بسم الله الرحمن الرحیم

Updates in Tricuspid Valve Surgery

Focused on Secondary TR

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Jan. 2019 , Dey 97

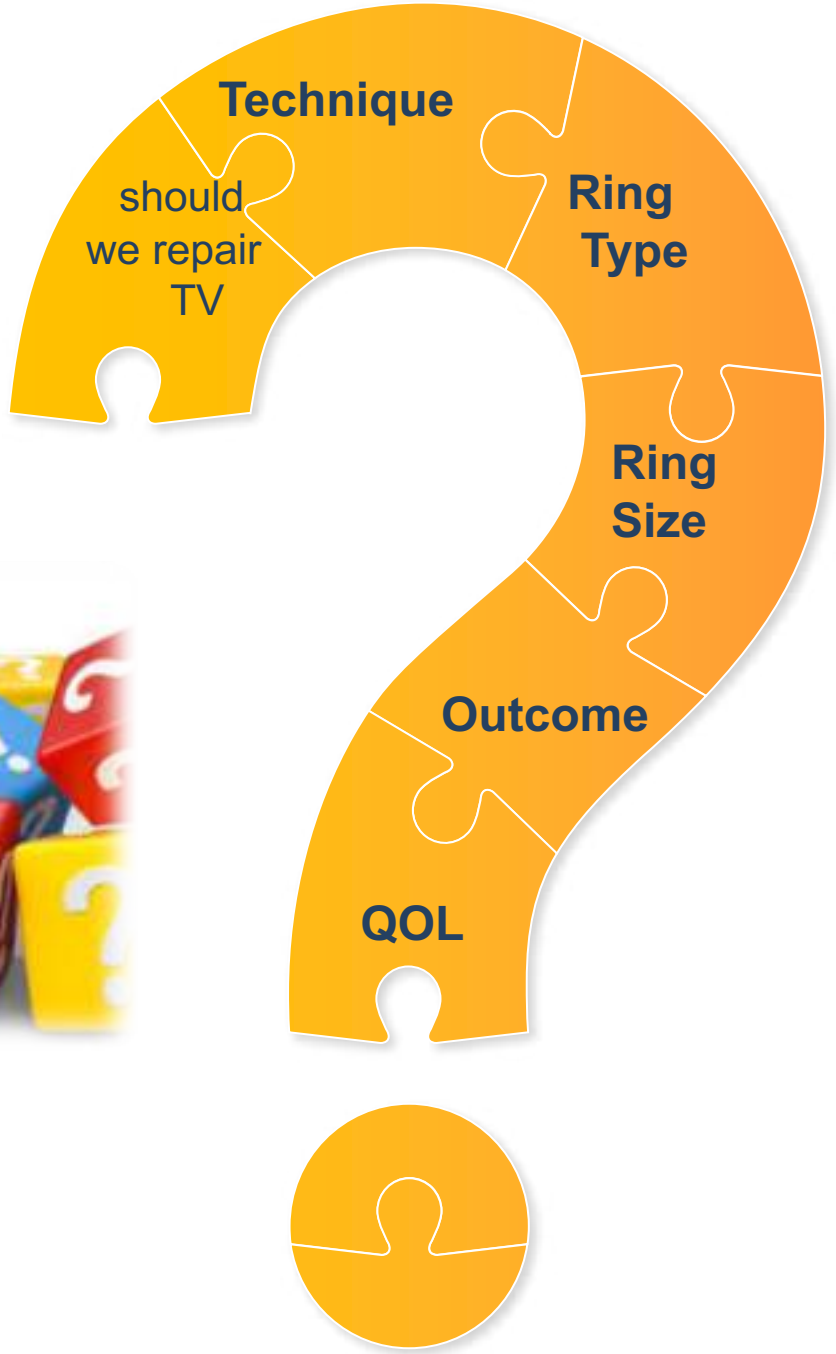
Clinical Scenarios

Daily Practice

A 50 Yrs gentleman presented by DOE FC II-III, with Sever MS, Mod TR, PAP 70

A 60 yrs lady presented By Prosthetic valve thrombosis, Sever TR, PAP 75, Sever RV dysfunction

A 56 yrs lady with Hx MVR presented by DOE FC II, Sever TR, PAP: 40 Mod RV dysfunction


Technique
should we repair TV
Ring Type
Ring Size
Outcome
QOL

Moderate to severe TR affects approximately 1.6 million patients in the United States,

Only 8,000 undergo tricuspid surgery annually

Most procedure are done in the context of other planned cardiac surgeries

Surgical avoidance of TV repair or residual TR is easily accepted in patients with Functional TR

KEY POINTS

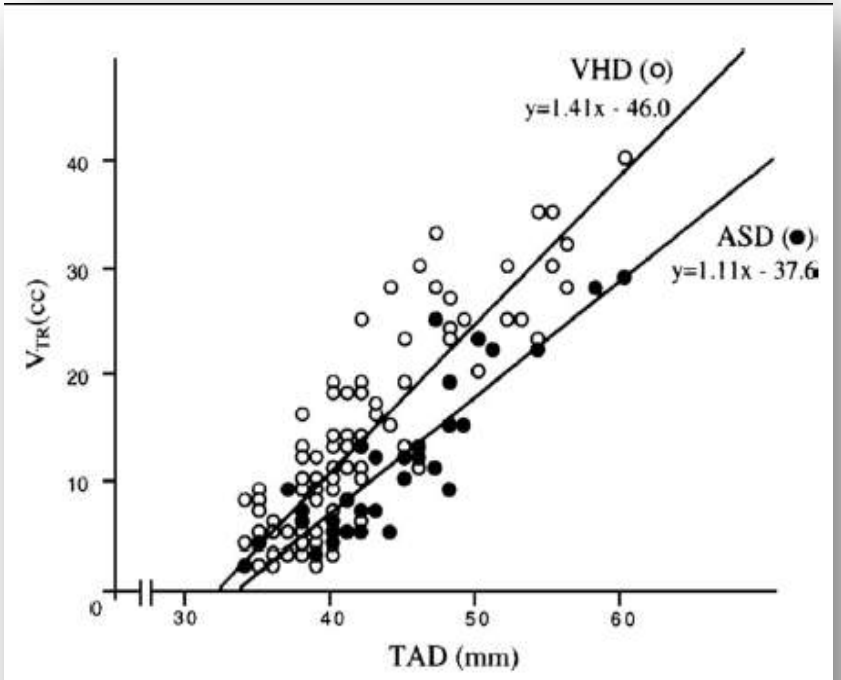


Figure 4 Correlation Between TAD and V_{TR}

There is good correlation in both patients with valvular heart disease (VHD) ($r = 0.87$) and patients with atrial septal defect (ASD) ($r = 0.88$). The correlation lines cross the x-axis at a tricuspid annulus diameter (TAD) value of 33 to 34 mm, which is the threshold for tricuspid regurgitation. Reprinted, with permission, from Sugimoto et al. (27). V_{TR} = tricuspid regurgitant volume.

JACC Vol. 53, No. 5, 2009
February 3, 2009:401–8

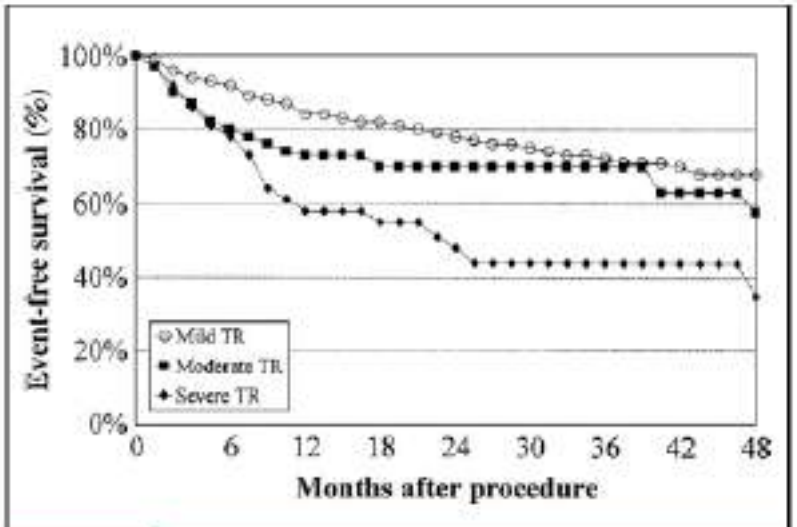


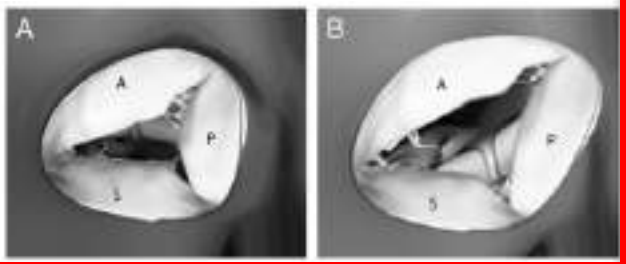
Figure 2 Event-Free Survival After Balloon Mitral Valvotomy by TR Severity

Events were defined as death, New York Heart Association functional class III or IV, MV surgery, or repeat mitral valve balloon valvotomy ($n = 318$). Patients with severe tricuspid regurgitation (TR) had significantly worse event-free survival compared with patients with mild TR. Reprinted, with permission, from Sagie et al. (18).

After Isolated MVR, 30-50% patients develop moderate or sever TR despite absent or mild TR at baseline

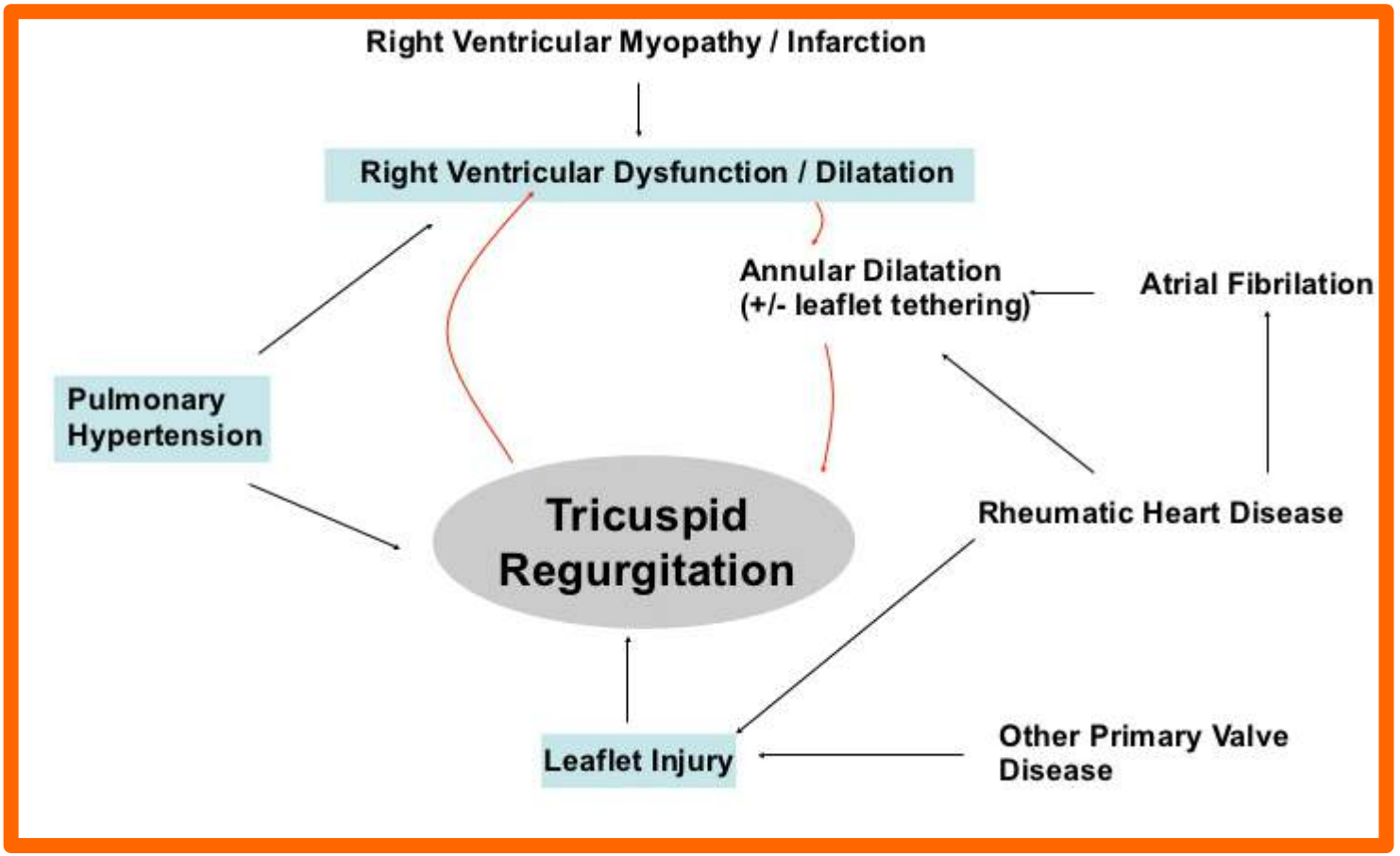
Dilated TV cannot spontaneously return to normal size

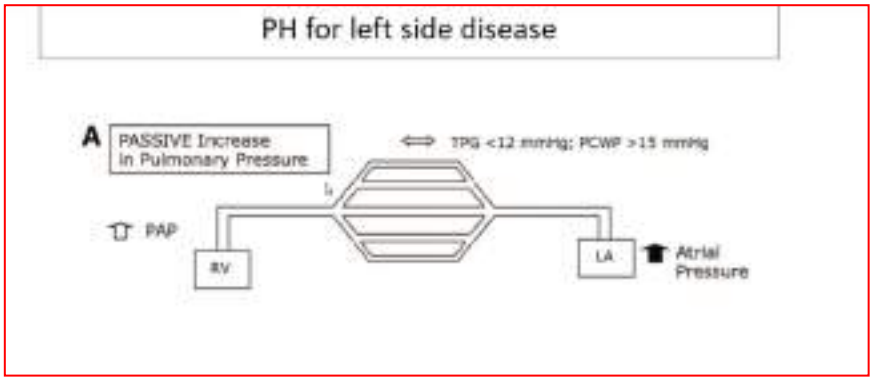
Complete reverse remodeling of the RV may not occur

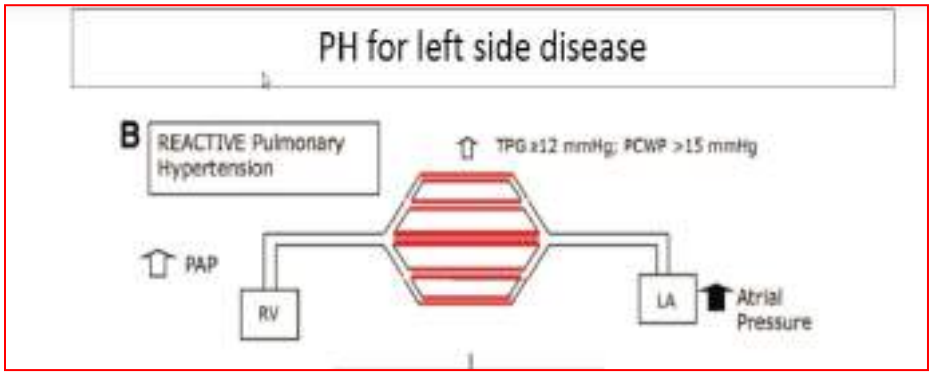


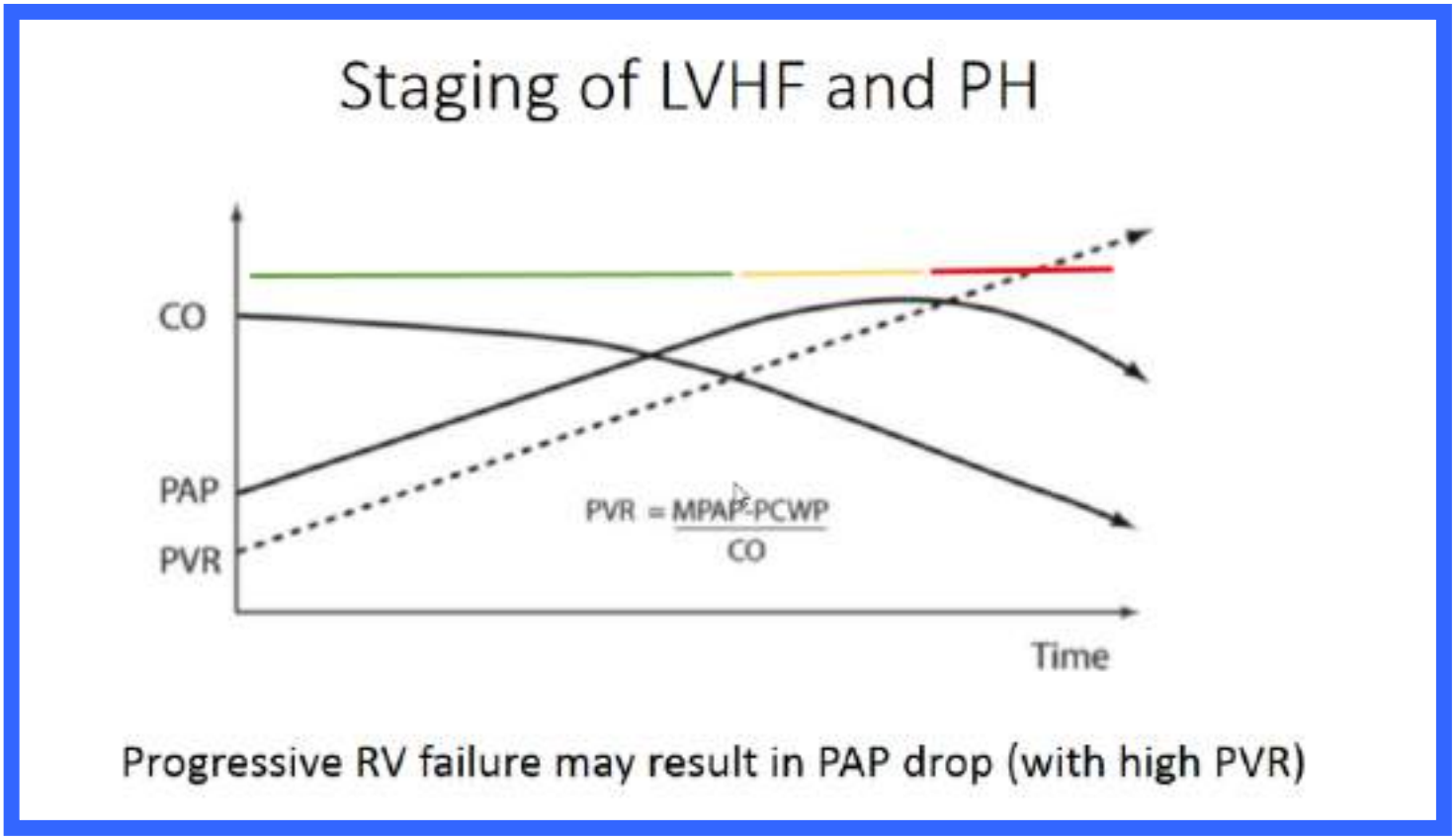
Dreyfus G. Ann Thoarc Surg 2005; 79:127-132
Porter A. J Heart Valve Dis 1999; 8:57-62
Izumi C. J Heat Valve Dis 2002; 11:353-6

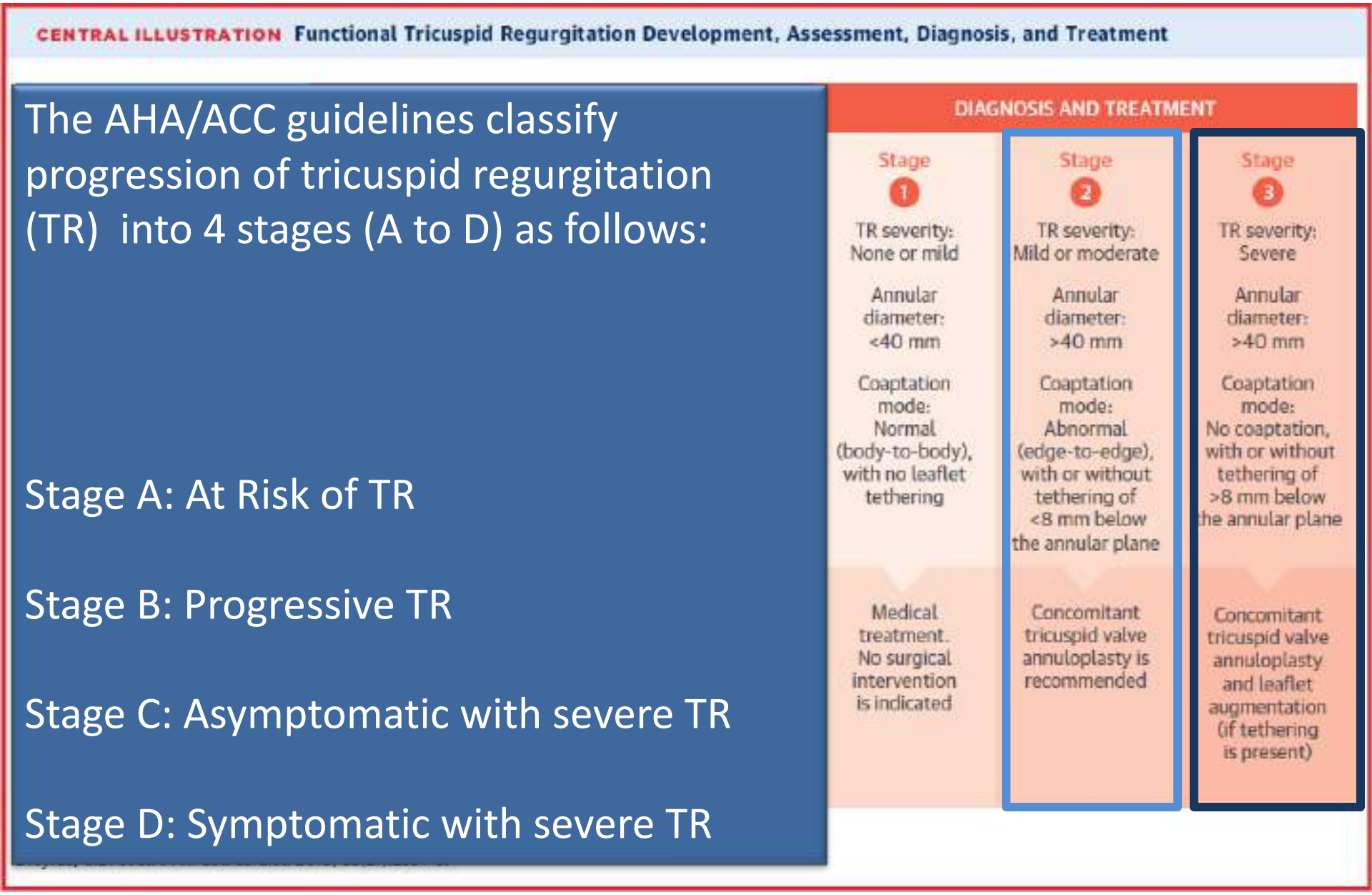
TR Pathophysiology



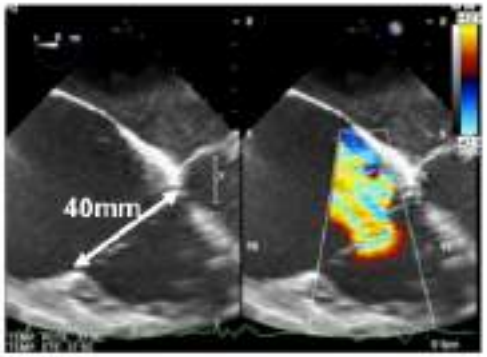

PH for left side disease
A
PASSIVE Increase in Pulmonary Pressure
TPG <12 mmHg; PCWP >15 mmHg
PAP
RV
LA
Atrial Pressure


PH for left side disease
B
REACTIVE Pulmonary Hypertension
TPG ≥12 mmHg; PCWP >15 mmHg
PAP
RV
LA
Atrial Pressure


Staging of LVHF and PH
CO
PAP
PVR
PVR = MPAP-PCWP / CO
Time
Progressive RV failure may result in PAP drop (with high PVR)


CENTRAL ILLUSTRATION Functional Tricuspid Regurgitation Development, Assessment, Diagnosis, and Treatment
The AHA/ACC guidelines classify progression of tricuspid regurgitation (TR) into 4 stages (A to D) as follows:
Stage A: At Risk of TR
Stage B: Progressive TR
Stage C: Asymptomatic with severe TR
Stage D: Symptomatic with severe TR
DIAGNOSIS AND TREATMENT
Stage 1
TR severity: None or mild
Annular diameter: <40 mm
Coaptation mode: Normal (body-to-body), with no leaflet tethering
Medical treatment. No surgical intervention is indicated
Stage 2
TR severity: Mild or moderate
Annular diameter: >40 mm
Coaptation mode: Abnormal (edge-to-edge), with or without tethering of <8 mm below the annular plane
Concomitant tricuspid valve annuloplasty is recommended
Stage 3
TR severity: Severe
Annular diameter: >40 mm
Coaptation mode: No coaptation, with or without tethering of >8 mm below the annular plane
Concomitant tricuspid valve annuloplasty and leaflet augmentation (if tethering is present)

Ann ?



Values of more than 27 mm in either maximal early systolic or minimal late end-systolic diameters

More than 40mm (21 mm/m2) maximum end-systolic diameter

Mean diastolic annulus diameter of 51 mm in the four-chamber view

54 mm in the short axis view

Largest diameter >70 mm in arrested heart

Outcomes of Mild to Moderate Functional Tricuspid Regurgitation in Patients Undergoing Mitral Valve Operations: A Meta-Analysis of 2,488 Patients

Ibrahim Kara, MD, Cengiz Koksal, MD, Alper Erkin, MD, Hakan Sacli, MD, Mucahit Demirtas, MD, Bilal Percin, MD, Mevriye Serpil Diler, MD, and Kaan Kirali, MD

Department of Cardiovascular Surgery, Sakarya University, Faculty of Medicine, Sakarya; Department of Cardiovascular Surgery, Kartal Kosuyolu Research and Training Hospital, Kartal, Istanbul; and Department of Cardiovascular Surgery, State Hospital of Beyhekim, Konya, Turkey

(Ann Thorac Surg 2015;100:2398–407)

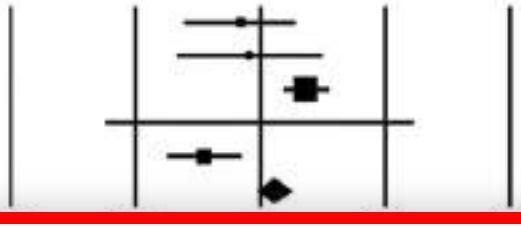
10 study
2488 pts
TR < 3+

A- Freedom from moderate to severe FTR

Study name	Odds ratio	Lower limit	Upper limit	Z-Value	p-Value	Relative weight
Kim et al., 2012	0,156	0,062	0,393	-3,941	0,000	20,57
Smid et al., 2010	0,023	0,001	0,421	-2,540	0,011	2,06
Ro et al., 2012	0,721	0,353	1,471	-0,899	0,369	34,57
Benedetto et al., 2012	0,056	0,003	1,073	-1,913	0,056	2,03

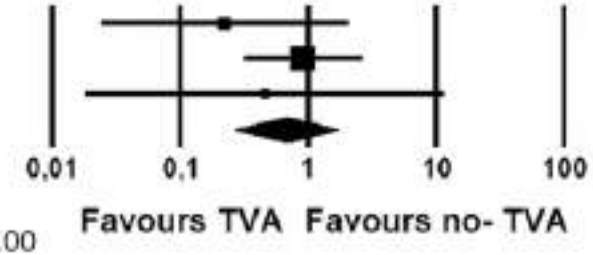
B- Mortality

Study name	Odds ratio	Lower limit	Upper limit	Z-Value	p-Value	Relative weight
Kim et al., 2012	0,697	0,251	1,939	-0,691	0,490	9,80
Smid et al., 2010	0,829	0,215	3,199	-0,272	0,785	5,62
Ro et al., 2012	2,343	1,558	3,522	4,091	0,000	61,57
Benedetto et al., 2012	1,000	0,059	17,065	0,000	1,000	1,27
Shi et al., 2012	0,357	0,180	0,709	-2,942	0,003	21,75
Overall effect	1,289	0,936	1,776	1,557	0,119	



C- Tricuspid valve reoperation

Study name	Odds ratio	Lower limit	Upper limit	Z-Value	p-Value	Relative weight
Kim et al., 2012	0,223	0,025	2,029	-1,331	0,183	17,38
Ro et al., 2012	0,918	0,316	2,665	-0,158	0,874	74,43
Shi et al., 2012	0,456	0,018	11,366	-0,478	0,632	8,19
Overall effect	0,678	0,270	1,701	-0,828	0,408	



Test for heterogeneity: Q= 1.48, df(Q)= 2 (p=0.47), I^2= 0.00

Table 2. Meta-Analysis of the Risk Factors for the Progression of Functional Tricuspid Regurgitation

Variable	SMD/OR (95% CI)	*p*
Age	−0.33 (−0.54 to −0.12)[a]	<0.01
Female gender	1.00 (0.63–1.60)	0.99
Rheumatic mitral etiology	0.46 (0.29–0.75)[a]	<0.01
Atrial fibrillation rhythm	0.34 (0.21–0.54)[a]	<0.001
No maze procedure	0.06 (0.02–0.15)[a]	<0.001
PASP	−0.04 (−0.27 to 0.19)	0.72
LVEF	0.08 (−0.15 to 0.31)	0.49
Large left atrial diameter	−0.34 (−0.58 to −0.10)[a]	<0.01
No TVA	0.29 (0.12–0.47)[a]	<0.001

FTR secondary to mitral valve disease is not a benign condition and that most of such patients may experience subsequent progression to significant

A more aggressive strategy involving concomitant mitral valve and tricuspid valve intervention in patients with mild to moderate FTR at baseline may be considered to prevent significant progression of FTR in the long-term and to improve clinical outcomes, particularly in high-risk individuals

Desai RR, Vargas Abello LM, Klein AL, et al.
J Thorac Cardiovasc Surg 2013; 146:1126–1132.

These improvements were temporary and by 3 years returned to preoperative levels

More aggressive approach to FTR

Review Article
http://dx.doi.org/10.4070/kcj.2016.46.4.443
Print ISSN 1738-5520 • On-line ISSN 1738-5555

kcj
Korean Circulation Journal

Revisit of Functional Tricuspid Regurgitation; Current Trends in the Diagnosis and Management

Denisa Muraru, MD, Elena Surkova, MD, and Luigi Paolo Badano, MD
Department of Cardiac, Thoracic and Vascular Sciences, University of Padua, School of Medicine, Padua, Italy

Table 2. Predictors of late functional tricuspid regurgitation

Age
Female
Atrial fibrillation
Tricuspid annulus dilation>40 mm (>21 mm/m^2)
Severe leaflet tethering
Right chamber dilation
Right ventricular dysfunction
Pulmonary hypertension
Longer time between mitral valve disease onset and corrective surgery
Left atrial dilation
Rheumatic valve disease
Ischemic heart disease
Left-sided prosthetic valve dysfunction

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Contents lists available at ScienceDirect

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journal homepage: www.elsevier.com/locate/ijcard

Therapeutic strategy for functional tricuspid regurgitation in patients undergoing mitral valve repair for severe mitral regurgitation

Takeshi Kitai [a,e,*], Yutaka Furukawa [a], Kenta Murotani [c], Chayakrit Krittanawong [e], Shuichiro Kaji [a], Tadaaki Koyama [b], Yukikatsu Okada [d]

TV repair was indicated if patients had at least one of the following conditions representing tricuspid annular dilatation:

- tricuspid regurgitation (TR) ≥ moderate,
- history of right heart failure,
- atrial fibrillation,
- pulmonary hypertension.

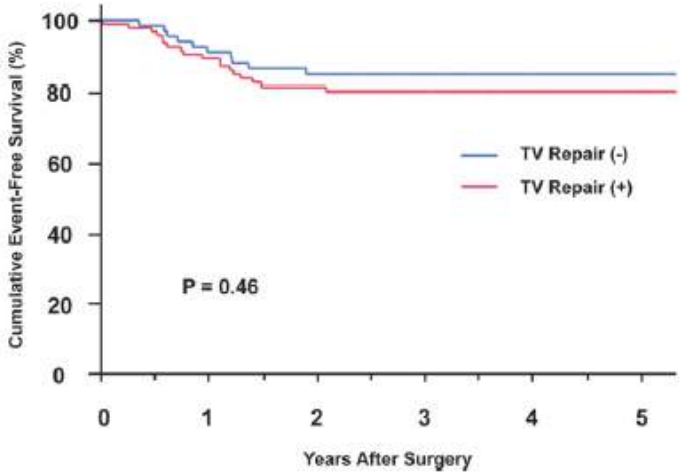


Fig. 4. The Kaplan–Meier estimates of freedom from all-cause death, re-do mitral and/or tricuspid surgery, and recurrence or progression of tricuspid regurgitation of moderate extent or worse.

Multidiscip Cardio Annal. 2016 October; 7(1):e9469. doi: 10.17795/mcardia.9469.

Published online 2016 September 27. Research Article

Tricuspid Regurgitation Dilemma: A Comparison Study between Surgical Versus Medical Management of Patients with Tricuspid Regurgitation

Anita Sadeghpour,[1] Azin Alizadehasl,[1,*] Zahra Azizi,[1] and Alireza Alizadeh Ghavidel[2]

[1]Echocardiography Research Center, Rajaie Cardiovascular Medical and Research Center, Iran University of Medical Sciences, Tehran, IR Iran

[2]Heart Valve Disease Research Center, Rajaie Cardiovascular Medical and Research Center, Iran University of Medical Sciences, Tehran, IR Iran

806 patients

Table 4. Independent Risk Factors of Mortality in Patients with Severe TR in the Surgical Treatment Group

Risk Factors	HR[a]	95%CI	P Value
Age at surgery	1.06	1.03 - 1.10	< 0.001
Length of admission	1.02	1.009 - 1.04	0.003
ICU stay days	1.04	1.02 - 1.06	< 0.001
Postoperative bleeding	10.62	3.80 - 29.60	< 0.001
Postoperative mediastinitis	7.79	1.013 - 60.06	0.04
Mechanical ventilation time, h	1.002	1.001 - 1.003	< 0.001
Preoperative NYHA FC	3.13	1.47 - 6.63	0.003
IVC size	4.33	1.59 - 11.79	0.004

At a follow-up time of 3.2 ± 1.6 (0.91 - 7) years, the rate of death was 6.6% for the

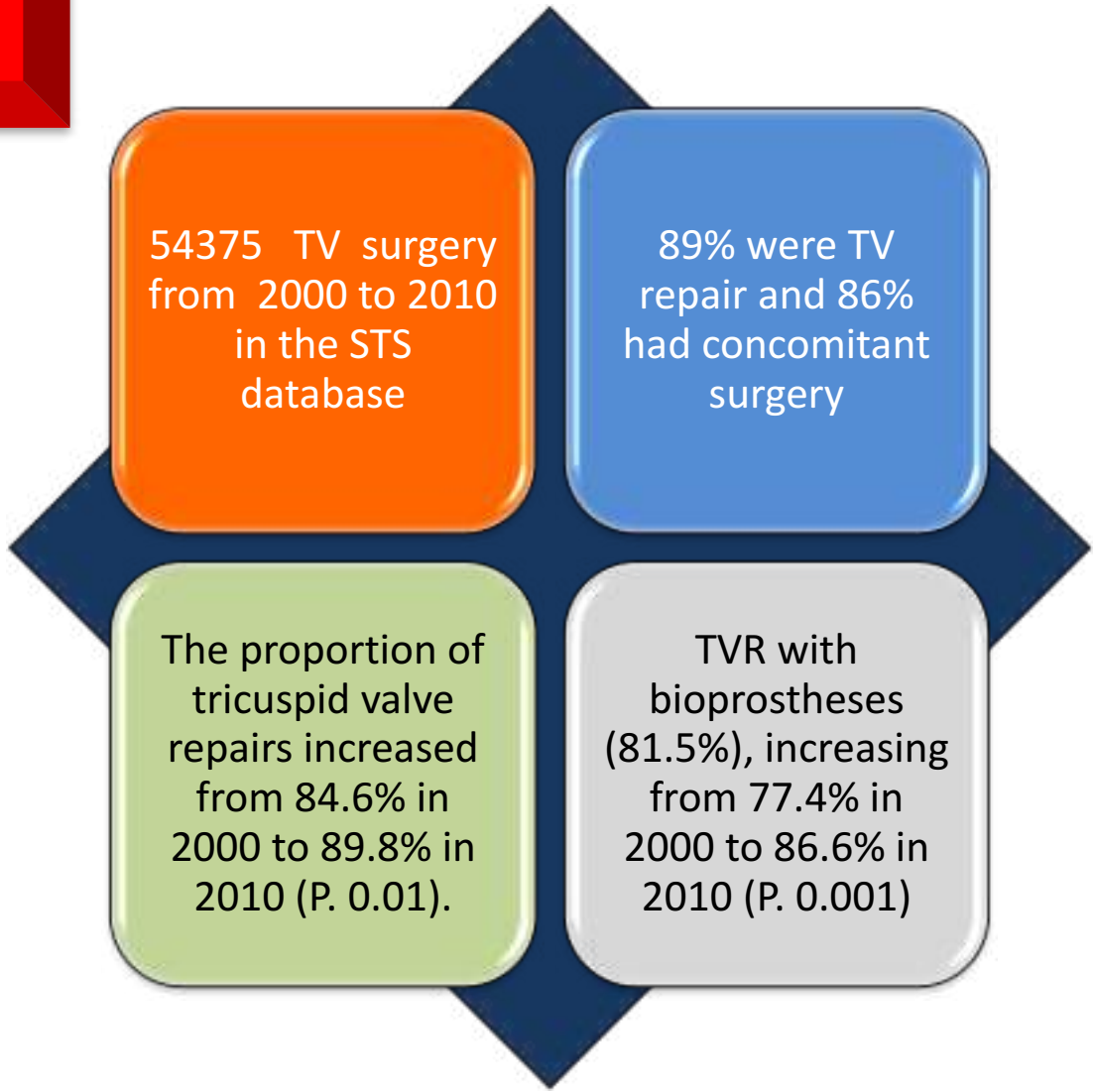
treatment

90.4% in the

In patients with severe TR in the NYHA FCs of III and IV, the 5-year survival rate was 78.6% in the surgical treatment group and

STS database

Kilic A, Saha-Chaudhuri P, Rankin JS, Conte JV.
Trends and outcomes of tricuspid valve surgery in North America: an analysis of more than 50 000 patients from the Society of Thoracic Surgeons Database.
Ann Thorac Surg 2013.



Comparison of Results of Tricuspid Valve Repair Versus Replacement for Severe Functional Tricuspid Regurgitation

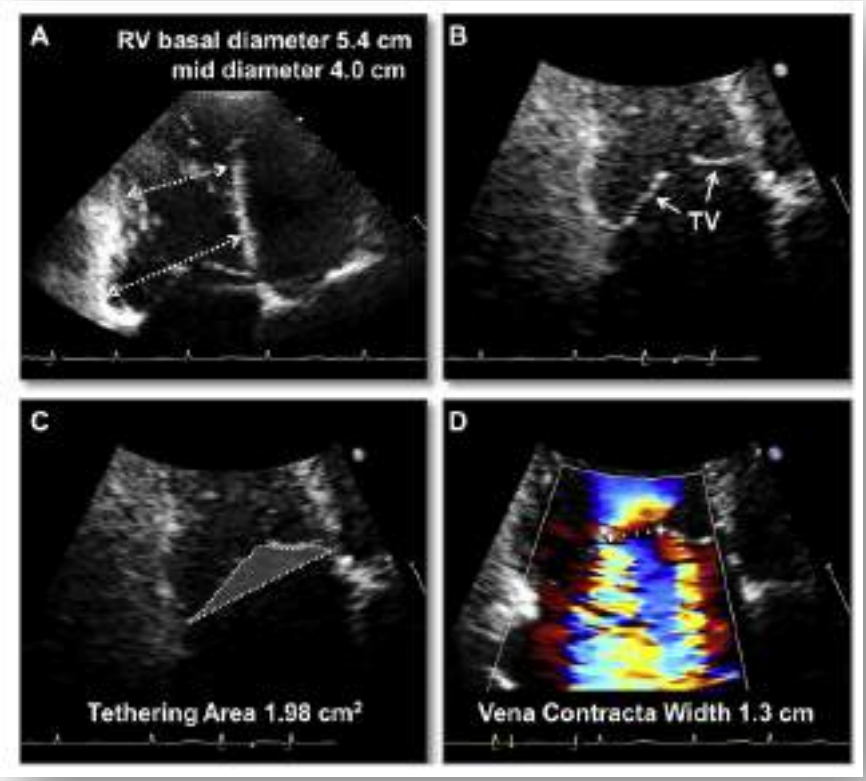
Jeong Yoon Jang, MD[a], Ran Heo, MD[b], Sahmin Lee, MD, PhD[b], Joon Bum Kim, MD, PhD[c], Dae-Hee Kim, MD, PhD[b], Sung-Cheol Yun, PhD[d], Jong-Min Song, MD, PhD[b], Jae-Kwan Song, MD, PhD[b], Jae-Won Lee, MD, PhD[c], and Duk-Hyun Kang, MD, PhD[b,*]

Am J Cardiol 2017;119:905e910

96 consecutive patients (20 men, 58 –11 years of age)

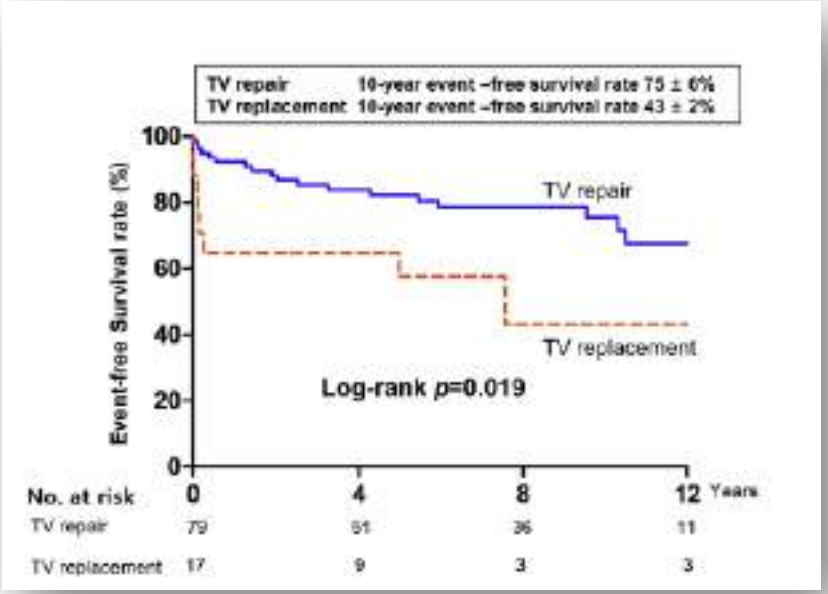
79 patients (repair group), whereas 17 patients underwent TVR

primary end point of the study was defined as the composite of operative mortality, cardiac death, repeat TV surgery, and hospitalization due to congestive heart failure during follow-up (87 Months)



All patients satisfied the following criteria for severe tethering of TV and very severe functional TR:

(1) total failure of coaptation of normal TV leaflets due to severe
tethering by RV dilatation;
(2) tethering area > 1.6 cm2;
(3) jet area >10 cm2;
(4) vena contracta width >1.0 cm;
(5) systolic flow reversal in the hepatic vein



operative mortality was significantly higher in the replacement group than in the repair group (p [0.008) (5% vs 29% in hospital death).

TVR was associated with higher operative mortality and worse long-term clinical outcomes in patients with very severe functional TR.

Repair should be the preferred surgical option even for severe TR associated with more advanced tethering and right ventricular dilatation.

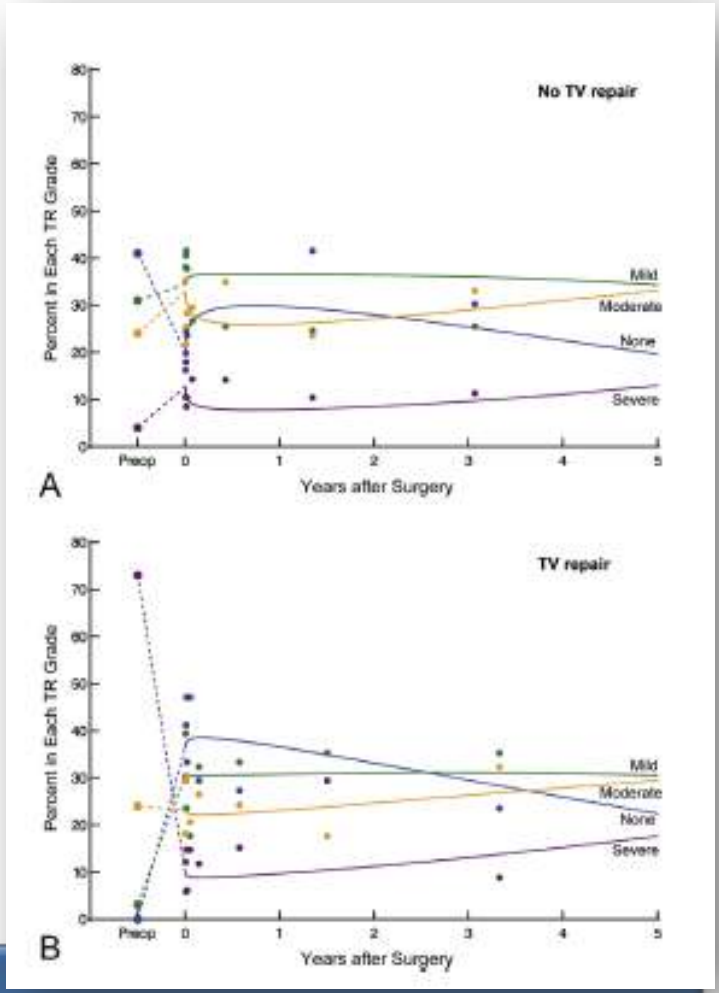
Tricuspid Regurgitation Associated With Ischemic Mitral Regurgitation: Characterization, Evolution After Mitral Surgery, and Value of Tricuspid Repair

José L. Navia, MD, Haytham Elgharably, MD, Hoda Javadikasgari, MD, Ahmed Ibrahim, MD, MS, Marijan Koprivanac, MD, Ashley M. Lowry, MS, Eugene H. Blackstone, MD, Allan L. Klein, MD, A. Marc Gillinov, MD, Eric E. Roselli, MD, and Lars G. Svensson, MD, PhD

Departments of Thoracic and Cardiovascular Surgery and Cardiovascular Medicine, Heart and Vascular Institute, Cleveland Clinic, Cleveland; and Department of Quantitative Health Sciences, Research Institute, Cleveland Clinic, Cleveland, Ohio

From 2001 to 2011, 568 patients with IMR underwent mitral valve surgery. They had varying degrees of TR and altered right-side heart morphology and function

131 had concomitant tricuspid valve repair.



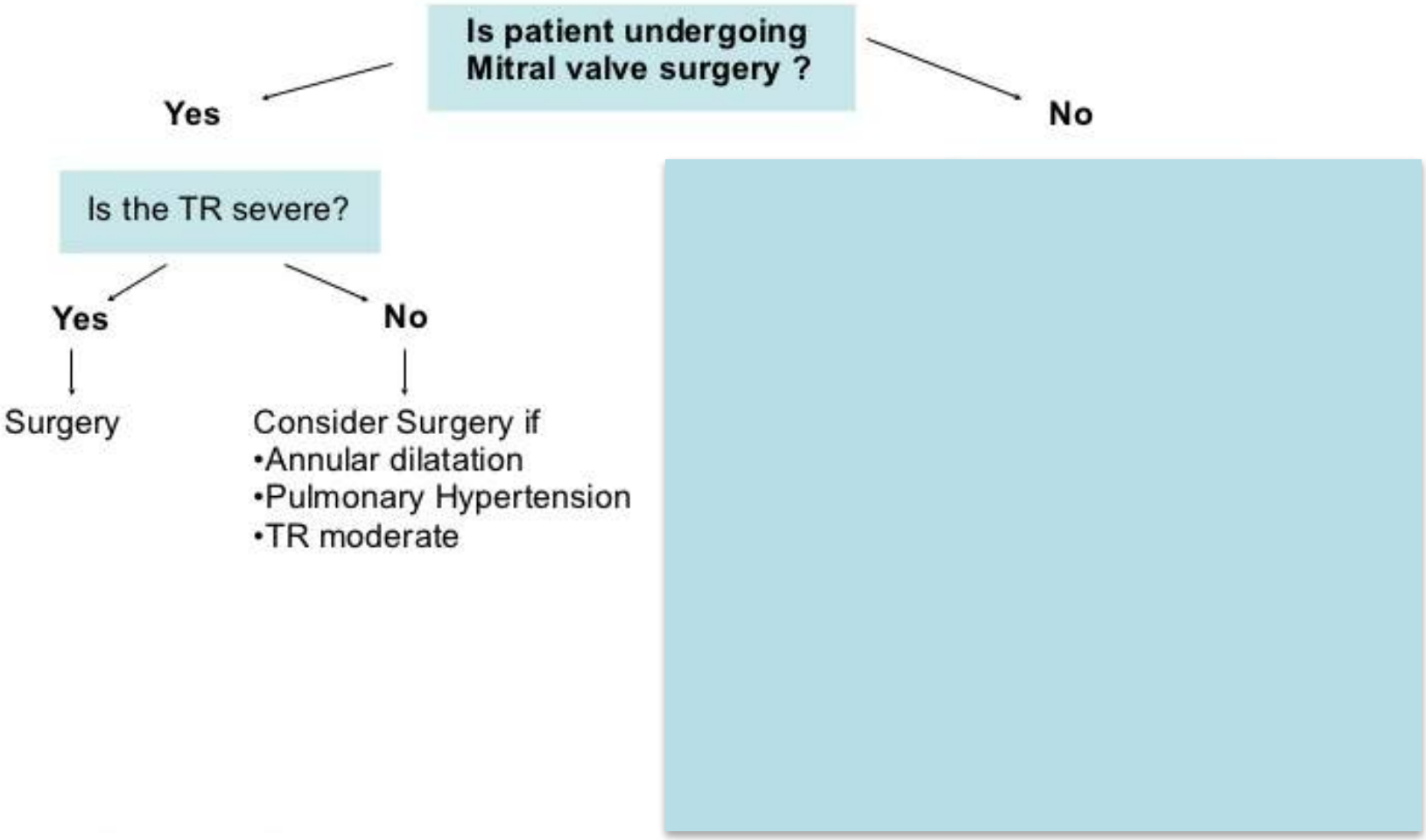
Tricuspid valve repair is effective initially, but as with mitral valve repair, TR progressively returns. Therefore, when the severity of TR and right-sided remodeling reaches the point of irreversibility, it may be an indication to eliminate the TR by replacing the tricuspid valve.

STS database

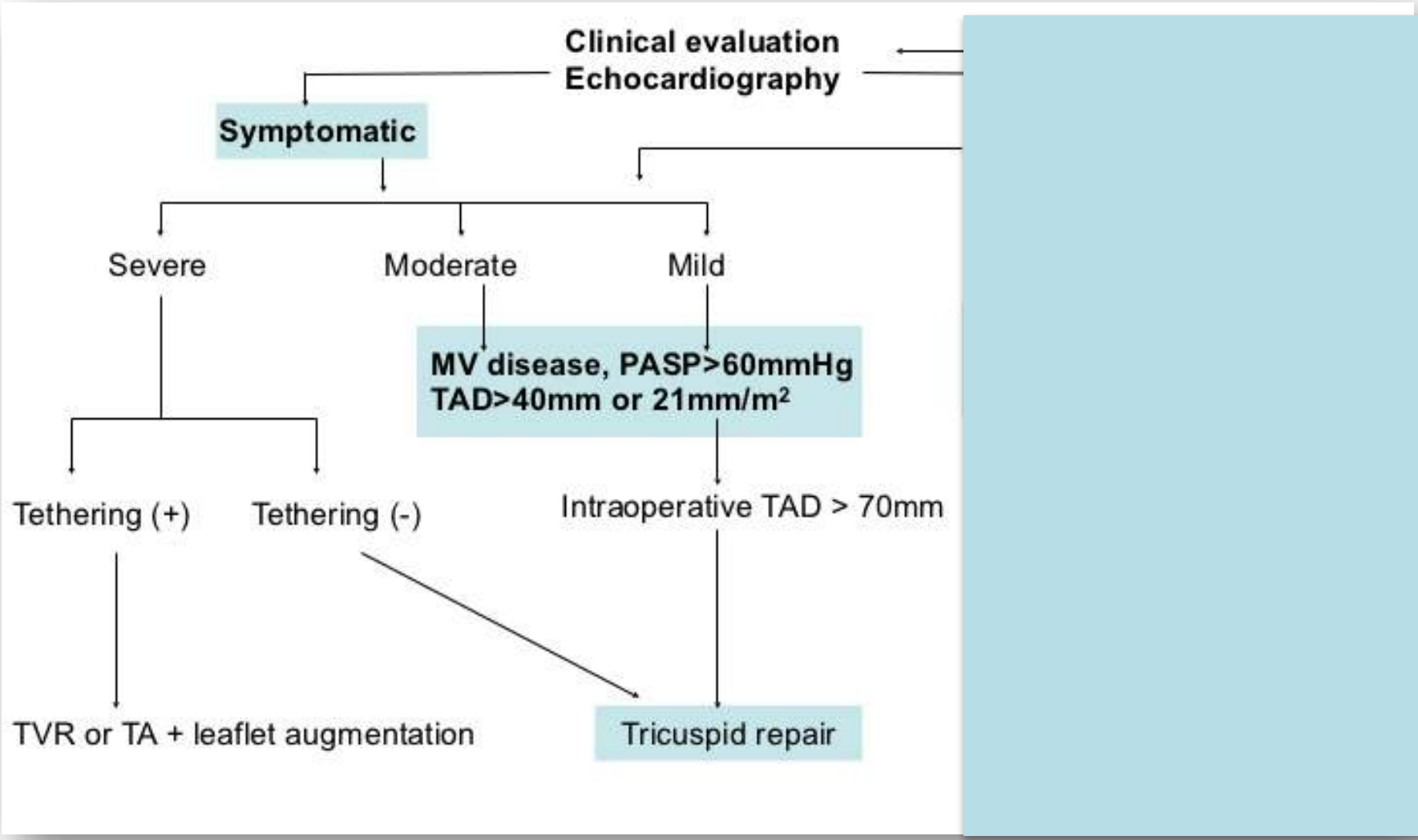
Last decade

TR management

Clinical judgement



Echo-based TR management



ESC European Society of Cardiology
European Heart Journal (2017) 38, 2739–2791
doi:10.1093/eurheartj/ehx391

ESC/EACTS GUIDELINES

2017 ESC/EACTS Guidelines for the management of valvular heart disease

The Task Force for the Management of Valvular Heart Disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

Recommendations on secondary tricuspid regurgitation		
Surgery is indicated in patients with severe secondary tricuspid regurgitation undergoing left-sided valve surgery.	I	C
Surgery may be considered in patients undergoing left-sided valve surgery with mild or moderate secondary tricuspid regurgitation even in the absence of annular dilatation when previous recent right-heart failure has been documented.	IIb	C

ESC European Society of Cardiology
European Heart Journal (2017) 38, 2739–2791
doi:10.1093/eurheartj/ehx391

ESC/EACTS GUIDELINES

2017 ESC/EACTS Guidelines for the management of valvular heart disease

The Task Force for the Management of Valvular Heart Disease of the European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS)

Secondary
Late TR

Reoperation on the tricuspid valve in cases of persistent tricuspid regurgitation after mitral valve surgery carries a high risk, mostly due to the late referral and the consequently poor clinical condition of patients.

After previous left-sided surgery and in absence of recurrent left-sided valve dysfunction, surgery should be considered in patients with severe tricuspid regurgitation who are symptomatic or have progressive RV dilatation/dysfunction, in the absence of severe RV or LV dysfunction and severe pulmonary vascular disease/hypertension.	IIa	C

Development of a Risk Prediction Model and Clinical Risk Score for Isolated Tricuspid Valve Surgery

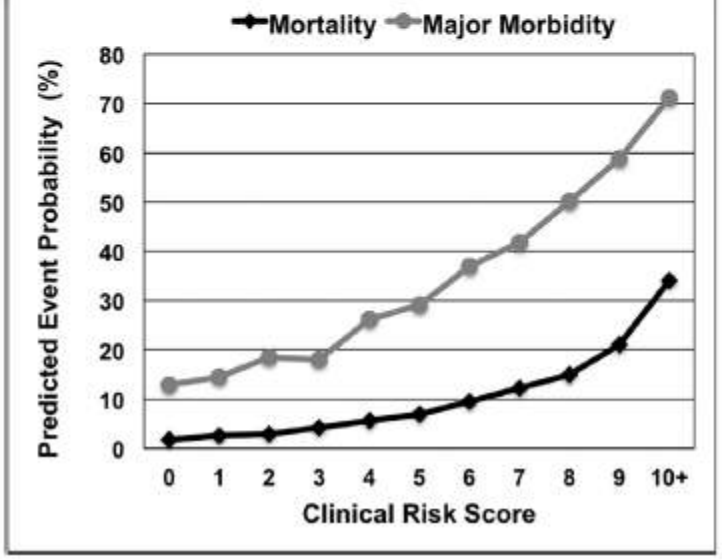
Damien J. LaPar, MD, MS, Donald S. Likosky, PhD, Min Zhang, PhD, Patty Theurer, BSN, C. Edwin Fonner, BA, John A. Kern, MD, Steven F. Bolling, MD, Daniel H. Drake, MD, Alan M. Speir, MD, Jeffrey B. Rich, MD, Irving L. Kron, MD, Richard L. Prager, MD, and Gorav Ailawadi, MD, on behalf of the Investigators for the Virginia Cardiac Surgery Quality Initiative and the Michigan Society of Thoracic and Cardiovascular Surgeons

(Ann Thorac Surg 2018;106:129–37)

Table 2. Multivariable Logistic Regression Analysis for Outcome of Operative Mortality

Factor	OR_{adj}	95% CI LL	95% CI UL	p Value	CRS Value
Age, years, versus <40					
40-69	2.26	1.15	4.45	0.02	2
70+	3.27	1.7	6.29	0.001	3
female	1.41	1.02	1.96	0.04	1
Stroke	2.03	1.29	3.2	0.002	2
Hemodialysis	3.34	2.09	5.35	<0.001	4
Chronic lung disease, versus none					
Moderate	1.36	0.93	2.63	0.09	1
Severe	3.04	1.86	5	<0.001	3
NYHA class, versus class III					
III	2.05	1.12	3.76	0.02	2
IV	3.23	1.8	6.16	0.001	3
Reoperation	1.59	1.13	2.19	0.005	2
Status, emergent	4.37	2.04	8.99	<0.001	4

Patient Factor	Mortality CRS	Major Morbidity CRS	Example Case
Age (years)			73 yo, female, moderate lung disease, NYHA Class III
50-59	0	1	
60-69	2	2	**Total Mortality CRS:** 3 + 1 + 1+ 2 = 7
70+	3	2	
Sex (Female)	1	1	**Total Major Morbidity CRS:** 2 + 1 + 1 + 2 = 6
Stroke	2	1	
Hemodialysis	4	1	**Predicted Mortality** = 12% (from graph below)
Chronic Lung Disease			
Moderate	1	1	**Predicted Major Morbidity** = 37% (from graph below)
Severe	3	1	
Ejection Fraction < 55%	0	2	
NYHA Class			
Class III	2	2	
Class IV	3	3	
Reoperation	2	3	
Status			
Emergent	4	9	



Review

Diagnosis and treatment of tricuspid valve disease: current and future perspectives

	Class of recommendation	Level of evidence
AHA and ACC (2014)[3]		
Primary TR		
Severe TR at the time of left-sided valve surgery	I	C
Symptoms caused by severe TR not responsive to medical therapy	IIa	C
Asymptomatic or minimally symptomatic severe TR and progressive right ventricular dilatation and/or dysfunction	IIb	C
Secondary TR		
Severe TR at the time of left-sided valve surgery	I	C
Mild, moderate, or greater TR at the time of left-sided valve surgery with either a dilated annulus (≥40 mm or ≥21 mm/m²) or evidence of previous right heart failure	IIa	B
Moderate TR and pulmonary hypertension at the time of left-sided valve surgery	IIb	C
Reoperation for persistent symptoms caused by isolated severe TR after previous left-sided valve surgery in absence of severe pulmonary artery hypertension or right ventricular dysfunction	IIb	C
ESC and EACTS (2012)[2]		
Primary TR		
Severe TR at the time of left-sided valve surgery	I	C
Severe symptomatic isolated TR without severe right ventricular dysfunction	I	C
Moderate TR at the time of left-sided valve surgery	IIa	C
Asymptomatic or mildly symptomatic isolated severe TR and progressive right ventricular dilatation or deterioration of right ventricular function	IIa	C
Secondary TR		
Severe TR at the time of left-sided valve surgery	I	C
Mild or moderate TR with dilated annulus (≥40 mm or >21 mm/m²) at the time of left-sided valve surgery	IIa	C
Severe TR late after left-sided valve surgery with symptoms or progressive right ventricular dilatation or dysfunction, in the absence of left-sided valve dysfunction, severe right or left ventricular dysfunction, and severe pulmonary vascular disease	IIa	C

Class of recommendation: I: benefit>>>risk; procedure should be done; usefulness or efficacy established; IIa: benefit>>risk; additional studies with focused objectives required; it is reasonable to do procedure; evidence favours usefulness or efficacy; IIb: benefit>risk; additional studies with broad objectives needed; procedure may be considered; usefulness or efficacy less well established. Level of evidence: B: limited populations evaluated; data derived from a single randomised trial or non-randomised studies; C: very limited populations studied; only consensus opinion of experts, case studies, standard of care. AHA=American Heart Association. ACC=American College of Cardiology. TR=tricuspid regurgitation. ESC=European Society of Cardiology. EACTS=European Association of Cardiothoracic Surgery.

Two principal surgical methods for FTR

Suture Annuloplasty

Ring Annuloplasty

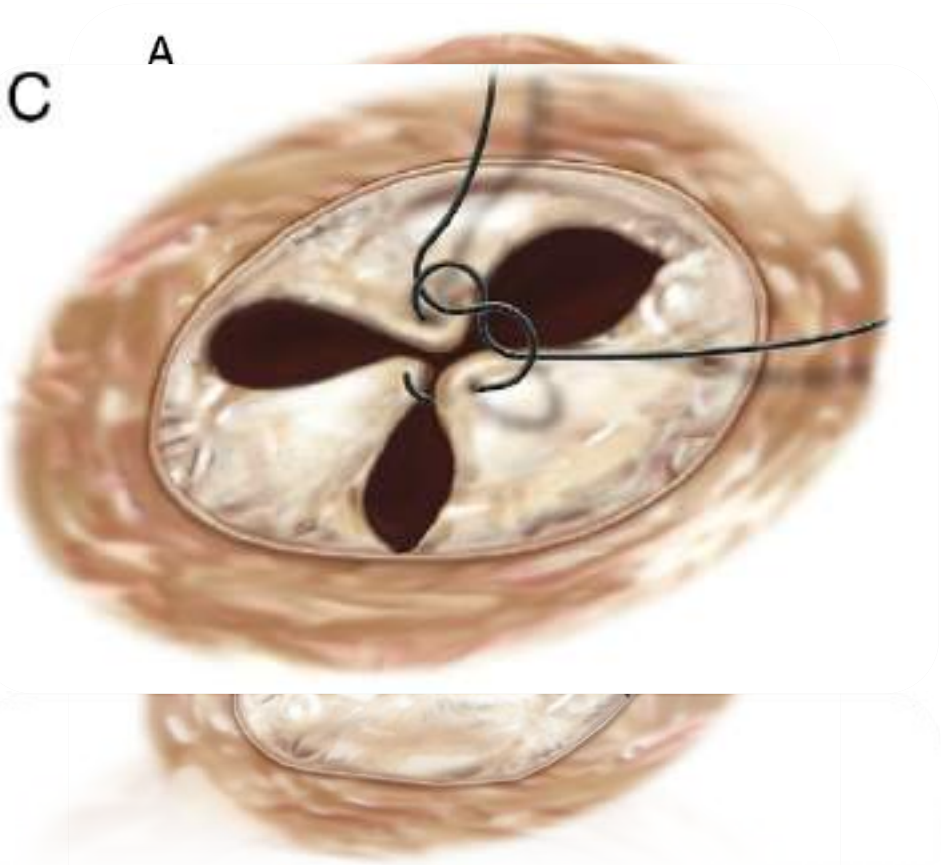


Figure 4 Kay Repair Technique

Suture vs Ring Annuloplasty

Table 2. Comparison of Selected Annuloplasty Approaches for Functional TR

	Bicuspidization	Classic De Vega	Flexible Band	Rigid Ring
Simplicity	Yes	Yes	No	No
Added time	<5 min	<10 min	10-20 min	15-20 min
Reproducibility	Low	Moderate	High	Very high
Annular stabilization	Posterior	Anterior/posterior	Anterior/posterior	Septal/anterior/posterior
Risk of heart block	None	Minimal	Minimal	Low
Residual TR	High	Moderate	Low	Low
Recurrent TR	High	Moderate	Low	Low
Cost	Cheap	Cheap	Expensive	Expensive

Seminars in Thoracic and Cardiovascular Surgery • Volume 22, Number 1

Suture Versus Ring Annuloplasty

Despite the absence of randomized trials, it is currently accepted by the majority of surgeons that ring repairs are more durable than suture repairs and are associated with better long-term and event-free survival

•McCarthy PM, Bhudia SK, Rajeswaran J, et al. Tricuspid valve repair: durability and risk factors for failure. J Thorac Cardiovasc Surg 2004;127:674–85.

•Tang GH, David TE, Singh SK, Maganti MD, Armstrong S, BorgerMA. Tricuspid valve repair with an annuloplasty ring results in improved long-term outcomes. Circulation 2006;114:I577– 81.

•Navil JL, Nowicki ER, Blackstone EH, et al. Surgical management of secondary tricuspid valve regurgitation: annulus, commissure, or leaflet procedure? J Thorac Cardiovasc Surg 2010;139:1473– 82.

Interactive CardioVascular and Thoracic Surgery 15 (2012) 129–135
doi:10.1093/icvts/ivs070 Advance Access publication 28 March 2012

Is a tricuspid annuloplasty ring significantly better than a De Vega's annuloplasty stitch when repairing severe tricuspid regurgitation?

Maziar Khorsandi[a], Amit Banerjee[b], Harpreet Singh[b] and Aseem R. Srivastava[c,*]

[a] Department of Cardiothoracic Surgery, Royal Infirmary of Edinburgh, Edinburgh, UK
[b] Department of Cardiothoracic and Vascular Surgery, G B Pant Hospital, New Delhi, India
[c] Department of Cardiothoracic Surgery, University of Pittsburgh Medical Center, Pittsburgh, USA

They conclude that:

There is good evidence to support **ring annuloplasty over De Vega's** annuloplasty.

Multiple recent cohort studies support the use of ring annuloplasty for moderate to severe TR over De Vega's annuloplasty

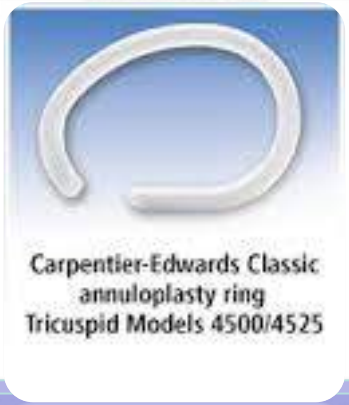
both in terms of the **rate of recurrence of TR** leading to reoperation and **long-term mortality**.

Ring Types

Flexible Band

2-dimensional shape and good results (97.5% freedom from TV reoperation at 10 years)

Onoda K, Yasuda F, Takao M, et al. Long-term follow-up afterCarpentier-Edwards ring annuloplasty for tricuspid regurgitation. Ann Thorac Surg 2000;70:796 –9.



Semi-Rigid

The incidence of recurrent significant TR 5 years after surgery with the standard Carpentier-Edwards ring and with the MC3 ring of 10% and 14% respectively, but this difference was not statistically significant

Navia JL, Nowicki ER, Blackstone EH, et al. Surgical management ofsecondary tricuspid valve regurgitation: annulus, commissure, or leaflet procedure? J Thorac Cardiovasc Surg 2010;139:1473–82.

Rigid

Flexible, Semi-rigid or Rigid ring?

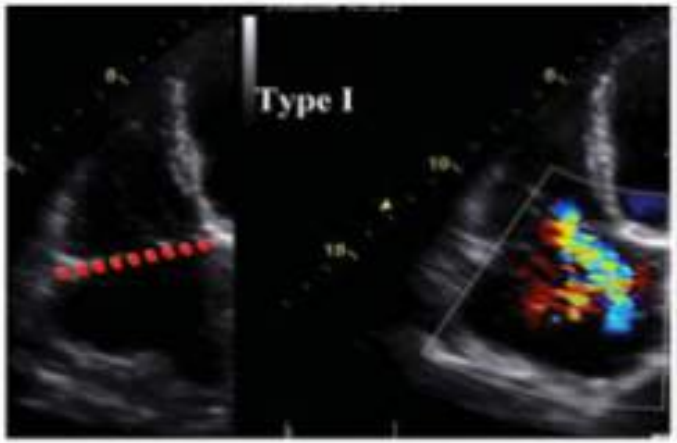
Rigid and semirigid rings not only effectively **restore annular diameter** (reduction annuloplasty)

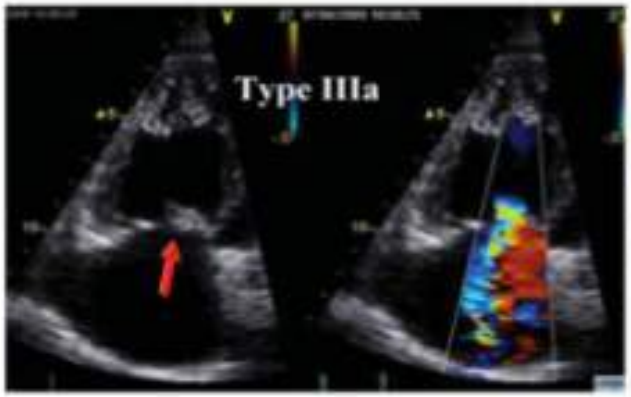
restore the 3-dimensional geometry of the tricuspid annulus in a fixed systolic position (remodeling annuloplasty)

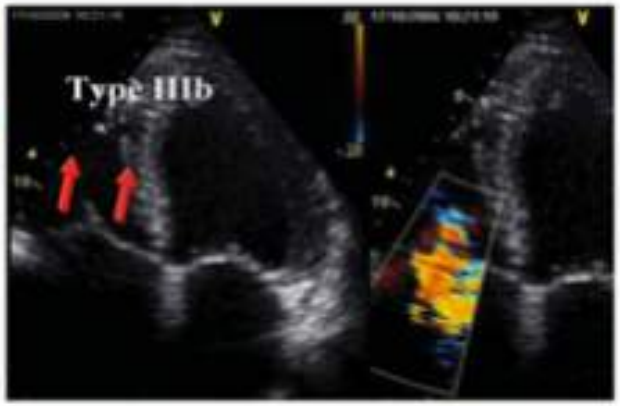
The main advantage of rigid rings over flexible bands is that the dimension of the septal annulus, which contributes to annular dilation in severely diseased valves, is both normalized and better stabilized reducing late recurrence of regurgitation

Is the ring annuloplasty enough for all cases?

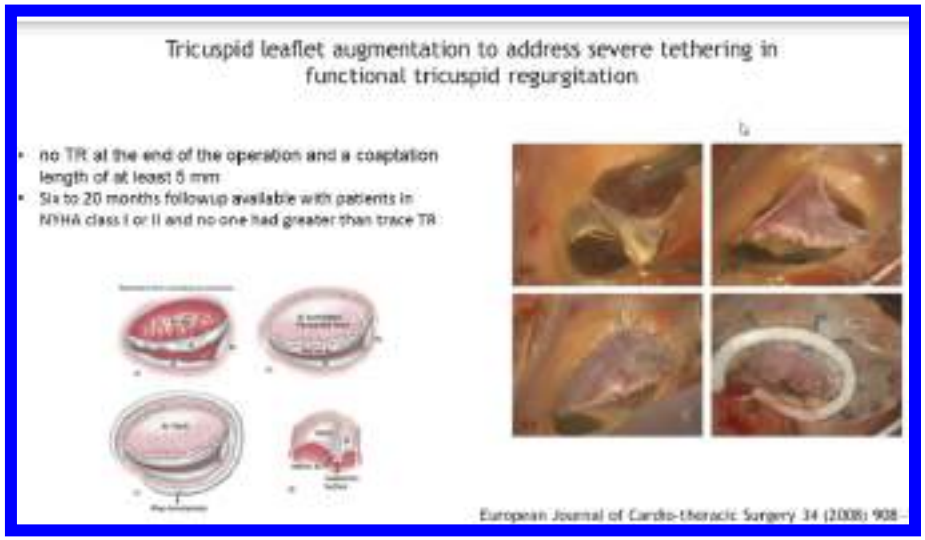
Mechanism of tricuspid regurgitation according to Carpentier







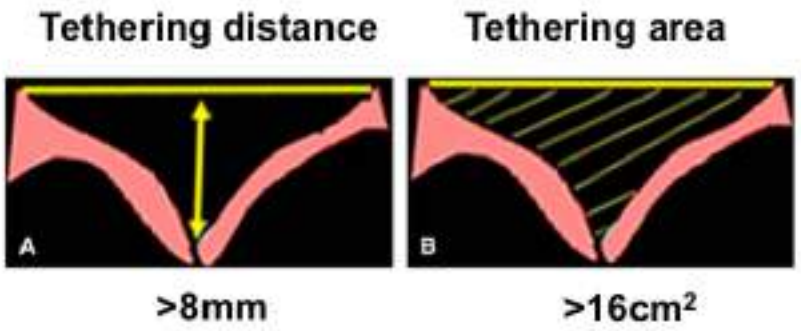
Additional techniques



If severe TV tethering is present

tethering distance 0.76 cm or tethering area 1.63 cm2

the use of adjunctive surgical techniques to tricuspid annuloplasty or TV replacement should be considered



Circulation Journal
Official Journal of the Japanese Circulation Society
http://www.j-circ.or.jp

ORIGINAL ARTICLE
Cardiovascular Surgery

Fate of Functional Tricuspid Regurgitation After Mitral Valve Repair for Degenerative Mitral Regurgitation

Takashi Murashita, MD; Yukikatsu Okada, MD, PhD; Hideo Kanemitsu, MD, PhD; Naoto Fukunaga, MD; Yasunobu Konishi, MD; Ken Nakamura, MD; Yoshito Sakon, MD; Tadaaki Koyama, MD, PhD

Table 3. Univariate Analysis of Predictors for Recurrence of Severe TR in the TV Repair (–) Group

	HR	95% CI	P value
Age	0.99	0.95–1.04	0.769
Male sex	0.31	0.09–1.12	0.748
Preoperative atrial fibrillation	4.85	1.38–17.1	0.014
Preoperative RVP	0.99	0.95–1.03	0.631
Preoperative TR grade	5.16	1.78–14.9	0.003
Postoperative severe MR recurrence	2.27	0.22–23.3	0.491

CI, confidence interval; HR, hazard ratio; RVP, right ventricular pressure; TR, tricuspid regurgitation; MR, mitral regurgitation.

Risk factors for repair failure

- Higher preoperative TR severity
- Higher pulmonary artery pressures,
- Larger ring size
- MV replacement rather than repair,
- worse LV dysfunction
- Increased LV remodeling
- Suture annuloplasty
- Presence of pacemaker leads through the valve area

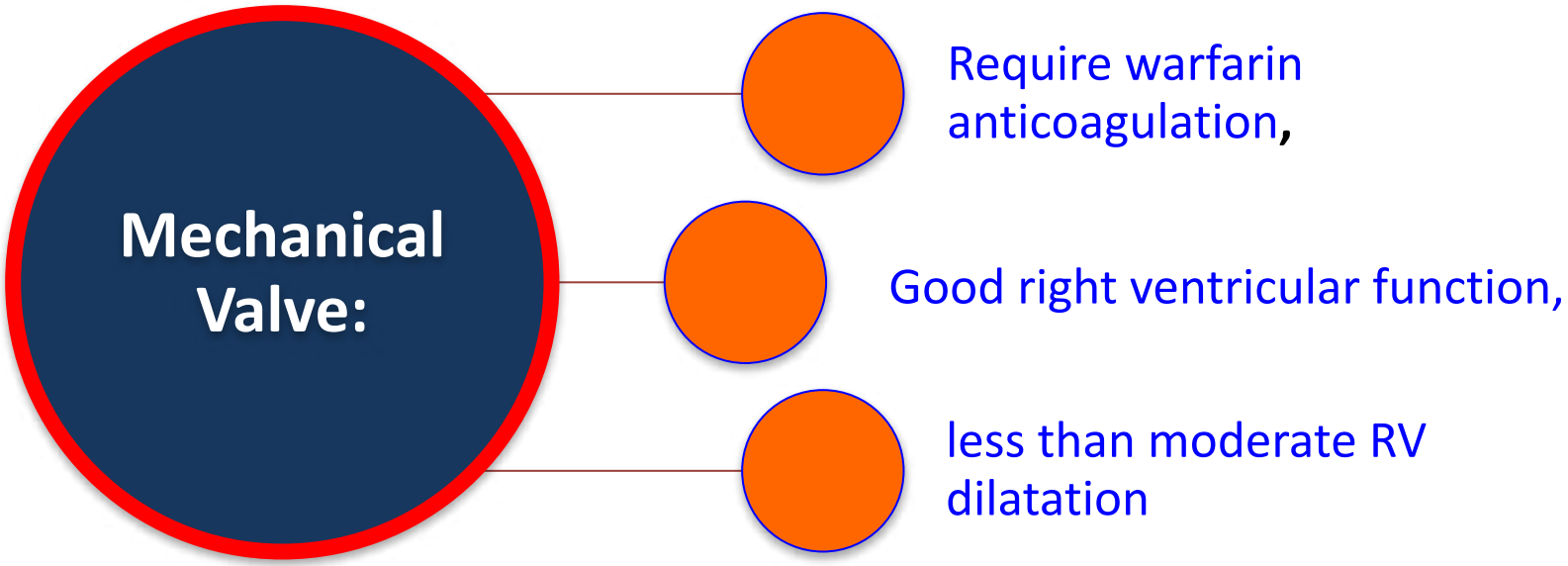
When we should replace TV in FTR?

In cases of extreme leaflet tethering, prosthetic replacement of the valve should be considered.

The ideal choice of prosthesis for tricuspid valve replacement remains a matter of controversy as both are associated with thromboembolism and relatively high frequency of reoperation.

When should a mechanical tricuspid valve replacement be considered?

Sameh M. Said, MD,[a] Harold M. Burkhart, MD,[a] Hartzell V. Schaff, MD,[a] Jonathan N. Johnson, MD, Heidi M. Connolly, MD,[c] and Joseph A. Dearani, MD[a]



(J Thorac Cardiovasc Surg 2013;■:1-6)

Tricuspid valve surgery

C.A. Mestres[1], G. Fita[2], V.M. Parra[3], J.L. Pomar[1], J.M. Bernal[4]

[1]*Department of Cardiovascular Surgery, Hospital Clínico. University of Barcelona. Barcelona, Spain;* [2]*Department of Anesthesiology, Hospital Clinico, University of Barcelona, Barcelona, Spain;* [3]*National Chest Institute and School of Medicine, University of Chile, Santiago Chile;* [4]*Department of Cardiovascular Surgery, Hospital Universitario Valdecilla, University of Cantabria, Santander, Spain*

HSR Proceedings in Intensive Care and Cardiovascular Anesthesia 2012; 4(4): 261-267

Table 2 - *Intra-, postoperative and follow-up data.*

	TV Replacement	TV Repair	p value
CPB time	79.9 ± 42.8	75.7 ± 45.7	
Ischemic time	21.8 ± 23.1	64.5 ± 48.8	n.s.
Mortality	8 (27.6 %)	-	0.0002
Cardiac	6	-	0.01
Bleeding	1	-	
Neurologic	1	-	
Late mortality	15 (51.7 %)	9 (50.0 %)	n.s.
Cardiac	2	3	
Valvular	1	1	
Unknown	7	1	
Reoperation	1	2	
Thromboembolism	1	-	
Hemorrhage	-	1	
Malignacy	1	-	
Others non cardiac	2	1	

TV = tricuspid valve; CPB = Cardiopulmonary Bypass

Rev Esp Cardiol. 2013;66(8):629-635

Original article

Short- and Long-term Outcomes of Surgery for Severe Tricuspid Regurgitation

Jorge Rodríguez-Capitán,[a,*] Juan J. Gómez-Doblas,[a] Leticia Fernández-López,[b] Raúl López-Salguero,[c] Manuel Ruiz,[d] Inés Leruite,[e] Fernando Cabrera-Bueno,[a] María J. Mataró-López,[a] Gemma Sánchez-Espín,[a] José M. Melero-Tejedor,[a] Carlos Porras-Martín,[a] Miguel Such,[a] and Eduardo de Teresa[a]

Surgical Outcomes by Type of Valve Surgery or Replacement

	Overall sample (n=119)	Tricuspid repair (n=84)			Tricuspid replacement (n=35)		
		Ringless (n=61)	Ring (n=23)	*P*	Biological valve (n=11)	Mechanical valve (n=24)	*P*
ECC time, min	126.7±43.3	118.9±34.6	128.4±35.1	.31	116.3±52.5	146.9±58.8	.25
Low post-surgery cardiac output	38.7% (46/119)	36.1% (22/61)	30.4% (7/23)	.63	45.5% (5/11)	50% (12/24)	.8
Complications							
Infectious	14.3% (17/119)	11.5% (7/61)	17.4% (4/23)	.47	0 (0/11)	25% (6/24)	.06
Neurological	5% (6/119)	3.3% (2/61)	8.7% (2/23)	.3	9.1% (1/11)	4.2% (1/24)	.56
Respiratory	32.8% (39/119)	24.6% (15/61)	30.4% (7/23)	.59	36.4% (4/11)	54.2% (13/24)	.32
Renal	14.3% (17/119)	13.1% (8/61)	21.7% (5/23)	.33	0 (0/11)	16.7% (4/24)	.15
Reoperation due to bleeding	7.6% (9/119)	8.2% (5/61)	4.3% (1/23)	.54	9.1% (1/11)	8.3% (2/24)	.94
Post-surgery	66.4% (79/119)	67.2% (41/61)	52.2% (12/23)	.2	72.7% (8/11)	75% (18/24)	.89
Mortality	18.5% (22/119)	13.1% (8/61)	26.16% (6/23)	.15	18.2% (2/11)	25% (6/24)	.66

Ringless repair was significantly associated with recurrence of severe TR.

The use of mechanical prostheses was associated with a high rate of thrombosis.

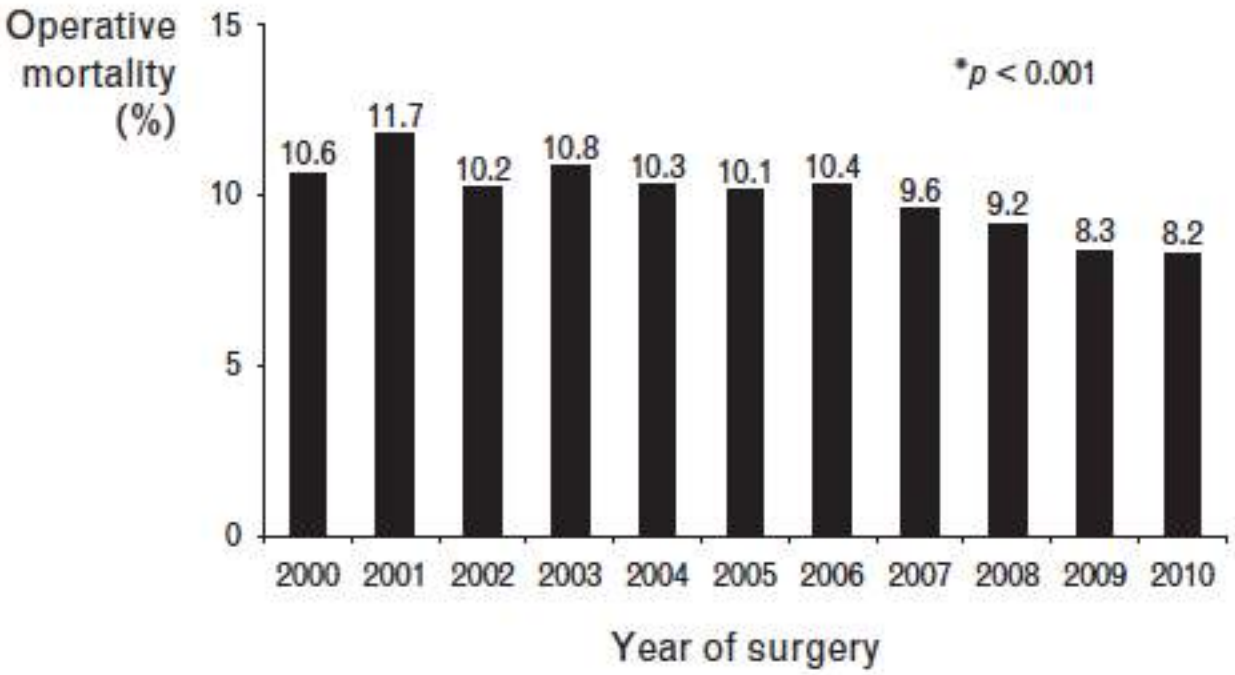
No significant differences in perioperative or total mortality were found between the different methods used for repair or valve replacement

REVIEW

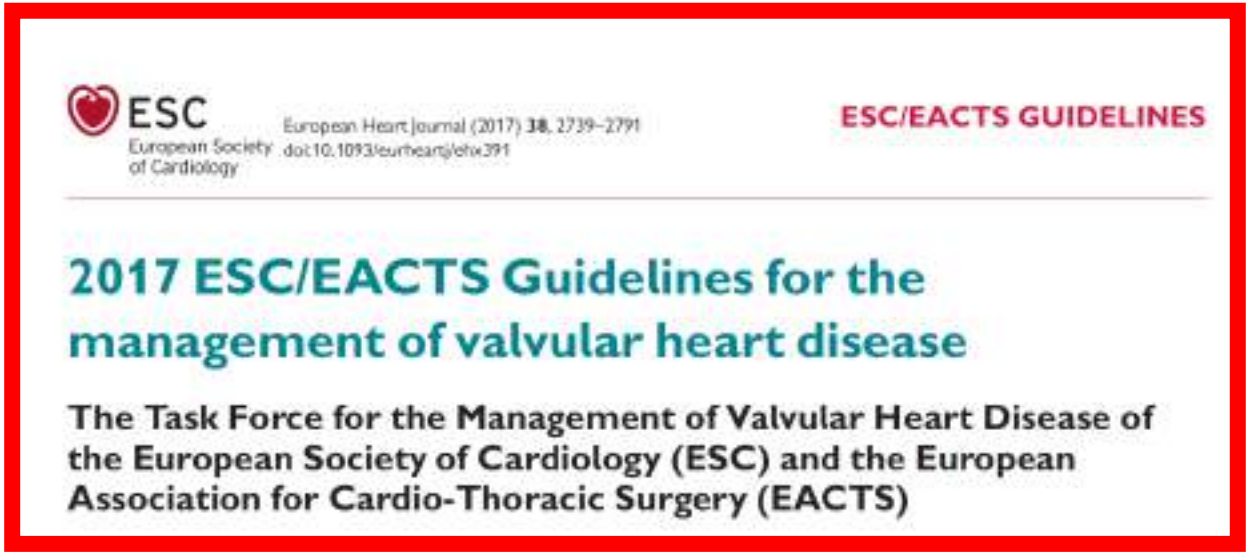
CURRENT OPINION

Surgical approach to functional tricuspid regurgitation: should we be more aggressive?

Jason H. Rogers[a] *and Steven F. Bolling*[b]



This rate was 20 % from1977-1998



If possible, valve repair is preferable to valve replacement. Ring annuloplasty, preferably with prosthetic rings, is key to surgery for secondary tricuspid regurgitation.

Valve replacement should be considered when the tricuspid valve leaflets are significantly tethered and the annulus is severely dilated.

Percutaneous repair techniques are in their infancy and must be further evaluated before any recommendations can be made

Future Perspective

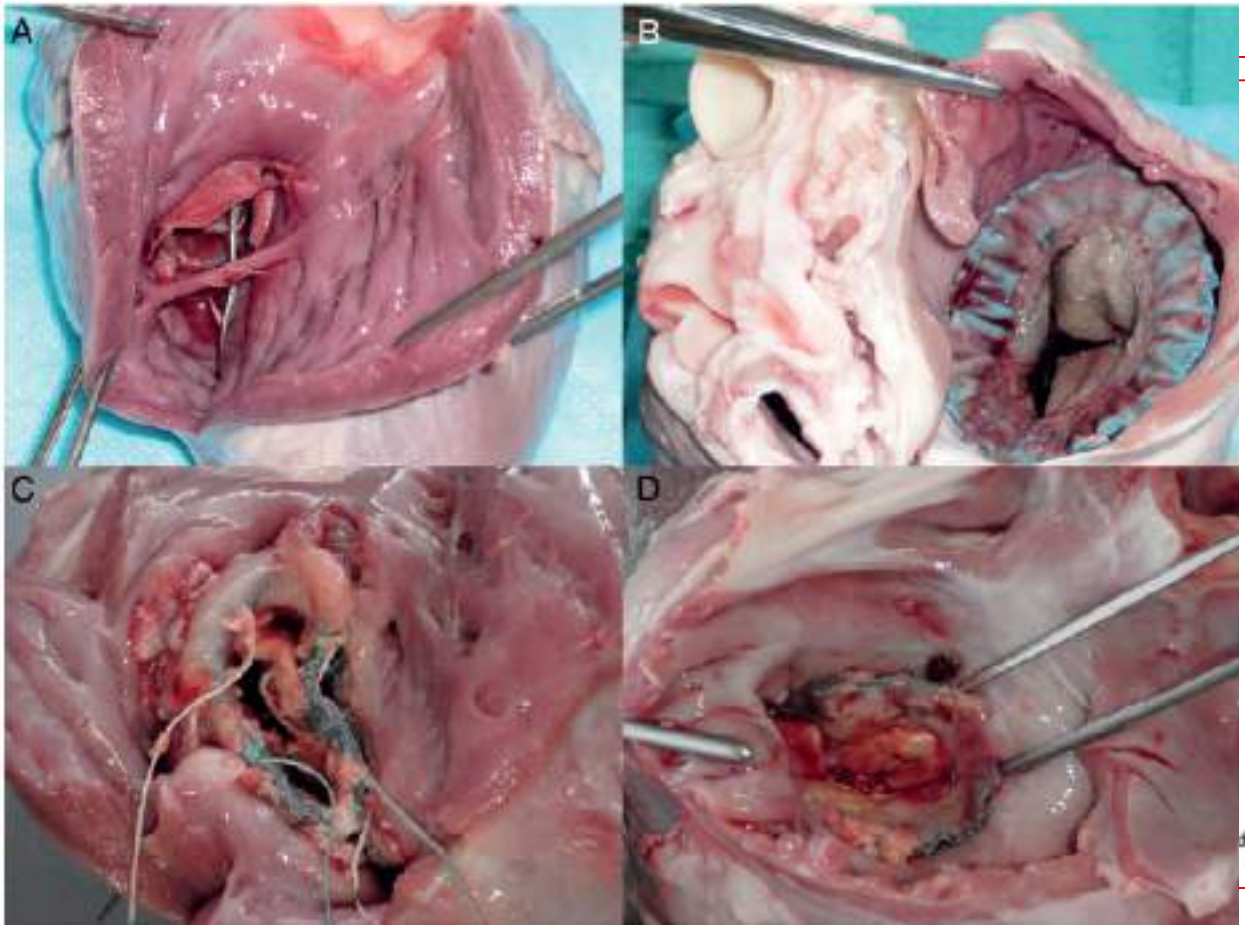
European Journal of Cardio-Thoracic Surgery (2014) 1–8
doi:10.1093/ejcts/ezt612

ORIGINAL ARTICLE

Off-pump tricuspid valved stent implantation: the next step

Jan-Paul Gundlach, Jawid Madjidyar, Martin Marczynski-Bühlow, Saskia Pokorny, Telse Maike Bähr, Jochen Cremer and Georg Lutter*

Department of Cardiovascula



Figur
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Percutaneous Transcatheter Valve-in-Valve Implantation With the Balloon-Expandable Valve for the Treatment of a Dysfunctional Tricuspid Bioprosthetic Valve — A Pediatric Case Report

Baher Matta Hanna, MD[1], Josep Rodés-Cabau, MD[2], Nagib Dahdah, MD[1]

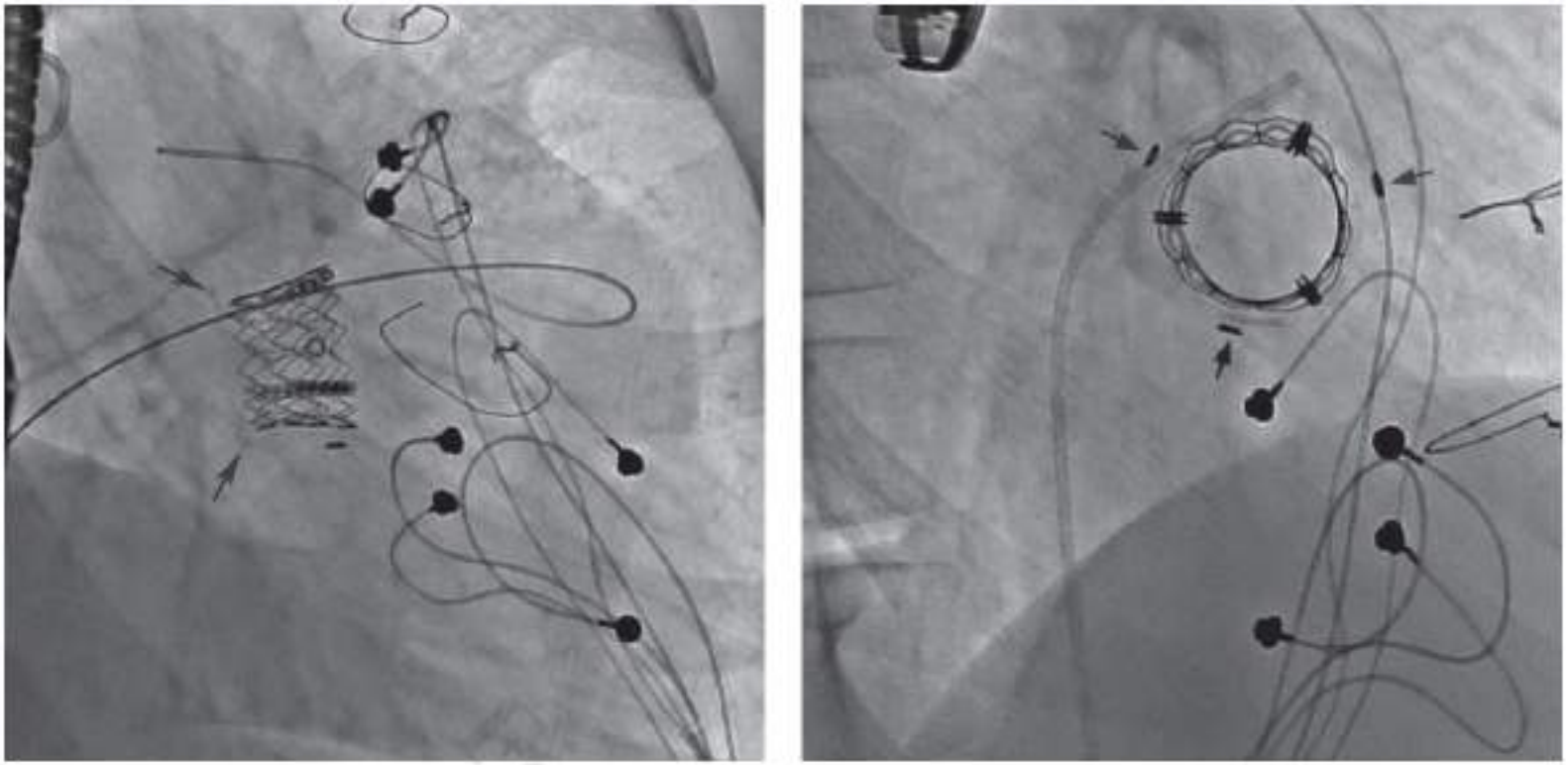
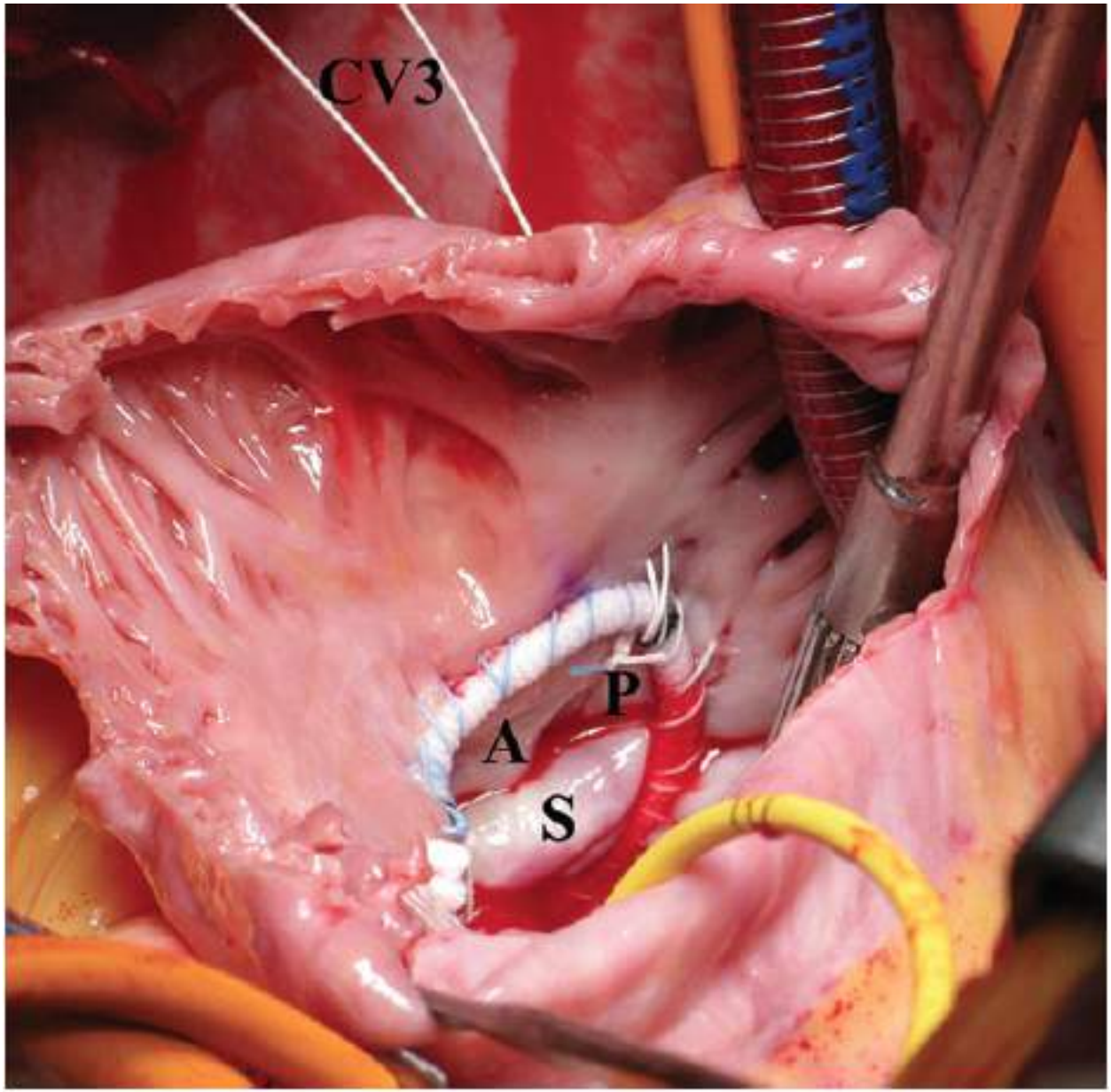


Figure 3. (A) *Following deployment, the SAPIEN stent is well seated between the proximal calcification (arrows) of the Mosaic frame and the distal radiopaque markers. The distal flare of the SAPIEN stent is due to the shape of the Mosaic frame.* (B) *A coaxial view of the SAPIEN valve inside*

J INVASIVE CARDIOL 2013;25(6):310-312

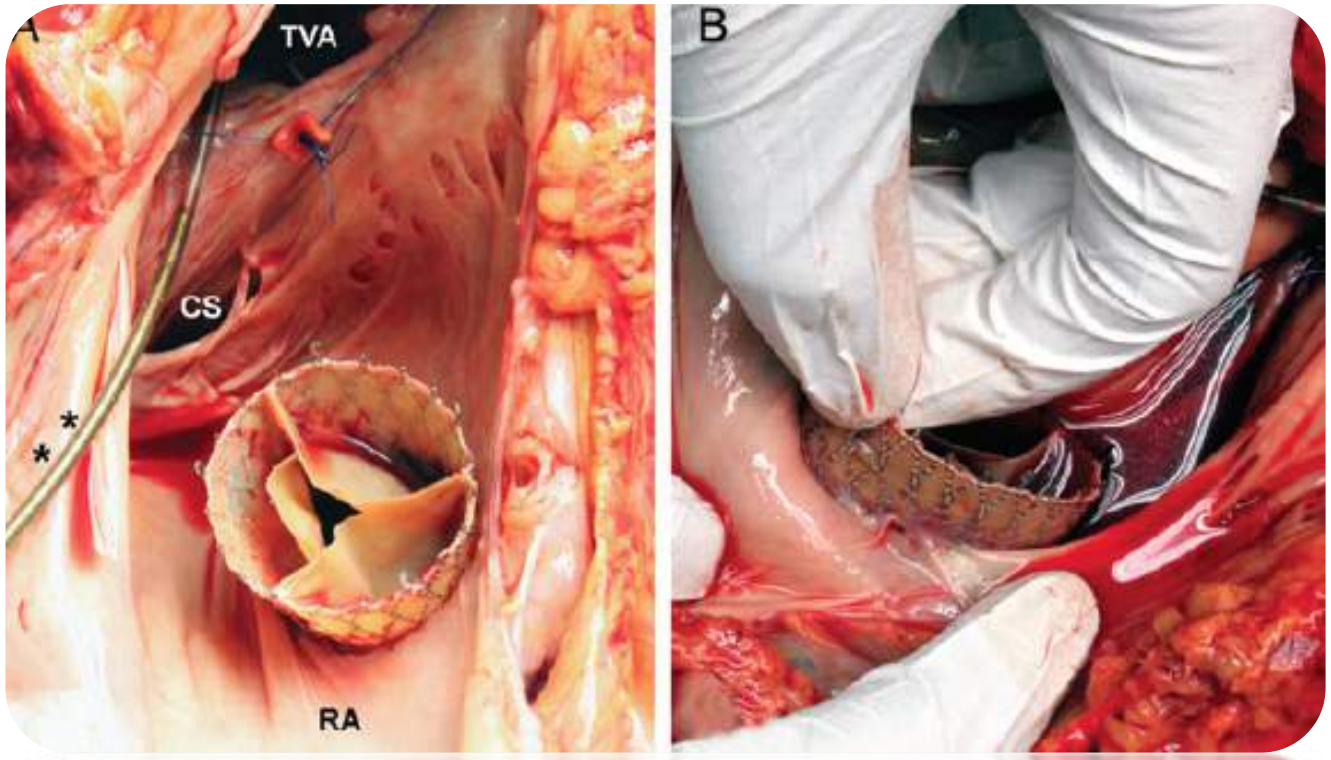
Interactive CardioVascular and Thoracic Surgery 17 (2013) 736–738
doi:10.1093/icvts/ivt253 Advance Access publication 2 July 2013



doi:10.1

Caval valve implantation for treatment of tricuspid regurgitation: post-mortem evaluation after mid-term follow-up

Alexander Lauten[1]*, Ali Hamadanchi[1], Torsten Doenst[2], and Hans R. Figulla[1]



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EDITORIAL COMMENT

Transcatheter Tricuspid Valve Repair

New Valve, New Opportunities, New Challenges*

Alexis Lalli, MD,[†] Antonio Mangieri, MD[†]

FIGURE 1 Transcatheter Therapies for Treating Tricuspid Valve Regurgitation

	Trialign	TriCinch	Cardioband	FORMA	TriClip	Millipede	TRAIPTA
							
Mechanism	Annuloplasty	Annuloplasty	Annuloplasty	Coaptation device	Leaflet plasty	Annuloplasty	Annuloplasty
Patients treated	± 50	±27	±19	±18	± 250	2 (surgical)	-
Ongoing Study	SCOUT II	PREVENT	TRI-REPAIR	SPACER	-	-	-
Clinical endpoints	30-day Overall Mortality	30-day Safety Endpoint	30-day Safety Endpoint and Serious Adverse Events	30-day Cardiac Mortality	-	-	-
Echo endpoints	TV Diameters EROA TV area TV tenting area RV TR grade	TR grade	SL Diameter EROA RVol TR grade	TR grade	-	-	-
RCA damage	✓✓	✓✓	✓/✓✓	✓	✓	✓/✓✓	✓✓
Device detachment	✓✓	✓✓/✓✓✓	✓/✓✓	✓✓	✓✓	✓/✓✓	✓✓
Cardiac perforation	✓	✓✓	✓✓	✓✓	✓	✓✓	✓✓✓
Technical difficulty	✓✓	✓	✓✓	✓	✓✓	✓✓	✓✓✓
Surgical predicate	✓	✓✓/✓✓✓	✓	✓✓✓	✓✓✓	✓	✓✓✓

YES

YES

YES

YES if:

Secondary TR needs aggressive approach	More patients with late-TR need surgical intervention	TV aanuloplasty adds little time to the surgery and is associated with low complication	Take enough time to tricuspid repair to have more durable results and better patients outcome	Individualize ring or prosthetic valve type