Surgery for Isolated TR

GILLES DREYFUS, MD, FRCS, FESC
PROFESSOR OF CARDIOTHORACIC SURGERY

HÔPITAL EUROPÉEN GEORGES POMPIDOU , PARIS , FRANCE
UNIVERSITÉ PARIS CITÉ

Disclosure

- Speaker and proctor fees for Edwards Lifescience®
- Speaker fee for Corcym®

Isolated TR and Surgery

- Surgery is said to carry unacceptable mortality: 15-30%
- Surgery challenged by TEER
- Recent publications have shown much better outcome
  - ✓ Age and comorbidities
  - ✓ Presence of RV failure
  - ✓ Right-heart catheterisation in case of PHT

Most importantly, TRI-SCORE, TRIGISTRY allow better patient selection

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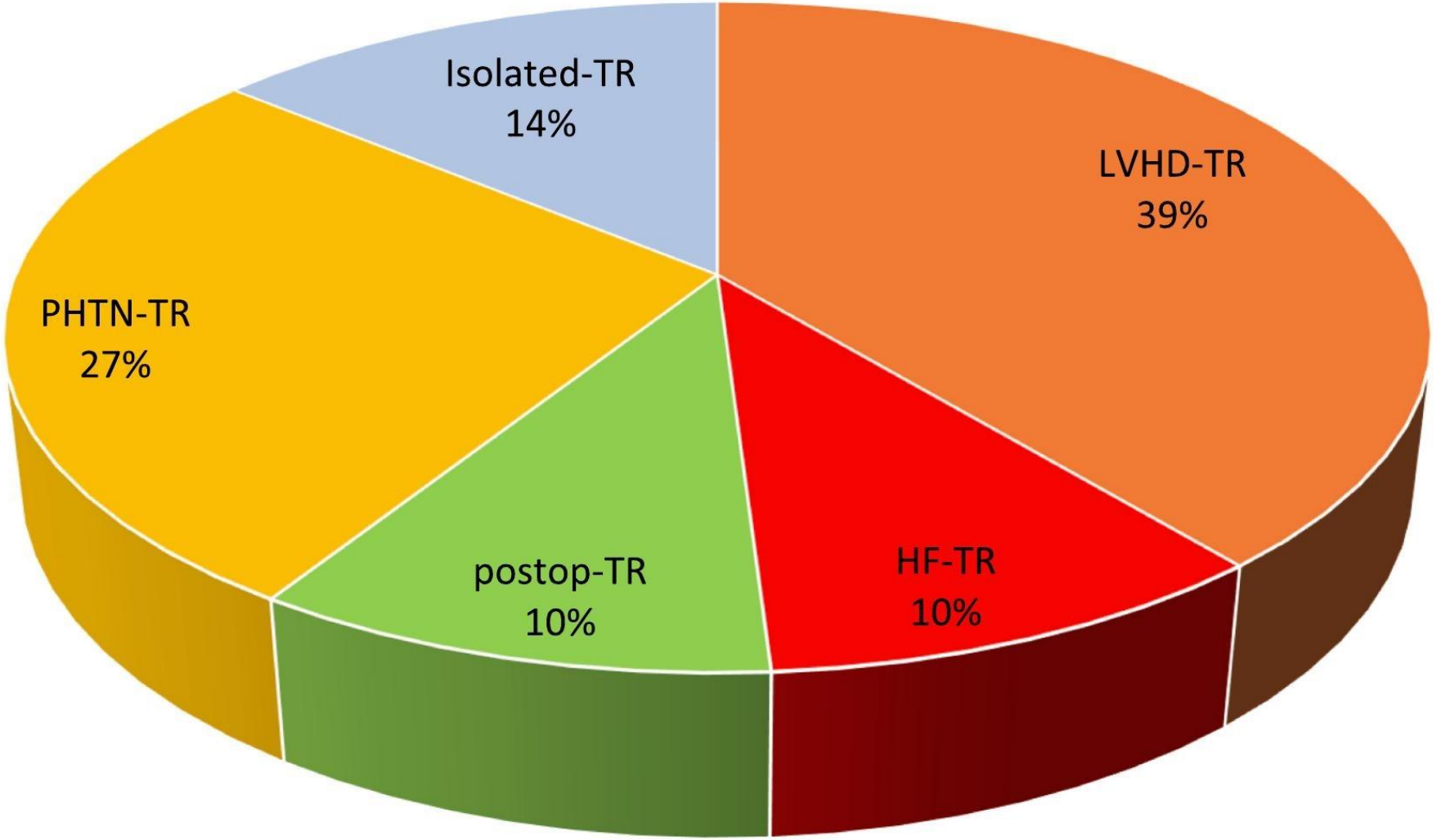
Outpatient tricuspid regurgitation in the community: Clinical context and outcome

Denis Leonardi [a] · Francesca Bursi [b] · Diego Fanti [a] · ... · Maurice Enriquez-Sarano [c] · Flavio Luciano Ribichini [a] · Giovanni Benfari [a] ... Show more



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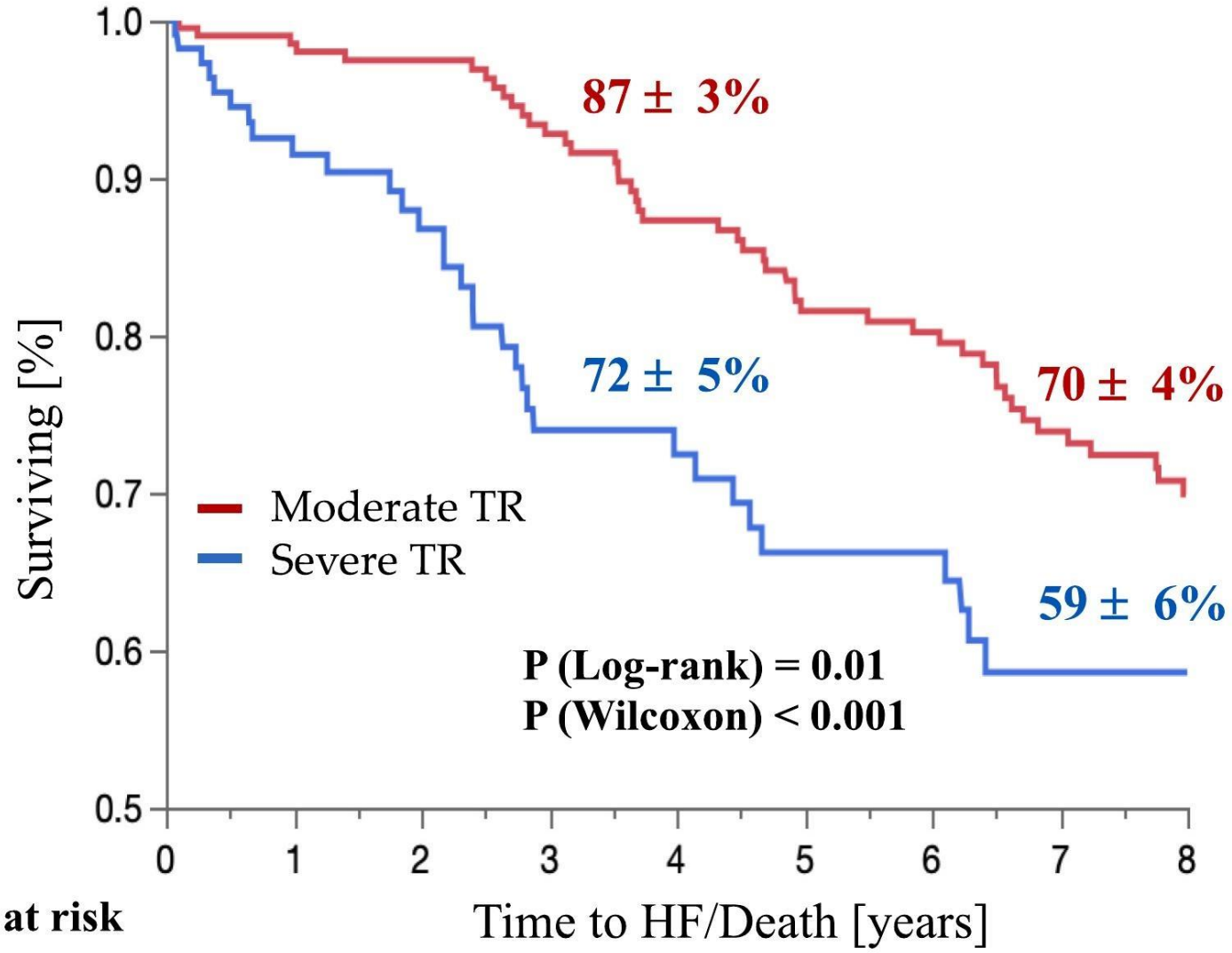

Patients at risk

Mod.	212	141	80
Sev.	115	48	25

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Outpatient tricuspid regurgitation in the community: Clinical context and outcome

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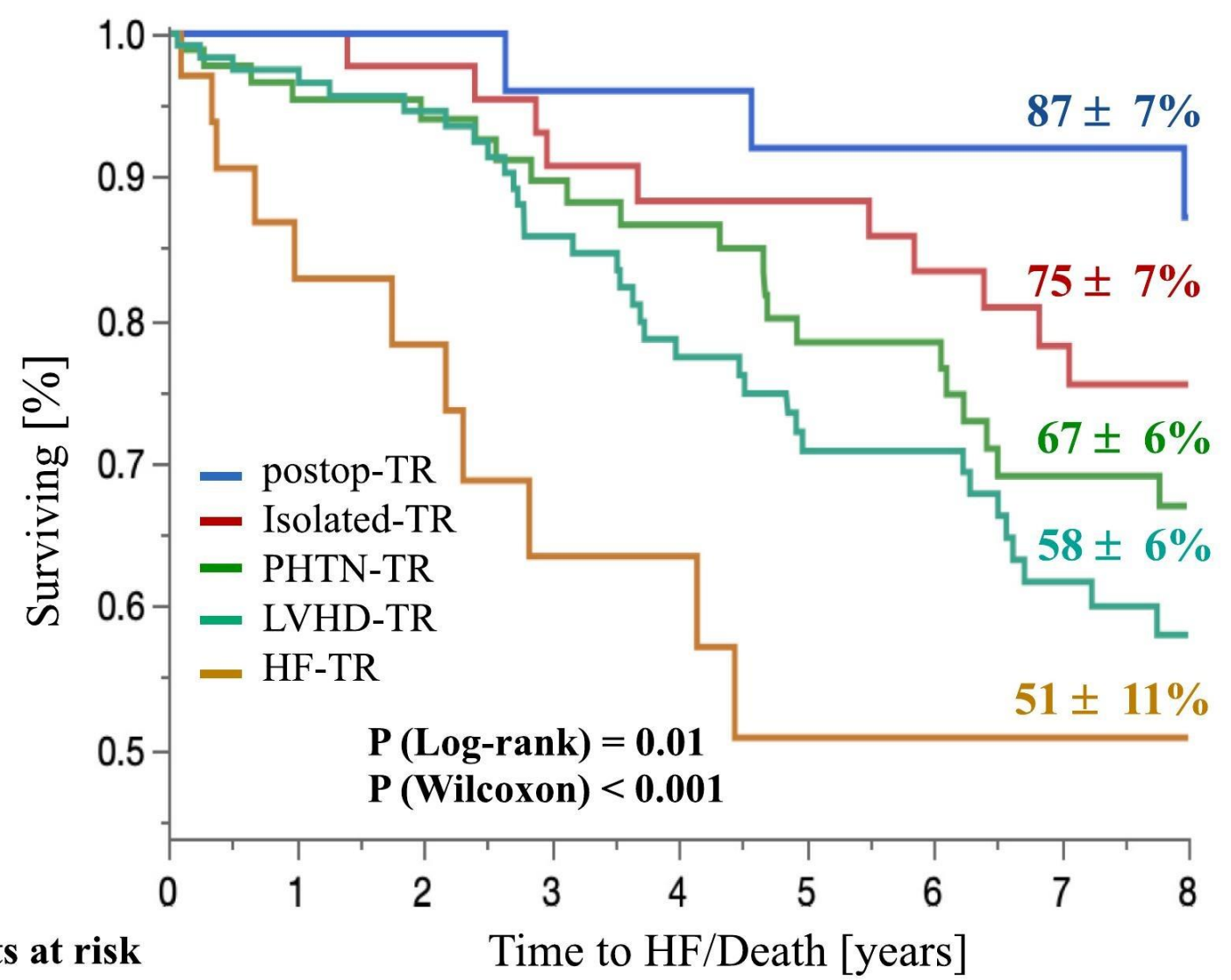
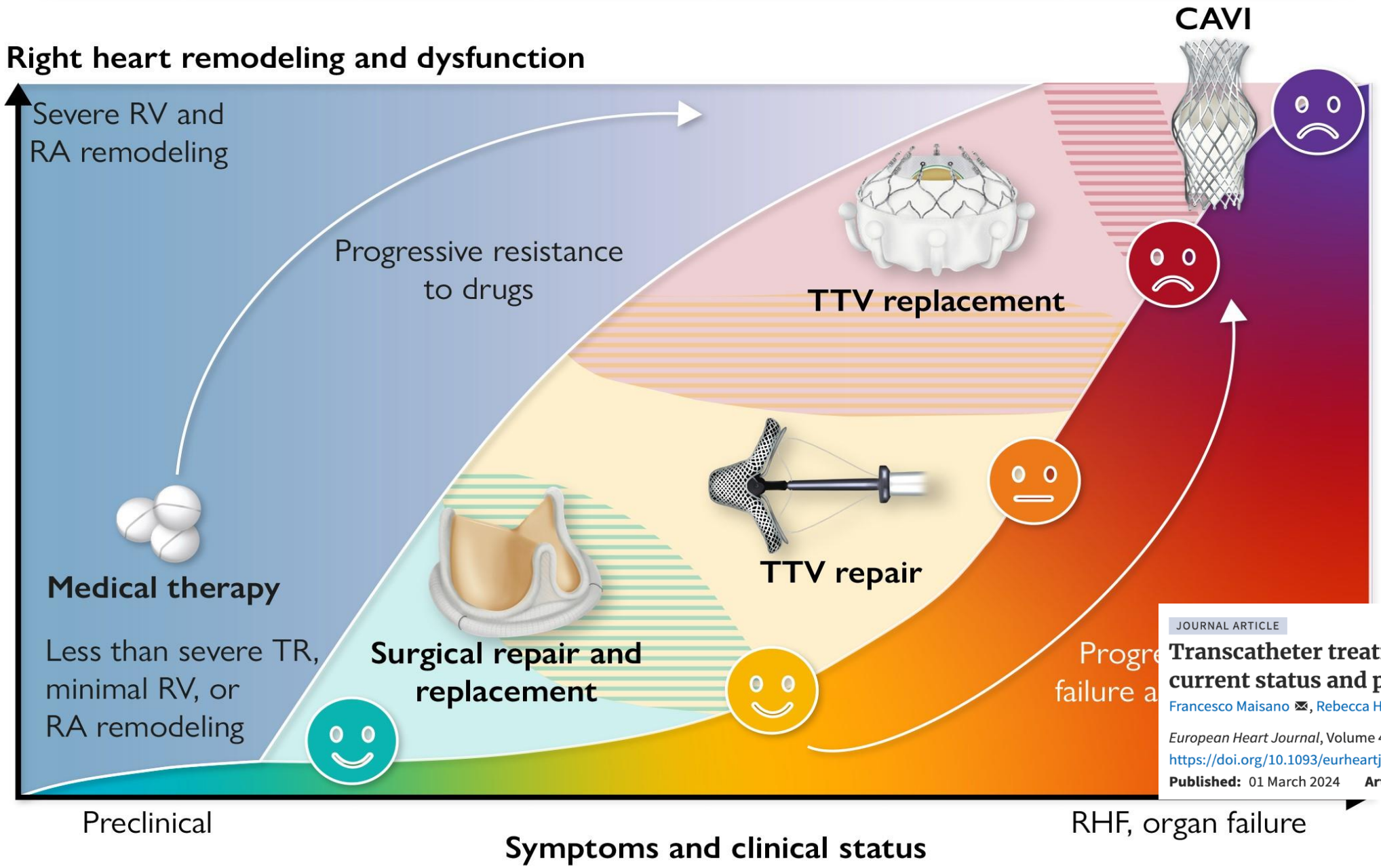


Patients at risk

postop-TR	31	24	19
Isolated-TR	46	37	26
PHTN-TR	89	55	28
LVHD-TR	127	63	28
HF-TR	34	10	6

Treatment of tricuspid valve regurgitation



JOURNAL ARTICLE

Transcatheter treatment of the tricuspid valve: current status and perspectives Get access

Francesco Maisano ✉, Rebecca Hahn, Paul Sorajja, Fabien Praz, Philipp Lurz

European Heart Journal, Volume 45, Issue 11, 14 March 2024, Pages 876–894, https://doi.org/10.1093/eurheartj/ehae082

Published: 01 March 2024 **Article history**

RAPID COMMUNICATION | Originally Published 3 May 2024 |

Natural History of Isolated Functional Tricuspid Regurgitation

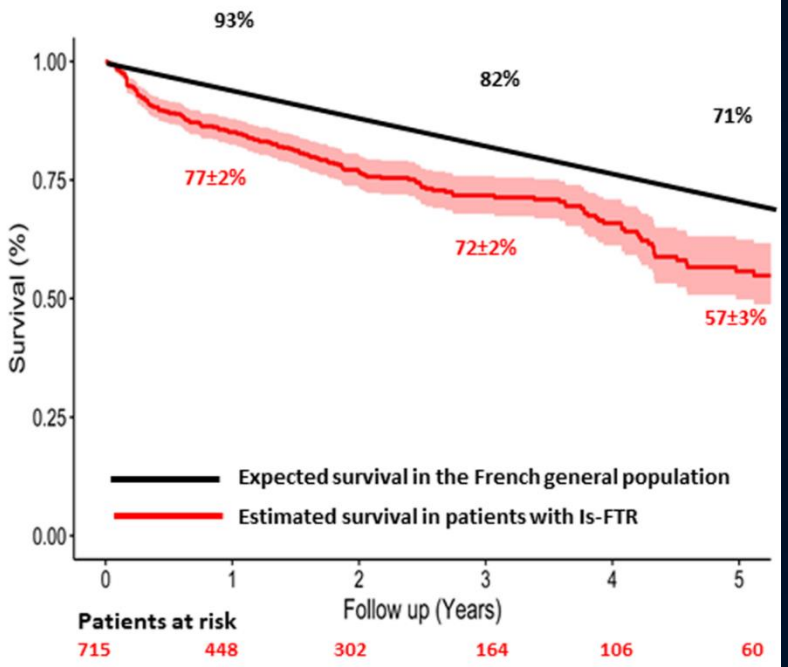
Christophe Tribouilloy, MD, PhD, Pierre Vanhaecke, MD, Julien Dreyfus, MD, PhD, Thierry Le Tourneau, MD, PhD, Yoan Lavie-Badie, MD, Christine Selton-Suty, MD, PhD, Augustin Coisne, MD, PhD, Erwan Donal, MD, PhD, Maurice Enriquez-Sarano, MD, and Yohann Bohbot, MD, PhD | AUTHOR INFO & AFFILIATIONS

Journal of the American Heart Association • Volume 13, Number 9 • https://doi.org/10.1161/JAHA.124.033933

A

Main baseline characteristics	715 patients
Age (years)	75 ± 12
Women (%, n)	61.5(440)
Charlson index	3.4 ± 2.4
Atrial fibrillation (%, n)	81.3(581)
Hypertension (%, n)	64.3(460)
Diabetes mellitus (%, n)	23.5(168)
Coronary artery disease (%, n)	22.1(158)
Chronic kidney disease (%, n)	36.4(260)
Signs of right heart failure (%, n)	61.8(442)
New York Heart Association I-II (%, n)	58.6(419)
TR effective regurgitant orifice area (mm^2)	62 ± 46
Tricuspid annulus diameter (mm)	45 ± 7
Right atrial area (cm^2)	33 ± 12
Right ventricular dilatation (%, n)	68.4(489)
Right ventricular dysfunction (%, n)	44.6(319)
Left ventricular ejection fraction (%)	59±7

B



	1 year	2 years	3 years	4 years	5 years
Expected survival (%)	93	87	82	75	71
Estimated survival (%)	85	77	72	67	57
Relative survival (%)	91	88	88	89	80

Management of Isolated Tricuspid Regurgitation: 2 Sides of the Same Coin

- Questionable statements
  - ✓ Cardiac surgery carries higher risk of morbidity and mortality in all patients with isolated secondary TR **NO**
  - ✓ It presumes that patients with severe TR should be treated medically until TTVI becomes the only option **NO**
- However, patients with TR who undergo early referral to surgery, when they have no right ventricle or peripheral organ damage, are at minimal risk and have excellent outcomes
- The only randomized study showed no benefit in terms of mortality and hospitalization for heart failure of TTVI vs medical therapy

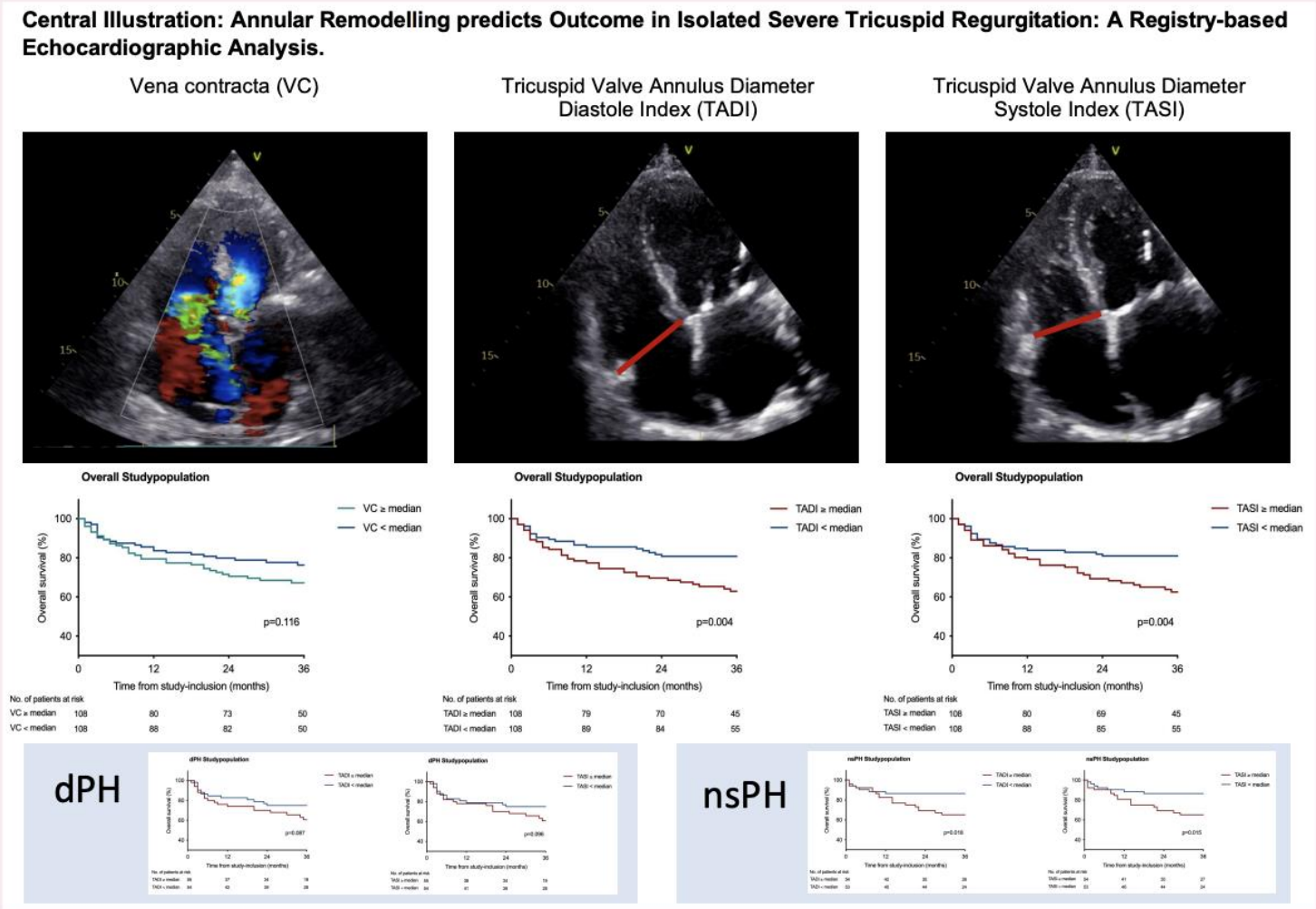
Luigi P. Badano, JACC: Cardiovascular Interventions
Volume 17, Issue 11, 10 June 2024, Page 1408

Annular remodelling predicts outcome in isolated severe tricuspid regurgitation: a registry-based echocardiographic analysis

- Severe isolated TR in the absence of AF is a rare finding with a grim prognosis.
- Underlying diseases are significant (pre-capillary) pulmonary hypertension and HFpEF.
- The newly proposed TR grades ‘massive’ and ‘torrential’ are uncommon in these patients and therefore of lesser clinical relevance.
- Tricuspid annular diameter dimensions rather than quantitative measures of TR proved to be of significant prognostic value indicating a continuous remodelling leading to a ‘point of no return’ with a dismal outcome.

Henrike Arfsten, European Heart Journal - Cardiovascular Imaging (2024) 25, 795–803

Graphical Abstract



Keywords tricuspid regurgitation • echocardiography • vena contracta width • regurgitant volume • EORA

Henrike Arfsten, European Heart Journal - Cardiovascular Imaging (2024) 25, 795–803

Isolated Tricuspid Valve Surgery (ITVS) is not a surgical indication

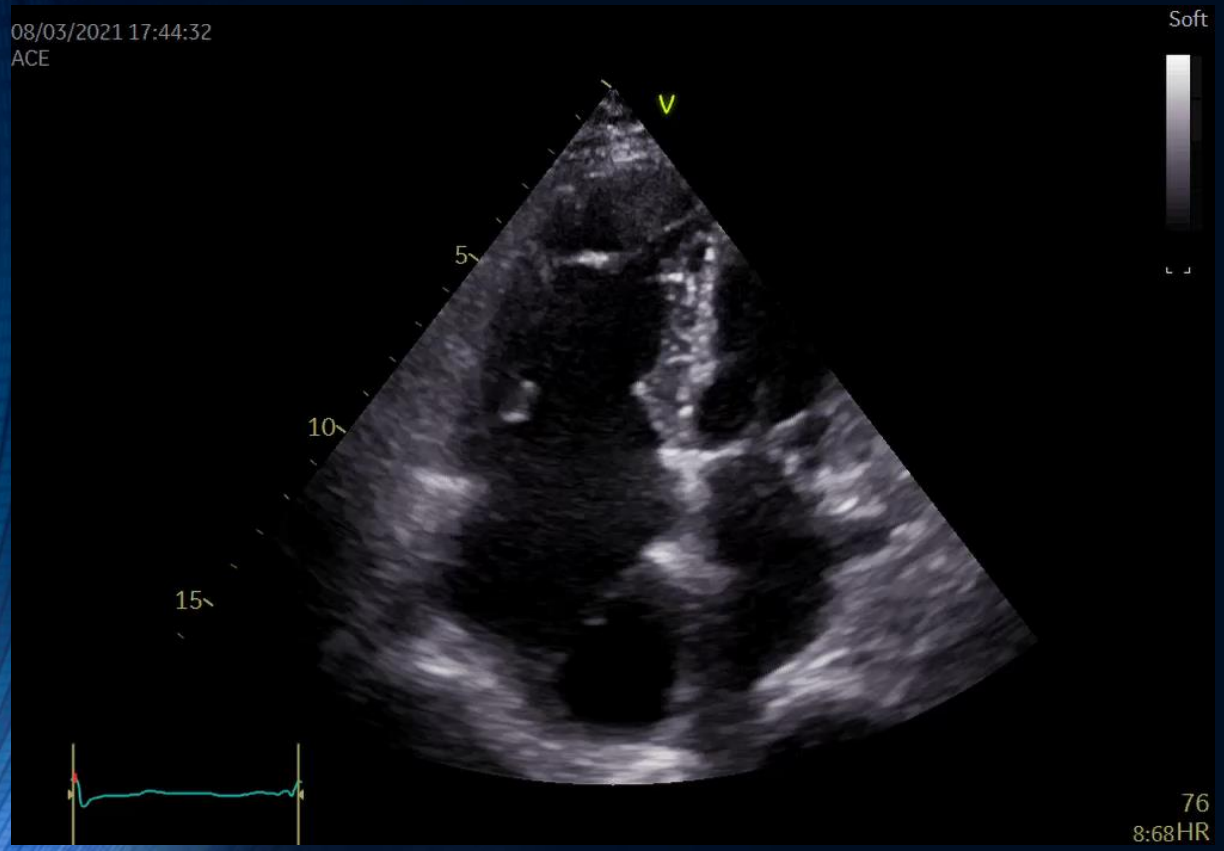
Is isolated TR a surgical failure ?

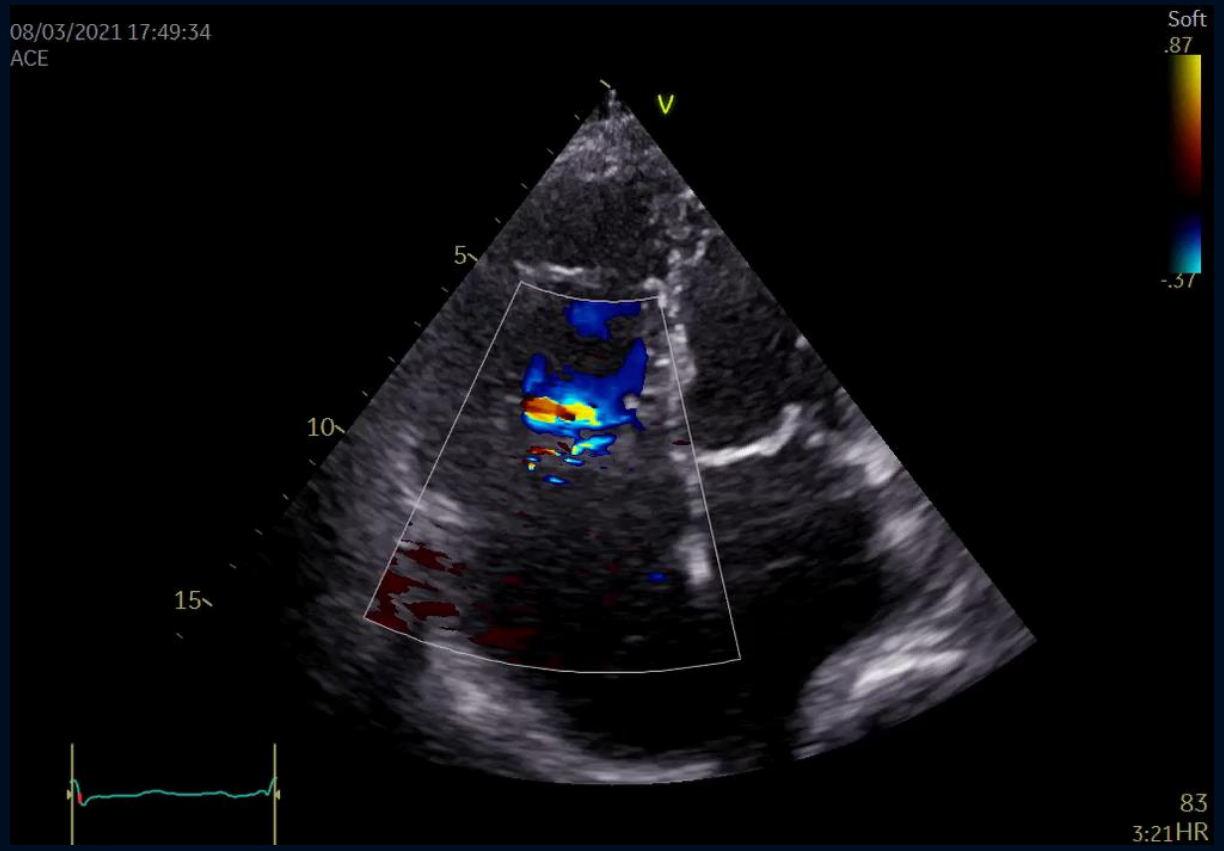
NO

Factors that have reduced operative mortality

- The **earlier** the surgery the better
- Low **risk score**
- Surgical **tips and tricks**
  - ✓MIS Vs Sternotomy
  - ✓Beating heart Vs cardioplegia
- **Tethering** with or without is key

Severe FTR with Tethering





Tethering shows RV spherical changes

- Annuloplasty alone or TriClip are not the solution
- Solutions are :
  - ✓Either extensive repair of the tricuspid valve (AL patch or papillary muscle sling)
  - ✓Either valve replacement
  - ✓For TEER, replacement seems the best option

European Journal of Cardio-Thoracic Surgery 57 (2020) 142–150
doi:10.1093/ejcts/ezz160 Advance Access publication 3 June 2019

ORIGINAL ARTICLE

Cite this article as: Chen J, Hu K, Ma W, Lv M, Shi Y, Liu J *et al.* Isolated reoperation for tricuspid regurgitation after left-sided valve surgery: technique evolution. Eur J Cardiothorac Surg 2020;57:142–50.

Isolated reoperation for tricuspid regurgitation after left-sided valve surgery: technique evolution

Jinmiao Chen [a,†], Kui Hu [a,b,†], Wenrui Ma [a,†], Minzhi Lv [c], Yu Shi [a], Ju Liu [d], Lai Wei [a], Yi Lin [a,*], Tao Hong [a,*] and Chunsheng Wang [a,*]

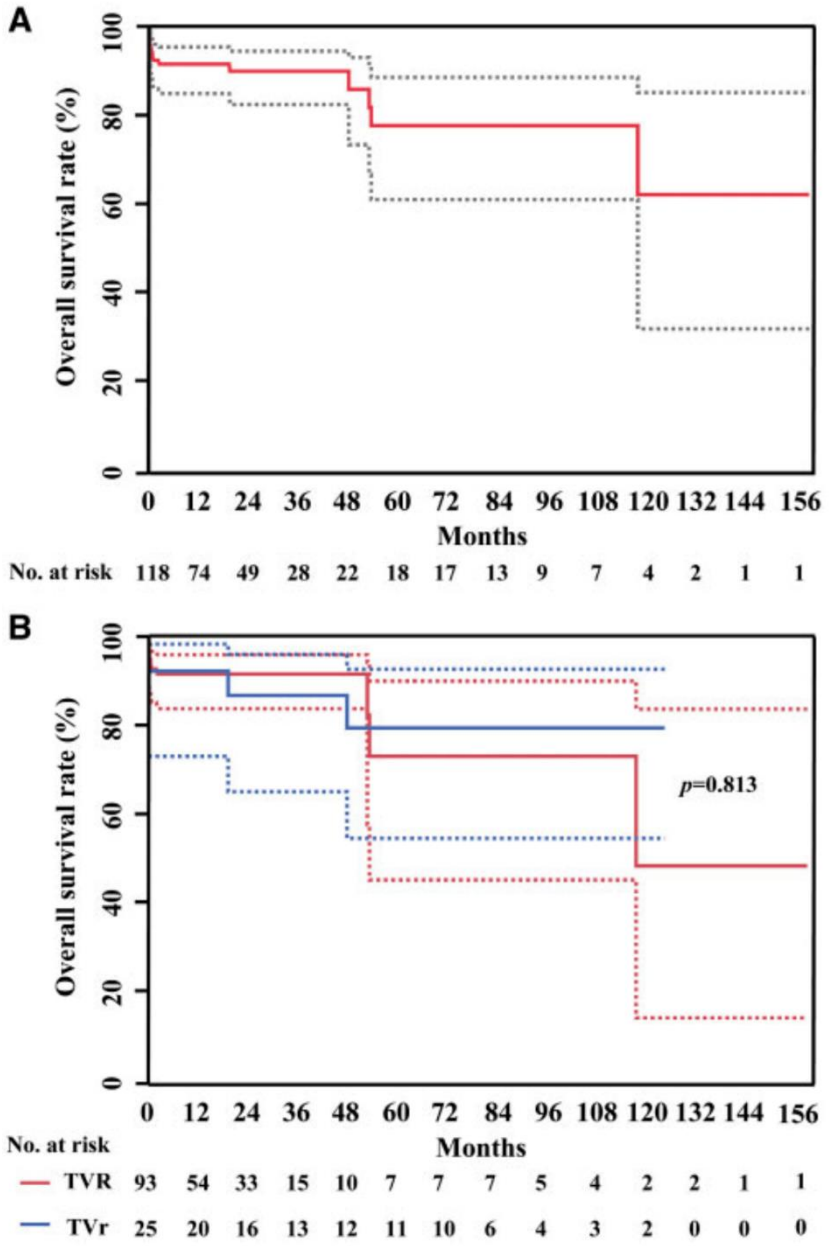


Figure 2: Kaplan–Meier overall survival curves for all patients (**A**) or according to different surgery types (**B**). The dotted lines indicate the 95% confidence intervals. TVr: tricuspid valve repair; TVR: tricuspid valve replacement.

Review

Isolated tricuspid regurgitation: A plea for early correction

Alessandra Sala [a,*,1], Roberto Lorusso [b,c,1], Ottavio Alfieri [a,1]

[a] Vita-Salute San Raffaele University, Department of Cardiac Surgery, IRCCS San Raffaele Hospital, Milan, Italy
[b] Cardio-Thoracic Surgery Department, Heart & Vascular Centre, Maastricht University Medical Centre (MUMC), Maastricht, the Netherlands
[c] Cardiovascular Research Institute Maastricht (CARIM), Maastricht, the Netherlands

ARTICLE INFO

Keywords:
Isolated tricuspid regurgitation
Early referral
Early correction
Tricuspid valve
Surgery
Transcatheter interventions

ABSTRACT

Isolated tricuspid regurgitation (TR) is gaining increasing recognition. Left untreated, isolated TR significantly worsens survival. Management of patients with severe isolated TR remains controversial and stand-alone surgery is rarely performed due to reported high in-hospital mortality. However, recent data has underlined how early referral and surgical correction result in excellent both short-and long-term results, with no in-hospital mortality, 100% 5-year survival and no further hospitalizations for right heart failure. These results should prompt a drastic change in attitude in the treatment, management and referral of patients with severe isolated TR, especially since surgery remains the only effective therapy.

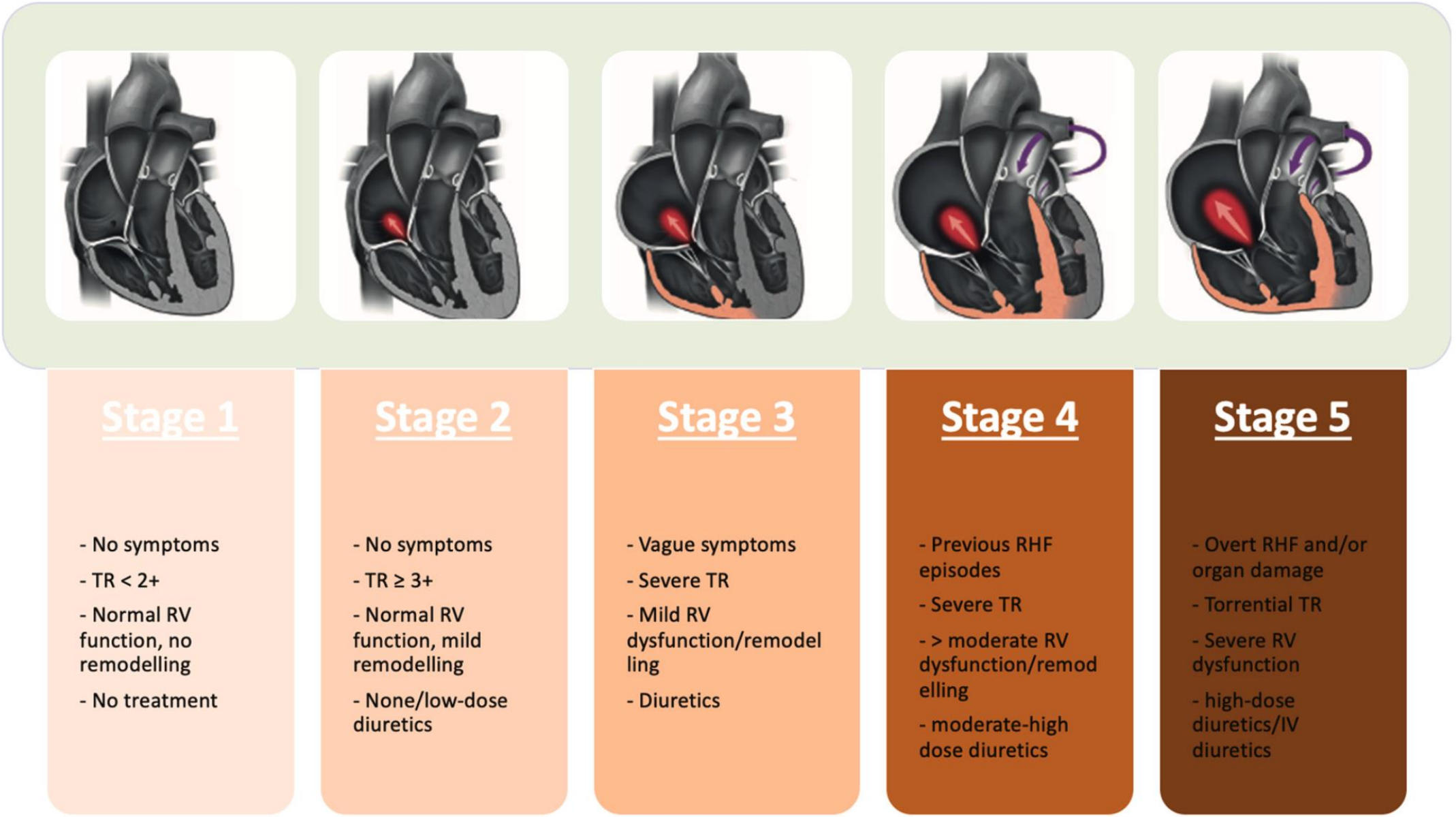
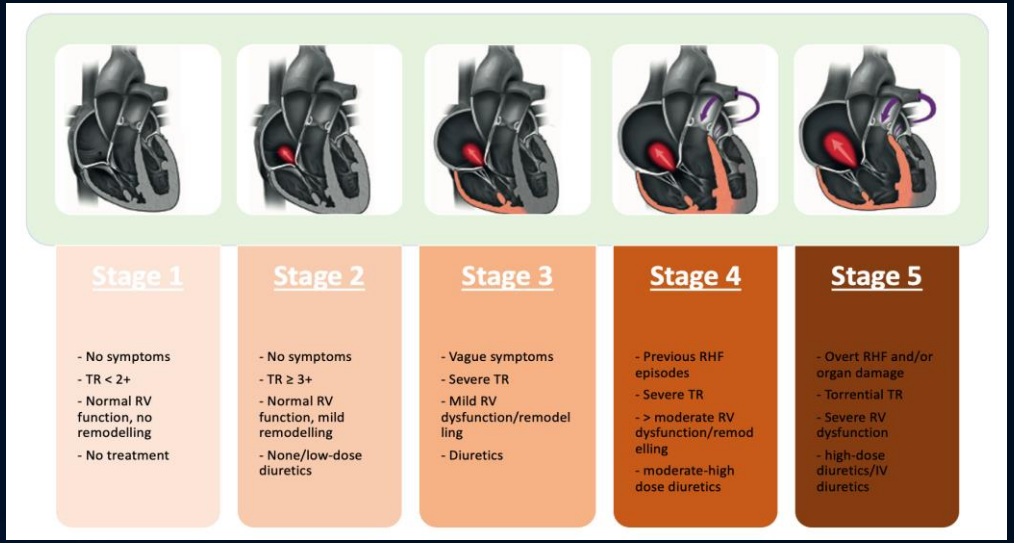
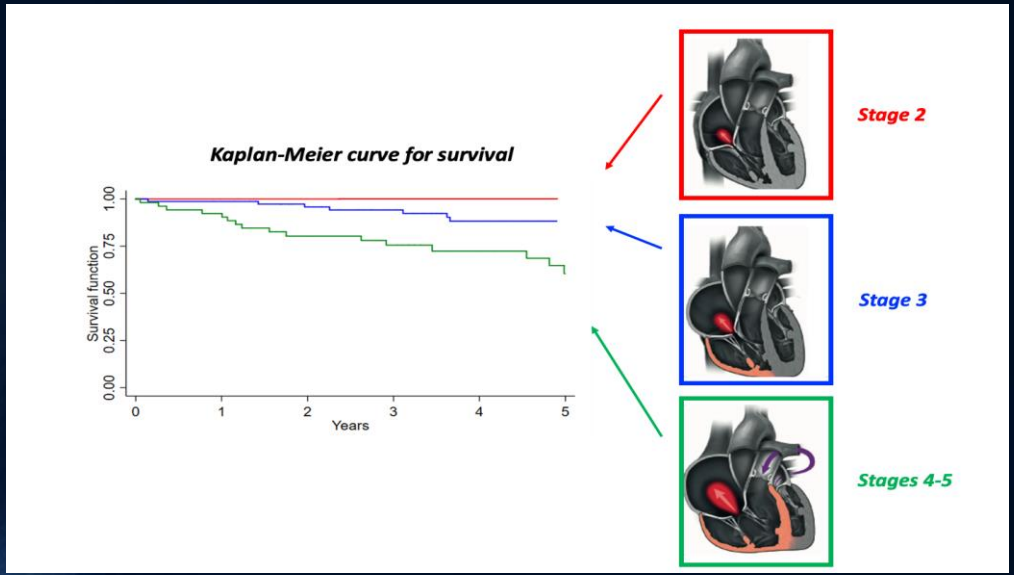
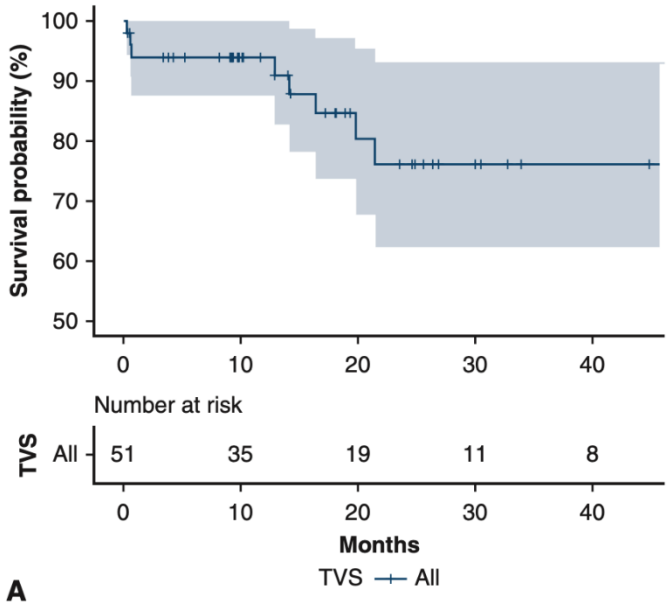


Fig. 1. 5 Stages classification and determinants/characteristics for distribution of patients [Reproduced with permission from Sala et al. [35]].





Surgery in Isolated TR before irreversible RV dysfunction or end organ dysfunction is **SAFE**



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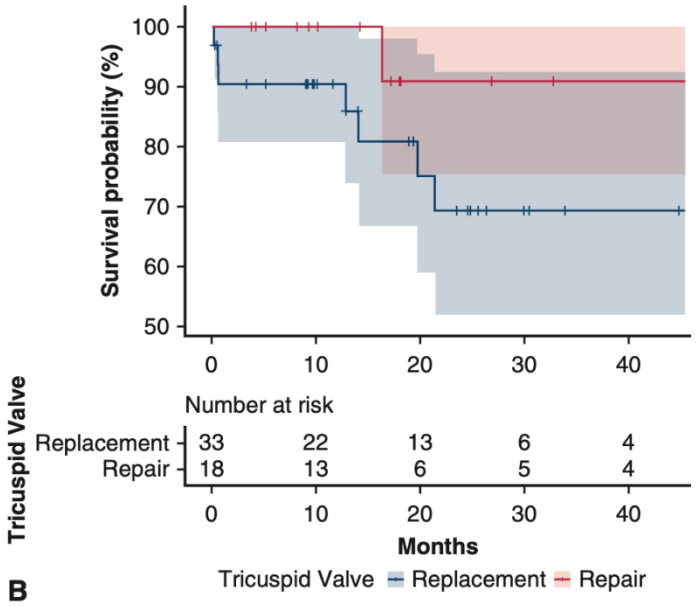

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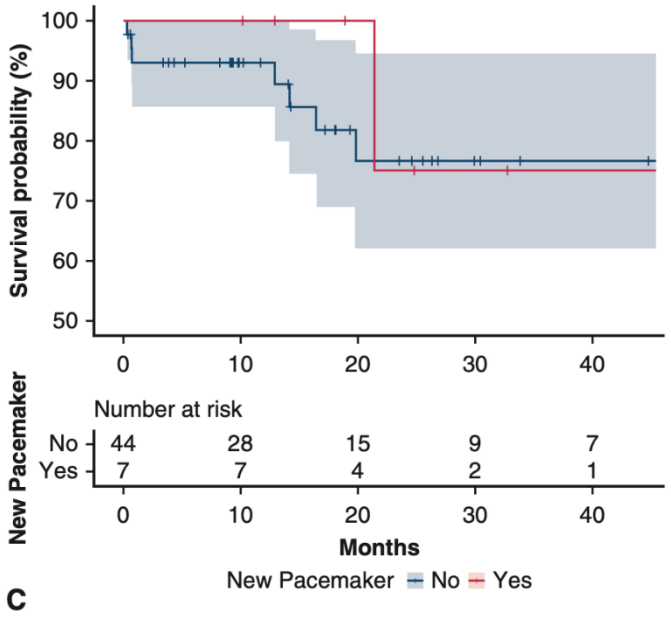

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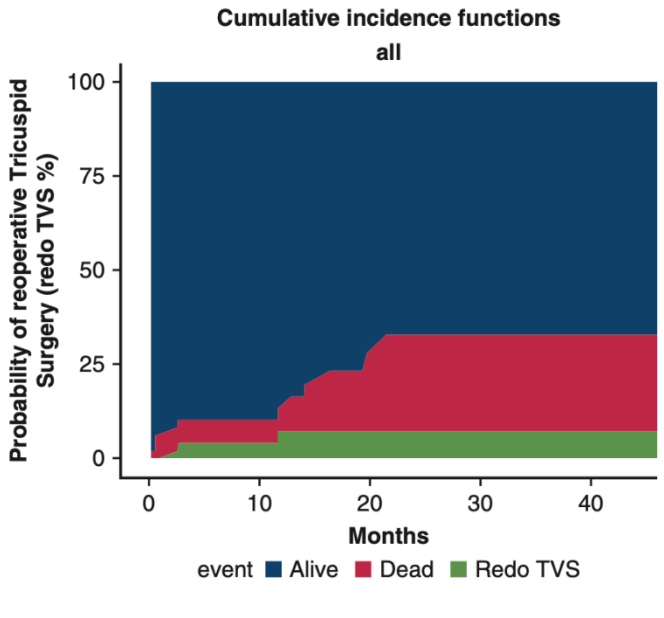


D

FIGURE 2. Survival analyses showing (A) KM curves for the overall cohort; (B) KM curves for tricuspid valve repair and replacement; and (C) KM curves for patients with or without new permanent pacemaker implantation; and (D) cumulative incidence function accounting for death as a competing event for reoperative tricuspid surgery. *TVS*, Tricuspid valve surgery; *KM*, Kaplan–Meier

Outcomes of minimally invasive isolated tricuspid valve repair and replacement through right mini-thoracotomy

Ahmed Alnajar, MD, MSPH,[a] Subhasis Chatterjee, MD,[b] Jacqueline K. Olive, MD,[c] Mahmut S. Kaymakci, MD,[d] Lauren Gray, MD,[b] Zachary Gray, PA,[b] Joao R. Breda, MD,[a] and Joseph Lamelas, MD[a]

JTCVS Open 2024

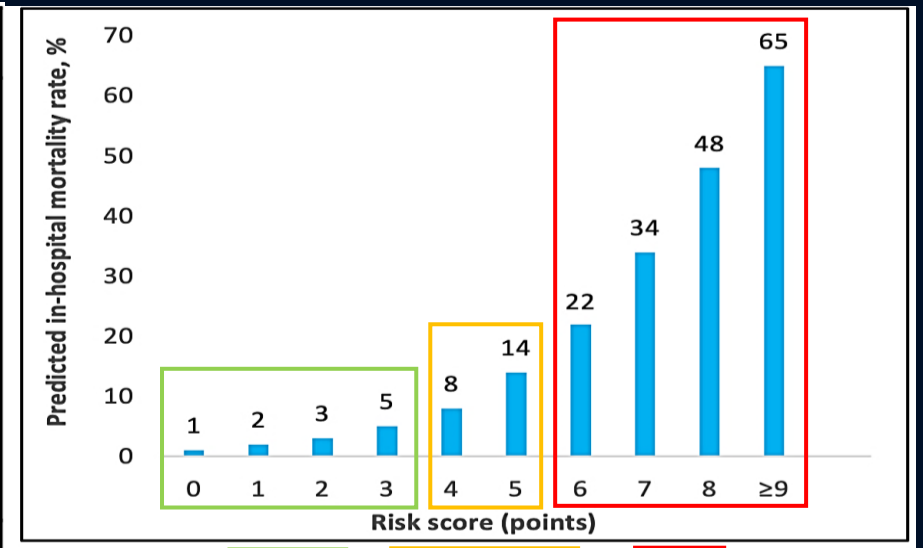
The TRI-SCORE Registry

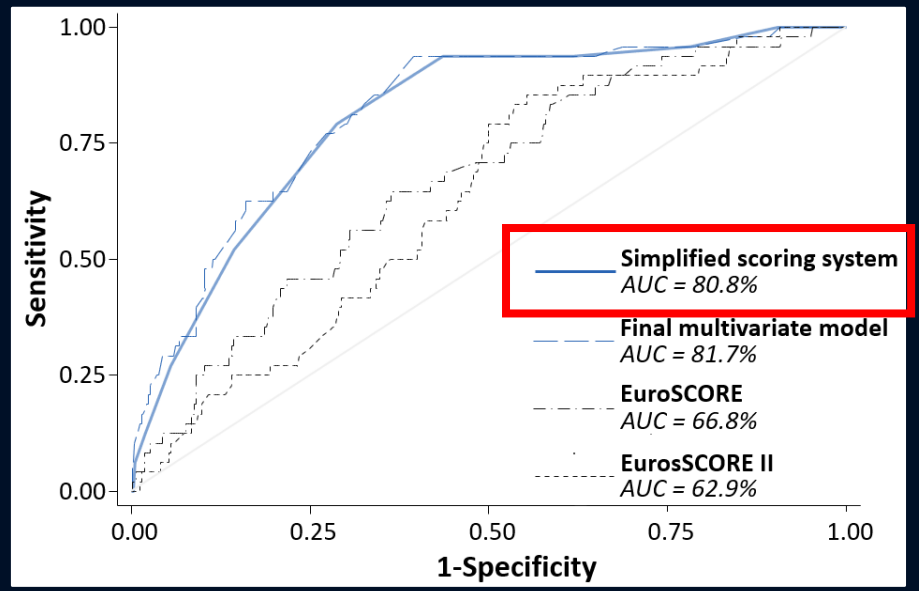
TRI-SCORE: dedicated risk score model to predict in-hospital mortality after ITVS

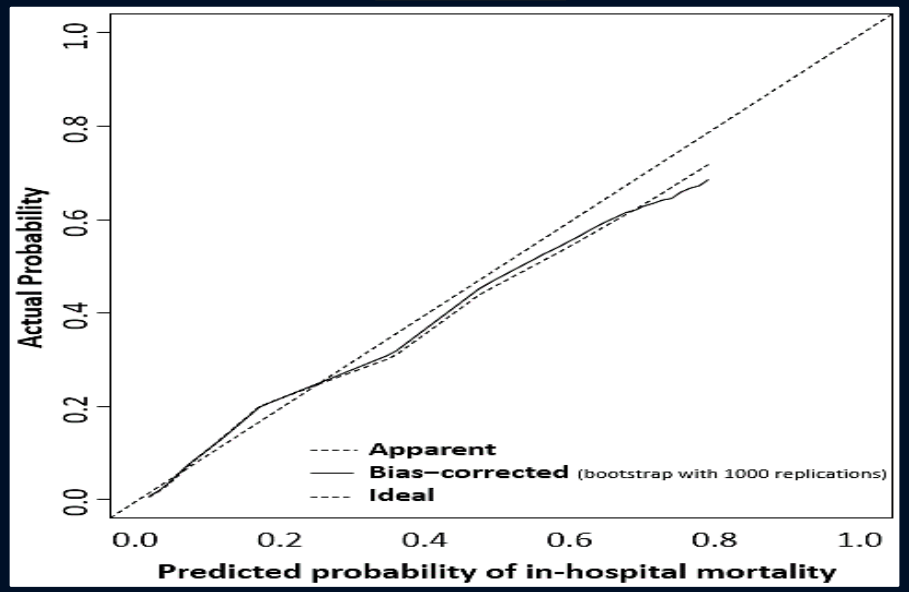
TRI-SCORE

- Clinical
- Biological
- Echocardiographic

Risk factors (final model from multivariate analysis)	Scoring
Age ≥ 70 years	1
NYHA functional class III-IV	1
Right-sided heart failure signs	2
Daily dose of furosemide ≥ 125mg	2
Glomerular filtration rate < 30 ml/min	2
Elevated total bilirubin	2
Left ventricular ejection fraction < 60%	1
Moderate/severe right ventricular dysfunction	1
Total	**12**







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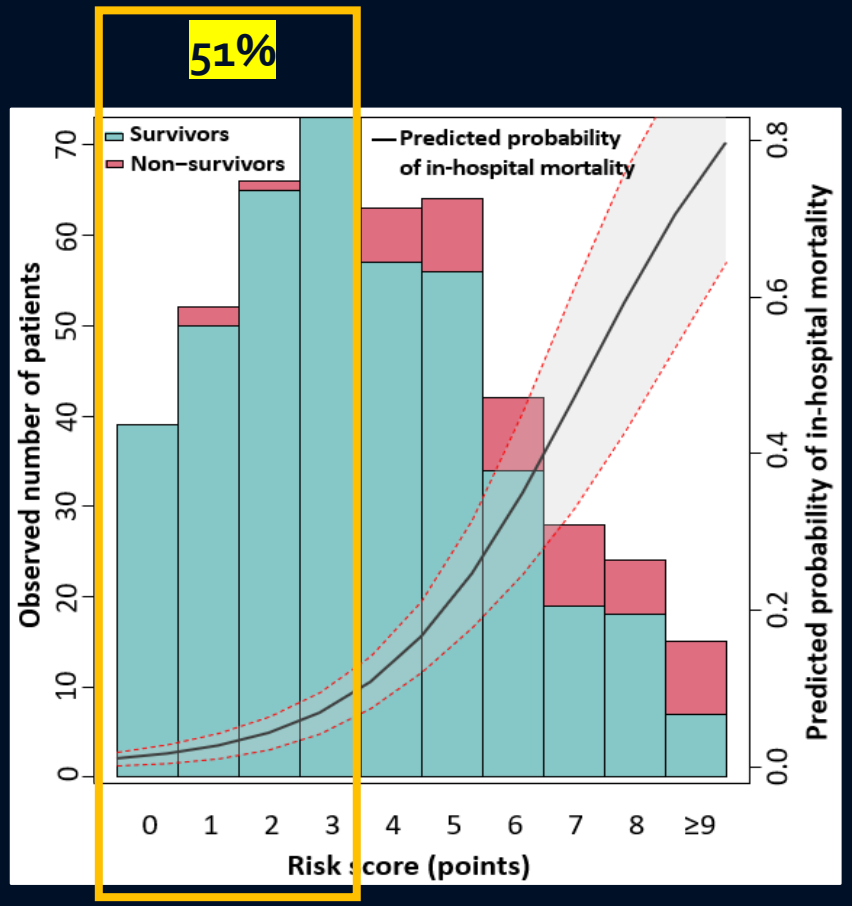
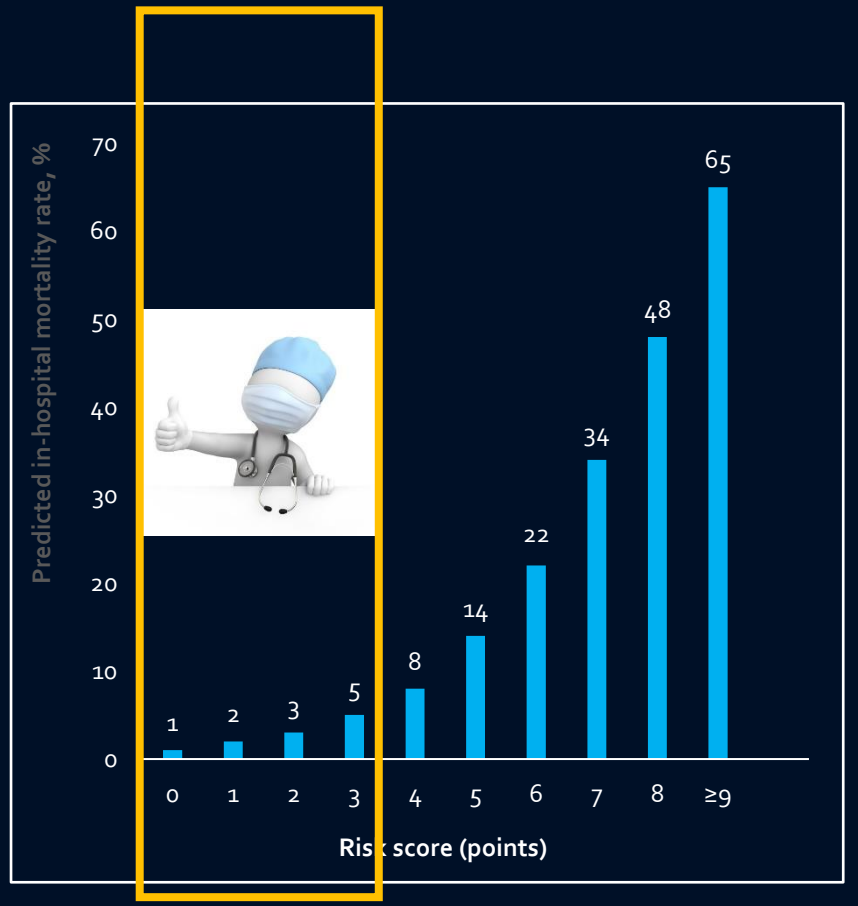
Prediction of in-hospital mortality after ITVS

➢ Patients with low score have an excellent outcome after TV surgery





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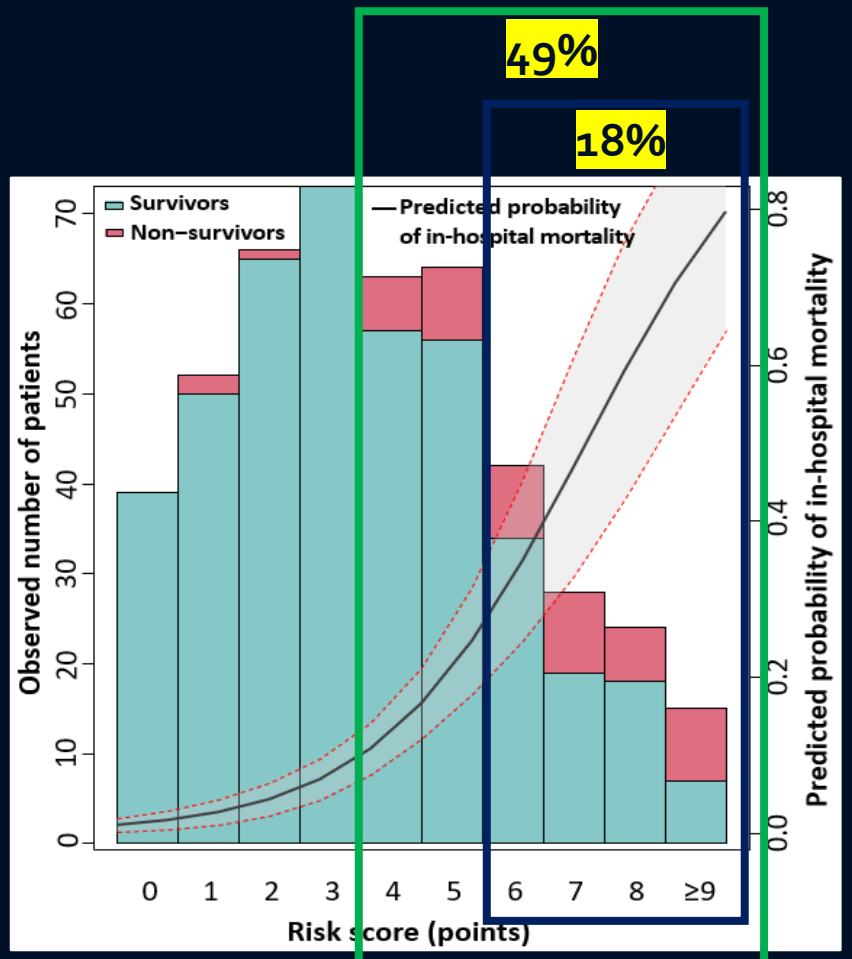
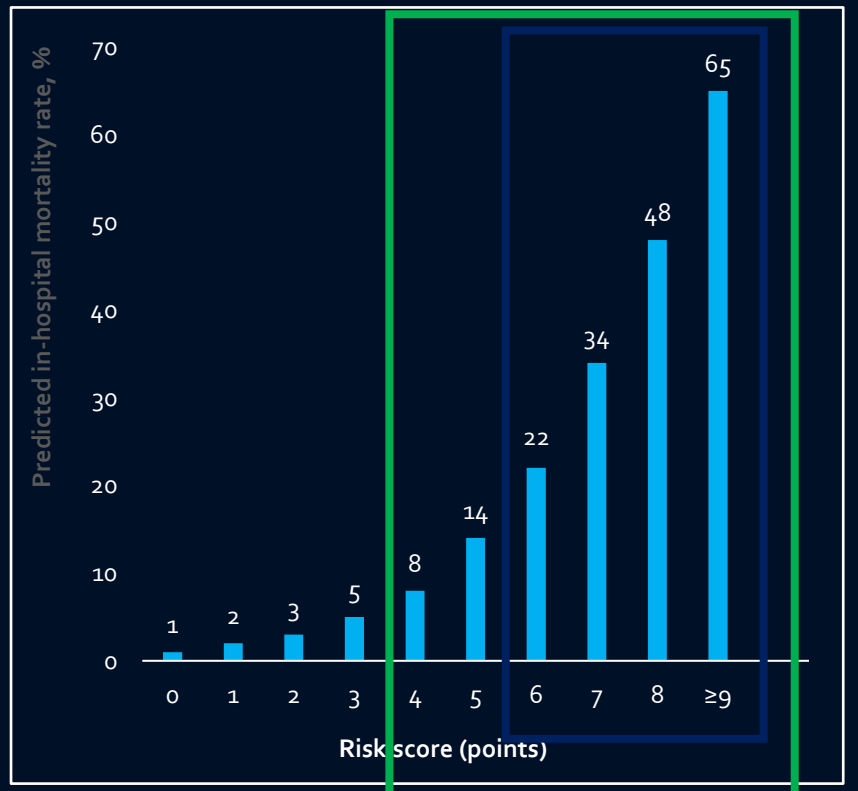
Prediction of in-hospital mortality after ITVS

➢ Patients referred late to TV surgery incur poor outcome





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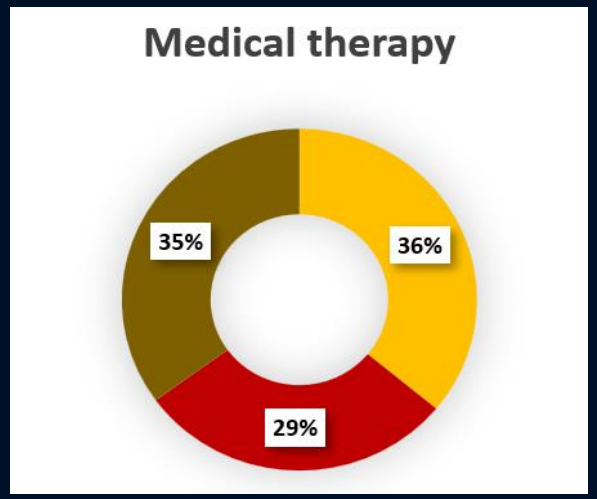
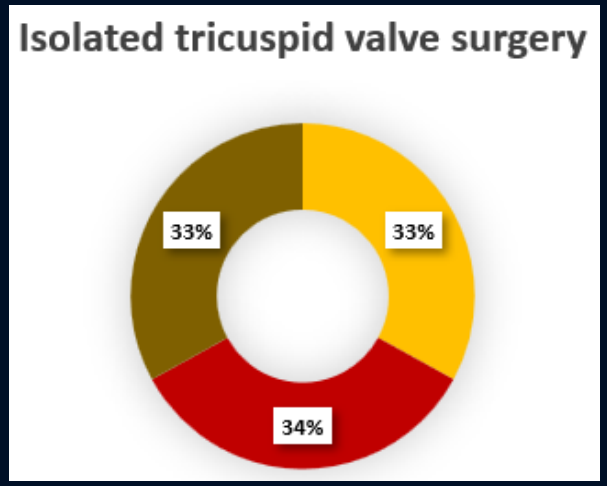
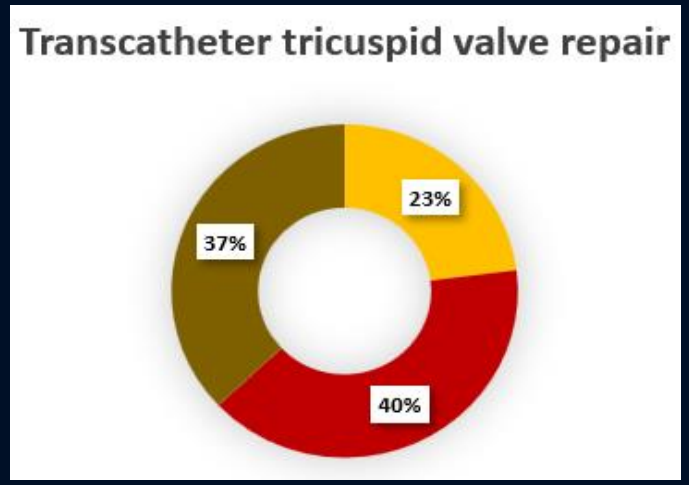
TRIGISTRY: IMPACT OF TRI-SCORE

TRI-SCORE







2,413 patients

- 1217 conservatively managed
- 551 isolated tricuspid valve surgery
- 645 transcatheter valve repair

- Low TRI-SCORE
- Intermediate TRI-SCORE
- High TRI-SCORE

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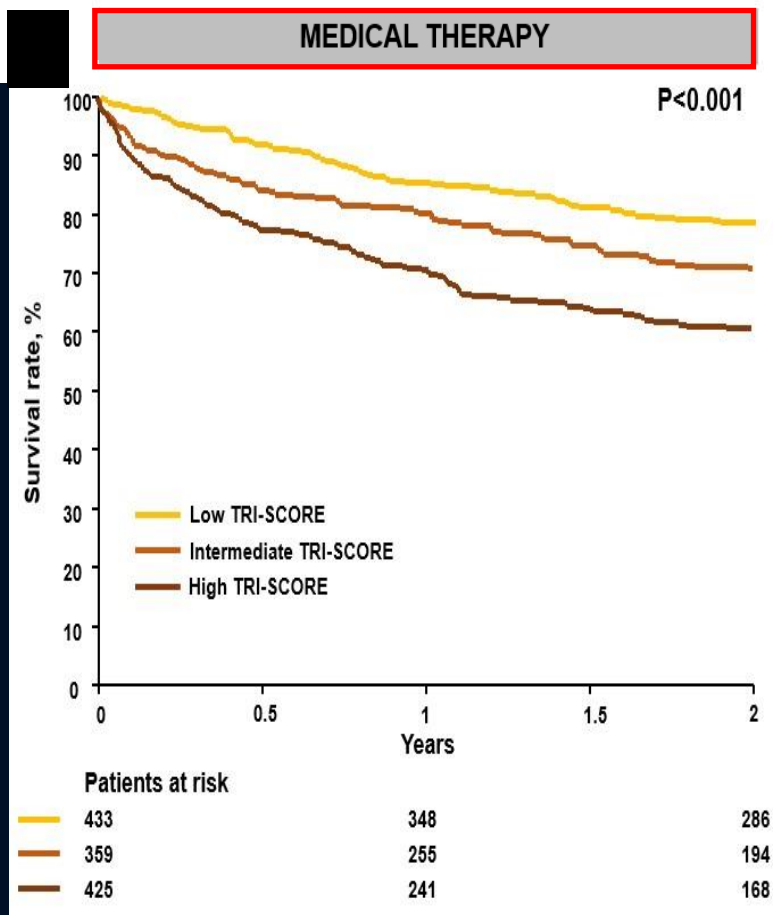
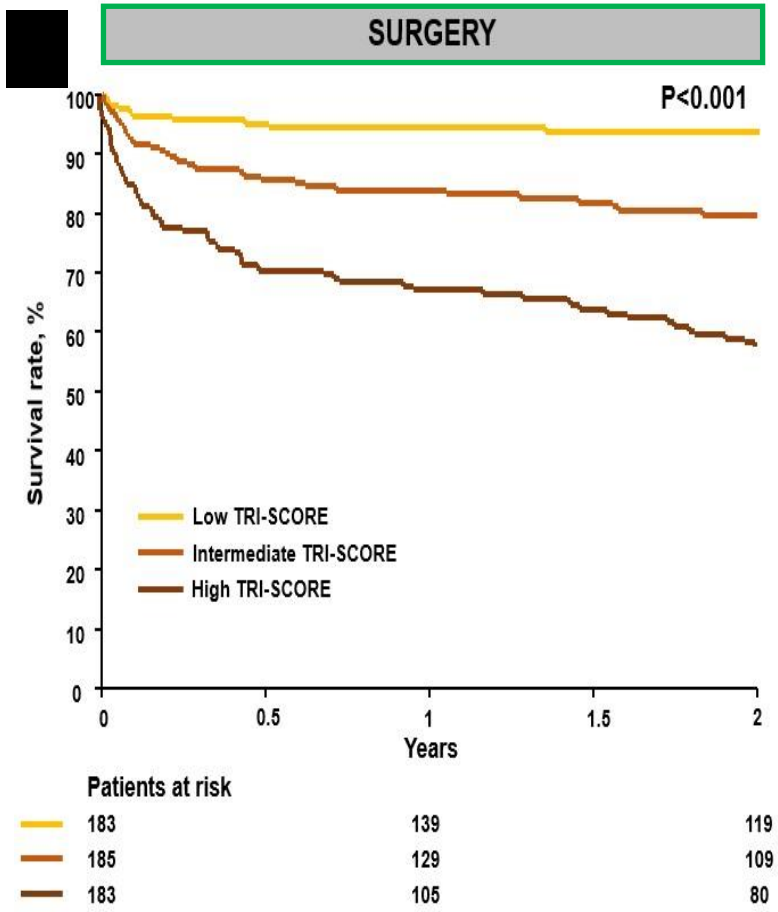
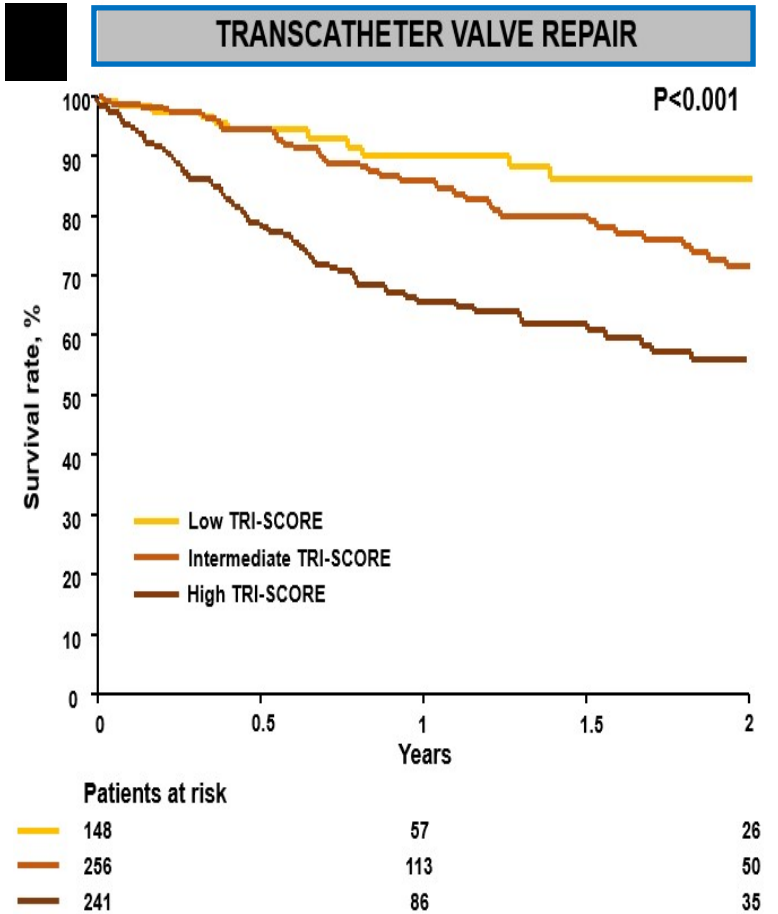
TRIGISTRY: IMPACT OF TRI-SCORE







Results remained unchanged after adjustment for age, sex, atrial fibrillation and comorbidities* (all P<0.001)

*diabetes, chronic lung disease, coronary artery disease, and prior left heart valve intervention

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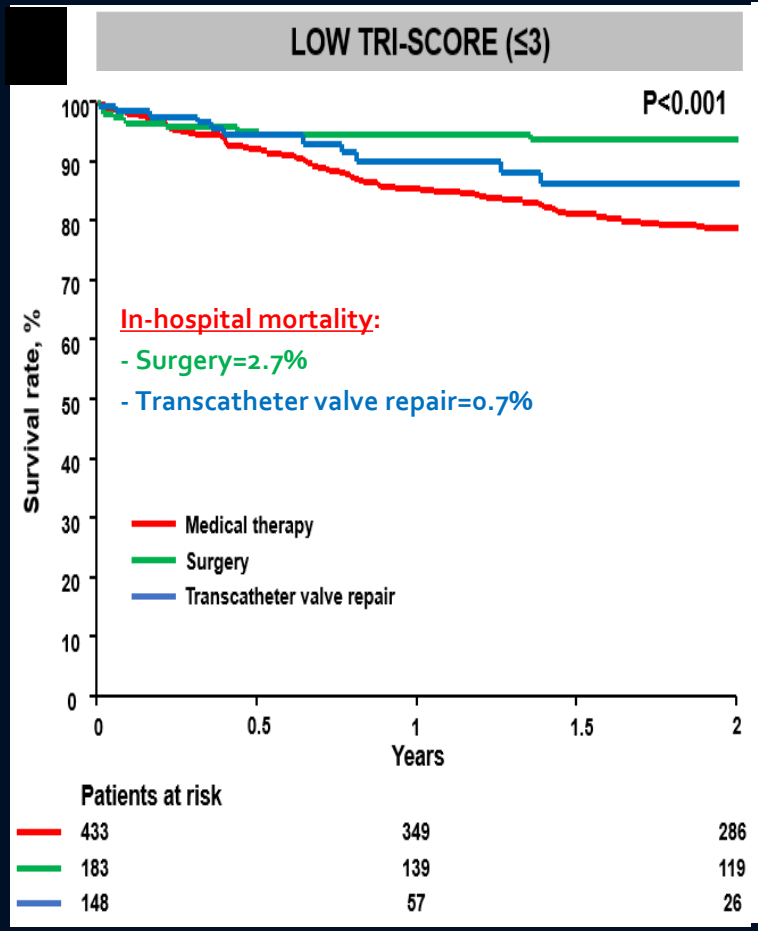
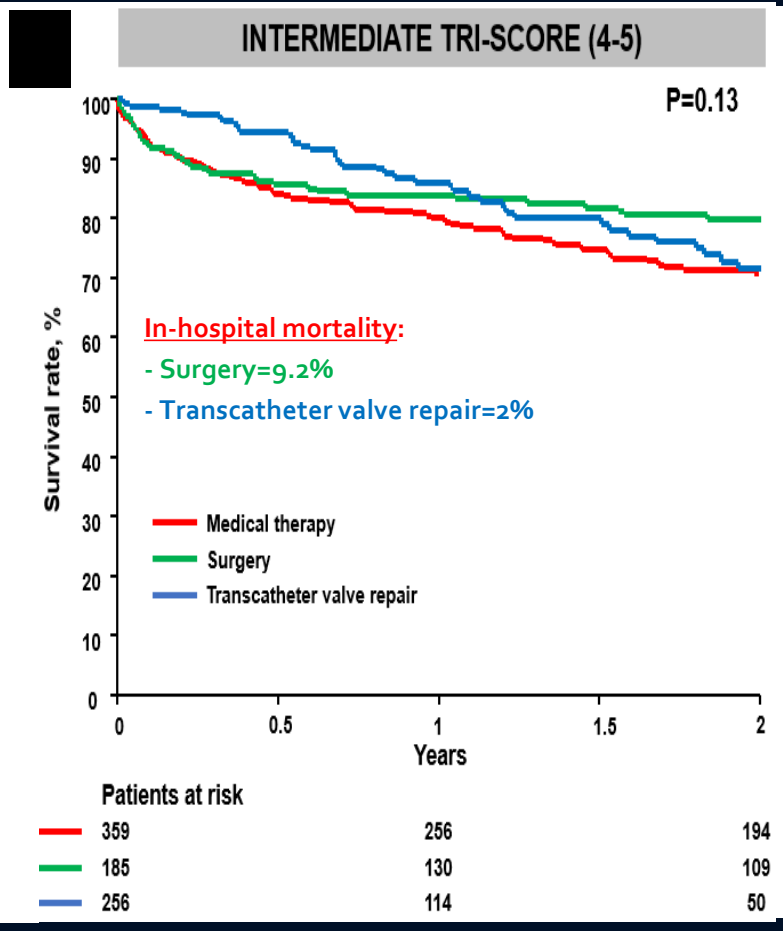
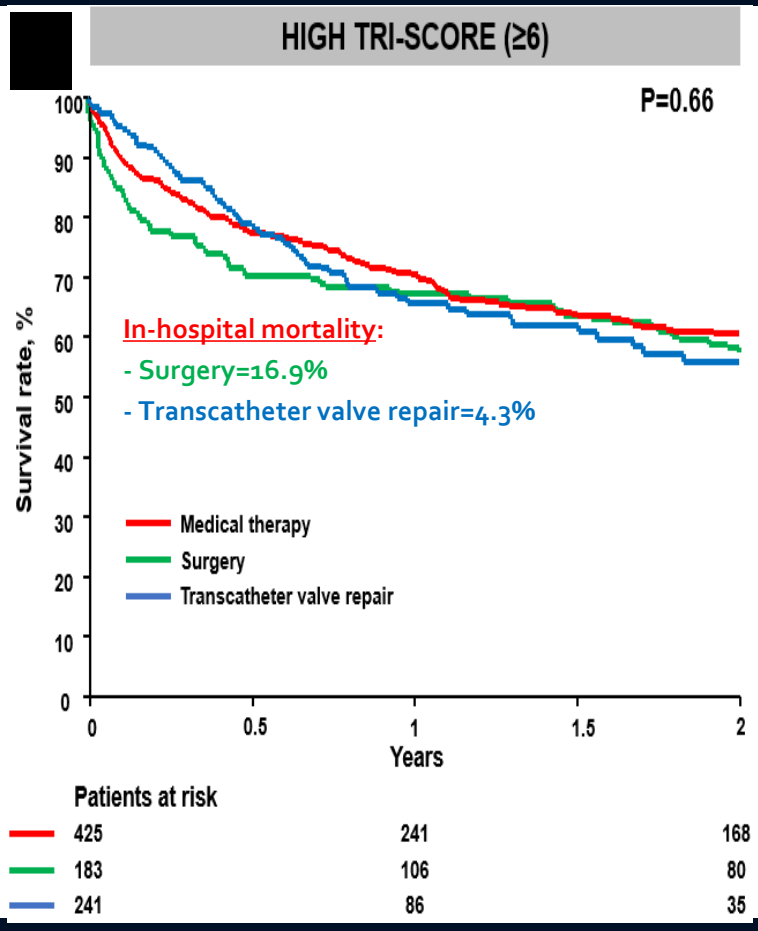
TRIGISTRY: IMPACT OF TREATMENT MODALITY







Results remained unchanged after adjustment for age, sex, atrial fibrillation and comorbidities*

P=0.006 for low TRI-SCORE

P=0.15 for intermediate TRI-SCORE

P=0.48 for high TRI-SCORE

*diabetes, chronic lung disease, coronary artery disease, and prior left heart valve intervention

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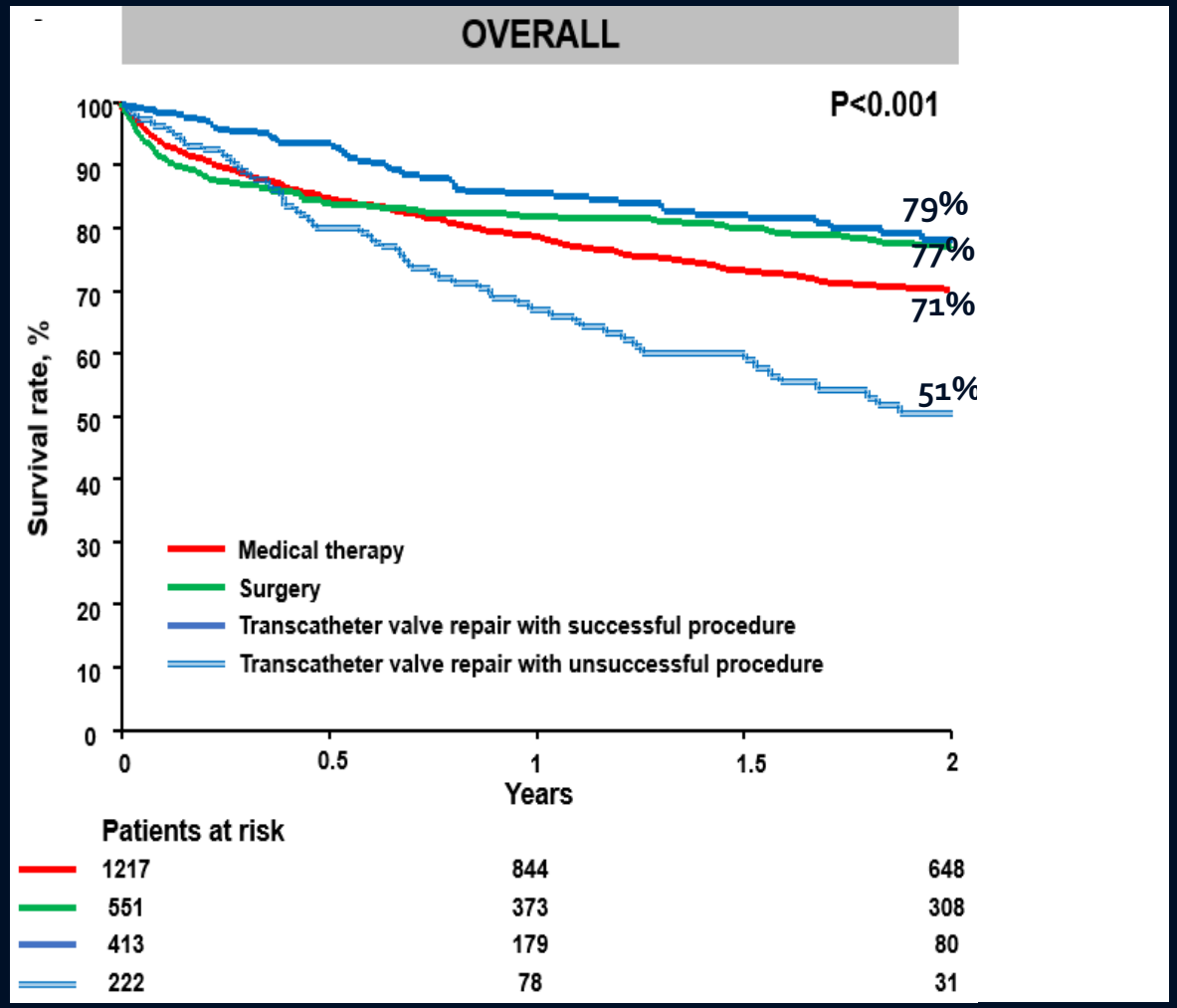
TRIGISTRY: IMPACT OF RESIDUAL TR

<u>Procedural success</u>: TR ≤ mild to moderate (2+) at discharge (after surgery or transcatheter intervention)

- Surgery = 97%

- Transcatheter = 65%



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TRIGISTRY: CONCLUSIONS

1. TRIGISTRY confirms and extends the predictive value of the TRI-SCORE irrespectively of treatment modality at 2 years

2. A tricuspid valve intervention was associated with better survival rates than medical therapy at 2 years in the low and, to a lower extent, intermediate TRI-SCORE categories while survival was similar across groups in the high TRI-SCORE category

3. TRIGISTRY highlighted the prognostic importance of optimal TR correction

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TRIGISTRY: PERSPECTIVES

- Our results suggest that, in patients with severe TR, a curative intervention should be considered at an early stage of the disease as assessed by the TRI-SCORE
- TRIGISTRY should guide the design of future randomized controlled trials aiming to formally demonstrate the benefit of tricuspid valve interventions

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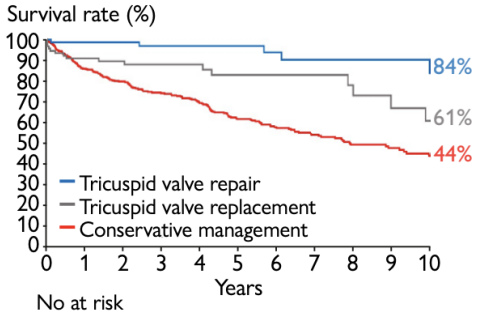
TRIGISTRY: multicenter registry

33 centers | **10** countries | **1768** patients with severe isolated functional tricuspid regurgitation

Comparison of 10-year survival rates between treatment modalities according to the TRI-SCORE category (low, intermediate and high)

- **1217** conservatively managed
- **551** isolated tricuspid valve surgery
  - **200** repair
  - **351** replacement

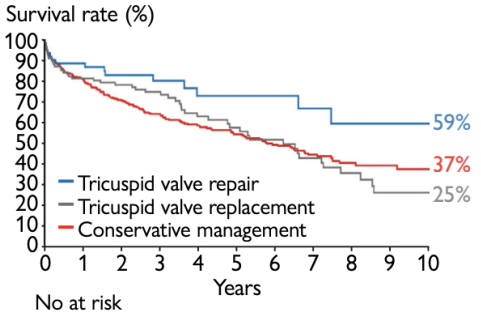
Low TRI-SCORE (≤ 3)



No at risk

83	62	38	27	19	13
100	57	36	24	15	9
408	271	205	139	69	42

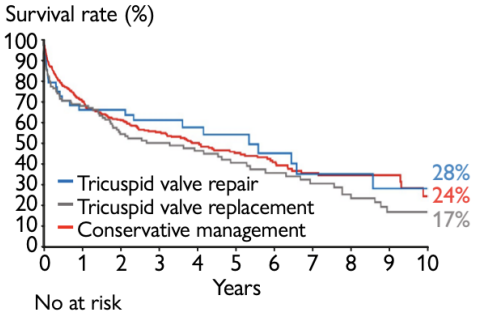
Intermediate TRI-SCORE (4–5)



No at risk

62	38	20	14	8	6
123	71	40	24	12	8
372	203	128	92	31	16

High TRI-SCORE (≥ 6)



No at risk

55	27	17	9	6	4
128	53	35	21	14	6
437	174	90	52	13	5

Propensity weighted hazard ratio

	Low TRI-SCORE (≤ 3)	Intermediate TRI-SCORE (4–5)	High TRI-SCORE (≥ 6)
Repair vs conservative management	0.11 (95% CI, 0.06–0.19), P < 0.0001	0.49 (95% CI, 0.35–0.68), P < 0.0001	0.86 (95% CI, 0.68–1.08), P = 0.20
Replacement vs conservative management	0.65 (95% CI, 0.47–0.90), P = 0.009	1.43 (95% CI, 1.18–1.72), P = 0.0002	1.58 (95% CI, 1.35–1.86), P < 0.0001
Repair vs replacement	0.17 (95% CI, 0.09–0.32), P < 0.0001	0.34 (95% CI, 0.24–0.48), P < 0.0001	0.54 (95% CI, 0.43–0.68), P < 0.0001

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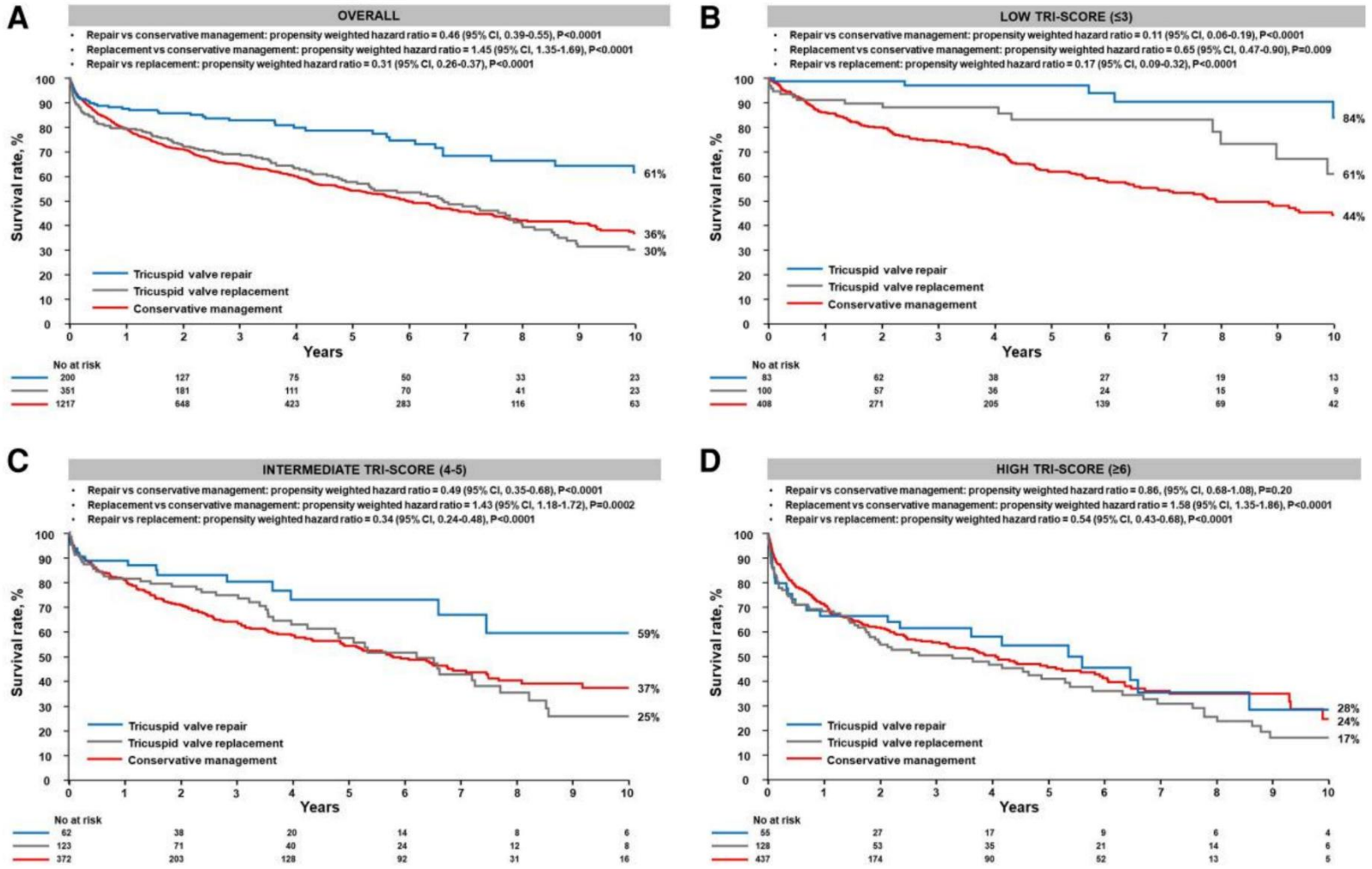


Figure 3 Survival rate according to the type of surgical intervention and TRI-SCORE category. The figure displays Kaplan–Meier survival curves of the conservative management, the surgical tricuspid valve repair, and the surgical tricuspid valve replacement groups at 10 years: (*A*) overall and (*B*) in the low TRI-SCORE (≤3 points), (*C*) intermediate TRI-SCORE (4–5 points), and (*D*) high TRI-SCORE (≥6 points) categories

TR lessons

TR is bad

Annuloplasty works

Don’t hurt RV /AV node

“Severe” TR is too late

Surgery for TR : How late Is too late?

- RV Dysfunction
  - ✓ Dobutamine stress test looking for an increase of 20% in cardiac output
  - ✓ Stroke volume RV outflow tract
  - ✓ If PHT invasive cardiac pressures and output assessment
- Biological Dysfunction
  - ✓ Liver : Bilirubin, INR
  - ✓ Creatinin level and clearance

Right heart catheterisation is essential when facing PHT

Patients die more of biological dysfunction than anything else

What can cardiologists learn from surgeons?

- Annular dilation without tethering is at best addressed by annuloplasty ring (or device) with excellent long-term results : less than 5% moderate or more TR at 10 years
- Tethering requires either a true repair or a valve replacement
- Isolated TR is not a contraindication given the absence of permanent RV failure and biological dysfunction
- Sick patients should require:
  - ✓ Right heart catheterization
  - ✓ Enhanced diuresis prior to intervention (decreased preload)
  - ✓ Study RV contractile reserve : Dobutamine test

TR Incidence Post MV Repair

- Data regarding the exact rate of isolated TR requiring TEER after untreated mitral valve repair is still being explored
- **Post-Mitral Valve Repair TR**: **Up to 25-35%** of patients can develop significant TR following mitral valve repair if it wasn't addressed at the time of surgery.
- **TEER Use**: The rate of TEER for untreated TR post-mitral valve repair isn't universally agreed upon but estimates suggest that **up to 5-10%** of patients may eventually undergo TEER due to worsening regurgitation over time.

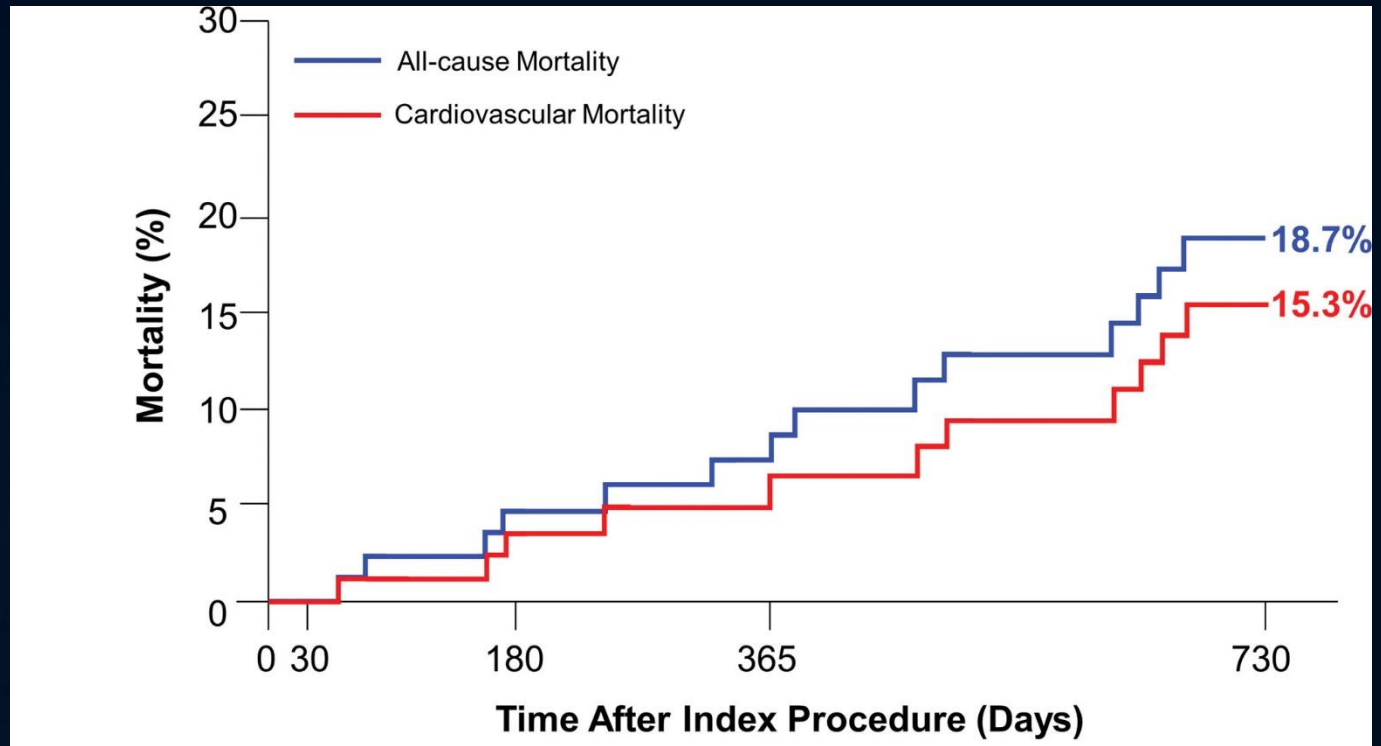
Mortality rate of untreated tricuspid regurgitation (TR)

- **Secondary Tricuspid Regurgitation (TR)**
  - ✓ **Severe TR**: Studies have shown that untreated severe secondary TR is associated with an **increased risk of mortality**, particularly when it is associated with heart failure or pulmonary hypertension.
    Mortality rates can range from **20-50% over 5 years** depending on the severity of symptoms and the presence of right heart failure.
  - ✓ **Heart Failure Patients**: In patients with heart failure and secondary TR, the mortality rate can approach **30-40% at 5 years** when TR is left untreated, largely due to worsening right ventricular failure and progression of systemic congestion.

Mortality rate of untreated tricuspid regurgitation (TR)

- **Isolated Tricuspid Regurgitation (TR)**
  - ✓ Isolated TR is less common but still associated with a progressive decline in right ventricular function and worsening heart failure if untreated. **Severe isolated TR, without intervention, can lead to a 20-30% 5-year mortality in symptomatic patients.**
  - ✓ **Milder forms of TR**: In cases of mild or moderate TR, the mortality rate is lower, but progression to more severe disease can occur, leading to worse long-term outcomes.

Kaplan-Meier analysis of all-cause and cardiovascular mortality through 2 y



Follow-up Day	0	30	180	365	730
# At Risk	85	85	78	70	46
All-cause Event Rate (%)	0.0	0.0	4.8	7.3	18.7
Cardiovascular Event Rate (%)	0.0	0.0	3.6	4.9	15.3

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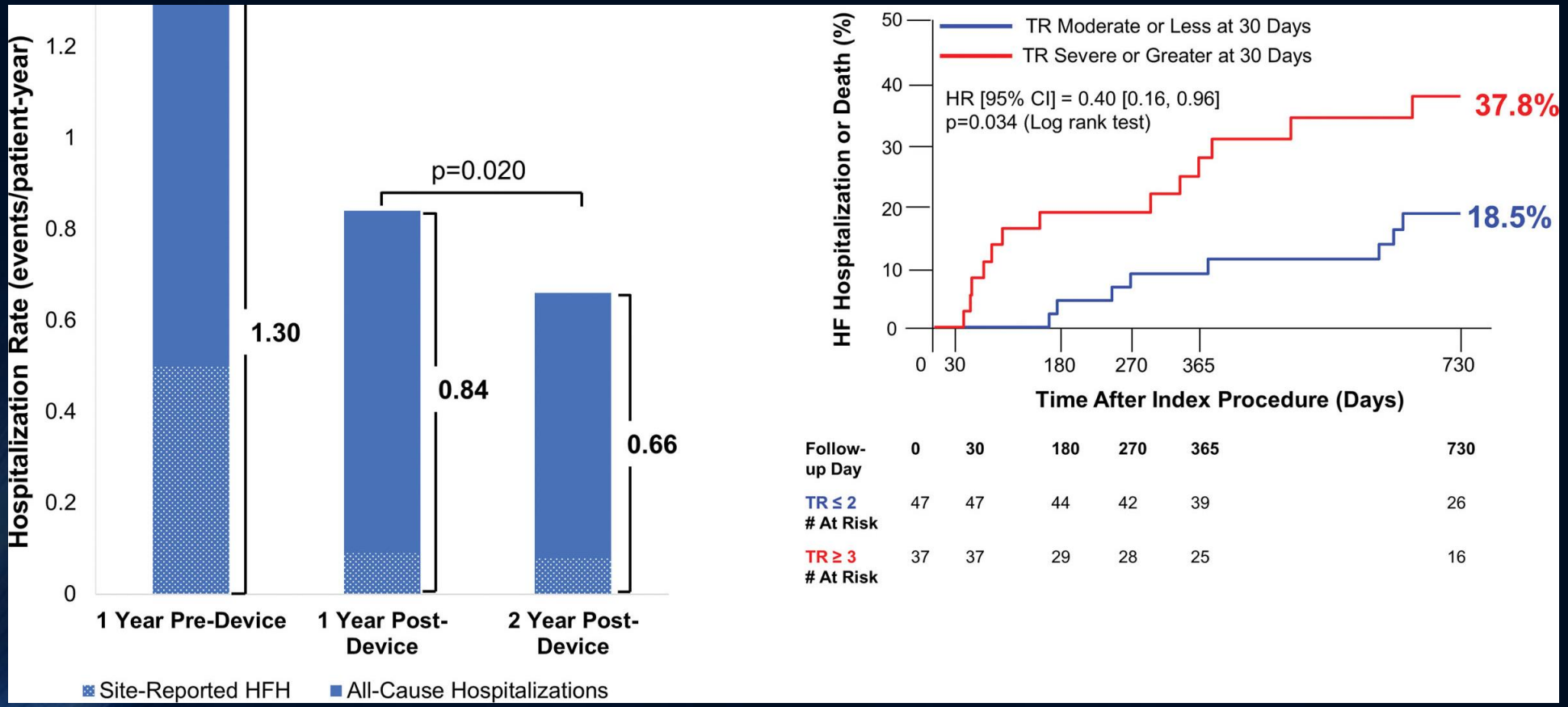
Hospitalization rate and site-reported heart failure (HF) following the TriClip procedure



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Early surgery or TEER is the key to success

TR 2024: Surgical management

TR not important…	NO
Look for TR in OR…	NO
Not much TR around….	NO
Repair Mitral, TR goes away …	NO
Adds operative mortality to do a TVr…	NO
Don't know how to, I'll hit the node…	NO
RV will fail…	NO
Will get TS…	NO
Won't make long-term difference…	NO
Guidelines are vague…	NO

TR : don't ignore it…

Conclusions

- Isolated TR remains a therapeutical challenge
- Surgery carries a higher in-hospital mortality but provides better mid-term results
- Risk factors have to be well analysed
- Age, renal function, liver function and coagulation profile are essential to decide if surgery is better or not than TEER

Thank You!