Percutaneous Tricuspid Valve Intervention: Multiple options to benefit patient outcomes

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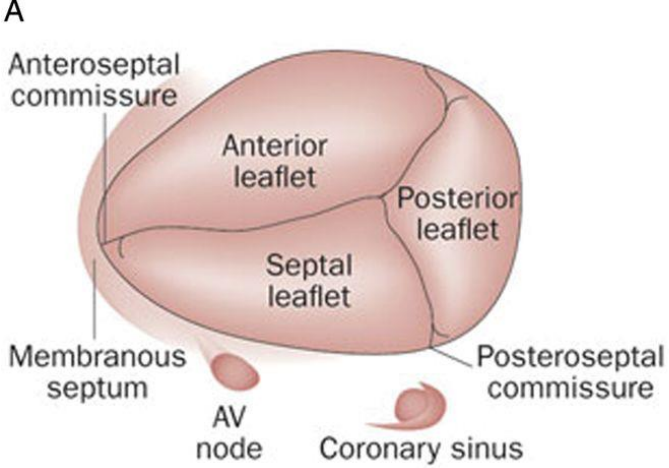
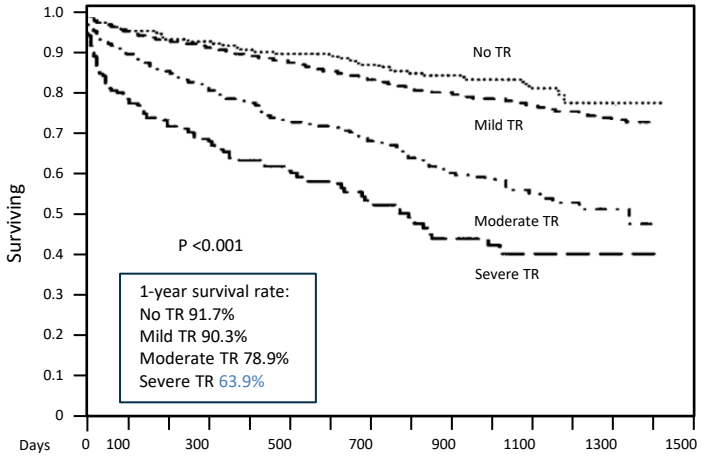


Pathology of functional TR

Prognosis of untreated TR is poor

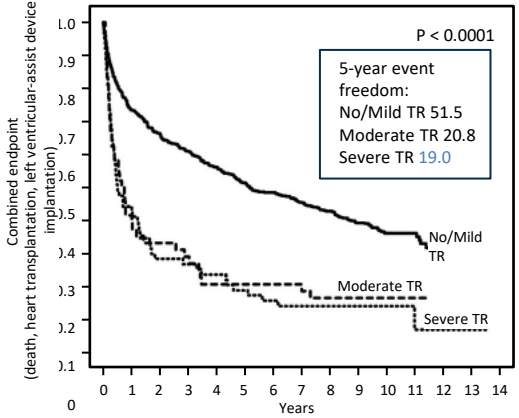
Tricuspid valve disease is a severe condition with impact on long term survival, especially in patients with chronic heart failure and LV dysfunction

Retrospective analysis of 5,223 patients (age 66.5 ± 12.8 years) adjusted for age, LVEF, inferior vena cava size, and RV size and function



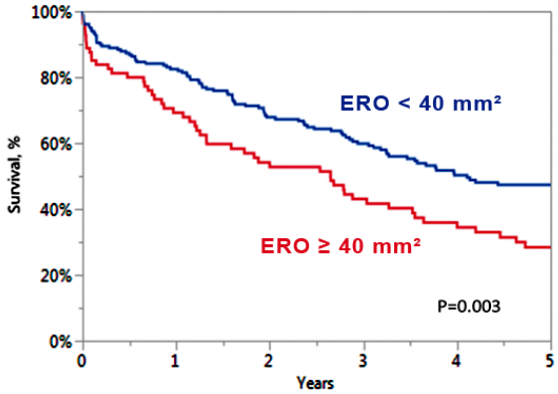
Nath et al. J Am Coll Cardiol 2004;43:405–09

Prospective analysis of 576 consecutive patients with CHF (age 56.4+ 11.2 years)



Neuhold et al. Eur Heart J 2013;34:844–52

Retrospective analysis of 291 patients with LVEF<50% and Functional TR (age 70 ± 12 yrs; EF 31±10%)



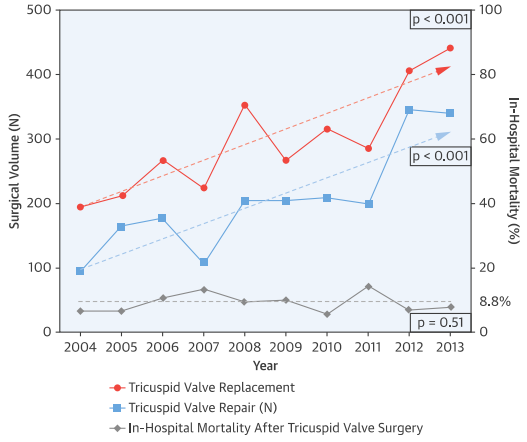
Topilsky et al. Eur Heart J Eur Heart J. 2018 Jul 27

Surgical outcomes of isolated TV surgery have historically been poor

5,005 isolated TV operations between 2004-2013 (~20% of cases in US)

TV repair in 40.8%: TV replacement in 59.2%

CENTRAL ILLUSTRATION Temporal Trends in Surgical Volume and Mortality for Isolated Tricuspid Valve Surgery



Zack, C.J. et al. J Am Coll Cardiol. 2017;70(24):2953-60.

In-Hospital Mortality Predictors

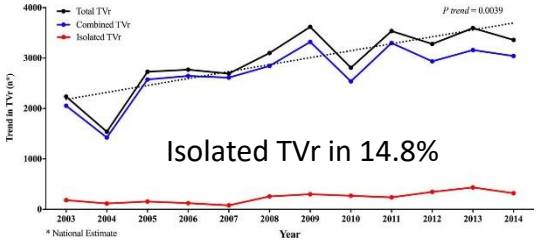
TABLE 3 Multivariate Logistic Regression for Predictors of In-Hospital Death in Patients Undergoing Isolated Tricuspid Valve Surgery From 2004 to 2013

Comorbidity	Odds Ratio	95% CI	p Value
Coagulopathy	2.37	1.44-3.82	<0.001
Hypertension	0.40	0.27-0.63	<0.001
End-stage renal disease	3.15	1.41-7.05	0.005
Age ≥60 yrs	2.02	1.22-3.34	0.006
Tricuspid valve replacement*	1.91	1.18-3.08	0.009
Charlson comorbidity index	1.58	0.93-2.67	0.09

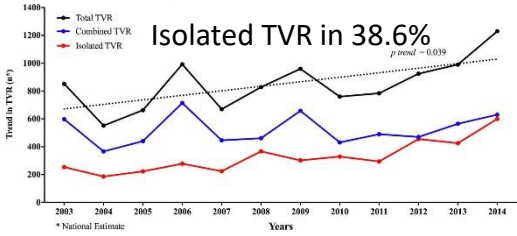
12,567 patients undergoing TV Repair & Replacement between 2003-2014

No of patients undergoing TV surgery for TR increased by 48% from 3100 in 2003 to 4600 in 2014

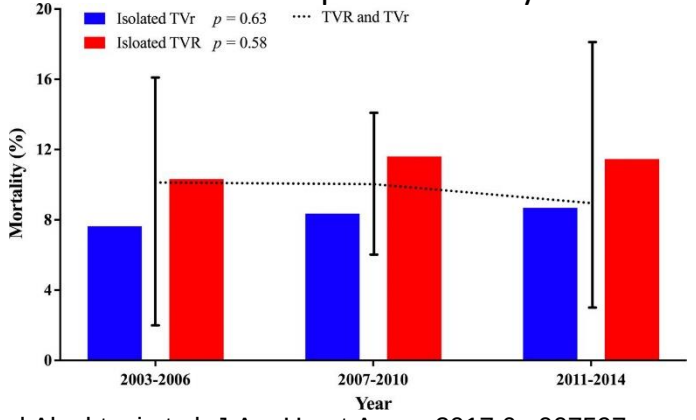
TV Repair (n=7132)



TV Replacement (n=2062)



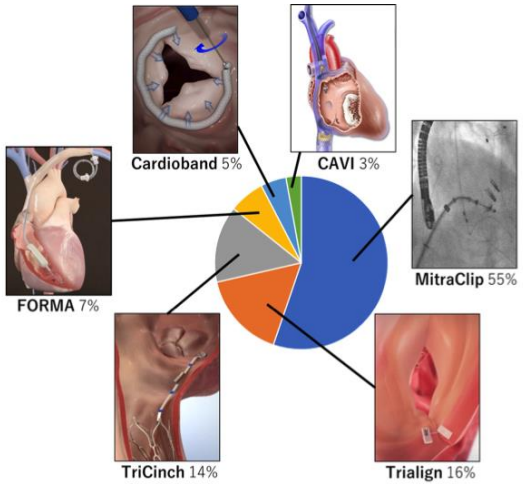
In-Hospital Mortality



Fahad Alqahtani et al. J Am Heart Assoc 2017;6:e007597

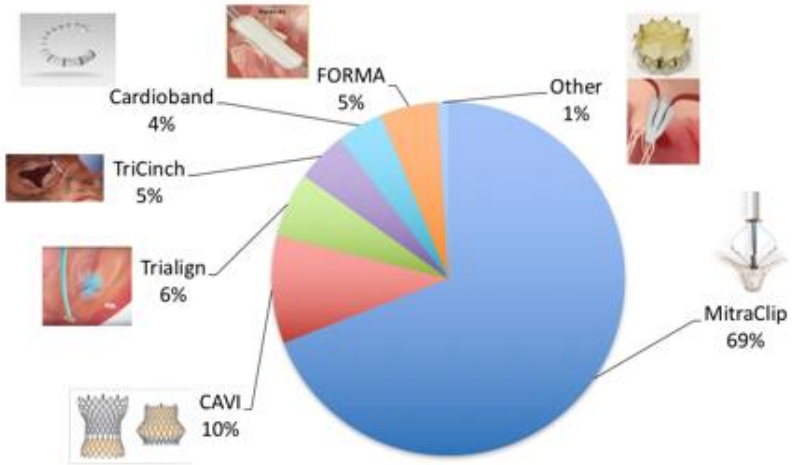
TriValve Registry

January 2014 – December 2016
N = 106



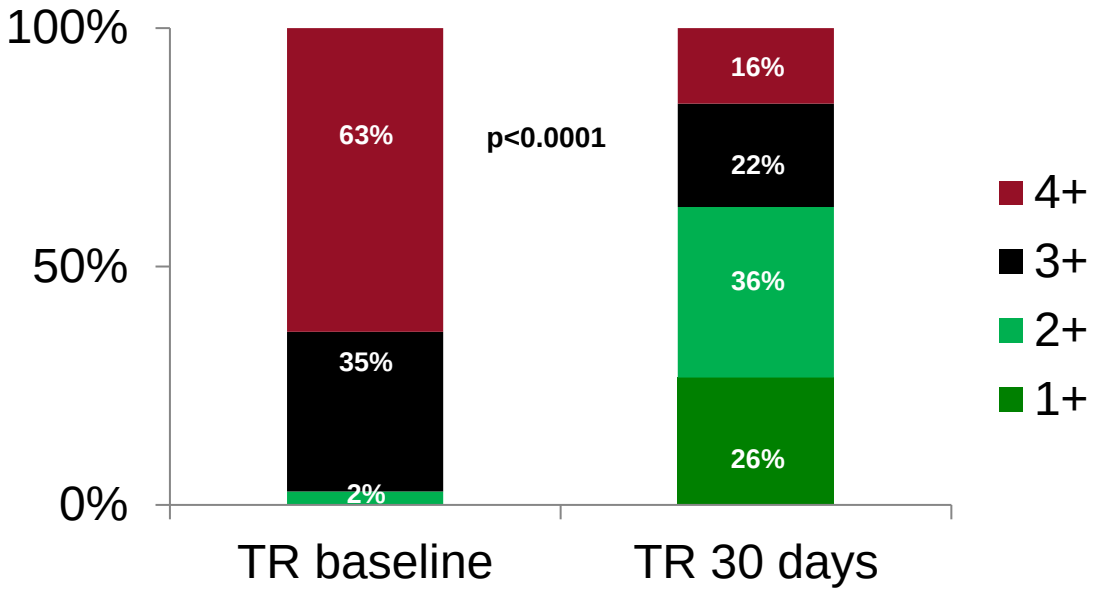
Taramasso et al. J Am Coll Cardiol Intv 2017;10:1982–90

January 2014 – May 2018
N = 304



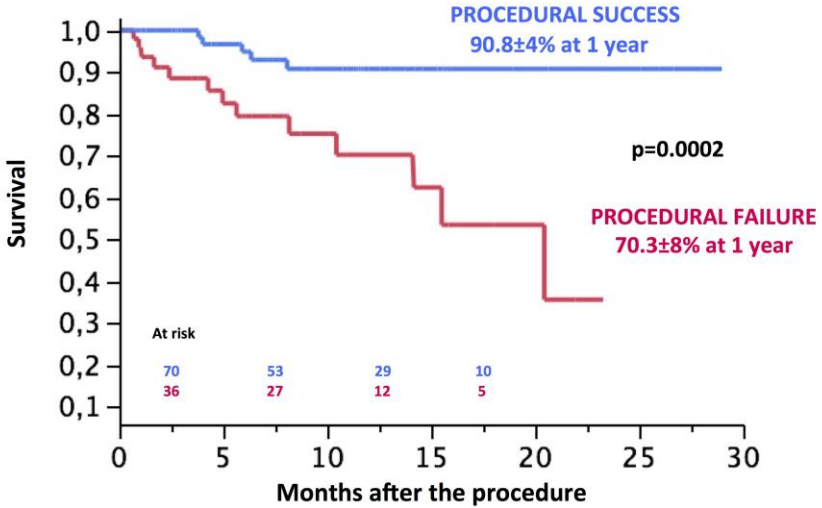
Taramasso et al. J Am Coll Cardiol Intv 2018

TriValve registry: significant TR reduction

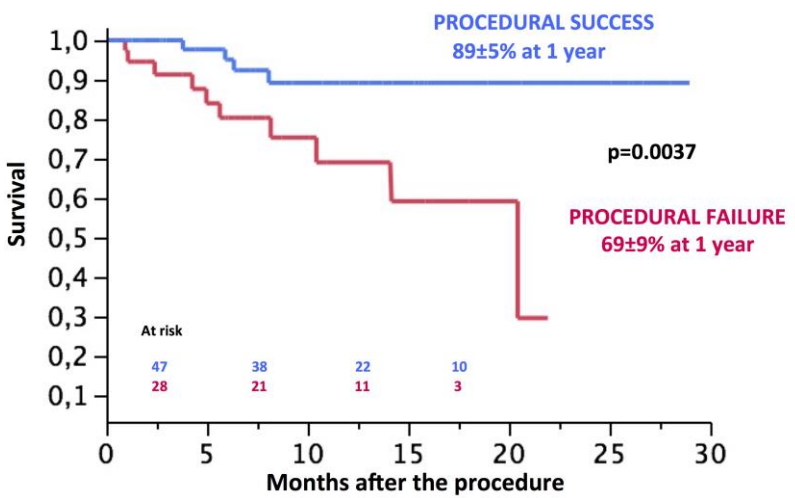


TriValve registry: survival outcomes

Overall survival according to procedural success



Survival isolated TTVR according to procedural success



Procedural success and higher values of sPAP at baseline were independently associated with increased mortality at follow-up.

TRILUMINATE Trial

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*

Safety Profile

Major Adverse Event (MAE) Through 30 Days Post-Procedure – no.(%)	Device N=172†
Total	**3 (1.7%)**
Cardiovascular mortality	1 (0.6%)
Endocarditis requiring surgery	0 (0%)
New-onset renal failure	2 (1.2%)
Non-elective CV Surgery, TVRS for device-related AE	0 (0%)

Other Clinical Safety Endpoints Through 30 Days Post-Procedure– no.(%)	Device N=172†
Any-cause mortality	1 (0.6%)
Tricuspid valve surgery	1 (0.6%)
Tricuspid valve re-intervention	3 (1.7%)
Major bleeding#	8 (4.7%)
Tricuspid mean gradient ≥ 5mmHg	8 (4.7%)
Single leaflet device attachment (SLDA)*	12 (7.0%)
Stroke	1 (0.6%)
Myocardial Infarction	0 (0%)
Embolization*	0 (0%)
Thrombosis	0 (0%)
New CRT/CRT-D/ICD/perm. pacemaker^	1 (0.6%)

†Attempted procedure population (3 subjects randomized to Device withdrew consent prior to index procedure)
#Defined as bleeding ≥ Type 3 based on a modified Bleeding Academic Research Consortium (BARC) definition
*SLDA and embolization evaluated through 30-day follow-up
^Assessed through adverse event reporting

TRILUMINATE™ PIVOTAL TRIAL

TRILUMINATE: Effective TR reduction with TriClip

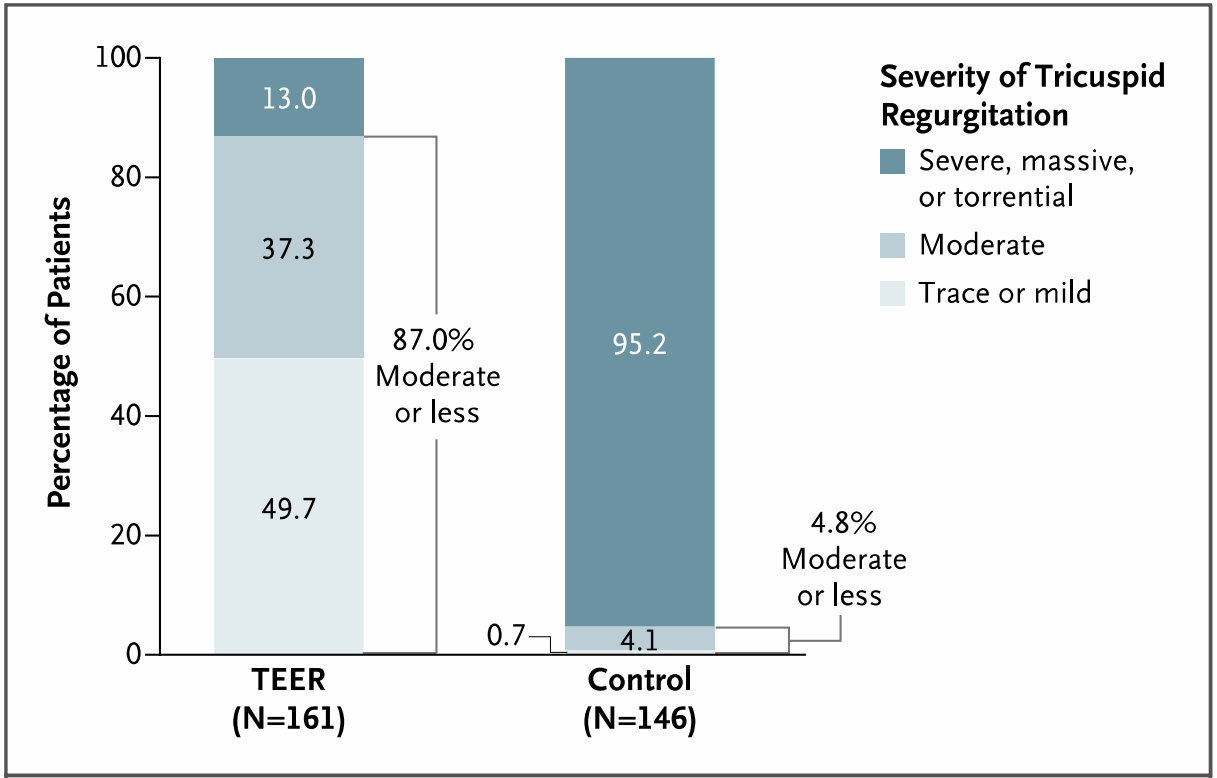
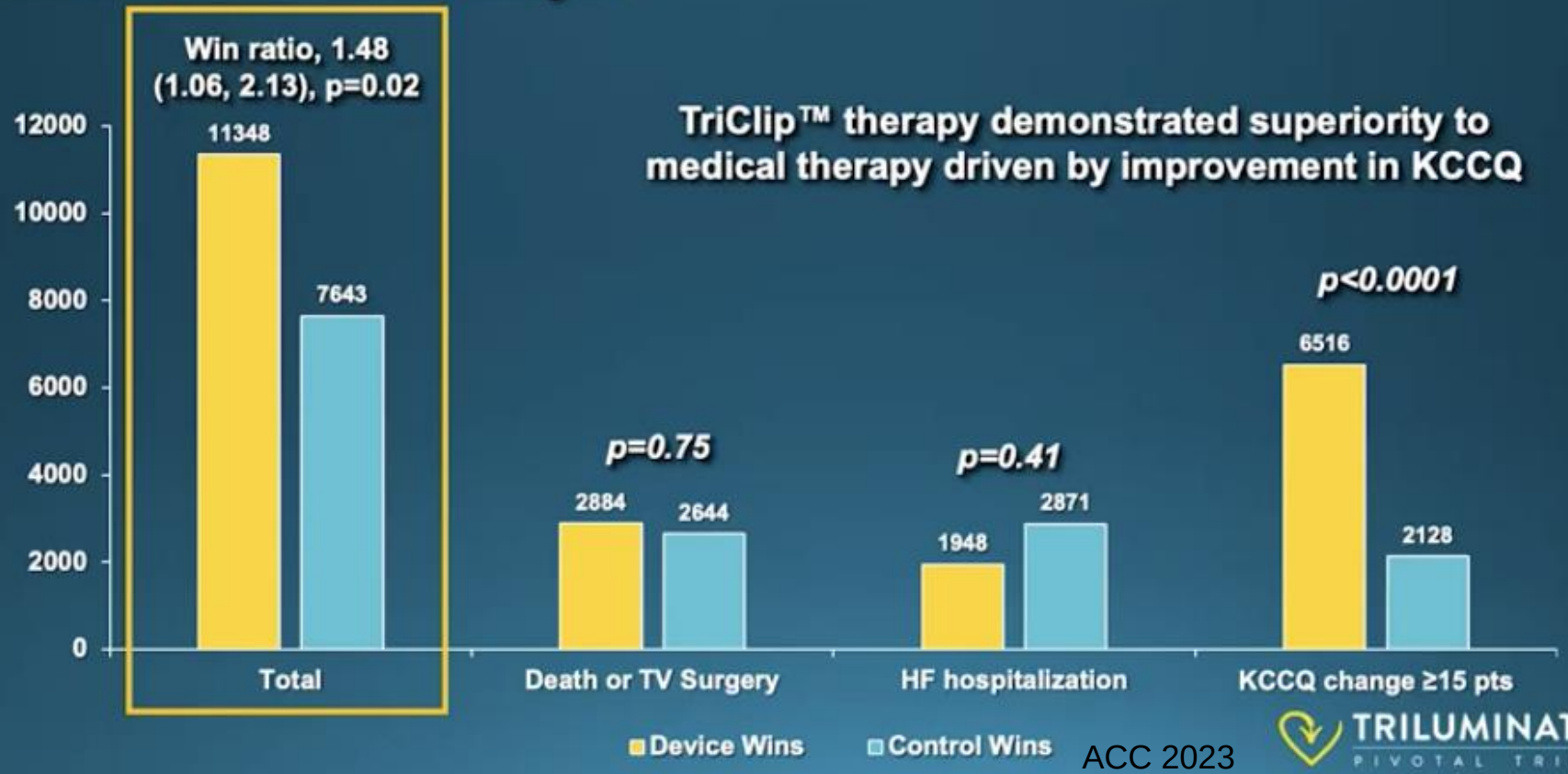


Figure 3. Severity of Tricuspid Regurgitation at 30 Days.

Primary Endpoint

Finkelstein-Schoenfeld Analysis



ACC 2023

TRILUMINATE™ PIVOTAL TRIAL

Edwards PASCAL Transcatheter Valve Repair System

Optimized leaflet capture

- Maneuvering in three planes
- Independent leaflet capture

Empowering

Effective MR reduction

- Broad paddles maximize leaflet coaptation
- Spacer fills regurgitant orifice area

Effective

Excellent safety profile

- Spacer and contoured paddles reduce stress on leaflets
- Elongation promotes safe subvalvular maneuvering

Safe

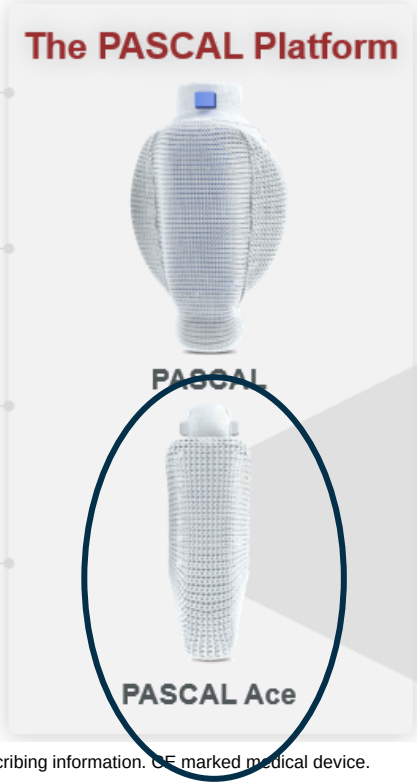
Edwards PASCAL Transcatheter Valve Repair System

Central Spacer
Bridge the coaptation gap

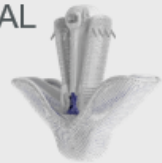
Elongation
Navigate in dense chordae

Nitinol Design
Passive closure, acute implant flexing

Independent Clasps
Optimize leaflet placement

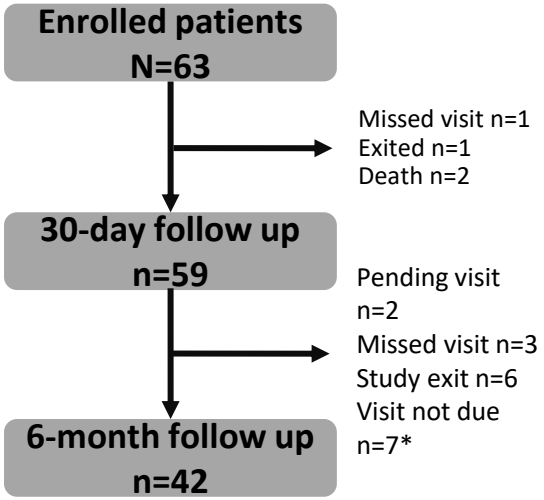


PASCAL Ace
A narrow profile and **central spacer** designed to complement PASCAL and further optimize treatment for patients



CLASP IITR Early Feasibility Study (EFS)

Enrollment and follow up



*One patient was also previously counted as missed for the 30-day visit.

Patient characteristics

	N=63 % or Mean ± SD
Age, years	78 ± 9
Female	56%
Mean STS mortality risk score (%)	7.5 ± 5.6
NYHA functional class III or IV	70%
Tricuspid regurgitation (massive or torrential)	69%
Systemic hypertension	94%
Pulmonary hypertension (PASP >30 mmHg)	53%
Conduction defects/heart block	33%
Atrial fibrillation/flutter	89%
Pacemaker or ICD	13%
Prior mitral, tricuspid or aortic valve surgery/intervention	32%

ICD, implantable cardioverter defibrillator; *NYHA*, New York Heart Association; *PASP*, pulmonary arterial systolic pressure; *STS*, Society for Thoracic Surgeons

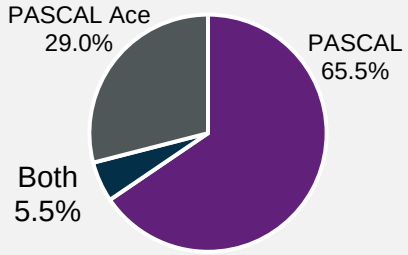
Procedural characteristics

CLASP TR EFS

	N=63 % (n/N) or Mean ± SD (N)
Successful implant rate[1,2] (ITT)	91% (57/63)
Successful implant rate[1] (AT)	100% (57/57)
Procedural success[3]	98% (44/45)
Clinical success[4]	87% (40/46)
Mean number of devices implanted per patient	1.5 ± 0.57 (57)
Time of procedure (implant insertion to release), mins	159 ± 129 (56)

[1]Implant deployed as intended and delivery system retrieved as intended at the time of the patient's exit from the cardiac catheterisation laboratory.
[2]Implants were successfully retrieved in six patients whose leaflets were unable to be captured due to complex anatomy with no adverse sequelae.
[3]Implant success with at least one grade reduction in TR at the end of the procedure without surgical or percutaneous intervention prior to hospital discharge.
[4]Procedural success without MAEs at 30 days. *MAEs,* major adverse events; *ITT,* intention to treat; *AT,* as treated

Implant rate
Per patient

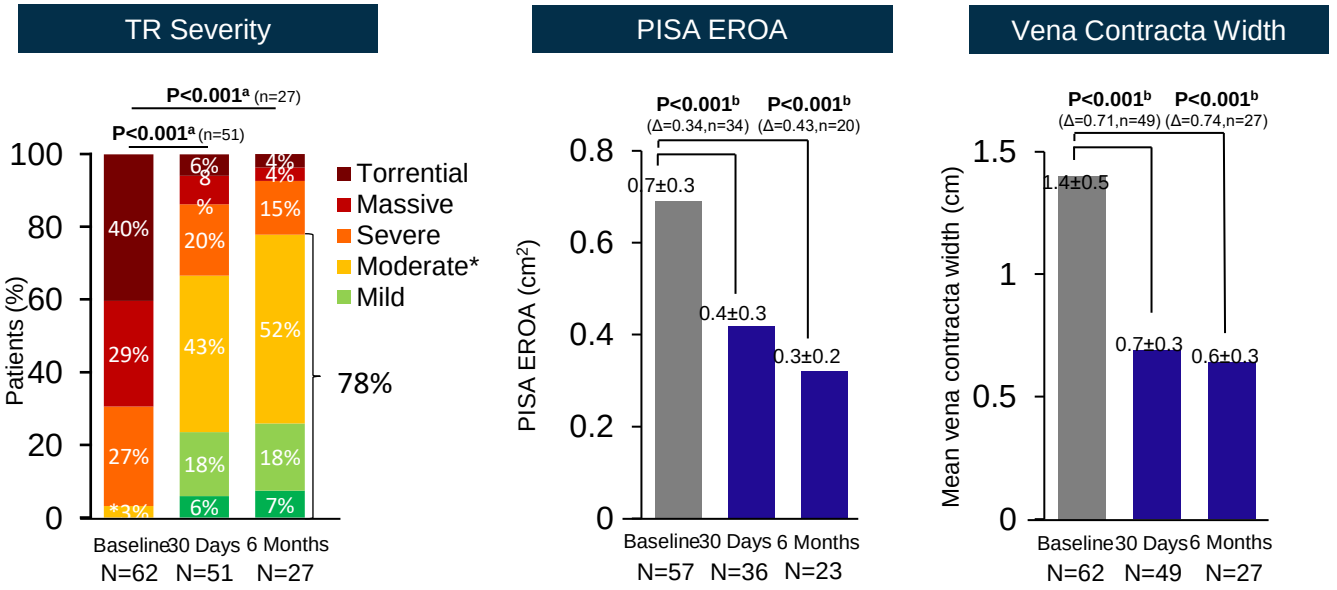


Events at 30 days and 6 months

CEC Adjudicated Events	30 days N=63 % (n)	6 months N=63 % (n)
Cardiovascular mortality	3.2% (2)[a]	3.2% (2)[a]
Myocardial infarction	0.0% (0)	0.0% (0)
Stroke	1.6% (1)[a]	3.2% (2)[a]
New need for dialysis or renal replacement therapy	0.0% (0)	0.0% (0)
Severe bleeding*	6.3% (4)	7.9% (5)
Re-intervention related to the device	0.0% (0)	1.6% (1)[b]
Major access site and vascular complications requiring intervention	1.6% (1)	1.6% (1)
Other events		
All-cause mortality	3.2% (2)[a]	3.2% (2)[a]
Heart failure rehospitalization	0.0% (0)	6.3% (4)
SLDA rate as assessed by core lab[c]	4.8% (3)	4.8% (3)

*Severe bleeding is major, extensive, life-threatening or fatal bleeding, as defined by Mitral Valve Academic Research Consortium (MVARC); [a]Not related to the study device or the procedure; [b]Surgical explant of study device successfully converted to tricuspid repair with a surgical ring.
[c]Cardiovascular Research Foundation

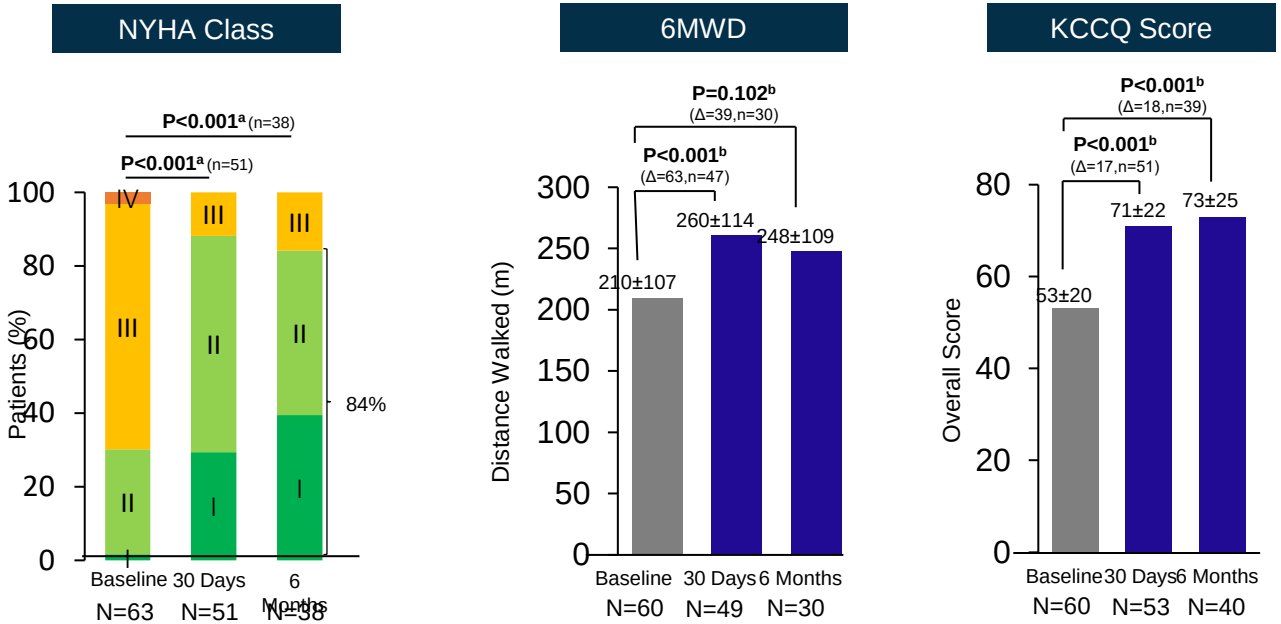
Significant improvements in echocardiographic outcomes at 6 months by core lab[1]



89% achieved ≥1 grade reduction and 70% achieved ≥2 grade reductions at 6 months

[1]Cardiovascular Research Foundation; *Two patients initially considered to have severe TR at baseline by transoesophageal echocardiography (TEE) were reclassified as moderate TR by transthoracic echocardiography (TTE); [a]Wilcoxon signed-rank test; [b]Paired t-test. *PISA EROA,* proximal isovelocity surface area effective regurgitant orifice area; *TR,* tricuspid regurgitation

Improved clinical, functional, and quality of life outcomes sustained at 6 months

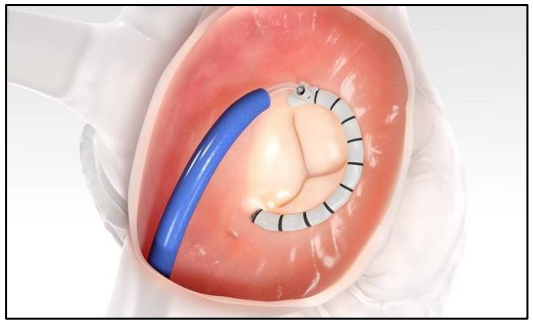


[a]Wilcoxon signed-rank test; [b]Paired t-test. *6MWD*, 6-minute walk distance; *KCCQ,* Kansas City Cardiomyopathy Questionnaire; *NYHA Class,* New York Heart Association; *TR,* tricuspid regurgitation

Cardioband Tricuspid Valve Reconstruction System

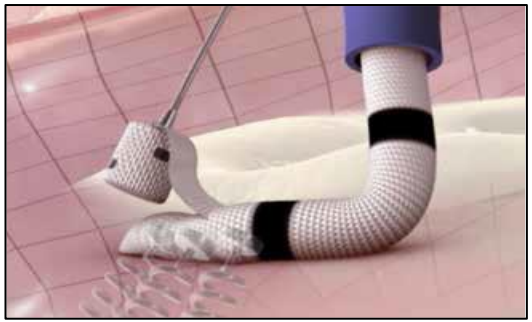
Cardioband tricuspid valve reconstruction system

Annular reduction



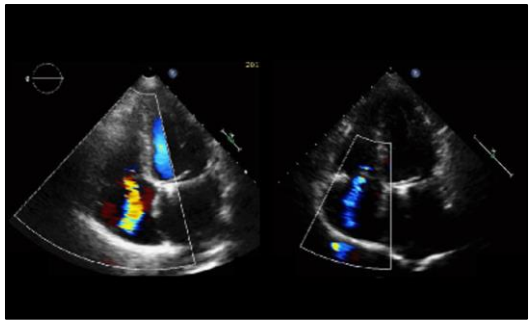
Restores valve to a more functional state, facilitating leaflet coaptation

Adjustable implantation



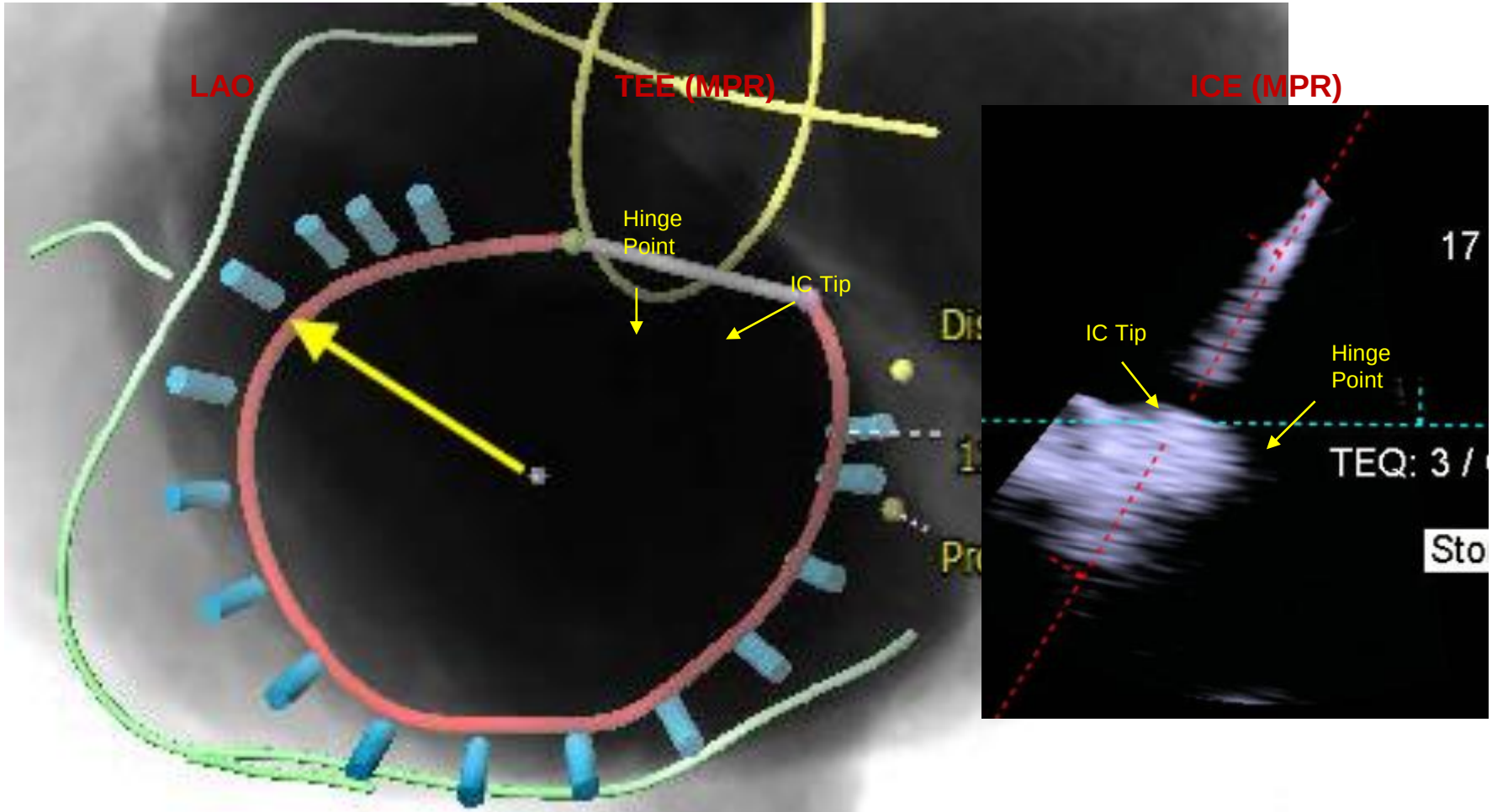
Enables annular reduction through a standardized procedure based on each patient’s anatomy

Real-time confirmation



Supports real-time annular adjustment and confirmation of procedural results through echocardiography

Decision Making: Flouro and TEE and ICE and Planning



Multicenter Study > JACC Cardiovasc Interv. 2022 Oct 10;15(19):1921-1932.
doi: 10.1016/j.jcin.2022.07.006. Epub 2022 Sep 14.

1-Year Outcomes of Cardioband Tricuspid Valve Reconstruction System Early Feasibility Study

William A Gray [1], Sandra V Abramson [2], Scott Lim [3], Dale Fowler [3], Robert L Smith [4], Paul A Grayburn [4], Susheel K Kodali [5], Rebecca T Hahn [5], Robert M Kipperman [6], Konstantinos P Koulogiannis [6], Mackram F Eleid [7], Sorin V Pislaru [7], Brian K Whisenant [8], James M McCabe [9], Jin Liu [10], Abdellaziz Dahou [11], Jyothy J Puthumana [12], Charles J Davidson [12]; Cardioband TR EFS Investigators

Collaborators, Affiliations + expand

PMID: 36202561 DOI: 10.1016/j.jcin.2022.07.006

Abstract

Background: Tricuspid regurgitation (TR) is prevalent and undertreated, with mortality and morbidity increasing with TR severity. Given poor outcomes with medical therapy and high in-hospital mortality for isolated tricuspid valve surgery, emerging transcatheter repair devices offer a promising alternative.

Objectives: The Edwards Cardioband Tricuspid Valve Reconstruction System Early Feasibility study (NCT03382457) evaluates the treatment of functional TR via annular reduction with the Cardioband Tricuspid Valve Reconstruction System (Edwards Lifesciences).

Methods: Patients with ≥ moderate functional TR were eligible for this prospective, single-arm multicenter study. At 1 year, patients were evaluated for echocardiographic parameters, clinical and quality-of-life measures, and major adverse events.

Results: The 37 patients enrolled had a mean age of 78 years; 76% were female; and they had ≥

Baseline and procedural results

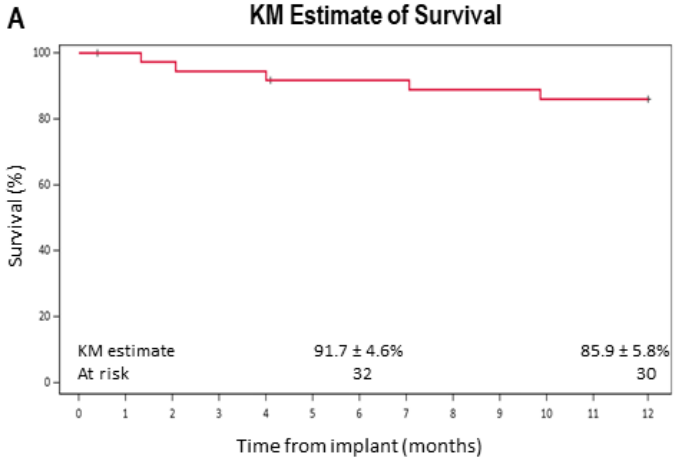
Baseline characteristics	N=37 % or Mean ± SD
Age, years	78 ± 7.5
Female	76%
TR grade ≥ severe[1] (torrential TR)	100% (60%)
NYHA functional class III or IV	65%
LVEF (%)	57.6 ± 5.7*
Hypertension	70%
Pulmonary hypertension	73%
Atrial flutter/fibrillation	97%
Myocardial infarction	11%
Stroke	5%
Prior surgery/intervention, any valve	38%
Pacemaker, ICD or CRT	30%
Ascites	22%
Chronic anemia	35%
Renal disease	38%

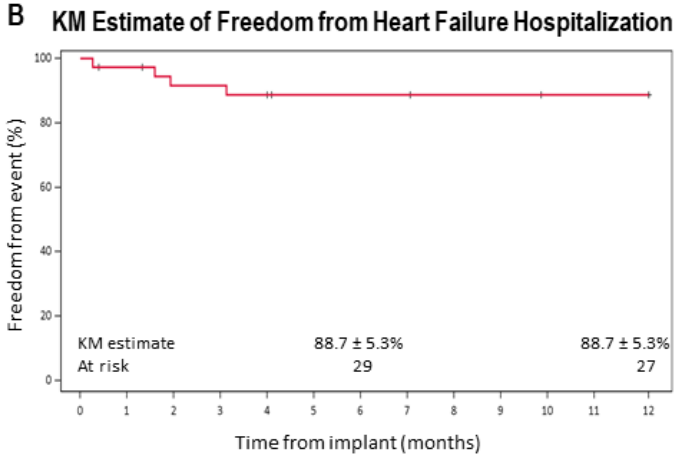
Procedural characteristics	N=37 % or Median (min, max)
Device success[2]	92%
Procedural success[3]	83%
Implant delivery system insertion to removal, mins	188.5 (93.0, 448.0)¶
Length of hospital stay (procedure to discharge), days	2.0 (1.0, 30.0)

[1]Core lab (Cardiovascular Research Foundation). [2]Device deployed and delivery system retrieved as intended before exiting the cardiac catheterization lab. [3]Procedural success with evidence of 30% TR relative reduction in EROA at end of procedure and without the need for surgical or percutaneous intervention before hospital discharge. *n=33 ¶n=34. TR, tricuspid regurgitation; NYHA, New York Heart Association; LVEF, left ventricular ejection fraction; ICD, implantable cardioverter-defibrillator; CRT, cardiac resynchronization therapy. CAUTION: Investigational device. Limited by Federal (or United States) law to investigational use. CAUTION: Investigational device. Limited by Federal (or United States) law to investigational use.

Safety outcomes

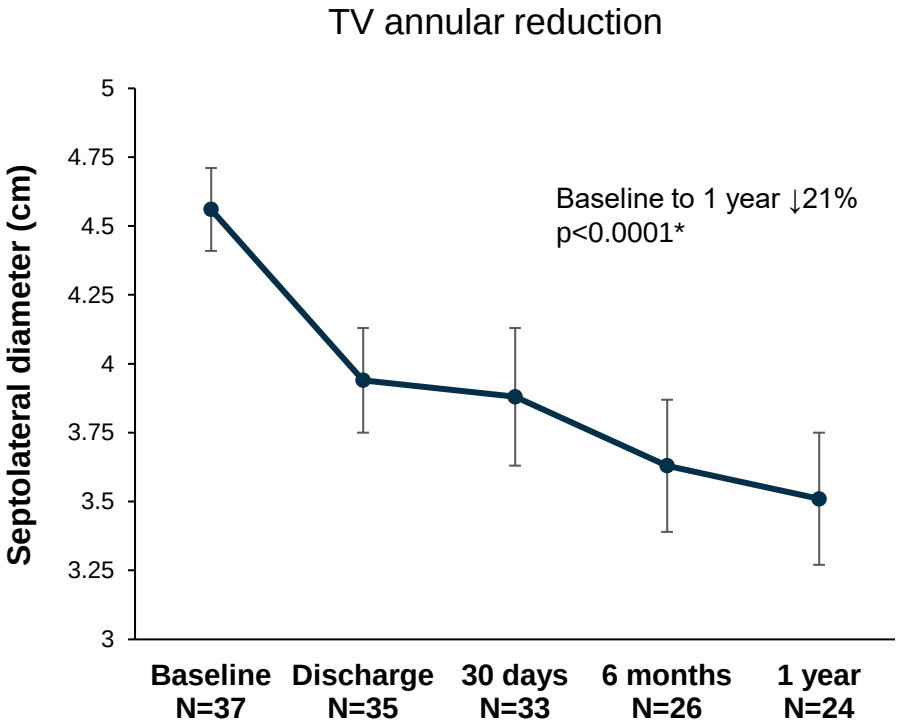
CEC-adjudicated major adverse events	30 days (N=37) % (n)	1 year (N=37) % (n)
Cardiovascular mortality	0	8.1% (3)
Myocardial infarction	0	0
Stroke	0	5.4% (2)
Right coronary artery perforation	0	0
Arrhythmia and conduction disorders requiring permanent pacing	0	0
New need for renal replacement therapy	0	0
Reintervention on previously implanted study device	0	5.4% (2)
Severe bleeding*	21.6% (8)	35.1% (13)
Life-threatening	2¶	1§
Fatal	0	3‡
Major access site and vascular complications requiring intervention	8.1% (3)	8.1% (3)
Tamponade	2.7% (1)	2.7% (1)
Other events		
All-cause mortality	0	13.5% (5)
Heart failure hospitalization	2.7% (1)	10.8% (4)

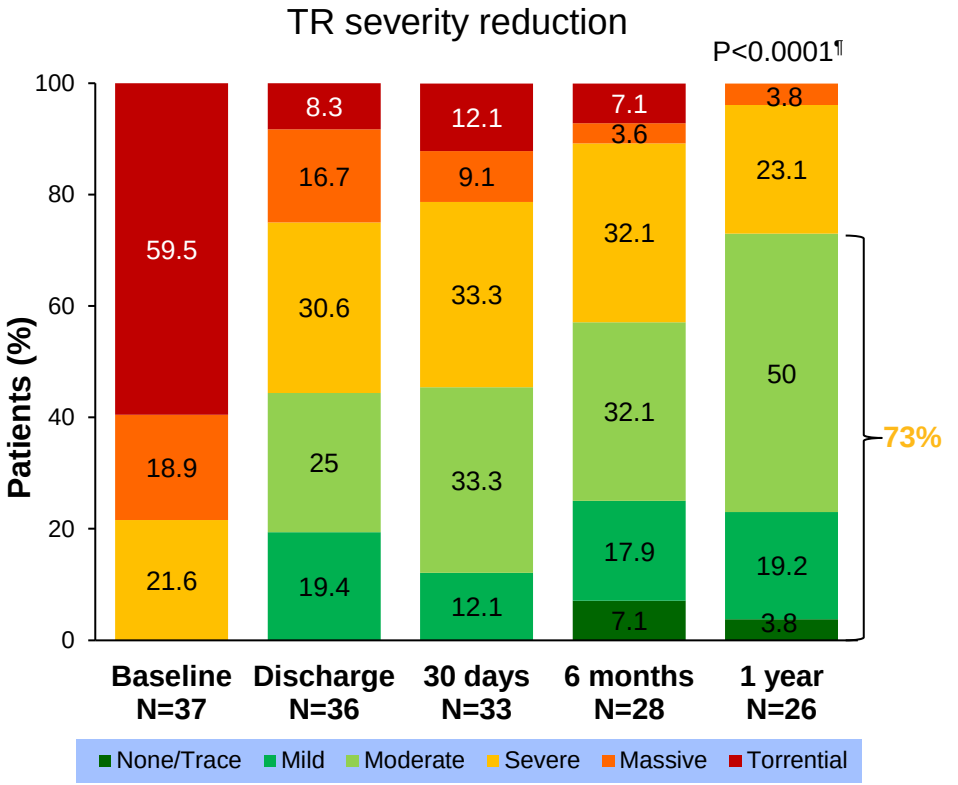




* Severe bleeding defined as major, extensive, life threatening, or fatal per Mitral Valve Academic Research Consortium; ¶ Pericardial effusion/tamponade (related to device and procedure), subdural hematoma (possibly related to procedure); § Hemothorax (related to device at reintervention); ‡ Erosive esophagitis (unrelated), GI hemorrhage (unrelated), cerebrovascular accident (unrelated). CAUTION: Investigational device. Limited by Federal (or United States) law to investigational use.

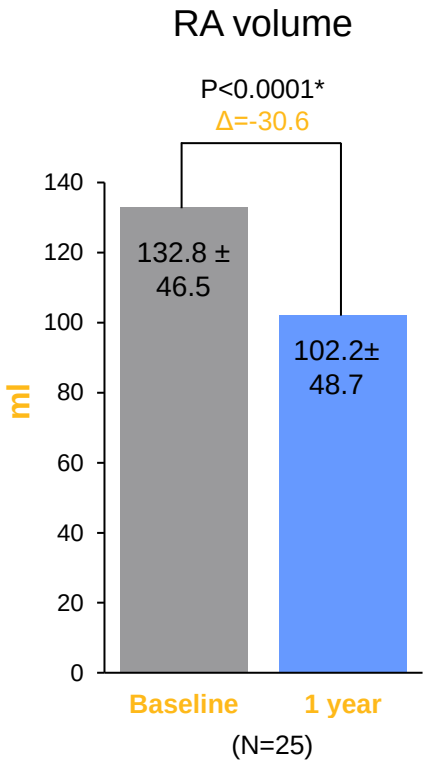
Significant annular and TR reduction sustained at 1 year





[1]Cardiovascular Research Foundation. *Paired t-test for mean tricuspid valve (TV) annulus diameter (end diastole, apical 4ch) baseline to 1 year. n=24, baseline=44.6mm, one year=35.1mm. Bars represent 95% CI. ¶Wilcoxon signed-rank test for tricuspid regurgitation (TR) grade at baseline and discharge and baseline and 1 year. N=26, Baseline tricuspid regurgitation (TR) grades by transthoracic echocardiography (TTE; n=26), 30.8% severe, 11.5% massive, 57.7% torrential. One-year TR grades: 3.8% none/trace, 19.2% mild, 50.0% moderate, 23.1% severe, 3.8% massive. CAUTION: Investigational device. Limited by Federal (or United States) law to investigational use.

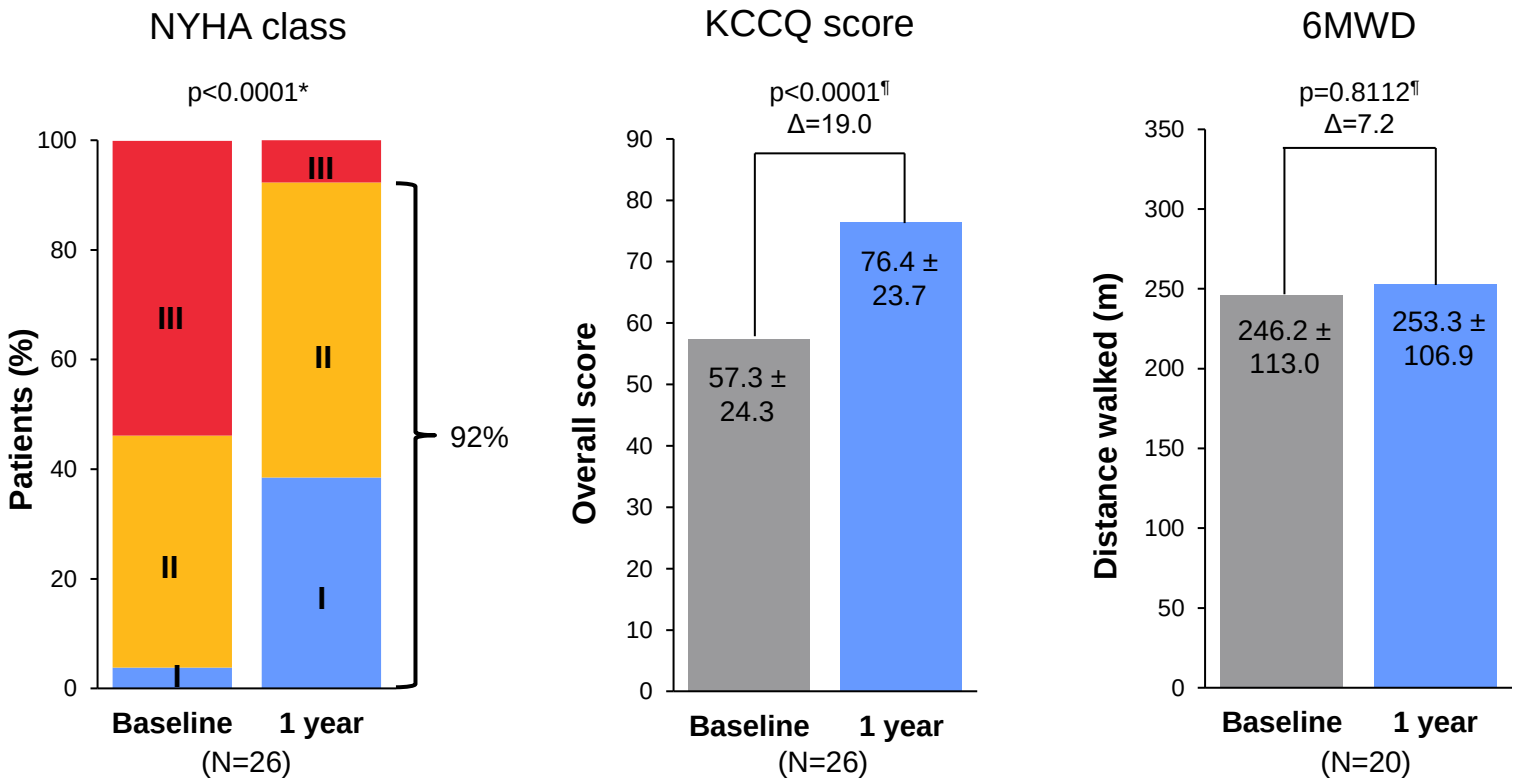
Echocardiographic improvements at 1 year



Parameter	Δ baseline to 1Y Mean ± SD (N)	P-value*
2D PISA EROA (cm^2)	-0.5 ± 0.3 (22)	<0.0001
Mean vena contracta (cm)	-0.8 ± 0.5 (25)	<0.0001
TV tenting height (end systole, apical 4Ch) (cm)	-0.2 ± 0.3 (19)	0.0299
RV end diastolic diameter mid (4Ch) (cm)	-0.6 ± 0.6 (26)	<0.0001
Inferior vena contracta diameter (cm)	-0.4 ± 0.6 (25)	0.0006
RV fractional area change (%)	-3.5 ± 7.1 (25)	0.0211

*P-values calculated by paired t-test

Clinical and quality-of-life improvements at 1 year



*Wilcoxon signed-rank test. ¶Paired t-test. NYHA, New York Heart Association; KCCQ, Kansas City Cardiomyopathy Questionnaire; 6MWD, 6-minute walk distance. CAUTION: Investigational device. Limited by Federal (or United States) law to investigational use.

Summary

- Medically “treated” severe TR has a poor outcome
- Surgical approaches have been associated with higher than acceptable mortality
- Multiple approaches to address severe TR
  - Two now have completed randomized trials vs. OMT---one further randomized trial completion imminent
  - These are likely to be the last RCT vs. OMT
- All studies generally demonstrate good safety profiles, sustained efficacy in TR reduction to 1 year and and improvements in PRO --- these results are remarkably consistent across devices

FDA Approves First Transcatheter Tricuspid Valve Replacement Device

(UPDATED) Edwards Lifesciences says there are "favorable trends" in hard outcomes among patients who have completed 1-year follow-up.

by L.A. McKeown | FEBRUARY 02, 2024

Thank you