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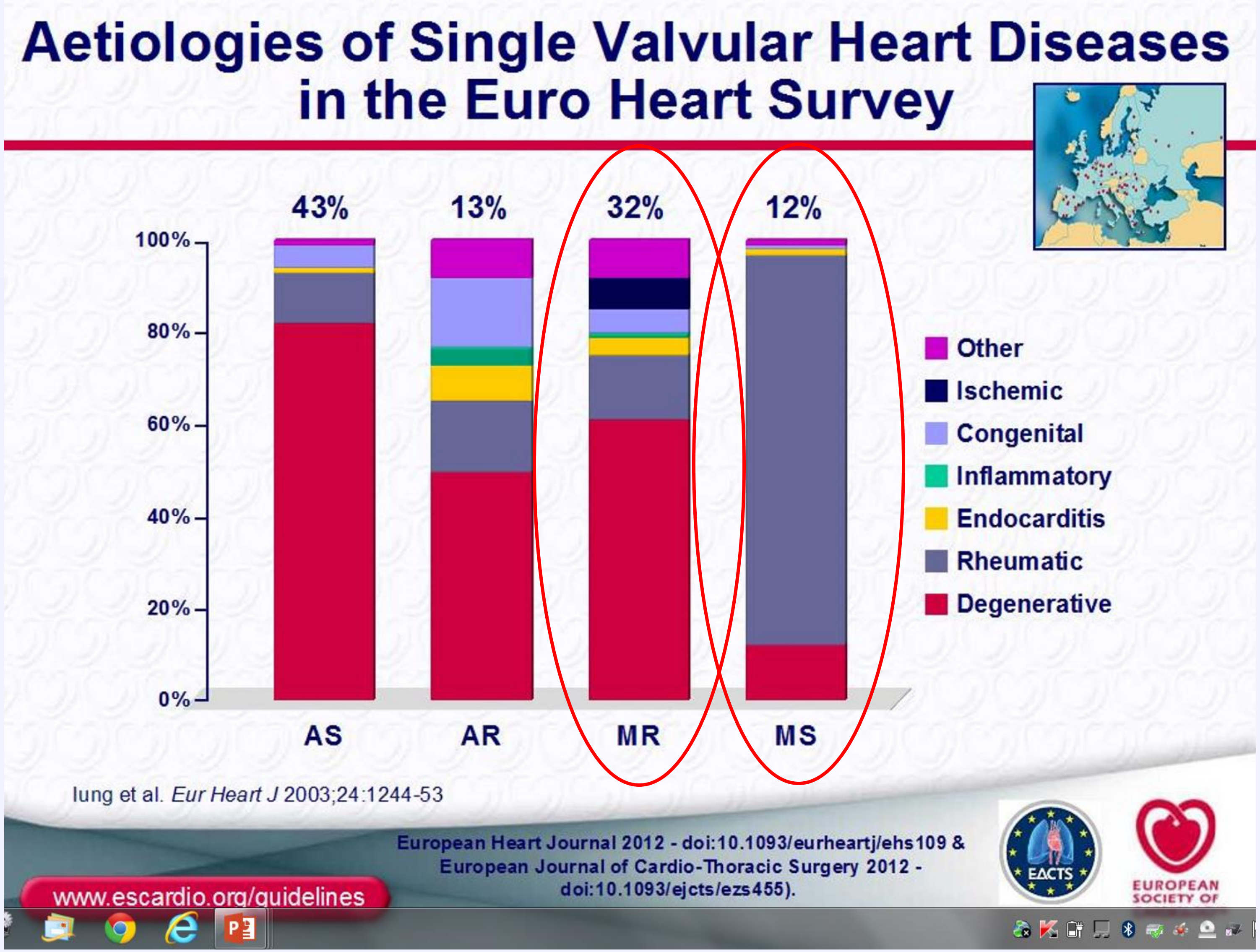
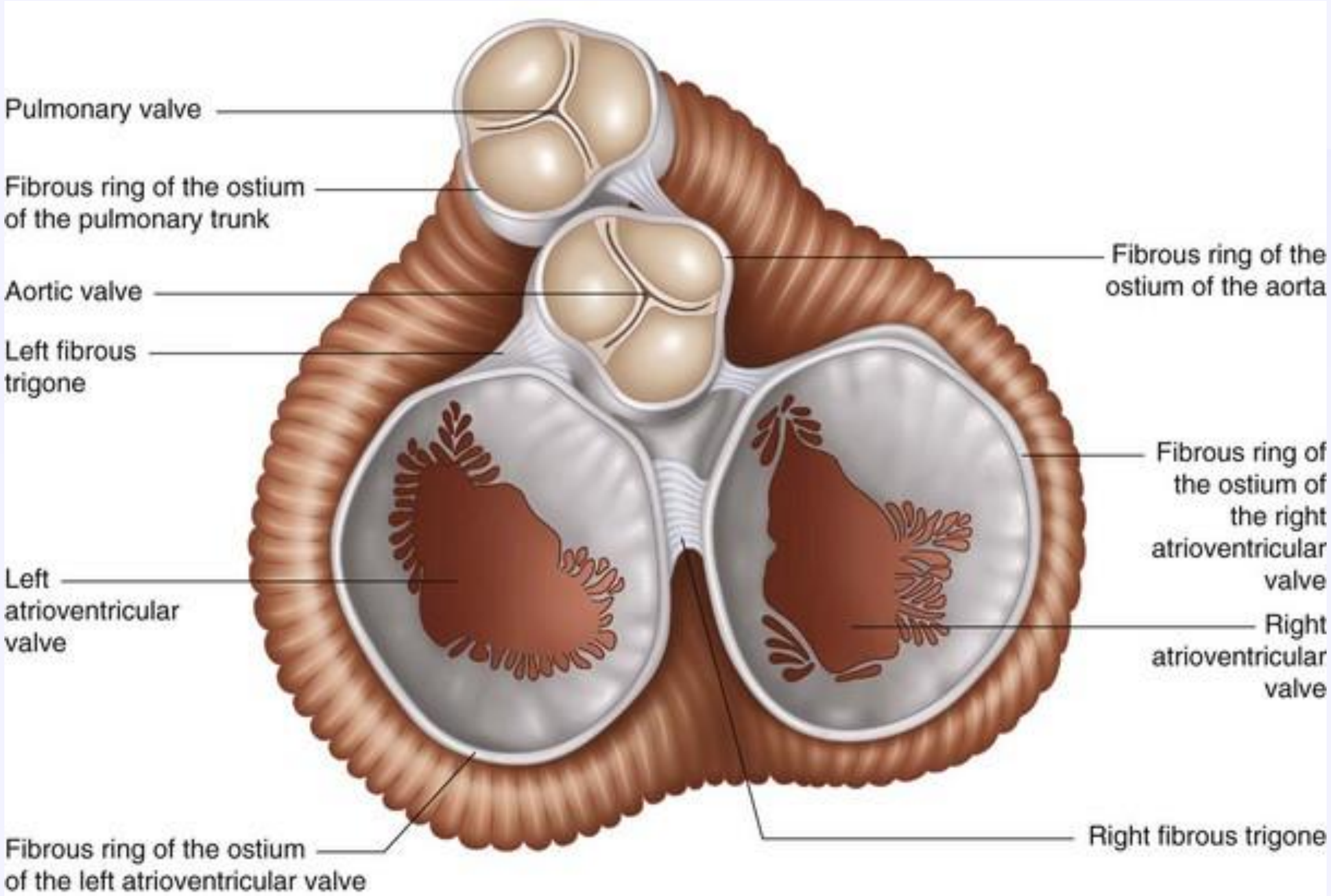
Mitral Valve:
Anatomy, Imaging, and Pathology

July 24, 2019

Department of Anesthesia and Pain Management- TGH, Toronto



Aetiologies of Single Valvular Heart Diseases in the Euro Heart Survey
43%
13%
32%
12%
100%
80%
60%
40%
20%
0%
AS
AR
MR
MS
Other
Ischemic
Congenital
Inflammatory
Endocarditis
Rheumatic
Degenerative
Iung et al. Eur Heart J 2003;24:1244-53
European Heart Journal 2012 - doi:10.1093/eurheartj/ehs109 & European Journal of Cardio-Thoracic Surgery 2012 - doi:10.1093/ejcts/ezs455).
www.escardio.org/guidelines
EACTS
EUROPEAN SOCIETY OF



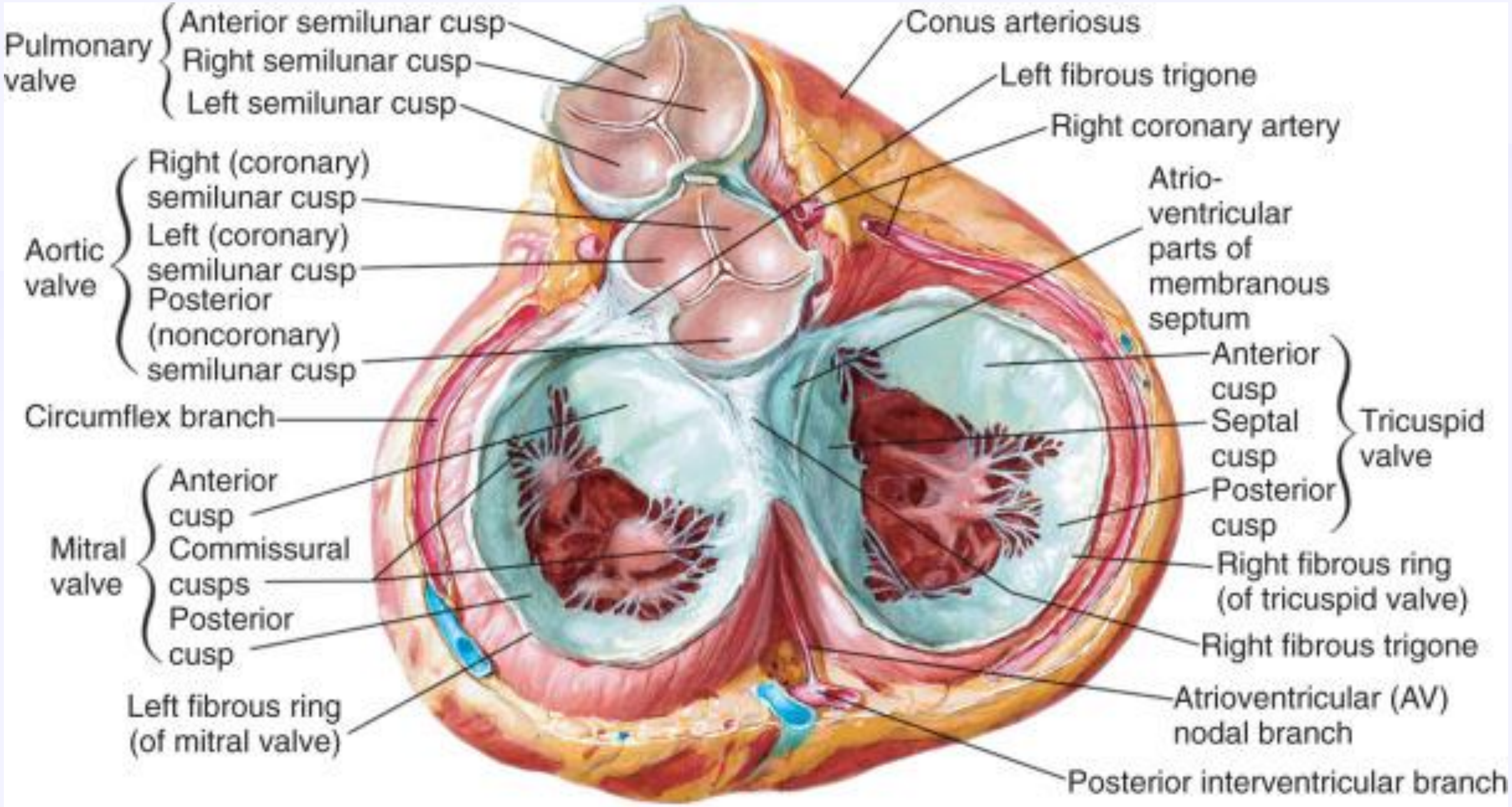
Fibrous skeleton of the heart (cardiac skeleton)

Fibrous skeleton of the heart

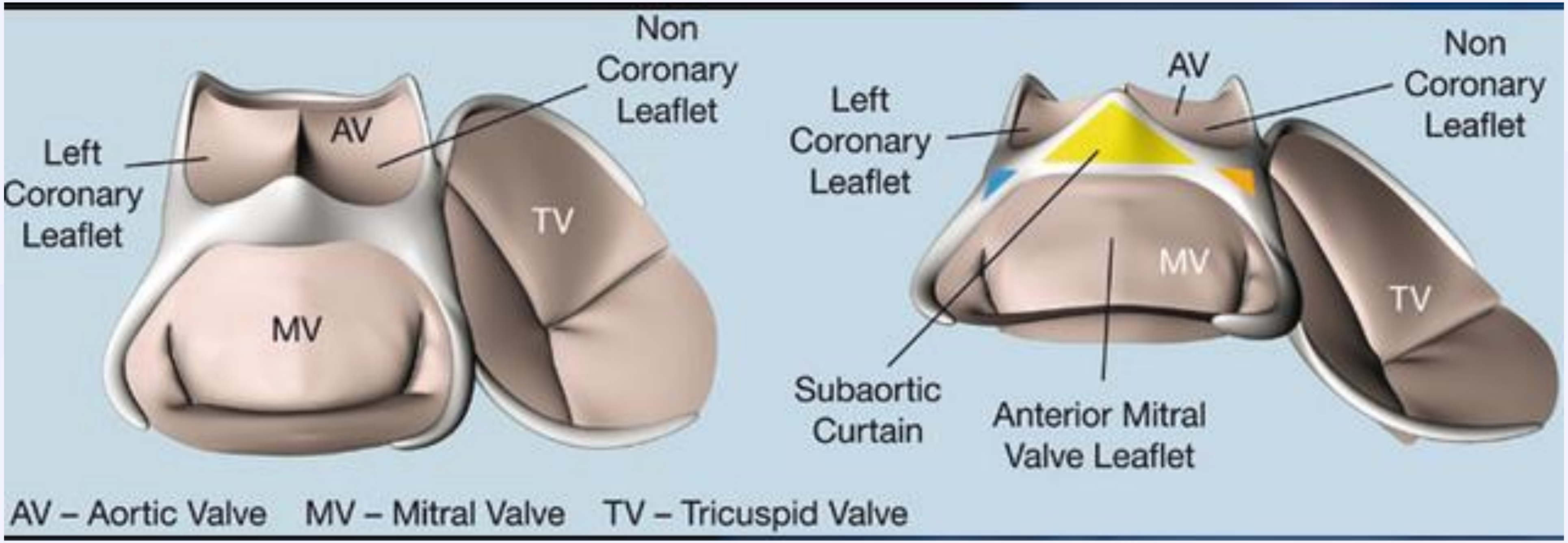
- Composed of dense connective tissue (fibrous), surrounds all 4 valves and bound them together.
- Two atria & two ventricles are attached to the conjoined fibrous rings in the form of fig. of “8” which bound AV orifices.
- Two coronets surround roots of aorta and pulmonary trunk.
- Pulmonary trunk lie at a higher level than aortic valve (connected to fibrous skeleton by conus ligament).
- Aortic annulus is central and wedged between mitral and tricuspid annuli.

Functions of cardiac skeleton

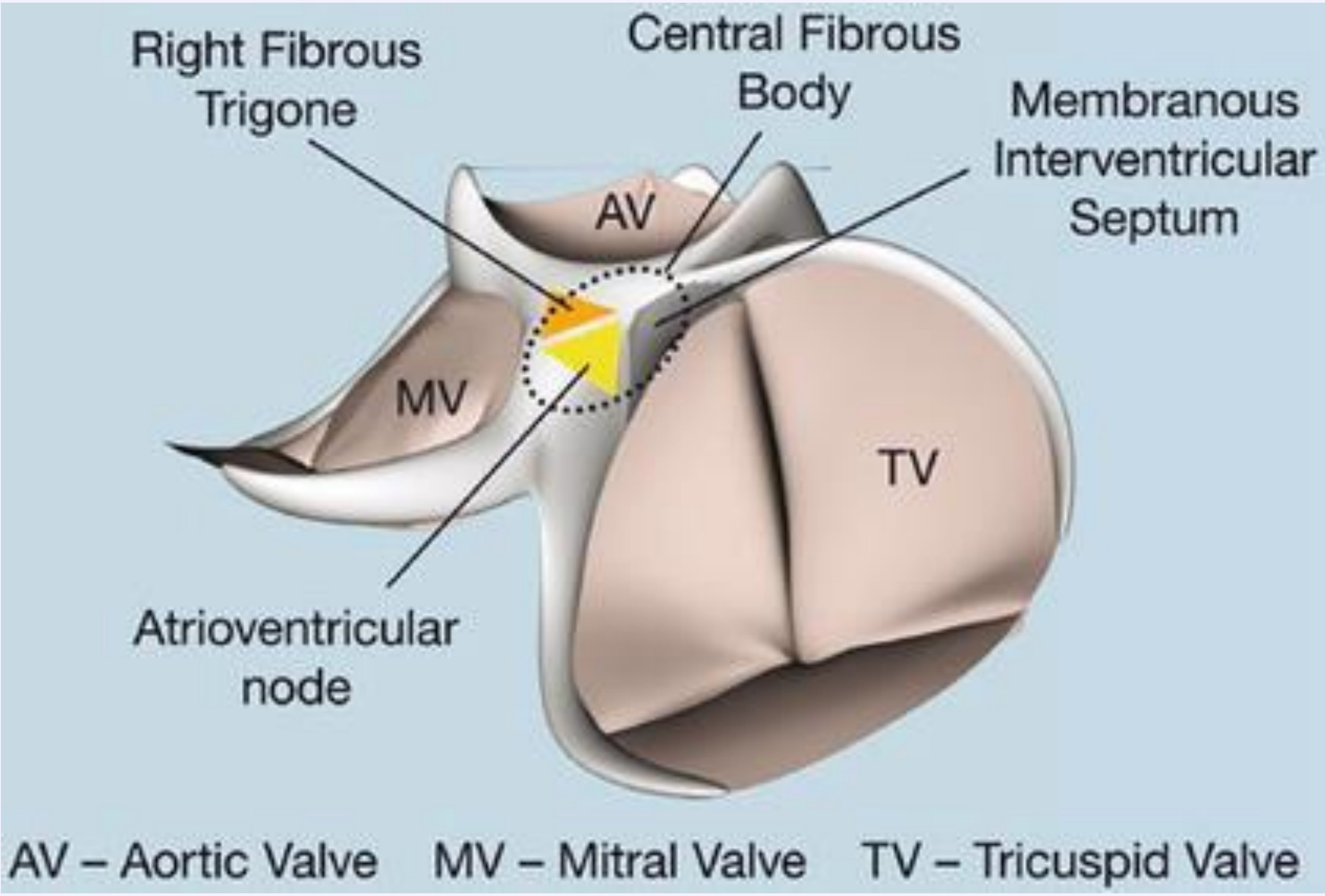
1. Anchors the bases of the cardiac valves and prevents overdilation of the valves.
2. Keep the atrioventricular and semilunar orifices patent.
3. Anchors the myocardium of the walls of all four cardiac chambers.
4. Allows independent atrial and ventricular contraction by electrically insulating the atria above the fibrous skeleton from the ventricles below.



Heart in diastole:
viewed from base with atria removed

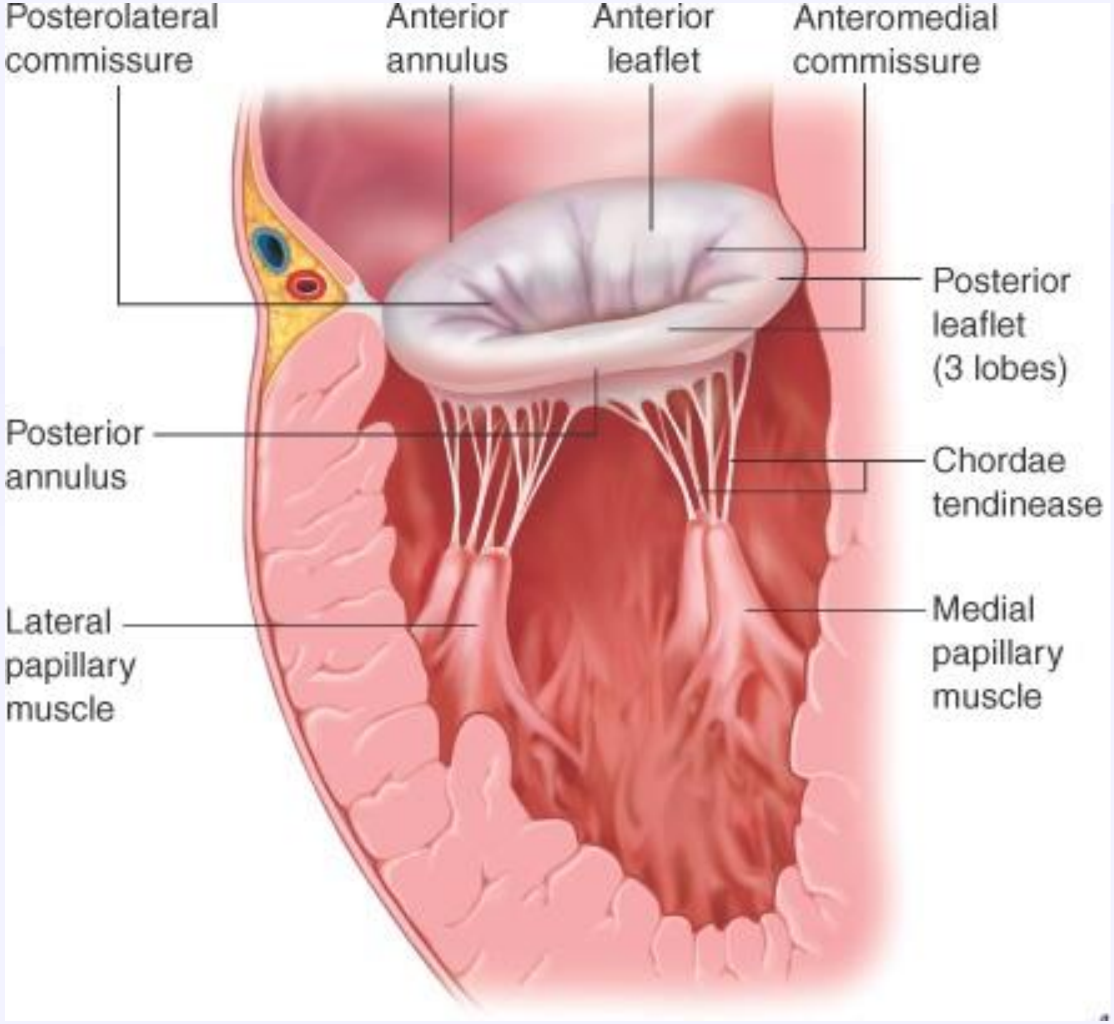


Relationship of trigones to the mitral valve commissures



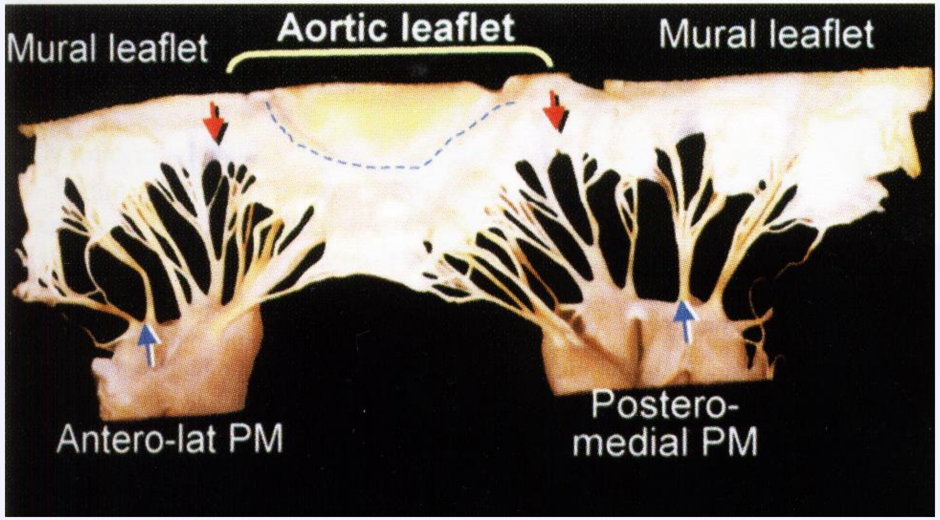
Keystone

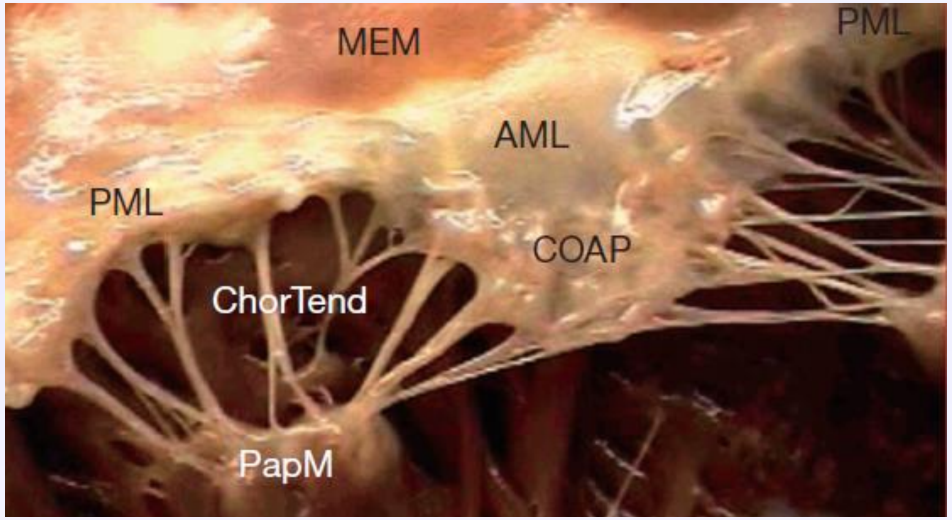
Central fibrous body (Keystone of the heart)



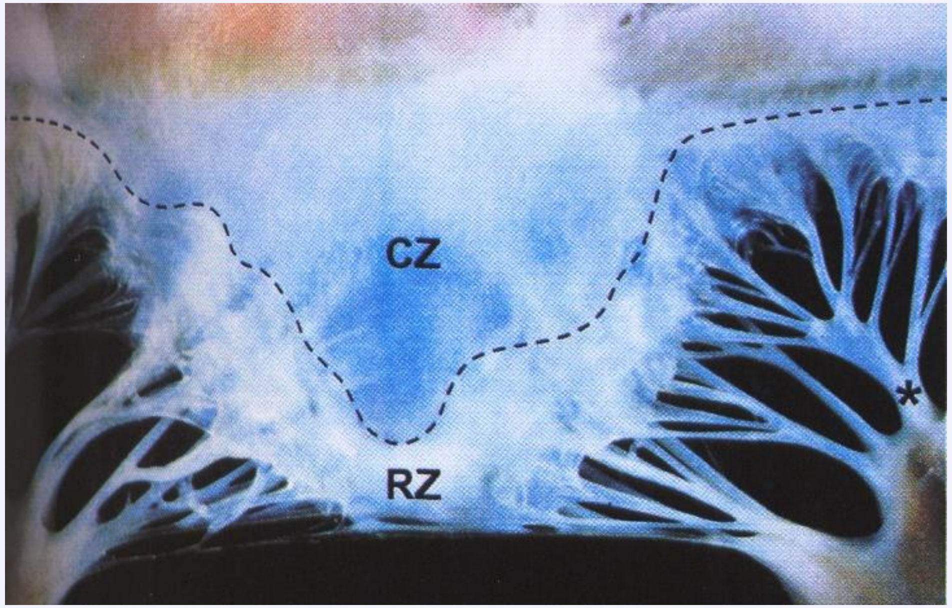
Mitre:
Ceremonial turban of bishops

Normal mitral valve viewed from posterior





- Each leaflet surface has 2 zones, membranous or clear zone and coaptation or rough zone
- Anterolateral papillary muscle (PM) has 2 heads and posteromedial papillary muscle has 3 heads
- Chordae tendineae from each leaflet are equally distributed between 2 PMs

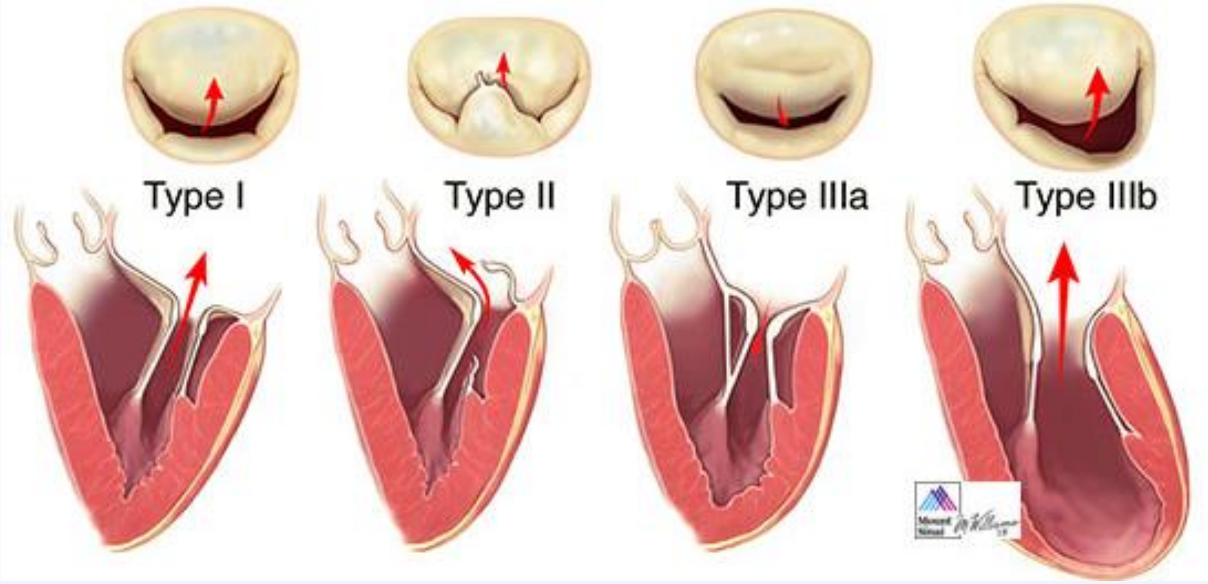


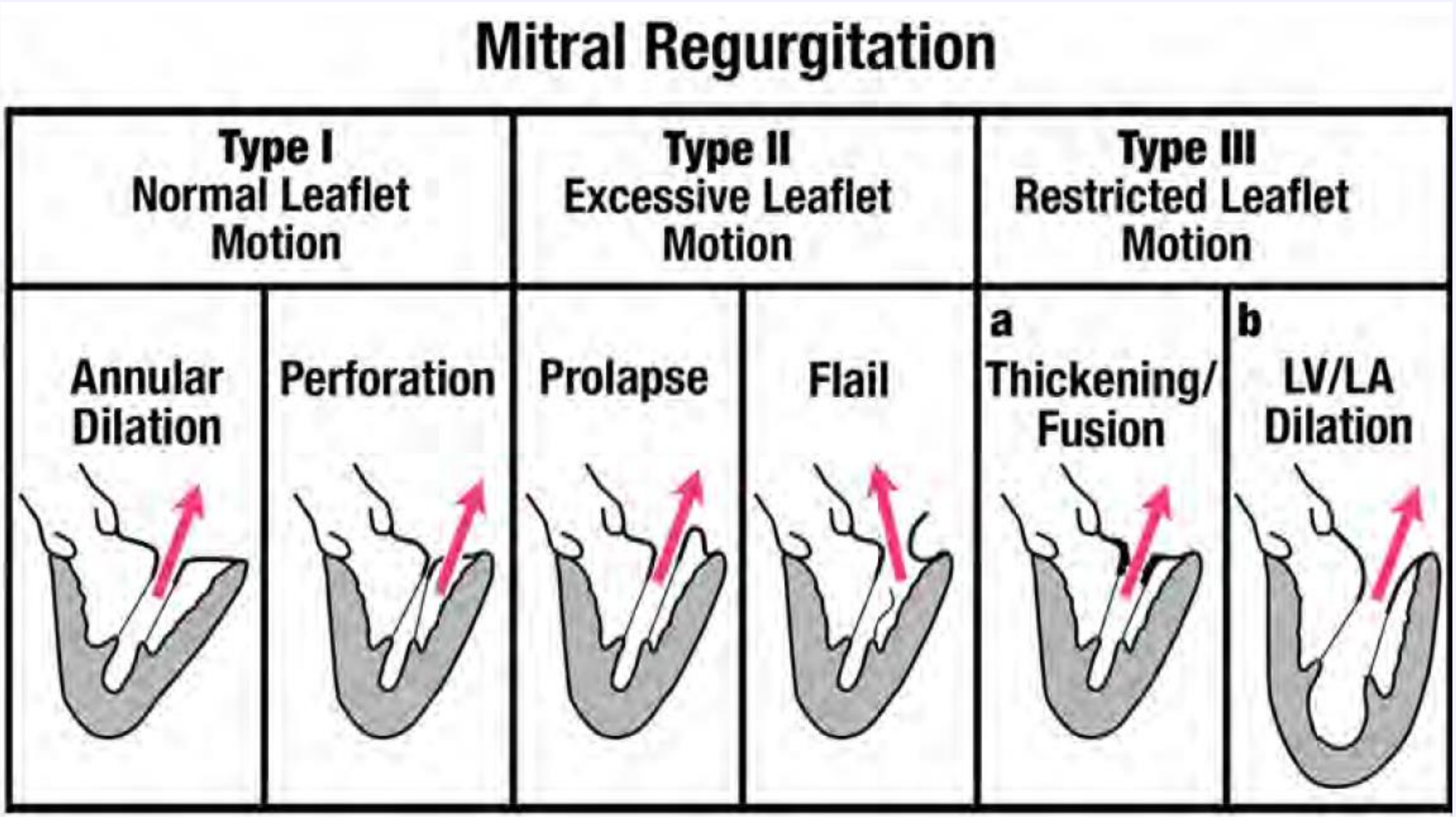
Tan TC, et al. *Ann Cardiothorac Surg* 2015

J Thorac Cardiovasc Surg. 1983 Sep;86(3):32 37. **Cardiac valve surgery--the "French correction".** Carpentier A

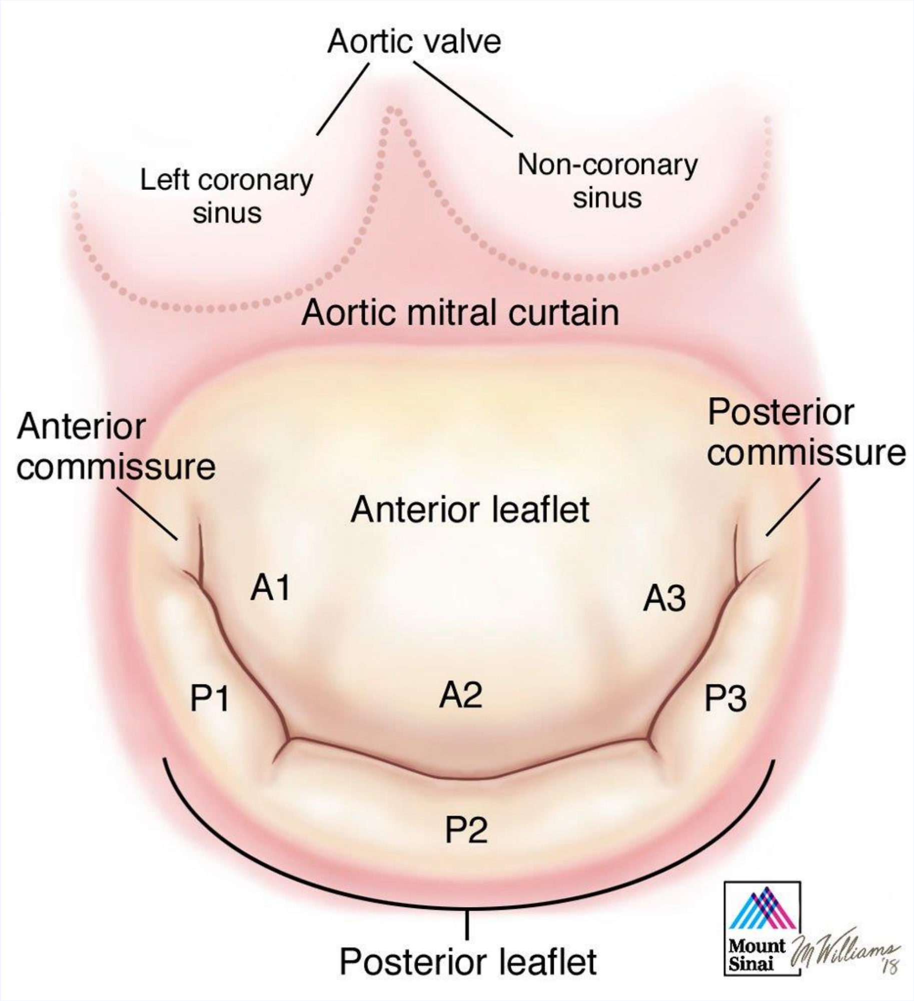
Carpentier's "Functional Classification"

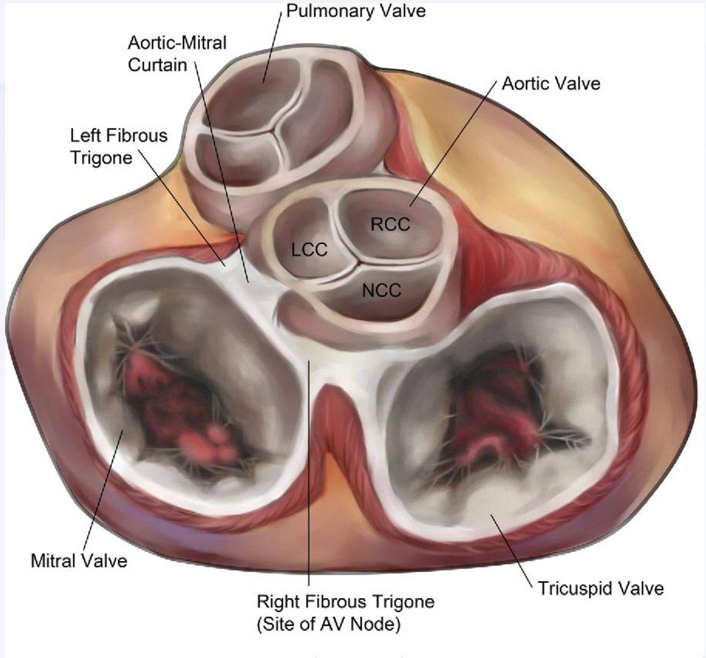
Type I	Normal leaflet motion
Type II	Excess leaflet motion (leaflet prolapse)
Type III	Restricted leaflet motion
IIIa	Restricted opening
IIIb	Restricted closure



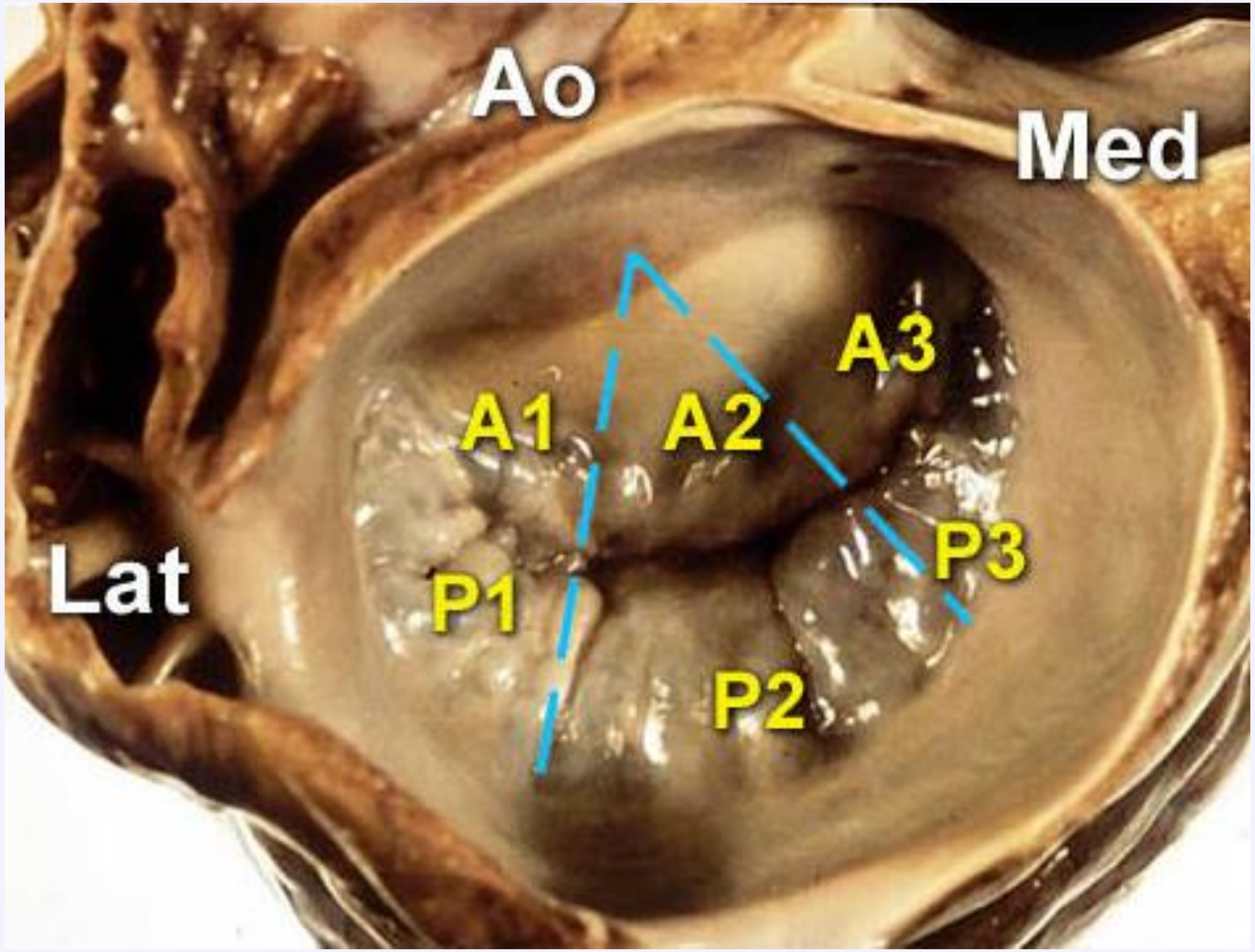

Mitral Regurgitation
Type I
Normal Leaflet
Motion
Type II
Excessive Leaflet
Motion
Type III
Restricted Leaflet
Motion
Annular
Dilation
Perforation
Prolapse
Flail
a
Thickening/
Fusion
b
LV/LA
Dilation

Carpentier's segmental classification of the mitral valve

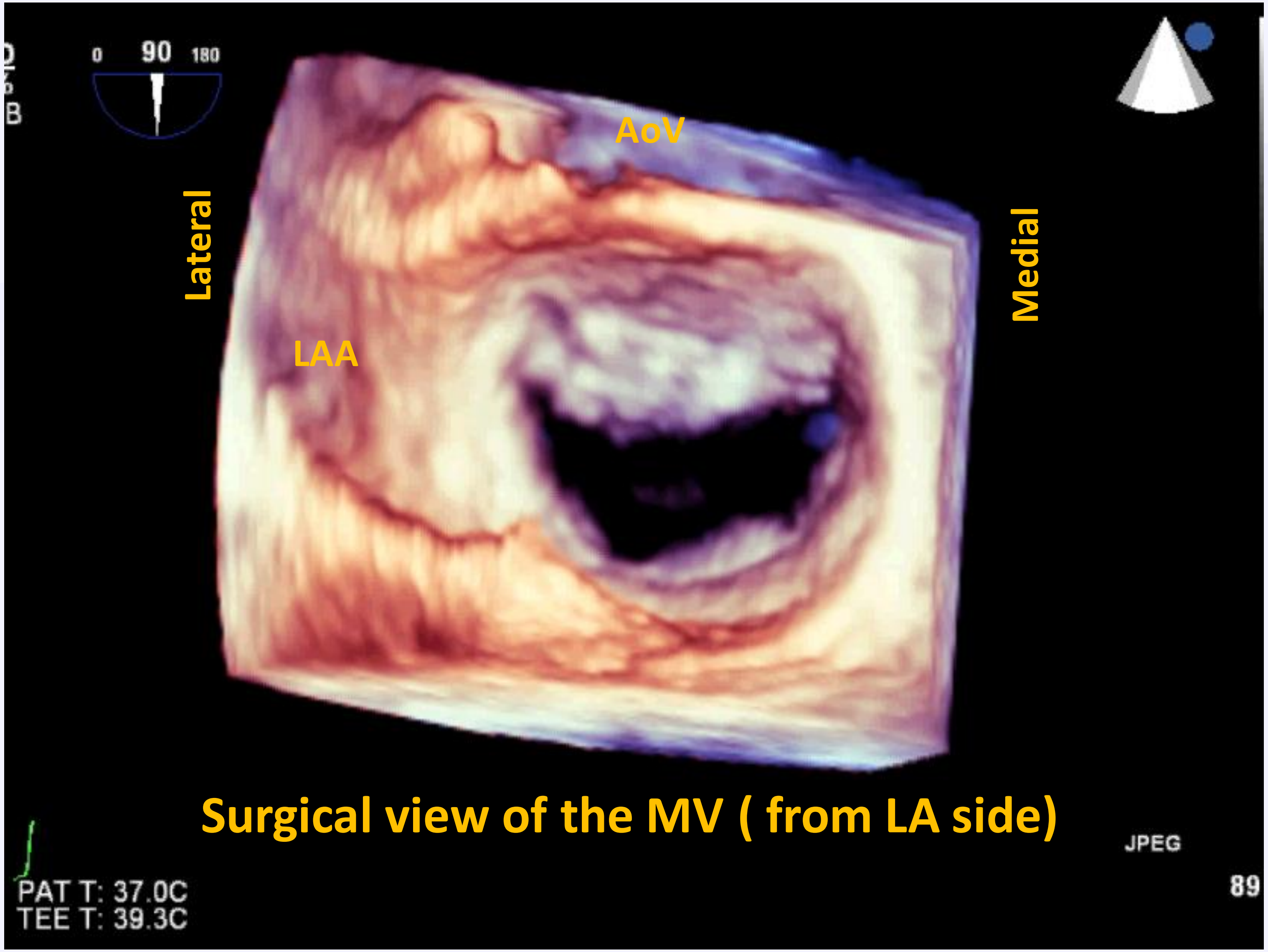


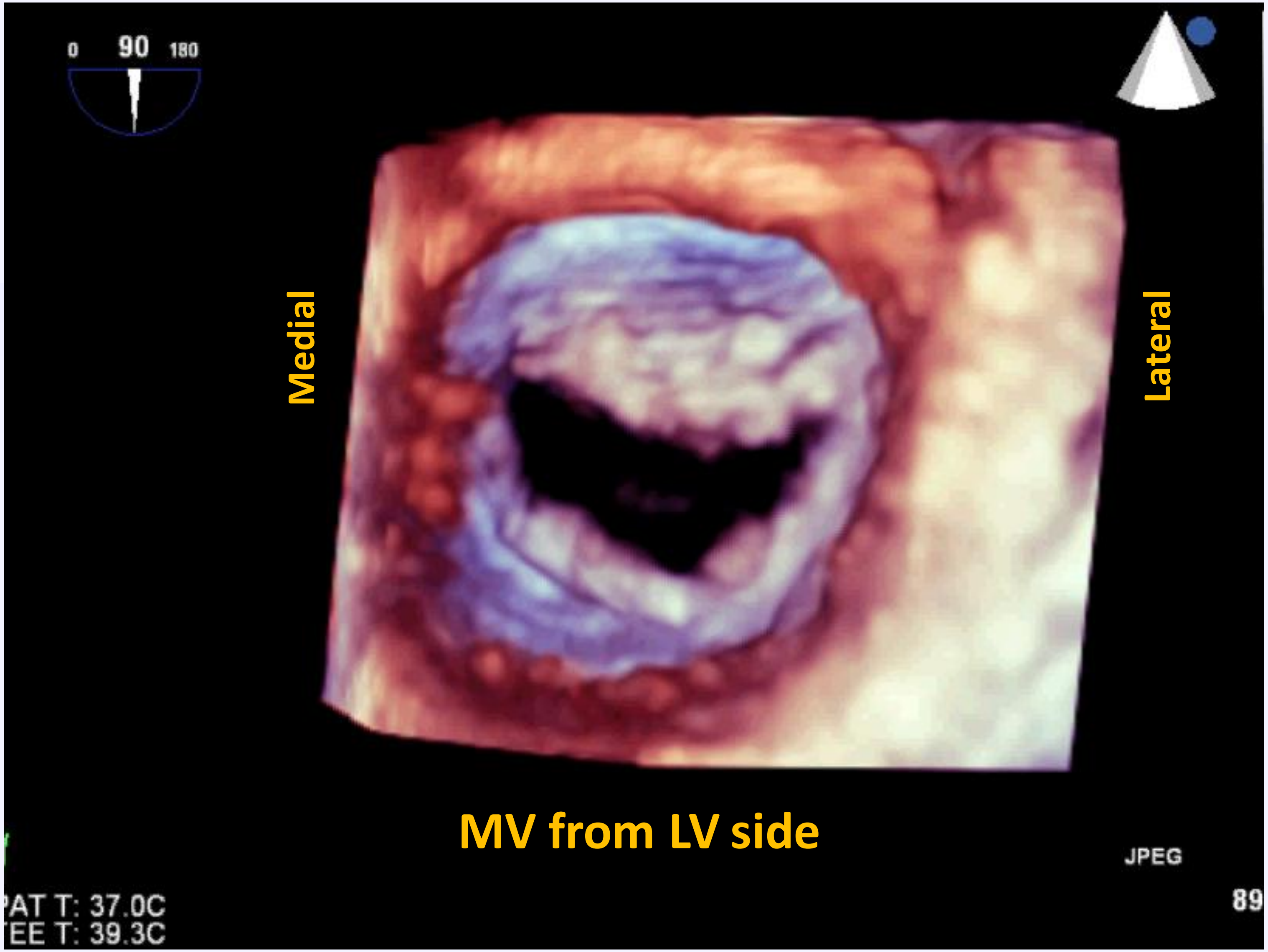


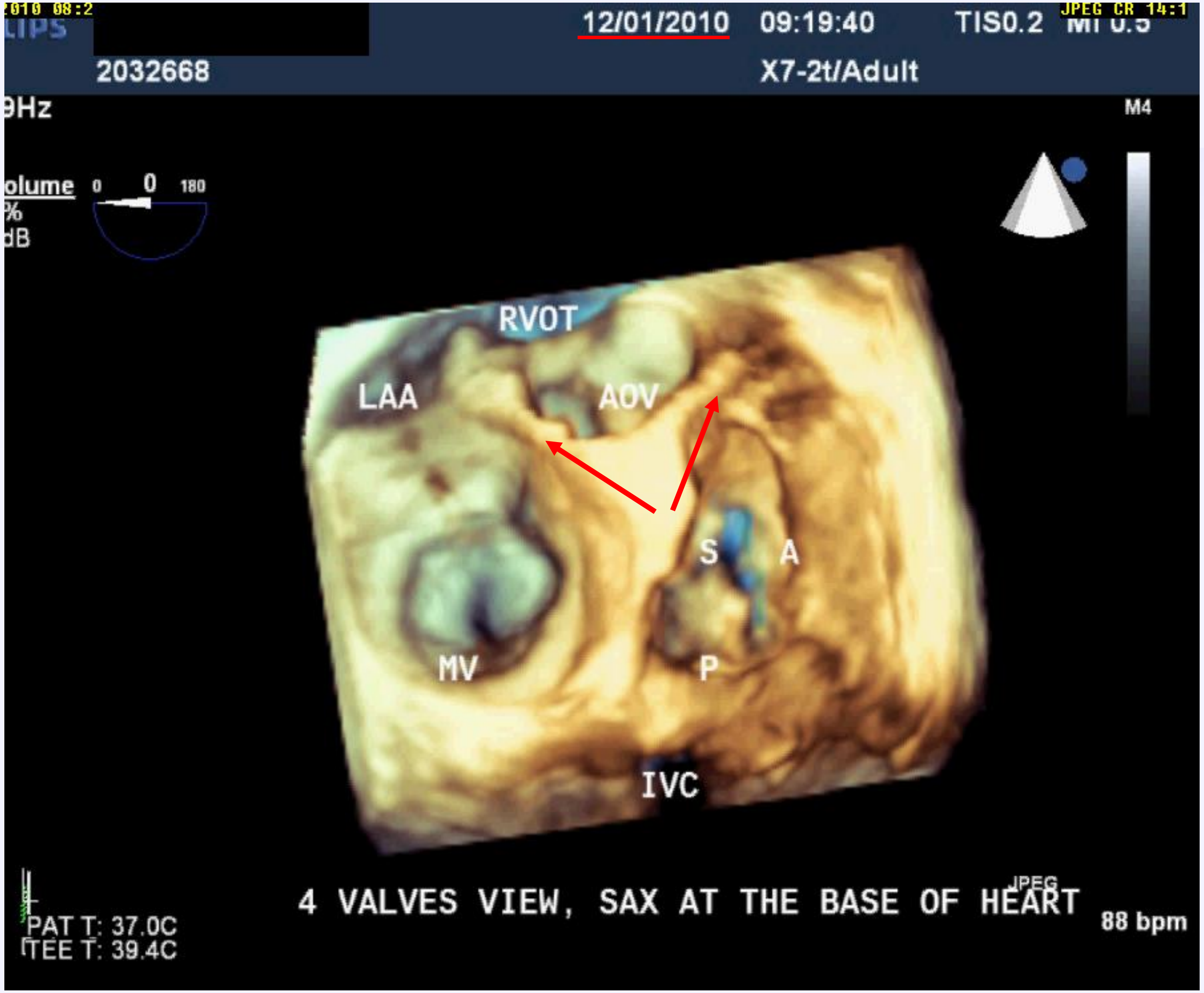
How to image the mitral valve?



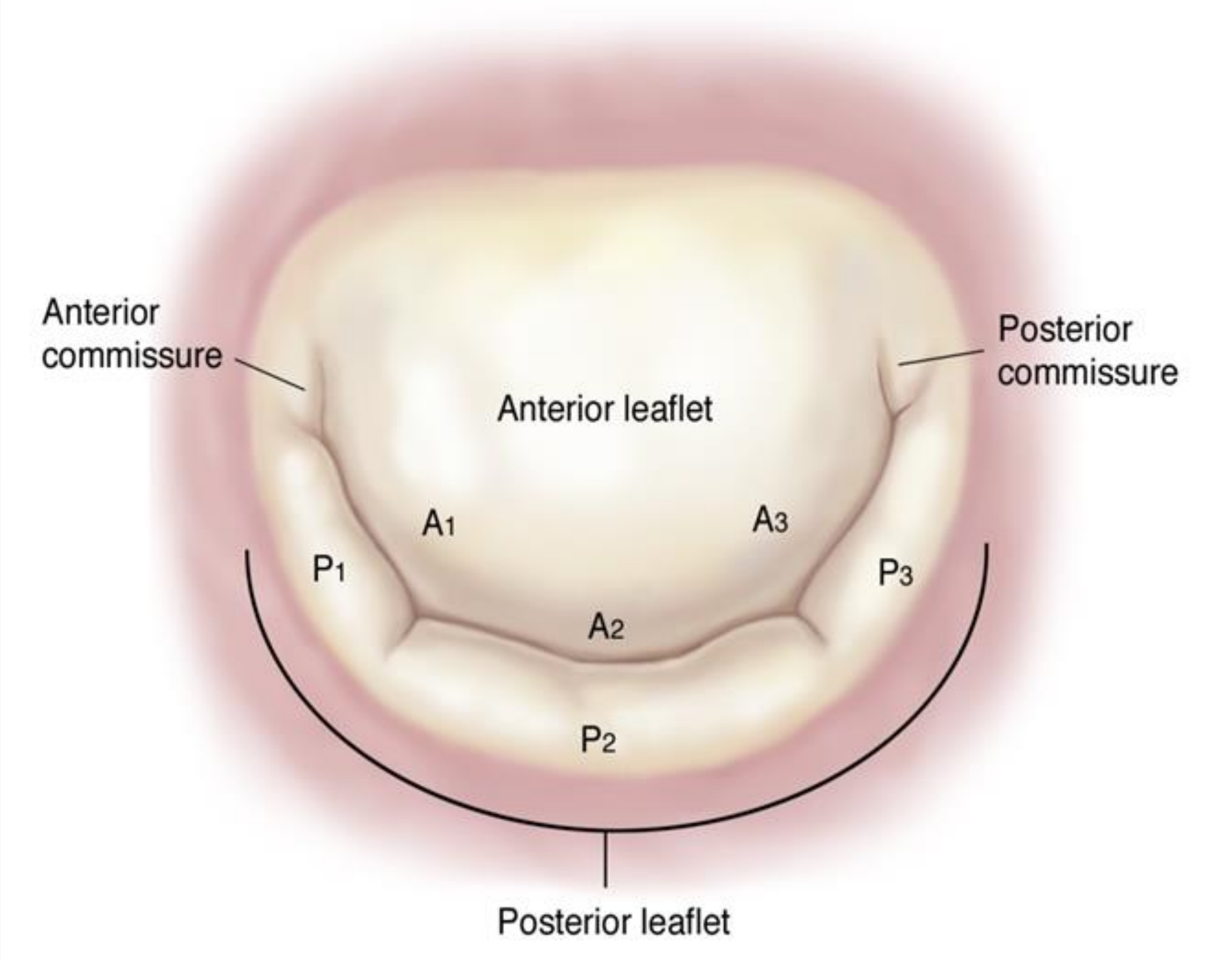
Surgeon’s view of the mitral valve from LA

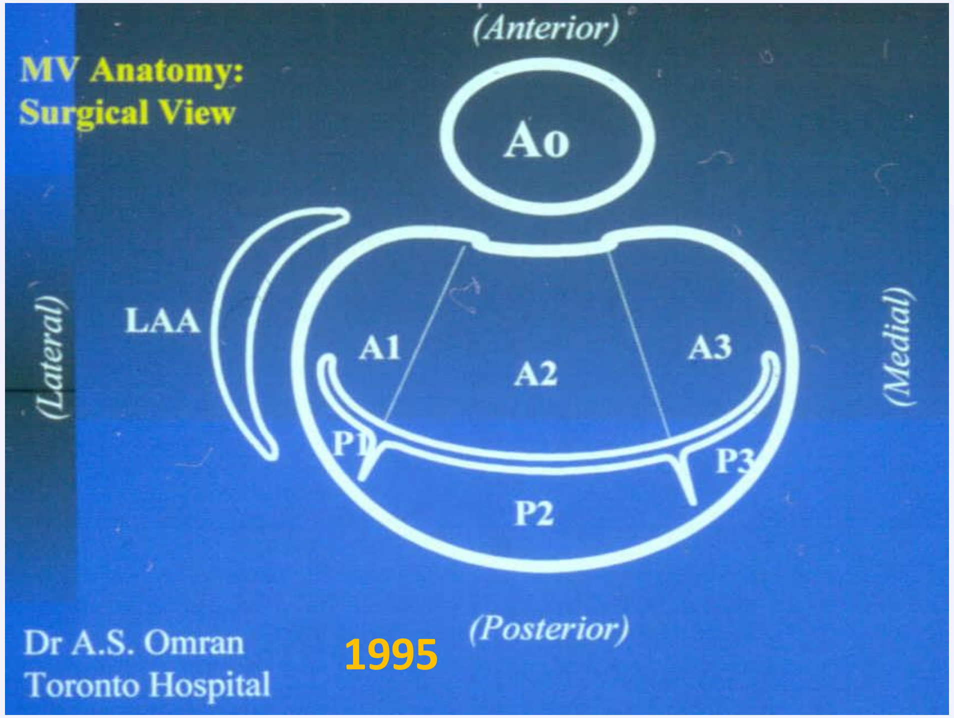

0
90
180
AoV
Lateral
Medial
LAA
Surgical view of the MV (from LA side)
JPEG
89
PAT T: 37.0C
TEE T: 39.3C

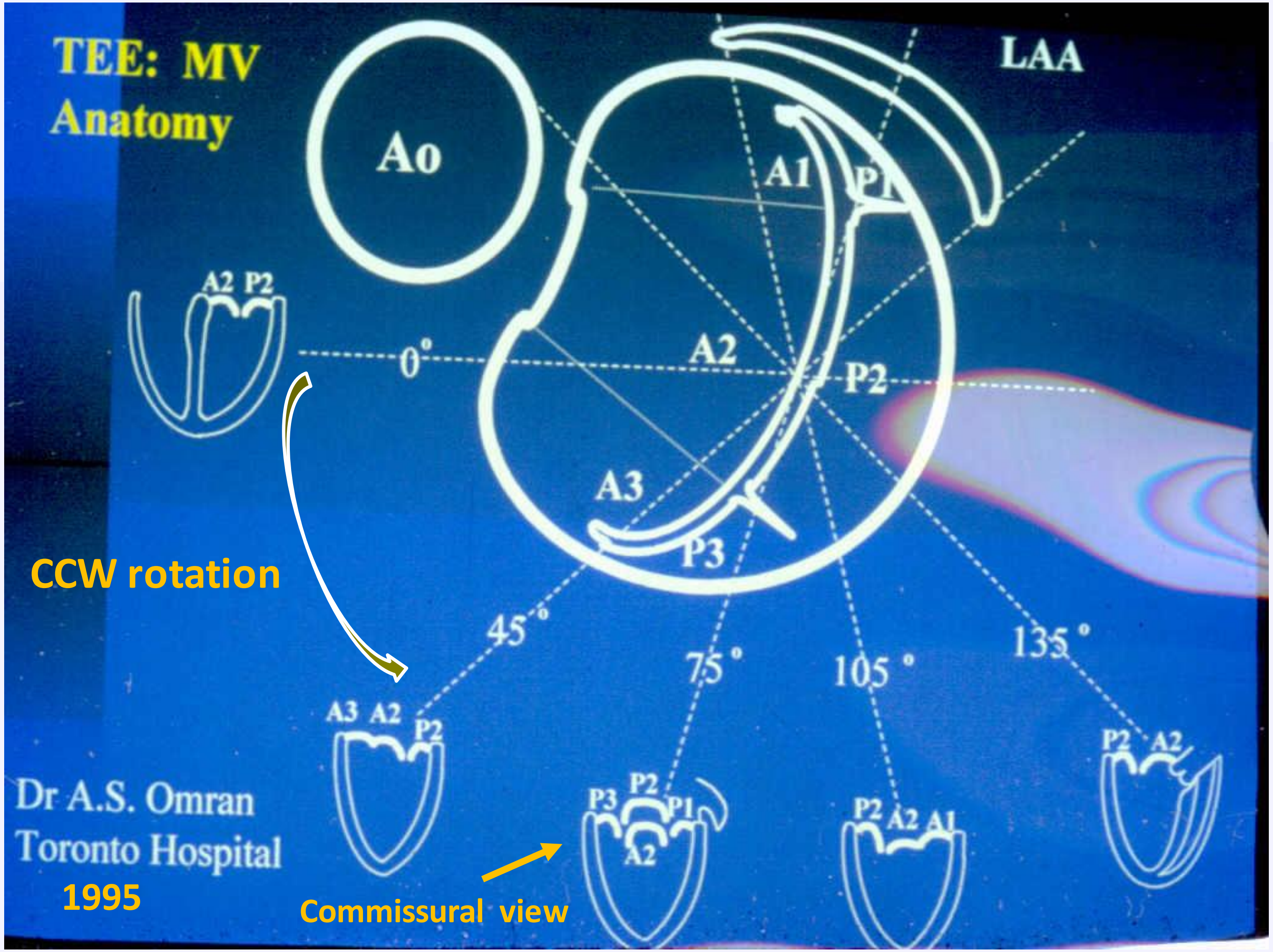

0
90
180
Medial
Lateral
MV from LV side
JPEG
89
PAT T: 37.0C
TEE T: 39.3C

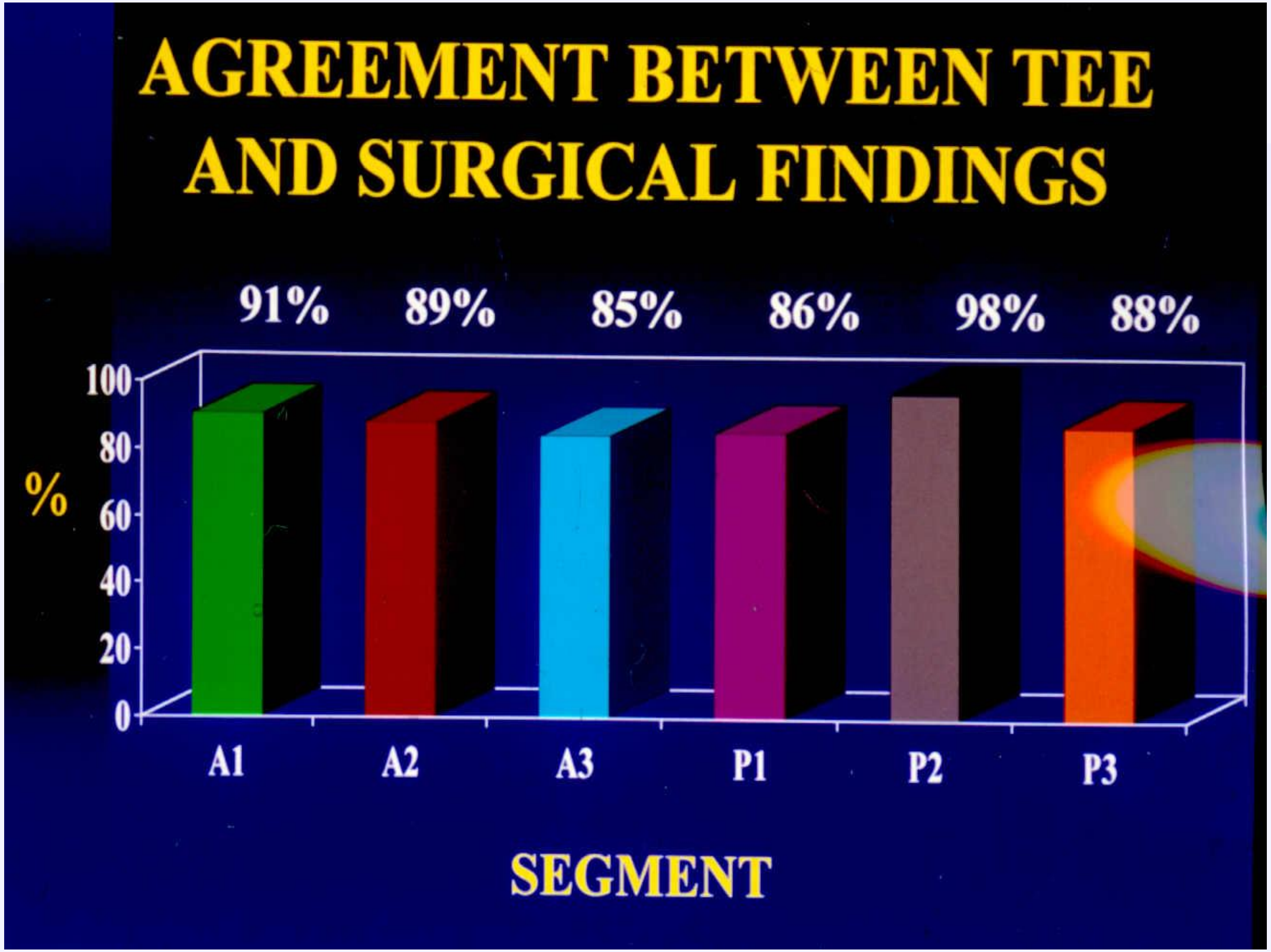


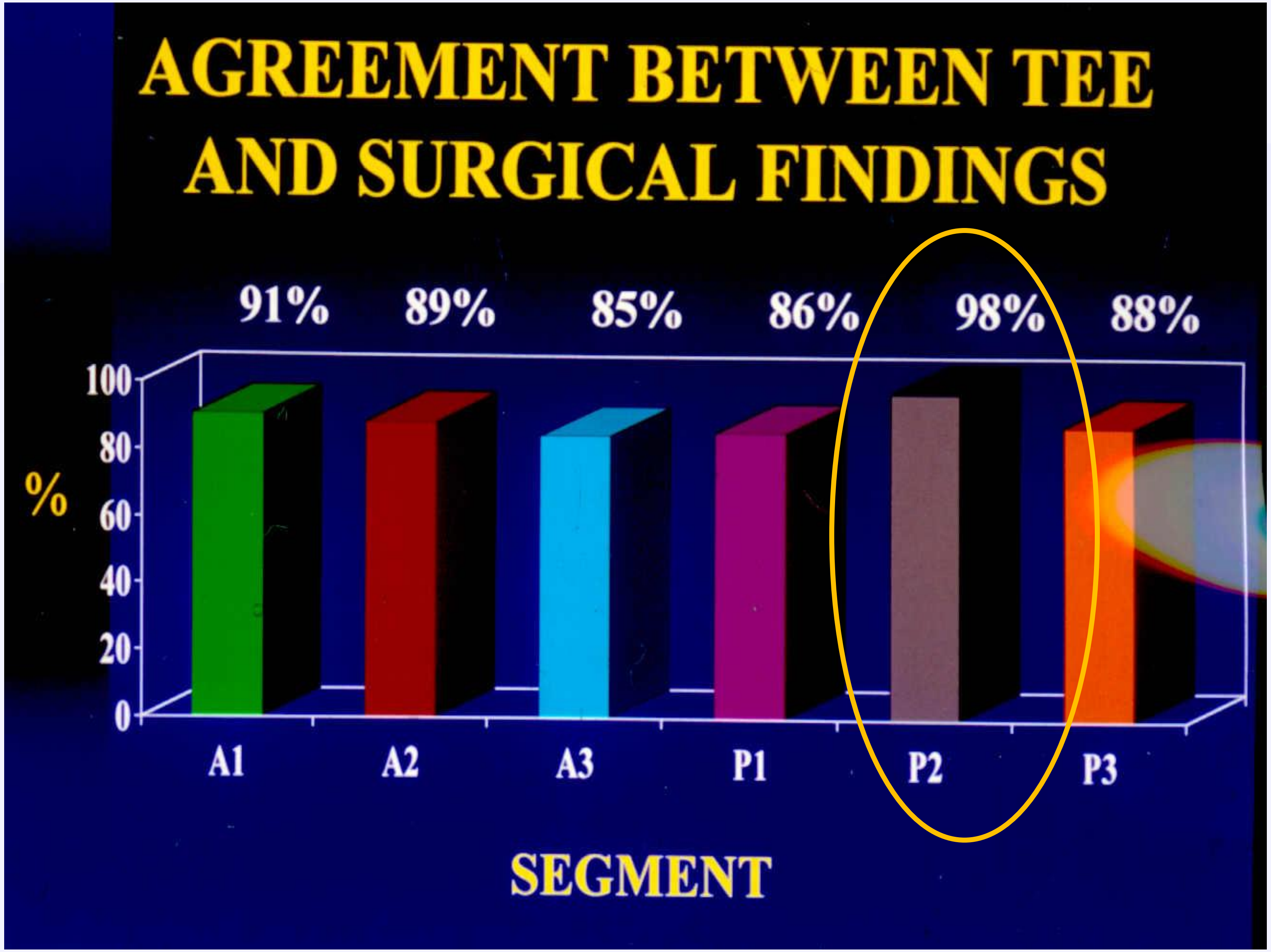
[redacted]
2032668
12/01/2010
09:19:40
TIS0.2
X7-2t/Adult
M4
RVOT
LAA
AOV
S
A
MV
P
IVC
4 VALVES VIEW, SAX AT THE BASE OF HEART
88 bpm
PAT T: 37.0C
TEE T: 39.4C


Anterior commissure
Posterior commissure
Anterior leaflet
A1
A3
A2
P1
P3
P2
Posterior leaflet


MV Anatomy:
Surgical View
(Anterior)
Ao
LAA
(Lateral)
(Medial)
A1
A2
A3
P1
P2
P3
(Posterior)
Dr A.S. Omran
Toronto Hospital
1995


TEE: MV
Anatomy
Ao
LAA
A1
P1
A2
P2
A3
P3
0°
45°
75°
105°
135°
A2 P2
A3 A2 P2
P3 P2 P1 A2
P2 A2 A1
P2 A2
CCW rotation
Commissural view
Dr A.S. Omran
Toronto Hospital
1995


AGREEMENT BETWEEN TEE
AND SURGICAL FINDINGS
91%
89%
85%
86%
98%
88%
100
80
%
60
40
20
0
A1
A2
A3
P1
P2
P3
SEGMENT


AGREEMENT BETWEEN TEE
AND SURGICAL FINDINGS
91%
89%
85%
86%
98%
88%
100
80
60
40
20
0
%
A1
A2
A3
P1
P2
P3
SEGMENT

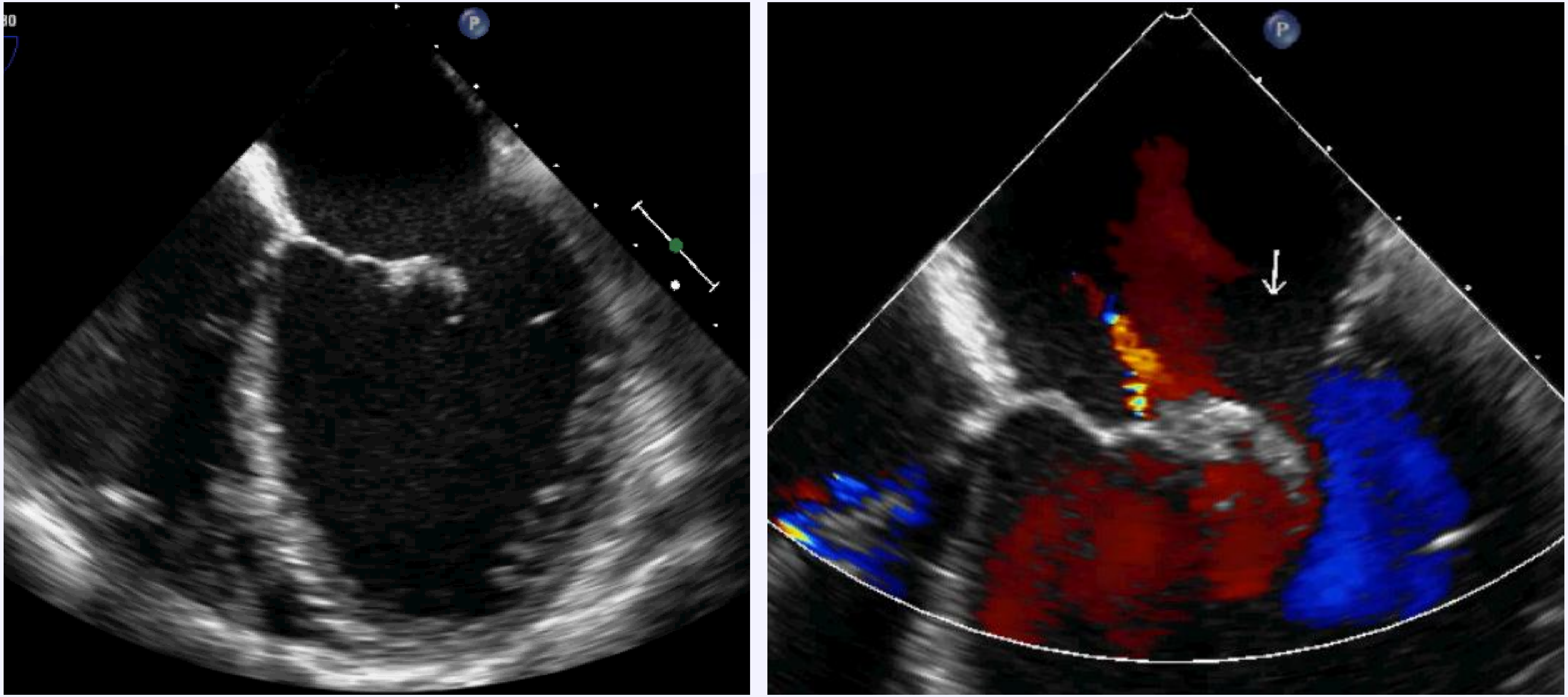
Intraoperative Transesophageal Echocardiography Accurately Predicts Mitral Valve Anatomy and Suitability for Repair

Ahmad S. Omran, MD, Anna Woo, MD, Tirone E. David, MD,
Christopher M. Feindel, MD, Harry Rakowski, MD, and Samuel C. Siu, MD, SM, *Toronto, Ontario, Canada*

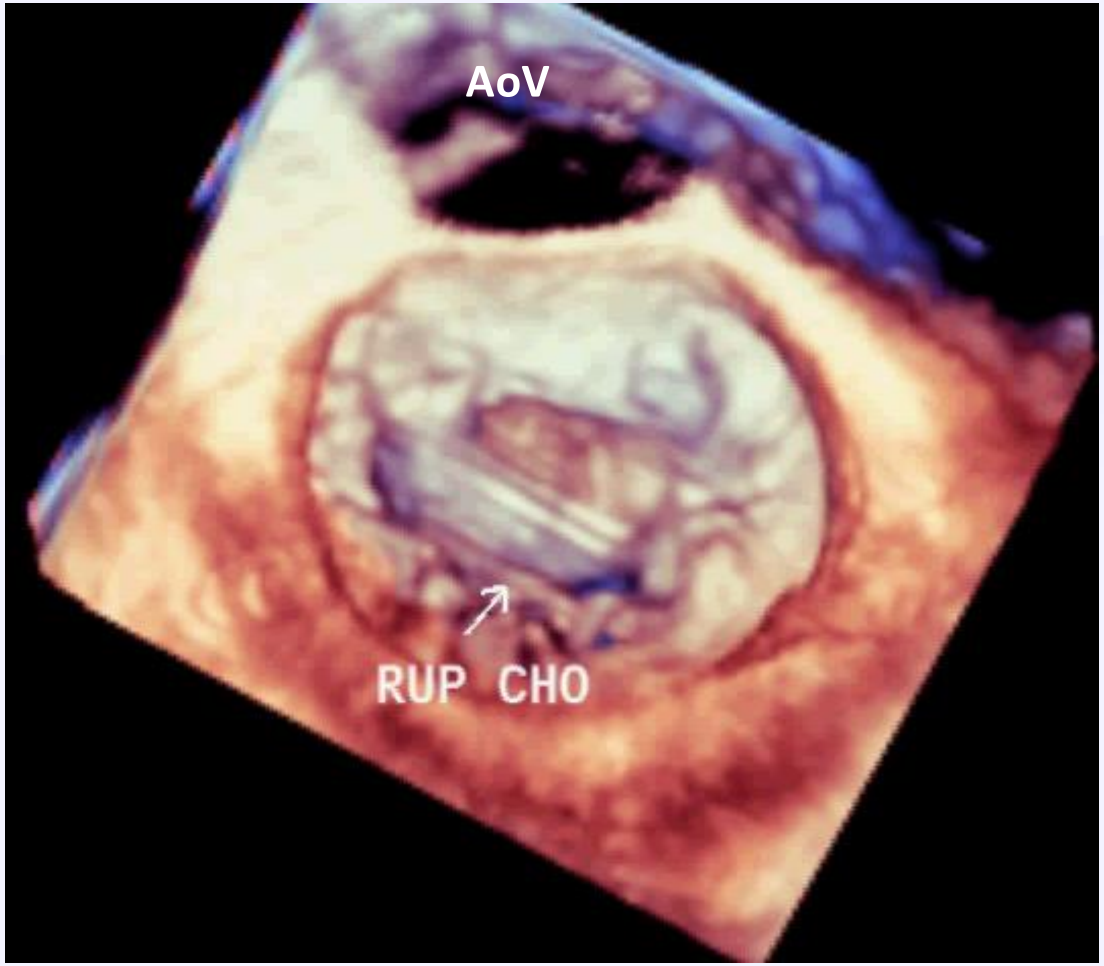
Mitral valve (MV) repair is the procedure of choice for MV prolapse or flail. However, valve repair is more technically demanding and requires a precise definition of MV morphology to determine the timing, complexity, and feasibility of repair. We prospectively examined 170 consecutive patients with MV prolapse or flail referred for MV repair. The MV valve was systematically assessed by intraoperative transesophageal echocardiography. MV anatomy was independently assessed at the time of operation. Accuracy of transesophageal echocardiography in identifying MV segments ranged from 90% to 97%, and was best for the middle segment/scallop of either anterior or posterior leaflet. MV repair was successful in 91% of patients. Success rate was the lowest (78%) in the presence of extensive bileaflet disease involving at least 2 segments of each leaflet. Independent predictors of unsuccessful repair were central jet of mitral regurgitation, calcification or severe dilatation of the mitral annulus, and extensive leaflet disease with involvement of at least 3 segments. (J Am Soc Echocardiogr 2002;15:950-7.)

Etiology of mitral valve regurgitation

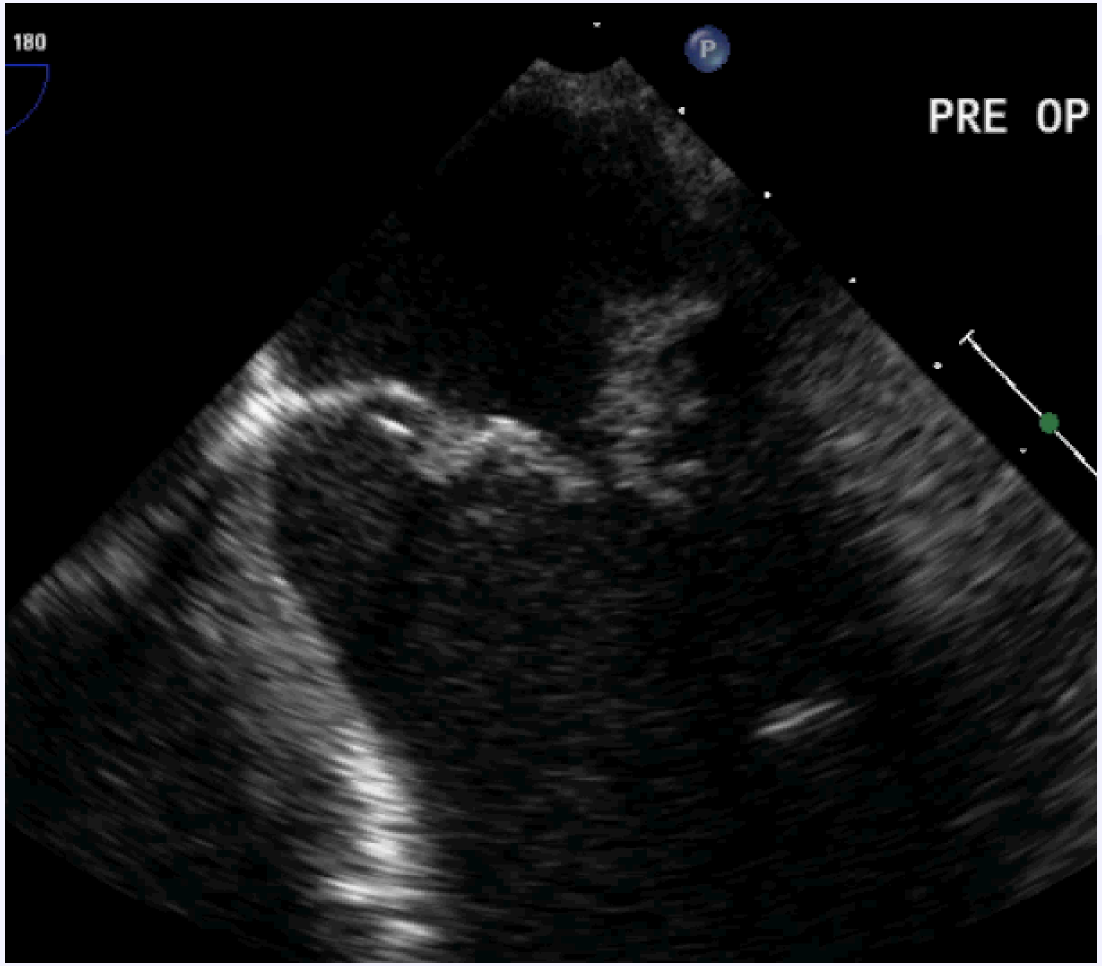
1. Degenerative mitral valve disease
2. Rheumatic heart disease
3. Ischemic heart disease
4. Infective endocarditis
5. Cardiomyopathies
6. Congenital heart disease (cleft mitral valve, arcade….)
7. Collagen vascular disease (SLE, other valvulitis)
8. Radiation-induced mitral valve disease

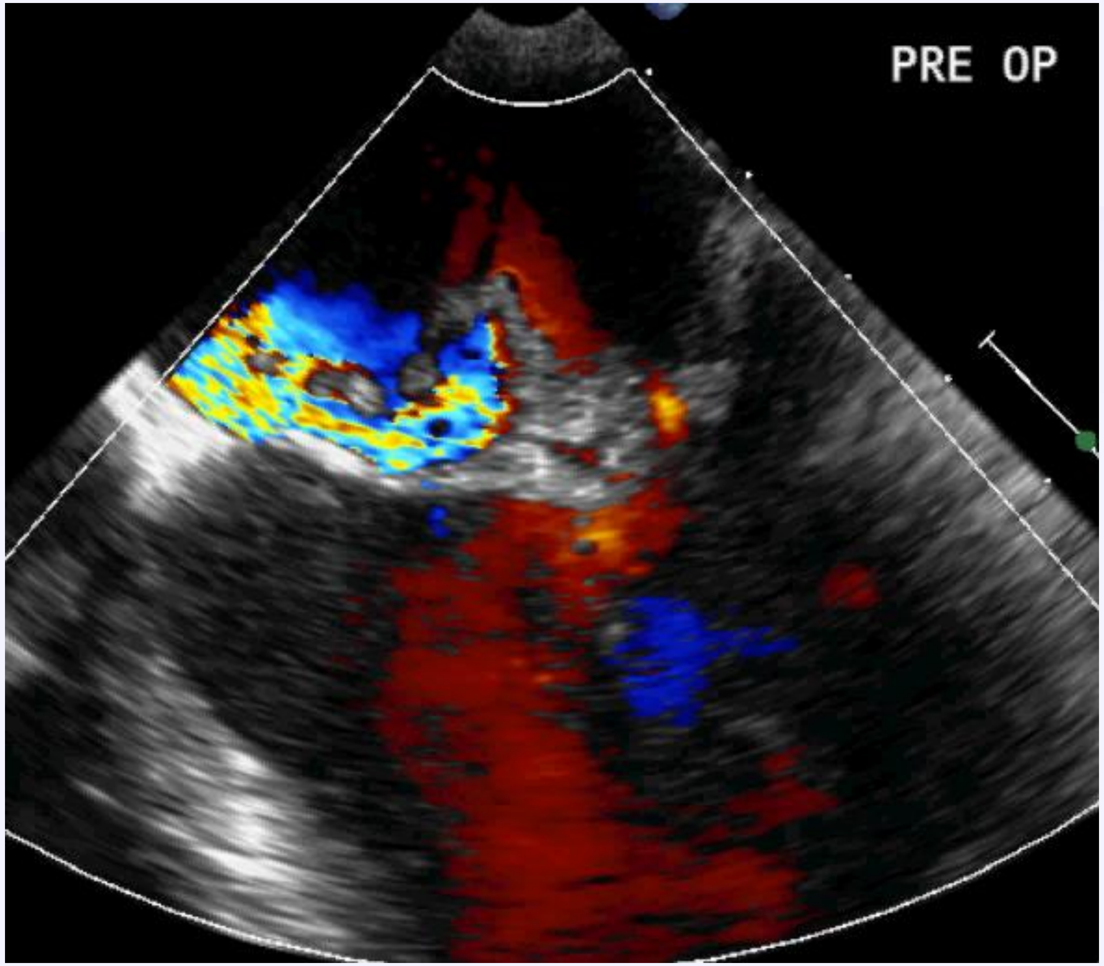


Flail anterior mitral leaflets, severe posteriorly directed jet of MR

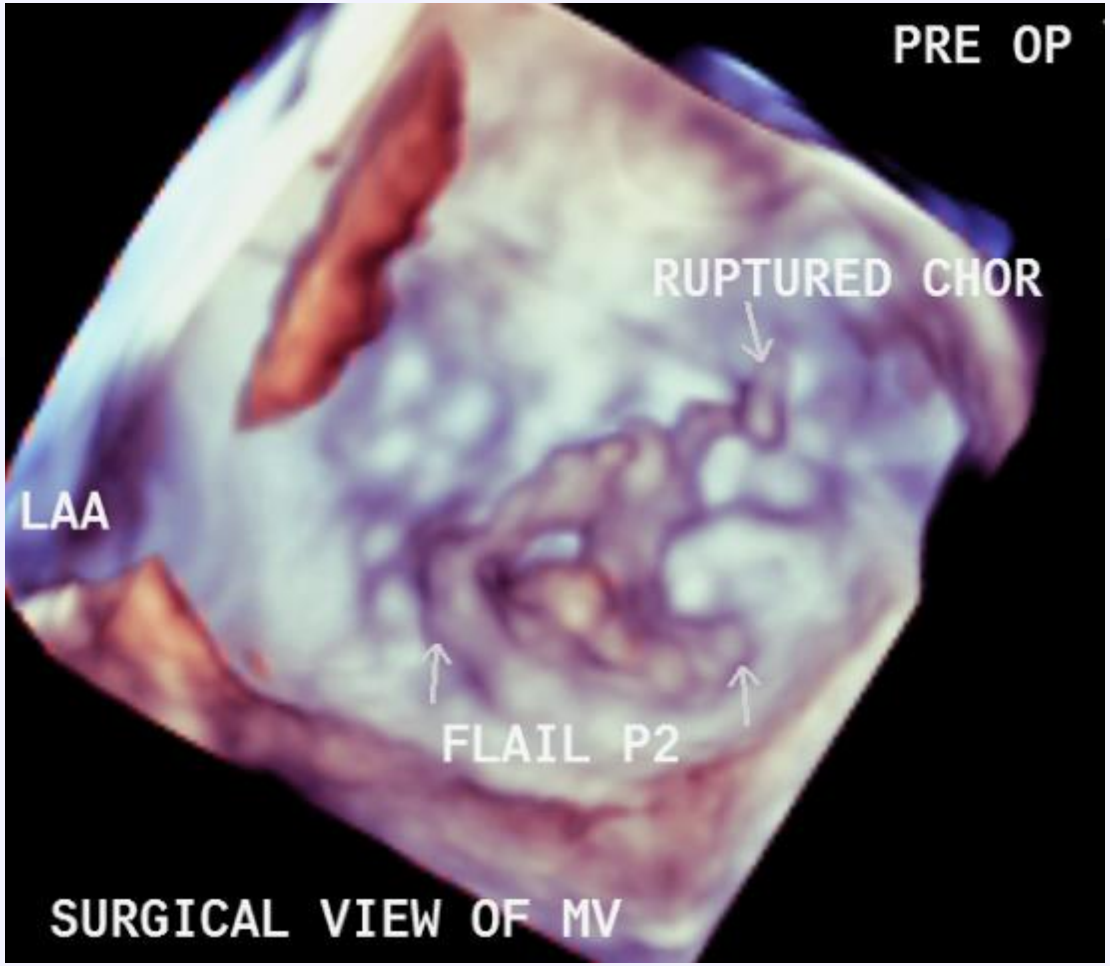


Dr. Najm, KACC. 2011

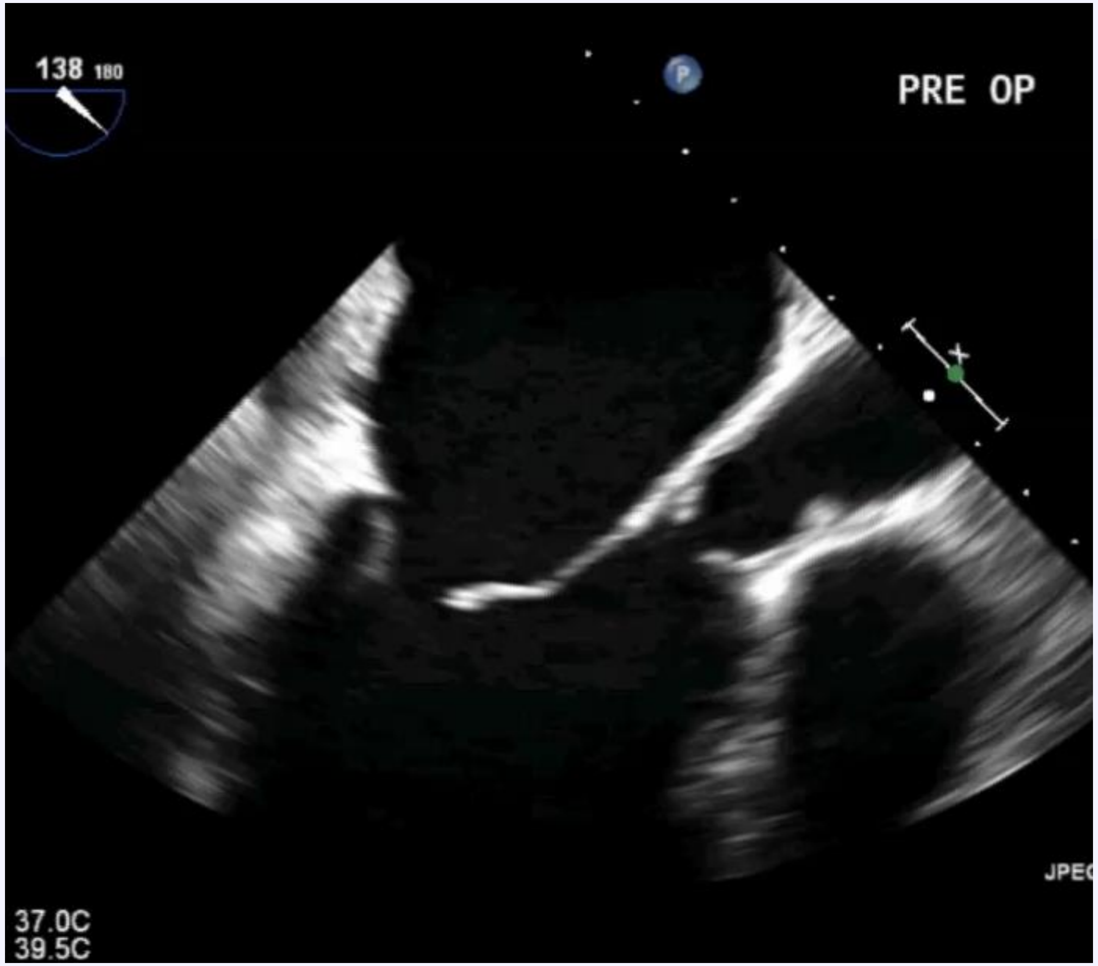


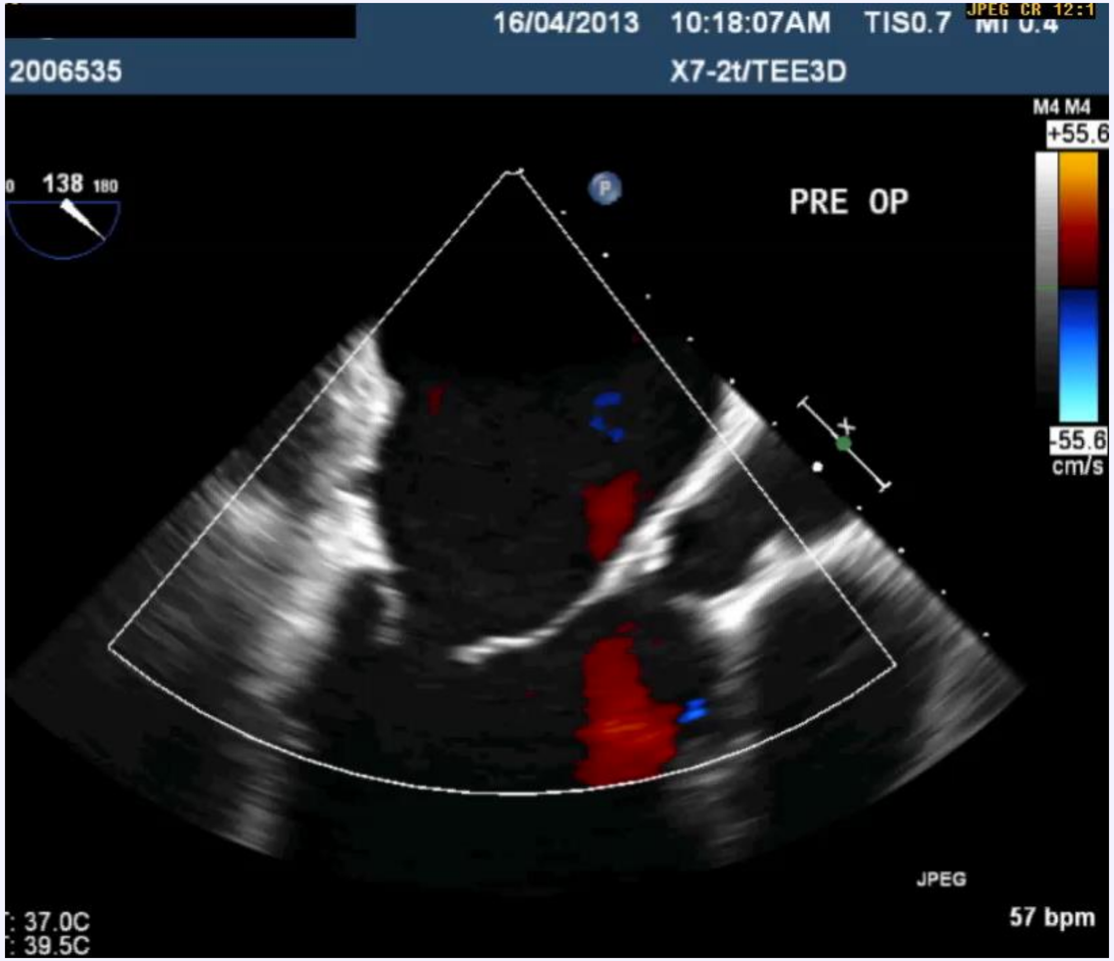


Flail posterior mitral valve leaflet, severe anteriorly directed jet of MR



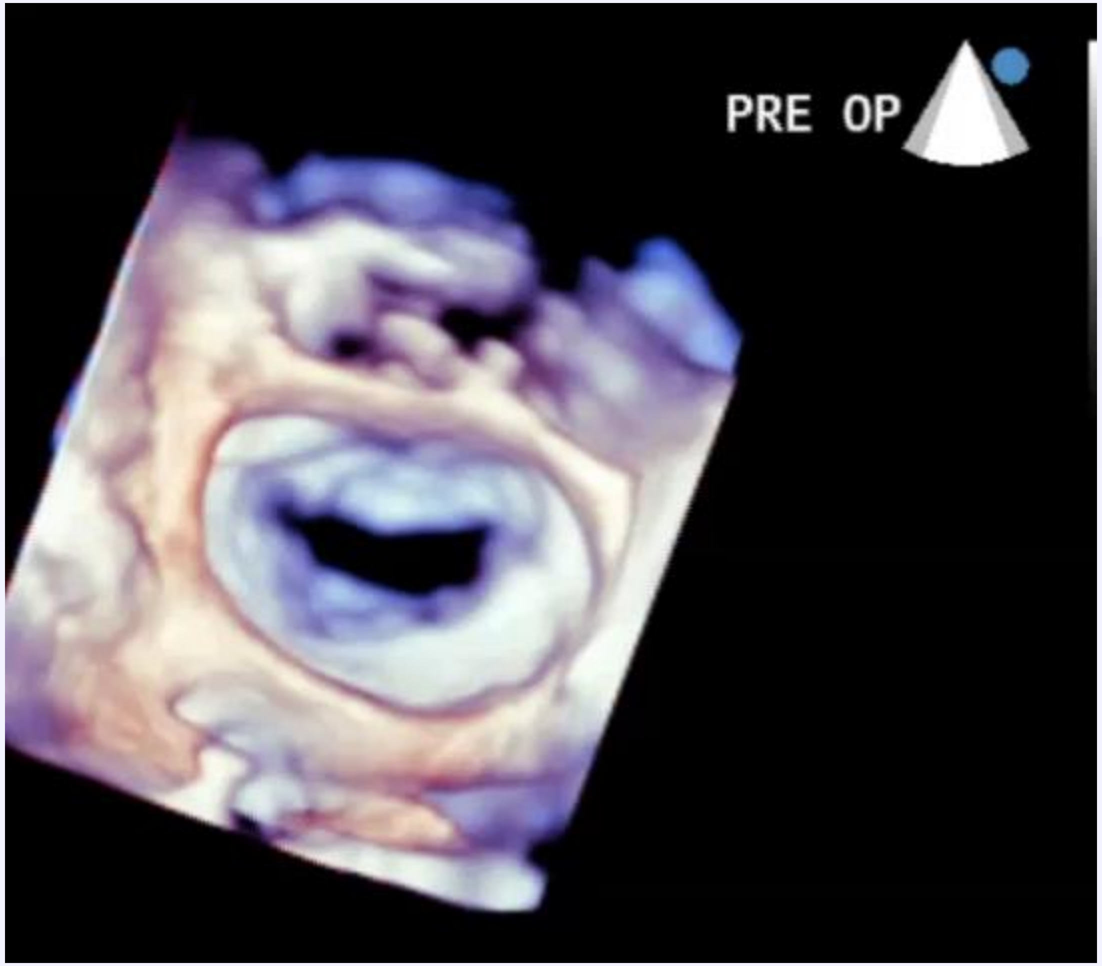
Dr. Najm, KACC. 2011



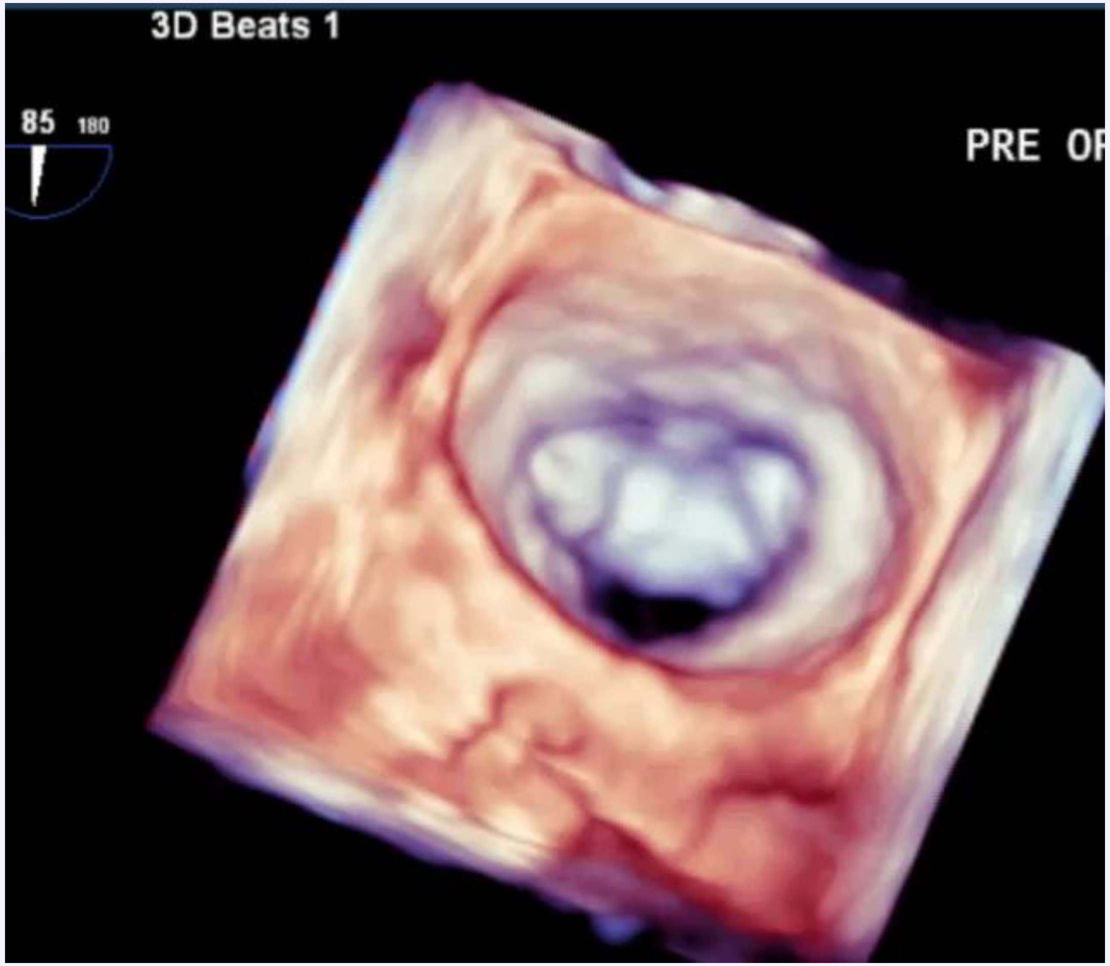


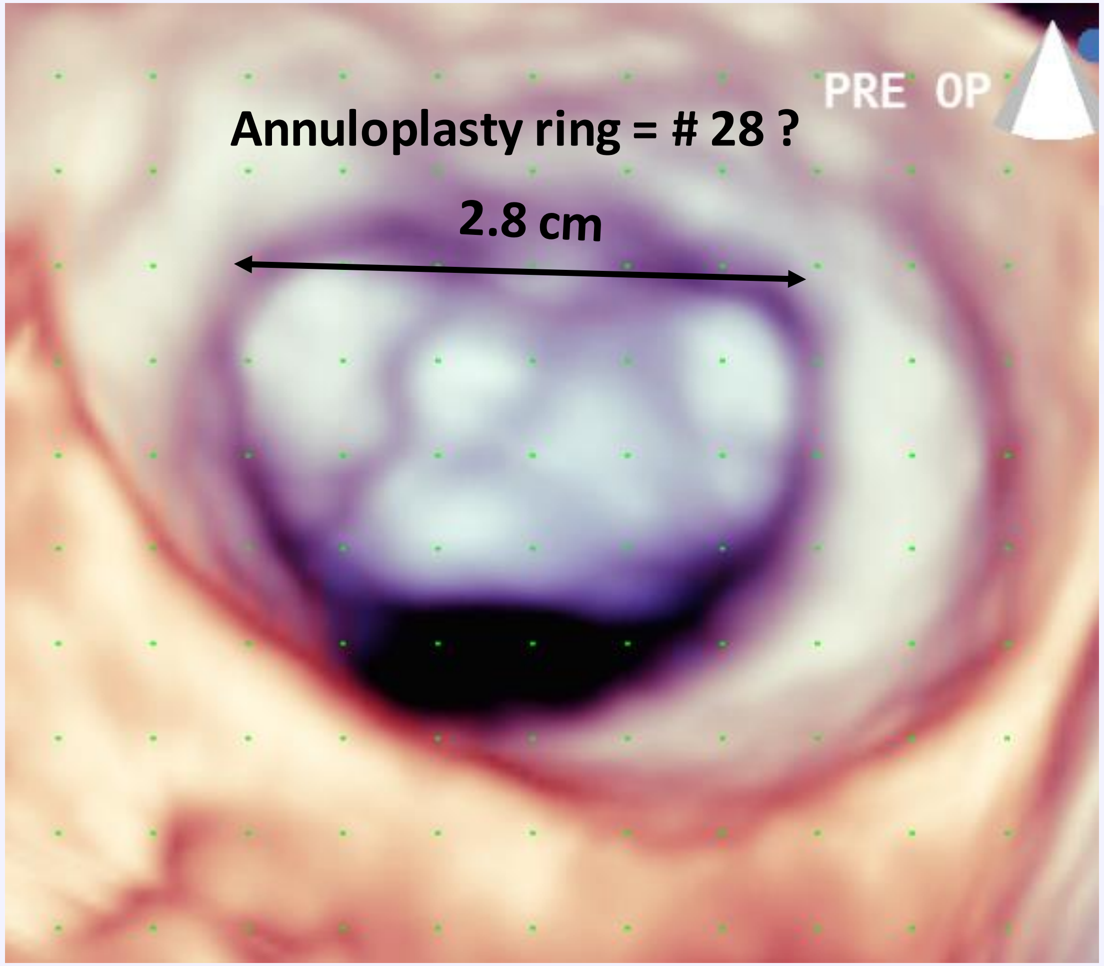
Severe ischemic MR due to inferolateral MI, severe tethering of the leaflets

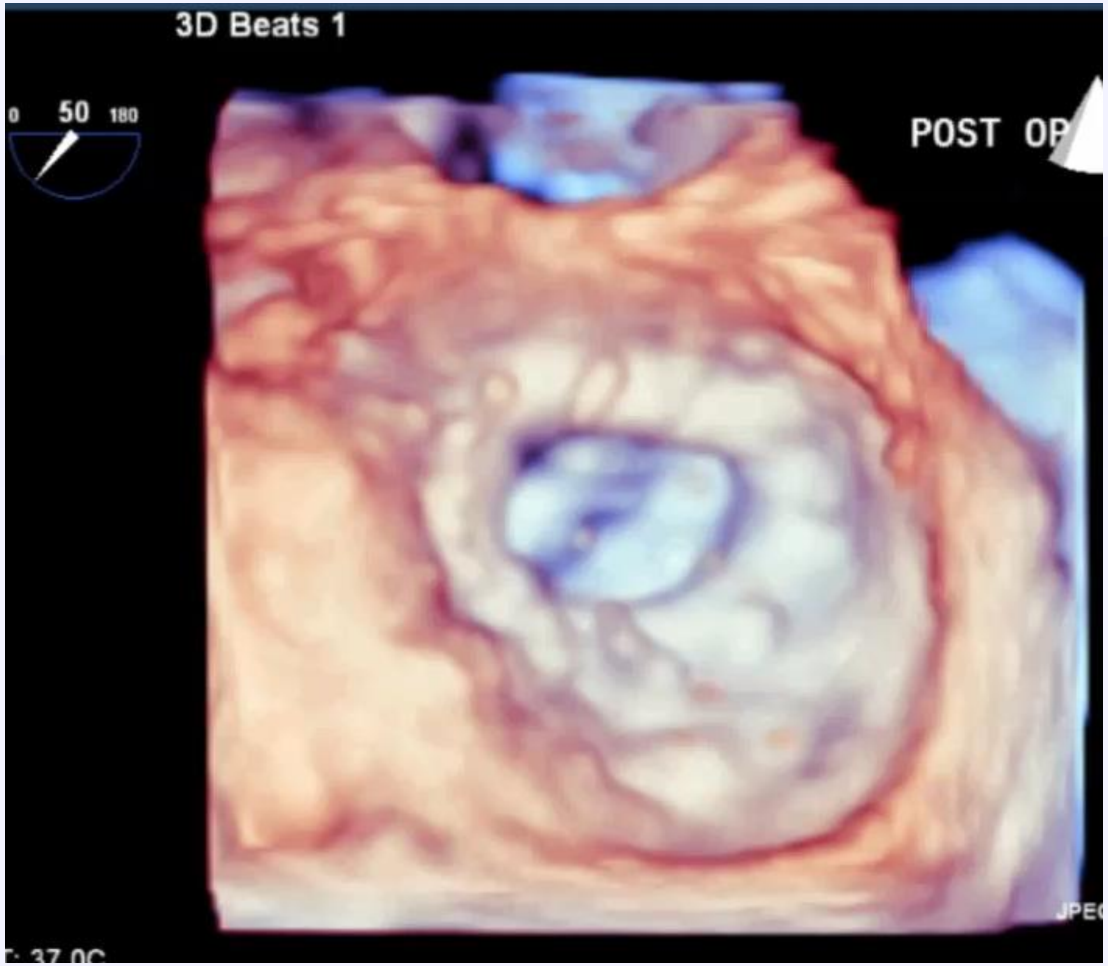

2006535
X7-2t/TEE3D
3D Beats 1
M4
0 85 180
PRE OP
JPEG
56 bpm
PAT T: 37.0C
TEE T: 39.6C

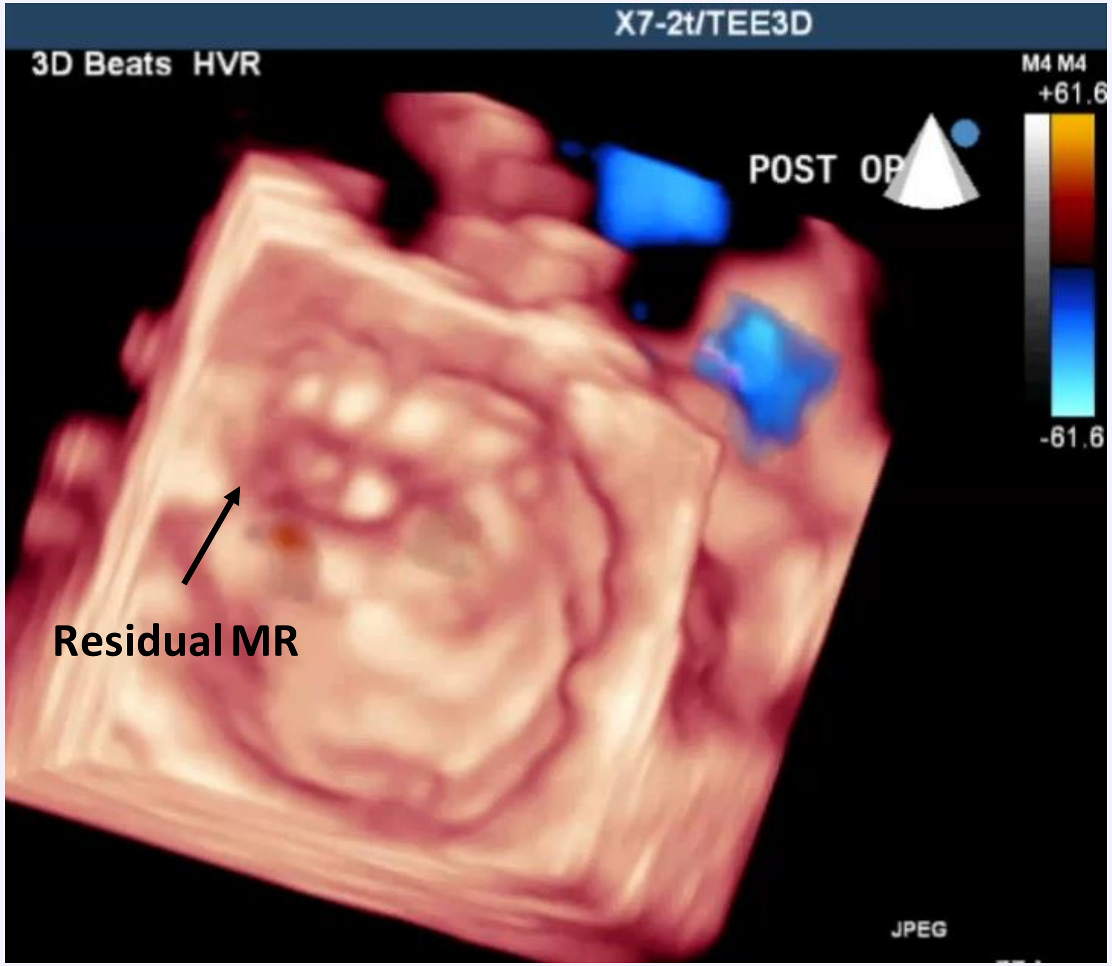

PRE OP


X7-2t/TEE3D
Beats HVR
M4 M4
+54.9
-54.9
PRE OP


3D Beats 1
85 180
PRE OP


PRE OP
Annuloplasty ring = # 28 ?
2.8 cm


3D Beats 1
0
50
180
POST OP
JPEG


X7-2t/TEE3D
3D Beats HVR
M4 M4
+61.6
-61.6
POST OP
Residual MR
JPEG

Recommendations for Noninvasive Evaluation of Native Valvular Regurgitation

A Report from the American Society of Echocardiography Developed in Collaboration with the Society for Cardiovascular Magnetic Resonance

William A. Zoghbi, MD, FASE (Chair), David Adams, RCS, RDCS, FASE, Robert O. Bonow, MD, Maurice Enriquez-Sarano, MD, Elyse Foster, MD, FASE, Paul A. Grayburn, MD, FASE, Rebecca T. Hahn, MD, FASE, Yuchi Han, MD, MMSc,* Judy Hung, MD, FASE, Roberto M. Lang, MD, FASE, Stephen H. Little, MD, FASE, Dipan J. Shah, MD, MMSc,* Stanton Shernan, MD, FASE, Paaladinesh Thavendiranathan, MD, MSc, FASE,* James D. Thomas, MD, FASE, and Neil J. Weissman, MD, FASE, *Houston and Dallas, Texas; Durham, North Carolina; Chicago, Illinois; Rochester, Minnesota; San Francisco, California; New York, New York; Philadelphia, Pennsylvania; Boston, Massachusetts; Toronto, Ontario, Canada; and Washington, DC*

JASE 2017

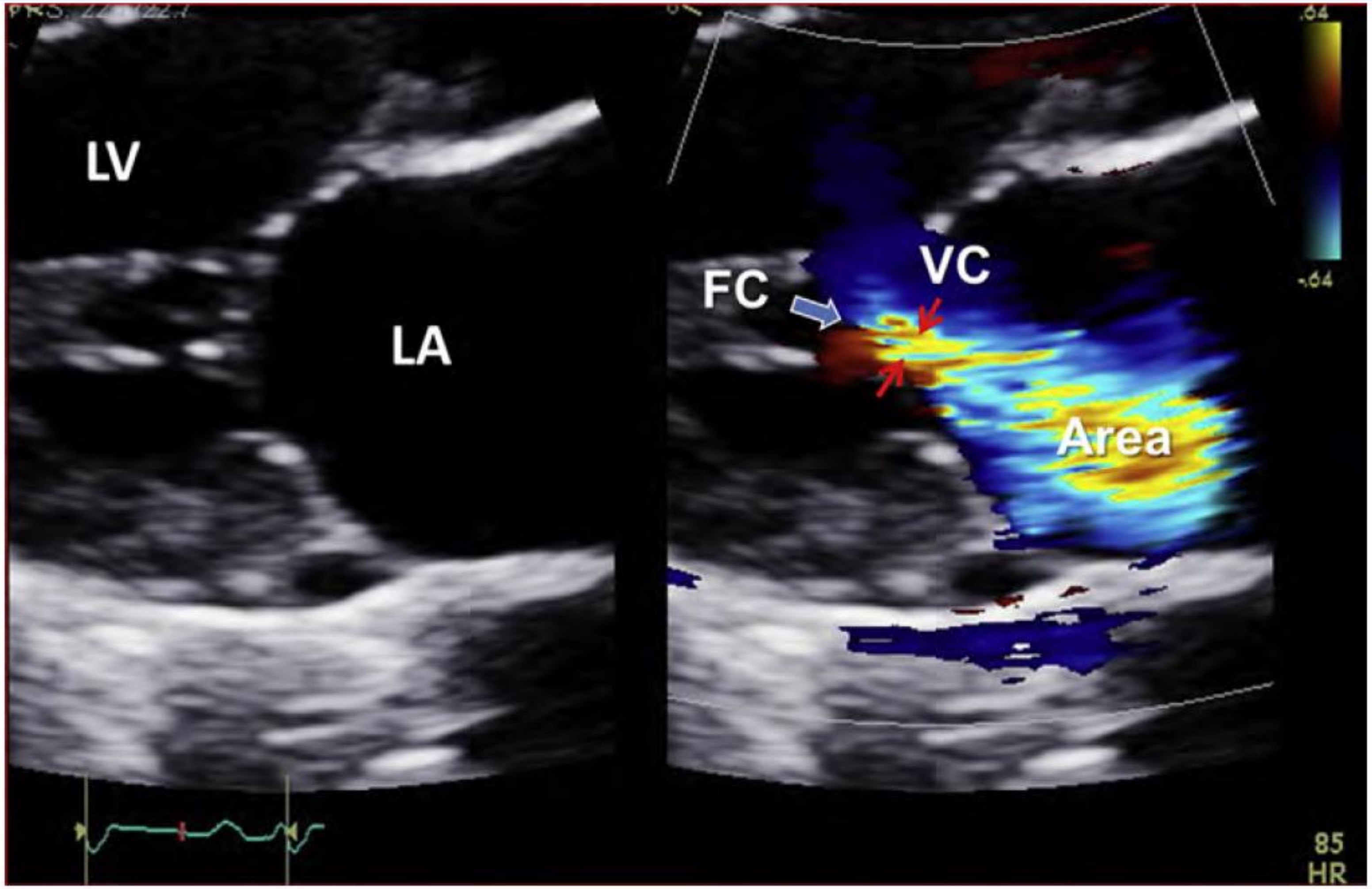


Figure 1 Depiction of the three components of a color flow regurgitant jet of MR: flow convergence (FC), VC, and jet area.

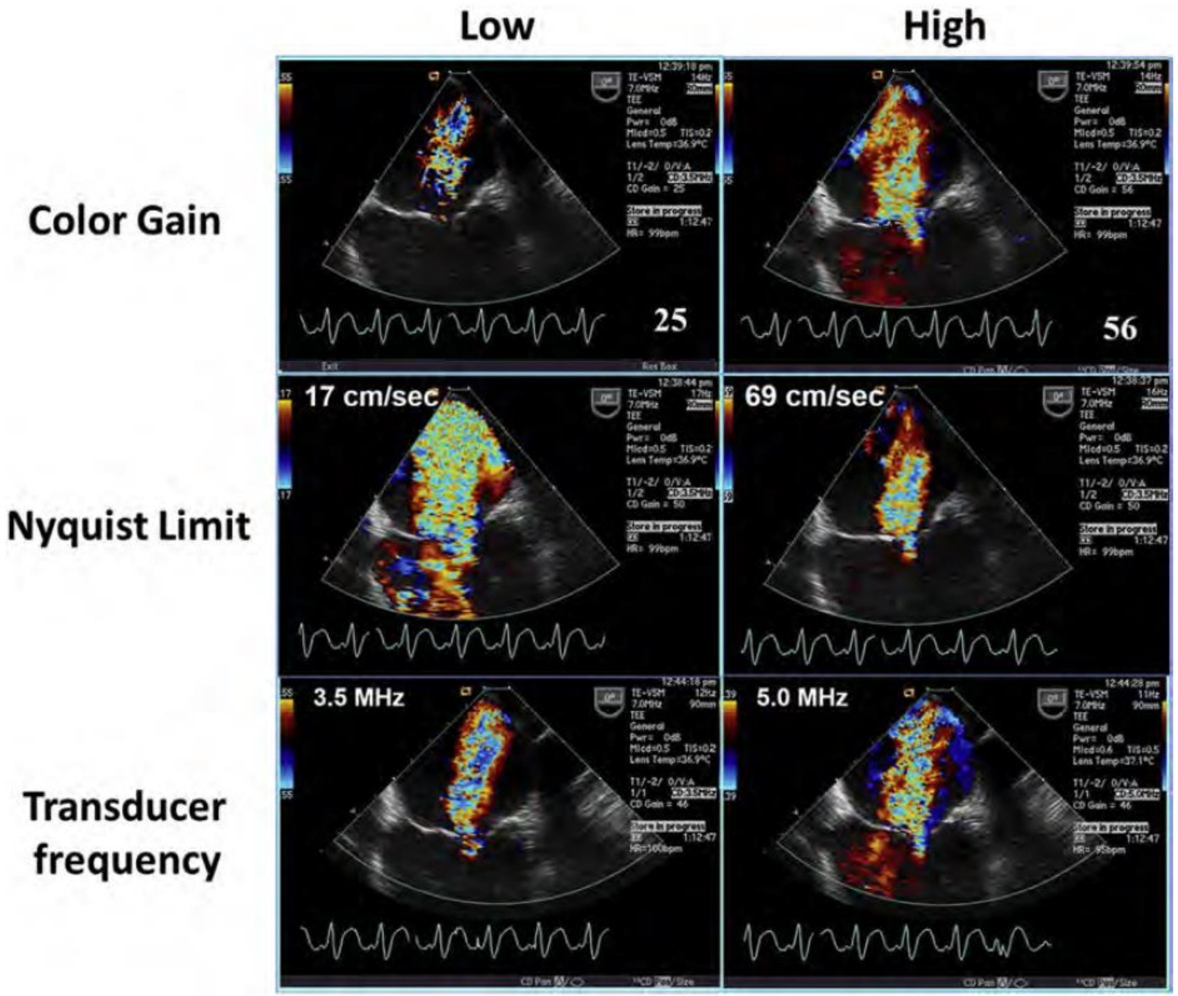


Figure 2 Effect of color gain, Nyquist limit, and transducer frequency on color jet area. Color gain should be optimized high, just below clutter noise level, otherwise the jet will be much smaller. A low Nyquist limit will emphasize lower velocities, and thus the jet will be larger; Nyquist should be between 50 and 70 cm/sec. A higher transducer frequency, as used in TEE, will also depict a slightly larger jet.

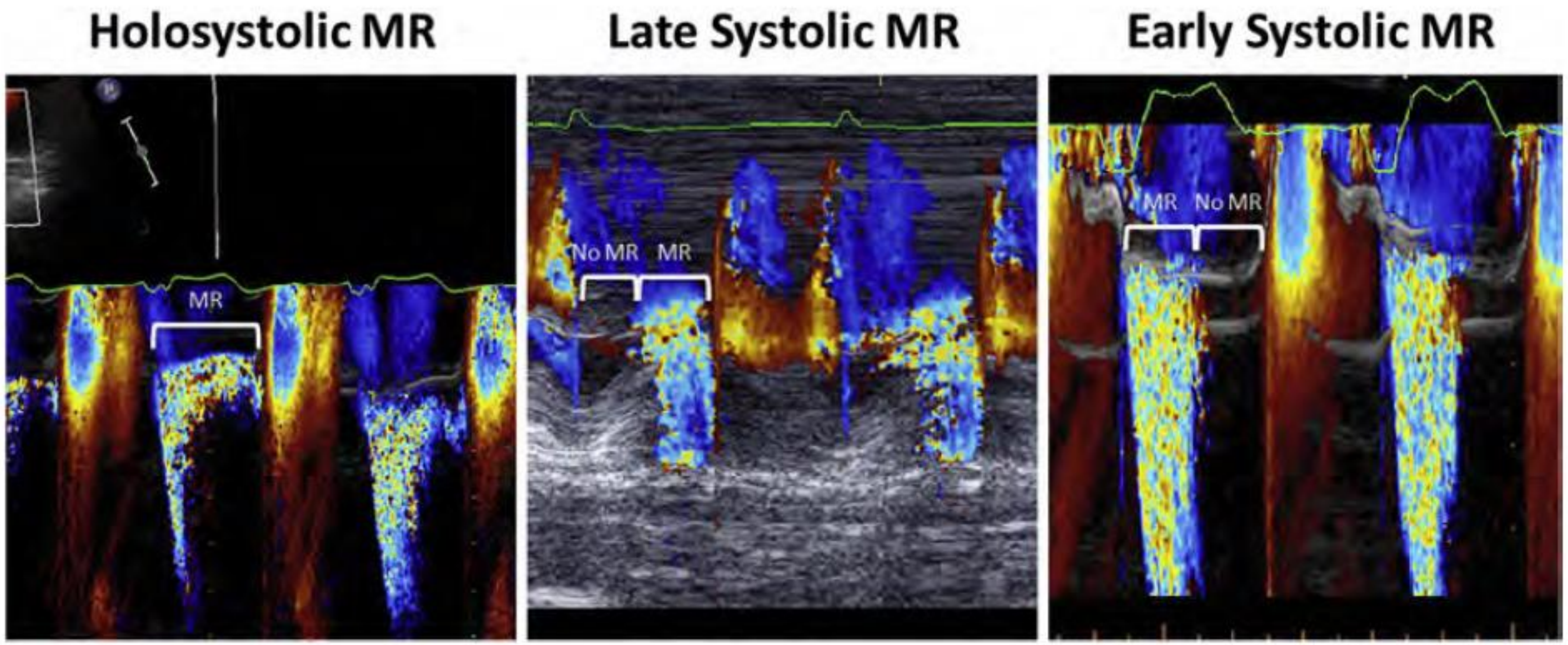


Figure 3 M-mode color images depict timing of MR: classic holosystolic MR, late systolic MR due to MVP, and early systolic MR in a patient with cardiomyopathy and left bundle branch block. Single-frame measurements of EROA or VC (width or area) will overestimate MR severity when it is not holosystolic.

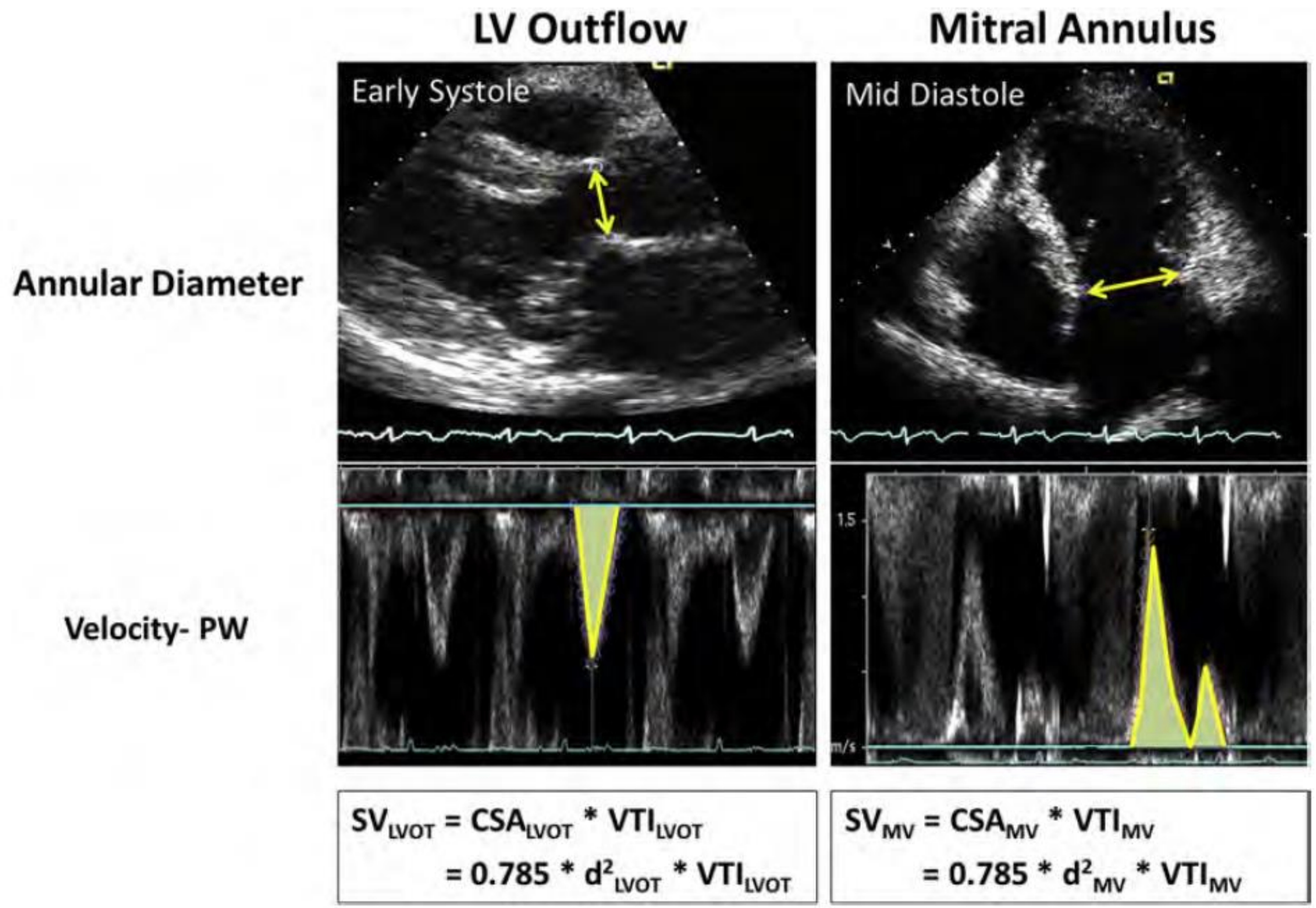


Figure 4 Echo-Doppler calculations of SV at the LVOT and MV annulus sites. In this example of severe MR, SV_{MV} was 183 mL (d = 3.5 cm, VTI = 19 cm) and SV_{LVOT} was 58 mL (d = 2.3 cm, VTI = 14 cm). This yielded an RVol of 125 mL and an RF of 125/183 or 68%. d, Diameter of the annulus; *PW*, pulsed wave Doppler.

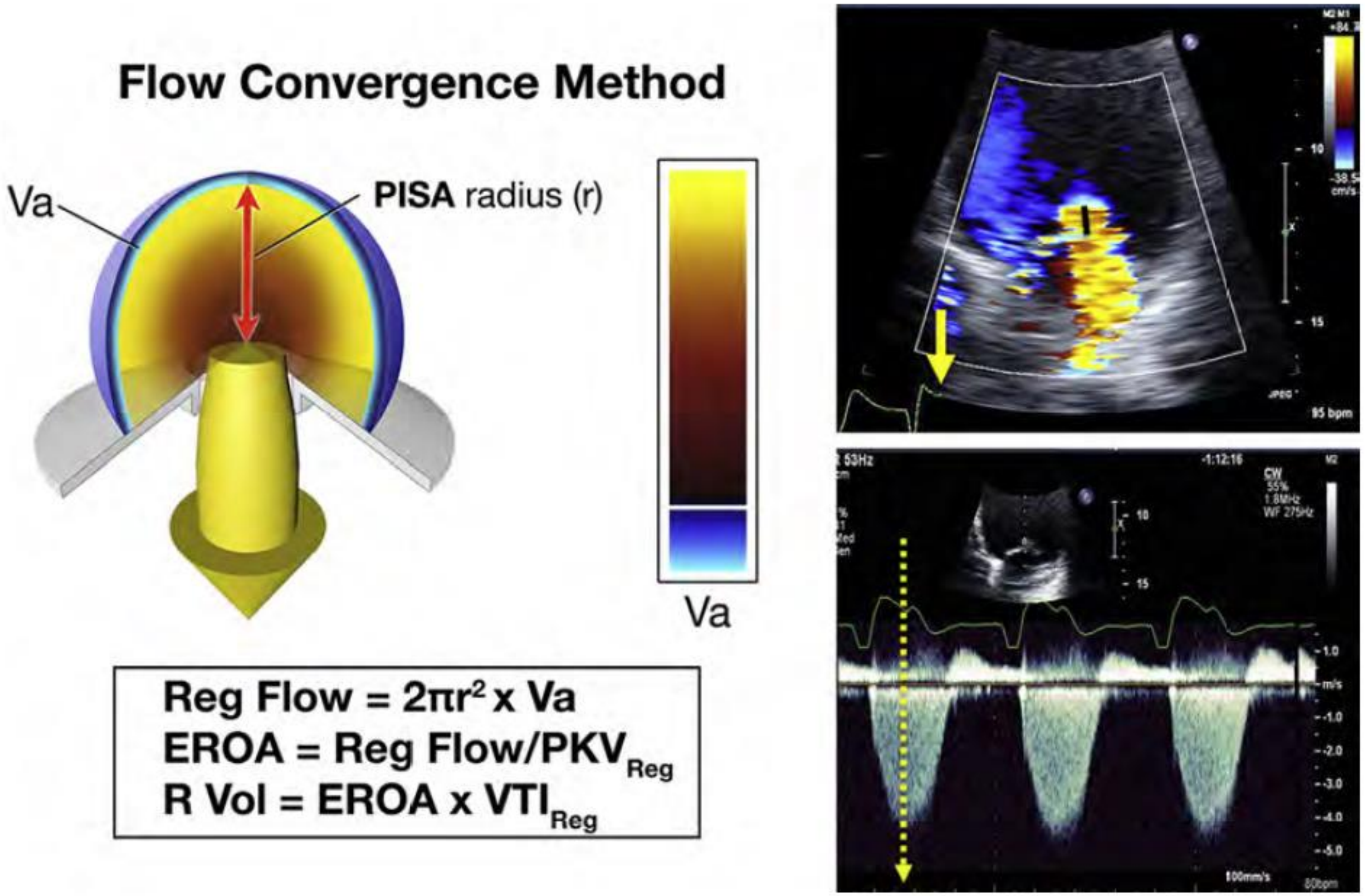


Figure 5 Schematic representation of the flow convergence method (PISA). The example on the right shows the measurement of the PISA radius and the timing of the selection of the color frame for measurement (*solid yellow arrow*), corresponding to the maximal jet velocity by CWD (*dashed arrow*). *Reg*, Regurgitation; *PKV*, peak velocity of regurgitant flow by CWD; *VTI*, velocity time integral of the regurgitant jet by CWD.

Table 5 Etiology of primary and secondary MR

Primary MR (leaflet abnormality)	
MVP myxomatous changes	Prolapse, flail, ruptured or elongated chordae
Degenerative changes	Calcification, thickening
Infectious	Endocarditis vegetations, perforations, aneurysm
Inflammatory	Rheumatic, collagen vascular disease, radiation, drugs
Congenital	Cleft leaflet, parachute MV
Secondary MR (ventricular remodeling)	
Ischemic etiology secondary to coronary artery disease	
Nonischemic cardiomyopathy	
Annular dilation	Atrial fibrillation, restrictive cardiomyopathy

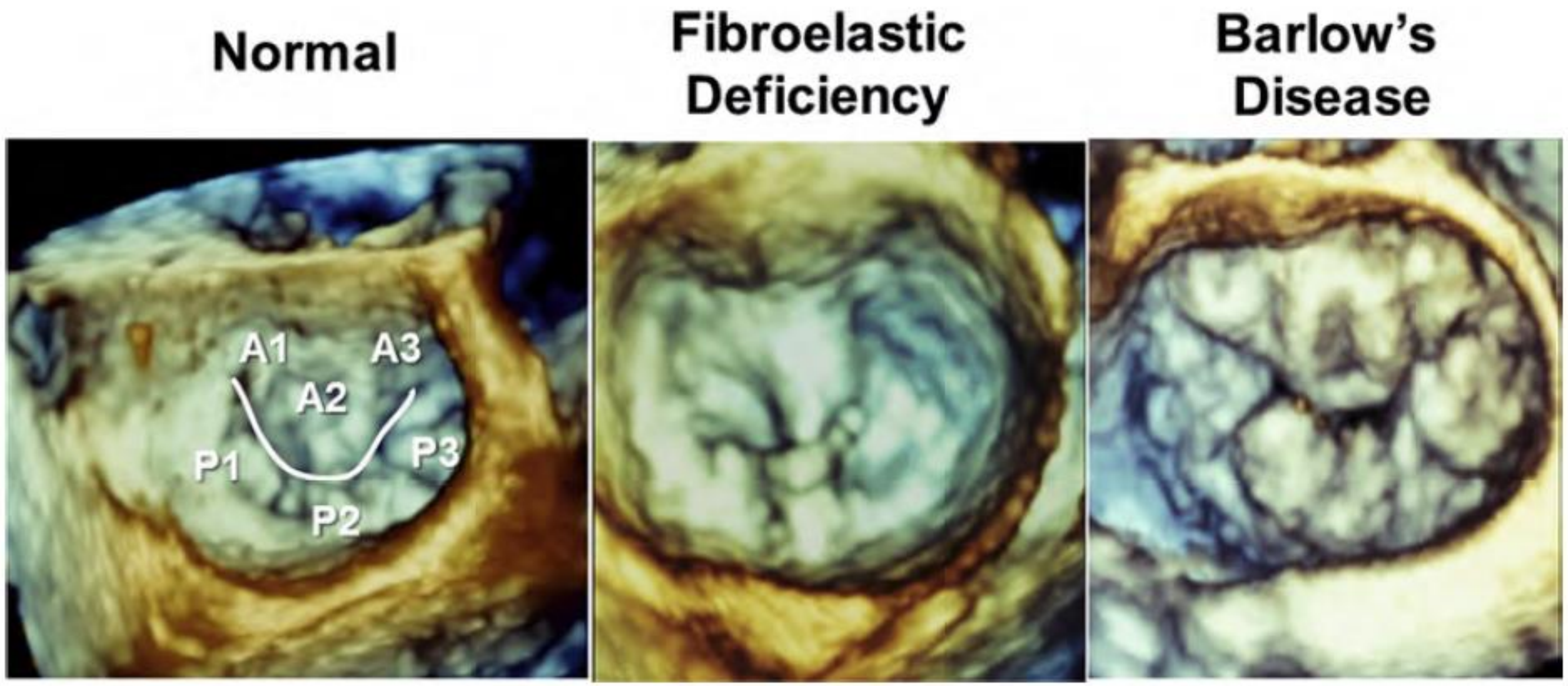


Figure 9 Three-dimensional echocardiographic frames of MVs from the LA view depicting a normal valve with delineation of the anterior and posterior scallops, a patient with fibroelastic deficiency and a flail P2 segment, as well as a patient with Barlow's disease.

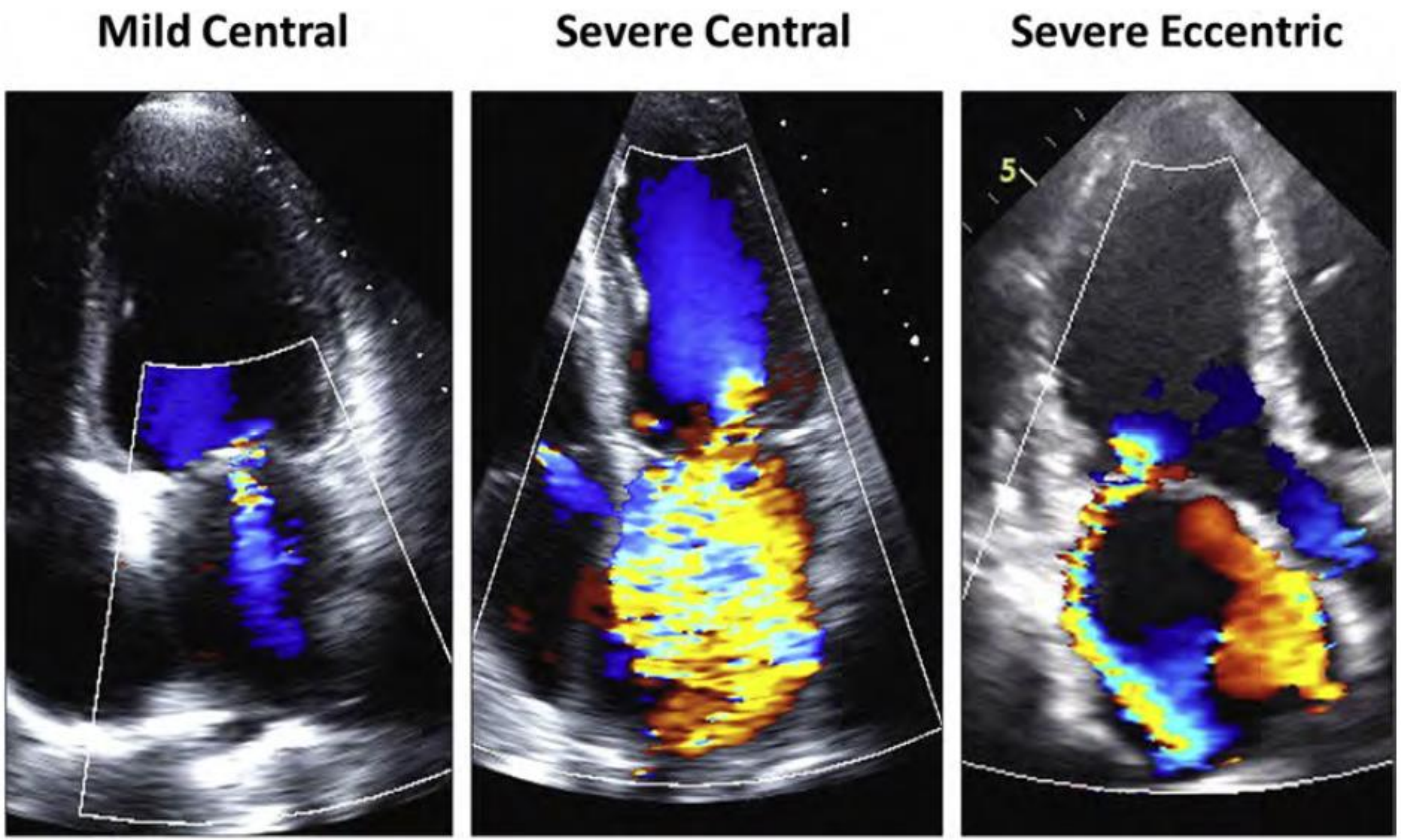


Figure 15 Color Doppler panel of mild and severe MR (central and eccentric). In the eccentric, wall-impinging jet case, the jet area is small, but the flow convergence and VC are large and alert to the severity of regurgitation.

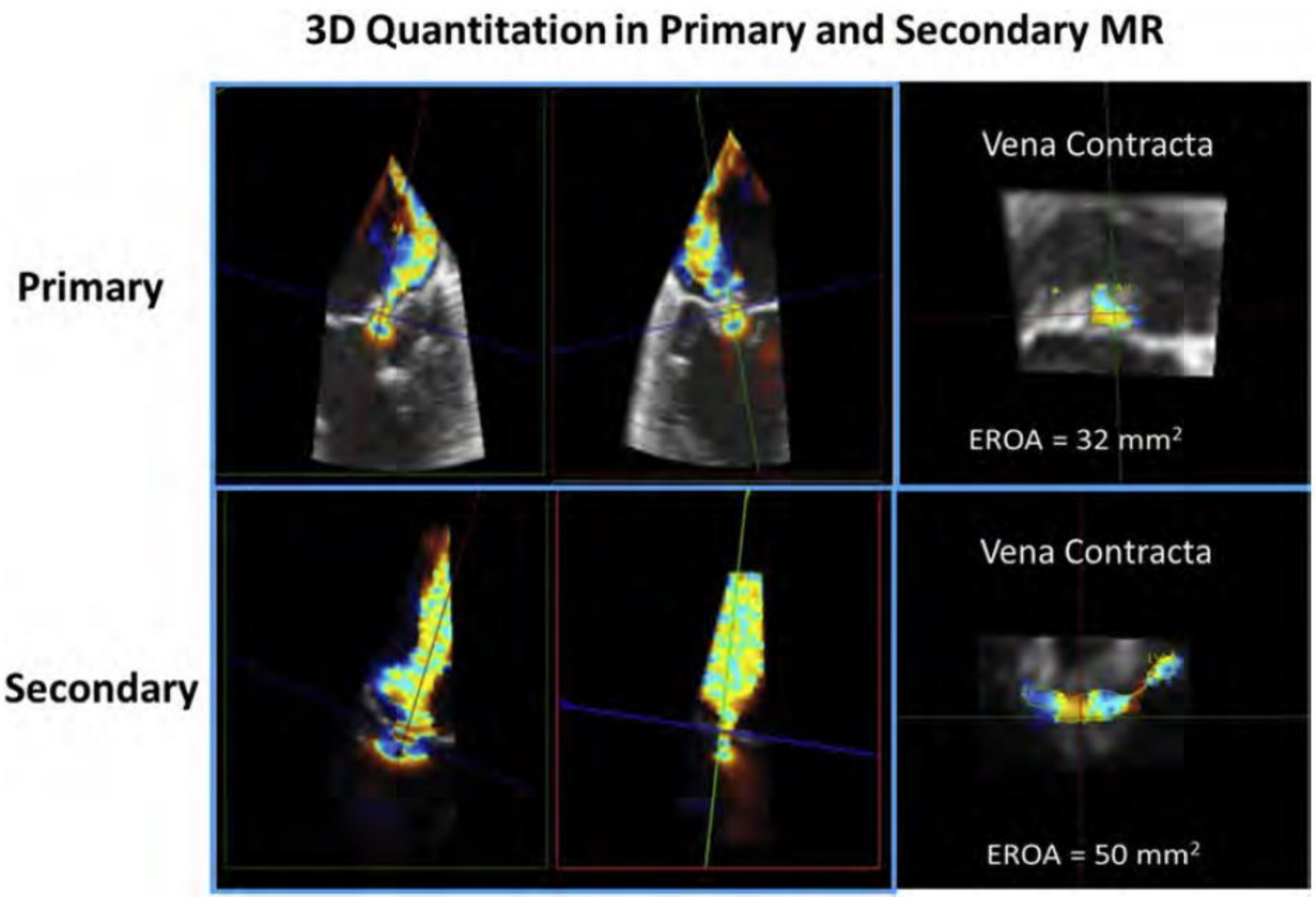
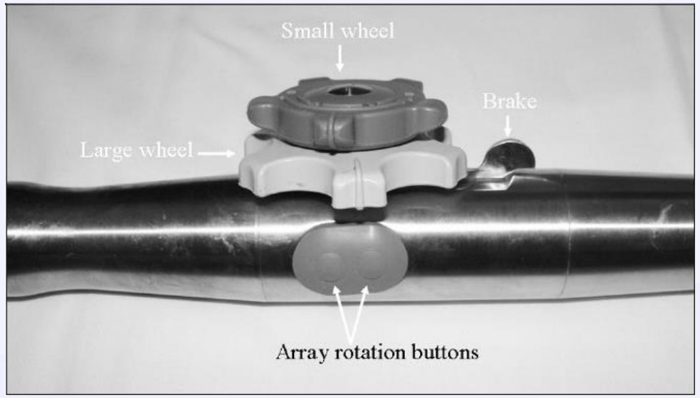
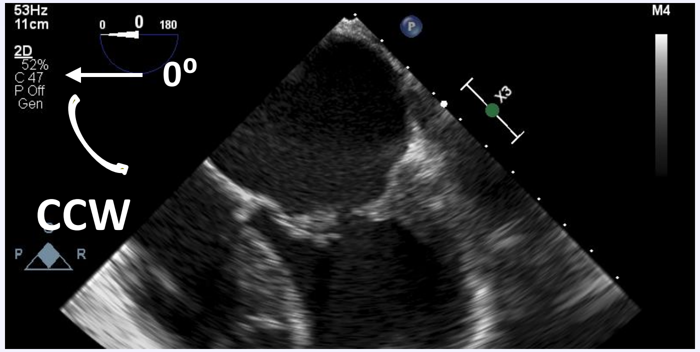


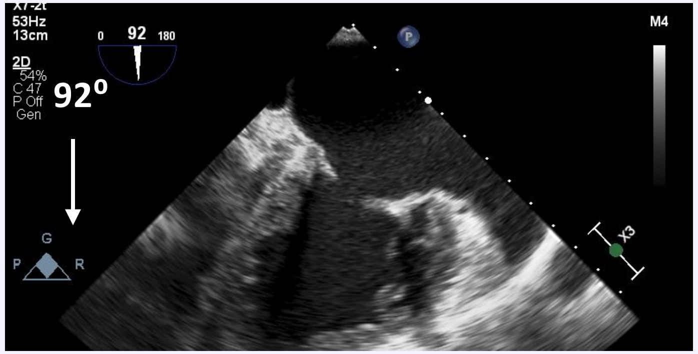
Figure 16 Two cases showing evaluation and quantitation of VCA with 3D echocardiography and multiplanar reconstruction. A case of primary MR (*upper panels*) with a circular VCA and hemispheric PISA and another with secondary MR (*lower panels*) with elliptical VCA and nonhemispheric PISA.

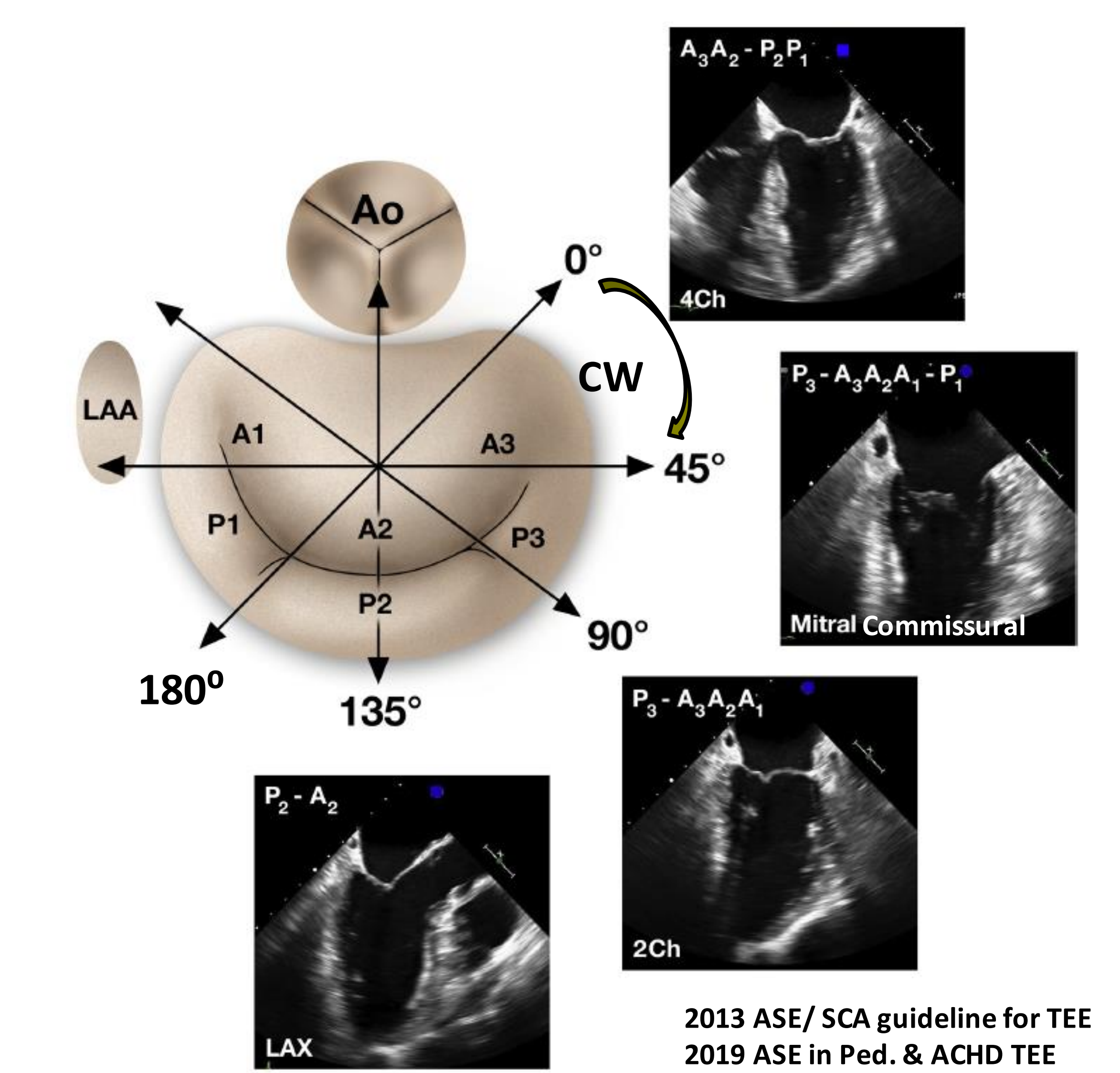
Table 8 Grading the severity of chronic MR by echocardiography

	MR severity[*]			
	Mild	Moderate		Severe
Structural				
MV morphology	**None or mild leaflet abnormality** (e.g., mild thickening, calcifications or prolapse, mild tenting)	Moderate leaflet abnormality or moderate tenting		**Severe valve lesions** (primary: flail leaflet, ruptured papillary muscle, severe retraction, large perforation; secondary: severe tenting, poor leaflet coaptation)
LV and LA size[†]	Usually normal	Normal or mild dilated		Dilated[‡]
Qualitative Doppler				
Color flow jet area[§]	**Small, central, narrow, often brief**	Variable		Large central jet (>50% of LA) or eccentric wall-impinging jet of variable size
Flow convergence[‖]	**Not visible, transient or small**	Intermediate in size and duration		**Large throughout systole**
CWD jet	Faint/partial/parabolic	Dense but partial or parabolic		Holosystolic/dense/**triangular**
Semiquantitative				
VCW (cm)	<0.3	Intermediate		≥0.7 (>0.8 for biplane)[¶]
Pulmonary vein flow[#]	**Systolic dominance** (may be blunted in LV dysfunction or AF)	Normal or systolic blunting[#]		Minimal to no systolic flow/ **systolic flow reversal**
Mitral inflow[**]	**A-wave dominant**	Variable		E-wave dominant (>1.2 m/sec)
Quantitative[††,‡‡]				
EROA, 2D PISA (cm^2)	<0.20	0.20-0.29	0.30-0.39	≥0.40 (may be lower in secondary MR with elliptical ROA)
RVol (mL)	<30	30-44	45-59[††]	≥ 60 (may be lower in low flow conditions)
RF (%)	< 30	30-39	40-49	≥50









2013 ASE/ SCA guideline for TEE
2019 ASE in Ped. & ACHD TEE

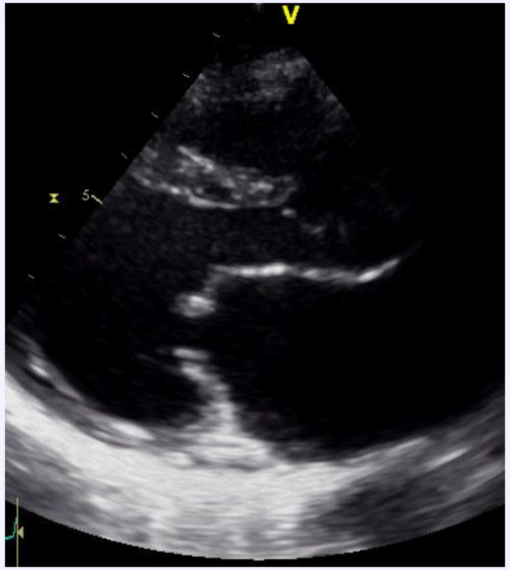
Mitral stenosis

Etiology of mitral stenosis (MS)

- ❑ Rheumatic
- ❑ Calcific, degenerative
- ❑ Congenital
- ❑ Post radiation
- ❑ Other

(drugs, SLE, rheumatoid arthritis, mucopolysaccharidosis, amyloidosis etc.)

Echocardiographic signs of rheumatic (MS)

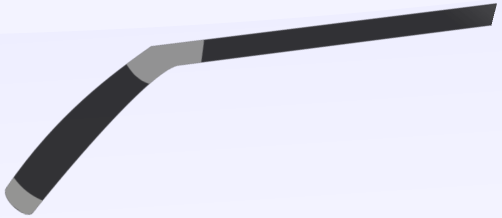


MOST FREQUENT

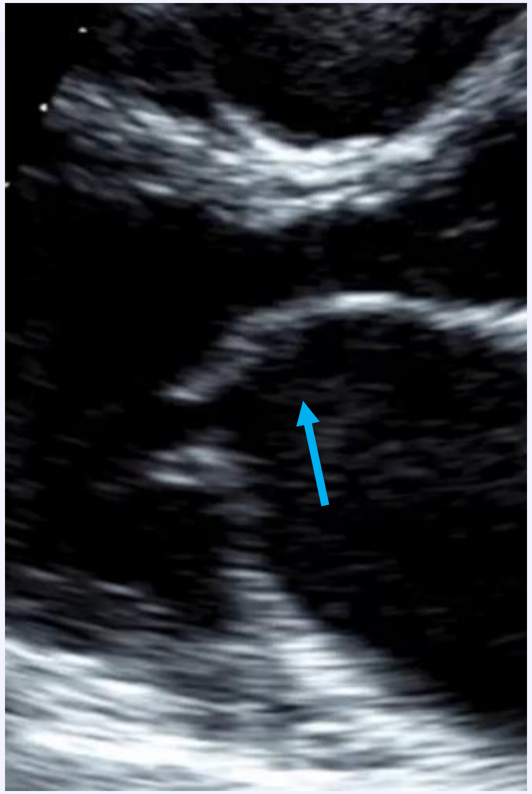
- **Commissural** fusion
- Thickening and calcification, predominantly affecting leaflet tips
- Doming and **“Hockey-stick”** appearance of leaflets
- **Chordal involvement** (fibrosis, shortening, fusion, and calcification)
- Thickening and calcification of the papillary muscles
- Calcification of the LA wall (coconut atrium)

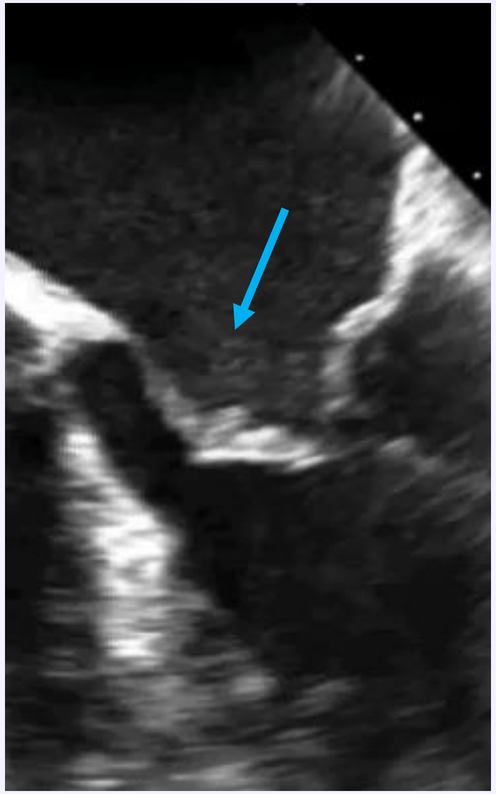
Rheumatic MS

- **Characteristic diastolic doming of the MV and commissural fusions**



"Hockey stick"





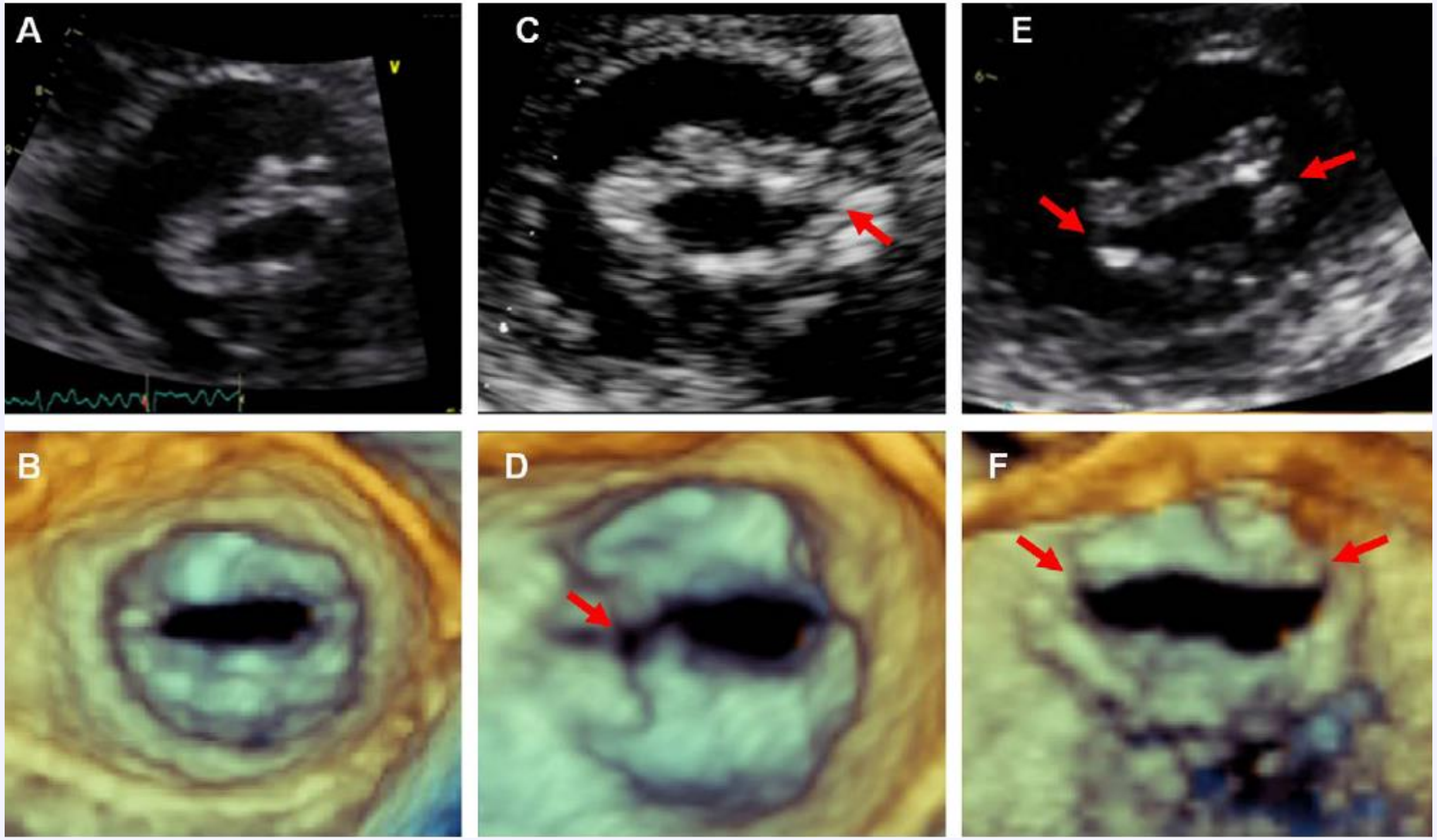
Rheumatic MS, MVR after failing PBMC

Dr Najm, KACC, 2009

Anatomic characteristics of the different types of MS

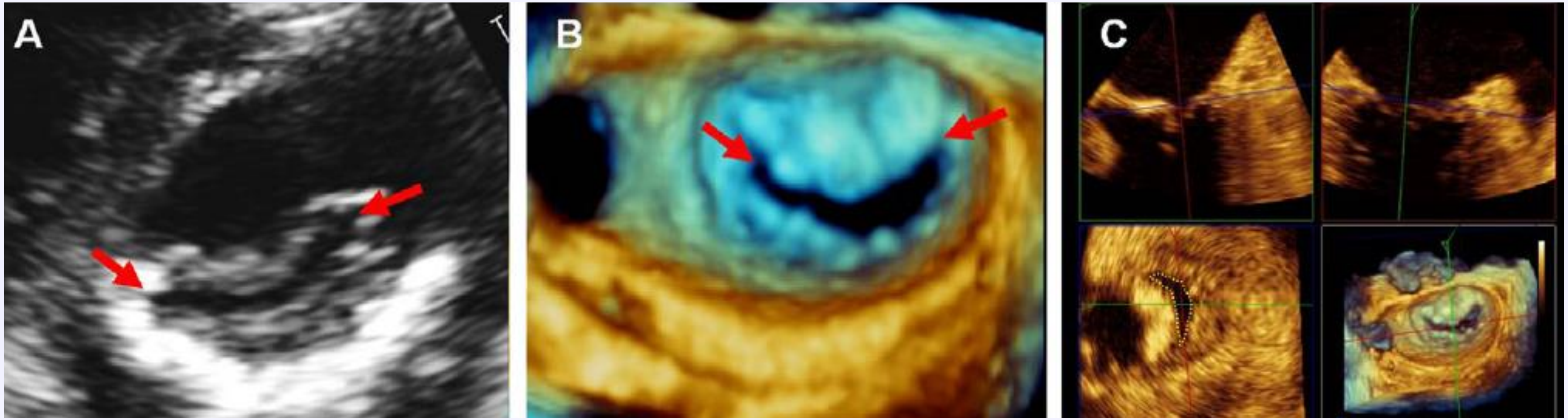
Etiology	Commissures	Mobility	Calcification
Rheumatic mitral stenosis			
Native valve	Fused	Restrictive motion of the posterior valve	0 to +++ (Possible)
Restenosis due to commissural refusion	At least partially fused	Restrictive motion of the posterior valve	0 to +++ (Possible)
Restenosis due to valve rigidity	At least one commissure completely open	Restrictive motion of the posterior valve	0 to +++ (Possible)
Degenerative mitral stenosis	Both commissures open	Normal mobility of the tip of both leaflets	+++ Important calcifications of the mitral annulus and the base of both leaflets
Post-radiation mitral stenosis	Both commissures open	Absence of restrictive motion of the posterior valve	+ to +++ Highly suggestive calcifications of the mitral aortic membrane
Congenital mitral stenosis	Not applicable (absence of commissure)	Normal	Usually not

Krapf L, et al. Archives of cardiovascular disease 2013



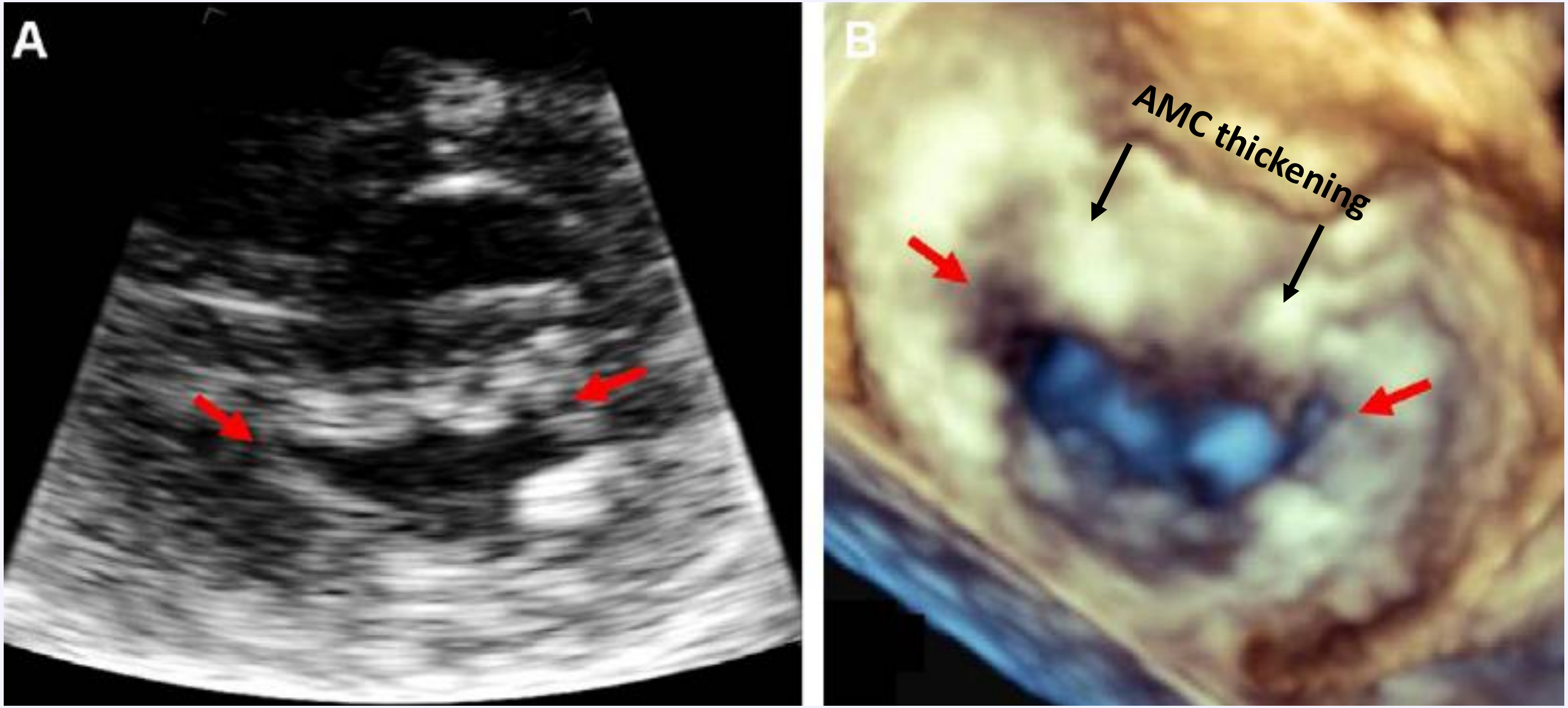
Examples of rheumatic MS in 2D TTE and 3D TEE. (A and B) Fused commissures. (C and D) Unicommissural (lateral commissure) opening. (E and F) Bilateral commissural opening.

Krapf L, et al. Archives of cardiovascular disease 2013



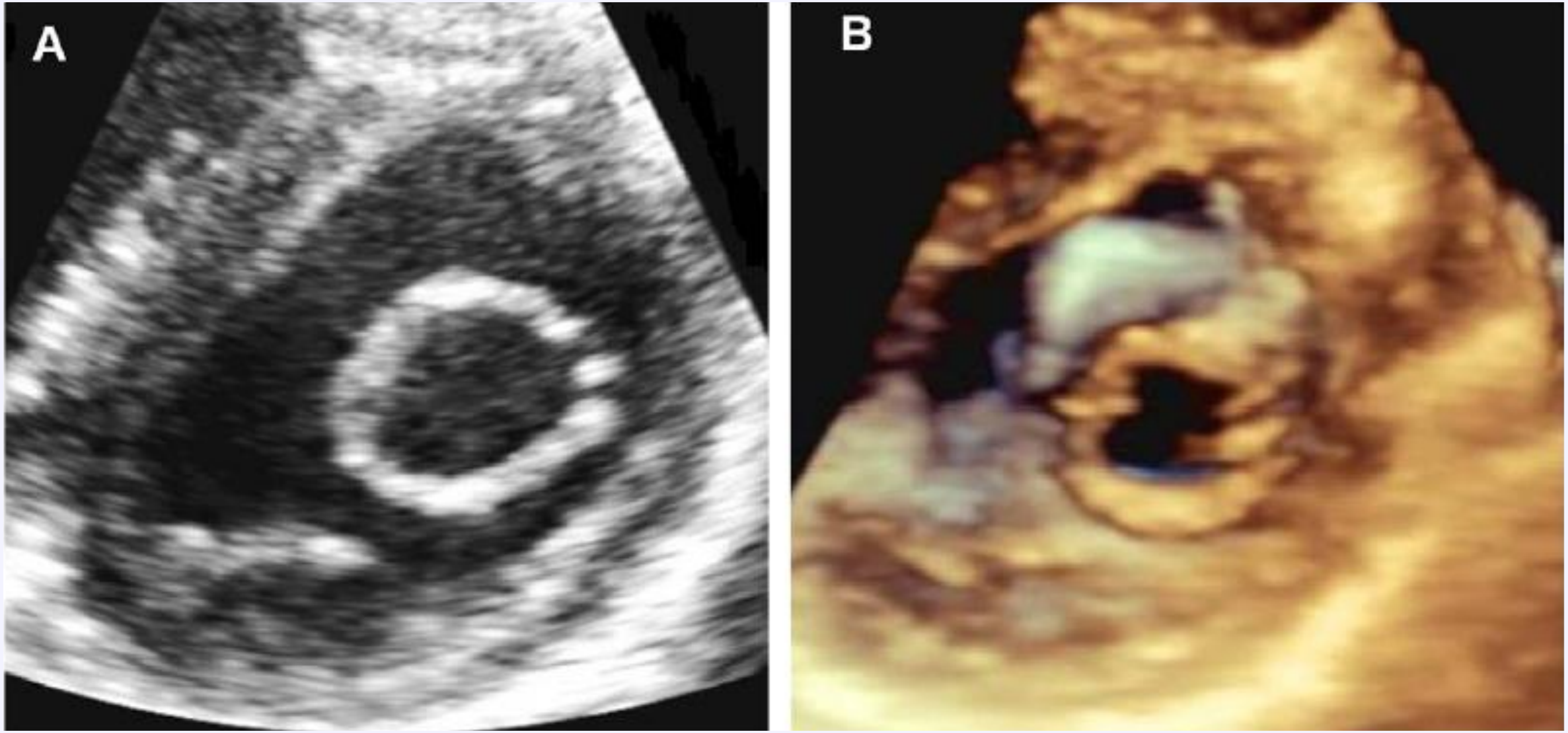
Degenerative MS. The annulus as well as the valve leaflets are thickened and calcified. In contrast, both commissures are open. TTE shows severe mitral annular calcification. 3D TEE allows more accurate assessment of the degree of commissural opening and measurement of mitral valve area by 3D planimetry and 3D MPR.

Krapf L, et al. Archives of cardiovascular disease 2013



Radiation- induced MS. Complete bilateral commissural opening in 2D TTE and 3D TEE. Severe thickening and calcification of aortic-mitral curtain (AMC).

Krapf L, et al. Archives of cardiovascular disease 2013



Congenital MS. Parachute-like congenital mitral valve disease with a circular orifice and no commissures.

Krapf L, et al. Archives of cardiovascular disease 2013

Echocardiographic Assessment of Valve Stenosis: EAE/ASE Recommendations for Clinical Practice

Helmut Baumgartner, MD,[†] Judy Hung, MD,[‡] Javier Bermejo, MD, PhD,[†]
John B. Chambers, MD,[†] Arturo Evangelista, MD,[†] Brian P. Griffin, MD,[‡] Bernard Iung, MD,[†]
Catherine M. Otto, MD,[‡] Patricia A. Pellikka, MD,[‡] and Miguel Quiñones, MD[‡]

JASE 2009

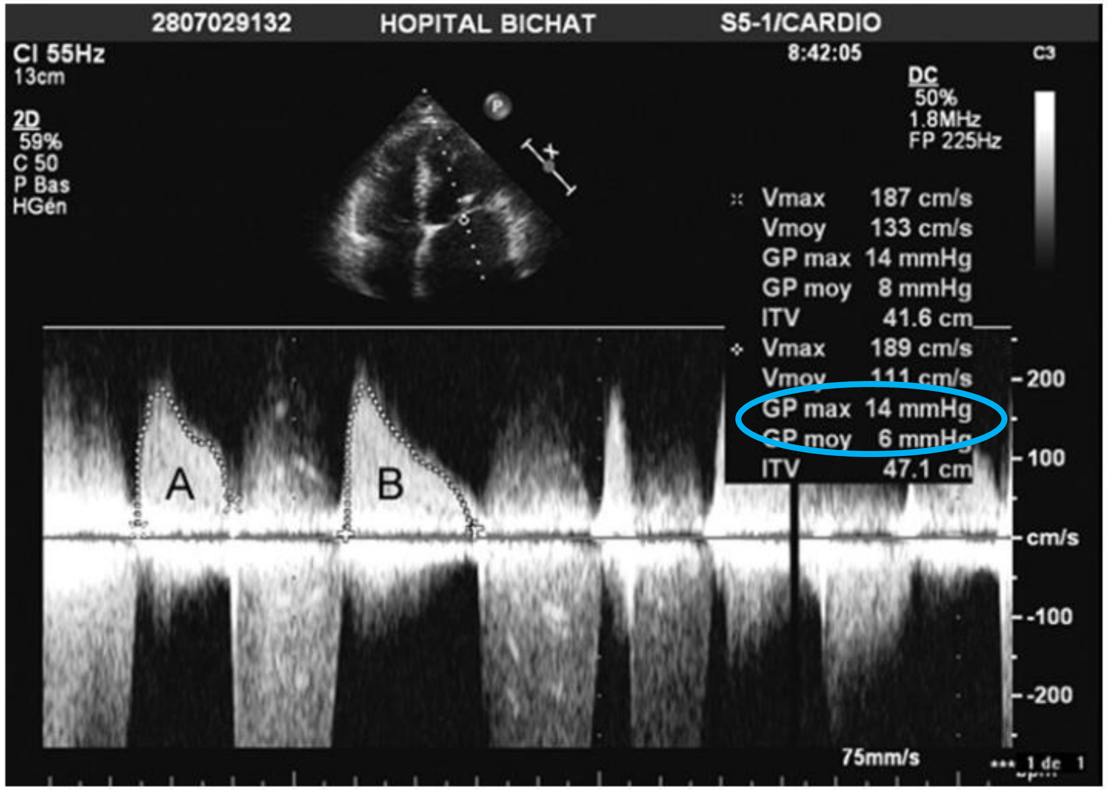


Figure 7 Determination of mean mitral gradient from Doppler diastolic mitral flow in a patient with severe mitral stenosis in atrial fibrillation. Mean gradient varies according to the length of diastole: it is 8 mmHg during a short diastole (**A**) and 6 mmHg during a longer diastole (**B**).

Peak & mean gradient across the mitral valve

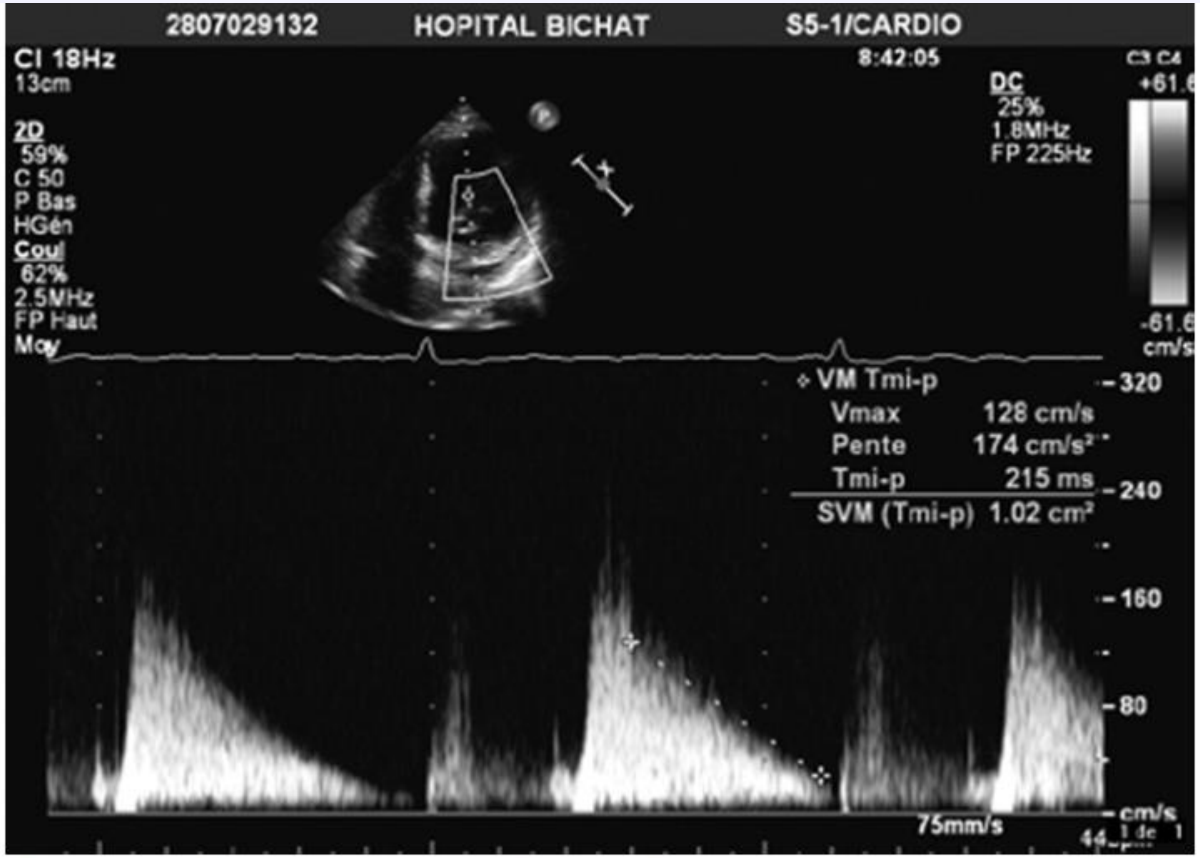


Figure 9 Estimation of mitral valve area using the pressure half-time method in a patient with mitral stenosis in atrial fibrillation. Valve area is 1.02 cm².

MVA by PHT (PHT = 215 ms, MVA = 1.02 cm2)

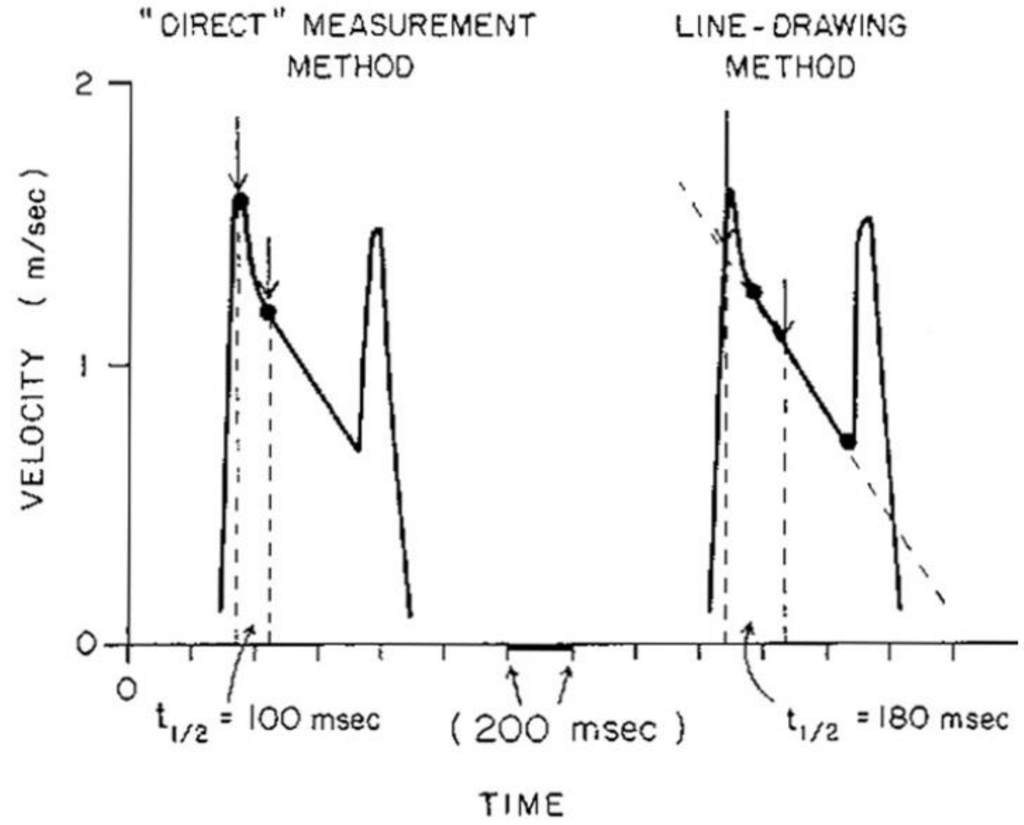


Figure 10 Determination of Doppler pressure half-time ($T_{1/2}$) with a bimodal, non-linear decreasing slope of the E-wave. The deceleration slope should not be traced from the early part (left), but using the extrapolation of the linear mid-portion of the mitral velocity profile (right). (Reproduced from Gonzalez *et*

Determination of Doppler PHT

Table 5 Assessment of mitral valve anatomy according to the Wilkins score[64]

Grade	Mobility	Thickening	Calcification	Subvalvular Thickening
1	Highly mobile valve with only leaflet tips restricted	Leaflets near normal in thickness (4–5 mm)	A single area of increased echo brightness	Minimal thickening just below the mitral leaflets
2	Leaflet mid and base portions have normal mobility	Midleaflets normal, considerable thickening of margins (5–8 mm)	Scattered areas of brightness confined to leaflet margins	Thickening of chordal structures extending to one-third of the chordal length
3	Valve continues to move forward in diastole, mainly from the base	Thickening extending through the entire leaflet (5–8 mm)	Brightness extending into the mid-portions of the leaflets	Thickening extended to distal third of the chords
4	No or minimal forward movement of the leaflets in diastole	Considerable thickening of all leaflet tissue (>8–10 mm)	Extensive brightness throughout much of the leaflet tissue	Extensive thickening and shortening of all chordal structures extending down to the papillary muscles

The total score is the sum of the four items and ranges between 4 and 16.

Wilkins score by TTE to assess suitability for percutaneous balloon mitral valvuloplasty or commissurotomy (PBMC)

Table 8 Approaches to evaluation of mitral stenosis

Measurement	Units	Formula / Method	Concept	Advantages	Disadvantages
Valve area					
- planimetry by 2D echo	cm²	tracing mitral orifice using 2D echo	direct measurement of anatomic MVA	- accuracy - independence from other factors	- experience required - not always feasible (poor acoustic window, severe valve calcification)
- pressure half-time	cm²	$220 / T_{1/2}$	rate of decrease of transmitral flow is inversely proportional to MVA	easy to obtain	dependence on other factors (AR, LA compliance, LV diastolic function…). Not valid in severe MAC and prosthetic MVR
- continuity equation	cm²	$MVA = (CSA_{LVOT})(VTI_{Aortic}) / VTI_{Mitral}$	volume flows through mitral and aortic orifices are equal	independence from flow conditions	- multiple measurements (sources of errors) - not valid if significant AR or MR
- PISA	cm²	$MVA = \pi(r^2)(V_{aliasing}) / \text{peak } V_{Mitral} \cdot \alpha/180°$	MVA assessed by dividing mitral volume flow by the maximum velocity of diastolic mitral flow	independence from flow conditions	technically difficult
Mean gradient	mm Hg	$\Delta P = \sum 4v^2 / N$	pressure gradient calculated from velocity using the Bernoulli equation	easy to obtain	dependent on heart rate and flow conditions
Systolic pulmonary artery pressure	mm Hg	$sPAP = 4v^2_{Tricuspid}$ + RA pressure	addition of RA pressure and maximum gradient between RV and RA	obtained in most patients with MS	- arbitrary estimation of RA pressure - no estimation of pulmonary vascular resistance
Mean gradient and systolic pulmonary artery pressure at exercise	mm Hg	$\Delta P = \sum 4v^2 / N$ $sPAP = 4v^2_{Tricuspid}$ + RA pressure	assessment of gradient and sPAP for increasing workload	incremental value in assessment of tolerance	- experience required - lack of validation for decision-making

Approaches to evaluation of mitral stenosis

Table 9 Recommendations for classification of mitral stenosis severity

	Mild	Moderate	Severe
Specific findings			
Valve area (cm^2)	>1.5	1.0–1.5	<1.0
Supportive findings			
Mean gradient (mmHg)[a]	<5	5–10	>10
Pulmonary artery pressure (mmHg)	<30	30–50	>50

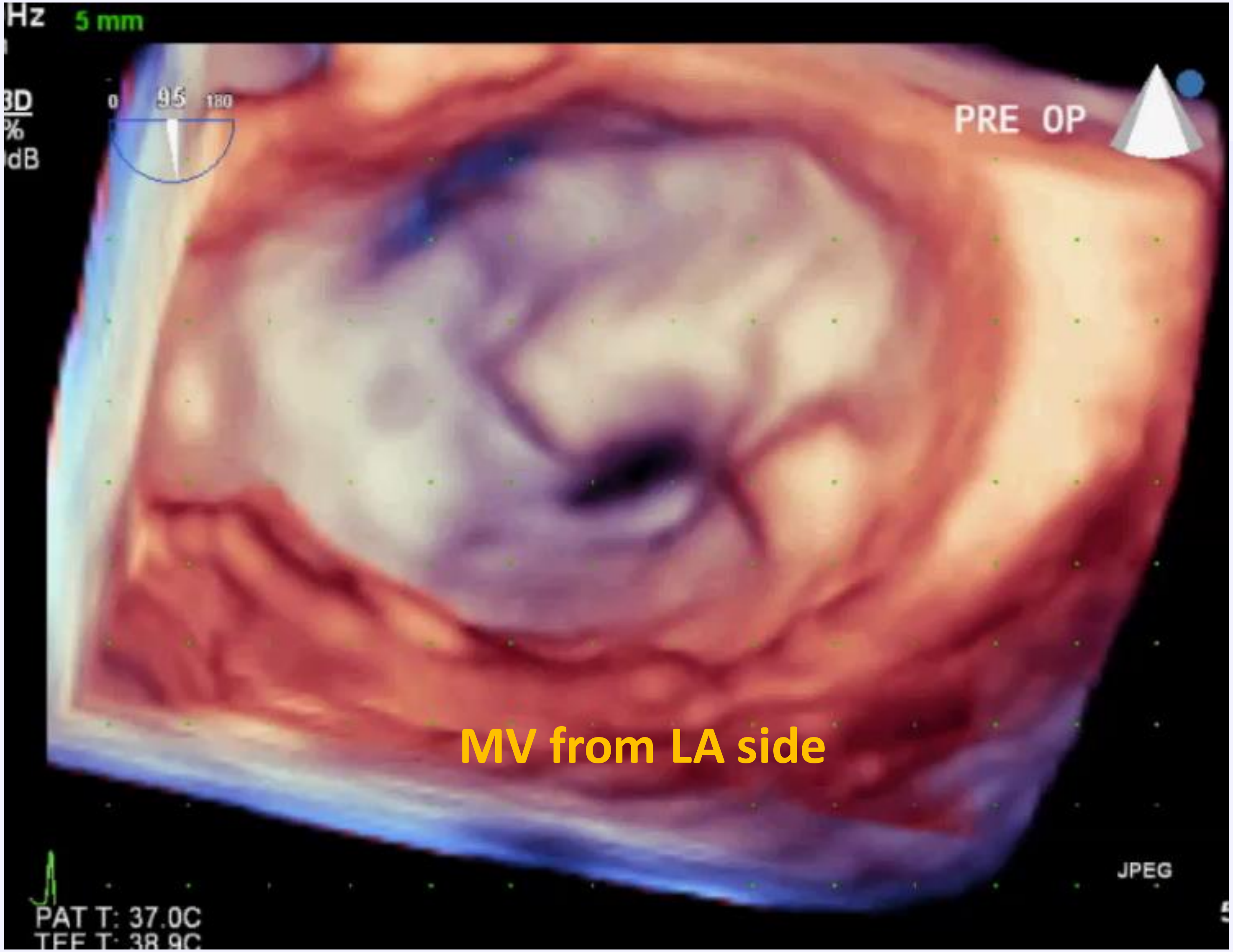
[a]At heart rates between 60 and 80 bpm and in sinus rhythm.

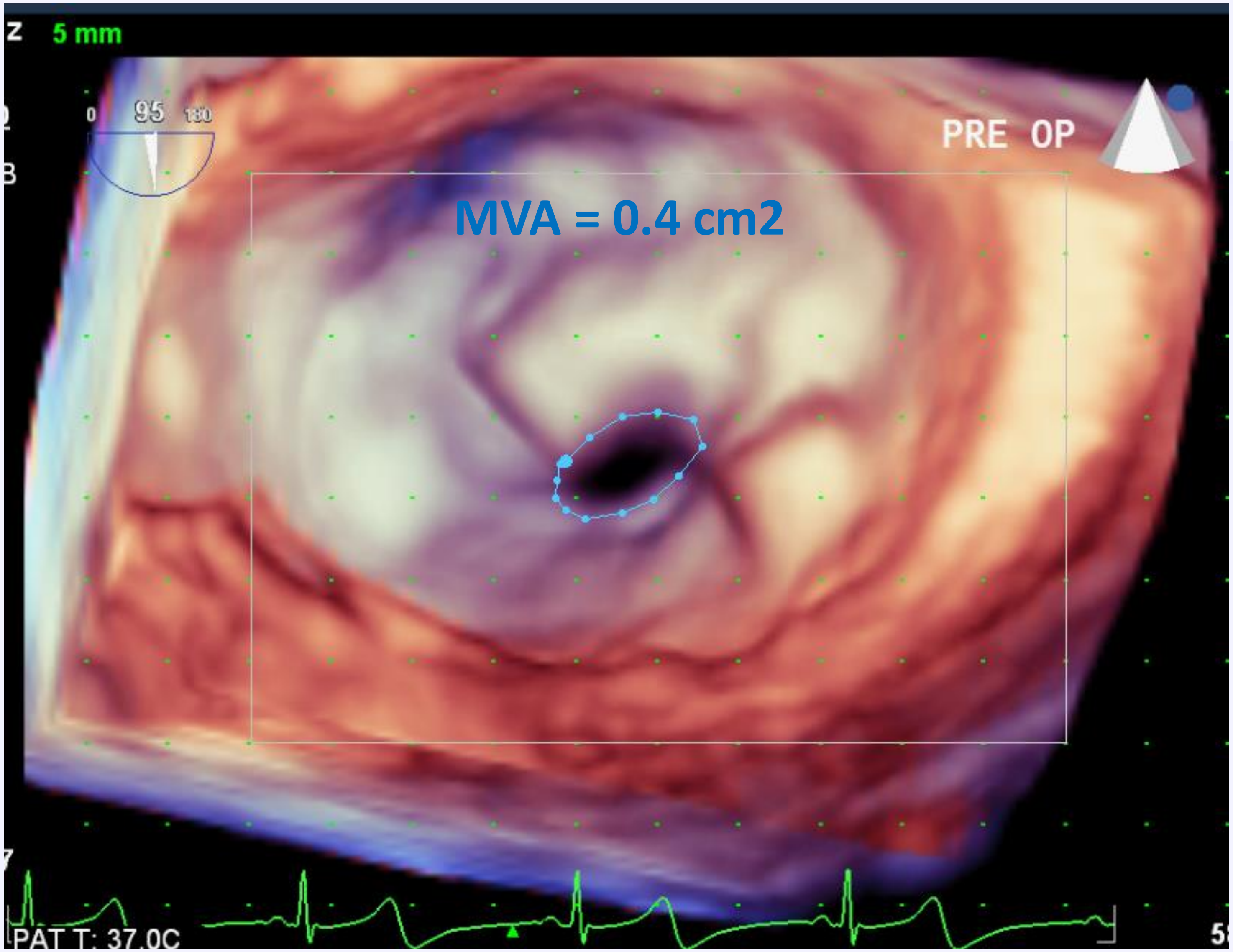
Classification of MS severity

Case

- 52-year-old man presented with SOB

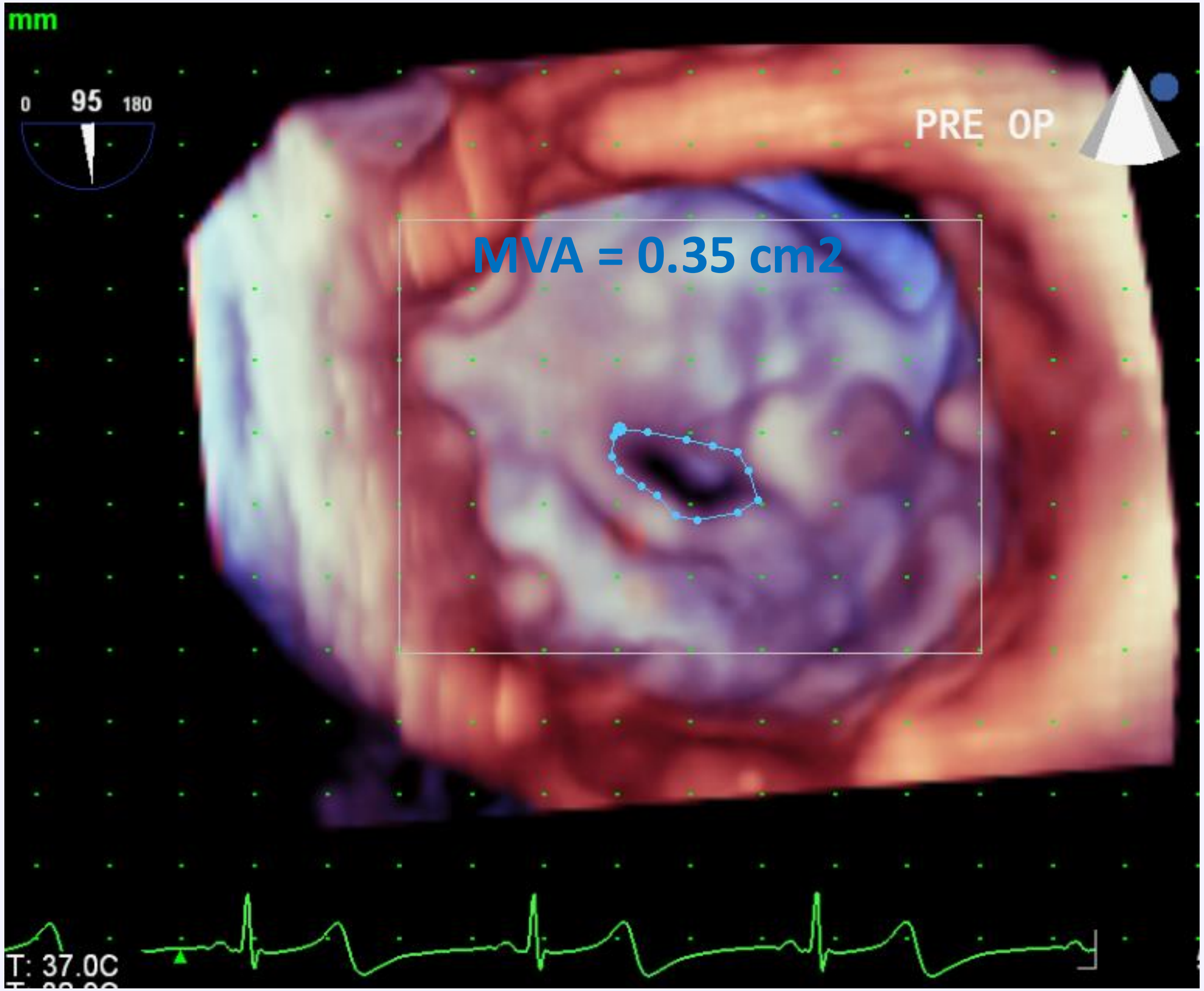

2383413
S5-1/CARDIAC NEW
FR 49Hz
16cm
2D
60%
C 45
P Low
HGen
M2
P
R
1.7
3.4
JPEG
71 bpm


Hz
5 mm
3D
%
dB
0
95
180
PRE OP
MV from LA side
JPEG
PAT T: 37.0C
TEE T: 38.9C

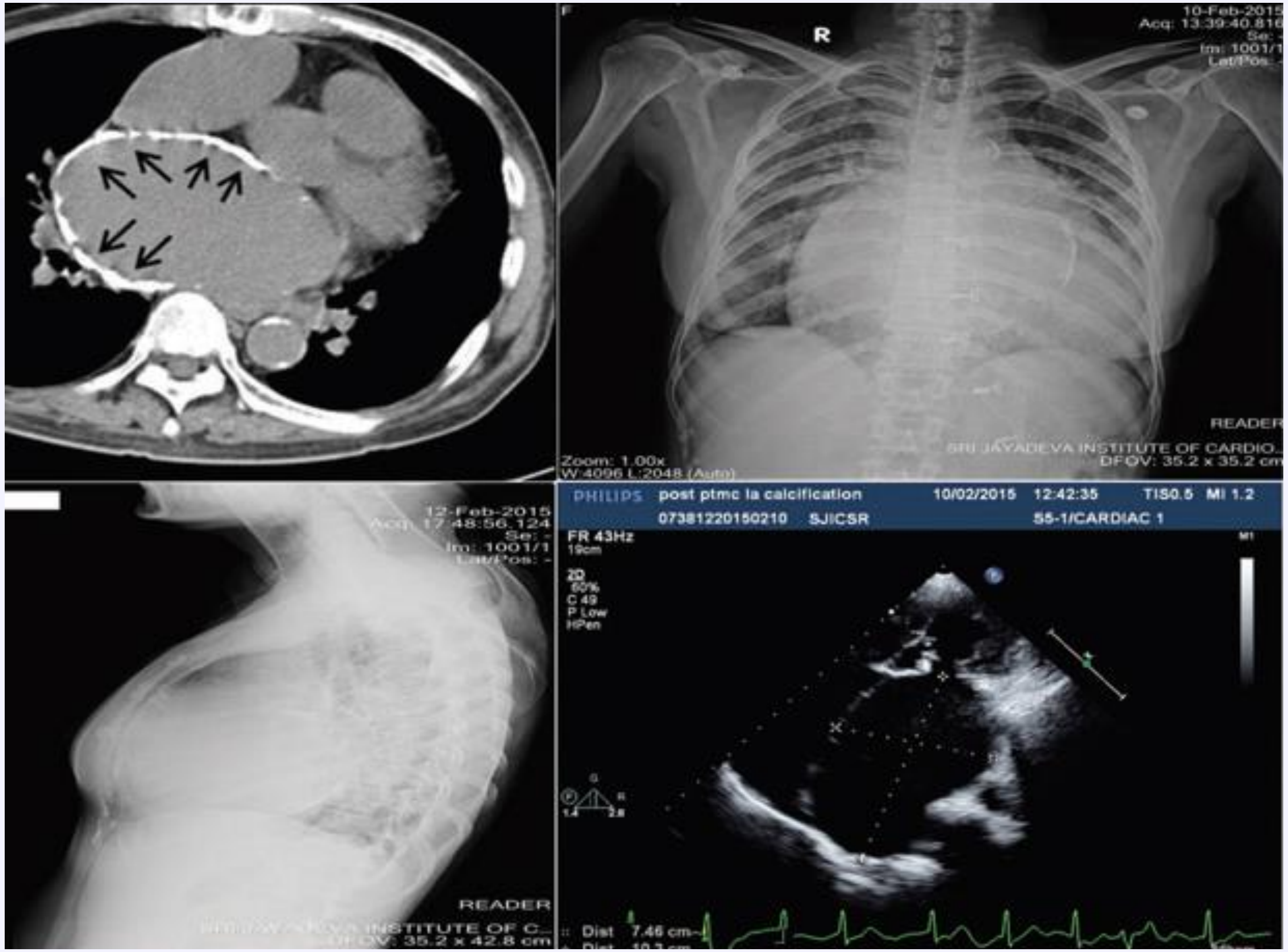


5 mm
95
PRE OP
MVA = 0.4 cm2
PAT T: 37.0C

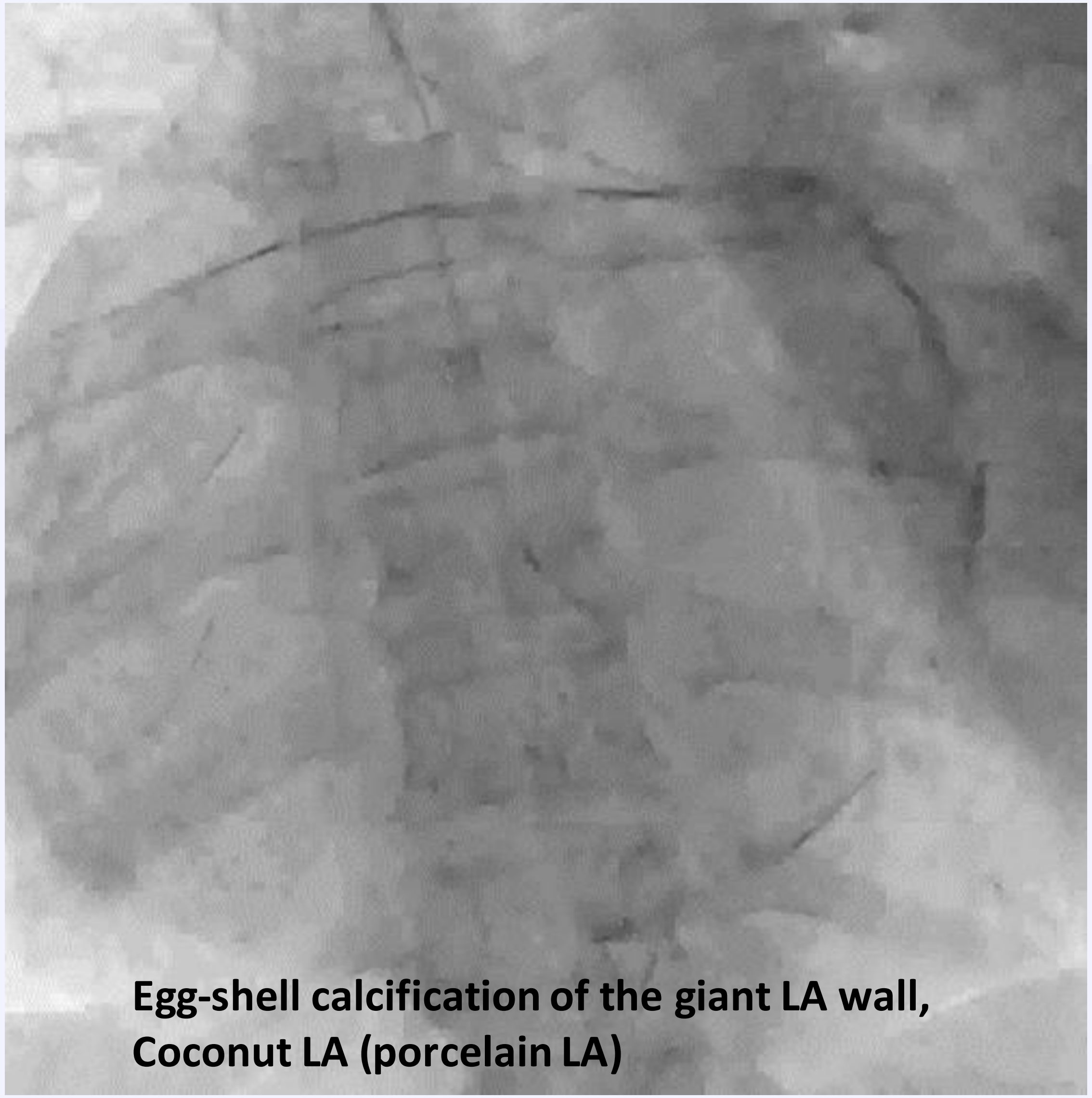

0
95
180
PRE OP
MV from LV side
JPEG
T: 37.0C
5


mm
0
95
180
PRE OP
MVA = 0.35 cm2
T: 37.0C

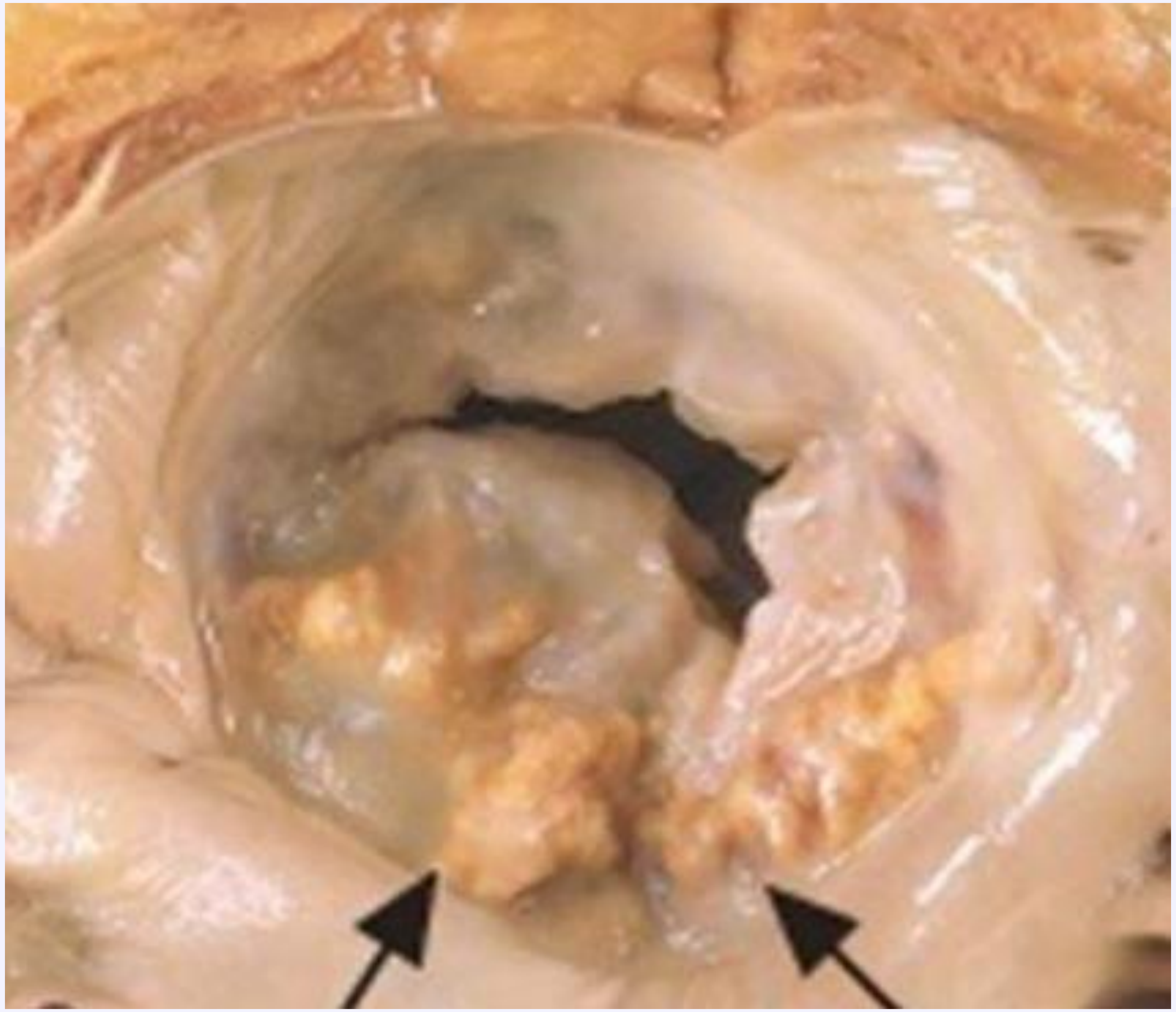
Coconut atrium (37 Y. woman)



Anandan PK, et al. European Heart Journal-Cardiovascular Imaging, 2015



**Egg-shell calcification of the giant LA wall,
Coconut LA (porcelain LA)**



Calcific mitral stenosis

Suggested reading materials

1. Omran AS, Woo A, David TE, et al. Intraoperative transesophageal Echocardiography Predicts Mitral Valve Anatomy and Suitability for Repair. J Am Soc Echocardiogr 2002;15:950-7.
2. Echocardiographic Assessment of Valve Stenosis: EAE/ ASE Recommendations for Clinical Practice. JASE 2009.
3. 2017 AHA/ ACC Focused Update of the 2014 AHA/ ACC Guideline for the Management of Patients with Valvular Heart Disease.
4. Recommendations for Noninvasive Evaluation of Native Valvular Regurgitation. A Report from the American Society of Echocardiography Developed in Collaboration with the Society for Cardiovascular Magnetic Resonance.

Questions

Question 1

All of the following structures are adjacent to the central fibrous body EXCEPT

A. Right fibrous trigone
B. Left sinus of Valsalva
C. Atrioventricular node
D. Membranous septum

Question 2

Based on Carpentier's functional classification of the mitral valve , a mitral valve with *ischemic MR is*:

A. Type 1 MV
B. Type 2 MV
C. Type 3b MV
D. Type 3a MV

Question 3

Which of the following statement about severe chronic mitral regurgitation IS CORRECT?

A. EROA ≥ 0.30 cm2
B. Vena contracta width ≥ 0.6 cm
C. Regurgitant volume ≥ 45 ml/beat
D. Color flow jet area > 50% of LA

Question 4

Which of the following statement about using color jet area for grading severity of MR IS CORRECT?

A. Jet area by TEE is larger compared with TTE
B. Jet area measured by colour will overestimate the degree of MR in a wall hugging jet
C. Lowering Nyquist Limit will decrease the jet area
D. Optimal Nyquist Limit foe measuring jet area is 50-70 cm/s

Question 5

All of the following statements about etiology of mitral stenosis are correct EXCEPT

A. Radiation-induced mitral stenosis involves mostly posterior mitral annulus
B. Calcific mitral stenosis is more common in elderly men
C. Rheumatic mitral stenosis are more common in men than in women
D. Rheumatic mitral stenosis usually involves mitral leaflets and mitral commissures are spared

Correct Answers

1- B
2- C
3- D
4- A
5- A


Toronto
Thank you.