



PLACE 2026
Roma, 25-27 Giugno 2026

CARDIOLOGIA NOVARA

Trattamento percutaneo dell'insufficienza tricuspidalica

Prof. Giuseppe Patti

**Direttore Cattedra e Scuola di Specializzazione in Malattie dell'Apparato Cardiovascolare,
Università del Piemonte Orientale**

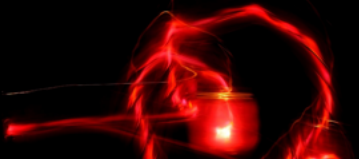
**Direttore Dipartimento Toraco-Cardio-Vascolare, AOU Maggiore della Carità di Novara
Presidente Eletto della Società Italiana di Cardiologia**



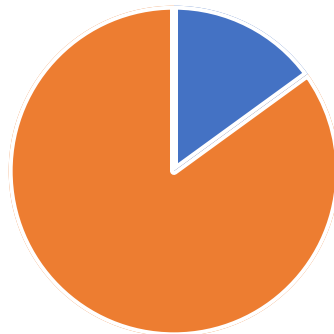
Tricuspid regurgitation - Agenda

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- ❖ **Causes**
- ❖ Pathogenetic course
- ❖ Prognosis
- ❖ Treatment – Surgery
- ❖ Treatment – Percutaneous repair
- ❖ Treatment – Percutaneous valve



Regurgitation



● Primary ● Secondary

PRIMARY 15%

- Organic (30%)
 - Rheumatic
 - Myxomatous
 - Ebstein anomaly
 - Endomyocardial fibrosis
 - Endocarditis
 - Carcinoid disease
 - Traumatic (blunt injury, laceration)
- Prolapse (20%)
- Iatrogenic (PMK/ICD) (50%)

SECONDARY 85%

- Left valve disease (LVD, 52%)
 - Aortic
 - Mitral
- Left heart disease (LHD, 13%)
 - HFrEF
 - HFpEF
- PH (25%)
 - WHO group 2
- Atriogenic (10%)
 - AF

Classification of TR etiology



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	Secondary		CIED (A)	Primary	
	2D TTE	3D TTE	2D TTE	3D TTE	
Parameter	Ventricular	Atrial	CIED Type A	Primary TR	
Carpentier Class	IIIb	I	I, IIIa, IIIb	Prolapse II	RHD IIIa
TV Tethering	++++	+/-	++	-	-
Leaflet Restriction	Systole	-	Systole/Diastole	-	Diastole
RA/TA Dilatation	++	++++	+/-	++	+++
RV Dilatation	+++	+/-	+/-	+/-	+/-
RV Dysfunction	+++	+/-	+/-	+/-	+/-
Annular remodeling	+	+++	+/-	+	
Tenting	+++	+/-			
RV remodeling	+++	+	+	++	
	mid-cavity + RV elongation	basal	based on TR severity	++ global	

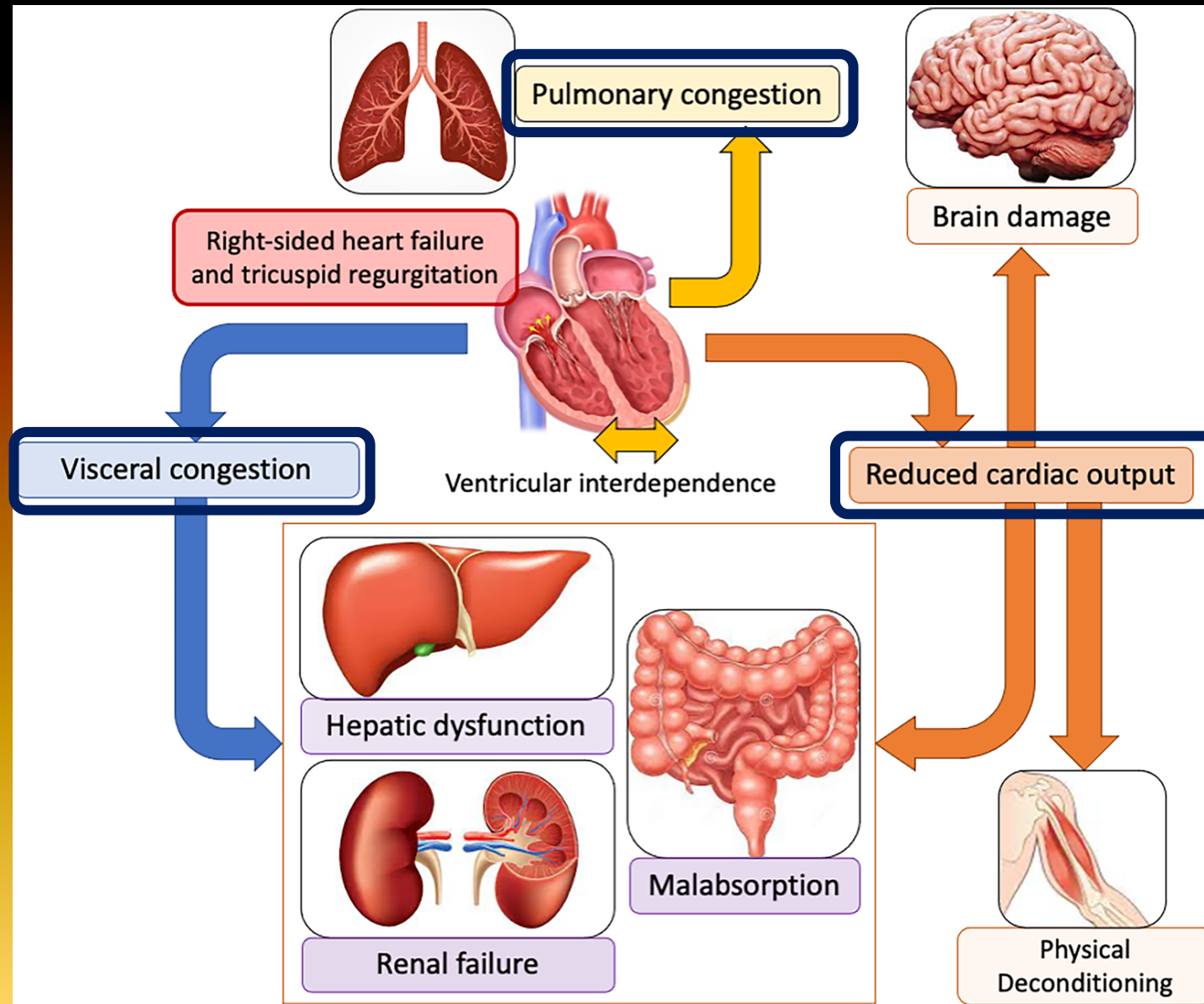


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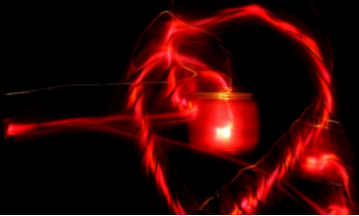
Tricuspid regurgitation is a multiorgan disease





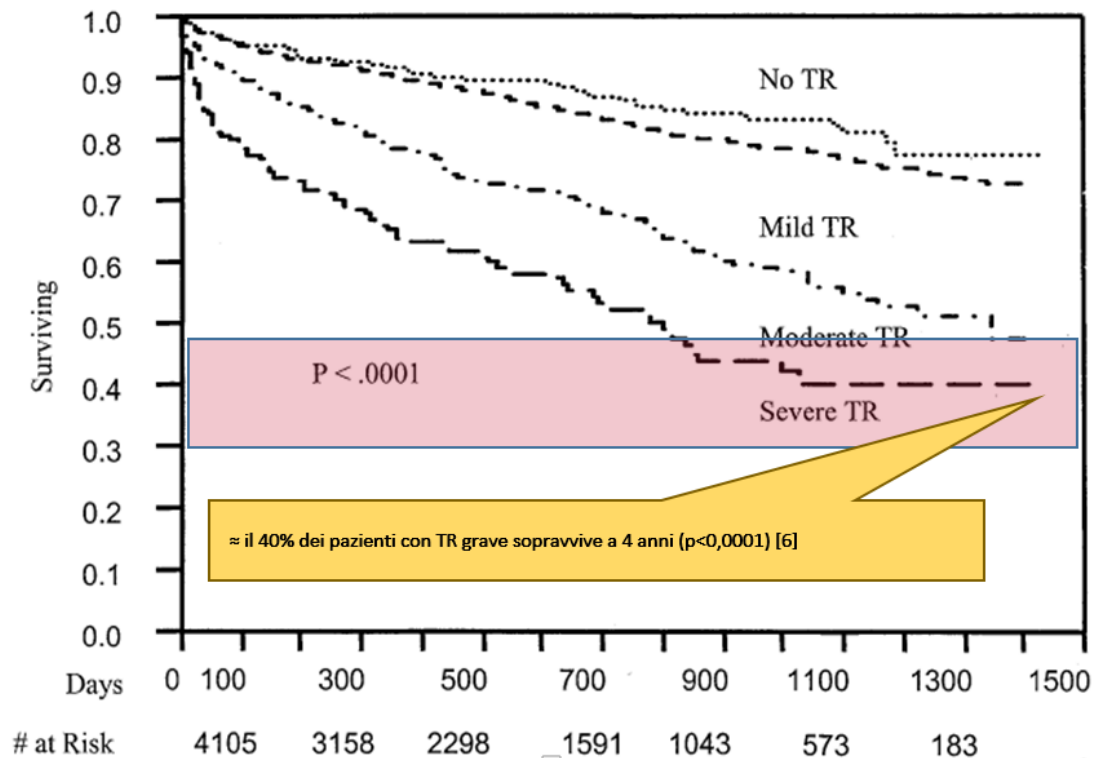
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Tricuspid regurgitation

Prognosis at 4 years: 60% mortality if severe TR



Moderate / severe TR (3-level grading) vs. no/mild TR patients showed

- ↑ 1.95-fold risk increase of all-cause mortality
- ↑ 2.56-fold risk increase of cardiac mortality
- ↑ 1.73-fold risk increase of HF-hospitalization



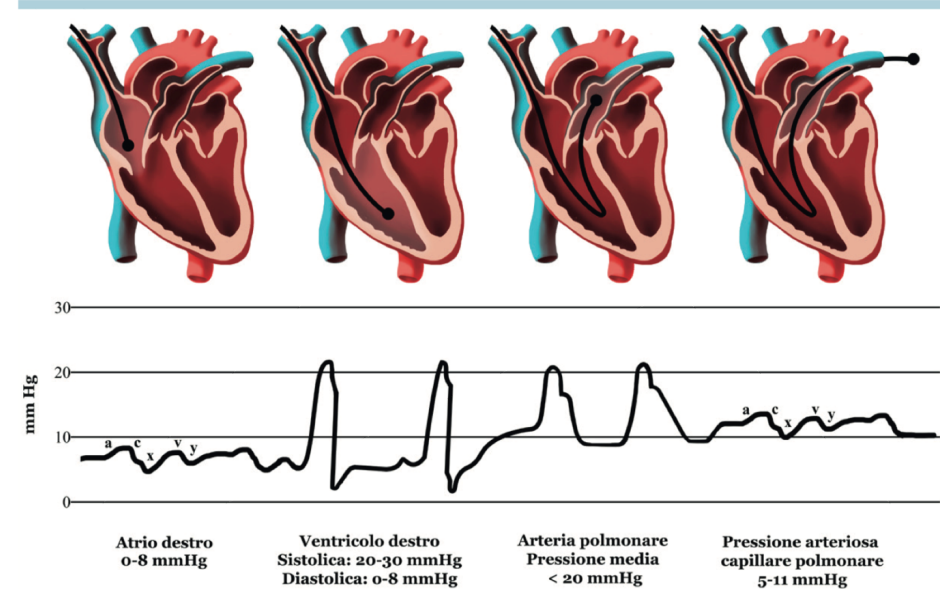
Cardiac catheterization

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PH associated with LHD

	Class	2022 Guidelines	Class
		RHC is recommended in patients with severe tricuspid regurgitation with or without LHD prior to surgical or interventional valve repair	I

- ❖ Assessment of pulmonary pressures and resistance
- ❖ Assessment of left cardiac pressures
- ❖ Assessment of hemodynamic status in the case of mixed valve disease (MR + TR)





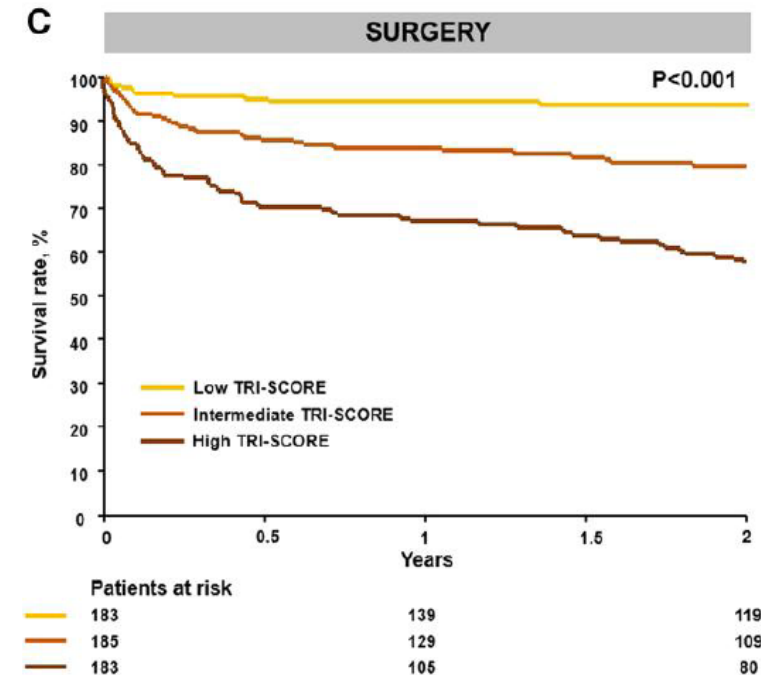
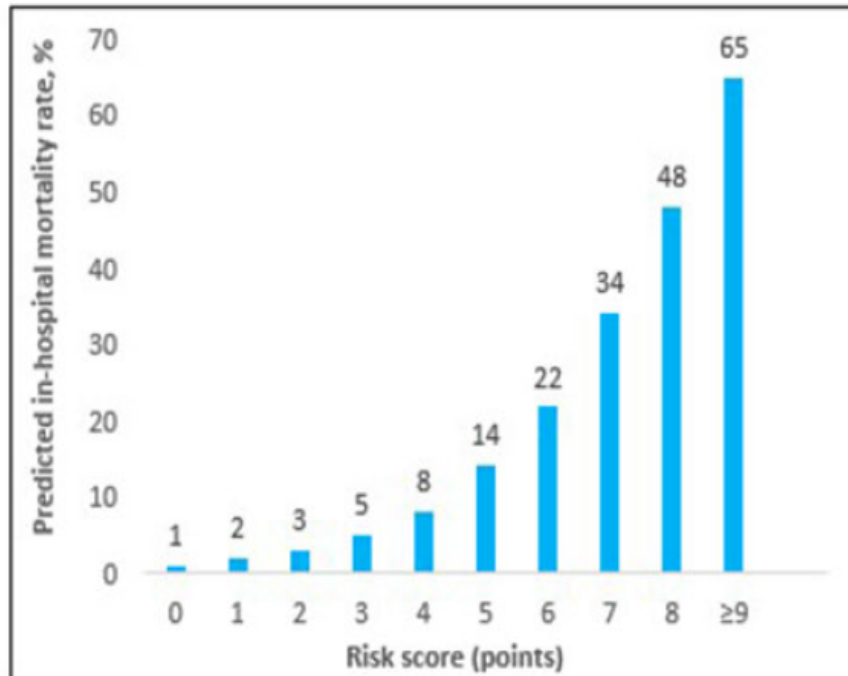
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TRISCORE and outcomes after tricuspid surgery

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 ≥ 125 mg	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

Dreyfus et al. Eur Heart J 2024





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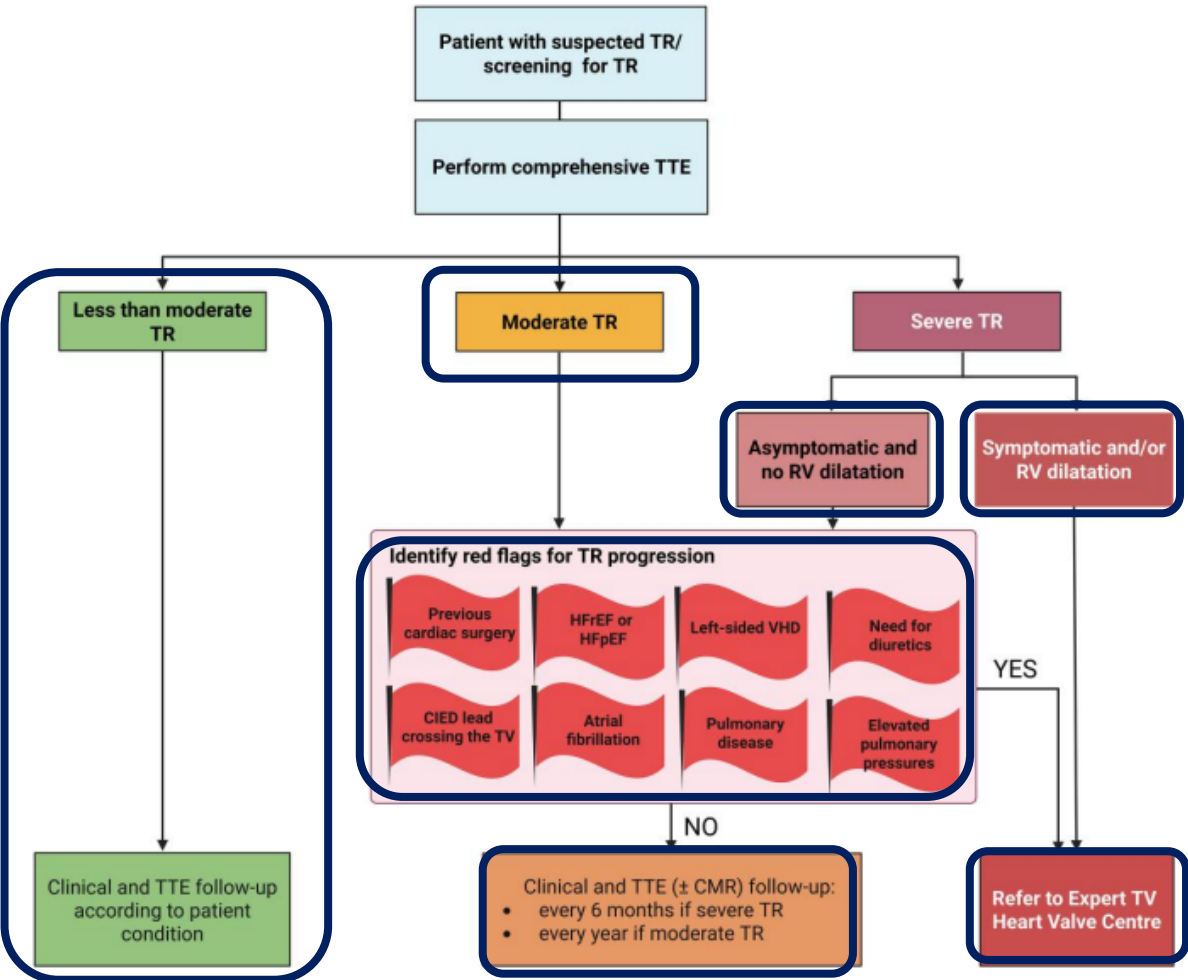
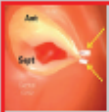
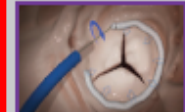
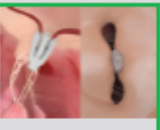
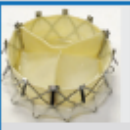
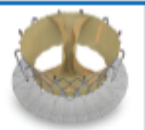
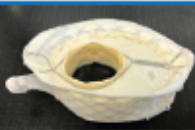


Figure 1 Follow-up of patients with tricuspid regurgitation as main valve lesion according to clinical and imaging assessment. Clinical and echocardiographic follow-up should be tailored according to symptomatic status, TR severity, RV dilatation, and the presence of markers for disease progression—all of which are directed at timely referral to a heart valve centre. CIED, cardiac implantable electronic device; CMR, cardiac magnetic resonance; HFpEF, heart failure preserved ejection fraction; HFrEF, heart failure reduced ejection fraction; RV, right ventricle; TTE, transthoracic echocardiography; TR, tricuspid regurgitation; TV, tricuspid valve; VHD, valvular heart disease

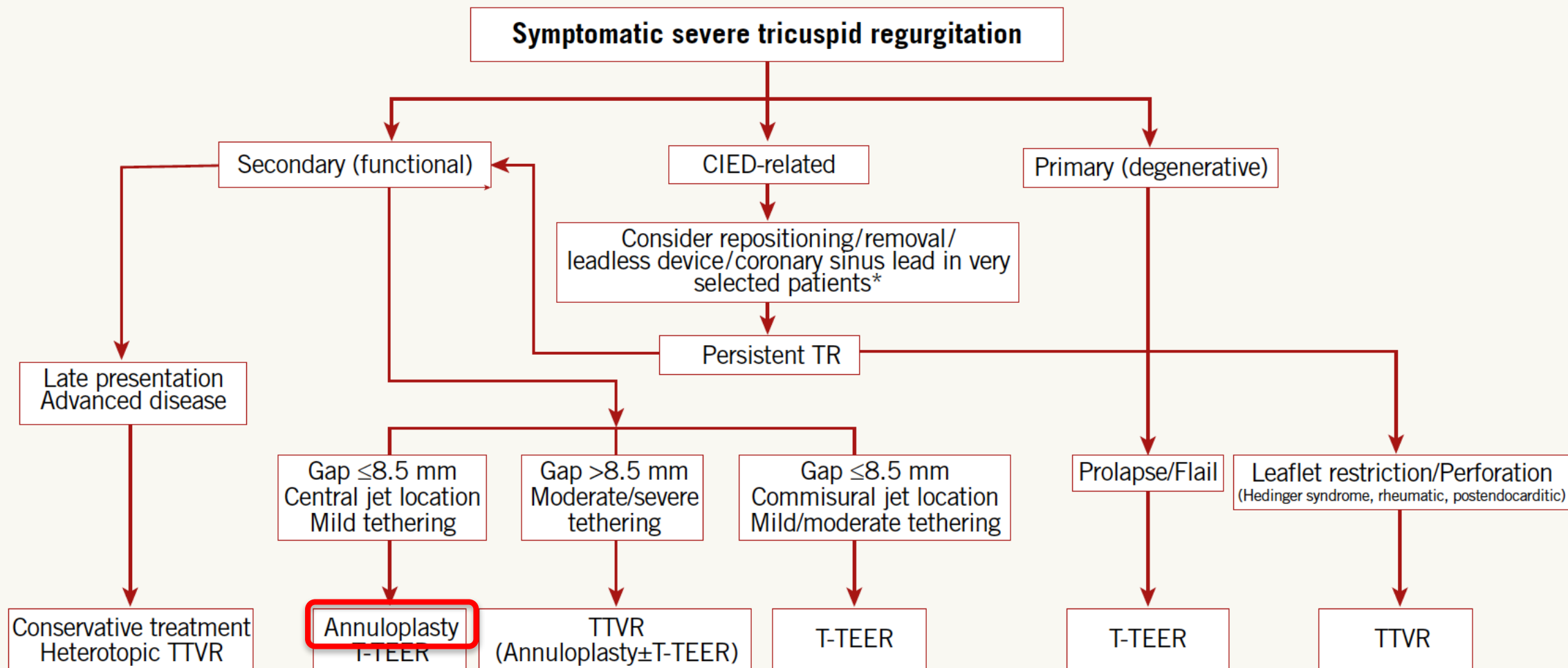


FIGURE 4 Transcatheter Tricuspid Valve Investigational Device

Anchor/ Mechanism	Historical and New Technologies							
Annuloplasty (Direct and Indirect) Device	 TriAlign	 4Tech	 Millepede	 Pasta	 Cardiac Implants	 MIA PolyCor	 Cardioband ☆	
Leaflet Device/ Spacers	 Mistral	 TriClip ☆	 PASCAL ☆	 FORMA	 CroiValve	 TV Occluder	 Coramaze	
Heterotopic Valve (in IVC/SVC)	 TriCentro	 SAPIEN in IVC	 TricValve ☆					
Orthotopic Valve Replacement	 Navigate	 Trisol	 V-dyne	 Tri-Cares	 LUX	 Intrepid	 EVOQUE	

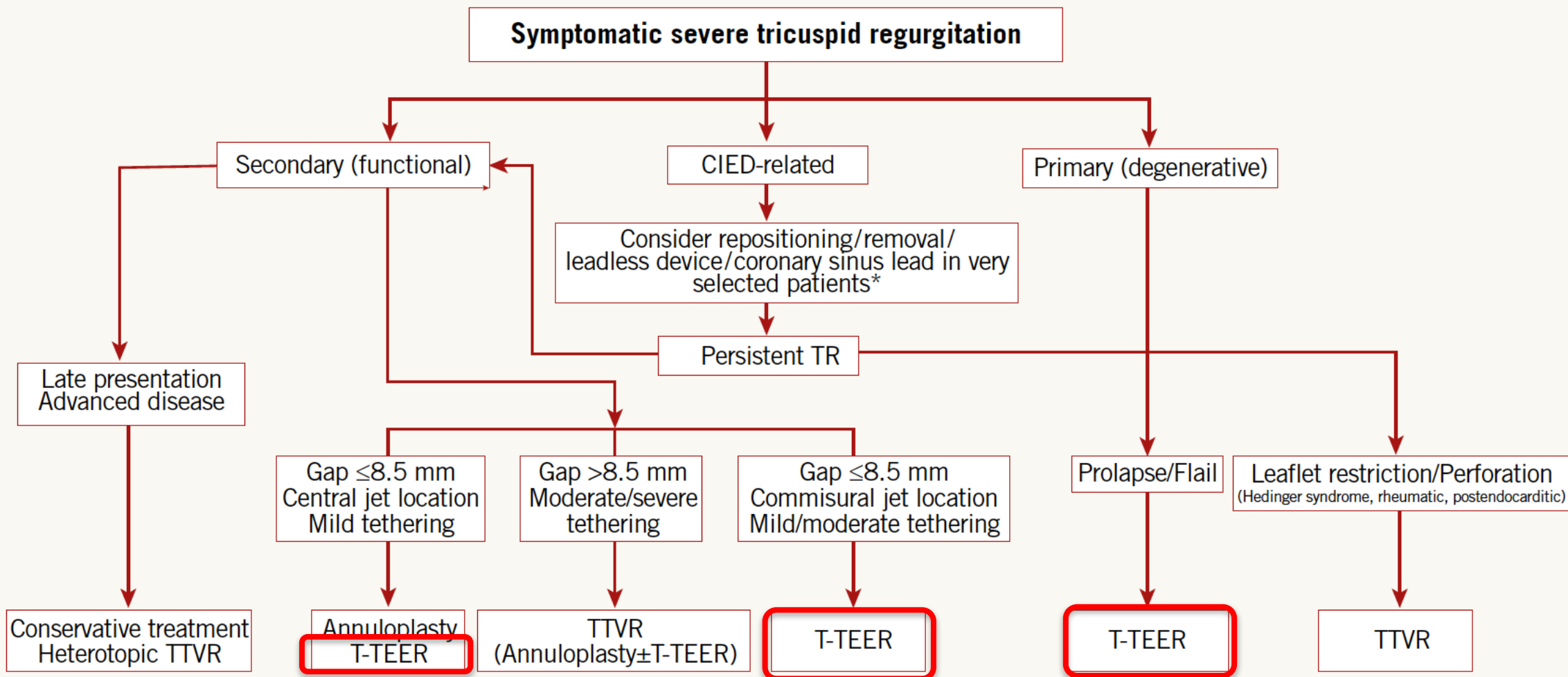
 = Not Available for Clinical Use = Randomized Controlled Trial
 = Early Human Use ☆ = CE Mark Approval in Europe
 = Early Feasibility Trial

Selection of transcatheter devices for TR



*cases without true impingement/leaflet attachment require a valve-directed therapy and most cases will not resolve by lead removal only

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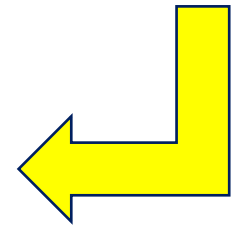
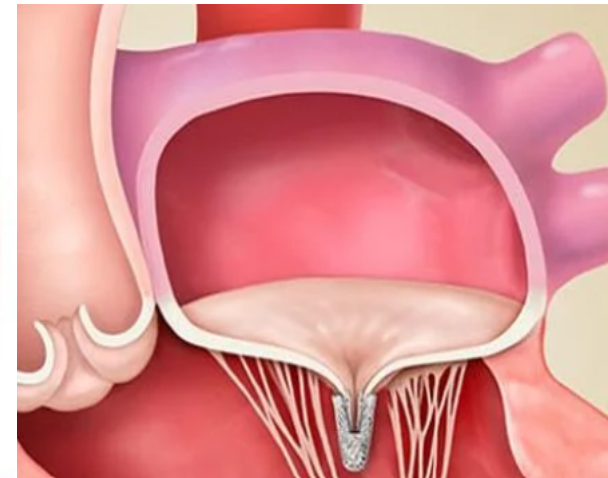
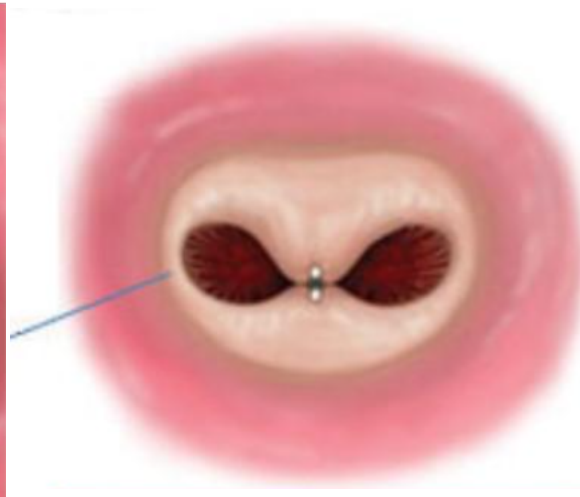
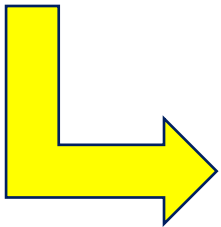
Edge-to-edge tricuspid valve repair



MitraClip™ 4th generation

(Abbott Vascular; Abbott Park, IL)

- Available in 4 sizes
- Wider arms
- Controlled grasping
- Continuous left atrial pressure monitoring

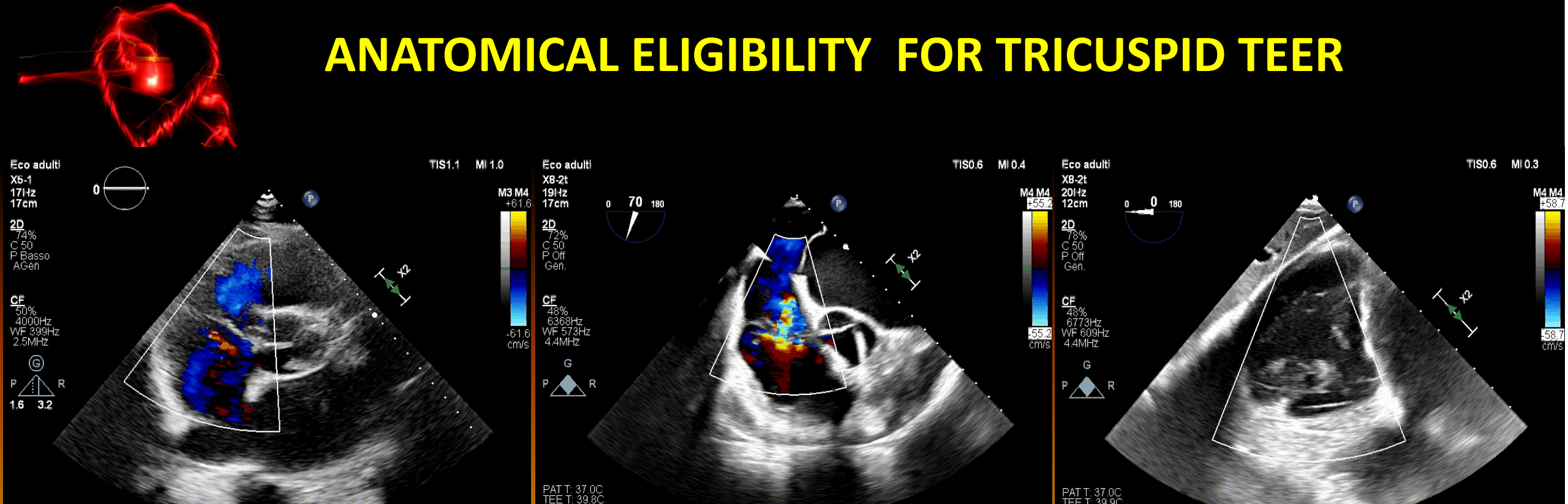


PASCAL™

(Edwards Lifesciences; Irvine, CA)

- Larger paddles
- Central spacer
- Independent grasping
- PASCAL Ace

ANATOMICAL ELIGIBILITY FOR TRICUSPID TEER



✓ GOOD ECHO VIEW *

- ✓ Lefleats ≥ 7 mm
- ✓ Minimal flail
- ✓ No tethering
- ✓ Septolateral gap < 6 mm *
- ✓ No Ca++
- ✓ No valve stenosis
- ✓ No sever anular dilation (> 40 mm)
- ✓ No leaflet indentation
- ✓ No leaflet thickening
- ✓ Central/Anteroseptal TR *
- ✓ No accessory leaflets
- ✓ No leaflet perforation
- ✓ No high chordal density *
- ✓ En-Face jet oval/linear *

* GLIDES score: the lowest is the number of unfavorable factors, the highest the procedural success: for score 0-1: 90% of TR reduction ≥ 2 grades, 97% of TR grade moderate or less (vs 12% and 12% if score ≥ 4 , respectively)



Meta-analysis of 14 observational studies and 1 randomized trial of transcatheter edge-to-edge repair of isolated moderate-to-severe tricuspid regurgitation

- ☐ **Procedural success 97%**
- ☐ **Peri-procedural serious complications: 1%**

- ☐ **Reduction TR volume**
- ☐ **Reduction TR grading**
- ☐ **Reduction tricuspid annular diameter**
- ☐ **Reduction PISA radius**

- ☐ **Increase NYHA class at 30 days**
- ☐ **Increase 6MWD at 1 year**

Results of CRTs on transcatheter treatment of TR

TRIAL	TR reduction and RV size	ALL-CAUSE DEATH	HF HOSPITALIZATION	QUALITY OF LIFE
TRILUMINATE pivotal (TriClip vs Medical Rx)		At 1 year, 2.3% TEER vs 3.6% controls (P=NS)	At 1 year, 12.8% TEER vs 17.2% controls (P=NS)	At 1 year, +18.2 pts TEER vs +7 pts controls (P<0.001)
	At 1 to 3 years maintained TR reduction, RV diameters and TA diameters	At 2 years, 17.9% TEER vs 17.1% controls (P=NS)	At 2 years, 23% TEER vs 26% controls (P=0.02)	At 2 years, +15.4 pts TEER vs +10.3 pts controls (P<0.001)
TRISCEND II pivotal (Evoque vs Medical Rx)	Maintained TR reduction, RV diameters and TA diameters	At 1 year, 14.8% Evoque vs 12.5% controls (P=NS)	At 1 year, 9.7% Evoque vs 10% controls (P=NS)	At 1 year, 72.4 (69.8-75.1) Evoque vs 54.7 (50.8-58.6) controls (P<0.001)
Tri.FR (TriClip vs Medical Rx)	Maintained TR reduction, RV diameters and TA diameters	At 1 year, 5.4% TEER vs 4.1% controls (P=NS)	At 1 year, 22% TEER vs 23% controls (P=NS)	At 1 year, +9 pts TEER vs +1 pt controls (P<0.02)

Results confirmed in real-world studies (CLASP with PASCAL, bRIGHT with Triclip)



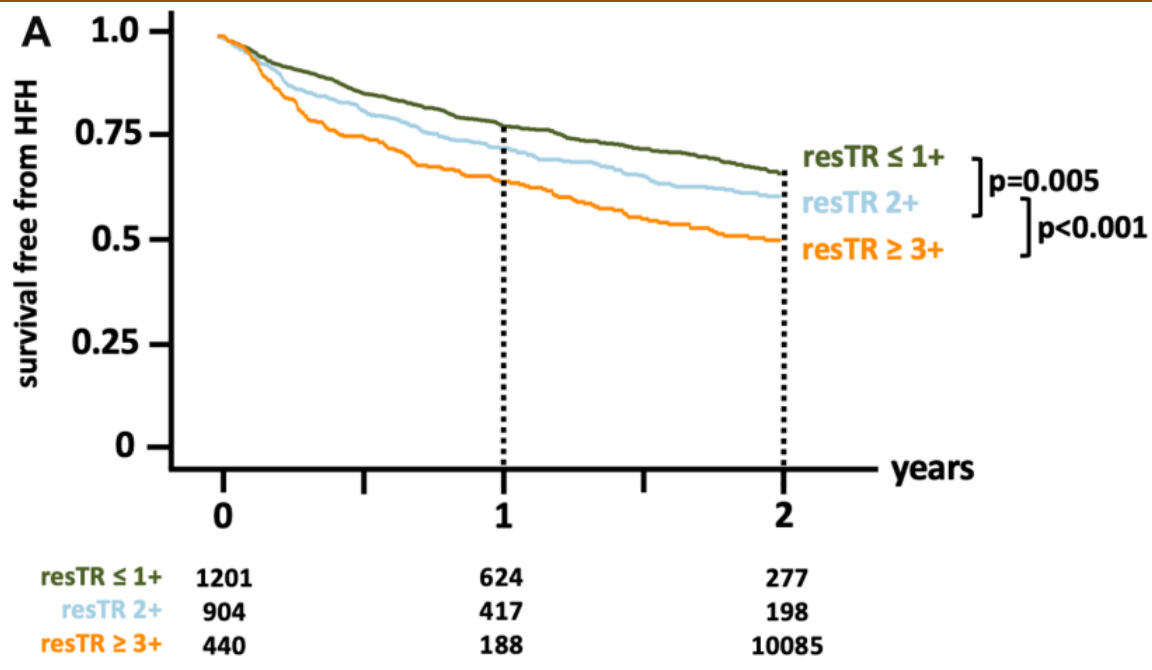
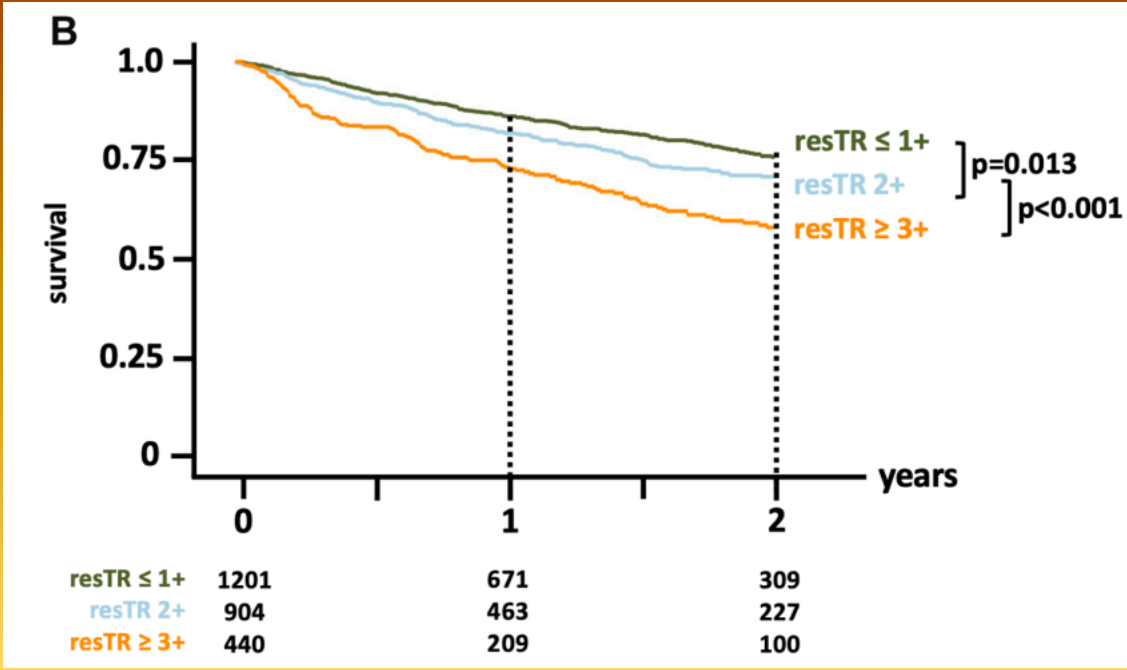
RESEARCH LETTER

The Less the Better

Mild vs Moderate Residual Tricuspid Regurgitation After T-TEER: Insights From EuroTR



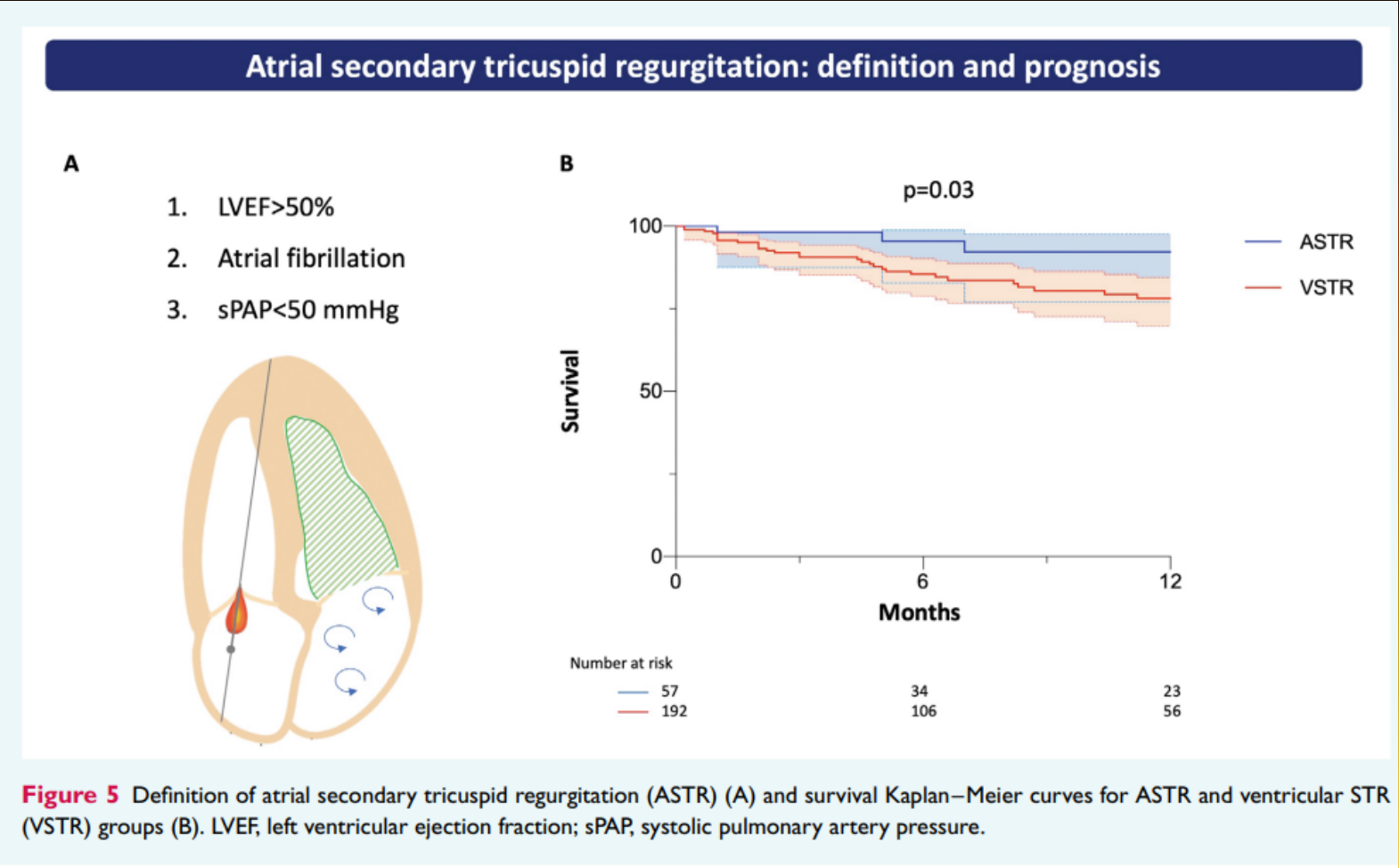
Lukas Stolz, MD,^{a,b} Philipp Lauten, MD,^c Christos Iliadis, MD,^d Daniel Kalbacher, MD,^{e,f} Mirjam G. Wild, MD,^g Mirjam Kessler, MD,^h Volker Rudolph, MD,ⁱ Philipp Lurz, MD,^j Holger Thiele, MD,^k Jörg Hausleiter, MD,^{a,b} the EuroTR Investigators*





Outcome of T-TEER according to type of secondary TR

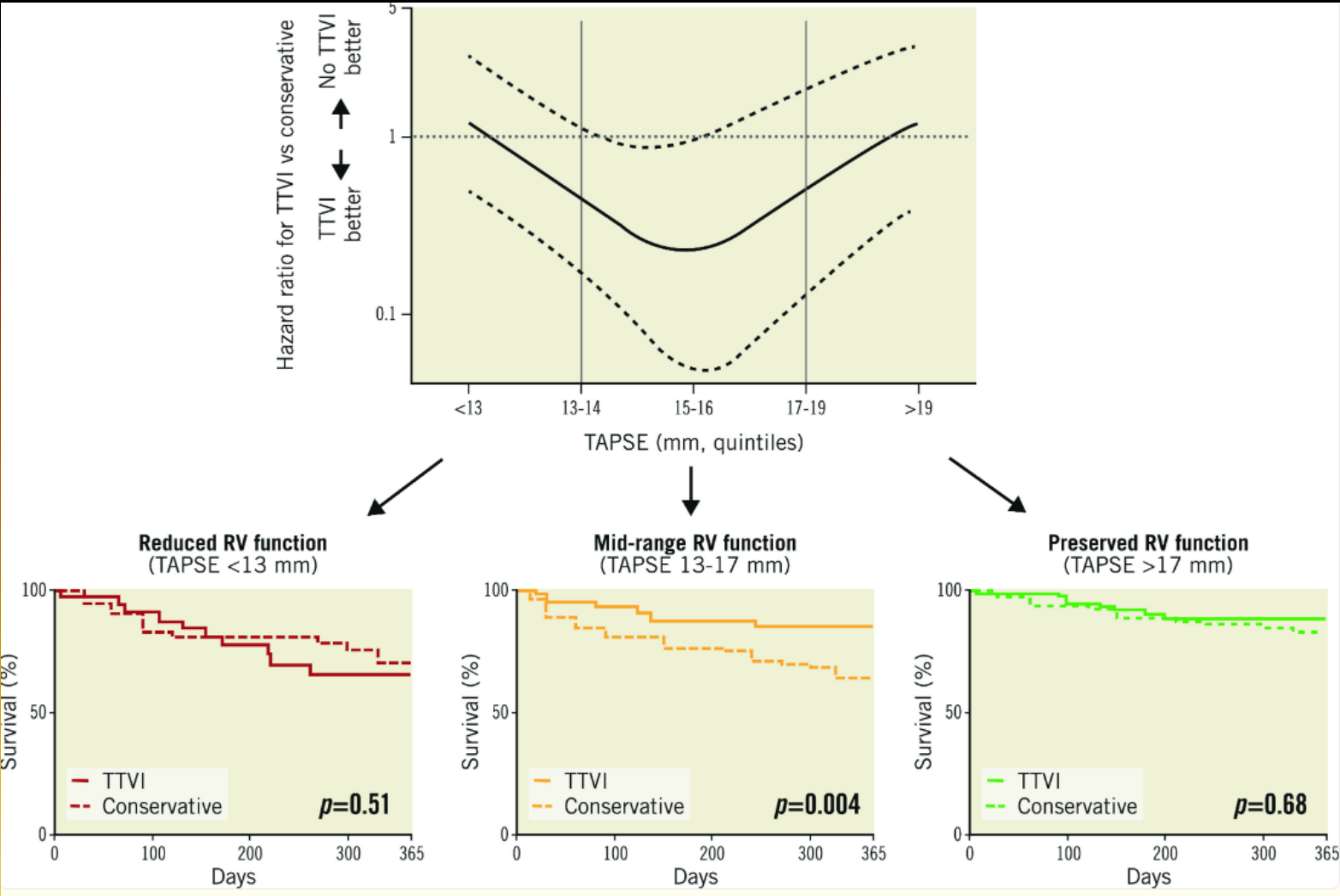
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Outcome of T-TEER according to RV function

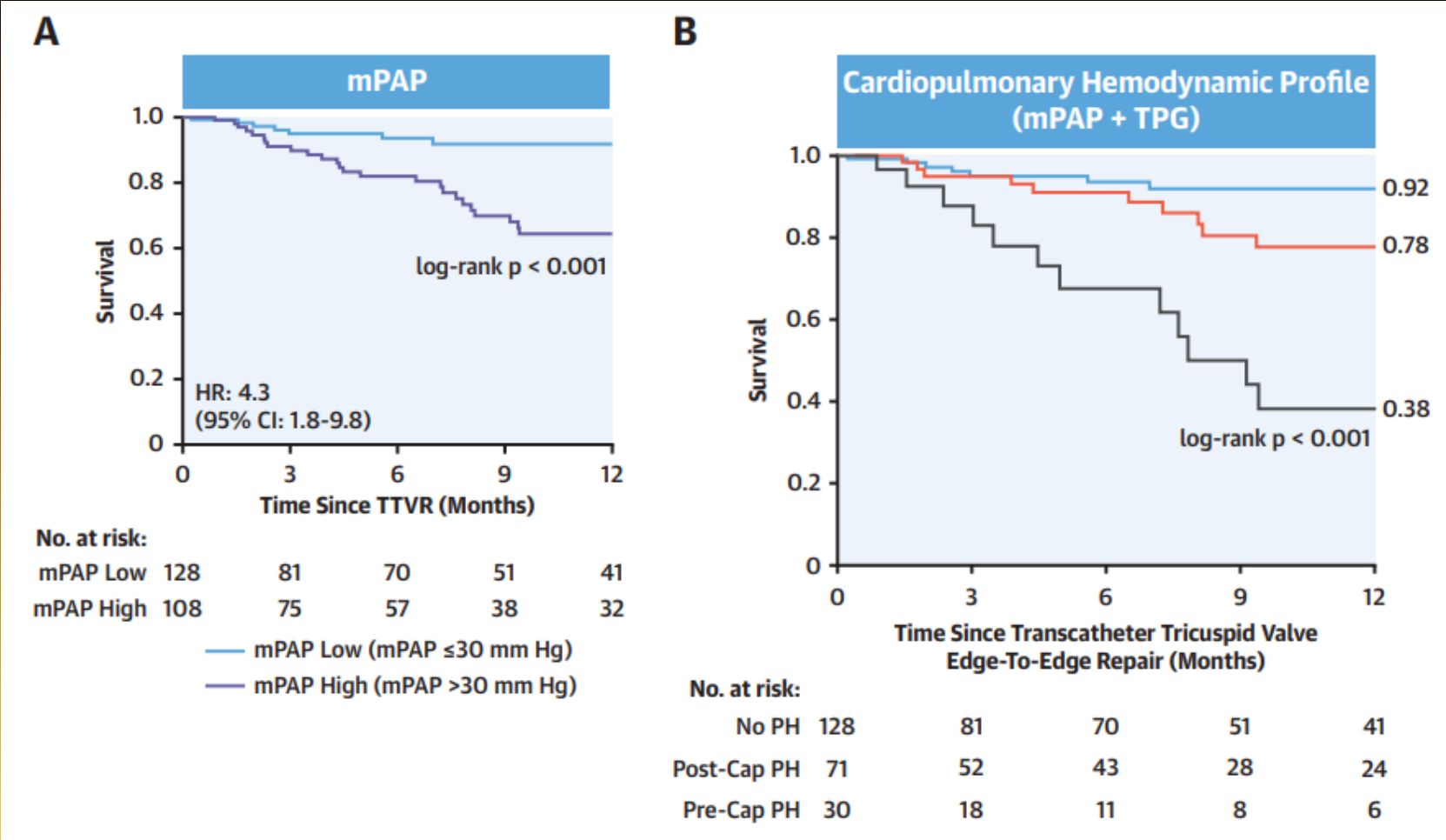
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Outcome of T-TEER according to pulmonary artery pressure

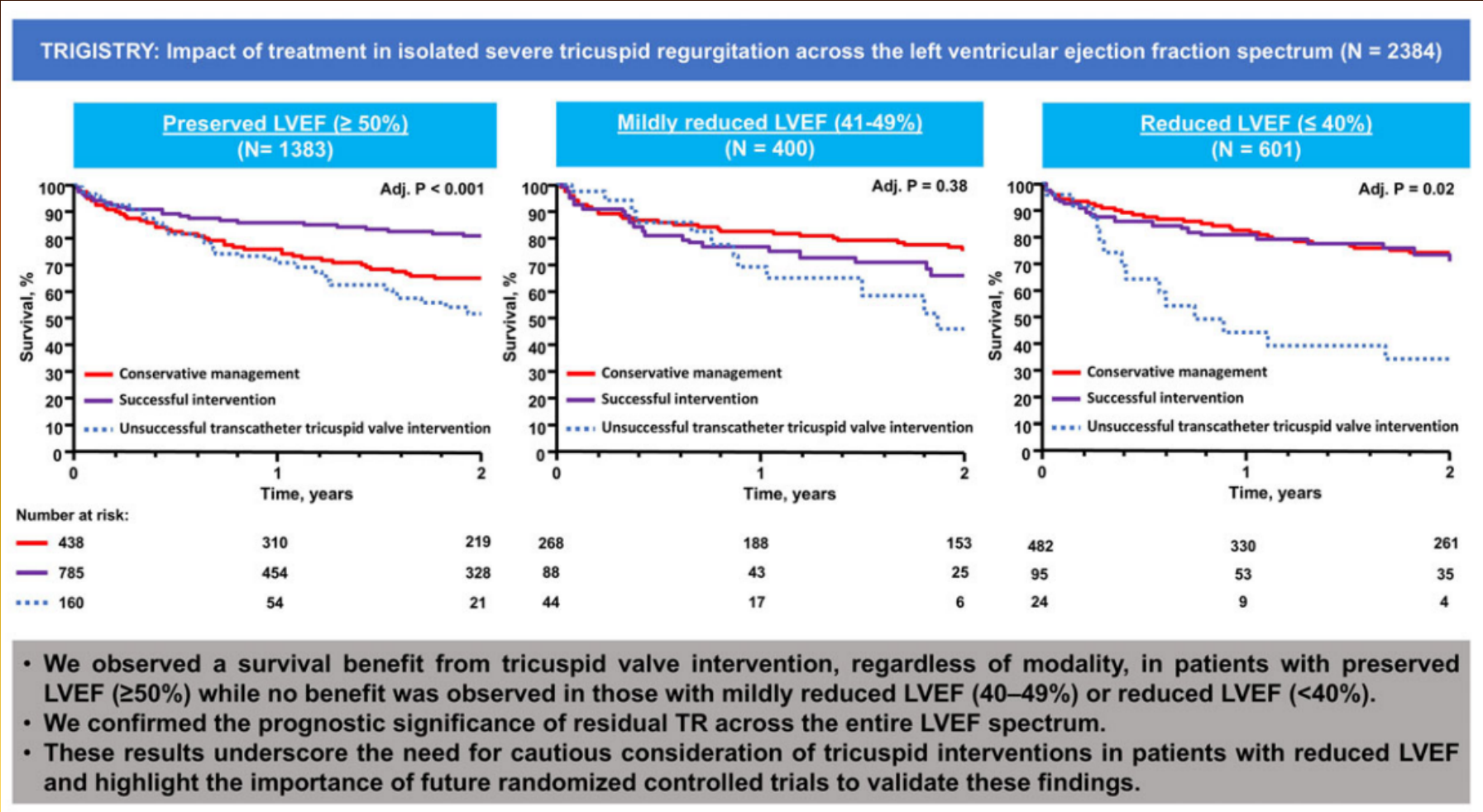
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Outcome of T-TEER according to LV function

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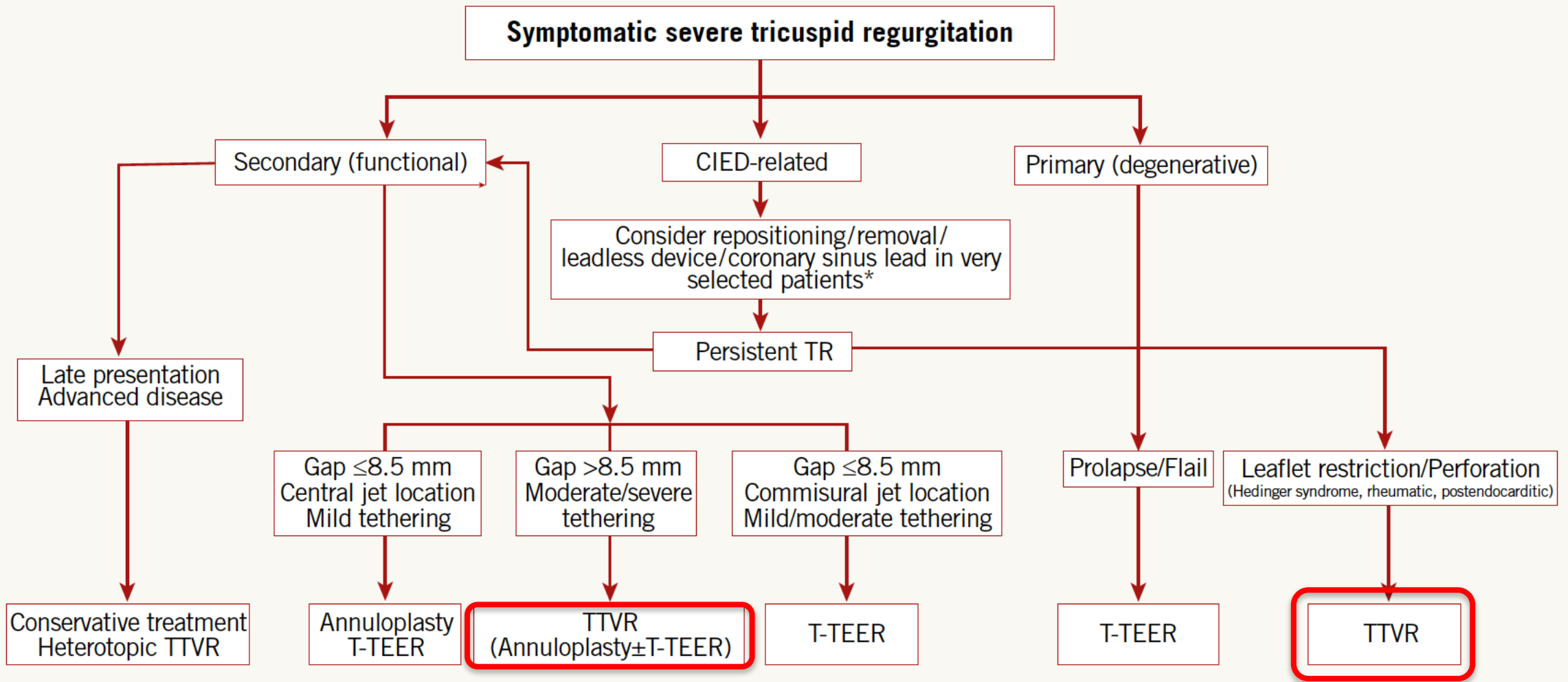


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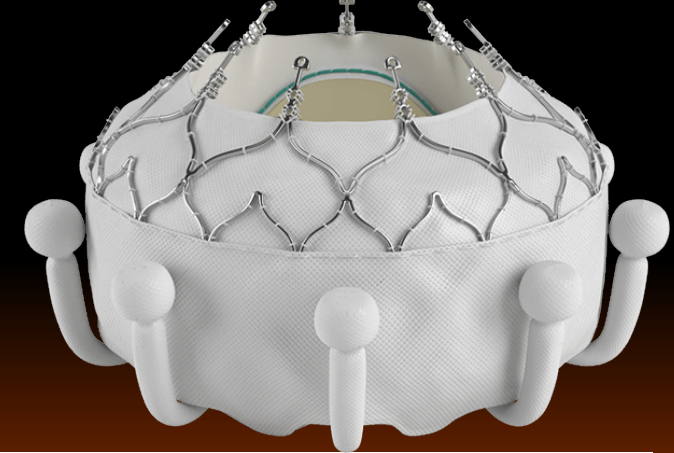
Selection of transcatheter devices for TR



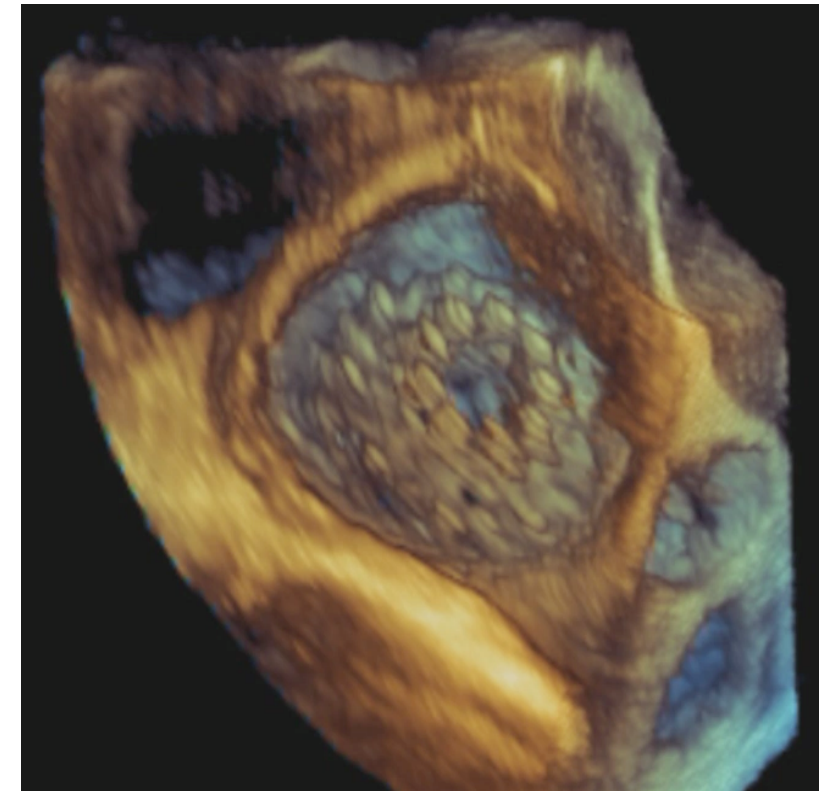
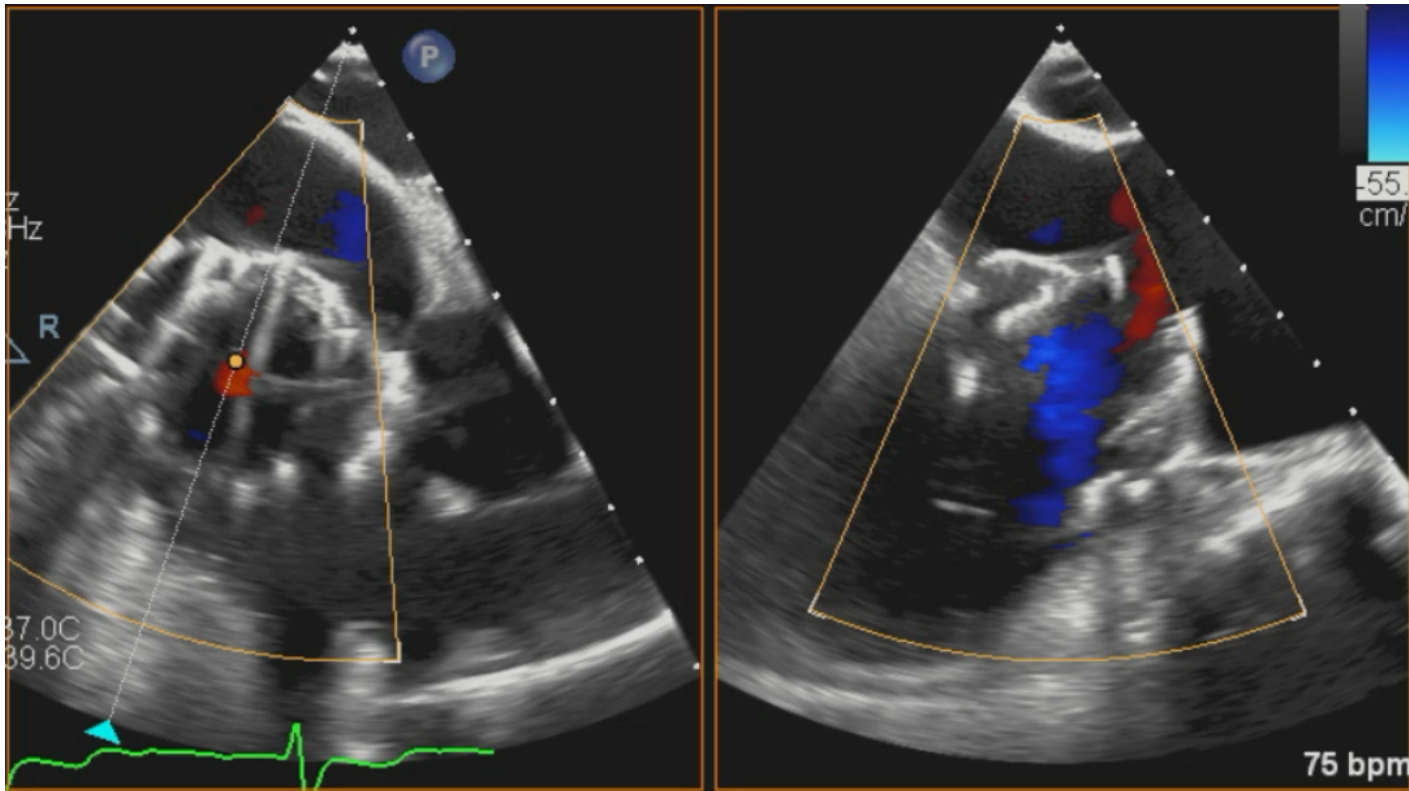
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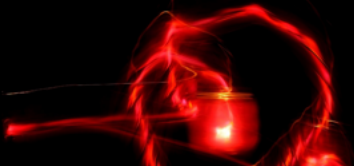


TTVR EVOQUE procedure final result



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2025 ESC guidelines on valvular heart disease

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New recommendation

Indications for intervention in tricuspid regurgitation—Section 11.4		
Careful evaluation of TR aetiology, stage of the disease (i.e. degree of TR severity, RV and LV dysfunction, and PH), patient operative risk, and likelihood of recovery by a multidisciplinary Heart Team is recommended in patients with severe TR prior to intervention.	I	C

Revised recommendation

2021	vs	2025
Indications for intervention in patients with severe tricuspid regurgitation without left-sided valvular heart disease requiring surgery—Section 11.4		
Transcatheter treatment of symptomatic secondary severe TR may be considered in inoperable patients at a Heart Valve Centre with expertise in the treatment of TV disease.	IIb C	Transcatheter TV treatment should be considered to improve quality of life and RV remodelling in <u>high-risk patients, with symptomatic severe TR despite optimal medical therapy</u> , in the absence of severe RV dysfunction or pre-capillary PH. IIa A

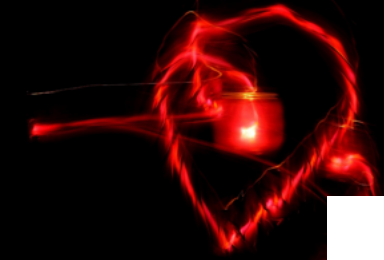
TAPSE >12, PAPS <70 mmHg, LVEF >40%



GRAZIE PER L'ATTENZIONE!!!!!!!!!!!!

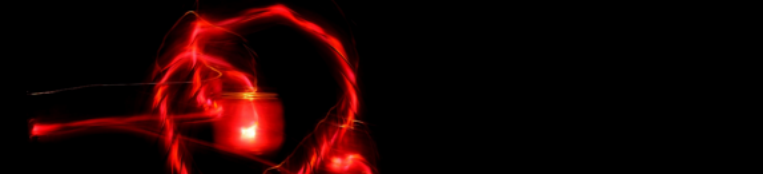
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Device Choice: Complex and Multi-factorial

Device Choice Parameters	Annuloplasty	Leaflet Repair	Replacement
Primary Etiology			
Coaptation Gap > 7mm			
Complex Subvalvar Anatomy			
CIED with Impingement		^a	
Leaflet tethering >10mm			
Leaflet Morphology (>3)			
Large Annulus			
Small RV dimensions			^b
Poor RV function			
Anticoagulation C/I			
Difficult TEE Imaging ^c			

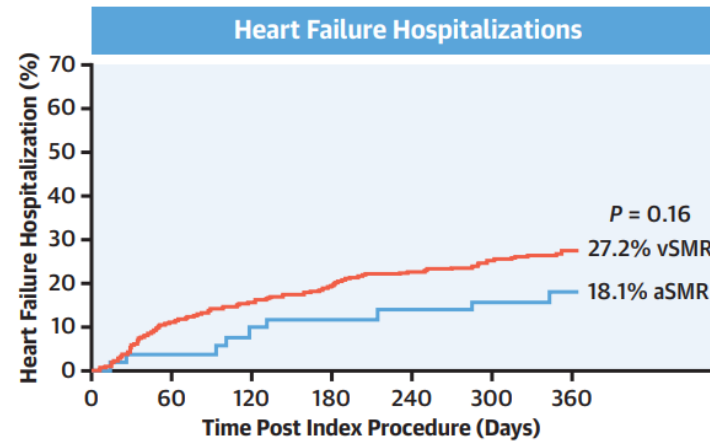


Clinical Outcomes With Transcatheter Edge-to-Edge Repair in Atrial Functional MR From the EXPAND Study

Nishtha Sodhi, MD,^a Federico M. Asch, MD,^b Tobias Ruf, MD,^c Aniela Petrescu, MD,^c Stephan von Bardeleben, MD,^c D. Scott Lim, MD,^a Francesco Maisano, MD,^d Saibal Kar, MD,^e Matthew J. Price, MD^f

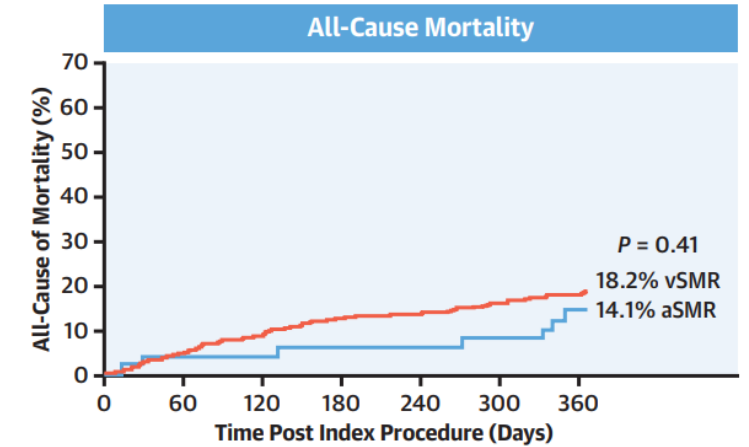


CENTRAL ILLUSTRATION Clinical Outcomes in Subjects With Atrial vs Ventricular Secondary Mitral Regurgitation



No. at Risk:

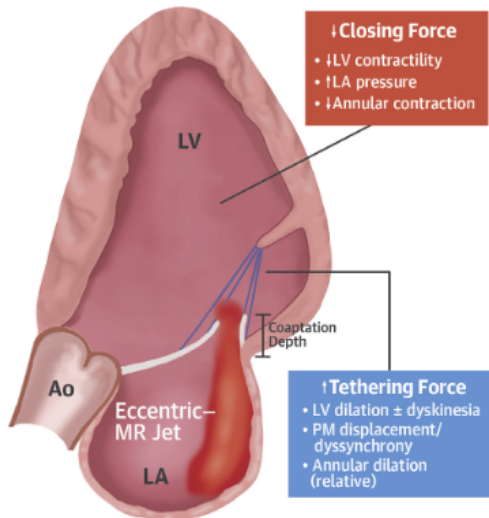
aSMR	53	49	44	24
vSMR	360	333	251	144



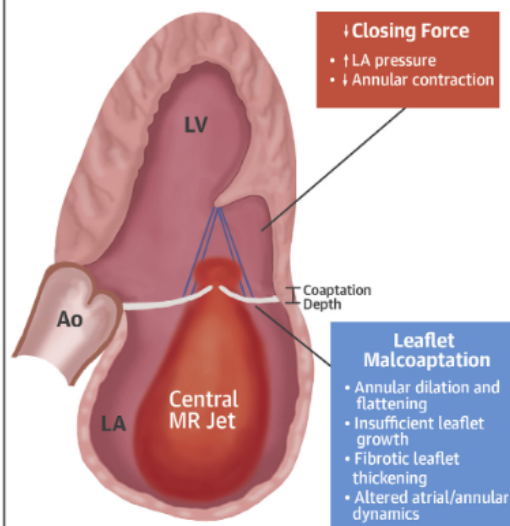
No. at Risk:

aSMR	53	50	49	29
vSMR	360	349	292	183

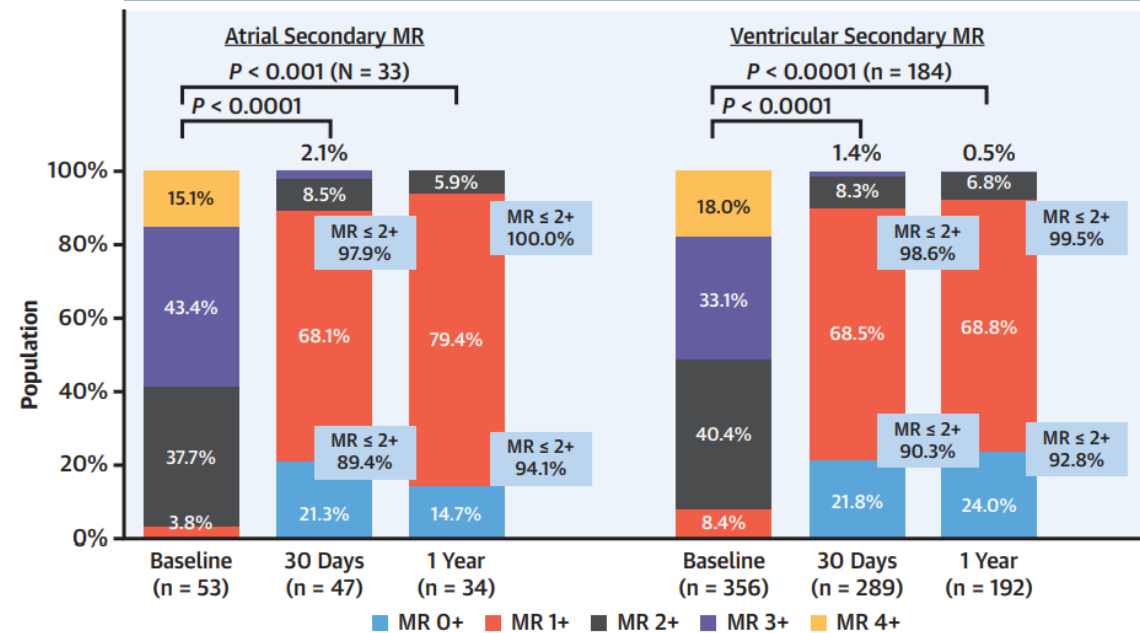
Secondary Mitral Regurgitation



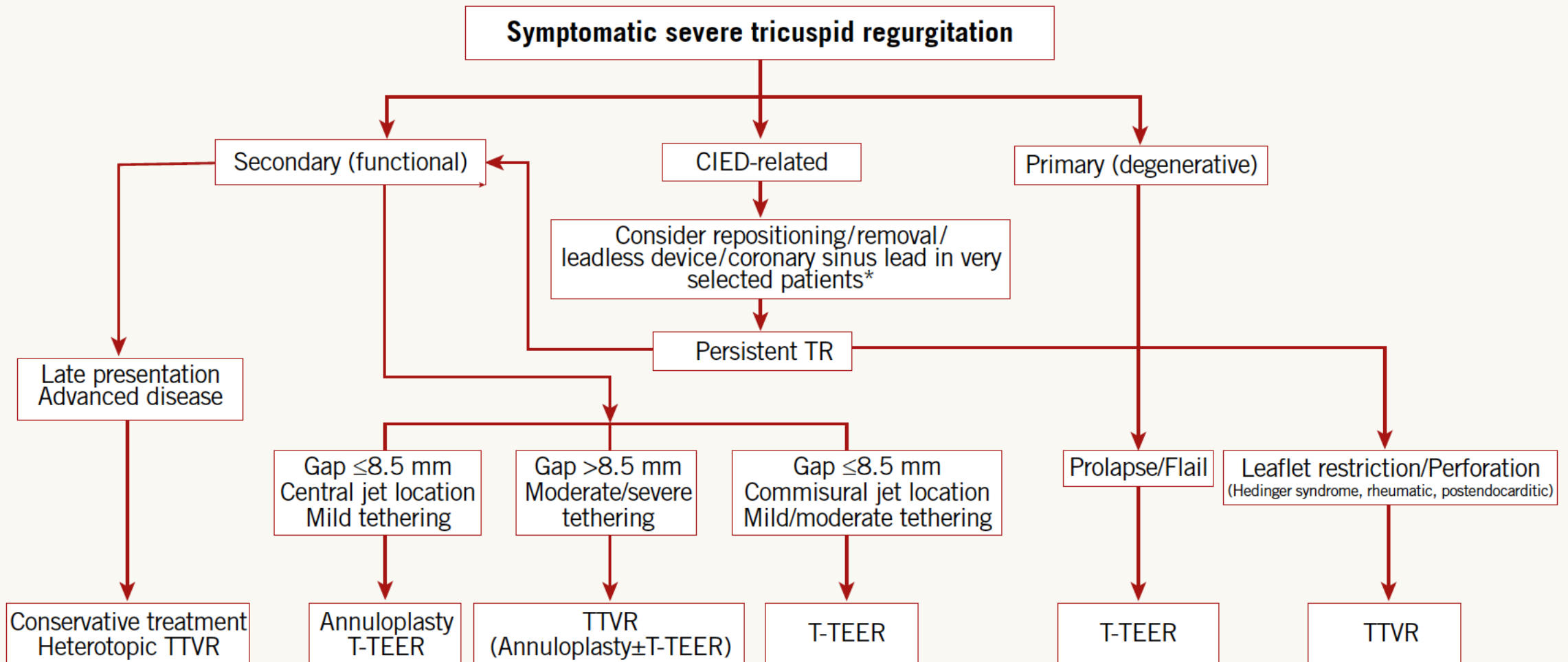
Atrial Functional Mitral Regurgitation



MR Severity Reduction Over 1 Year



Selection of transcatheter devices for TR



*cases without true impingement/leaflet attachment require a valve-directed therapy and most cases will not resolve by lead removal only