

2023

11^{ème}

SÉMINAIRE de CARDIOLOGIE
INTERVENTIONNELLE de TROYES

01 & 02
AVRIL



SALLE DU CONSEIL MUNICIPAL
HOTEL DE VILLE de TROYES

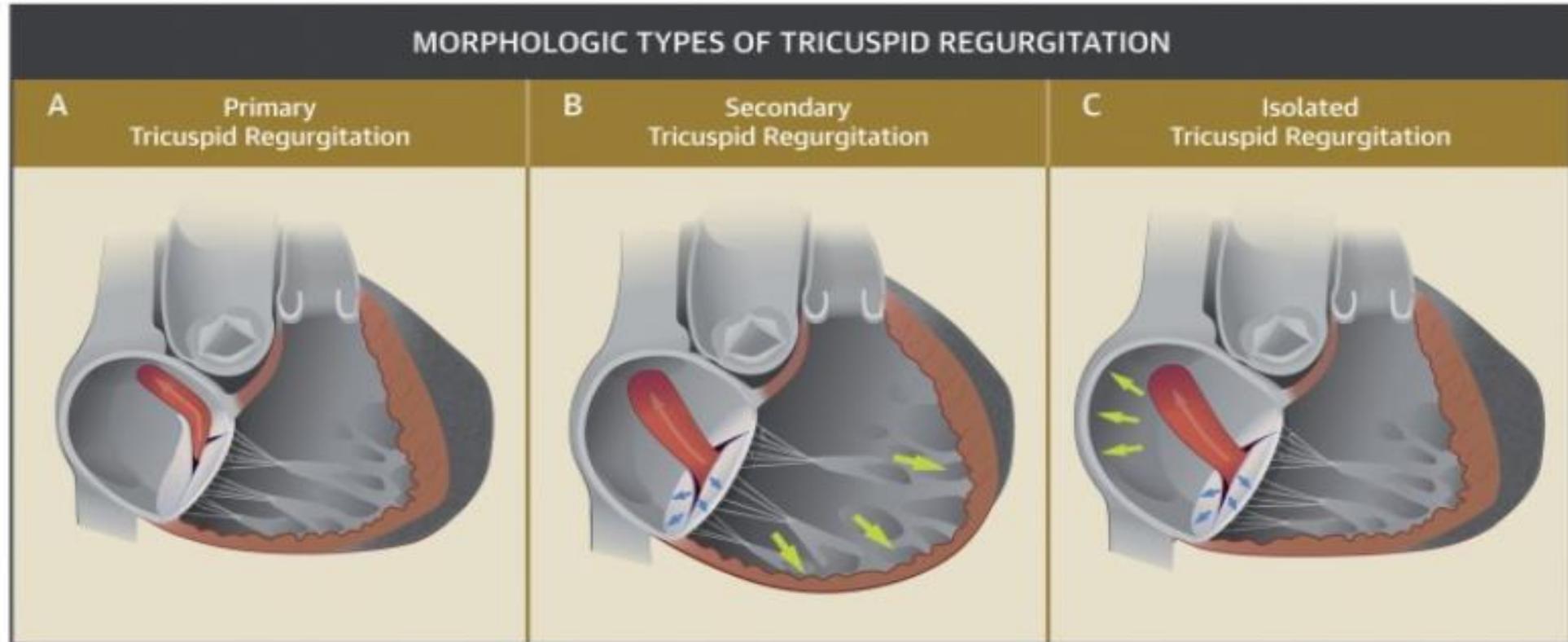


Insuffisance Tricuspidie: traitement percutané

Dr Madjid Boukantar
CHU Henri Mondor, Créteil
Madjid.boukantar@aphp.fr

Pourquoi des solutions percutanées ?

Généralités

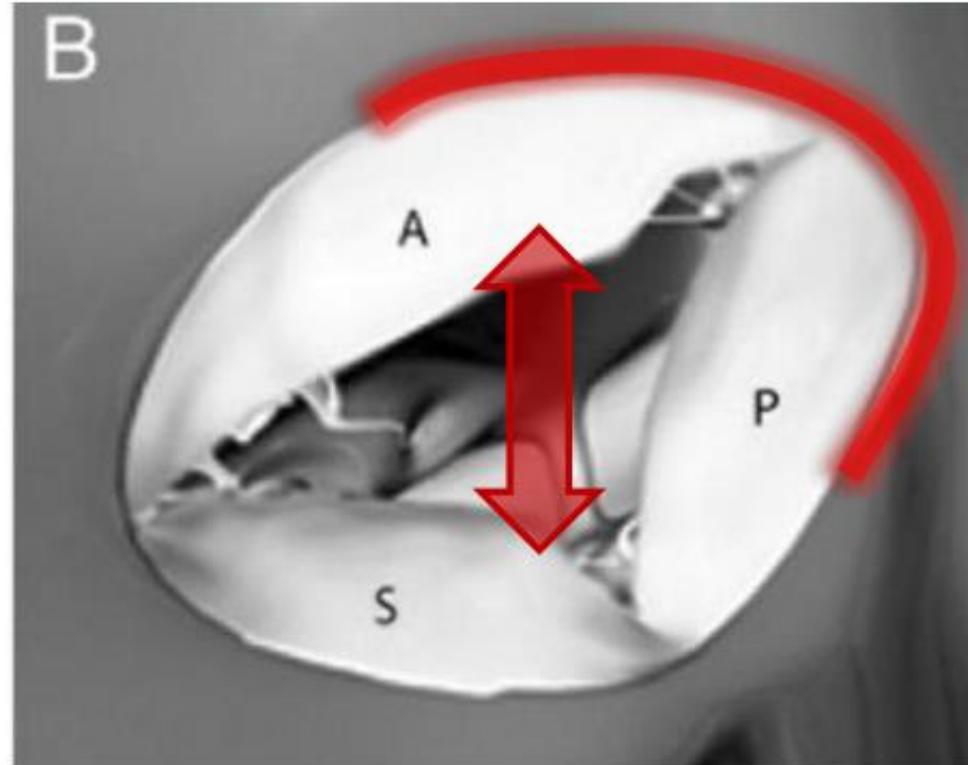
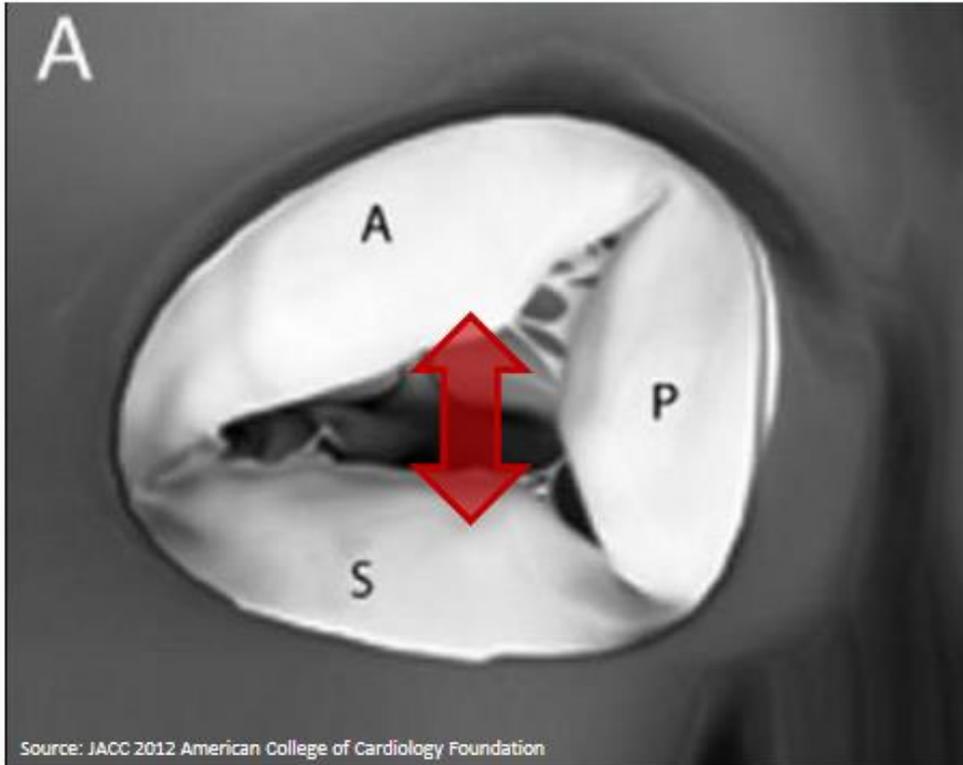


Prihadi, E.A. et al. J Am Coll Cardiol Img. 2019;12(3):491-9.

Mécanisme : dilatation annulaire

Valve Tricuspid Normale

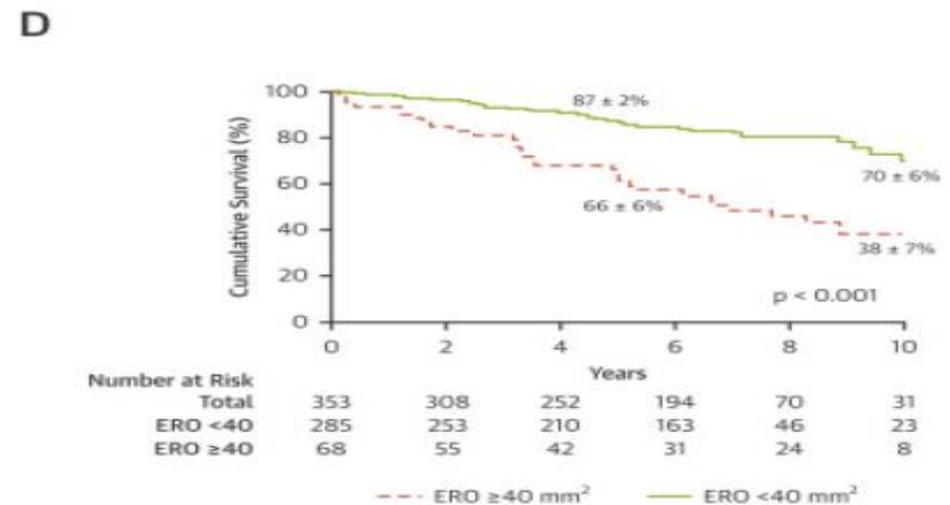
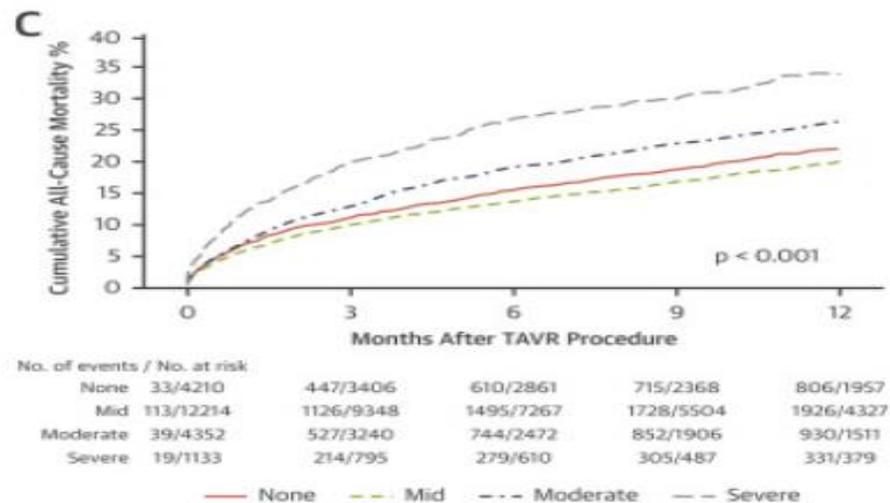
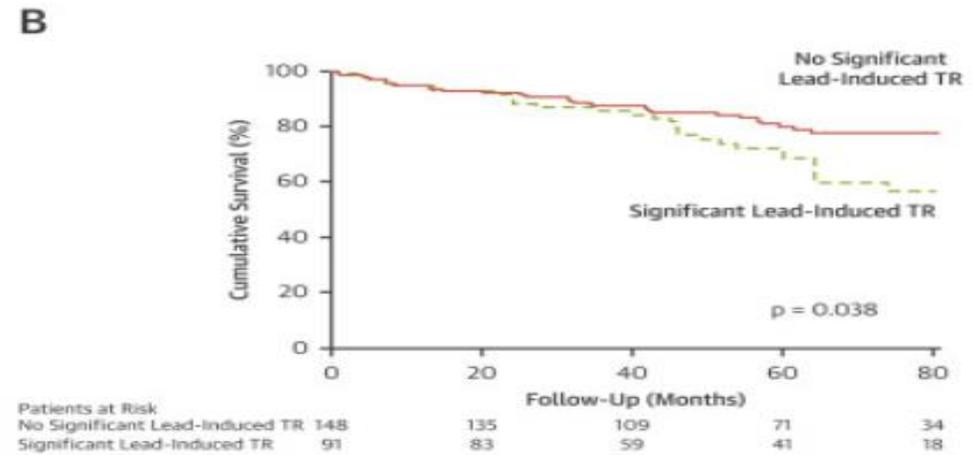
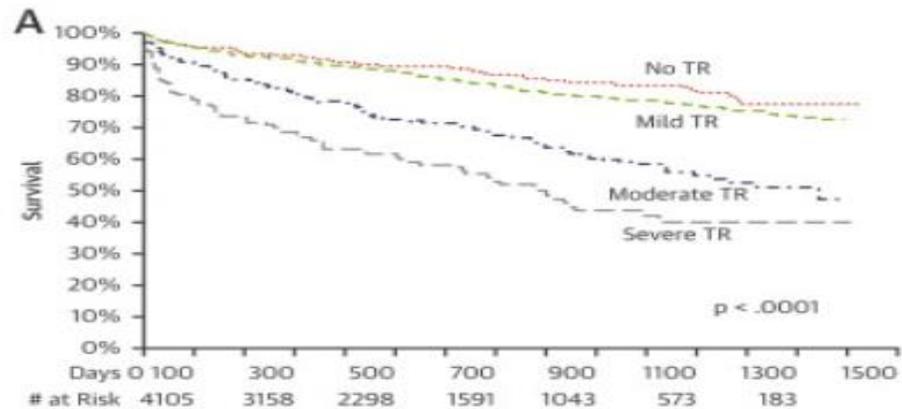
Dilatation Antero-Postérieur de l'Anneau Tricuspide



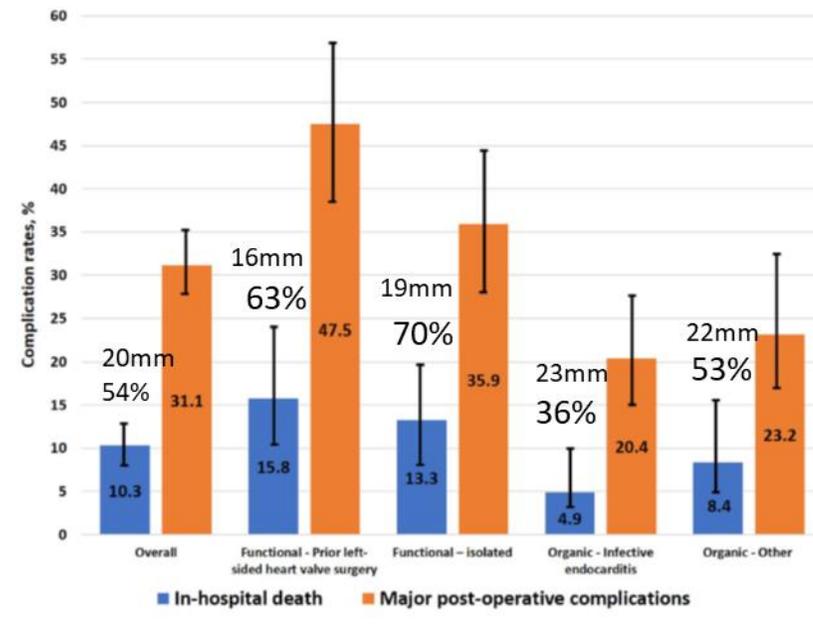
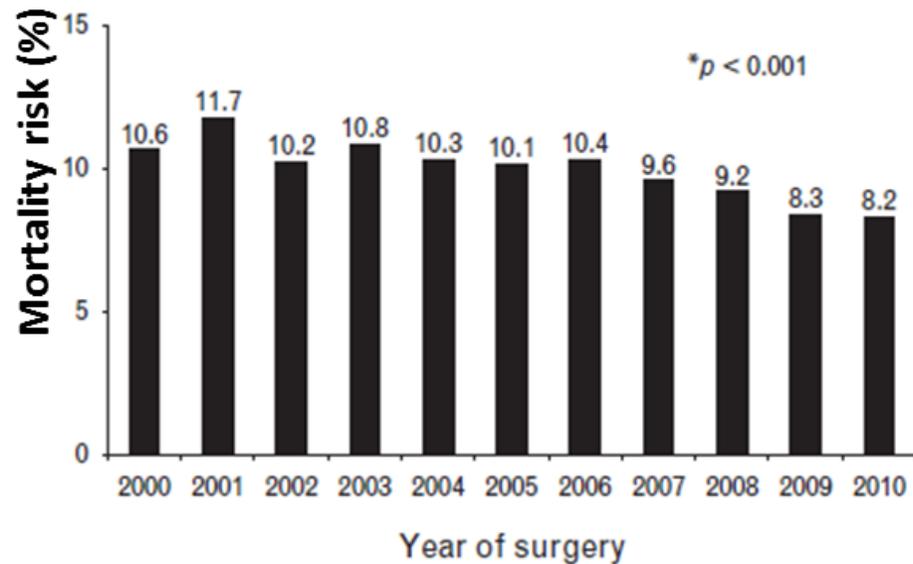
Source: JACC 2012 American College of Cardiology Foundation

A = Anterior leaflet; P = Posterior leaflet; S = Septal leaflet

Impact pronostic



Risque opératoire

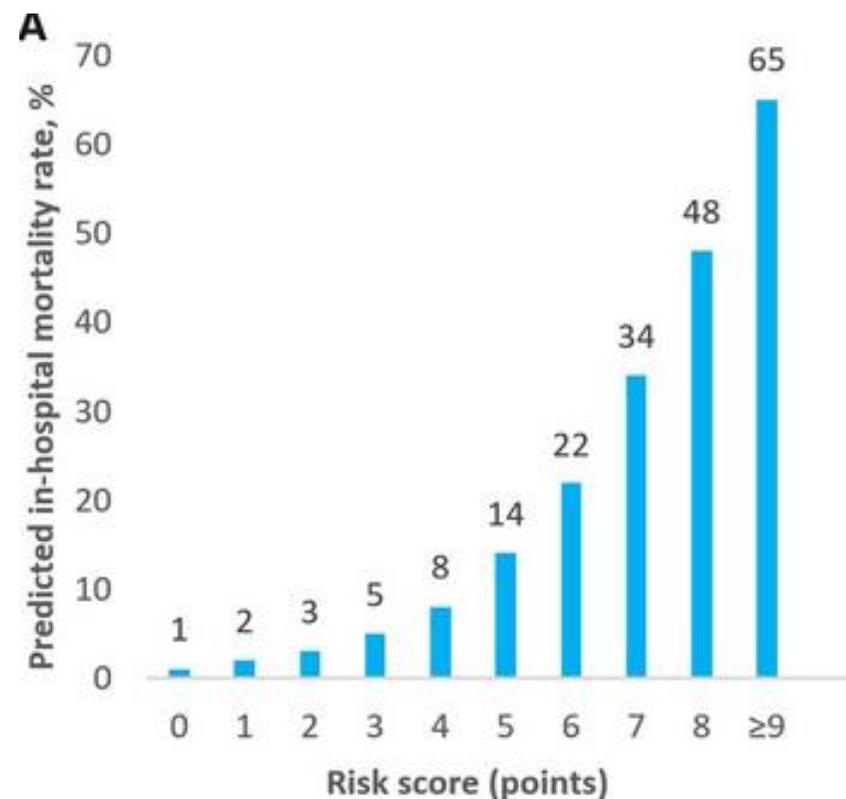


- ❑ La mortalité est d'environ 10% lorsque l'on inclut les fuites organiques et fonctionnelles
- ❑ Dans les fuites fonctionnelles pures, la mortalité est plutôt de 13 à 16%

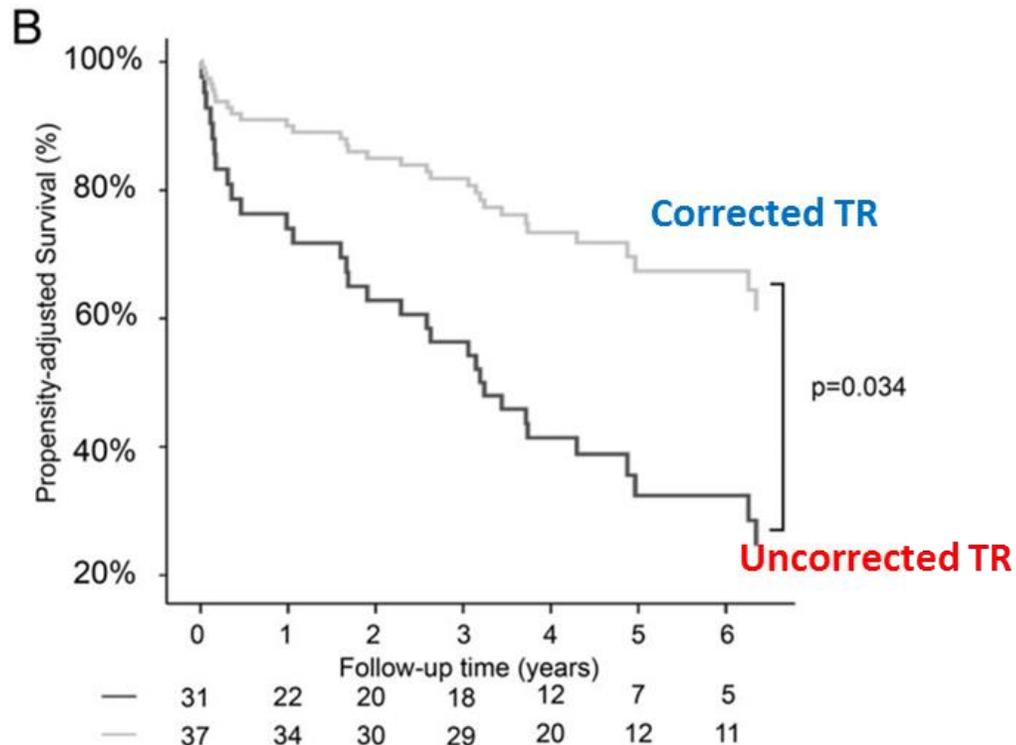
TRI-SCORE

Facteurs de risque et système de score pour la mortalité intrahospitalière après une chirurgie valvulaire tricuspide isolée

Facteurs de risque (modèle final issu d'une analyse multivariée)	Score
Âge \geq 70 ans	1
Classe fonctionnelle NYHA III-IV	1
Signes d'insuffisance cardiaque droite	2
Dose quotidienne de furosémide 125 mg	2
Débit de filtration glomérulaire < 30 ml/min	2
Élévation de la bilirubine totale	2
Fraction d'éjection ventriculaire gauche < 60 %	1
Dysfonction ventriculaire droite modérée/sévère	1
Total	12

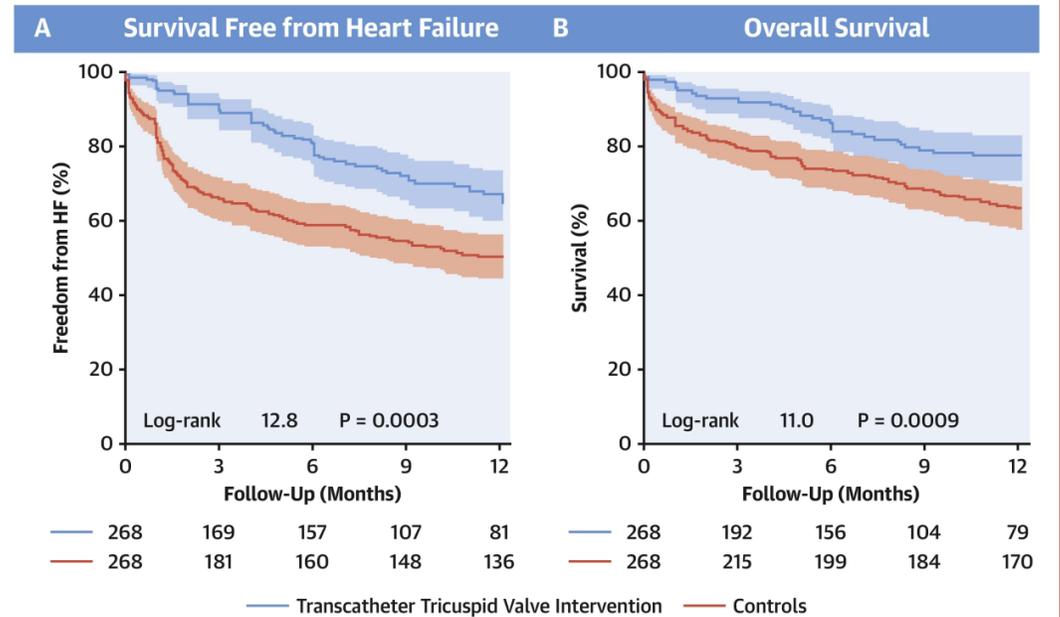


Faut-il corriger les IT?



Rogers Curr Opin Cardiol 2014

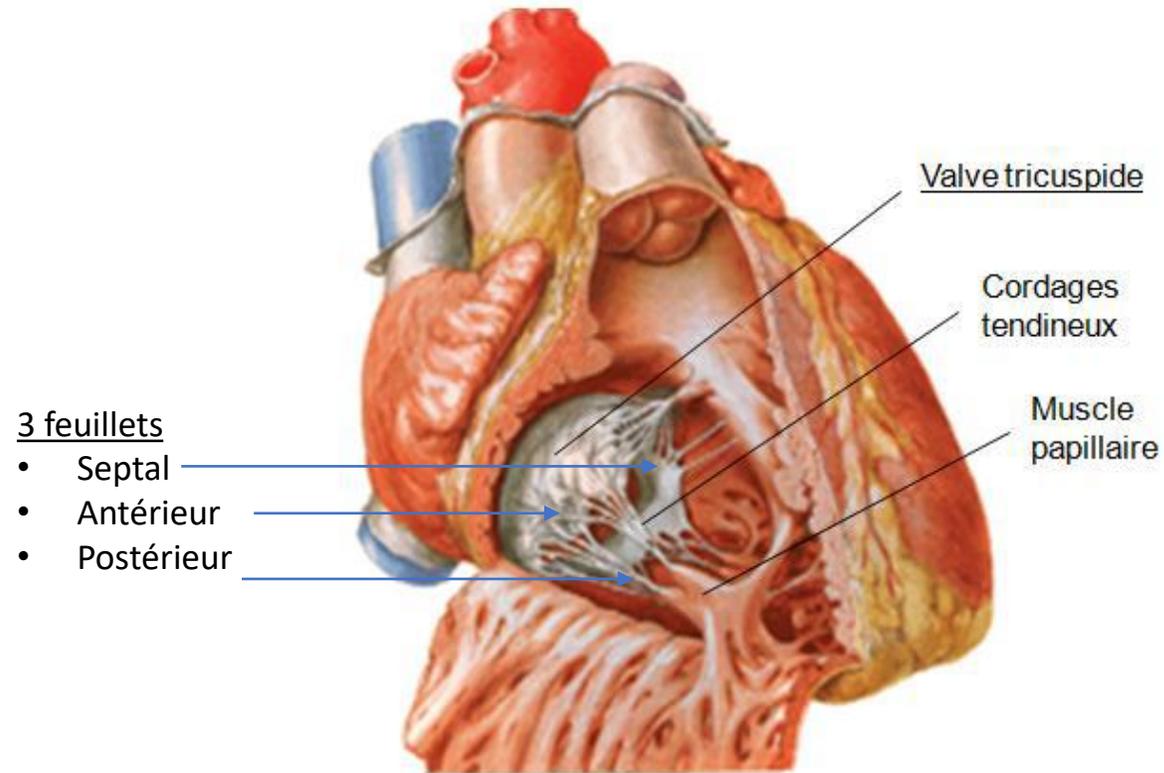
CENTRAL ILLUSTRATION: Transcatheter Treatment of Severe Tricuspid Regurgitation: Primary and Secondary Endpoints



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

Maurizio Taramasso, J Am Coll Cardiol 2019

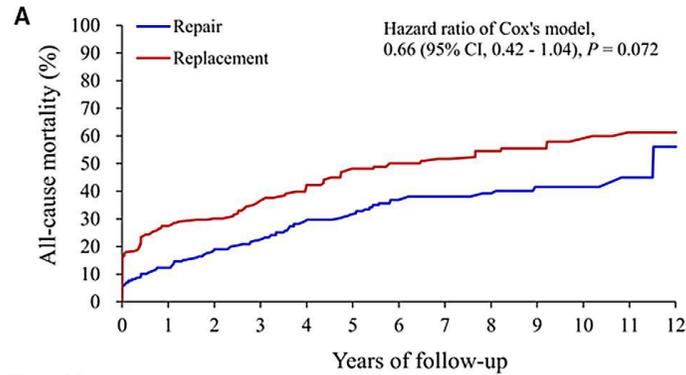
Réparer ou remplacer?



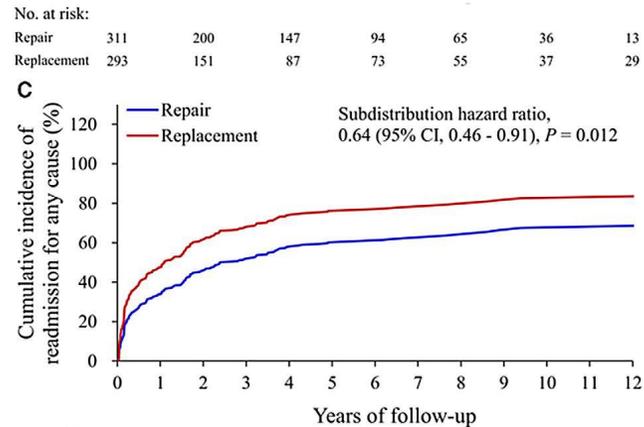
- 3 feuillets
 - Nombreux cordages
- complique potentiellement la réparation

Isolated tricuspid surgery

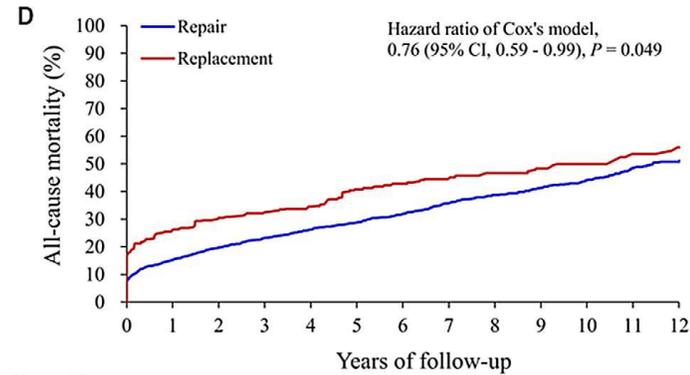
Concomitant tricuspid surgery



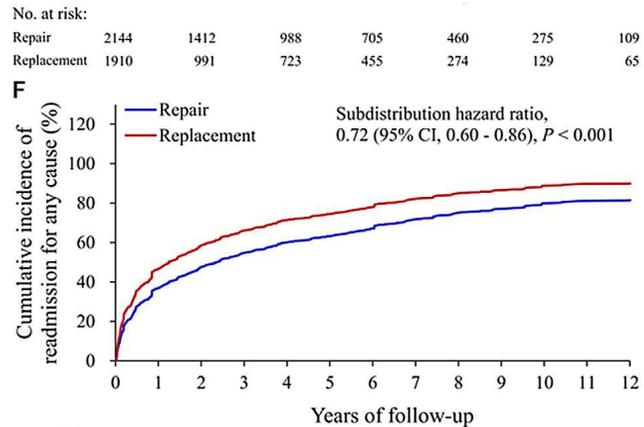
No. at risk:								
Repair	330	223	162	107	75	47	22	
Replacement	340	194	148	103	73	49	31	



No. at risk:								
Repair	311	140	75	54	34	19	8	
Replacement	293	71	32	19	12	3	3	



No. at risk:								
Repair	2312	1586	1186	888	602	380	161	
Replacement	2281	1348	1038	643	420	255	118	



No. at risk:								
Repair	2144	931	516	321	168	83	30	
Replacement	1910	604	401	199	84	38	26	

Journal of the American Heart Association

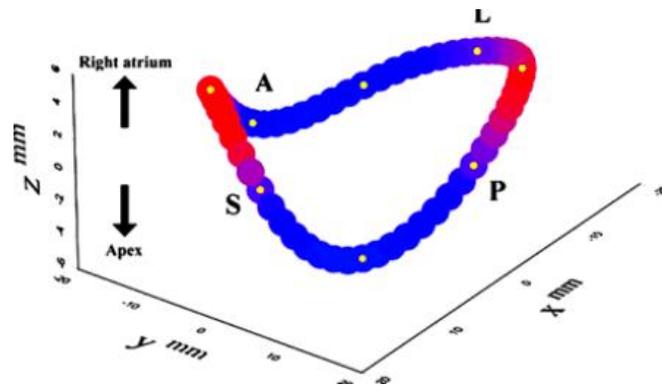
2020

ORIGINAL RESEARCH

Late Outcomes of Valve Repair Versus Replacement in Isolated and Concomitant Tricuspid Valve Surgery: A Nationwide Cohort Study

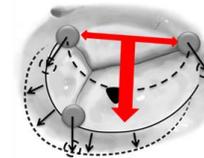
Wang-Kin Wong , BDS, MD¹; Shao-Wei Chen , MD, PhD²; An-Hsun Chou, MD, PhD³; Hsiu-An Lee, MD⁴; Yu-Ting Cheng, MD⁵; Feng-Chun Tsai, MD⁶; Kuang-Tso Lee, MD⁷; Victor Chien-Chia Wu, MD⁸; Chun-Li Wang, MD⁹; Shang-Hung Chang, MD, PhD¹⁰; Pao-Hsien Chu, MD¹¹

Réparer ou remplacer?

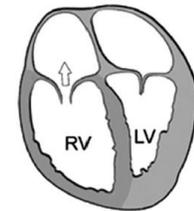


Diamètre <40mm ou <21mm/m²
Normal=28±5mm²
Surface =8cm²
Variation de surface 30%

1- Dilatation de l'anneau



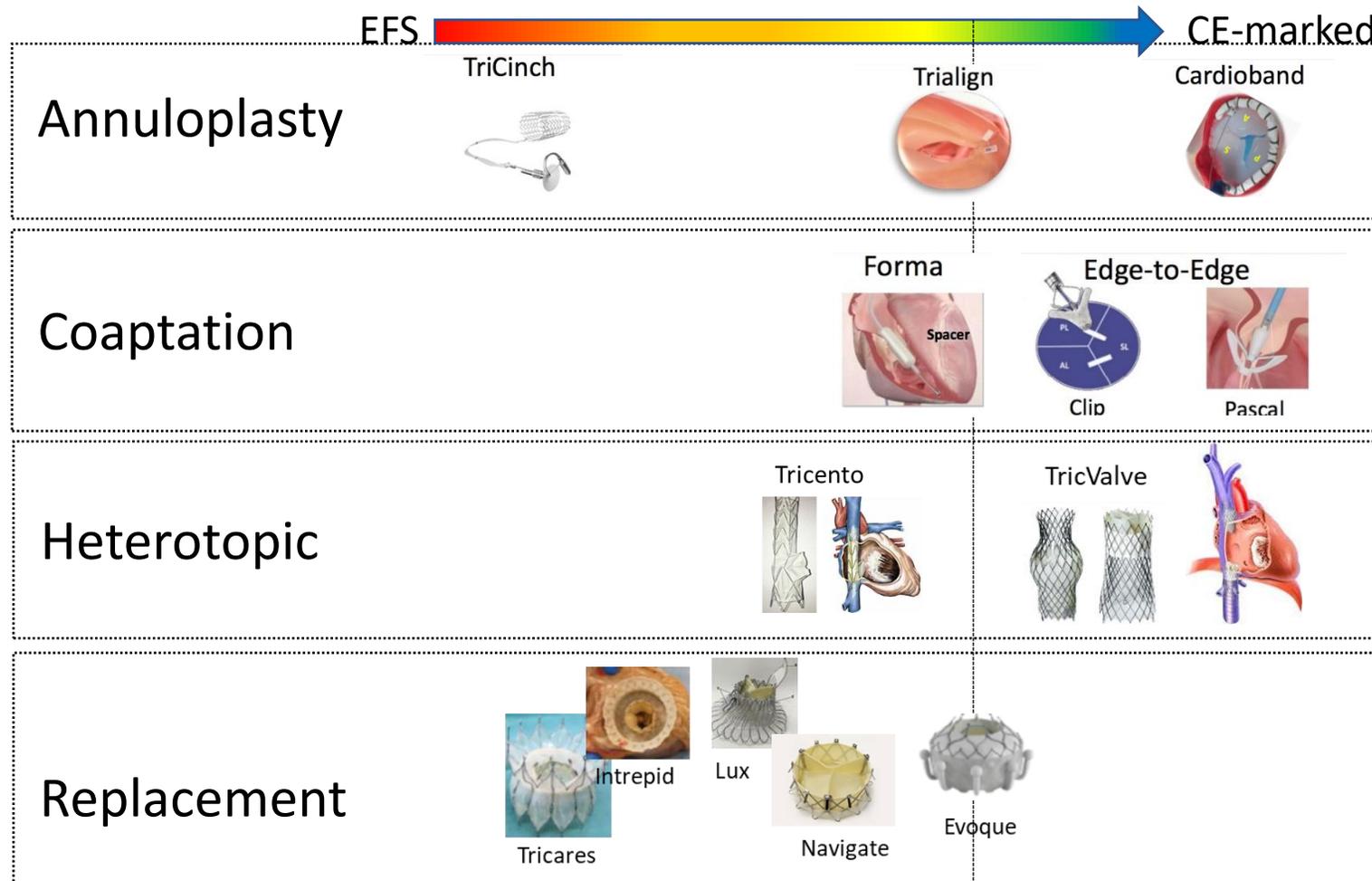
2- Dilatation du VD



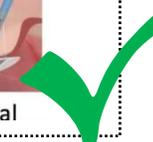
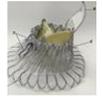
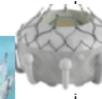
- Anneau en forme de selle de cheval
- Variation au cours du cycle cardiaque
- Dilatation importante anneau et VD
- Pas de « landing zone » évidente, pas de calcifications
- Faible épaisseur du tissu myocardique
- Proximité de la coronaire droite à l'anneau tricuspide

→ complique potentiellement le remplacement

Différentes possibilités

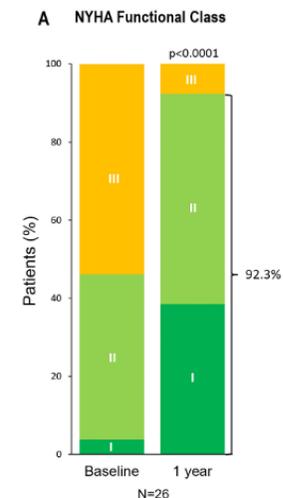
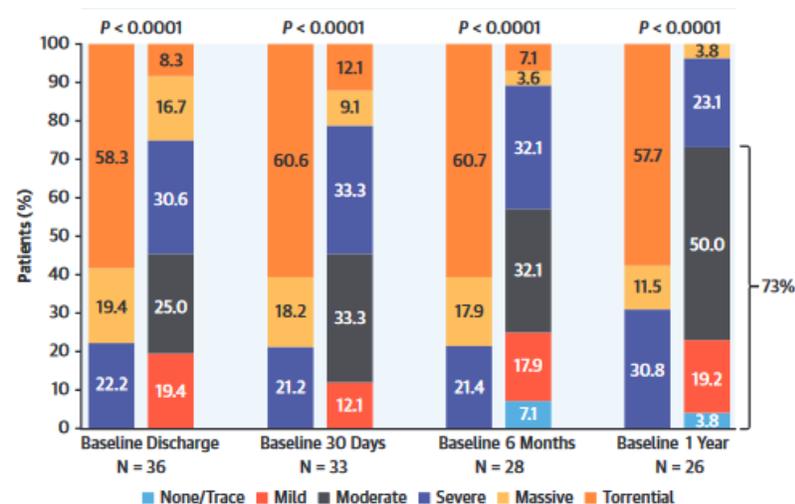


Différentes possibilités

	EFS		CE-marked		
Annuloplasty	TriCinch 	Trialign 	Cardioband 		
Coaptation		Forma 	Edge-to-Edge Clip 	Pascal 	
Heterotopic		Tricento 	TricValve 		
Replacement	Navigate 	Intrepid 	Lux 	Tricares 	Evoque 

Annuloplasty: cardioband

Cardioband Anchor Deployment

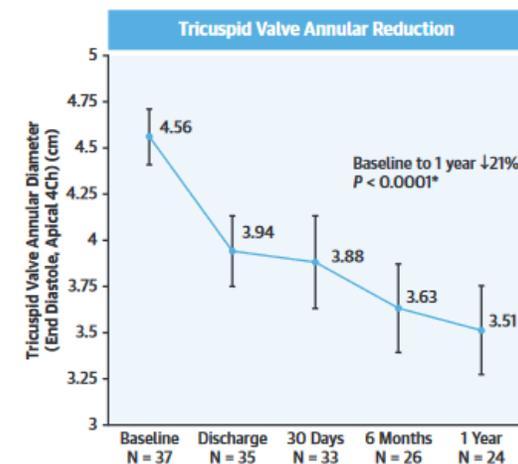


Population: IT fonctionnelle sévère (EROA=0.79±0.51cm²)

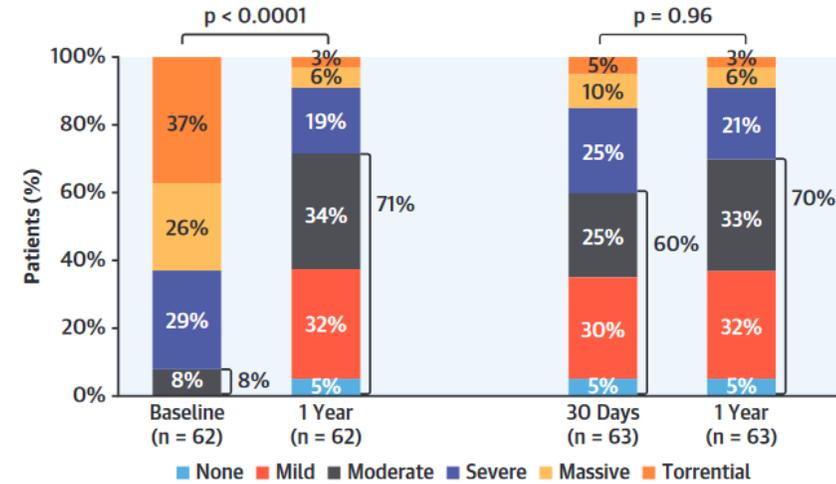
Résultats: Succès d'implantation 100%, mortalité péri-procédure: 6,7%
Amélioration clinique (82% vs. 17% en classe NYHA II à 2 ans)

Limites

Durée de procédure : **4,2±1,5 heures** (16 vis en moyenne) - ETO+++
Efficacité modérée sur la fuite [**24% grade ≤II**, à 1 an]



Réparation bord à bord: triclip



Population: N=85 patients IT fonctionnelle modérée à sévère (EROA=0.65±0.29 cm²)

Résultats: 5% de mortalité à 1 mois (non liée à la procédure) 90% Succès implantation –

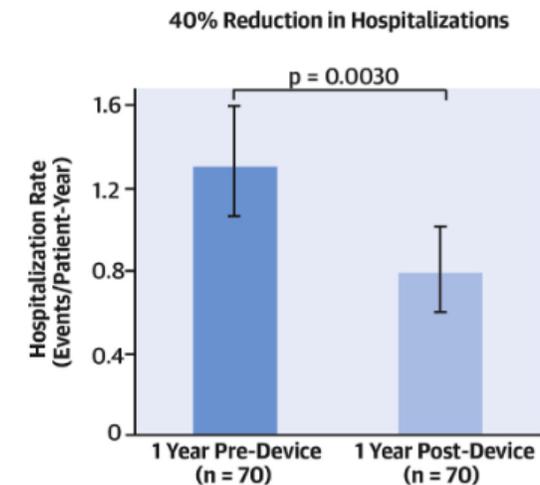
Amélioration clinique soutenue (80% vs. 25% en classe NYHA I-II à 1 mois et un an)

Limites

Durée de procédure : 2,6±1 heures (67% 1-2 clips -77% sur la commissure AS)

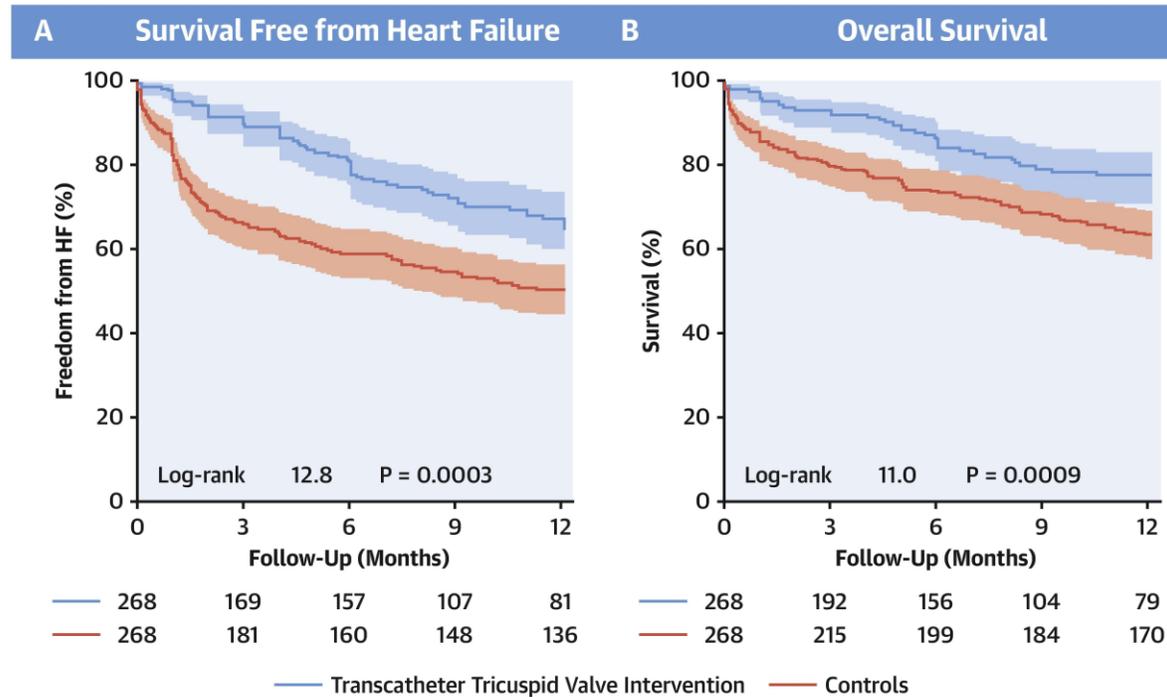
Qualité imagerie ETO +++

Efficacité modérée sur la fuite [37% grade ≤II, 70% ≤3]



Réparation bord à bord: clip

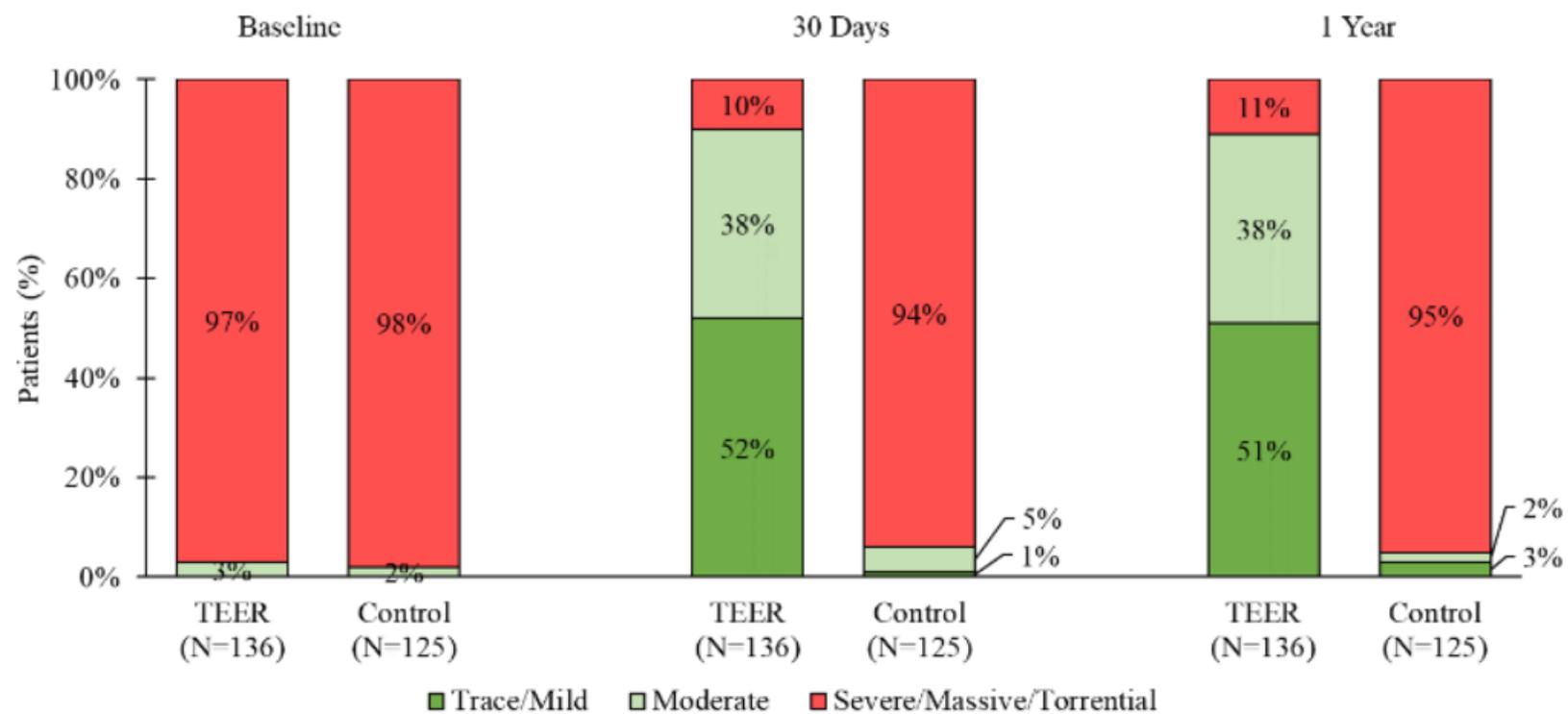
CENTRAL ILLUSTRATION: Transcatheter Treatment of Severe Tricuspid Regurgitation: Primary and Secondary Endpoints



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

Transcatheter Versus Medical Treatment of Patients With Symptomatic Severe Tricuspid Regurgitation

Registre TTVR vs. contrôles appariés
229/268 Mitraclip (85%)



ORIGINAL ARTICLE

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*

ABSTRACT

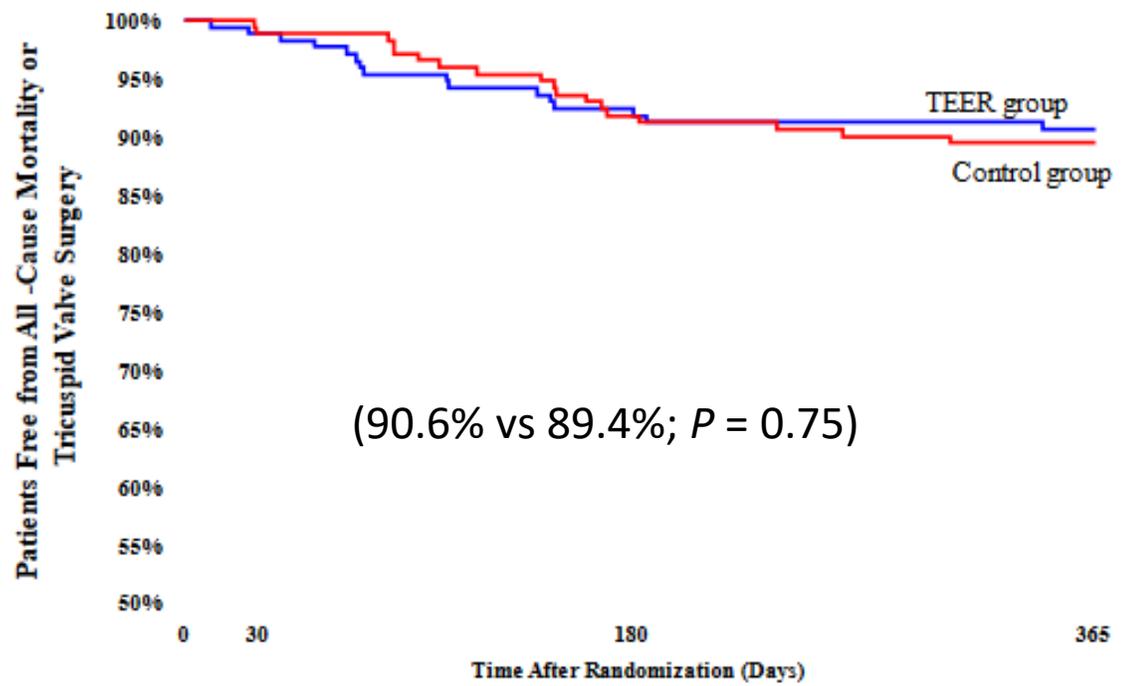
Characteristic	TEER Group (N=175)	Control Group (N=175)
Age — yr	78.0±7.4	77.8±7.2
Female sex — no. (%)	98 (56.0)	94 (53.7)
New York Heart Association class III or IV — no. (%)	104 (59.4)	97 (55.4)
Atrial fibrillation — no. (%)	153 (87.4)	162 (92.6)
Atrial flutter — no./total no. (%)	20/174 (11.4)	22/174 (12.6)
Dyslipidemia — no. (%)	117 (66.9)	92 (52.6)
Hypertension — no. (%)	142 (81.1)	141 (80.6)
Stroke — no. (%)	11 (6.3)	19 (10.9)
Transient ischemic attack — no. (%)	13 (7.4)	17 (9.7)
Diabetes mellitus — no. (%)	28 (16.0)	27 (15.4)
Peripheral vascular disease — no. (%)	16 (9.1)	18 (10.3)
Coronary-artery bypass grafting — no. (%)	31 (17.7)	36 (20.6)
Percutaneous coronary intervention — no. (%)	26 (14.9)	23 (13.1)
Kidney disease — no. (%)	62 (35.4)	62 (35.4)

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 \pm 1.8	0.6 \pm 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 \pm 10.5	-25.2 \pm 10.3	17.1 (-12.0 to 46.1)	0.25

* Plus–minus values are means \pm SD. All analyses were performed in the intention-to-treat population (all patients who underwent randomization, grouped according to their assigned treatment) unless otherwise noted. CI denotes confidence interval.

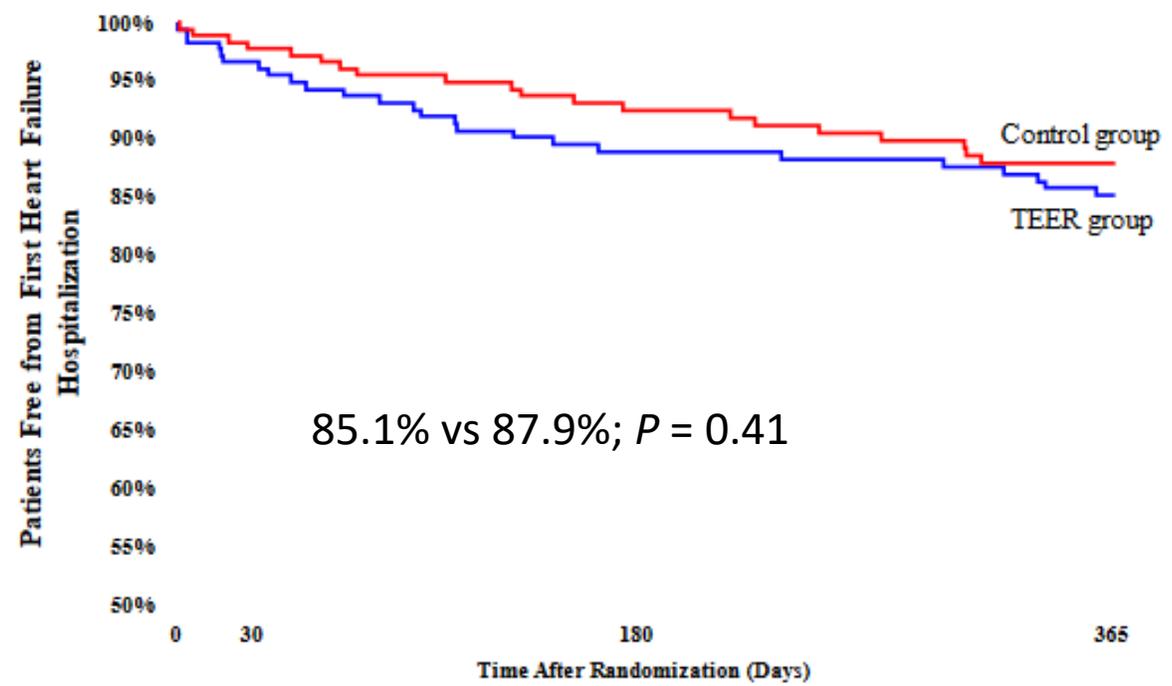
A

Freedom from All -Cause Mortality or Tricuspid Valve Surgery

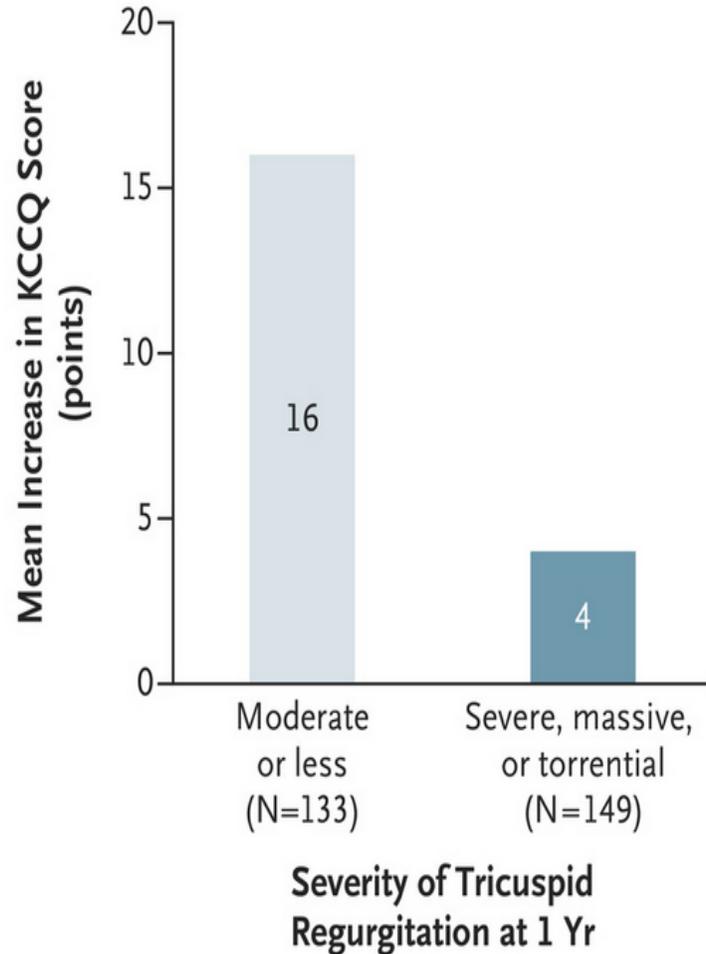


B

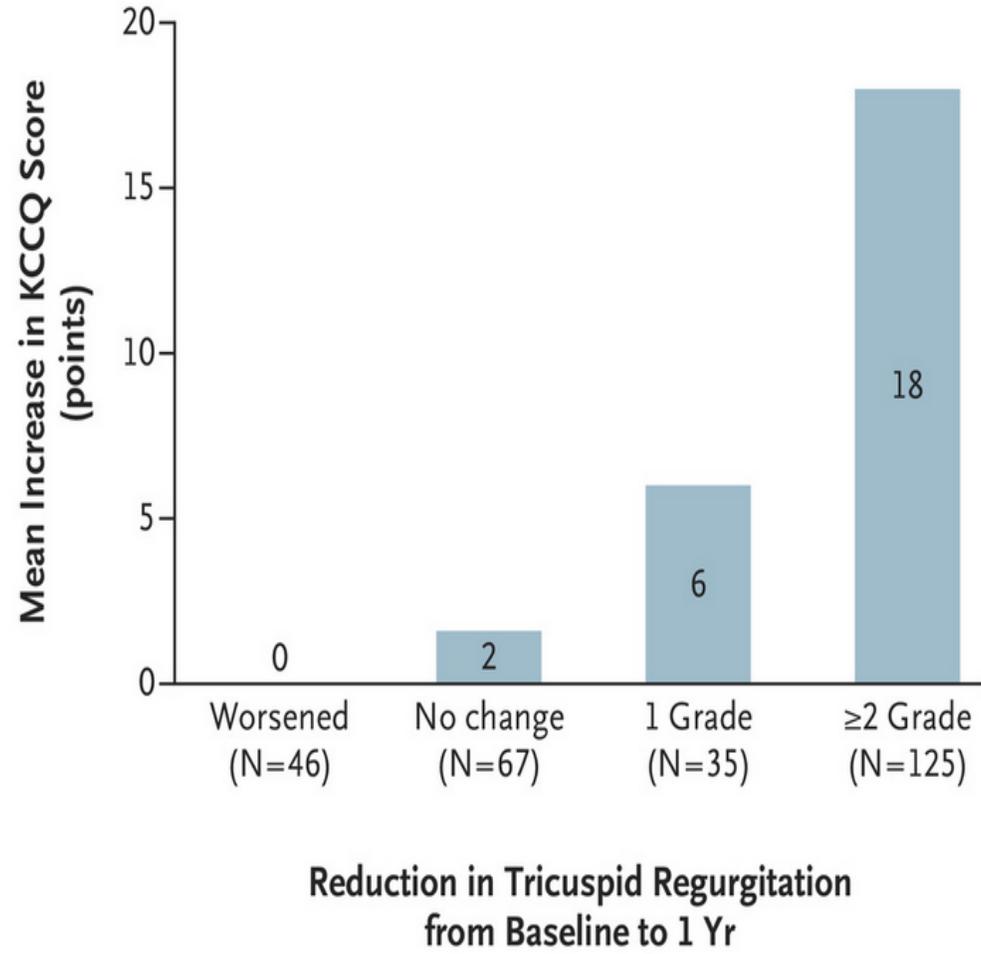
Freedom from First Heart Failure Hospitalization



A Change in Quality of Life According to Severity of Residual Tricuspid Regurgitation



B Change in Quality of Life According to Magnitude of Reduction in Tricuspid Regurgitation



Conclusions

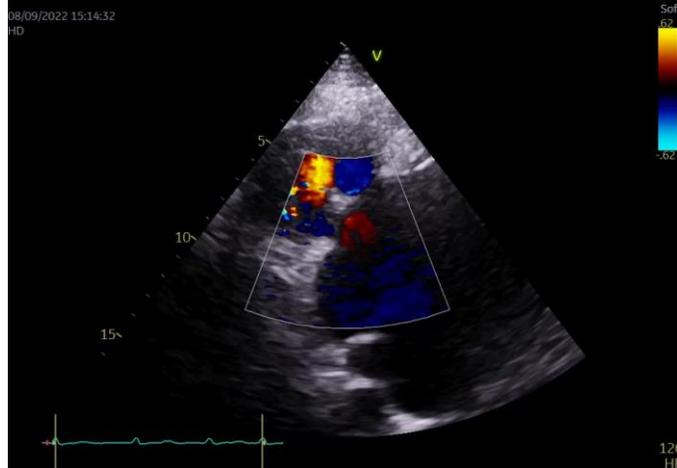
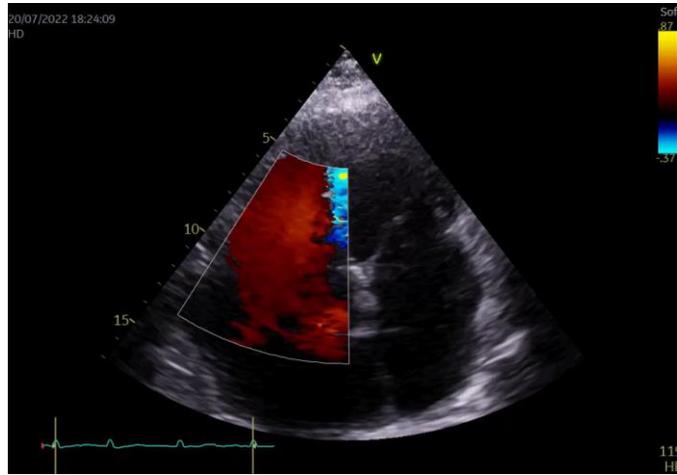
- Procédure sûre
- Procédure efficace
- Bénéfice sur la réduction de la fuite
- Bénéfice sur la qualité de vie et les symptômes
- Pas de bénéfice sur la survie et les hospitalisations à 12 mois

Réparation bord à bord: clip

Femme 75 ans. FA permanente depuis 2010

Cardiopathie rythmique avec dilatation majeure de l'OD et fuite tricuspide torrentielle

Décision de réparation percutanée par Mitraclip



Le remplacement valvulaire

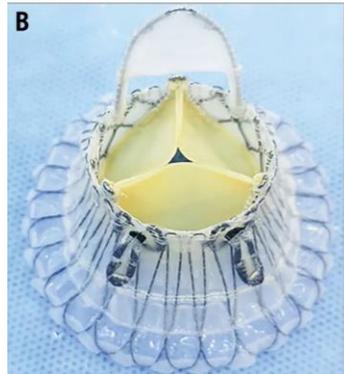
Valves

A

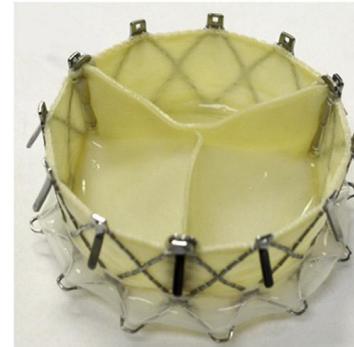


Evoque

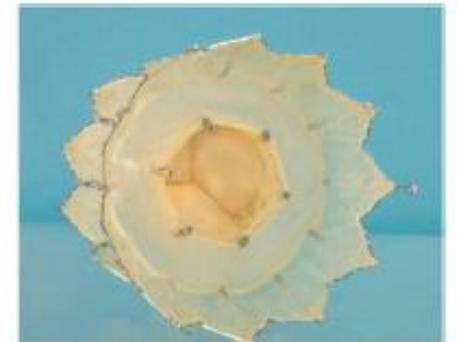
B



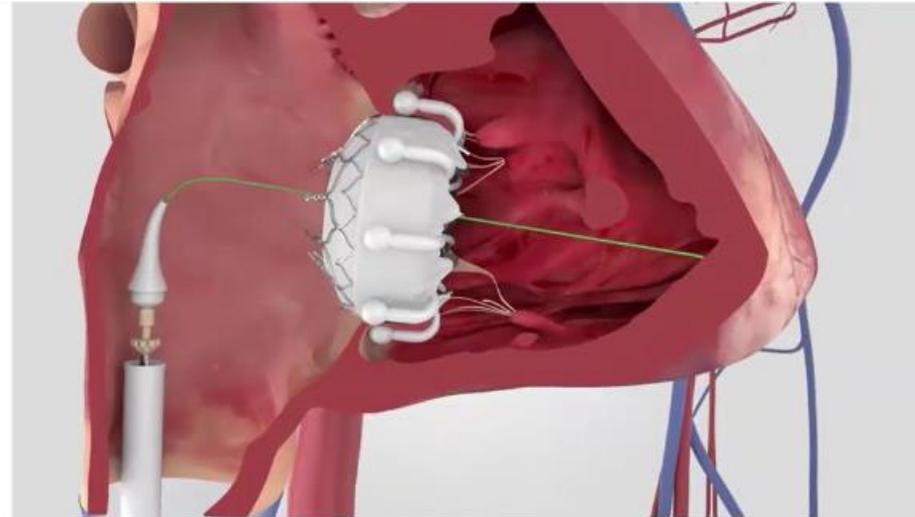
Luxvalve



Navigate



Valve Evoque



Atraumatic anchors compatible with pre-existing leads and respect the native anatomy

Conforming frame designed to achieve optimal retention force

Multiple sizes offer treatment for a broad range of tricuspid pathologies and anatomies (52, 48, 44 mm)

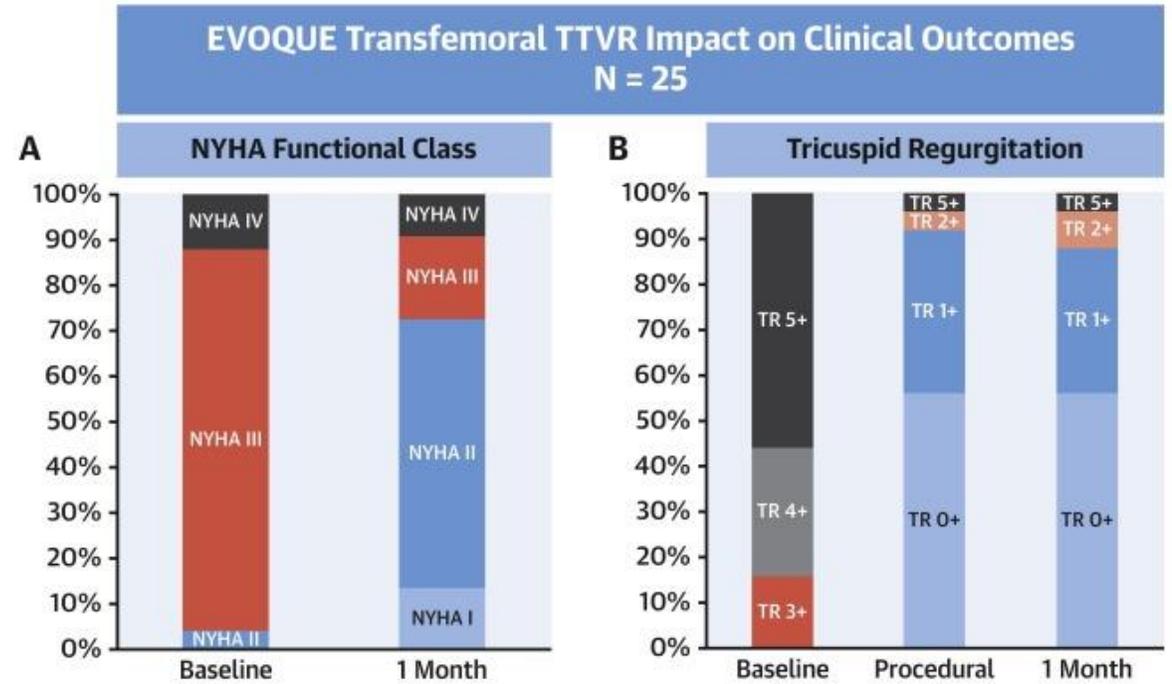
28F transfemoral delivery system compatible with all valve sizes

TRISCEND Study : 1 month

A



CENTRAL ILLUSTRATION: Outcomes After EVOQUE Transfemoral Transcatheter Tricuspid Valve Replacement for Severe Tricuspid Regurgitation



Fam, N.P. et al. J Am Coll Cardiol Interv. 2021;14(5):501-11.

TRISCEND Study : 6-months



TRISCEND study 6-months



#PCRTricuspid

Early feasibility study to evaluate the Safety and Performance of the Edwards EVOQUE TTVR System

Prospective, single-arm, multicenter study

<ul style="list-style-type: none"> • Tricuspid regurgitation affects a large, often undertreated, population. • TTVR therapy using the EVOQUE system proved to be feasible, acceptable in terms of safety profile, and effective at 30 days. 	<ul style="list-style-type: none"> ➤ High risk population: <ul style="list-style-type: none"> • mean age of 79.2 ± 7.39 years • mean STS score (MV repair) of 7.4 ± 5.39% • 90% in atrial fibrillation • High bleeding risk • TR at least severe in 88% of patients ➤ Device success: 96.2% ➤ Median length of stay: 3 days (0.35) ➤ Composite of MAEs: 18.5% ➤ Severe bleeding: 17.7% ➤ Bleeding related to the main procedure: 1.6% ➤ New permanent pacemaker: 10.5% ➤ Stroke: 0% ➤ Myocardial infarction: 0% 	<ul style="list-style-type: none"> ➤ All cause Mortality: 3.2% ➤ Cardiovascular Mortality: 2.4% ➤ TR severity @6m: 100% TR≤1 ➤ KM Survival @6m: 96±2% ➤ KM Freedom from HF Hospitalization @6m: 94±2% ➤ KM composite MAEs: 20±4%
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TTVR using the EVOQUE system demonstrated favorable 30-day outcomes sustained at 6-months showing significant TR reduction, 96% of survival, 94% of freedom from HF hospitalization, improvements in NYHA class, KCCQ score and 6MWD

Designed by @Sticht_Alex & @Coriolisnothas

LuX-Valve

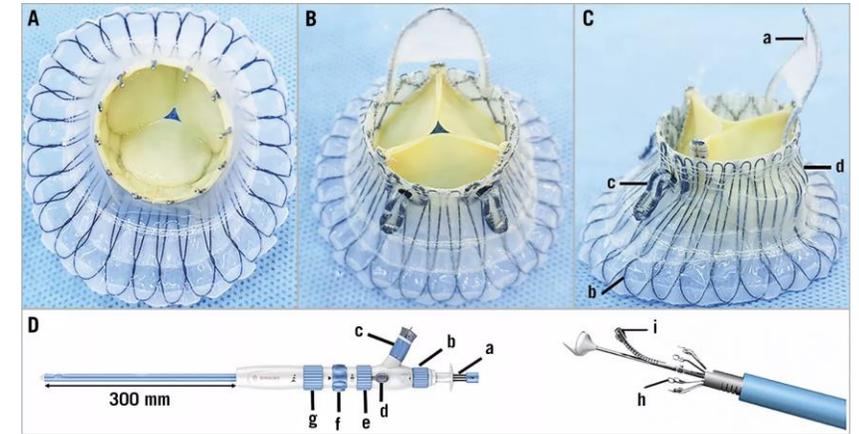
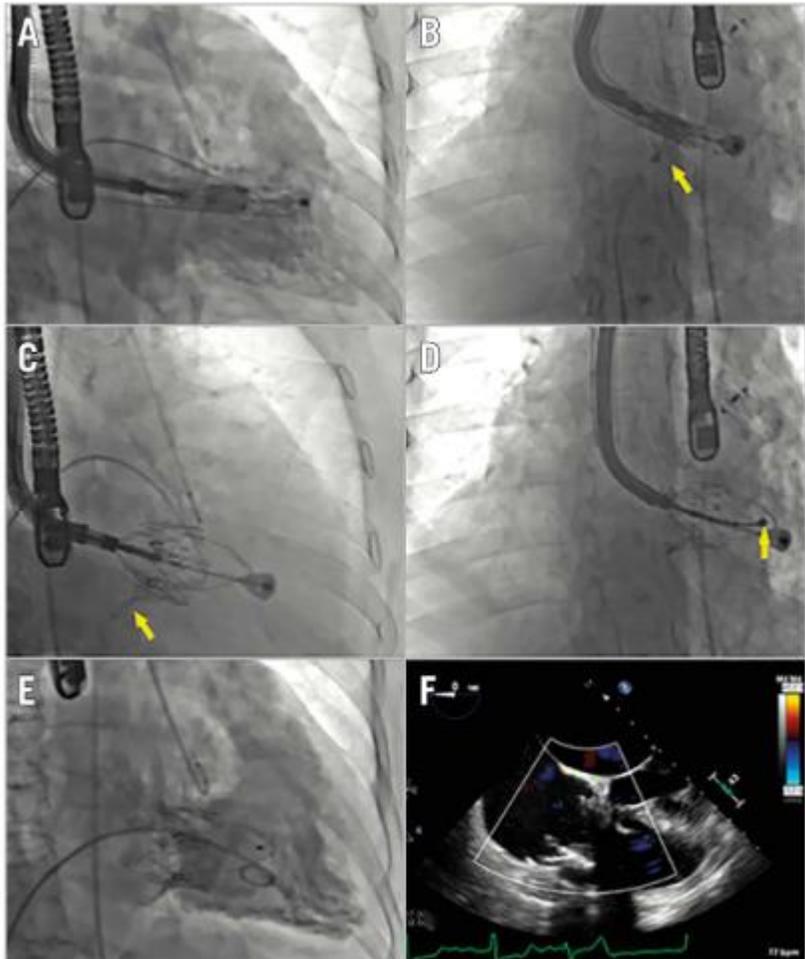


Table 2. Clinical outcome at 30-day follow-up (n=6).

Mortality	0 (0)
Myocardial infarction	0 (0)
Stroke	0 (0)
Convention to surgery	0 (0)
Heart failure hospitalisation	0 (0)
Major bleeding	1 (17%)
Conduction abnormality requiring pacemaker	0 (0)
Dialysis	0 (0)

Table 3. Baseline and follow-up echocardiographic parameters.

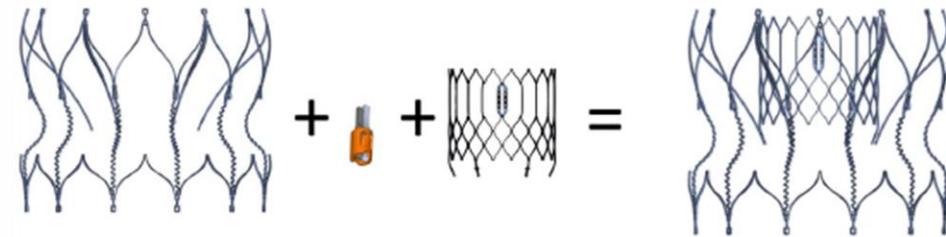
Baseline echo parameters		Patient #1	Patient #2	Patient #3	Patient #4	Patient #5	Patient #6
LAESVI, ml/s ²		1,068.9	401.3	159.7	94.9	89.3	306.3
LVEDVI, ml/s ²		97.1	56.6	45.6	83.2	56.4	68.0
LVEF, %		60	60	64	56	70	55
RAESVI, ml/s ²		167.3	145.7	75.1	126.0	319.5	330.5
RVEDAI, cm ² /s ²		14.3	16.5	13.7	16.1	24.6	28.9
TAPSE, cm		1.5	1.8	2.0	1.2	1.3	1.1
RV fractional area change, %		25	45	47	23	22	48
RV global longitudinal strain, %		-13.7	-10.2	-12.6	-15.7	-14.9	-12.8
Mean transvalvular gradient, mmHg		2.2	4.6	3.7	3.3	6.6	4.5
TR defining parameters	EROA, cm ²	1.0	0.7	1.1	0.9	1.2	0.8
	VC width, mm	11	8	13	10	16	9
	IVC, mm	28	24	29	28	30	32
TR grade		Torrential	Massive	Torrential	Torrential	Torrential	Torrential
TV annular diameter (4Ch, end-diastole), cm		4.0	4.1	4.1	4.6	4.7	4.4
Minimum/maximum diameters of TV annular (3D TEE, end-diastolic), cm		3.8x4.1	4.0x4.3	4.1x4.2	4.1x4.6	4.1x4.7	4.0x4.5
Baseline CT annular measurements (end-diastolic)	Minimum/maximum diameters, cm	3.9x4.3	3.9x4.4	4.0x4.2	4.2x4.8	4.3x5.0	4.1x4.7
	LuX-Valve model implanted	JS/TTVI-28-50	JS/TTVI-28-50	JS/TTVI-28-50	JS/TTVI-28-55	JS/TTVI-28-55	JS/TTVI-28-55
Release time of the guiding sheath, min		10.7	6.2	8.5	9.8	13.6	9.1
Intraprocedural, post-device TEE	Tricuspid regurgitation, total	Moderate	No	No	Mild	Mild	Mild
	Central	No	No	No	No	No	No
	Paravalvular	Moderate	No	No	Mild	Mild	Mild
One-year follow-up, post-device TTE	RAESVI, ml/s ²	/	85.9	56.4	93.3	105.4	152.0
	RVEDAI, cm ² /s ²	/	9.7	8.3	11.5	19.8	17.7
	TAPSE, cm	/	2.0	1.8	1.7	1.5	1.9
	RV fractional area change, %	/	47	39	32	26	40
	RV global longitudinal strain, %	/	-17.5	-19.3	-22.1	-20.4	-18.2
	Mean transvalvular gradient, mmHg	/	3.1	2.4	1.8	4.1	2.2
	Tricuspid regurgitation, total	/	No	No	Mild	Mild	Mild
	Central	/	No	No	No	No	No
Paravalvular	/	No	No	Mild	Mild	Mild	

Release time of the guiding sheath, min		10.7	6.2	8.5	9.8	13.6	9.1
Intraprocedural, post-device TEE	Tricuspid regurgitation, total	Moderate	No	No	Mild	Mild	Mild
	Central	No	No	No	No	No	No
	Paravalvular	Moderate	No	No	Mild	Mild	Mild
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	Mean transvalvular gradient, mmHg	/	3.1	2.4	1.8	4.1	2.2
	Tricuspid regurgitation, total	/	No	No	Mild	Mild	Mild
	Central	/	No	No	No	No	No
Paravalvular	/	No	No	Mild	Mild	Mild	

CT: computed tomography; EROA: effective regurgitant orifice area; IVC: inferior vena cava; LAESVI: left atrium end-systolic volume index; LVEDVI: left ventricular end-diastolic volume index; LVEF: left ventricular ejection fraction; RAESVI: right atrium end-systolic volume index; RV: right ventricular; RVEDAI: right ventricular end-diastolic area index; TAPSE: tricuspid annular plane systolic excursion; TEE: transoesophageal echocardiography; TR: tricuspid regurgitation; TV: tricuspid valve

Twelve-month outcomes of the LuX-Valve for transcatheter treatment of severe tricuspid regurgitation

TRICARES : TOPAZE



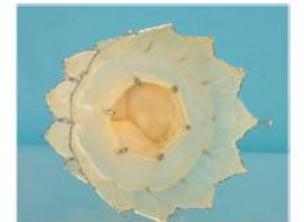
- stent très souples permettant de suivre les variations géométriques du VD
- Dé-corrélation de la fonction ancrage et valvulaire

Topaz TTVR - Early Compassionate Use Experience



Baseline	CU 1* June 7 th , 2021	CU 2** June 28 th , 2021	CU 3* Oct 4 th , 2021	CU4* Oct 4 th , 2021
Age, Gender	70, F	86, F	82, F	88, F
NYHA Class	III	III	III	III/IV
Tricuspid Regurgitation (Grade 1-5)	Massive (4)	Torrential (5)	Severe (3)	Torrential (5)
Co-morbidities	Afib, DM, HTN, ASD, chron. Renal Failure,	Afib, HTN, HF, chron. Renal Failure, Pulm. Emphysema,	Afib, chron. Renal Failure, Cancer (Breast 1970&98)	Afib, HF, Pericarditis, chron. Renal Failure, Hypothyroidism
TRI-SCORE ¹ estimated in-hospital mortality rate	5 14%	6 22%	5 14%	8 48%

¹ Julien Dreyfus et al. TRI-SCORE: a new risk score for in-hospital mortality prediction after isolated tricuspid valve surgery, Eur Heart J 2021 Sep 29;ehab679. doi: 10.1093/eurheartj/ehab679.

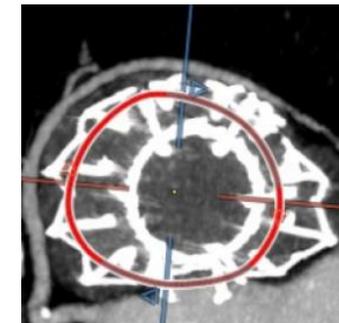
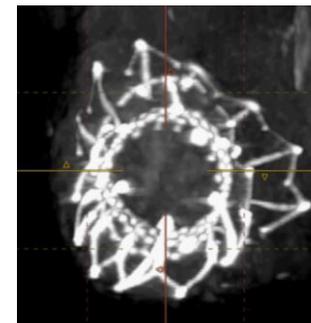


TRICARES



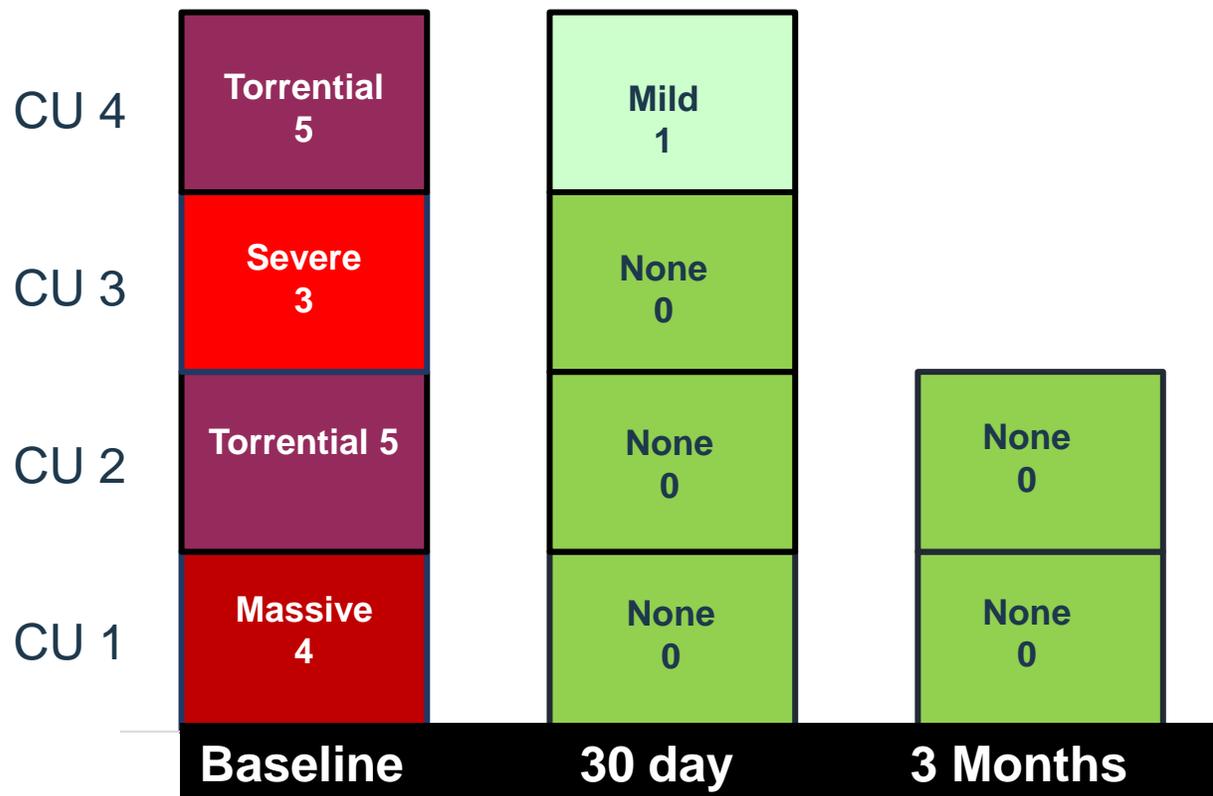
Procedure Discharge	CU 1	CU 2	CU 3	CU 4
Procedure Time*	18 min	12 min	20 min	48 min
NYHA Class Discharge	I	I	I	II
Tricuspid Regurgitation (Grade 1-5)	None (0)	None (0)	None (0)	Mild (1)
Discharged on POD	4	4	15	15

Adverse Events 30 day	Base N= 4
Mortality	0
Stroke	0
Reintervention*	1
HF hospitalization	0
Dialysis requirement	0
New PPM	0



TR Grade Over Time

Topaz TTVR - Early Compassionate Use Experience



Adverse Events 30 day	Base N= 4
Mortality	0
Stroke	0
Reintervention*	1
HF hospitalization	0
Dialysis requirement	0
New PPM	0

* Valve implanted as intended, due to two radiation therapy highly pathologic leaflets / very thick and fibrotic, incomplete anchoring, movement of valve at inferior aspect of valve, surgical reintervention, fixation of valve with U pledgeted sutures

CONCLUSION

- Réparation: TRICLIP, PASCAL, Annuloplastie
 - Exclusions anatomiques: fréquentes
 - Durée de procédure: longue à très longue
 - Dépendance à l'imagerie per-procédure: importante
 - Résultats incomplets ?: à valider sur les études en cours
- Valves percutanées
 - Exclusion anatomique: moins fréquente (évolution taille des dispositifs)
 - Durée de procédure: courte
 - Dépendance à l'imagerie: faible
 - Résultats semble-t-il plus complets
 - Durabilité ? Thrombose ?
- Questions en suspens
 - Durabilité ? Thrombose ?
 - Chronologie des interventions