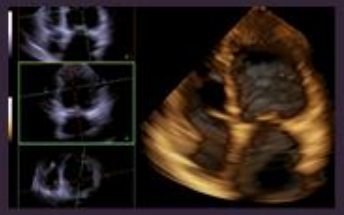

EuroValve
March 10-11, 2016

Should we operate on tricuspid valve at the time of left-sided valve surgery?

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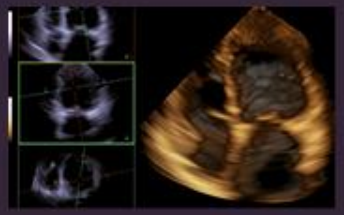


EuroValve
March 10-11, 2016

Faculty disclosure

Giovanni La Canna

I have no financial relationships to disclose.

Tricuspid regurgitation and left-sided valve disease

- **Tricuspid Regurgitation**

- **Etiology**
- *-organic*
- *-functional/secondary*
- *-catheter-induced*

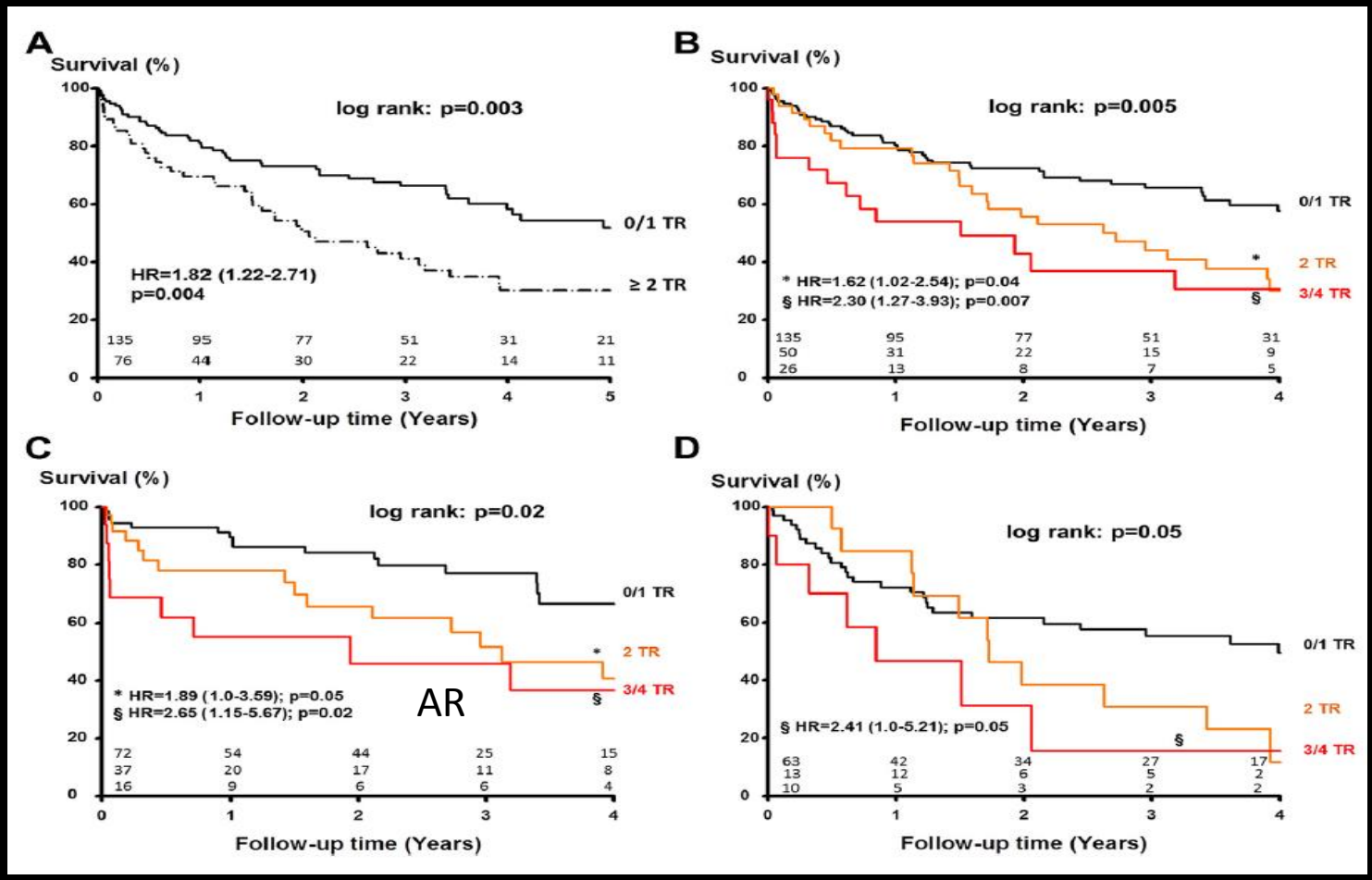
- **Clinical scenario**
- *Concomitant*
- *Reversed*
- *Fluctuating*
- *Late*
- *Silent*
- *Clinically overt*
- *Masked*

- **Left-sided valve disease**

- **Mitral valve**
- *Rheumatic*
- *Degenerative*
- *Functional/Secondary*

- **Aortic valve**
- *Stenosis*
- *Insufficiency*

TRICUSPID REGURGITATION
AND
«LOW-GRADIENT LOW -EF AORTIC STENOSIS»



Dahou A et al.

J Am Coll Cardiol Intv 2015;8:588-96

Challenging concerns

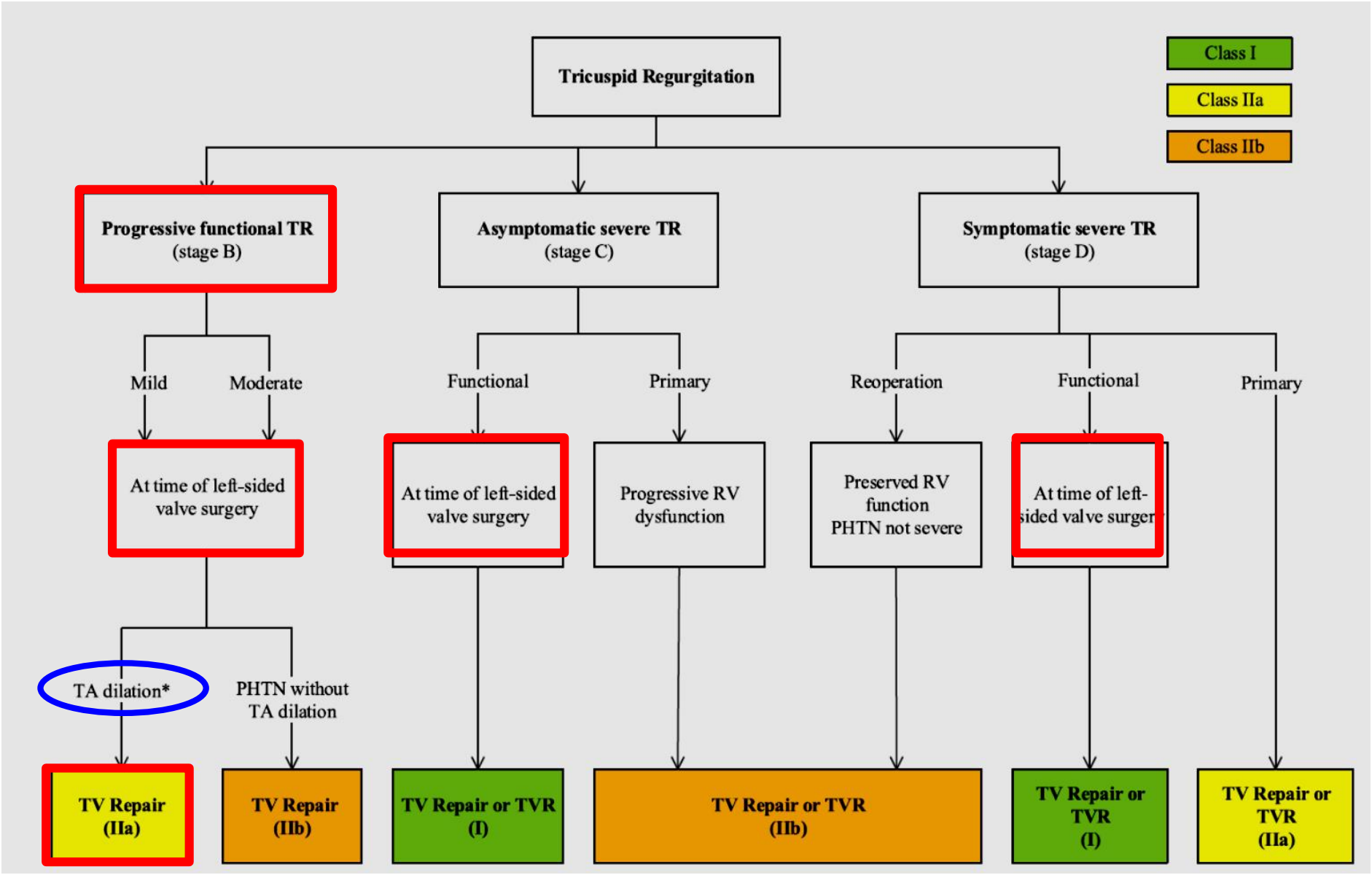
- Predictability of time-course of TR following successful left-sided valve surgery:

  - *persistence or reversibility of severe TR*

  - *late occurrence of TR*

- High-risk surgical treatment of re-developed TR
- Surgical strategy to avoid TR recurrence

2014 AHA VHD Guidelines



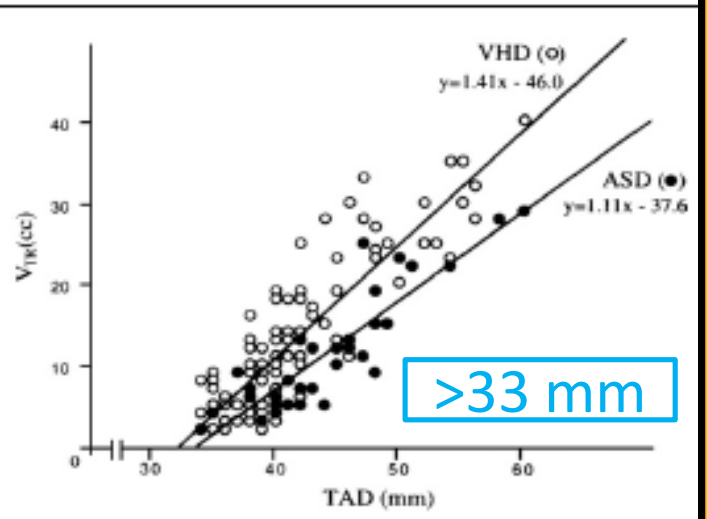
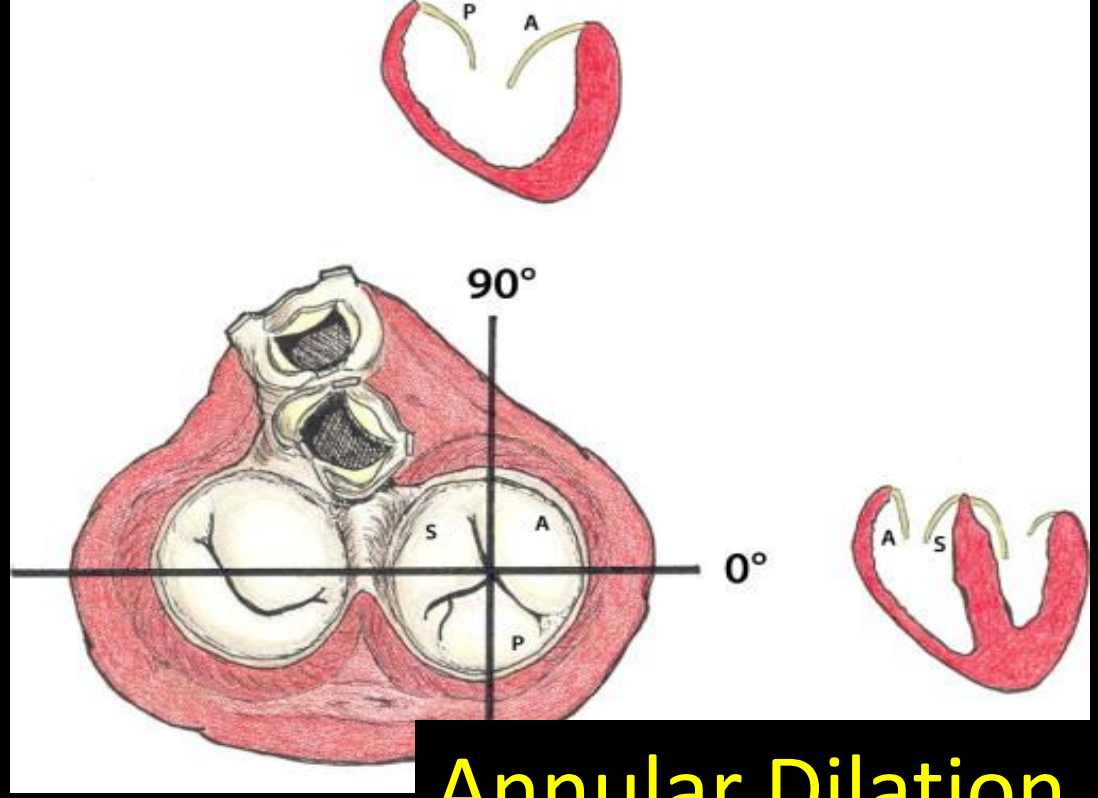


Figure 4 Correlation Between TAD and V_{TR}

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

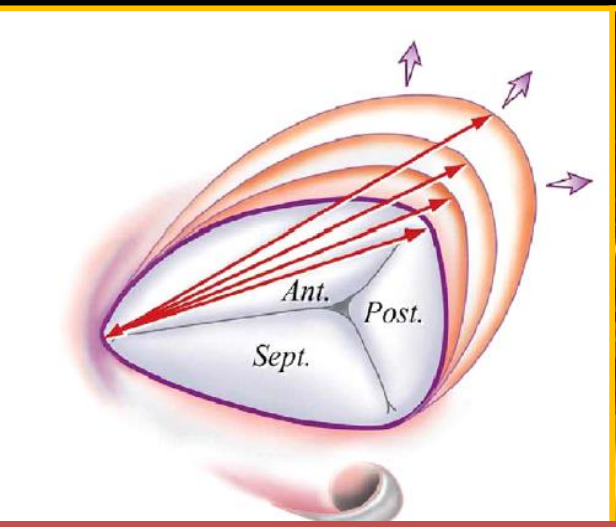
Sugimoto JTCS 1999; 117:463-71

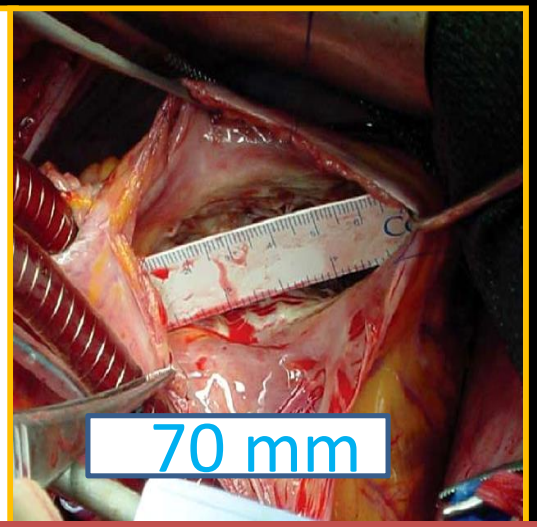


Annular Dilation

Need of standardized targeting values

- Diameter > 21 mm/m2
- Diameter >35 mm
- Diameter > 40 mm

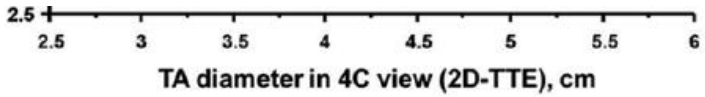


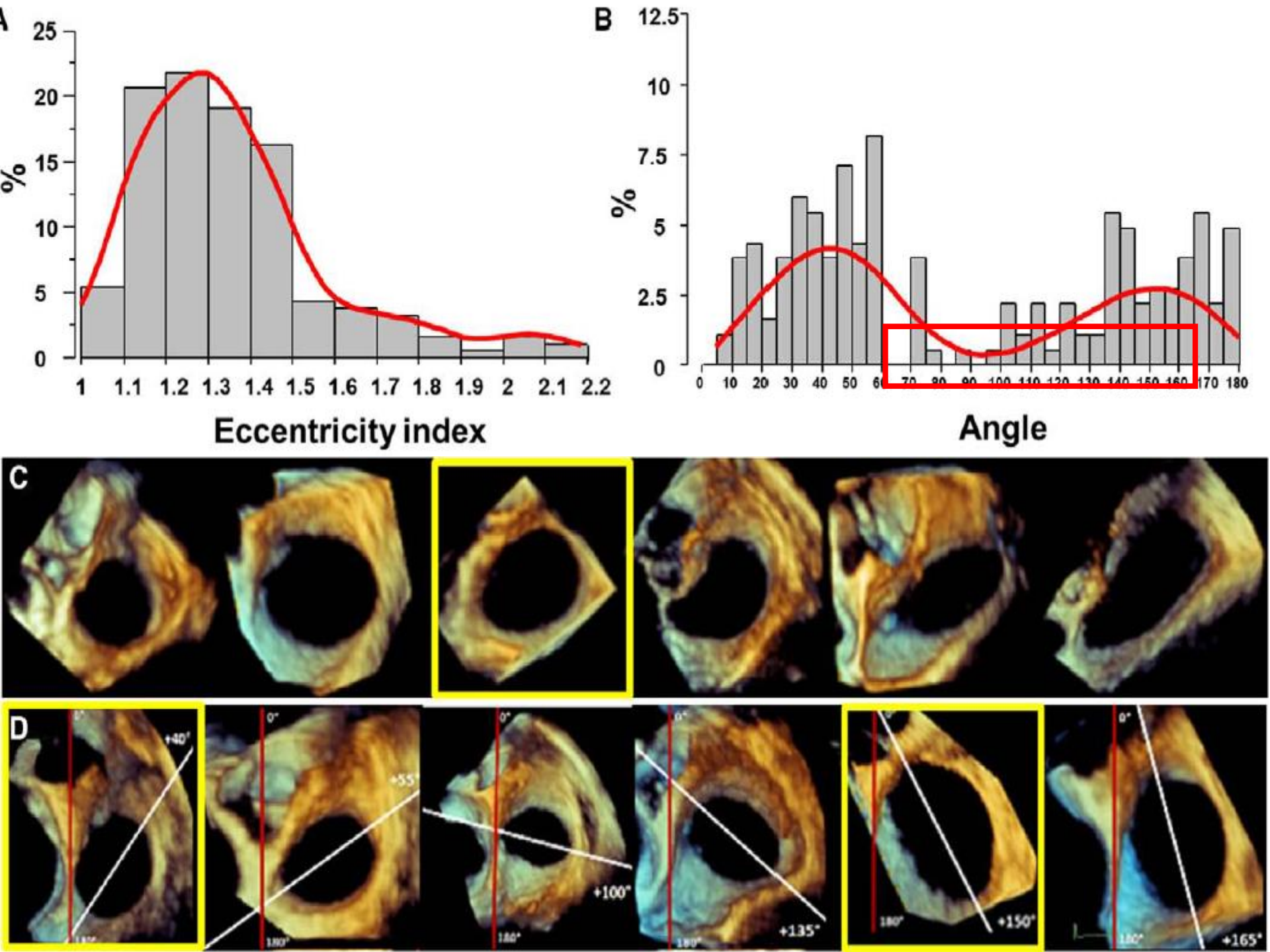


Dreyfus GD, et al. Ann Thorac Surg 2005; 79: 127-32.

Comparison of 2-Dimensional, 3-Dimensional, and Surgical Measurements of the Tricuspid Annulus Size

In contrast, surgical measurements, performed in unloaded conditions, were highly variable depending of the traction strength applied to the tricuspid valve highlighting the need to develop a standardized method using dedicated tools for the assessment of TA size. We propose the thresholds of 42 mm or 23 mm/m^2 that may lead to consider tricuspid surgery at the same time as left-sided surgery. Further prospective studies using this methodology and those thresholds are now necessary to validate whether a preventive strategy can improve outcome.




A
25
20
15
10
5
0
%
1
1.1
1.2
1.3
1.4
1.5
1.6
1.7
1.8
1.9
2
2.1
2.2
Eccentricity index
B
12.5
10
7.5
5
2.5
0
%
0
10
20
30
40
50
170
180
Angle
C
D
+40°
+55°
+100°
+135°
+150°
+165°

Geometric Determinants of Functional Tricuspid Regurgitation

Insights From 3-Dimensional Echocardiography

Thanh-Thao Ton-Nu, MD, FRCP; Robert A. Levine, MD; Mark D. Handschumacher, David J. Dorer, PhD; Chaim Yosefy, MD; Dali Fan, MD, PhD; Lanqi Hua, RDCS Leng Jiang, MD; Judy Hung, MD

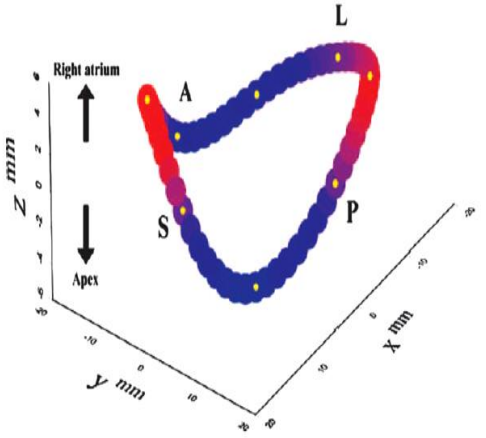
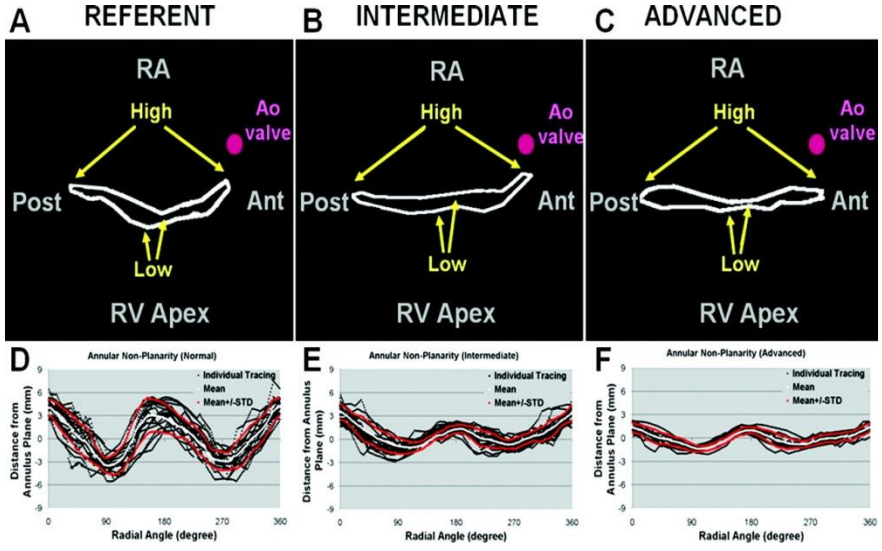
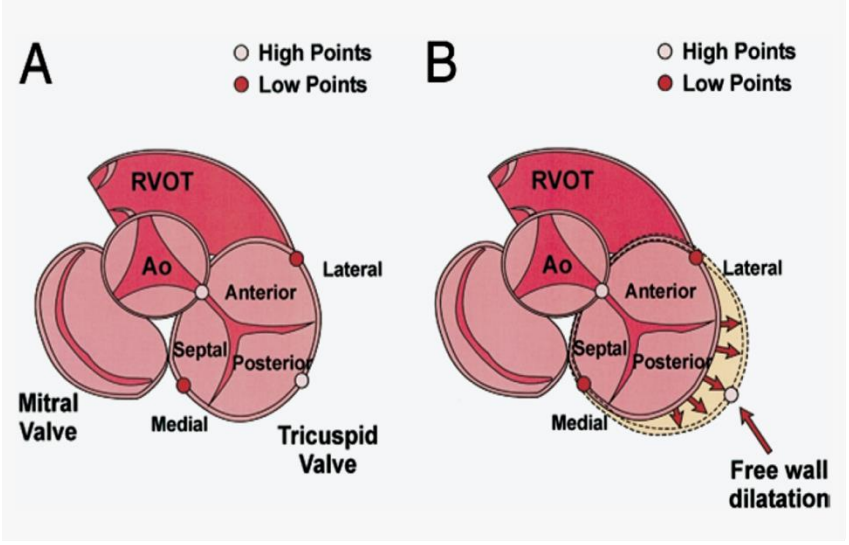


Figure 6. The reconstructed ring shape for tricuspid annuloplasty, based on the average results obtained in healthy subjects at the time of minimum TA area. The positive x-y-z axis indicates the respective directions toward the septum, the posterior wall, and the right atrium. At the yellow dot, the average of each of the manually selected TA locations is shown. The reconstructed TA locations were color coded by assigning shades of red to points located above the best-fit plane toward the atrium and shades of blue to points located below the best-fit plane toward the apex. A indicates anterior; L, lateral; P, posterior; and S, septum.





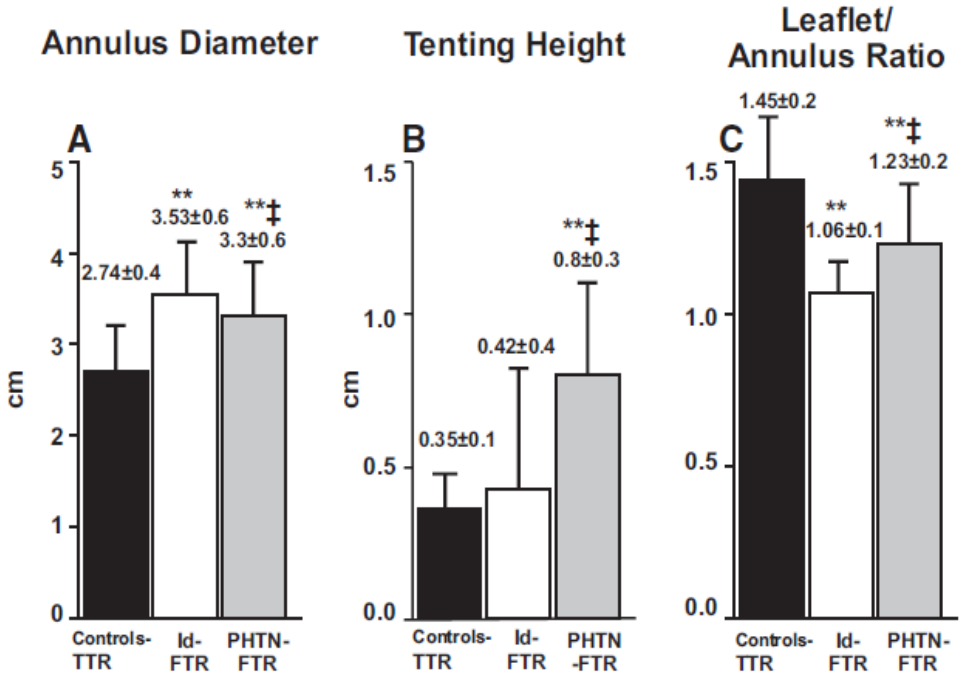
Conclusions—The normal TVA has a bimodal shape with distinct high points located anteroposteriorly and low points located mediolaterally. With functional TR, the annulus becomes larger, more planar, and circular. These changes in annular shape with TR have potentially important mechanistic and therapeutic implications for tricuspid valve repair. (***Circulation*. 2006;114:143-149.**)

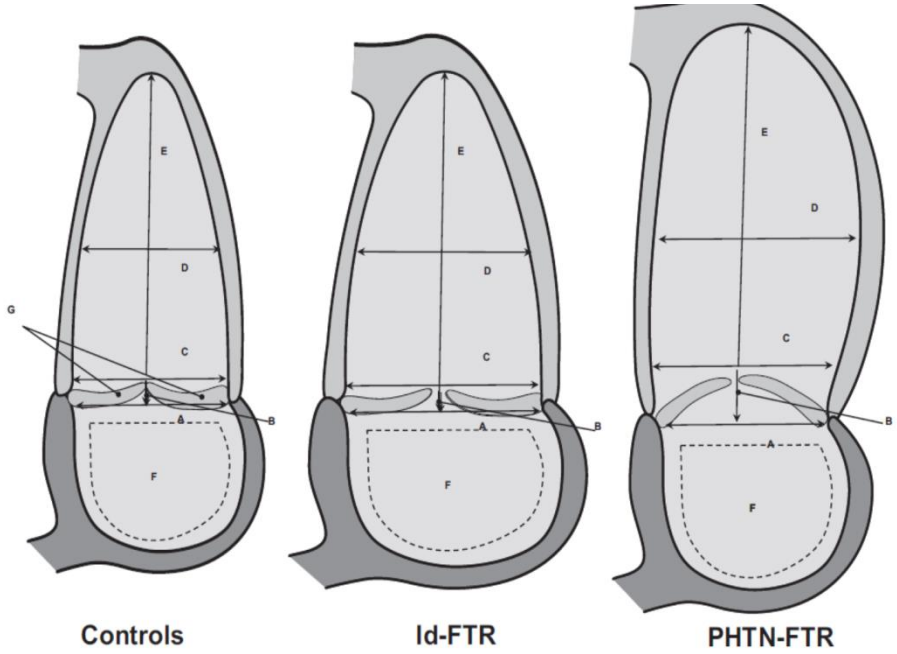
Circulation

Clinical Context and Mechanism of Functional Tricuspid Regurgitation in Patients With and Without Pulmonary Hypertension

Yan Topilsky, MD; Amber Khanna; MD; Thierry Le Tourneau; MD; Soon Park; MD; Hector Michelena; MD; Rakesh Suri; MD, DPhil; Douglas W. Mahoney; MS; Maurice Enriquez-Sarano, MD

Circ Cardiovasc Imaging. 2012;5:314-323.

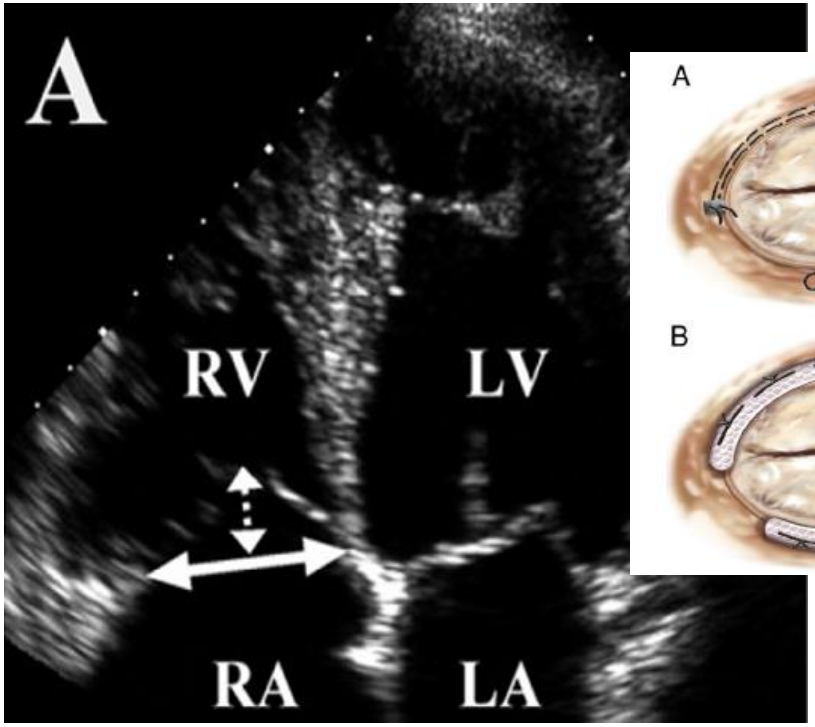


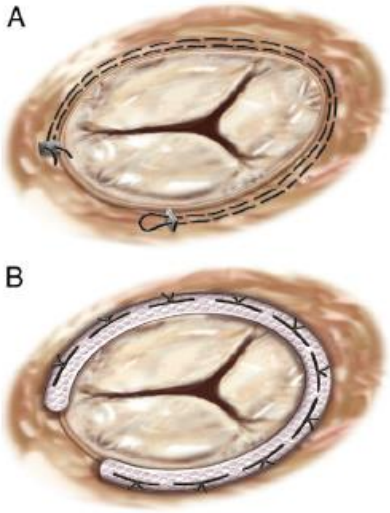


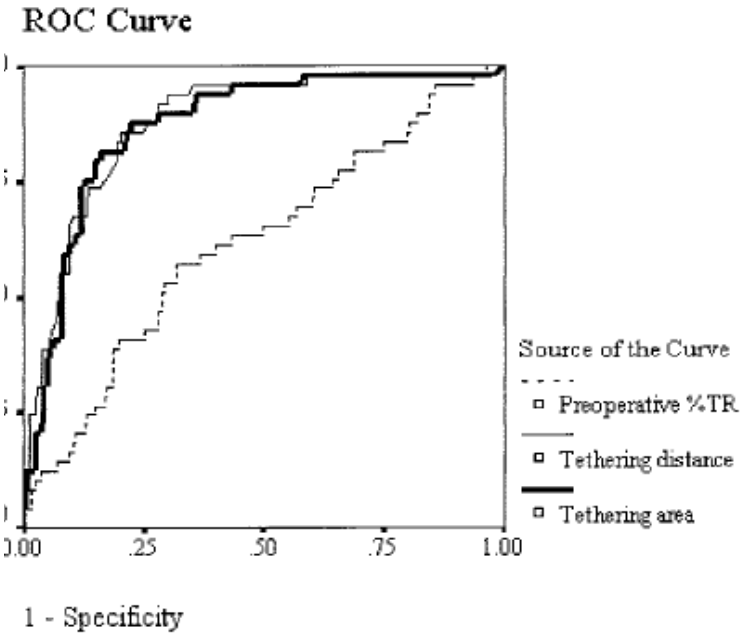
Tricuspid Valve Tethering Predicts Residual Tricuspid Regurgitation After Tricuspid Annuloplasty

Shota Fukuda, MD; Jong-Min Song, MD; A. Marc Gillinov, MD; Patrick M. McCarthy, MD; Masao Daimon, MD; Vorachai Kongsaerepong, MD; James D. Thomas, MD; Takahiro Shiota, MD

Circulation. 2005;111:975-979.







Coaptation Depth 8 mm

Tenting area 1.74 cm2

CENTRAL ILLUSTRATION **Functional Tricuspid Regurgitation Development, Assessment, Diagnosis, and Treatment**

FTR DISEASE PROCESSES

Left-sided heart disease

Atrial fibrillation

Right ventricular (RV) afterload increase (with or without pulmonary hypertension)

RV remodeling

Altered RV function

Tricuspid annular dilation. (In some instances leaflet tethering occurs with the same triggering factors)

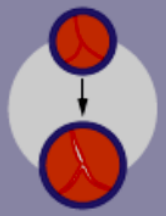
Abnormalities of tricuspid anatomy and function lead to functional tricuspid regurgitation (FTR)

FTR ASSESSMENTS

Tricuspid regurgitation (TR)

TR is the leakage of blood backwards through the tricuspid valve each time the right ventricle contracts

Color flow jet visualization is used to evaluate PISA radius and effective regurgitant orifice or regurgitant volume



Annular dilation

The annular ring is attached to the tricuspid valve leaflets. Dilation can result in poor leaflet apposition

2D-echocardiography coupled with 3D imaging is used to accurately measure annular diameter

Leaflet coaptation mode

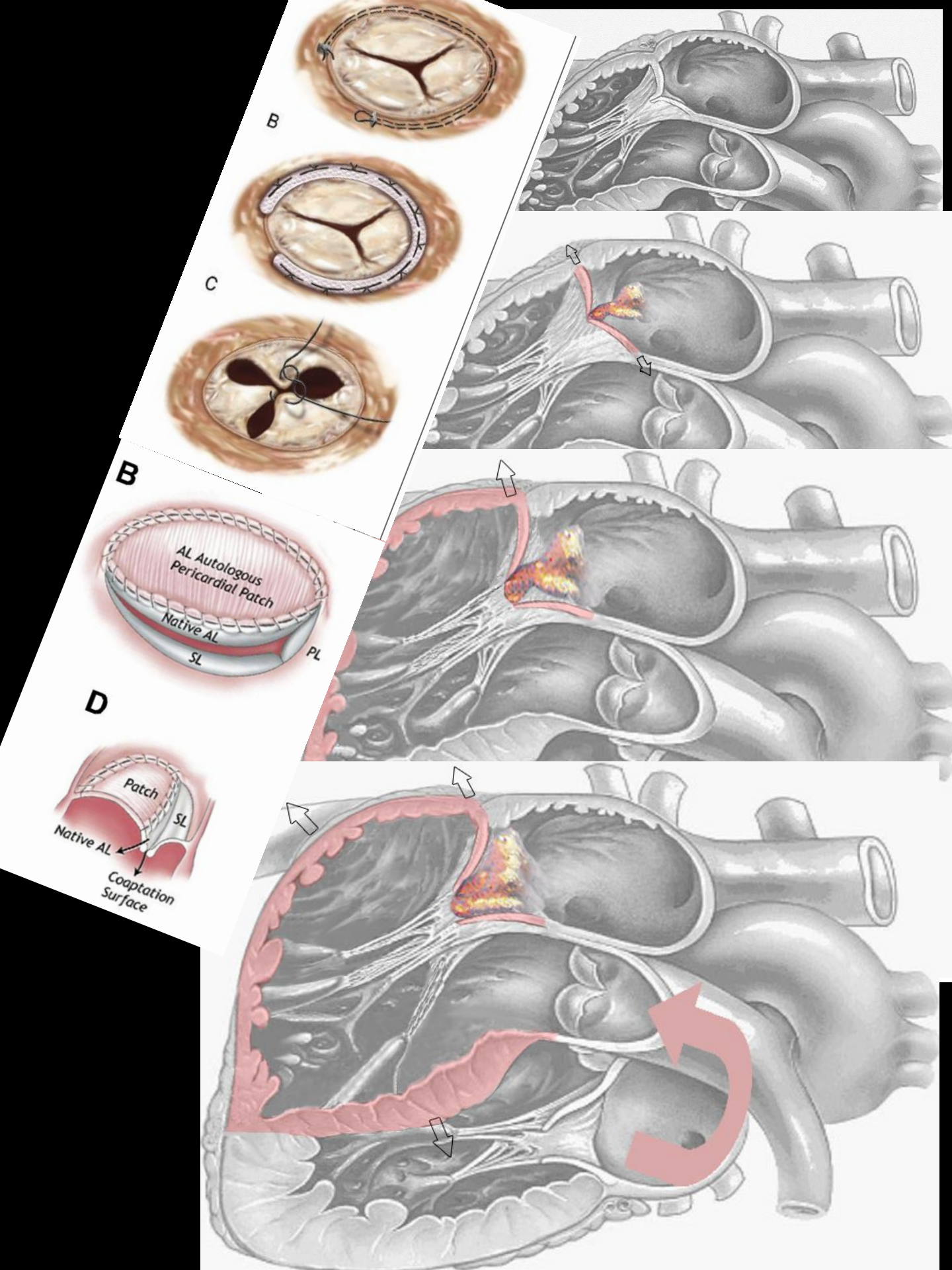
Coaptation is the surface where the leaflets meet. If decreased, contact is made at the leaflet edge (edge-to-edge), leaflet tethering can restrict leaflet closure

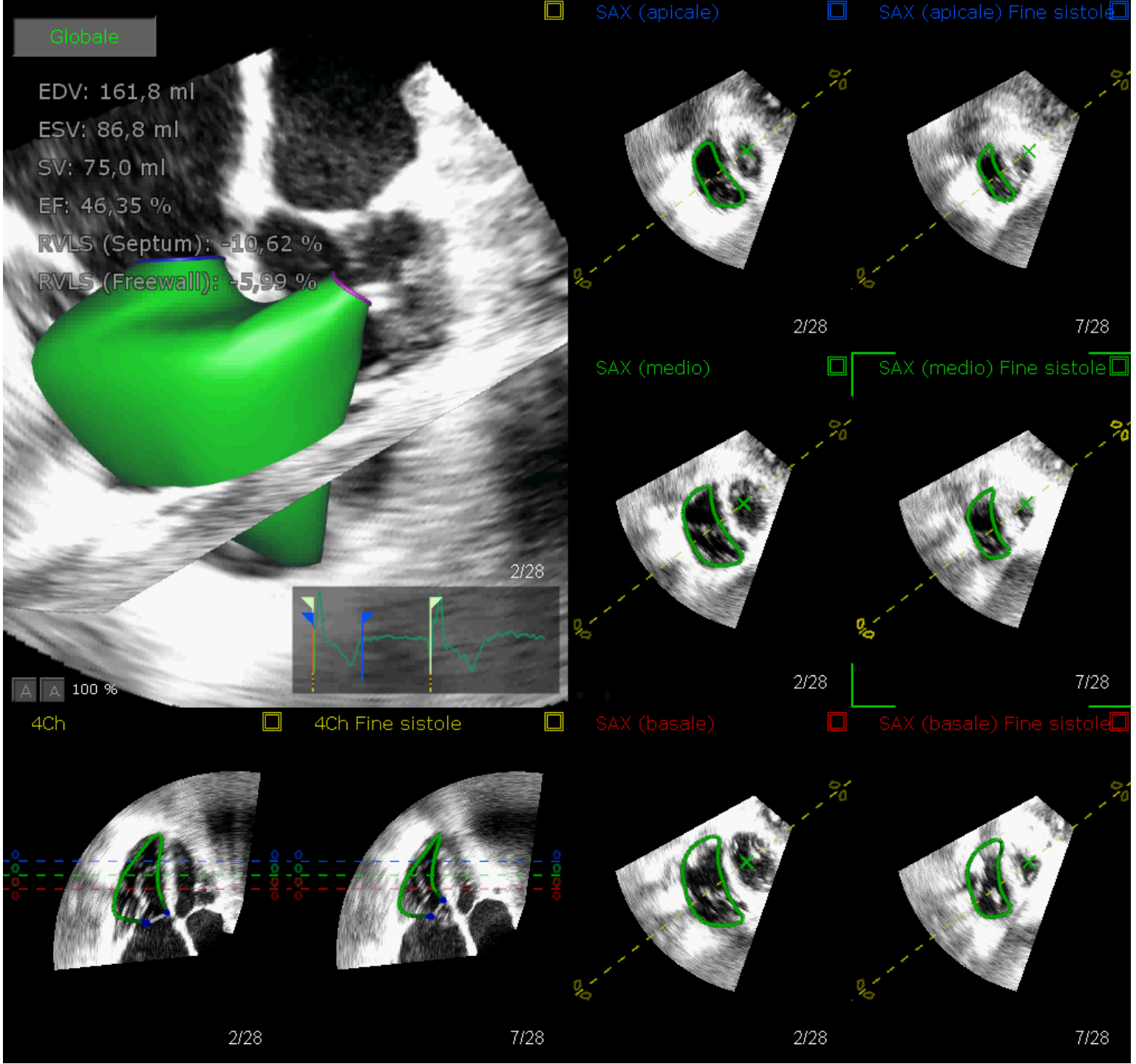
3D-echocardiography is recommended to measure tenting volume (TV) — the area within the tricuspid leaflets

DIAGNOSIS AND TREATMENT

Stage 1	Stage 2	Stage 3
TR severity: None or mild	TR severity: Mild or moderate	TR severity: Severe
Annular diameter: <40 mm	Annular diameter: >40 mm	Annular diameter: >40 mm
Coaptation mode: Normal (body-to-body), with no leaflet tethering	Coaptation mode: Abnormal (edge-to-edge), with or without tethering of <8 mm below the annular plane	Coaptation mode: No coaptation, with or without tethering of >8 mm below the annular plane
Medical treatment. No surgical intervention is indicated	Concomitant tricuspid valve annuloplasty is recommended	Concomitant tricuspid valve annuloplasty and leaflet augmentation (if tethering is present)

Dreyfus, G.D. et al. J Am Coll Cardiol. 2015; 65(21):2331–6.


B
C
B
AL Autologous Pericardial Patch
Native AL
SL
PL
D
Patch
SL
Native AL
Coaptation Surface


Globale
EDV: 161,8 ml
ESV: 86,8 ml
SV: 75,0 ml
EF: 46,35 %
RVLS (Septum): -10,62 %
RVLS (Freewall): -5,99 %
2/28
100 %
4Ch
4Ch Fine sistole
SAX (apicale)
SAX (apicale) Fine sistole
2/28
7/28
SAX (medio)
SAX (medio) Fine sistole
2/28
7/28
SAX (basale)
SAX (basale) Fine sistole
2/28
7/28
2/28
7/28

Should prophylactic tricuspid annulopasty be performed at the time of degenerative MR repair?

- Lack of randomized studies

- «Early surgery» vs «watchful waiting strategy»

Late Tricuspid Regurgitation following mitral valve repair for degenerative MR

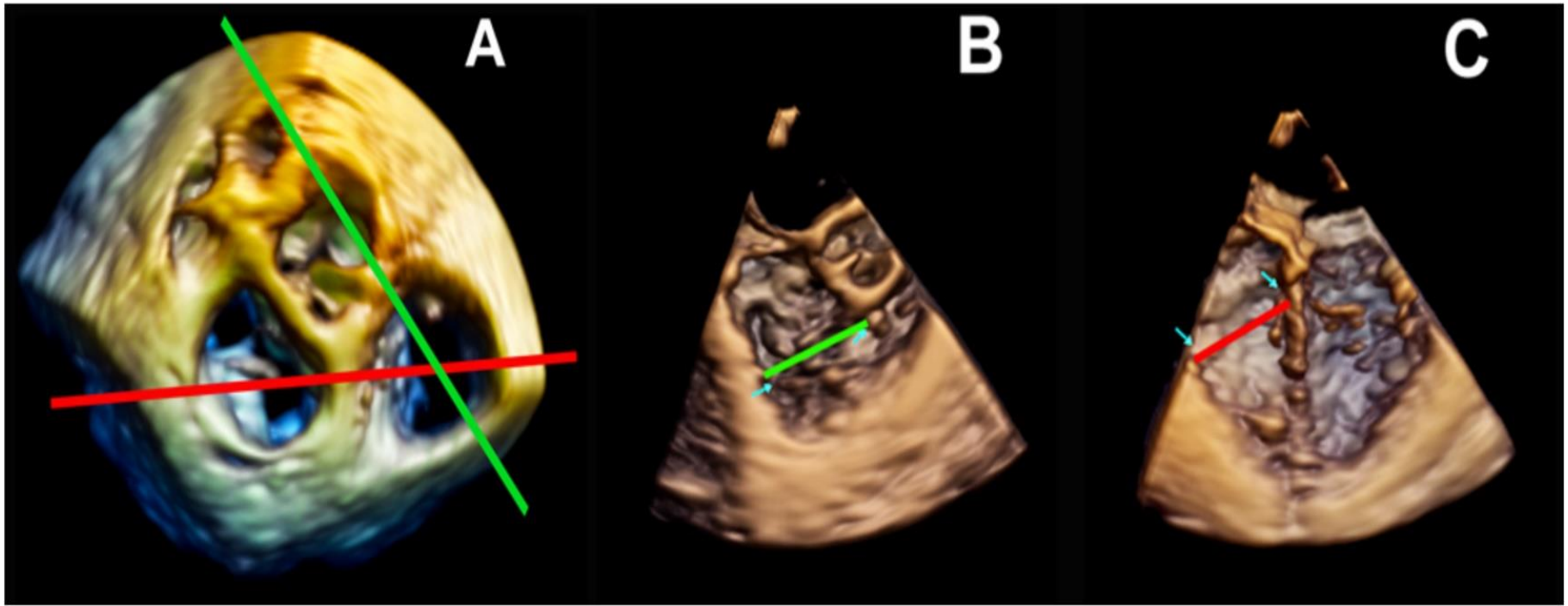
G.La Canna et al. San Raffaele Hospital, Milan, Italy

706 prospective cohort patients with degenerative MR ***without significant TR***

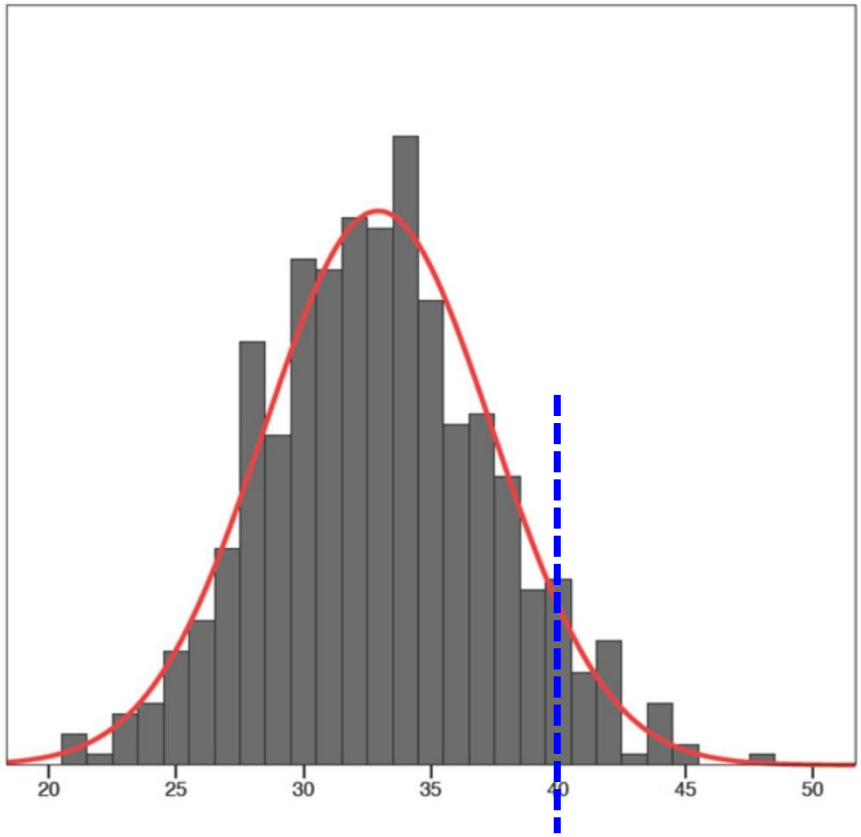
3D analysis of tricuspid annulus

Mitral Repair, Maze procedure for AFi

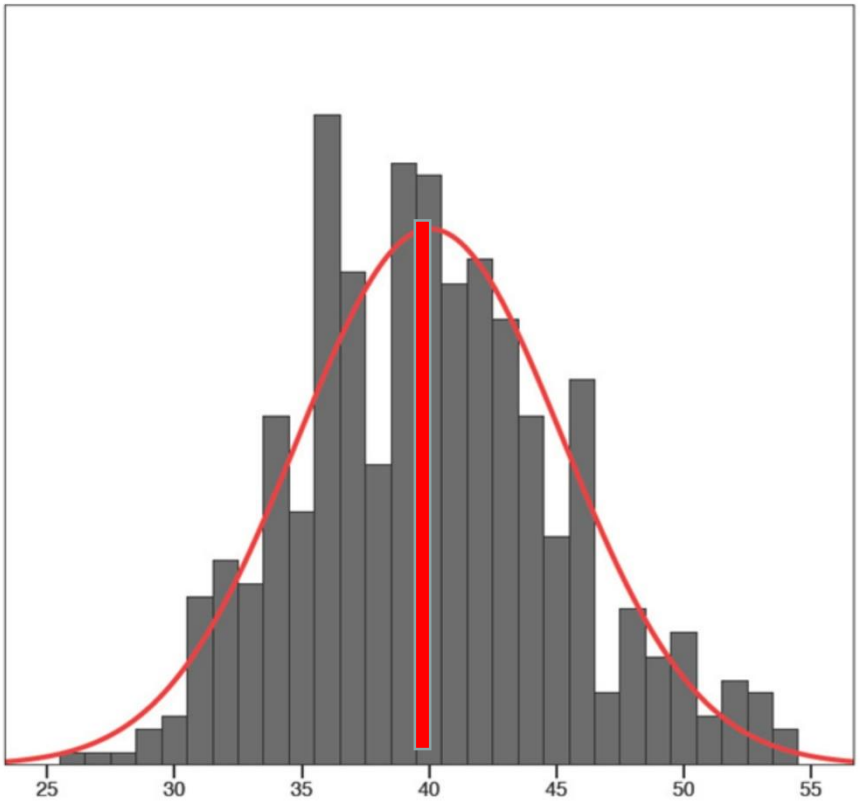
End-point: late TR (mean follow-up 2 yrs)



Distribution of pre-operative tricuspid annulus diameters at TEE



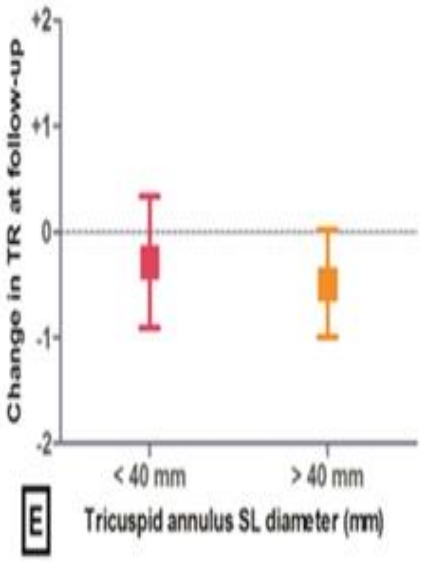
Septo-lateral diameter (mm)

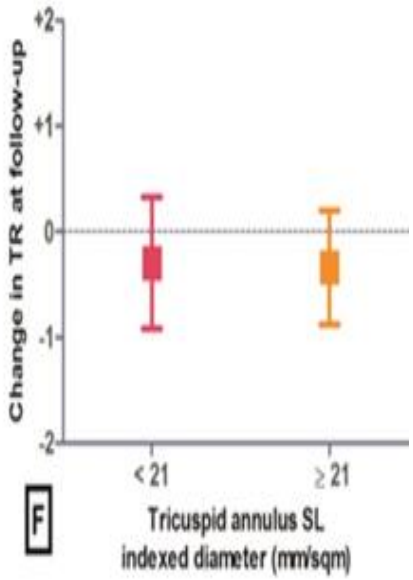


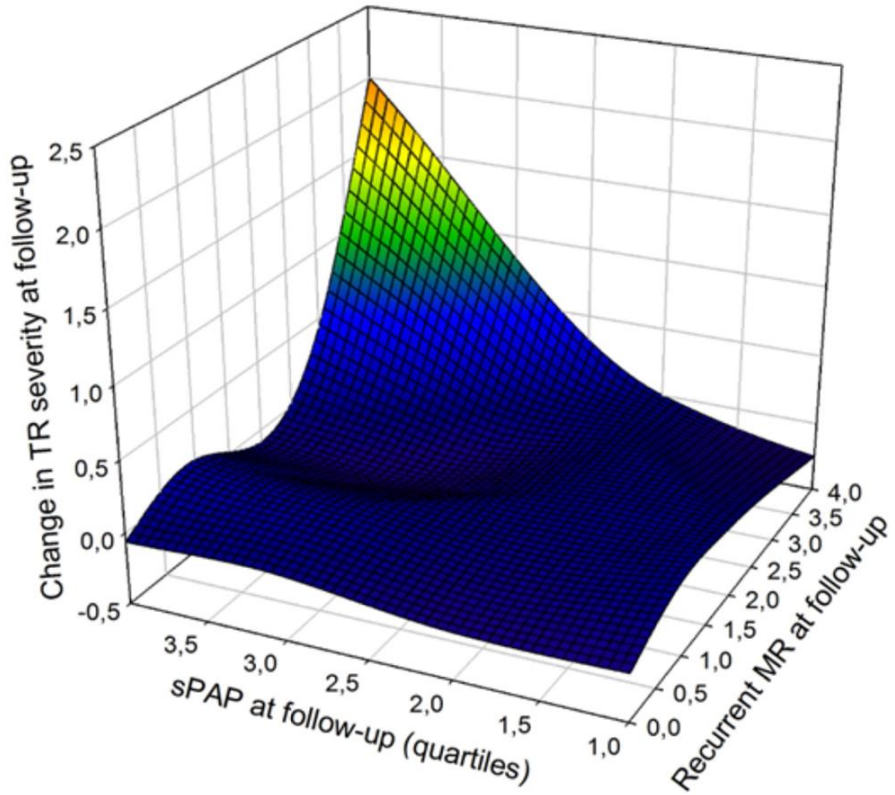
Antero-posterior diameter (mm)

Using a cut-off ≥ 40 mm or ≥ 21 mm/$m^{2,}$, 49 (6.9%) and 65 (9.2%) patients had pre-operative SL dilatation, respectively

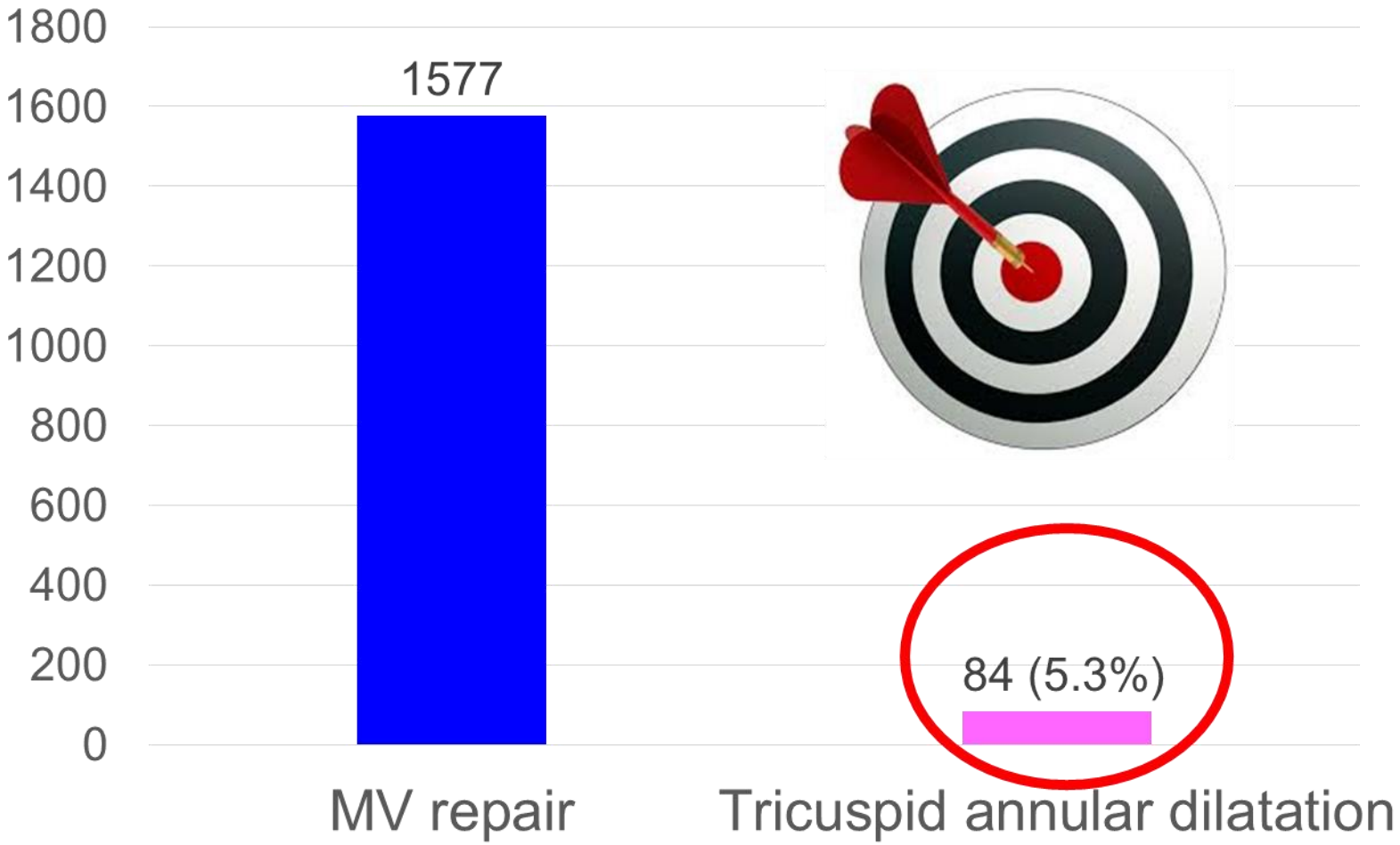
TR worsening occurred in 39 pts (5.5%) at 2 years and did not correlated with the size of tricuspid annulus







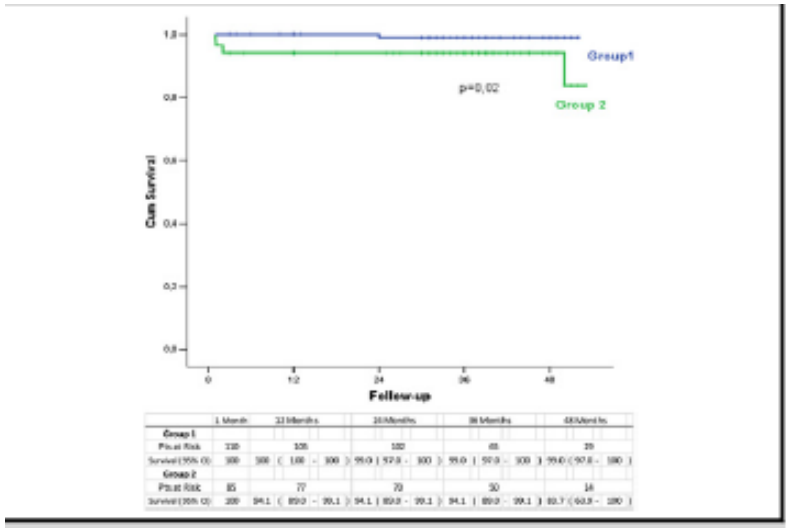
Prevalence of tricuspid annular dilatation in patients with less than severe TR (≤2+) undergoing early MV repair for degenerative MR at San Raffaele University Hospital (June 2011 - March 2015)



Conduction disorders after tricuspid annuloplasty with mitral valve surgery: Implications for earlier tricuspid intervention

Jérôme Jouan, MD,[a,b] Alessandro Mele, MD,[a] Emmanuelle Florens, MD,[a,b] Gilles Chatellier, MD, PhD,[b,c] Alain Carpentier, MD, PhD,[a,b] Paul Achouh, MD, PhD,[a,b] and Jean-Noël Fabiani, MD[a,b]

J Thorac Cardiovasc Surg 2016;151:99-103



Freedom from permanent pacemaker implantation.

Central Message

In MV surgery, the risk for permanent pacemaker requirement was increased after concomitant tricuspid annuloplasty.

Perspective

The risk for permanent pacemaker implantation after combined MV surgery and prophylactic tricuspid ring annuloplasty is increased but remains overweighed by the hazard of developing late secondary TR.

CONCLUSIONS

- Severe TR should be operated at the time of left-sided surgery addressing the surgical strategy to functional anatomy
- Less-than-severe TR requires careful assessment of valve-ventricle complex targeting the risk of late TR (3D-guided assessment)
- The risk of pacemaker implantation due to annuloplasty
- Degenerative Mitral Regurgitation may be at low risk of late TR (early surgery, concomitant AFi treatment)
- Ongoing percutaneous therapy is promising to avoid the high risk re-operation owing to late TR