	≤15	16–49	≥50
Structural parameters			
RV, RA, IVC size[e]	Usually normal	Normal of mild dilation	Usually dilated

Multi-modality imaging assessment of native valvular regurgitation: an EACVI and ESC council of valvular heart disease position paper

Patrizio Lancellotti [1,2,3]*, Philippe Pibarot [4], John Chambers[5], Giovanni La Canna[6], Mauro Pepi[7], Raluca Dulgheru[1], Mark Dweck[8], Victoria Delgado [9], Madalina Garbi[10], Mani A. Vannan[11], David Montaigne [12], Luigi Badano[13,14], Pal Maurovich-Horvat[15], Gianluca Pontone [16], Alec Vahanian [17,18], Erwan Donal [19], and Bernard Cosyns [20]; On behalf of the Scientific Document Committee of the European Association of Cardiovascular Imaging

ESC European Society of Cardiology
European Heart Journal - Cardiovascular Imaging (2017) **18**, 1342–1343
doi:10.1093/ehjci/jex139

EDITORIAL

The need for a new tricuspid regurgitation grading scheme

Rebecca T. Hahn[1] and Jose L. Zamorano[2]*

Table 1 Proposed expansion of the 'Severe' grade

Variable	Mild	Moderate	Severe	Massive	Torrential
VC (biplane)	<3 mm	3-6.9 mm	7–13 mm	14–20 mm	≥21 mm
EROA (PISA)	<20 mm^2	20–39 mm^2	40–59 mm^2	60–79 mm^2	≥80 mm^2
3D VCA or quantitative EROA[a]			75–94 mm^2	95–114 mm^2	≥115 mm^2

VC, vena contracta; EROA, effective regurgitant orifice area; 3D VCA, three-dimensional vena contracta area.
[a]3D VCA and quantitative Doppler EROA cut-offs may be larger than PISA EROA.

ESC European Society of Cardiology
European Heart Journal (2021) 00, 1–72
doi:10.1093/eurheartj/ehab395

ESC/EACTS GUIDELINES

2021 ESC/EACTS Guidelines for the management of valvular heart disease

Developed by the Task Force for the management of valvular heart disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

Echocardiographic evaluation of tricuspid regurgitation severity is based on an integrative approach considering multiple qualitative and quantitative parameters (*Table* 9). Due to the non-circular and non-planar shape of the regurgitant orifice, biplane vena contracta width should be considered in addition to the conventional 2D measurement.[402] Similarly, underestimation of tricuspid regurgitation severity by the PISA method may occur.[403] In case of inconsistent findings, the 3D vena contracta area may be evaluated, although diverging cut-offs have been reported.[402,404–406] Recently, a new grading scheme including two additional grades ('massive' and 'torrential') has been proposed[407] and used in clinical studies on transcatheter interventions.[408,409] Studies showed an incremental prognostic value of the two additional grades (massive and torrential) in terms of mortality and rehospitalization for heart failure in patients with advanced disease.[410–412]

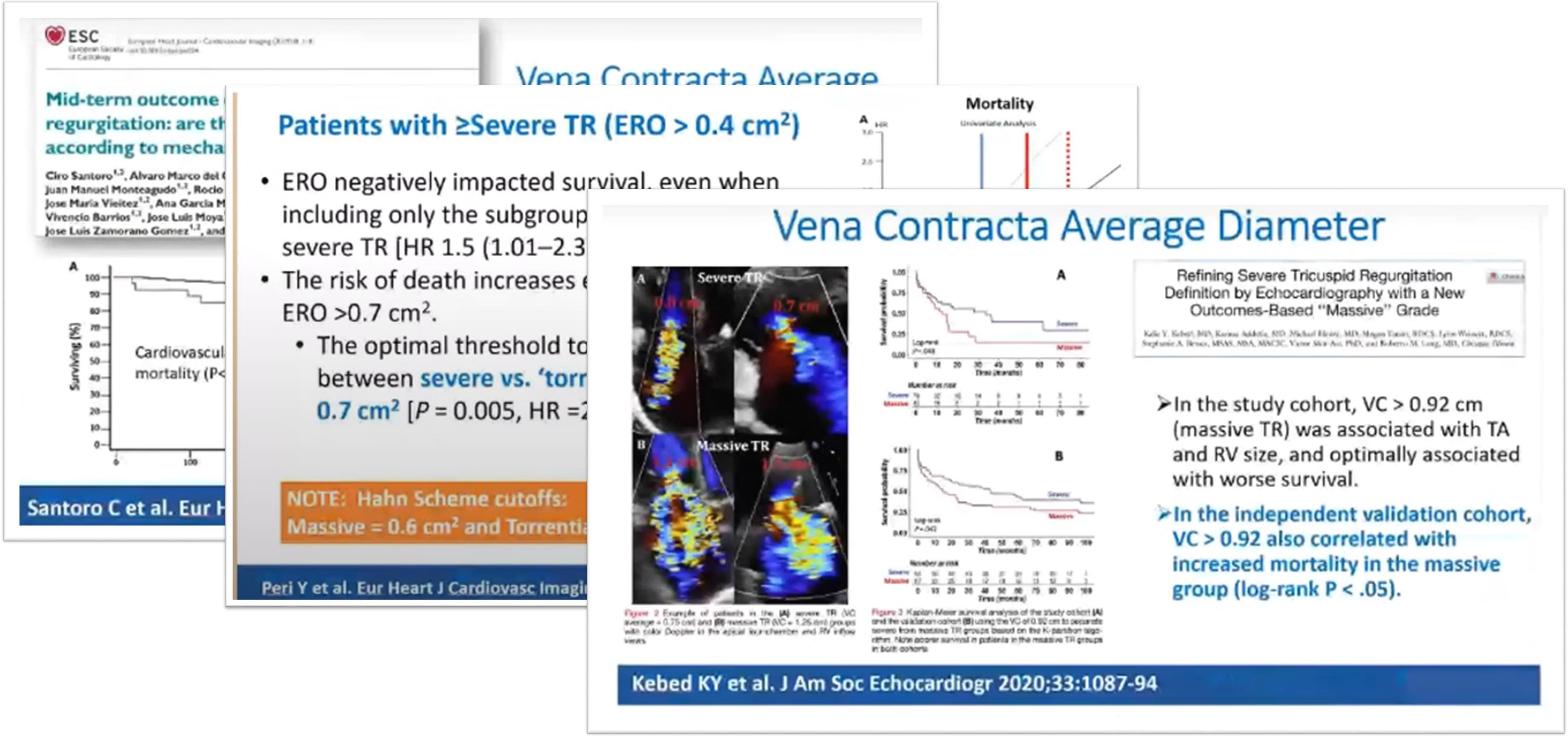
ESC European Society of Cardiology
European Heart Journal - Cardiovascular Imaging (2022) 00, 1–62
https://doi.org/10.1093/ehjci/jeab253

EACVI DOCUMENT

Multi-modality imaging assessment of native valvular regurgitation: an EACVI and ESC council of valvular heart disease position paper

Key point: When feasible, the PISA method is the best to quantify the TR severity. A TR PISA radius >9 mm at a Nyquist limit of 28 cm/s indicates severe TR. An EROA $\geq$40 mm^2 and/or a R Vol $\geq$45 mL indicates severe TR. When severe, TR can be subcategorized into severe, massive and torrential, which is of clinical interest in patients referred for transcatheter intervention.

Lancellotti P et al. Eur Heart J Cardiovasc Imaging. 2022 Mar 16



Evidence for outcomes associated with extended grading scheme in native TR e post- TTVI

JACC: CARDIOVASCULAR INTERVENTIONS
VOL. 13, NO. 17, 2020

PUBLISHED BY ELSEVIER

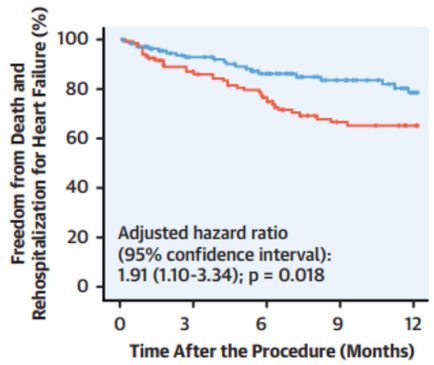
Impact of Massive or Torrential Tricuspid Regurgitation in Patients Undergoing Transcatheter Tricuspid Valve Intervention

Mizuki Miura, MD, PhD,[a] Hannes Alessandrini, MD,[b] Abdullah Alkhodair, MD,[c] Adrian Attinger-Toller, MD,[c]

A

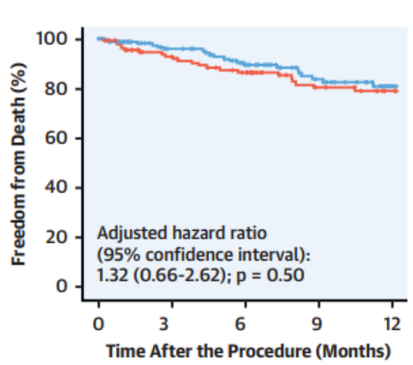
Variable	Severe	Massive	Torrential
Vena contracta width (biplane)	7-13 mm	14-20 mm	≥21 mm
Effective regurgitant orifice area (proximal isovelocity surface area)	40-59 mm^2	60-79 mm^2	≥80 mm^2
3-dimensional VCA or quantitative effective regurgitant orifice area	75-94 mm^2	95-114 mm^2	≥115 mm^2

B



No. at risk:					
Severe Tricuspid Regurgitation	179	107	85	62	41
Massive/Torrential Tricuspid Regurgitation	154	96	81	53	51
Kaplan-Meier Rate					
Severe Tricuspid Regurgitation	0	7.2%	13.8%	16.4%	21.6%
Massive/Torrential Tricuspid Regurgitation	0	13.0%	23.3%	33.5%	34.7%

C

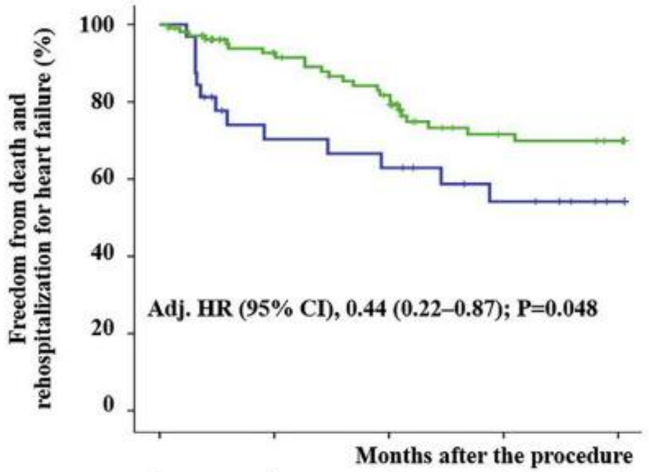


No. at risk:					
Severe Tricuspid Regurgitation	179	130	102	71	55
Massive/Torrential Tricuspid Regurgitation	154	105	92	65	61
Kaplan-Meier Rate					
Severe Tricuspid Regurgitation	0	4.2%	10.7%	16.4%	19.1%
Massive/Torrential Tricuspid Regurgitation	0	7.1%	13.5%	19.6%	20.9%

Baseline massive or torrential TR is associeted with an increased risk for all-cause Mortality and rehosp for heart failure 1 year after TTVI

A

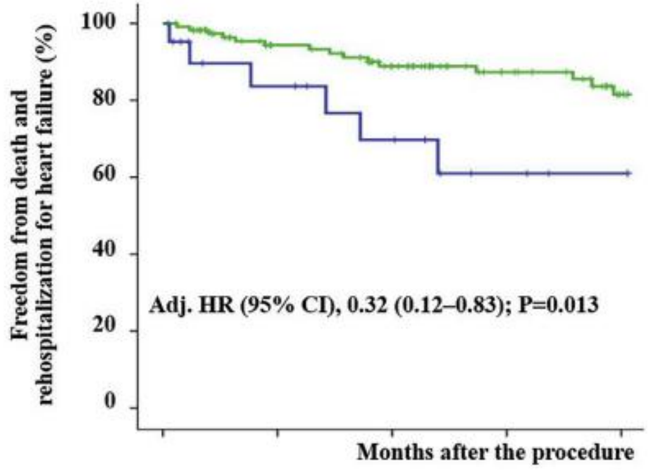
Massive/Torrential



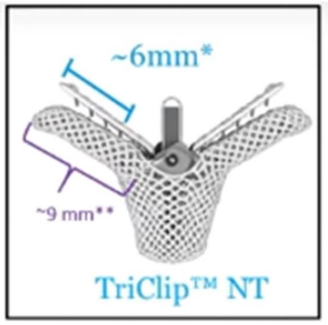
No at risk	0	3	6	9	12
Procedural success	119	80	67	43	41
Procedural failure	35	19	17	12	12
Kaplan–Meier rate					
Procedural success	0.0%	7.4%	18.2%	28.4%	30.1%
Procedural failure	0.0%	29.7%	37.1%	45.8%	45.8%

B

Severe

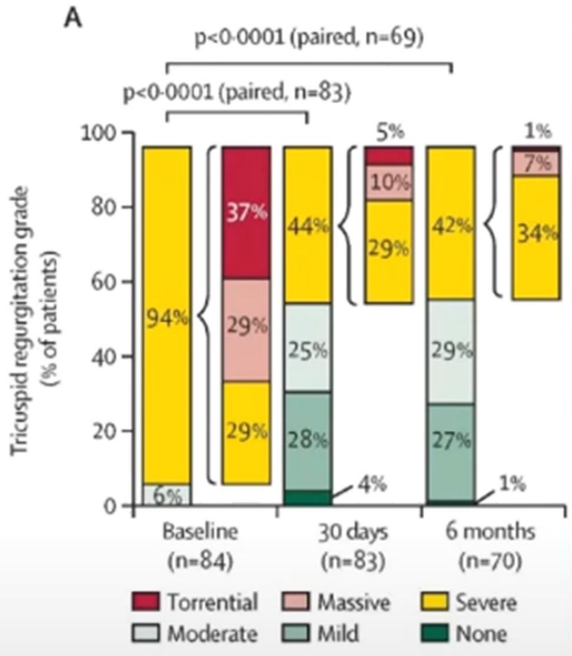


Procedural success (TR<2) is associated with improved outcomes, even in with baseline massive/torrential TR

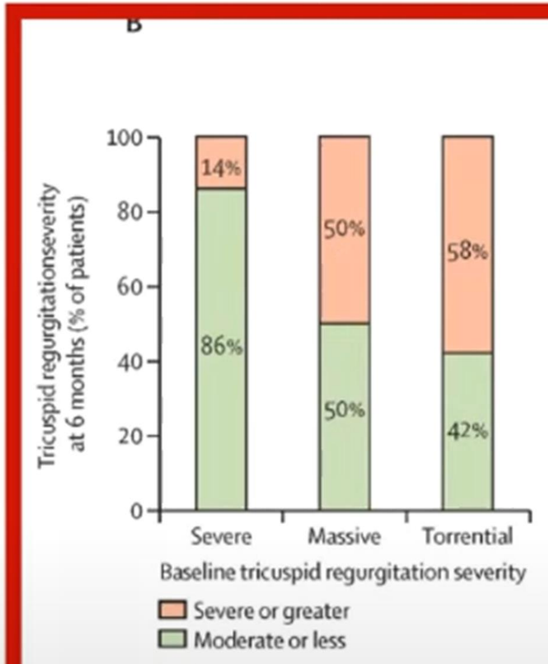


Transcatheter edge-to-edge repair for reduction of tricuspid regurgitation: 6-month outcomes of the TRILUMINATE single-arm study

Georg Nickenig, Marcel Weber*, Philipp Lurz, Ralph Stephan von Bardeleben, Marta Sitges, Paul Sorajja, Jörg Hausleiter, Paolo Denti, Jean-Noël Trochu, Michael Näbauer, Abdellaziz Dahou, Rebecca T Hahn*

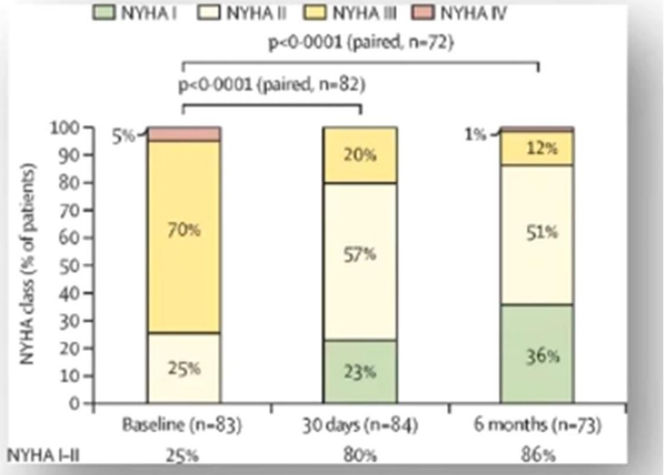


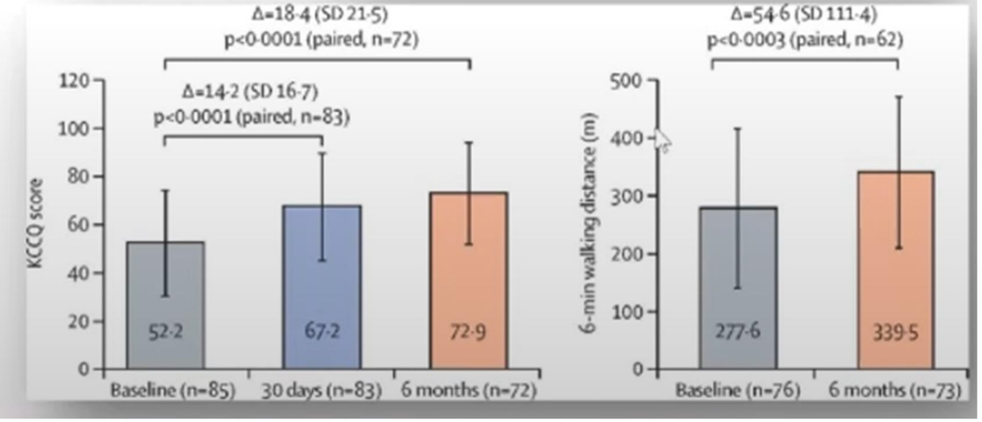
(A) Severity of tricuspid regurgitation at baseline, 30 days and 6 months



(B) Proportion of patients with reduced tricuspid regurgitation severity by baseline severity status.

The TriClip system appears to be safe and effective at reducing tricuspid regurgitation by at least one grade. This reduction could translate to significant clinical improvement at 6 months post procedure.





JACC: Cardiovascular Interventions
Volume 17, Issue 12, 24 June 2024, Pages 1485-1495

Original Research

Structural

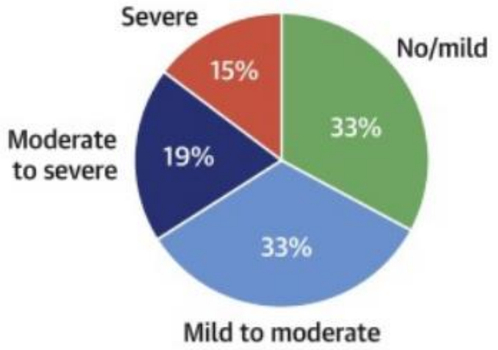
Prognostic Implications of Residual Tricuspid Regurgitation Grading After Transcatheter Tricuspid Valve Repair

Julien Dreyfus MD, PhD [a], Maurizio Taramasso MD, PhD [b], Karl-Patrik Kresoja MD [c], Hazem Omran MD [d], Christos Iliadis MD [e], Giulio Russo MD [f], Marcel Weber MD [g], Luis Nombela-Franco MD, PhD [h], Rodrigo Estevez Loureiro MD, PhD [i], Jörg Hausleiter MD [j], Azeem Latib MD [k], Lukas Stolz MD [j], Fabien Praz MD [l], Stephan Windecker MD [l], Jose Luis Zamorano MD [m], Ralph Stephan von Bardeleben MD [c], Gilbert H.L. Tang MD, MSc, MBA [n], Rebecca Hahn MD [o], Edith Lubos MD [p], John Webb MD [q]...Jose Luis Zamorano [84]

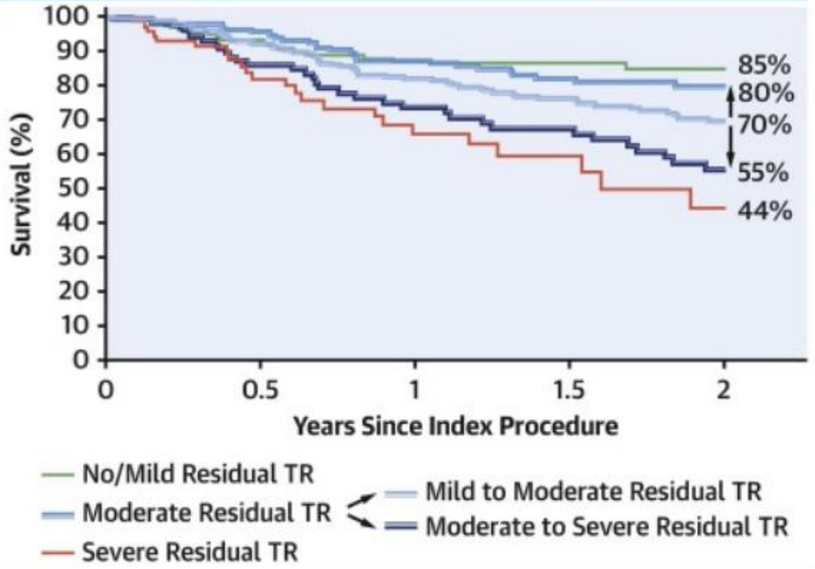
CENTRAL ILLUSTRATION: Impact on Mortality of Residual Tricuspid Regurgitation Grade After Transcatheter Tricuspid Valve Repair

TRIGISTRY: Transcatheter Tricuspid Valve Repair in Severe Isolated Functional Tricuspid Regurgitation, N = 613

A Residual TR at Discharge



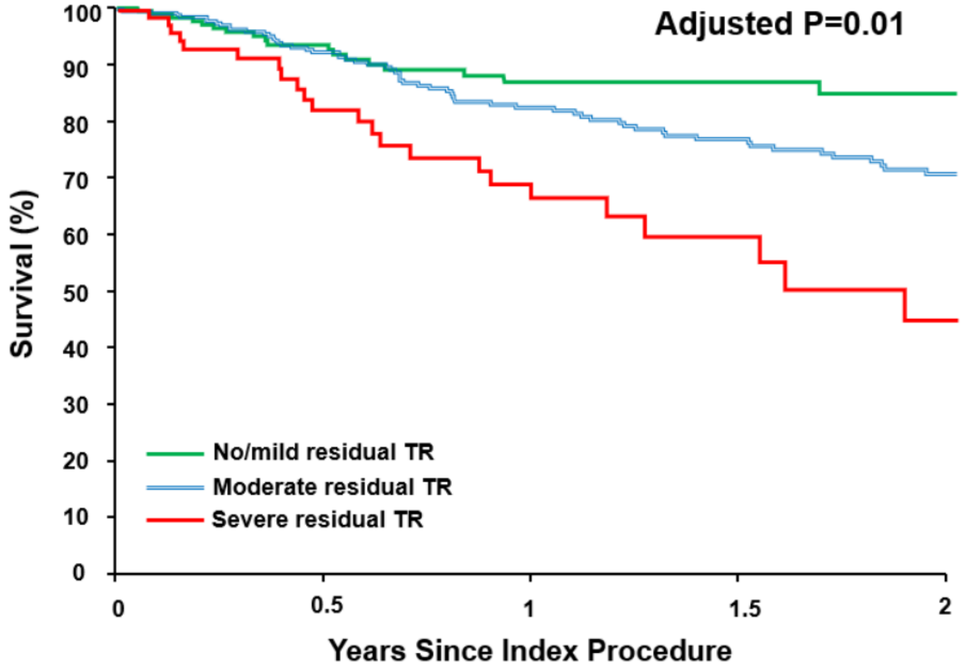
B Survival According to Residual TR Severity



- Survival at 2 years following TTVR was worse in patients with moderate to severe compared to mild to moderate residual TR ($P = 0.006$) but not different between no/mild and mild to moderate ($P = 0.67$) and between moderate to severe and residual TR ($P = 0.96$)
- Prediction of survival is improved using a more granular 4-grade TR classification (ie, dividing moderate residual TR into 2 subgroups)
- These results highlight the importance of achieving mild to moderate or less residual TR during transcatheter tricuspid valve repair

Dreyfus J, et al. J Am Coll Cardiol Intv. 2024;17(12):1485-1495.

"Need to separate moderate into mild-to-moderate and moderate-to-severe"

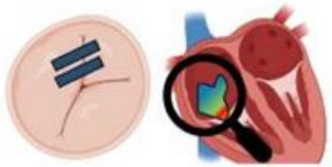


Prognostic Implications of Residual Tricuspid Regurgitation Grading After Transcatheter Tricuspid Valve Repair

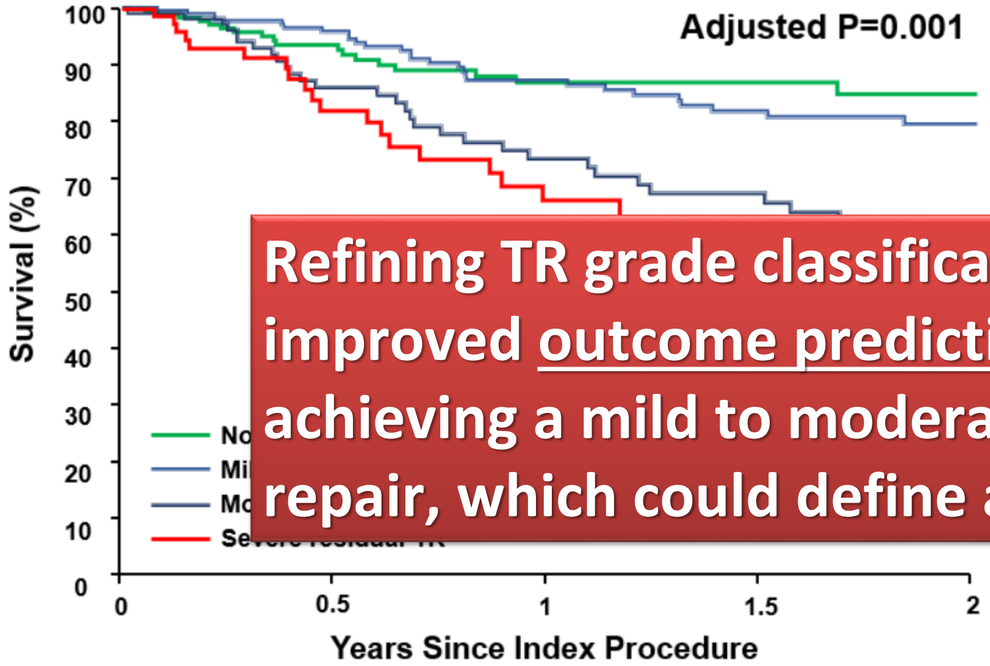
Designed by Alex Sticchi & Federico Bargagna. Source: PCRonline.com

613 Patients from TRIGISTRY with severe isolated functional TR who underwent TTVI, evaluated according to the severity of residual TR at discharge. 2 years follow-up.

Significantly **different adjusted survival rates between residual mild, moderate and severe TR** after TTVI (*p=0.0001*).



Significantly **lower survival in patients with moderate to severe residual TR** compared with mild to moderate residual TR after TTVI (*P= 0.006*).



Refining TR grade classification with a more granular 4-grade scheme improved outcome prediction. Results highlight the importance of achieving a mild to moderate or lower residual TR grade during TTV repair, which could define a successful intervention.

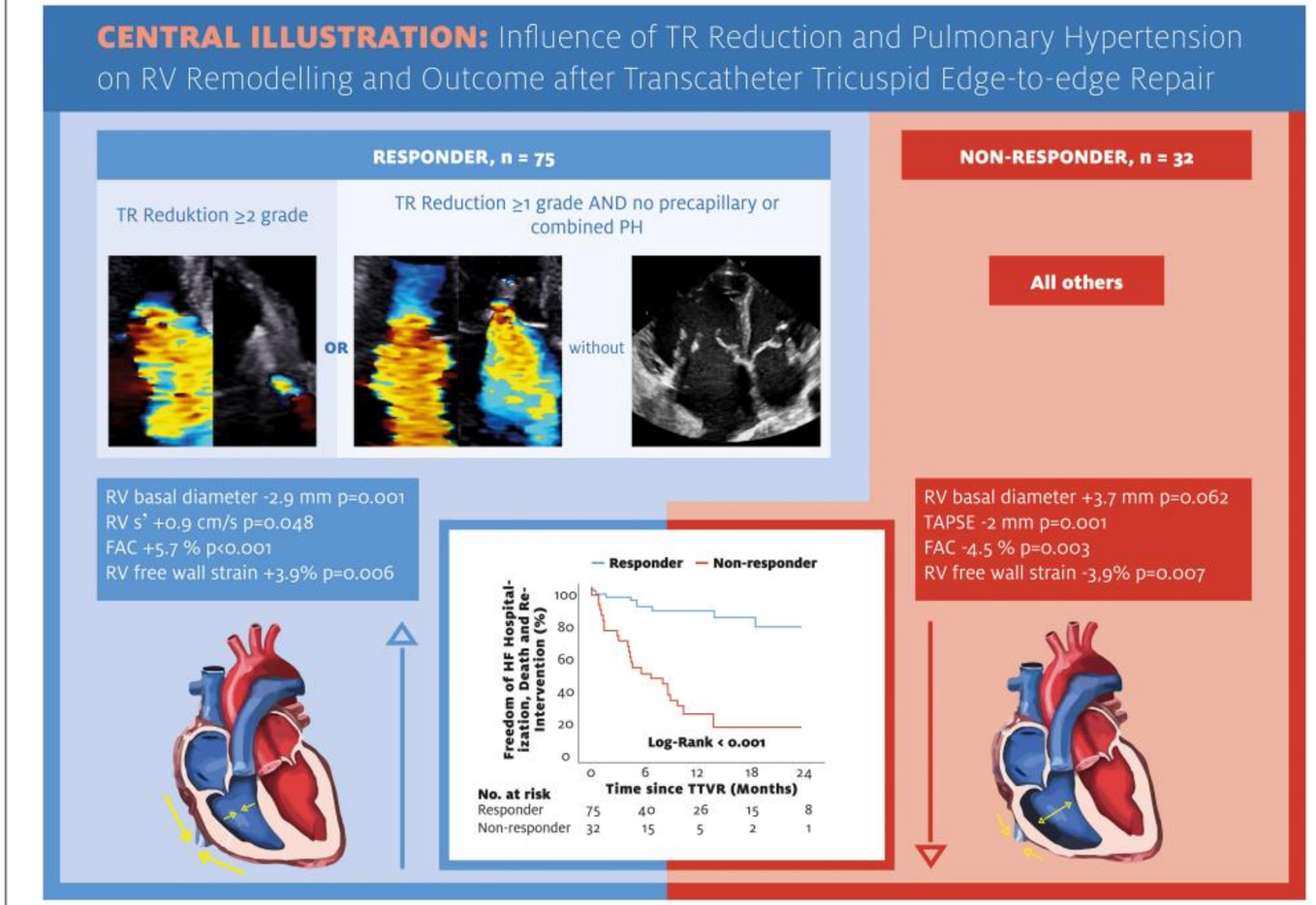
frontiers | Frontiers in Cardiovascular Medicine

ORIGINAL RESEARCH
published: 02 June 2022
doi: 10.3389/fcvm.2022.891468

Invasive Hemodynamic Assessment and Procedural Success of Transcatheter Tricuspid Valve Repair—Important Factors for Right Ventricular Remodeling and Outcome

Varius Dannenberg[1], Matthias Koschutnik[1], Carolina Donà[1], Christian Nitsche[1], Katharina Mascherbauer[1], Gregor Heitzinger[1], Kseniya Halavina[1], Andreas A. Kammerlander[1], Georg Spinka[1], Max-Paul Winter[1], Martin Andreas[2], Markus Mach[2], Matthias Schneider[3,4], Anna Bartunek[5], Philipp E. Bartko[1], Christian Hengstenberg[1], Julia Mascherbauer[1,6] and Georg Goliasch[1]

- **RESPONDERS:**
  - Significant RV reverse remodeling in responders with a decrease in RV diameters (-2.9 mm, p = 0.001) at a mean follow-up of 229 days (±219 SD) after TTVR.
  - RV function improved in responders (FAC + 5.7%, $p < 0.001$)
- **NON-RESPONDERS:**
  - More persistent symptoms than responders (NYHA ≥3, 72% vs. 11% at follow-up).



TTVR patients divided into responders and non-responders by preinterventional hemodynamic assessment and procedural success show a marked difference in RV (reverse) remodeling and outcome. While RV function improves in responders, it deteriorates in non-responders.

Can we improve outcome with TTVI?

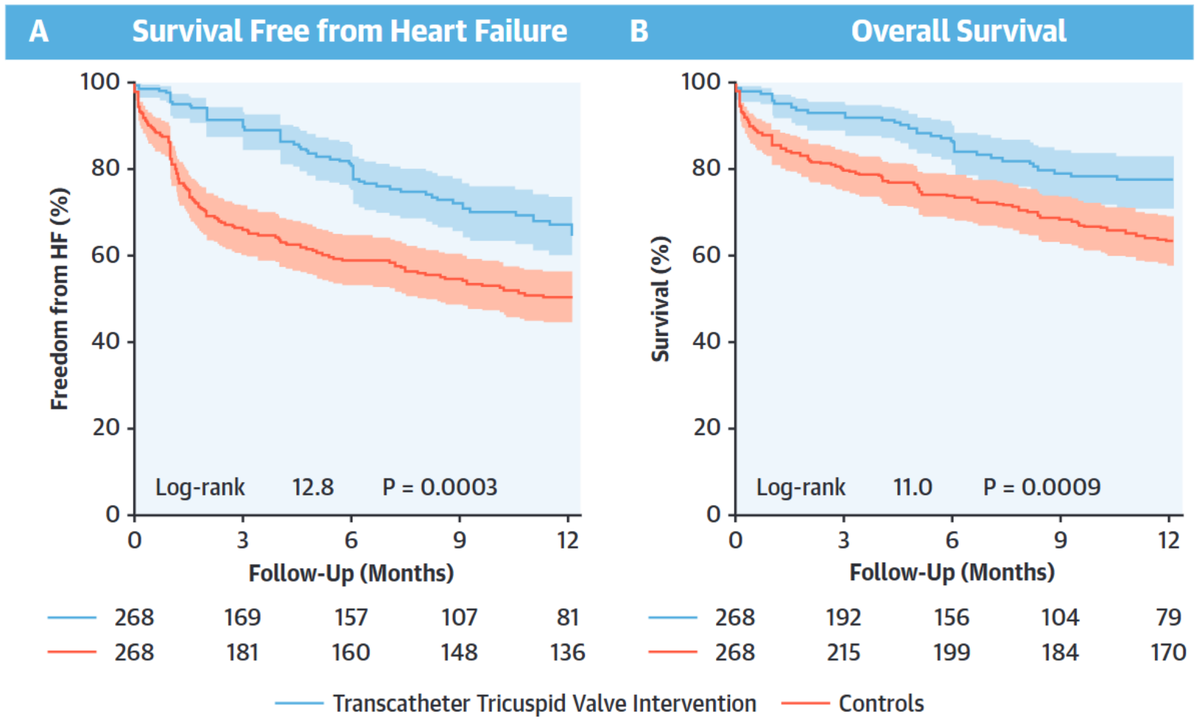
JOURNAL OF THE AMERICAN COLLEGE OF CARDIOLOGY VOL. 74, NO. 24, 2019
© 2019 BY THE AMERICAN COLLEGE OF CARDIOLOGY FOUNDATION
PUBLISHED BY ELSEVIER

Transcatheter Versus Medical Treatment of Patients With Symptomatic Severe Tricuspid Regurgitation

Maurizio Taramasso, MD, PhD,[a,*] Giovanni Benfari, MD,[b,*] Pieter van der Bijl, MD,[c] Hannes Alessandrini, MD,[d]

In this propensity-matched case-control study, TTVI is associated with greater survival and reduced HFrehospitalization compared with medical therapy alone.

CENTRAL ILLUSTRATION **Transcatheter Treatment of Severe Tricuspid Regurgitation: Primary and Secondary Endpoints**



Taramasso, M. et al. J Am Coll Cardiol. 2019;74(24):2998-3008.

Kaplan-Meier curves for transcatheter tricuspid valve intervention **(blue curve)** versus control subjects **(red curve)** according to primary **(A)** and secondary **(B)** endpoint. **Shading** identifies the pointwise confidence interval.

frontiers | Frontiers in Cardiovascular Medicine

SYSTEMATIC REVIEW
published: 11 July 2022
doi: 10.3389/fcvm.2022.919395

Clinical and Echocardiographic Outcomes of Transcatheter Tricuspid Valve Interventions: A Systematic Review and Meta-Analysis

Anna Sannino [1,2], Federica Ilardi [2,3], Rebecca T. Hahn [4], Patrizio Lancellotti [5,6], Philipp Lurz [7], Robert L. Smith [1], Giovanni Esposito [2] and Paul A. Grayburn [1]*

- ***EOA Decrease mean difference [MD] −0.31 cm2 ; 95% CI: −0.39 to −0.23cm2 , p < 0.001***
- ***Regurgitant volume (MD −23.54 ml; 95% CI: −29.68 to −17.4 ml, p = 0.03)***

TTVI significantly reduces TR severity and increases FSV and is associated with improved survival at 1 year compared with patients without procedural success.

Transcatheter Tricuspid Valve Interventions	Clinical Outcomes	Right Ventricular Size and Functional Remodeling
Leaflet Devices Annuloplasty TTVR CAVI	30-day mortality → 5% 6-month mortality → 10% 1-year mortality → 25%	↓ Tricuspid Annular Diameter ↓ RV basal diameter ↓ TAPSE & Fractional Area Change ↑ Forward Stroke Volume

The NEW ENGLAND JOURNAL of MEDICINE

ESTABLISHED IN 1812 MAY 18, 2023 VOL. 388 NO. 20

Transcatheter Repair for Patients with Tricuspid Regurgitation

Paul Sorajja, M.D., Brian Whisenant, M.D., Nadira Hamid, M.D., Hursh Naik, M.D., Raj Makkar, M.D., Peter Tadros, M.D., Matthew J. Price, M.D., Gagan Singh, M.D., Neil Fam, M.D., Saibal Kar, M.D., Jonathan G. Schwartz, M.D., Shamir Mehta, M.D., Richard Bae, M.D., Nishant Sekaran, M.D., Travis Warner, M.D., Moody Makar, M.D., George Zorn, M.D., Erin M. Spinner, Ph.D., Phillip M. Trusty, Ph.D., Raymond Benza, M.D., Ulrich Jorde, M.D., Patrick McCarthy, M.D., Vinod Thourani, M.D., Gilbert H.L. Tang, M.D., Rebecca T. Hahn, M.D., and David H. Adams, M.D., for the TRILUMINATE Pivotal Investigators*

Table 2. Primary and Secondary End Points.*

End Point	TEER Group (N=175)	Control Group (N=175)	Difference (95% CI)	P Value
Primary				
Hierarchical composite of death from any cause or tricuspid-valve surgery; hospitalization for heart failure; and improvement of ≥15 points in KCCQ score at 1 yr — no. of wins†	11,348	7643	1.48 (1.06 to 2.13)	0.02
Secondary, listed in hierarchical order				
Kaplan–Meier estimate of percentage of patients with freedom from major adverse events through 30 days after the procedure (lower 95% confidence limit)‡	98.3 (96.3)	—	—	<0.001
Change in KCCQ score from baseline to 1 yr — points§	12.3±1.8	0.6±1.8	11.7 (6.8 to 16.6)	<0.001
Tricuspid regurgitation of no greater than moderate severity at 30-day follow-up — no. of patients/total no. (%)¶	140/161 (87.0)	7/146 (4.8)	—	<0.001
Change in 6-min walk distance from baseline to 1 yr — m‖	−8.1±10.5	−25.2±10.3	17.1 (−12.0 to 46.1)	0.25

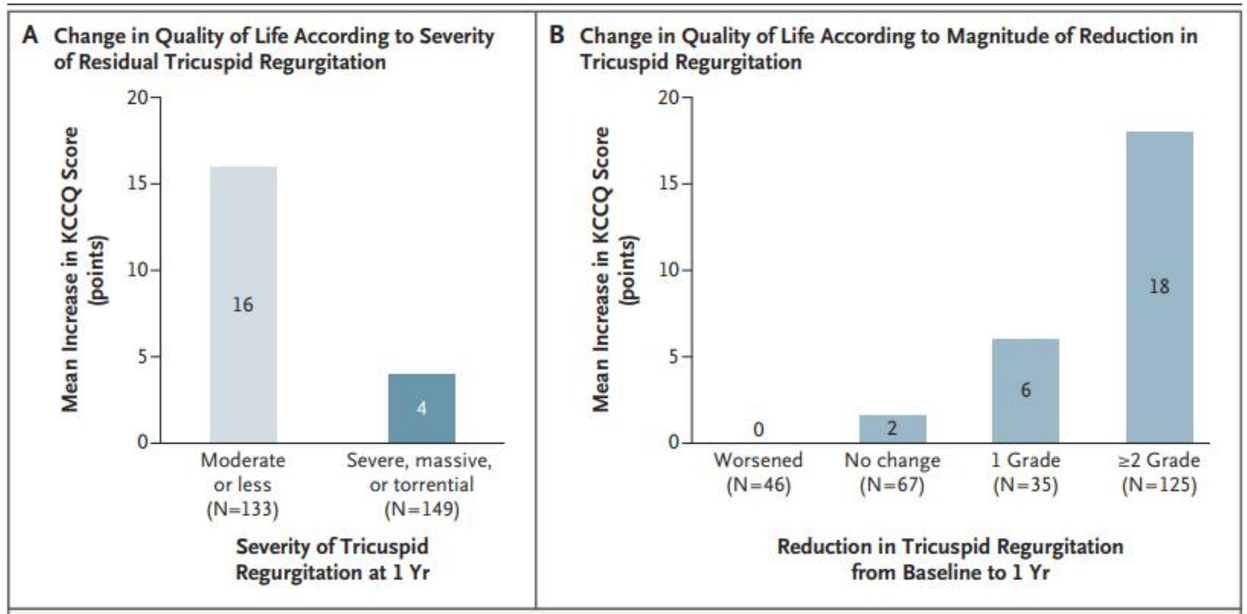


Figure 2. Changes in Quality of Life from Baseline to 1 Year, Stratified According to the Severity of Residual Tricuspid Regurgitation and the Magnitude of the Reduction in Tricuspid Regurgitation.

Tricuspid TEER was safe for patients with severe tricuspid regurgitation, reduced the severity of tricuspid regurgitation, and was associated with an improvement in quality of life.

WHAT ARE THE EXPECTED BENEFITS?

- *Mortality?*
- *HF hospitalizations?*
- *Patient reported outcomes?*

WHO BENEFIT FROM TTVI?

- ***Mortality**: Atrial vs Ventricular functional TR?*
- ***HF hospitalizations**: failed OMT?*

WHICH DEVICE THERAPY PROVIDE BENEFIT?

- *Device that are safe with few MACE?*
- *Device that reliably provide an optimal reduction in TR?*