Echo to Guide Percutaneous Interventions

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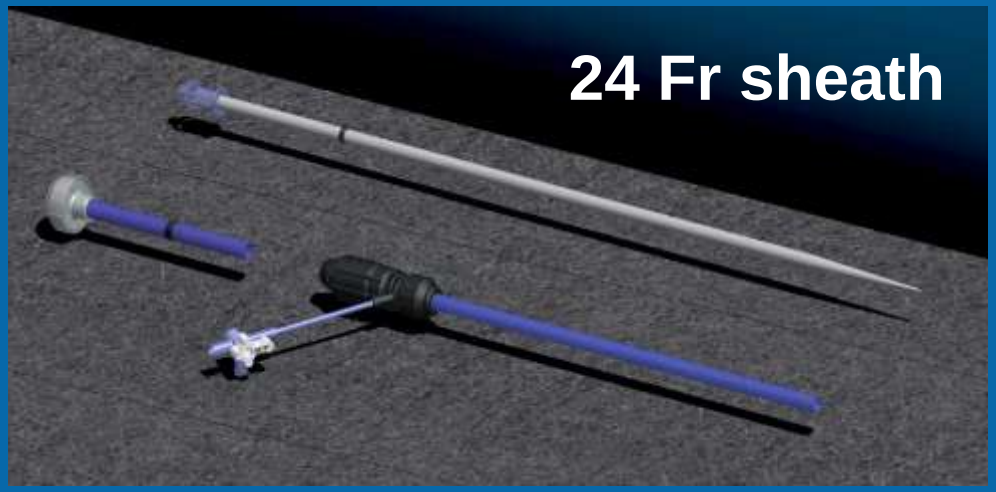
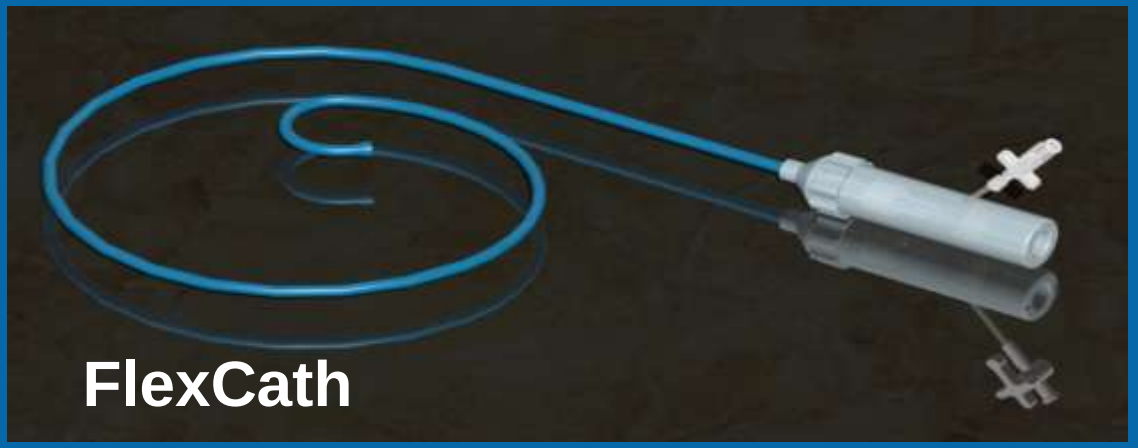
Echocardiography in Guiding Percutaneous Interventions

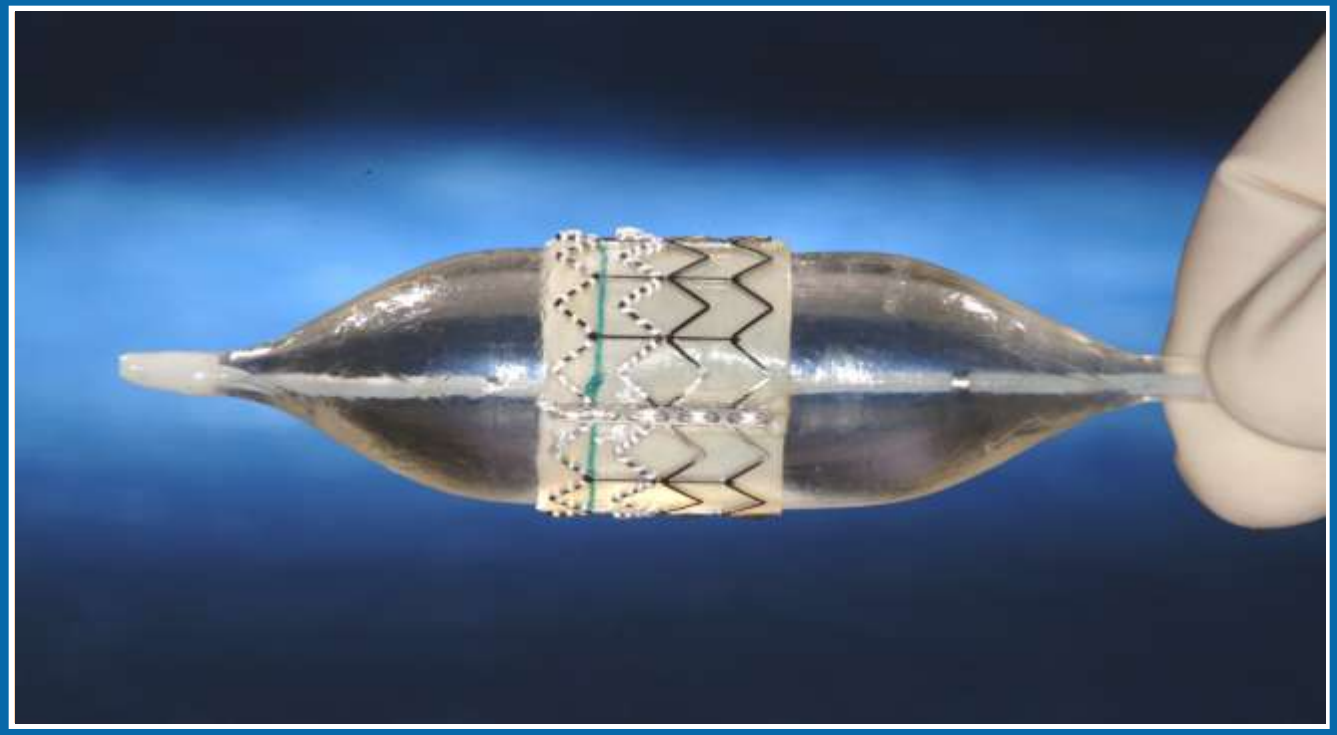
- Myxomatous mitral valve disease
- Aortic valve disease
- Per-valvular regurgitation

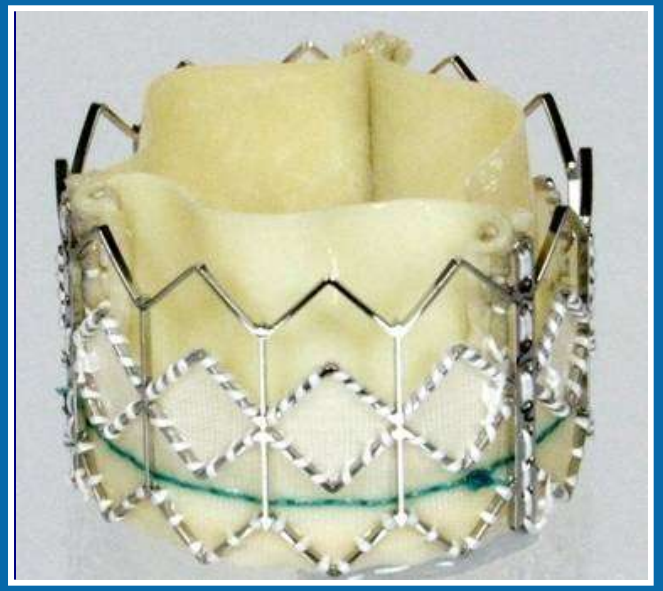
Cribier-Edwards Percutaneous Heart Valve *SYSTEM*





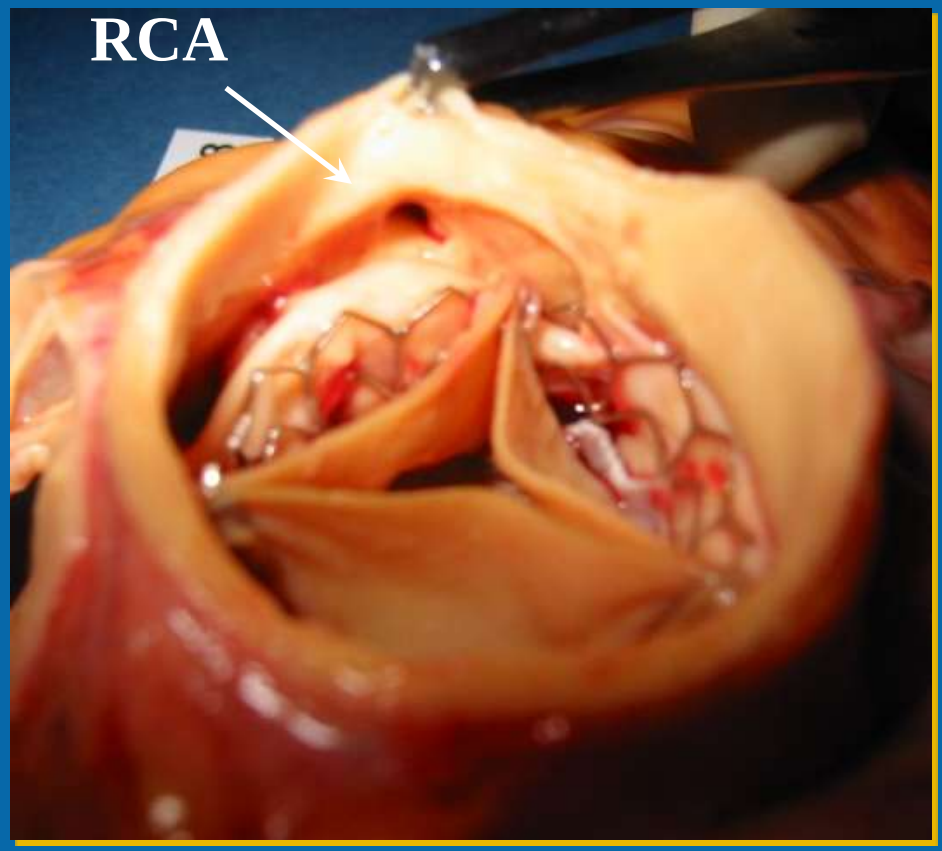
Transcatheter Heart Valve

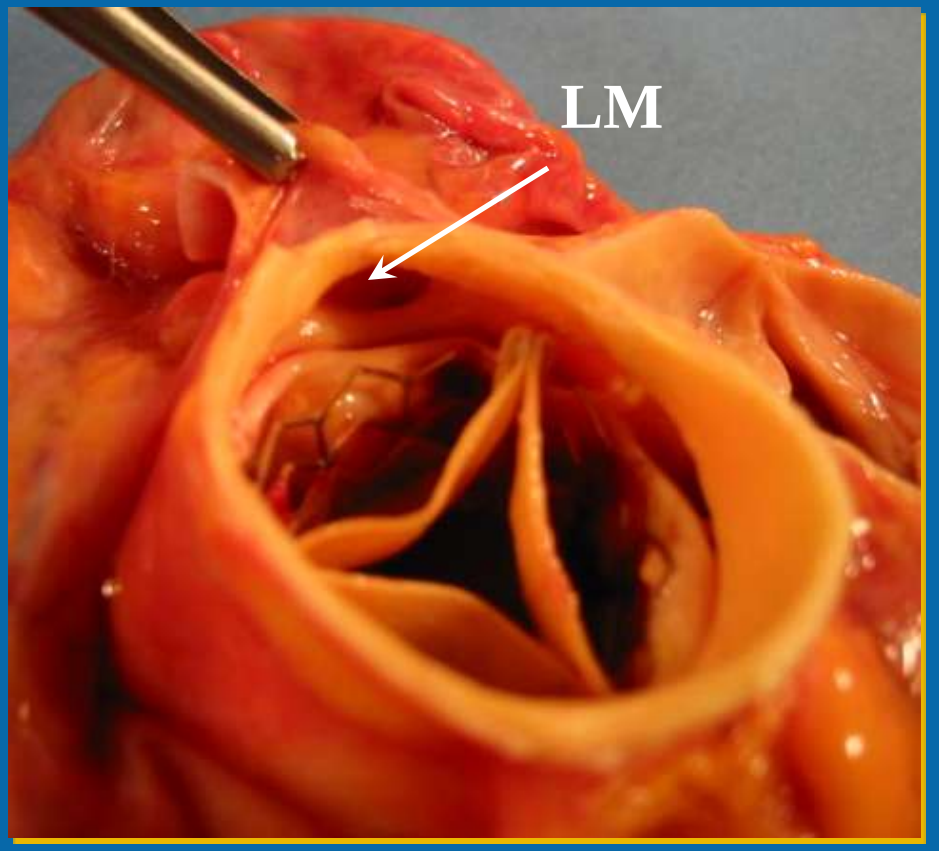




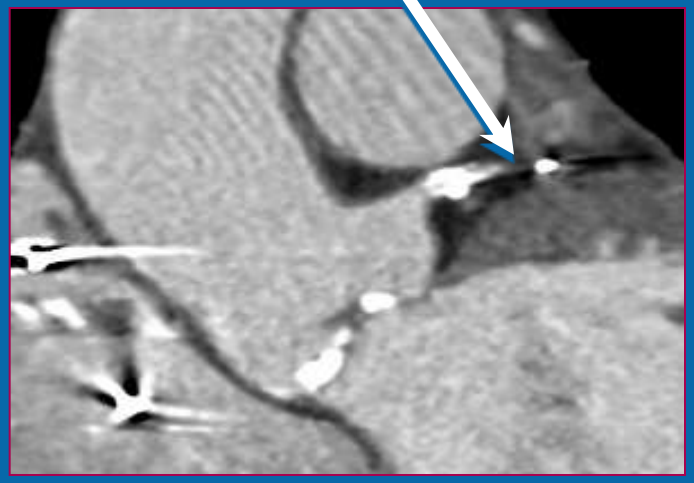
- Balloon expendable
- Stainless steel stent
- Bovine (equine) pericardium
- Optimal hemodynamics

Patent Coronary Arteries

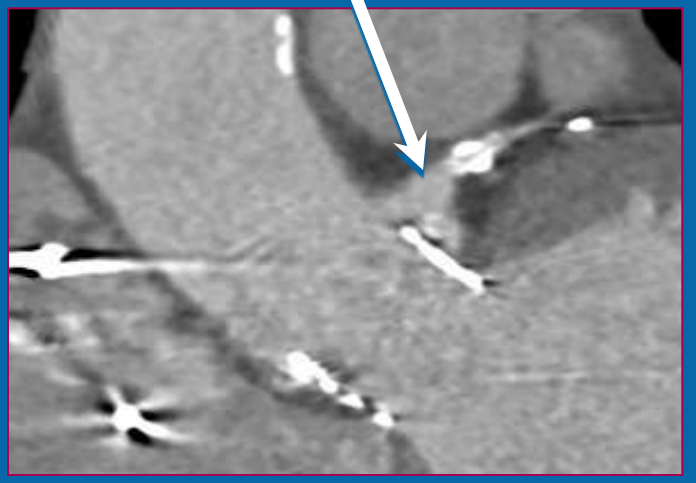


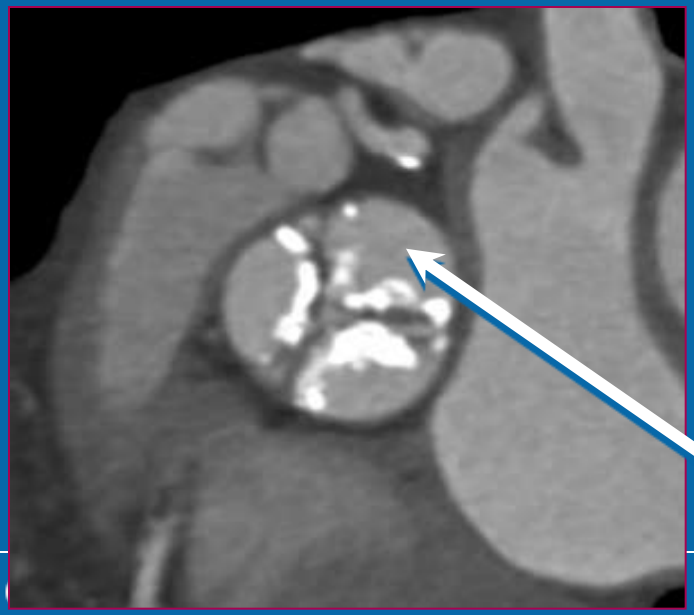


Left main ostium

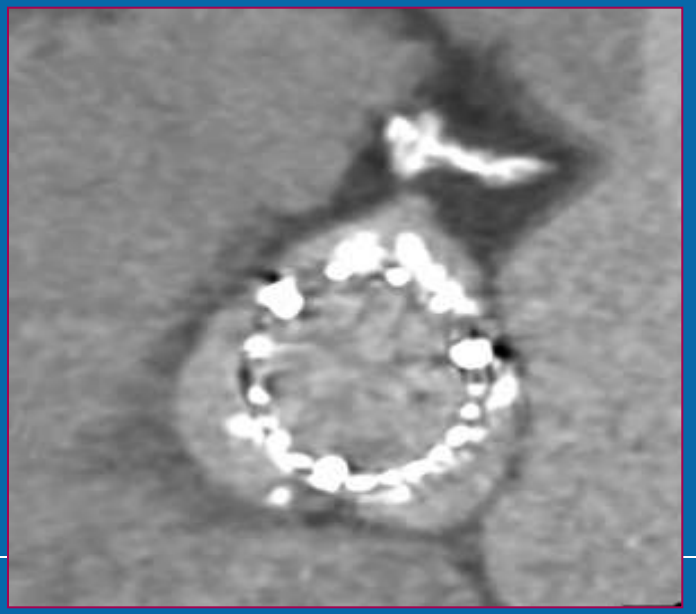


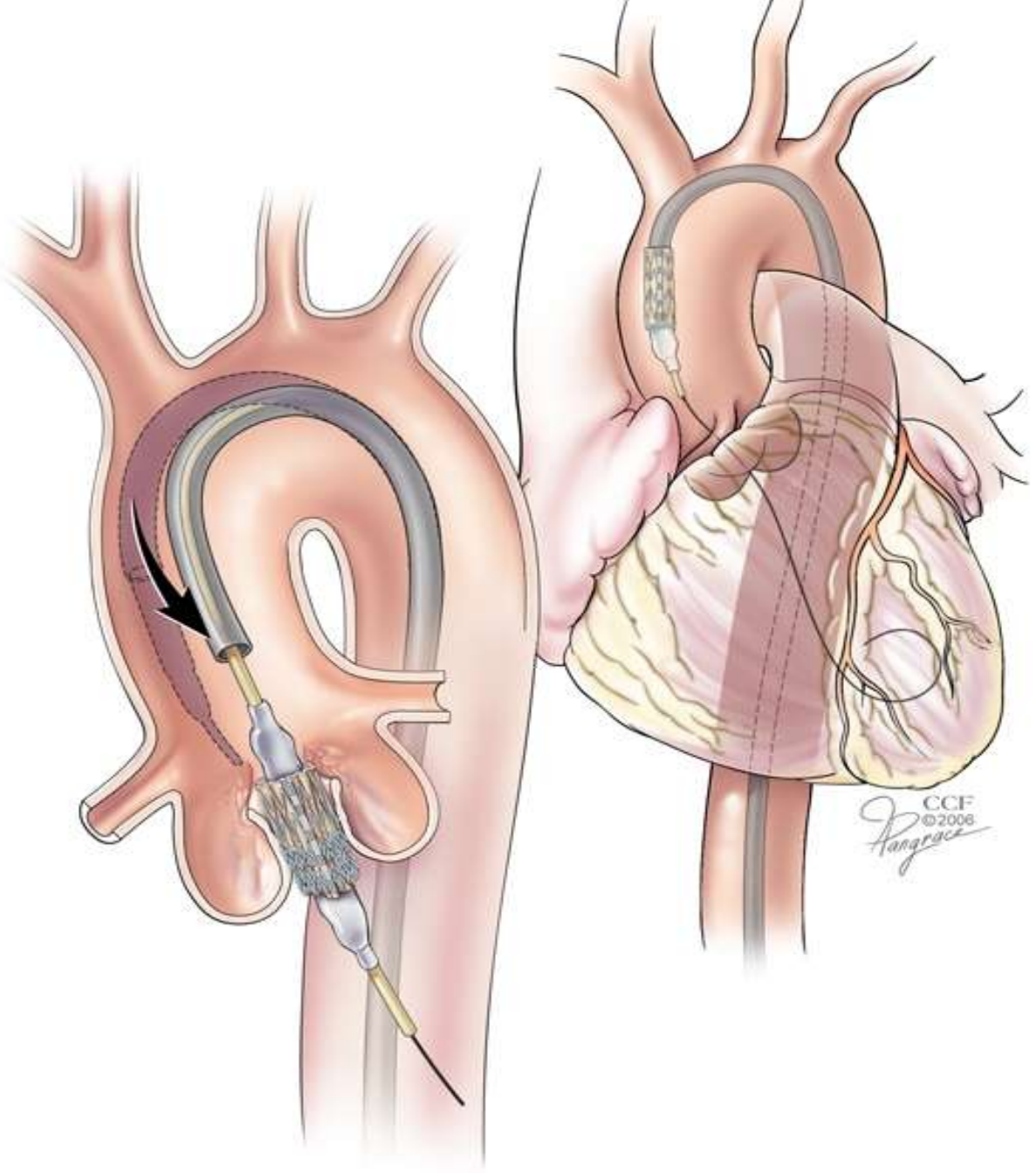
Left main ostium





Left cusp

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©2008
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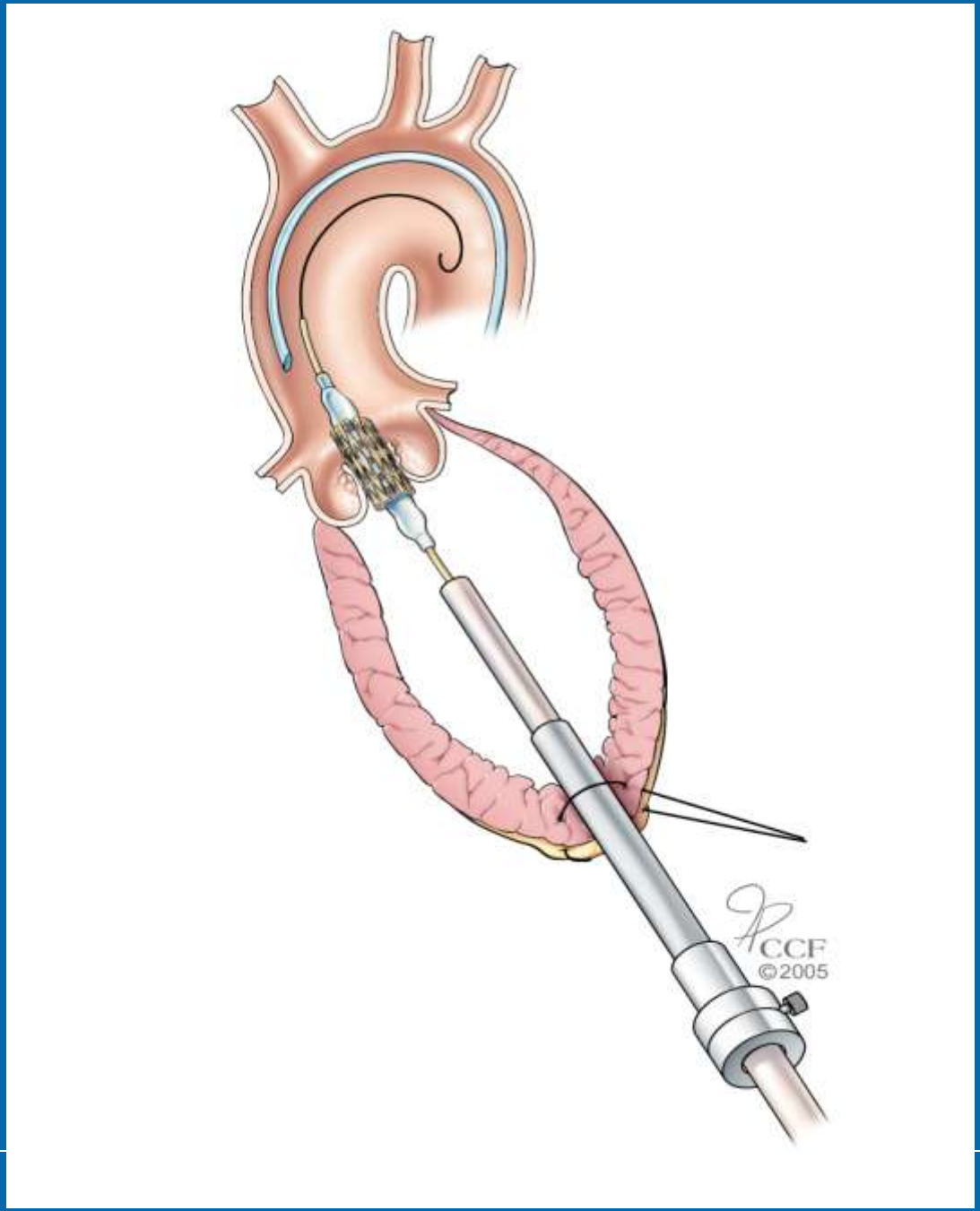
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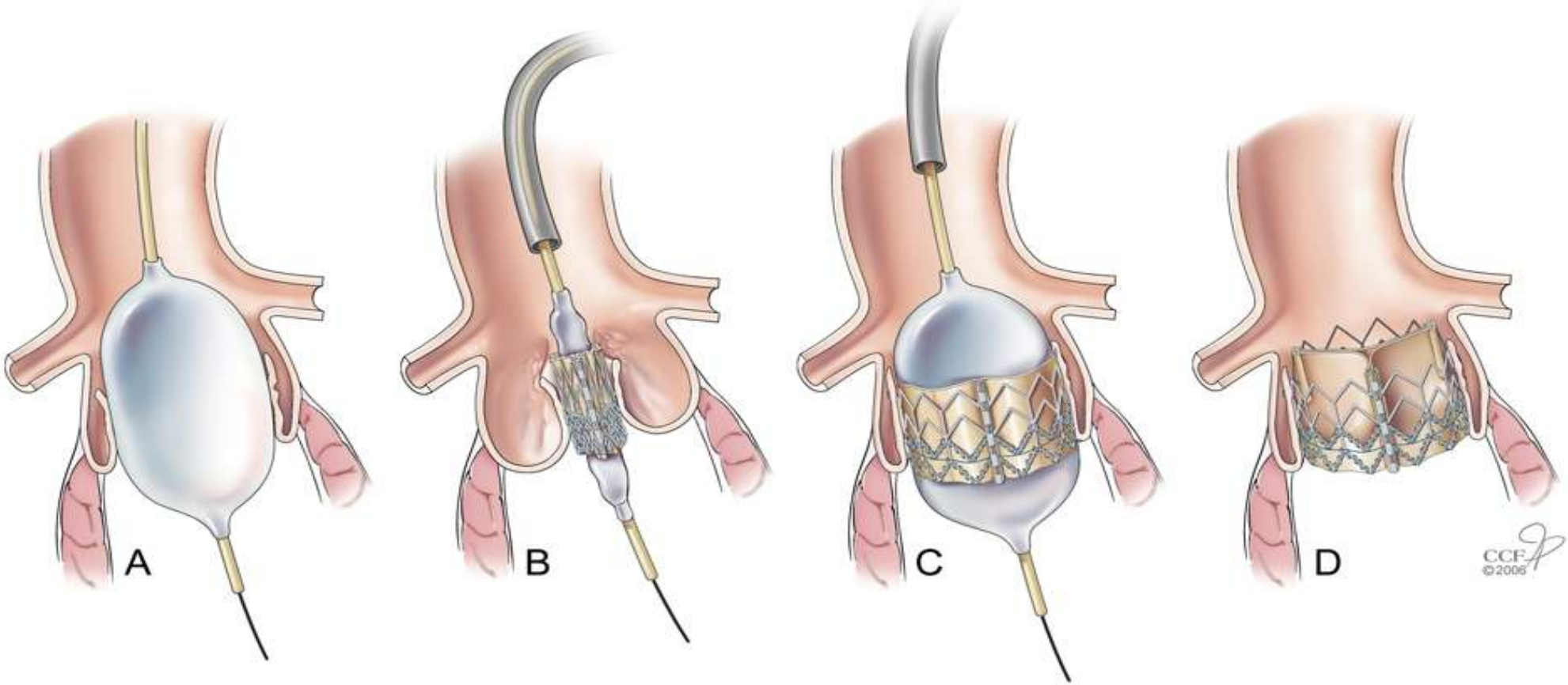
A
B
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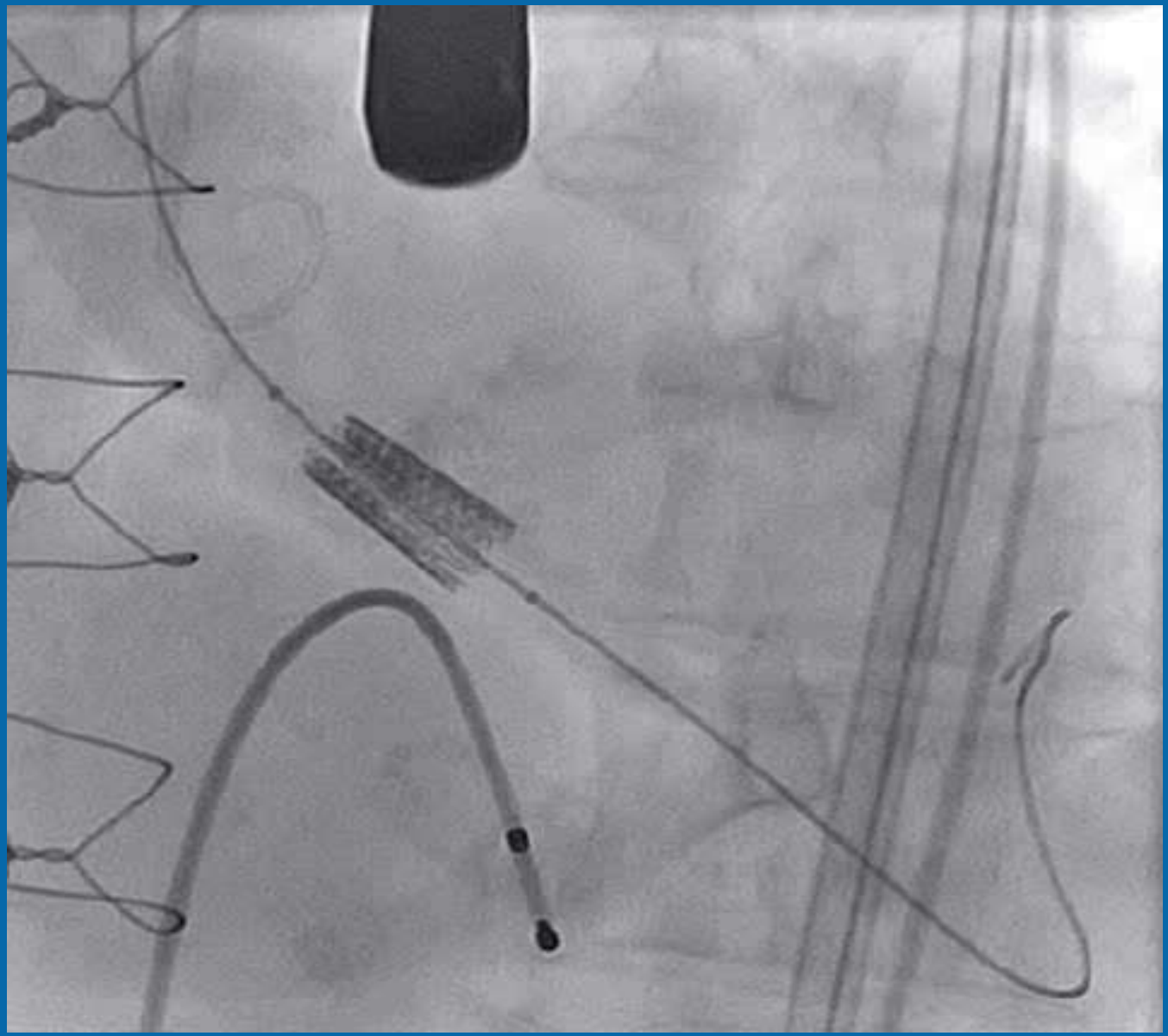
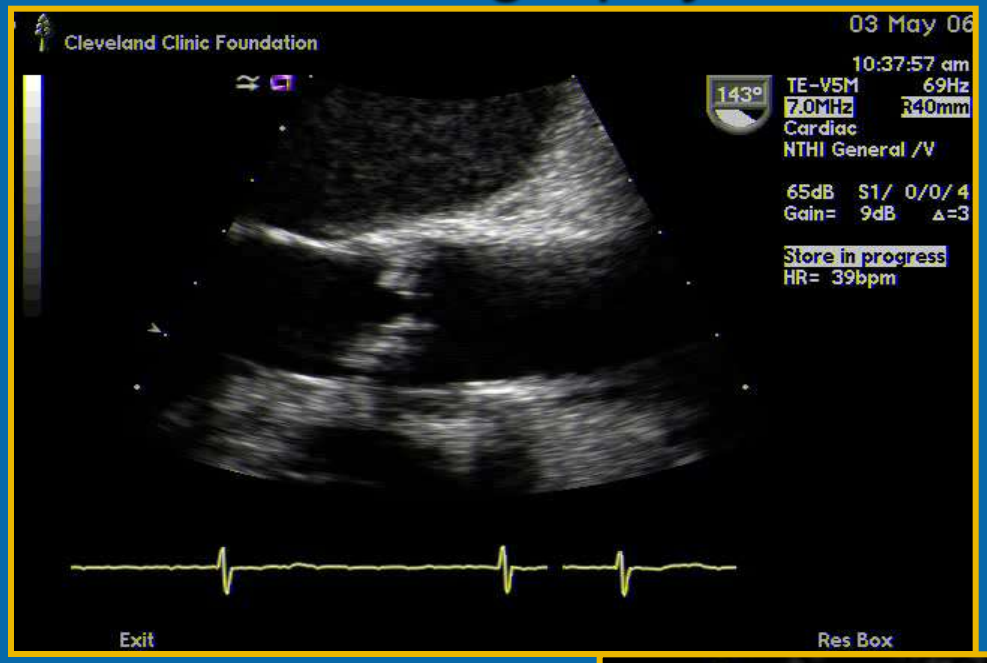
©2006

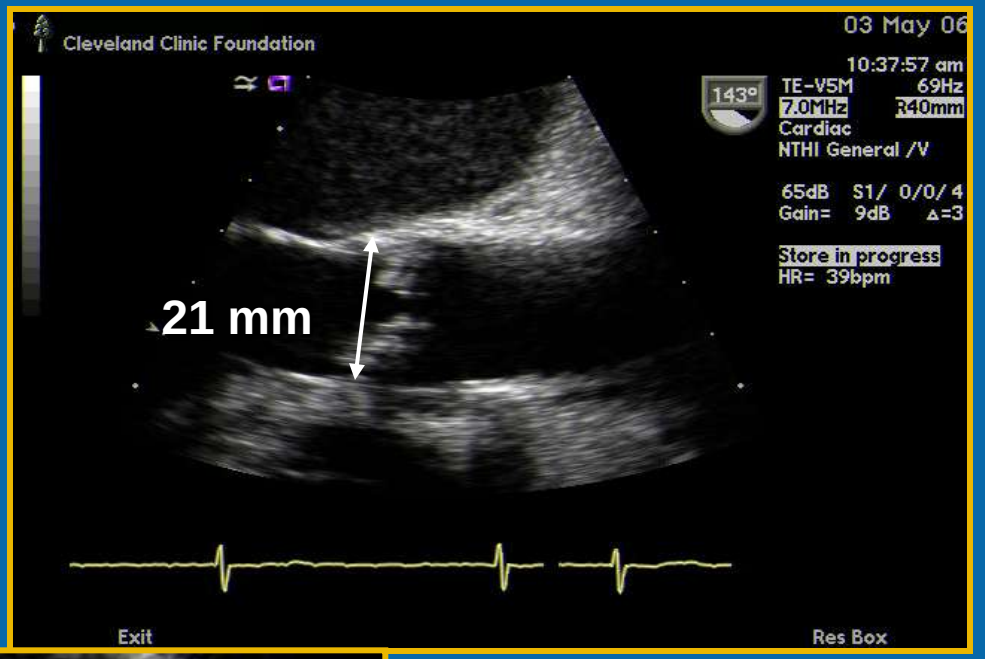


Patient #1 R.M.
90 yo Man

- 90 year-old male
- Severe aortic stenosis with NYHA Class III symptoms
- Past Medical History:
  - Coronary Artery Disease with CABGx4 in 1998
  - Right Carotid Endarterectomy
  - Atrial fibrillation
  - Hypertension
  - Marked Thoracic Kyphosis

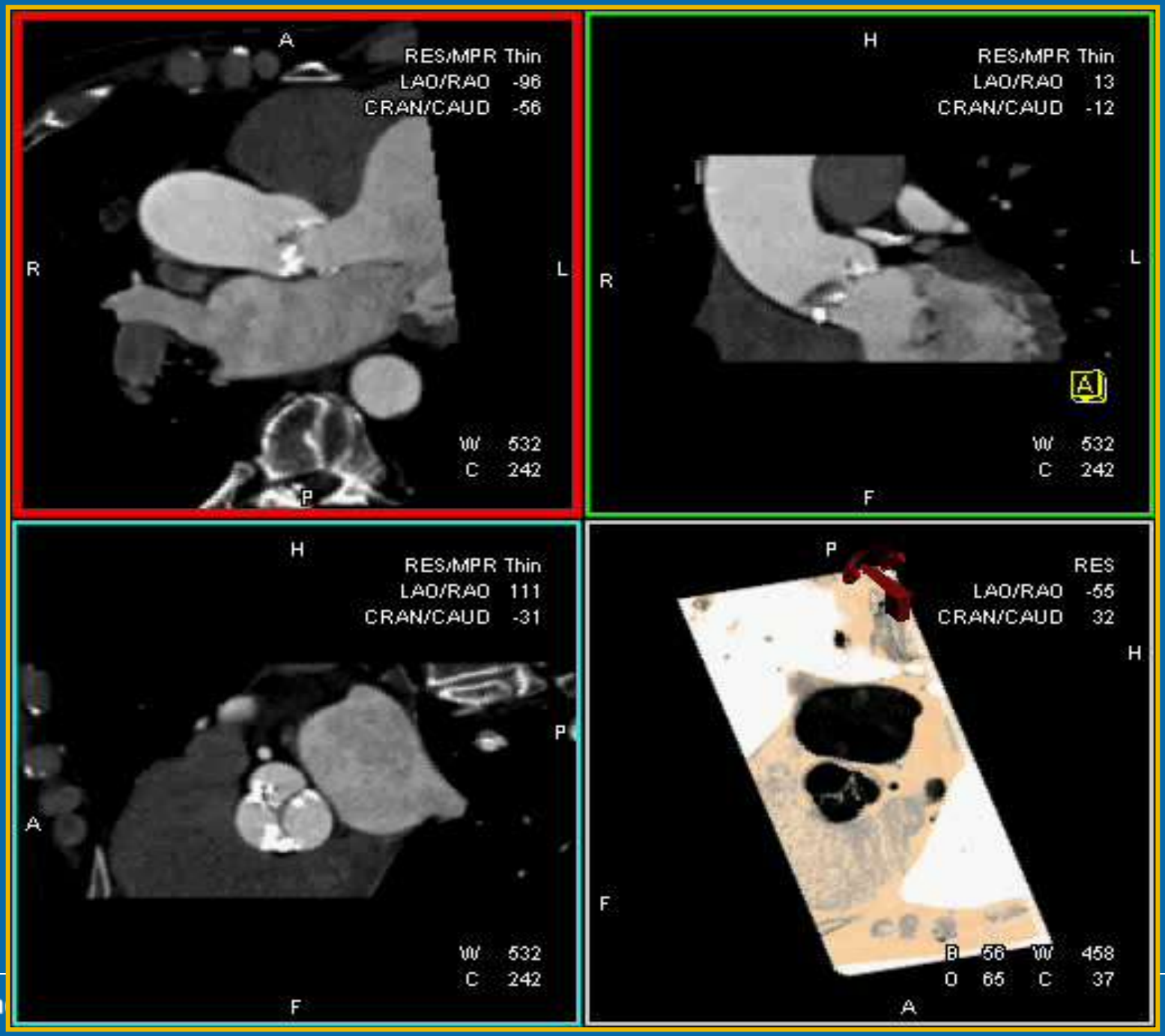
Echocardiography





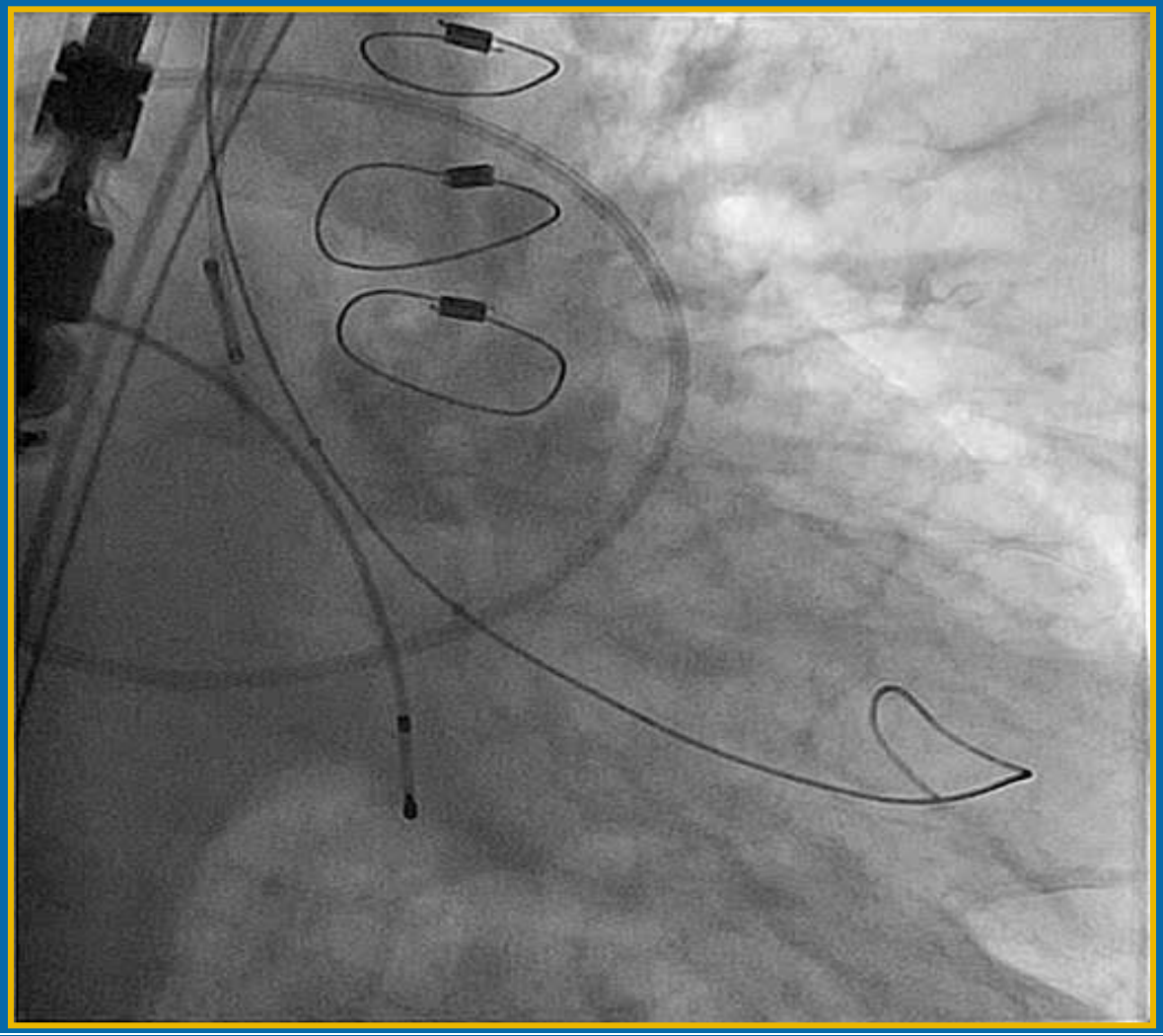
Echocardiogram

- LVEF 50%
- Stage II Diastolic Dysfunction
- Mild left ventricular hypertrophy
- Severe Aortic Stenosis (57/33 mmHg) valve area 0.7cm^2. 1-2+ AI.
- 1-2+ Mitral Regurgitation
- RVSP 69mm Hg

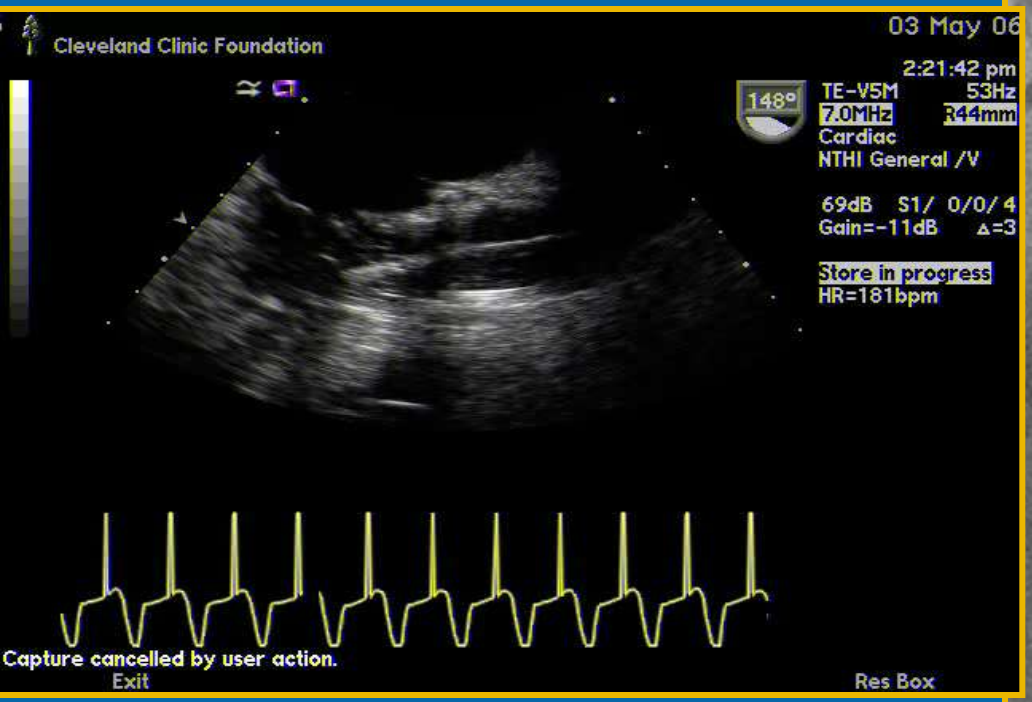

A
RES/MPR Thin
LAO/RAO -96
CRAN/CAUD -56
R
L
W 532
C 242
P
H
RES/MPR Thin
LAO/RAO 13
CRAN/CAUD -12
R
L
A
W 532
C 242
F
H
RES/MPR Thin
LAO/RAO 111
CRAN/CAUD -31
P
A
W 532
C 242
F
P
RES
LAO/RAO -55
CRAN/CAUD 32
H
F
B 56 W 458
O 65 C 37
A

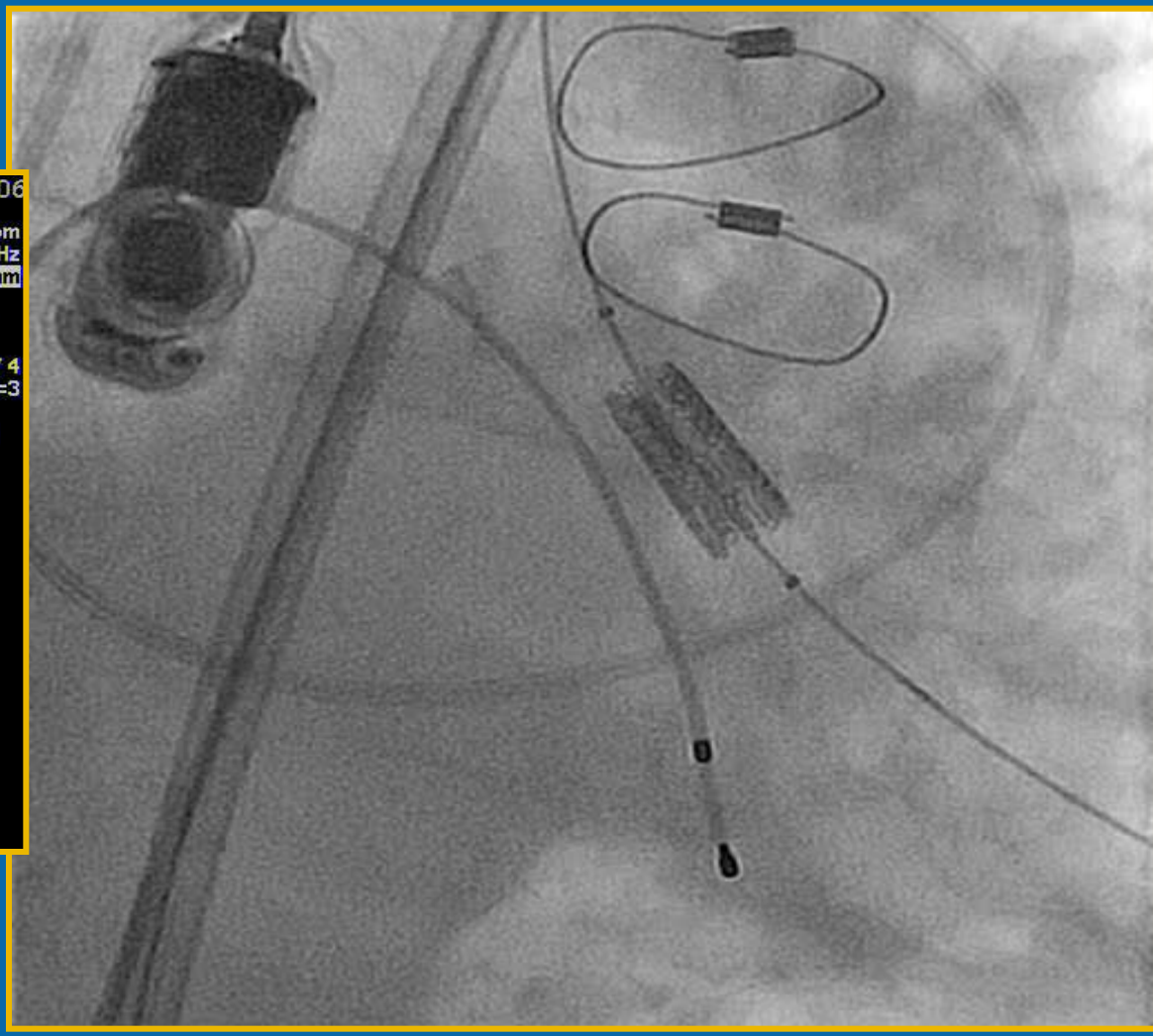
Balloon Valvuloplasty

Used to Predilate the Valve

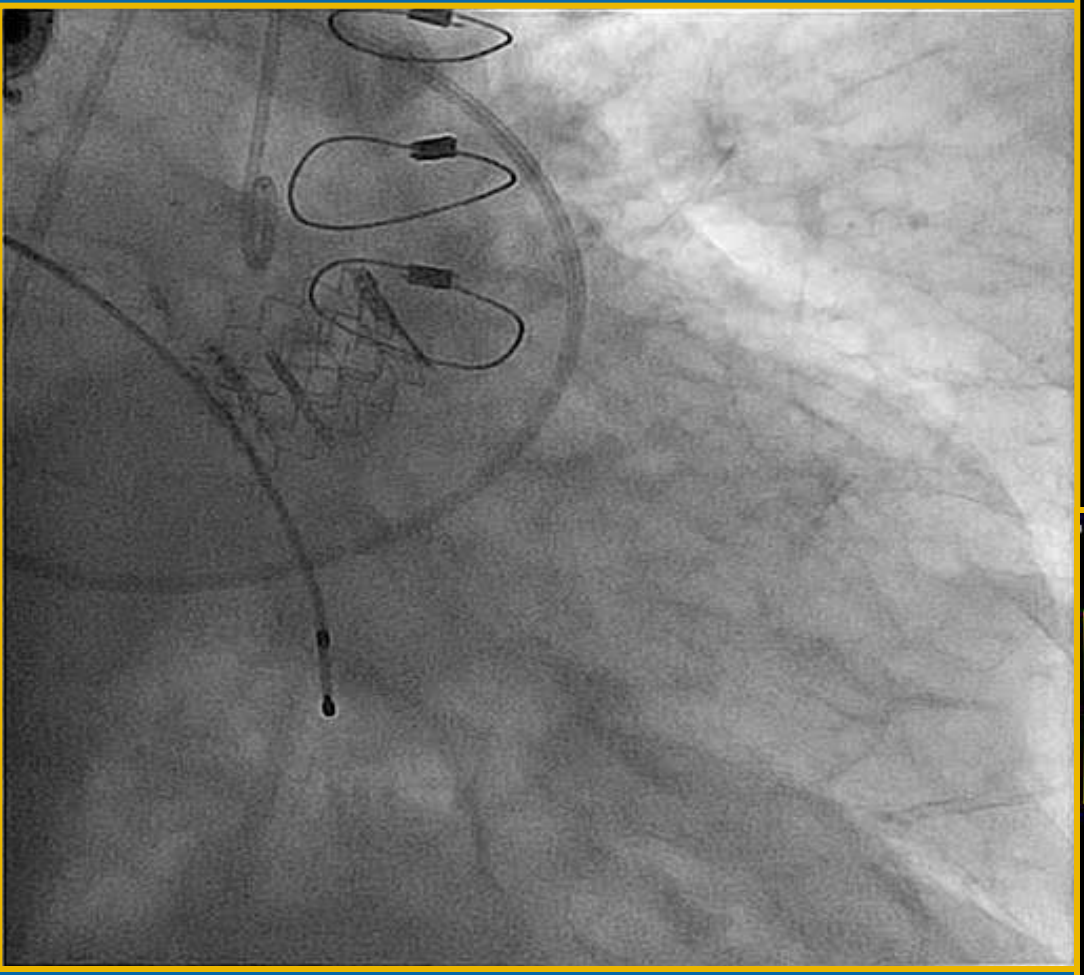


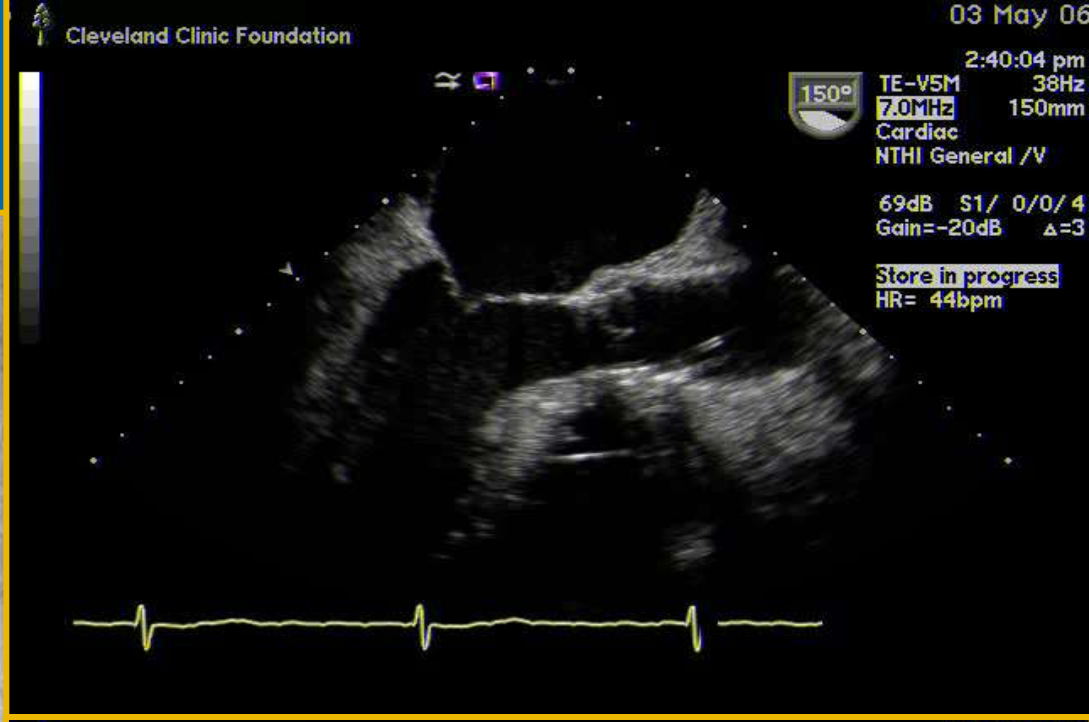
Valve Deployment

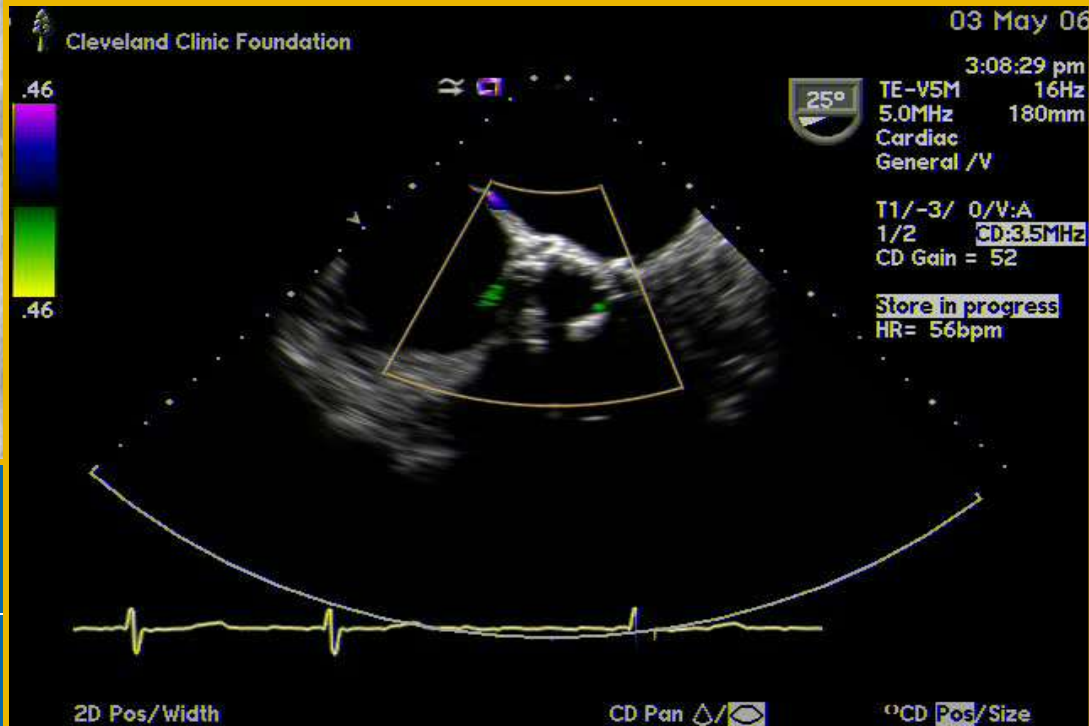




Result







Patient is playing golf 1 year later!

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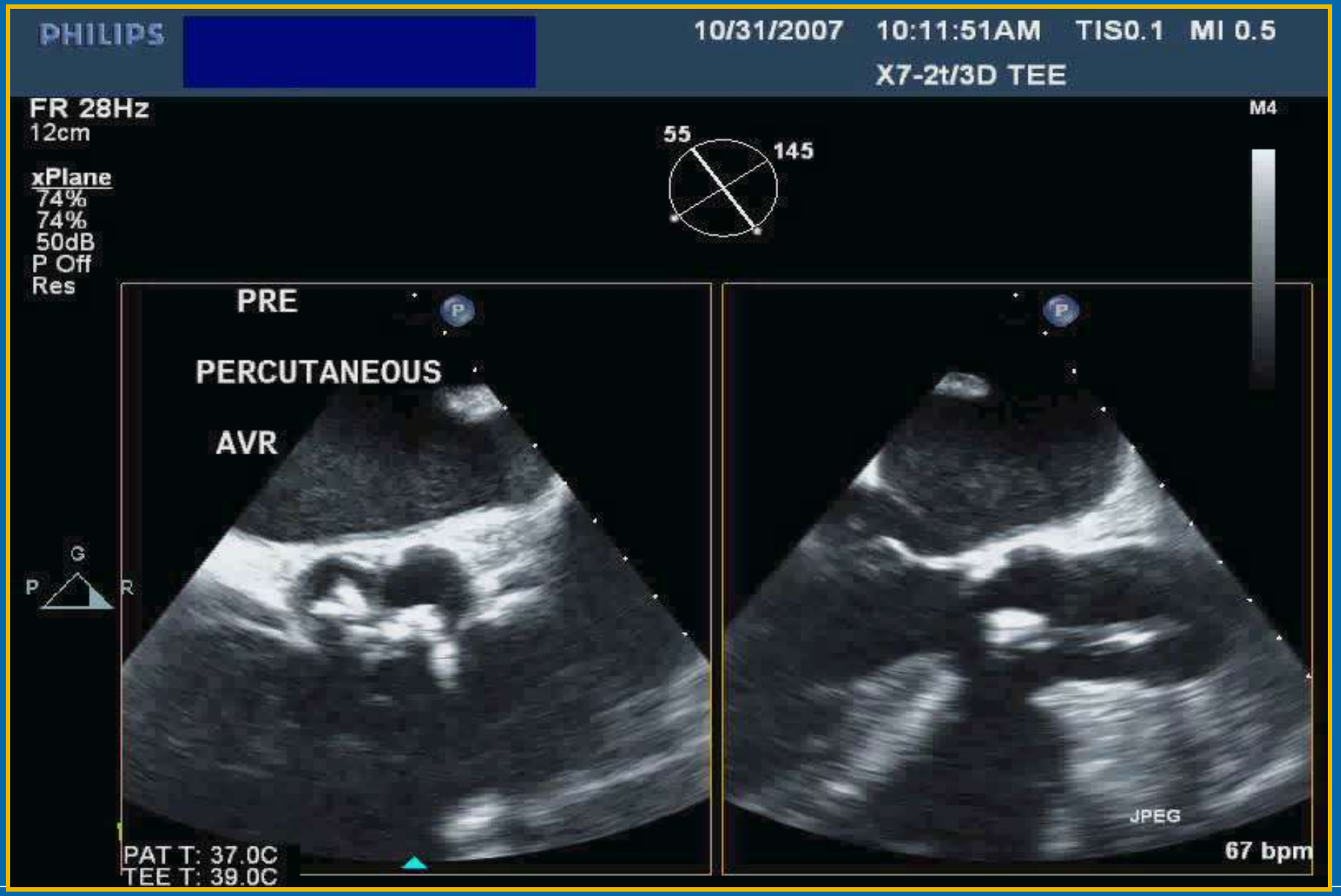
3D TEE in guiding PAVR

Live 3D Guidance of PAVR



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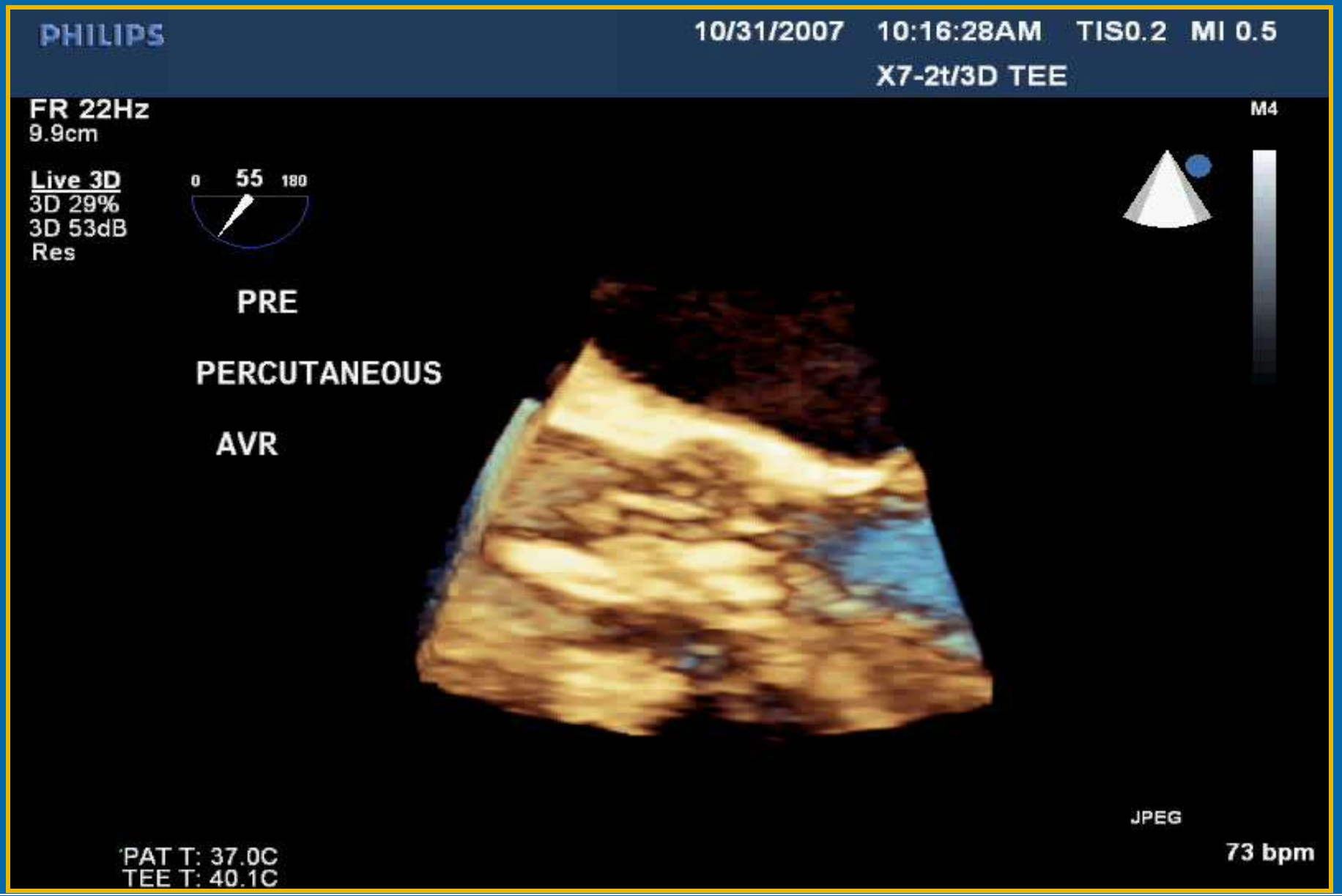
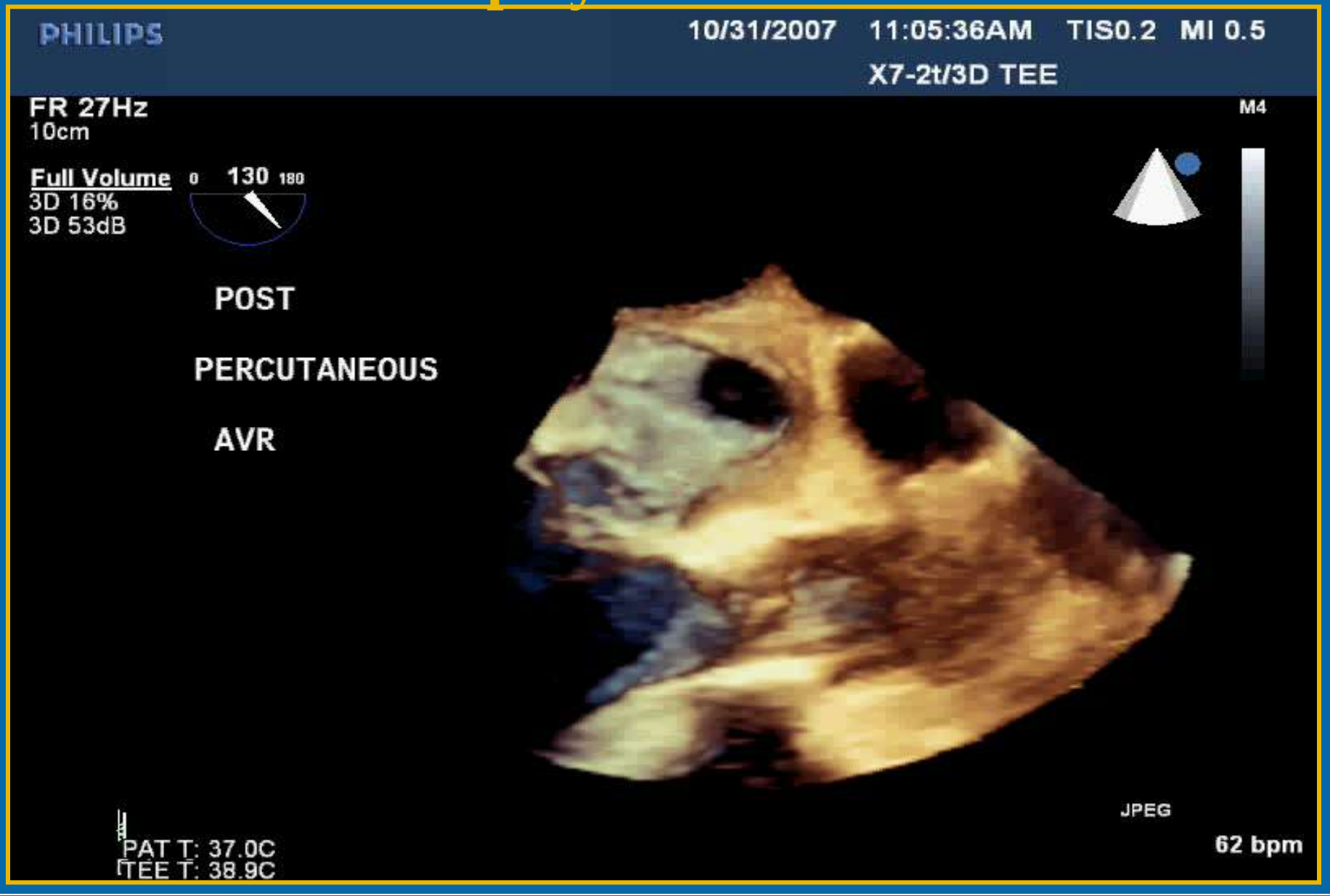
Placing device relative to valve during PAV

Live 3D Guidance of PAVR



Rapid pacing ⇒ balloon inflation of bioprosthesis

Post-Deployment Assessment



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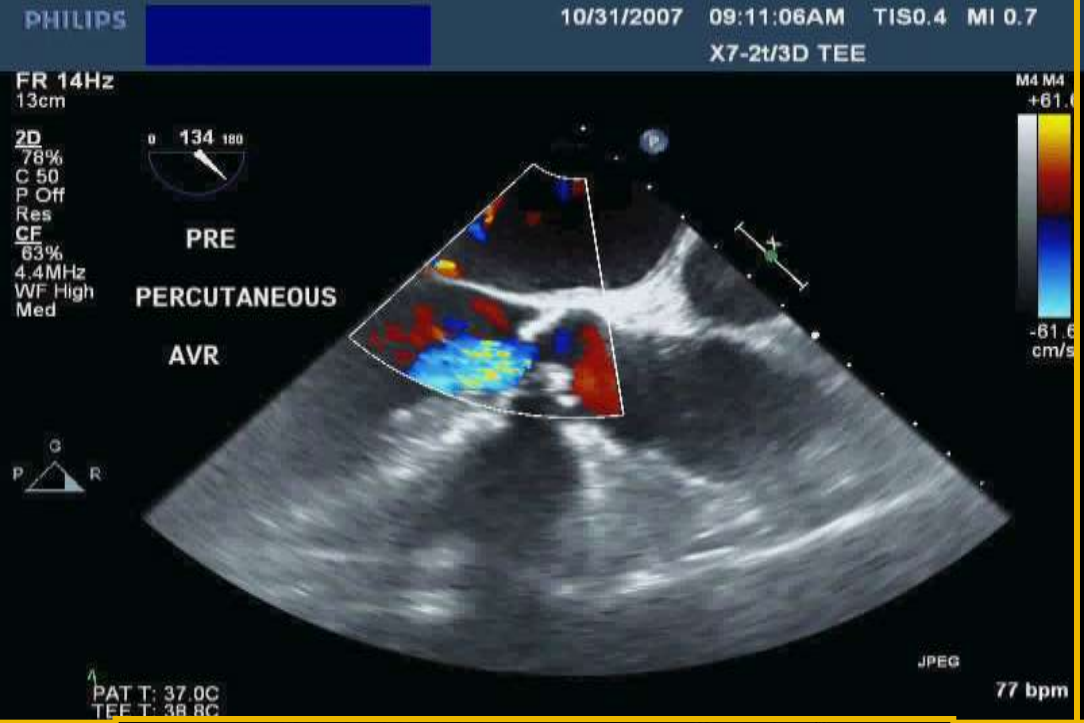
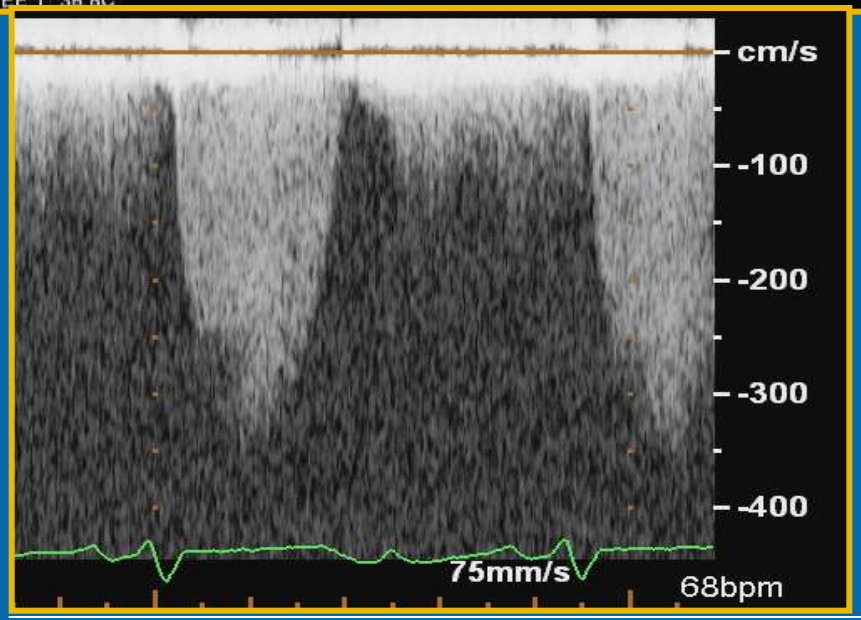
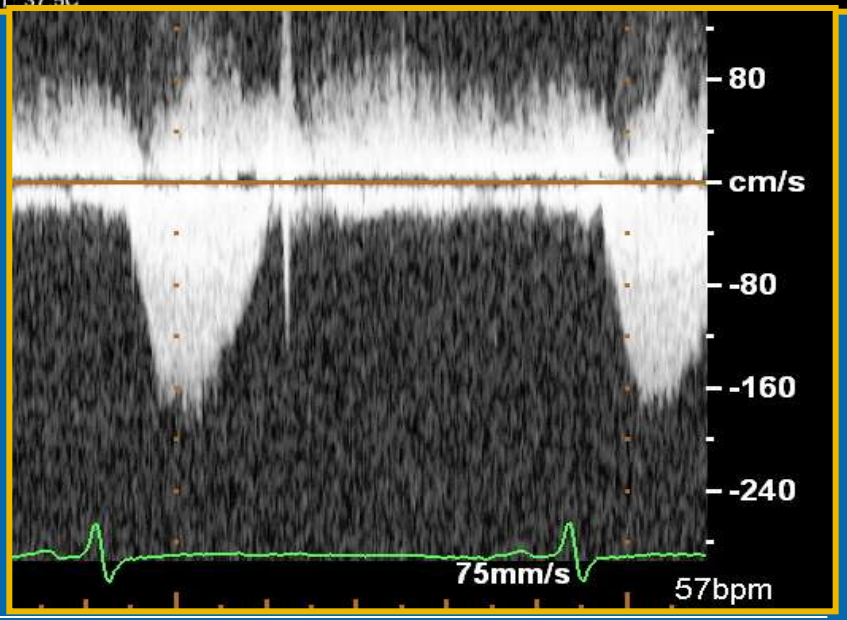
Leaflet motion after PAVR







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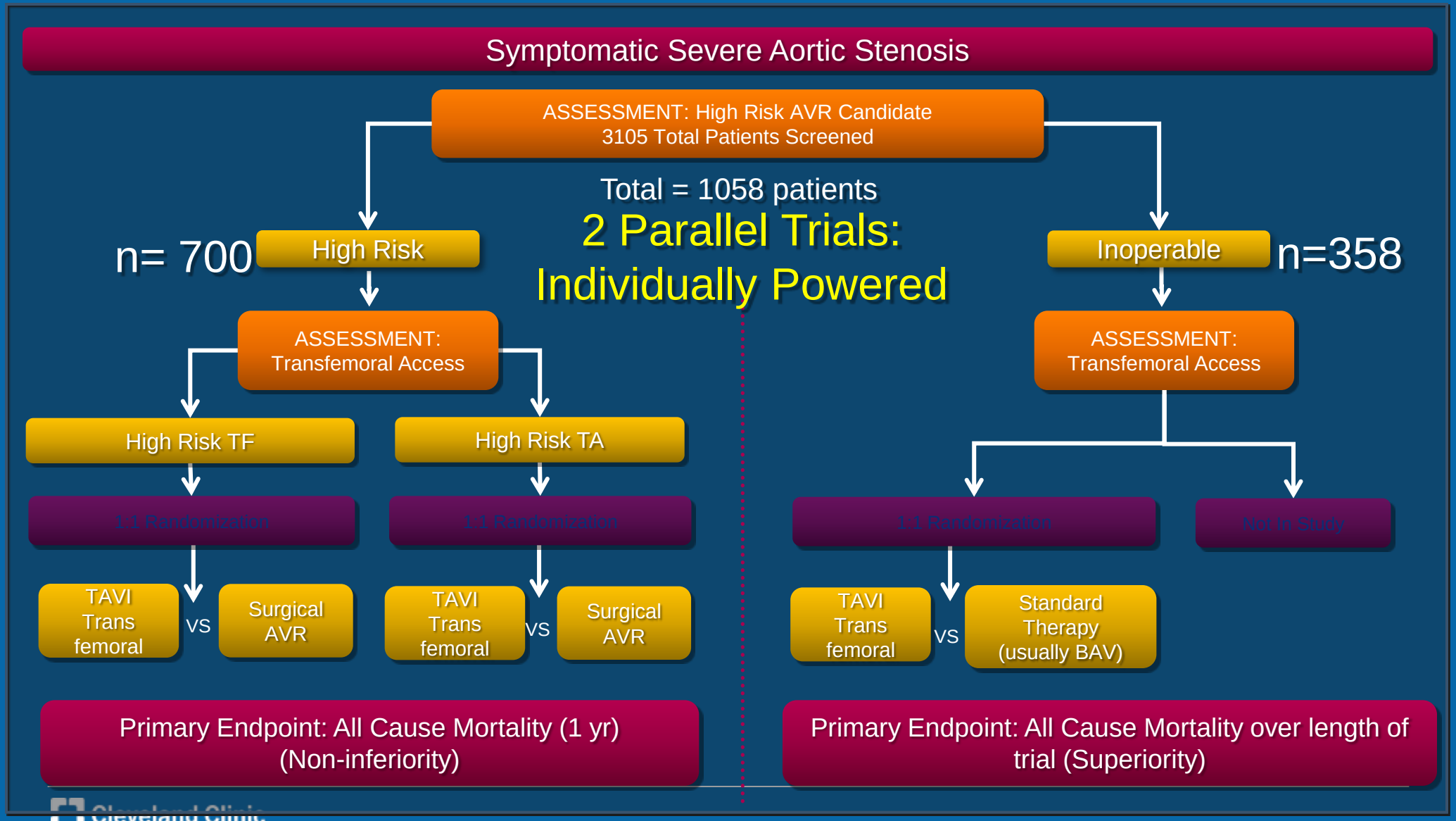
2-3+ AR, Δp = 54/38 mmHg

1+ AR, Δp = 12/8 mmHg

PARTNER Study Design



Primary Endpoint

- *All-cause mortality over the duration of the study*

Co-Primary Endpoint

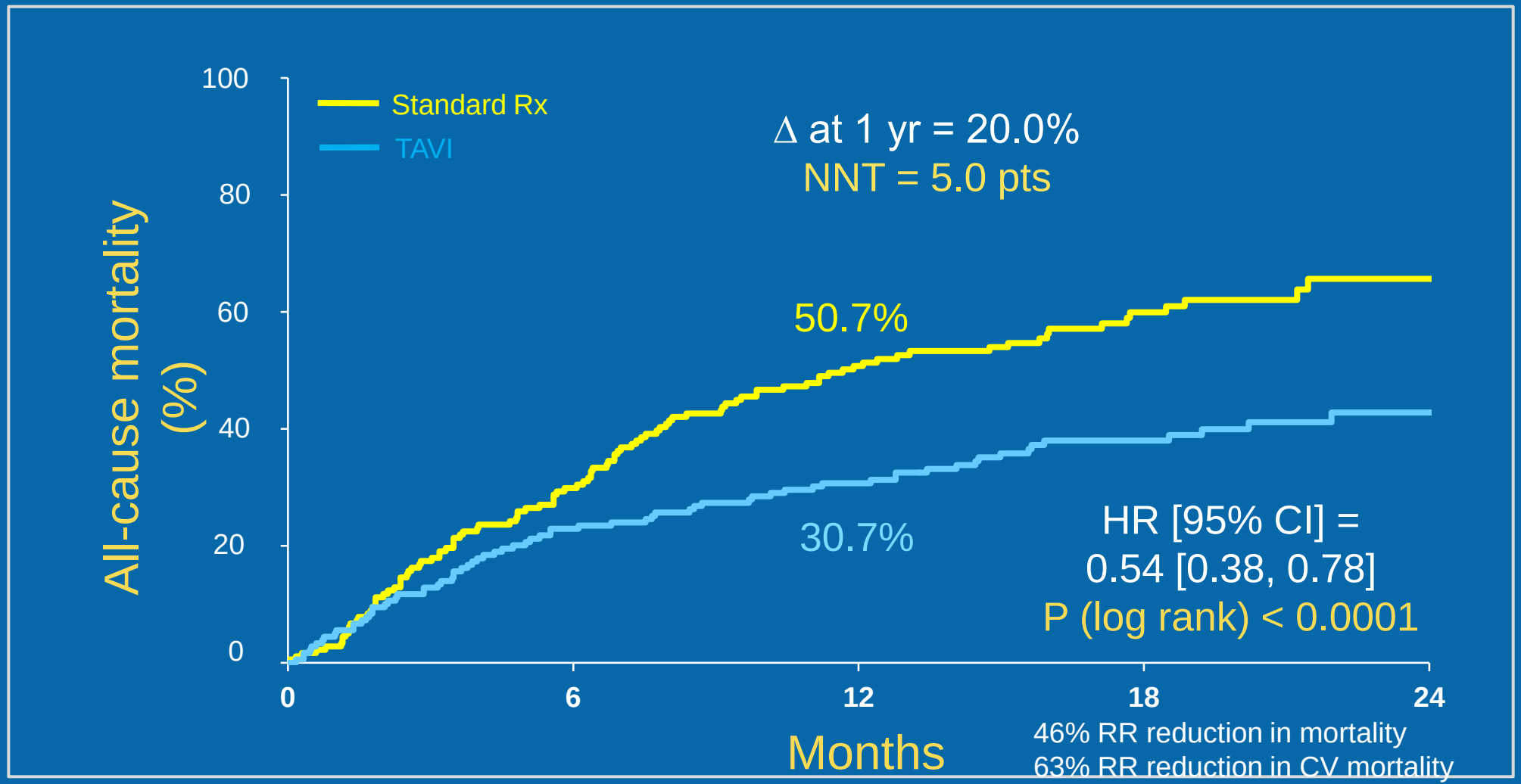
- ***Hierarchical composite of all-cause mortality and repeat hospitalization over the duration of the study***

Procedural Outcomes

TAVI (179 patients)

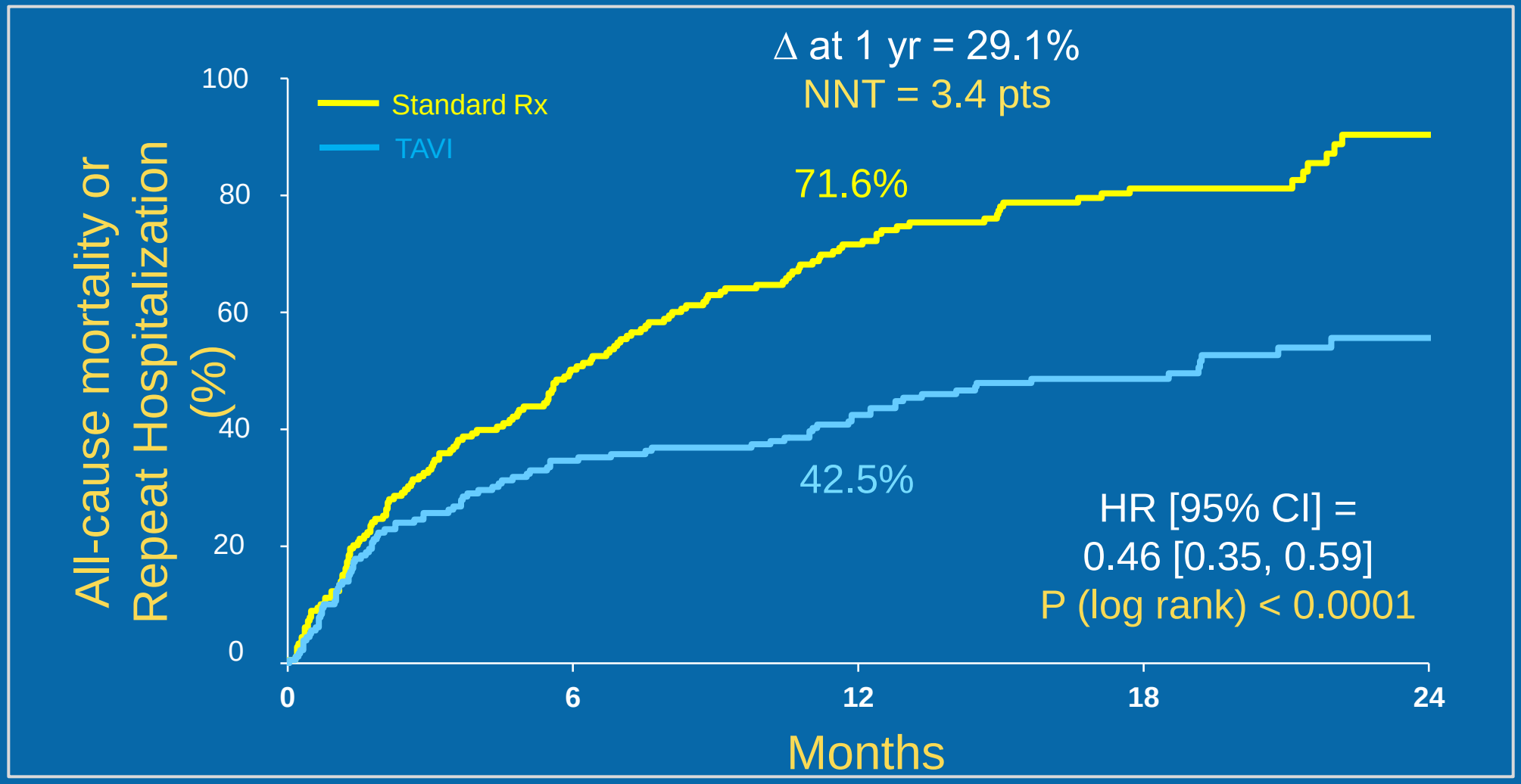
- ***6 (3.4%) pts did not receive TAVI***
  - **2 died before scheduled implant**
  - **2 unsuccessful transfemoral access**
  - **2 intra-procedural annulus measurement too large and procedure aborted**
- ***After randomization, median time to TAVI was 6 days*** **(inter-quartile range 3 - 11 days)**
- ***During TAVI (first 24 hours)***
  - **2 (1.1%) deaths**
  - **3 (1.7%) major strokes**
  - **1 (0.6%) valve embolization**
  - 2 (1.1%) pts with multiple (≥ 2) valve implants
- In the first 30 days, 11 (6.4%) pts receiving TAVI died

All Cause Mortality



Numbers at Risk					
TAVI	179	138	122	67	26
Standard Rx	179	121	83	41	12

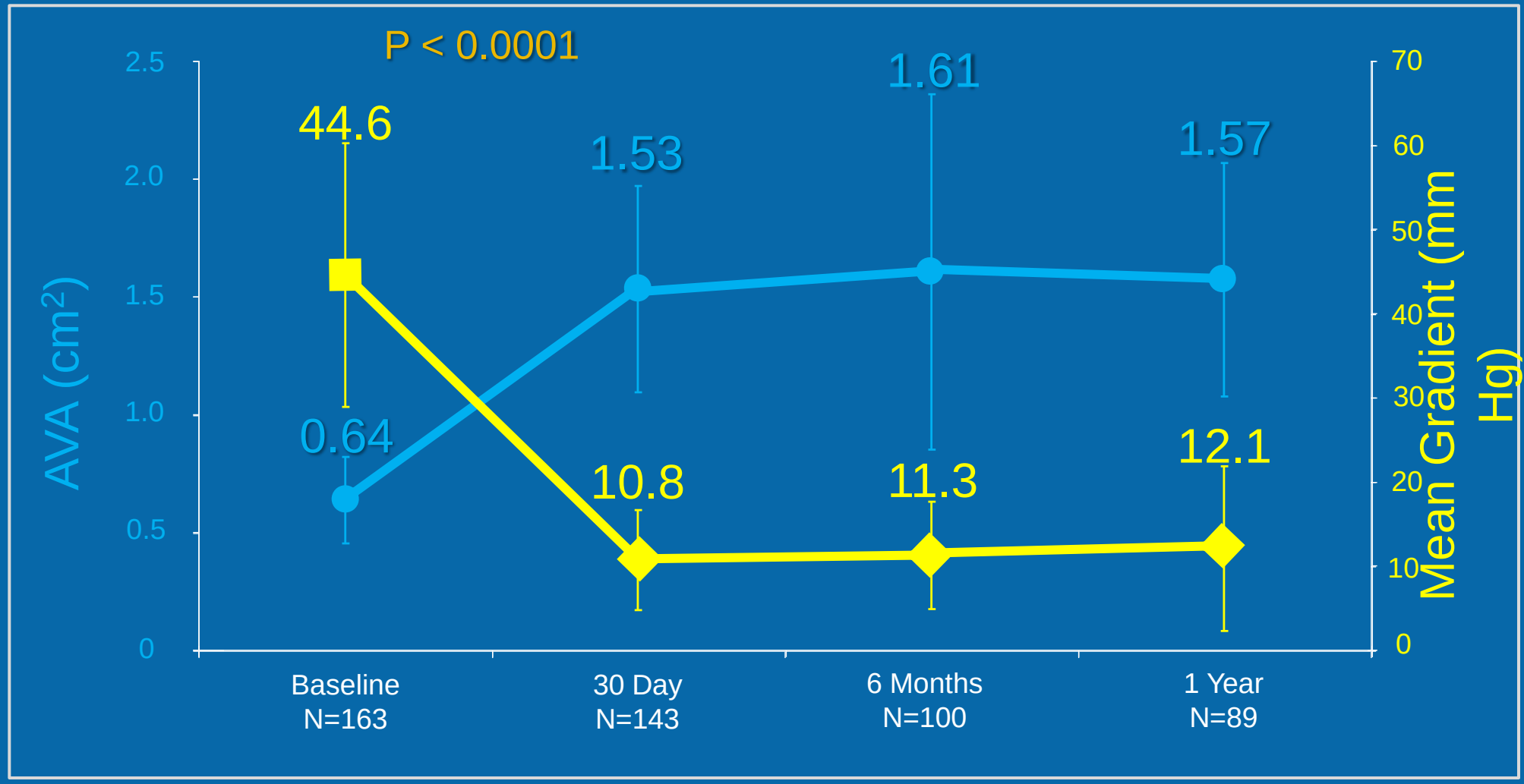
Mortality or Repeat Hosp



Numbers at Risk					
TAVI	179	117	102	56	22
Standard Rx	179	121	49	23	4

AVA and Mean Gradients

All TAVI patients



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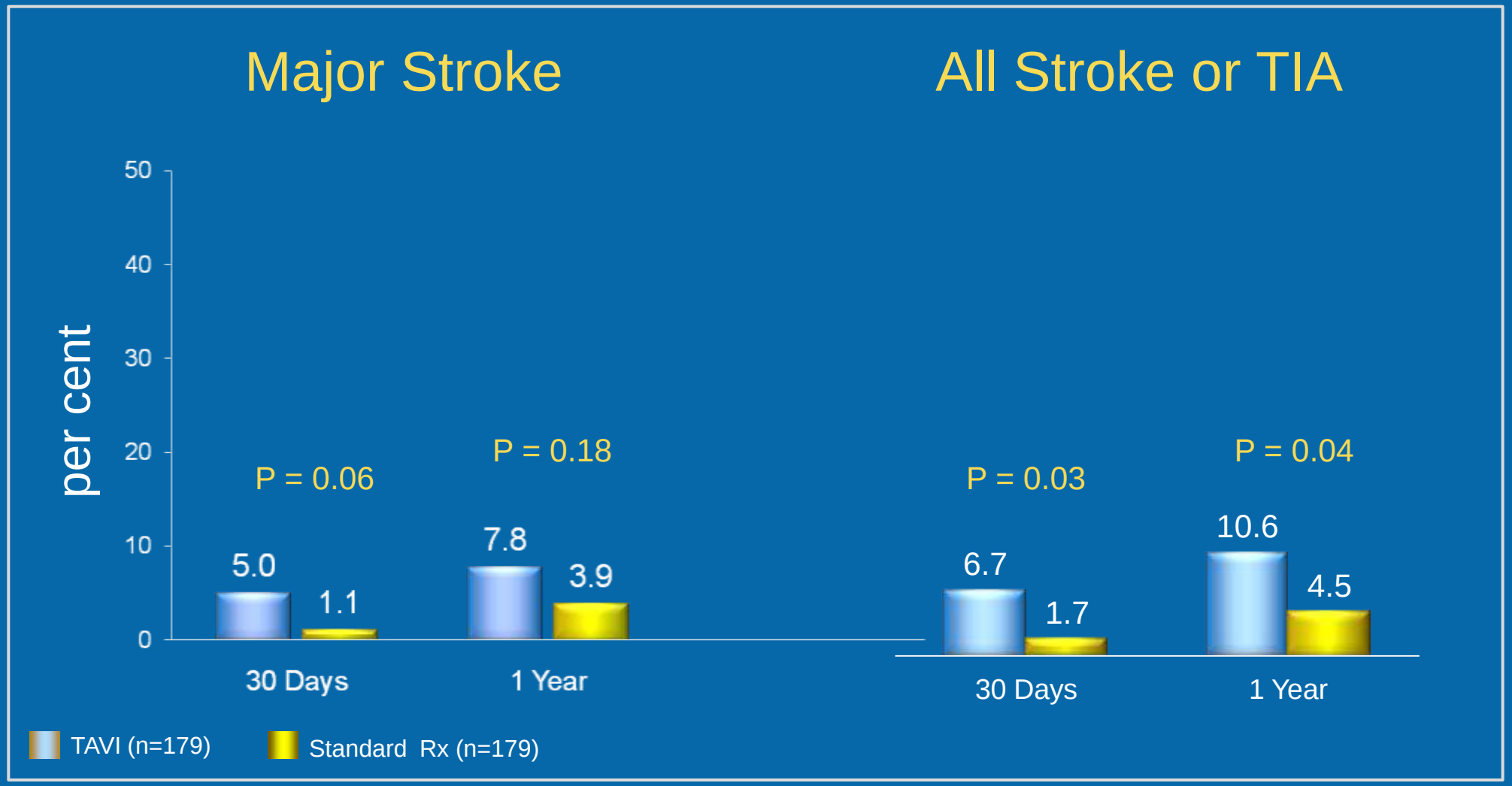
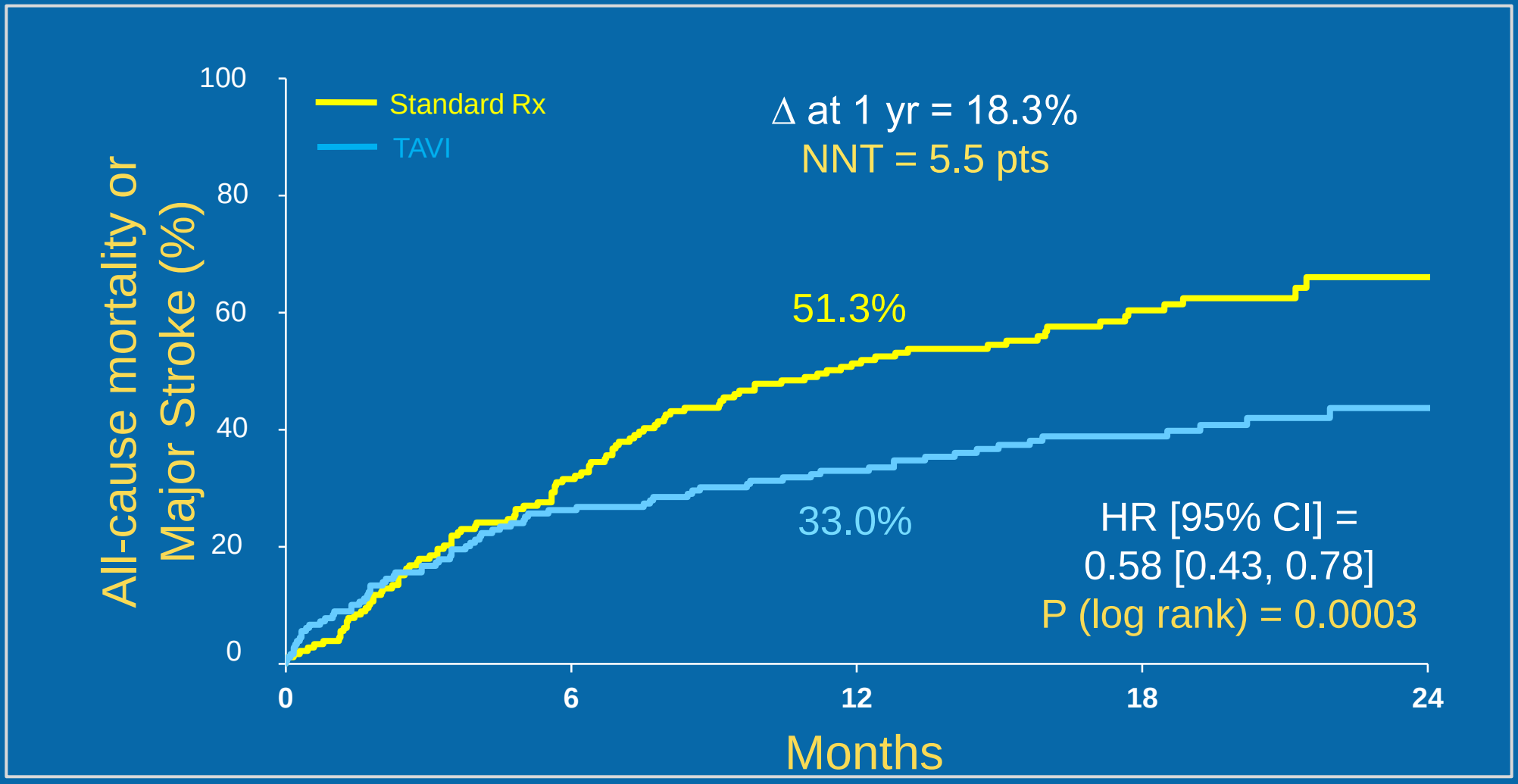
Error bars = ± 1 Std Dev

Clinical Outcomes at 30 Days and 1 Year



Mortality or Major Stroke



Numbers at Risk					
TAVI	179	132	118	56	25
Standard Rx	179	118	83	41	12

Conclusions

In patients with severe AS and symptoms, who are not suitable candidates for surgery…

- TAVI was accomplished with acceptable safety
- TAVI markedly reduced the rate of…
  - all-cause mortality by 46%
  - all-cause mortality & hospitalization by 54%,
- TAVI improved cardiac symptoms
- TAVI resulted in more frequent complications
  - major vascular complications
  - major bleeding episodes
  - major strokes

Clinical Implications

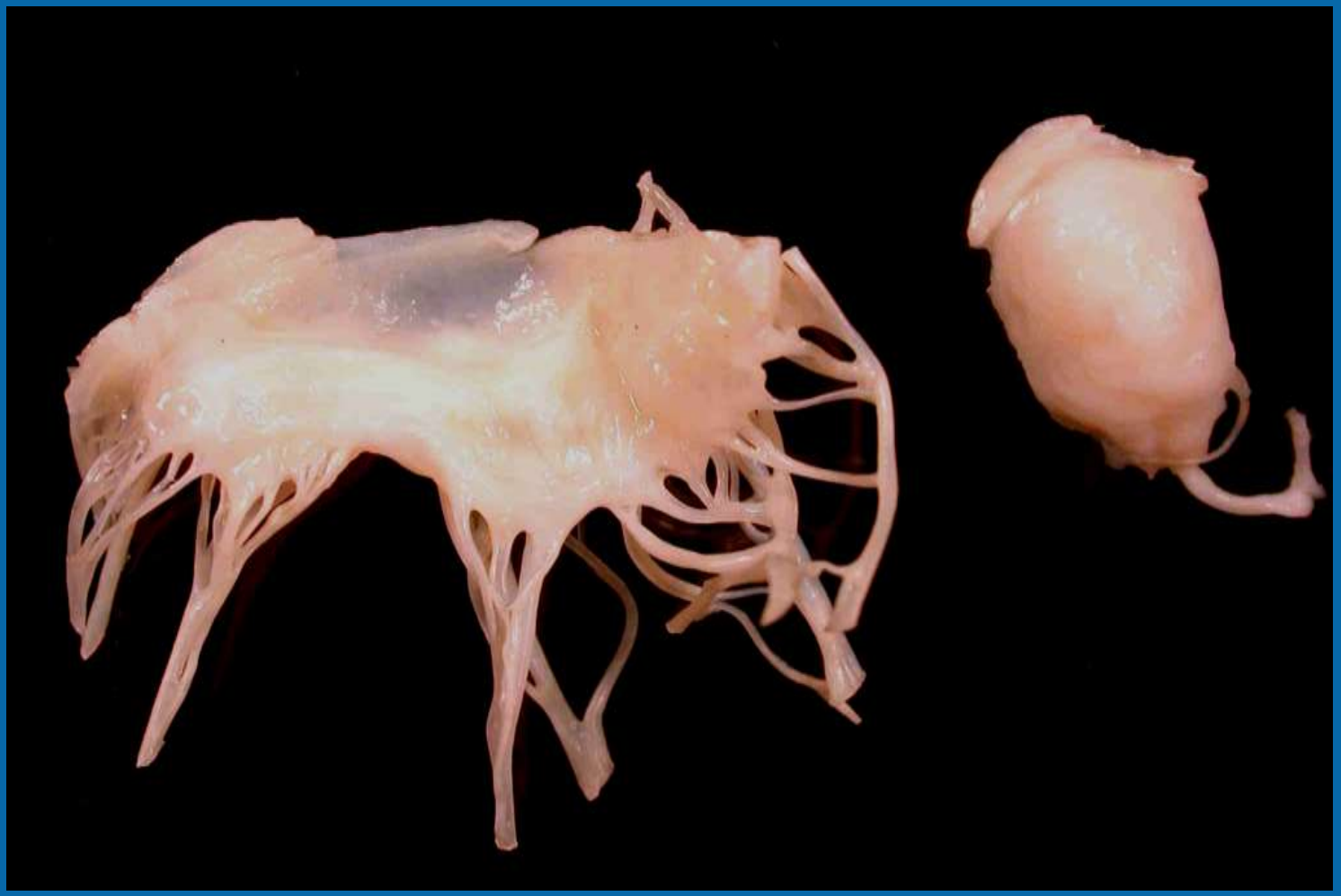
- Balloon-expandable TAVI should be the new standard of care for patients with aortic stenosis who are not suitable candidates for surgery!

Echo to Guide Clinical Management in Patients with Mitral Regurgitation

Morphology

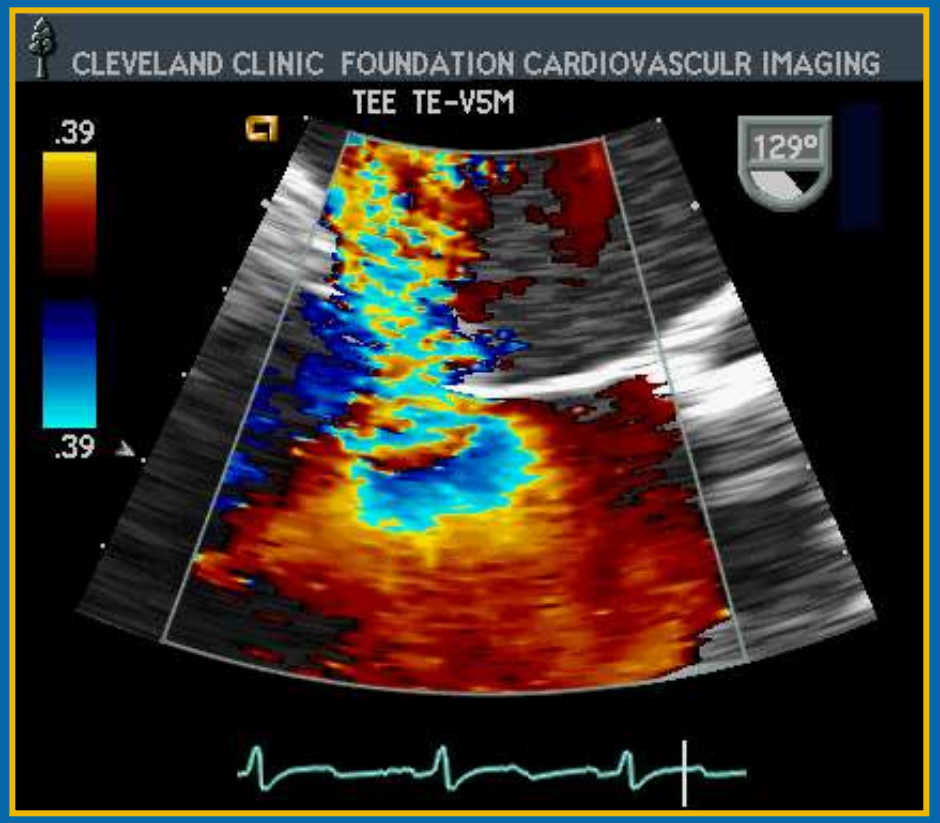
	Rheumatic	Myxomatous
LV	Normal/Small	Dilated
MV	Thick/restricted	Thick/hypermobile
Chordae	Short	Long
AV involved	Often	Rare
Ca++	+++	+

Myxomatous Mitral Valve Disease



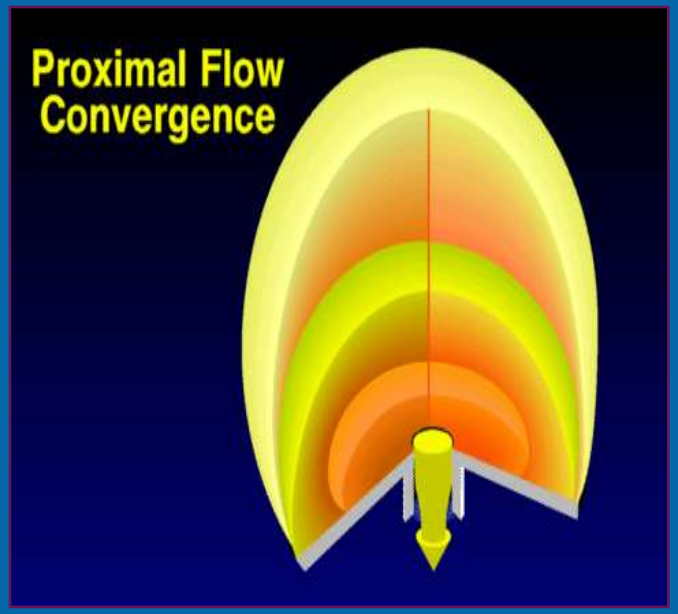
Quantitation of Mitral Regurgitation by Echo

- Color jet area
- PISA
- Vena contracta
- Volumetric Assessment
- Jet density by CW Doppler
- Chamber Size
- Pulmonary veins

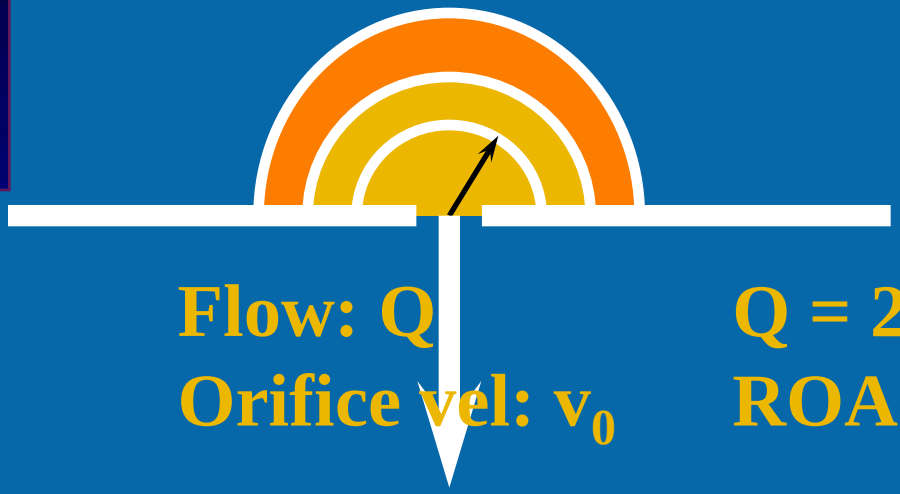


Regurgitant Orifice Area > 0.4 cm^2 = Severe

Proximal Flow Convergence Method



Aliasing velocity: v (= 42 cm/s)
Aliasing radius: r



Flow: Q $Q = 2\pi r^2 v$

Orifice vel: v_0 $ROA = Q/v_0$

Flow thru any isovelocity shell is equal to instantaneous orifice flow

Indications for Transthoracic Echocardiography

CLASS I

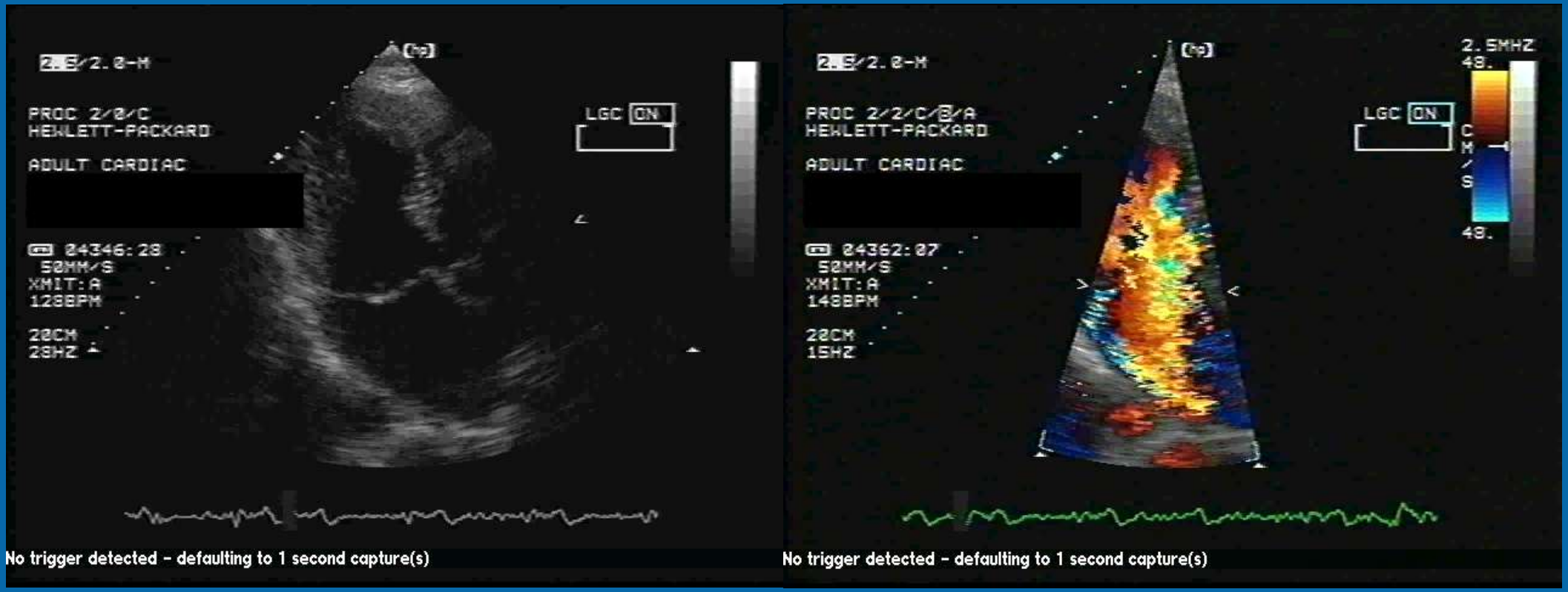
- **1. TTE is indicated for baseline evaluation of LV size and function. RV and left atrial size, pulmonary artery pressure and severity of MR (Table 4) in any patient suspected of having MR, (Level of Evidence: C)**
- **2. TTE is indicated for delineation of the mechanism of MR. (Level of Evidence: B).**
- **3. TTE is indicated for annual or semiannual surveillance of LV function (estimated by ejection fraction and end-systolic dimension) in asymptomatic patients with moderate to severe MR. (Level of Evidence: C)**
- **4. TTE is indicated in patients with MR to evaluate the MV apparatus and LV function after a change in signs or symptoms. (Level of Evidence: C)**
- **5. TTE is indicated to evaluate LV size and function and MV hemodynamics in the initial evaluation after MVR or MV repair. (Level of Evidence: C)**

INDICATIONS FOR TEE

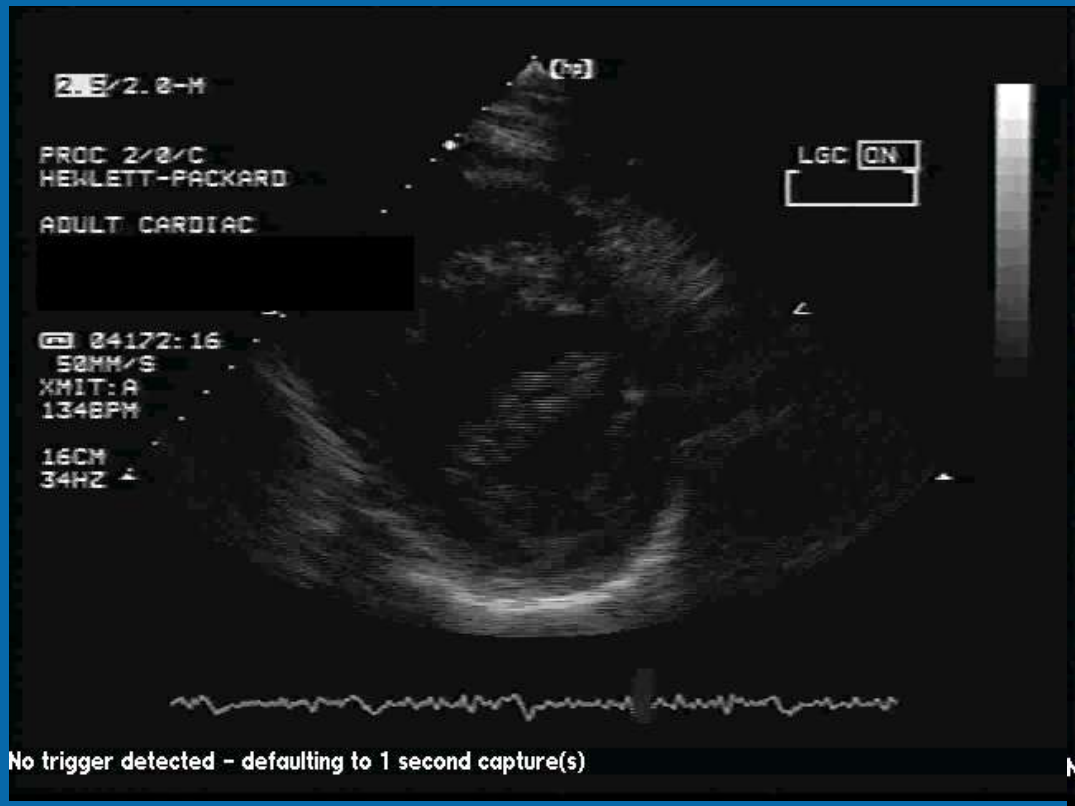
CLASS I

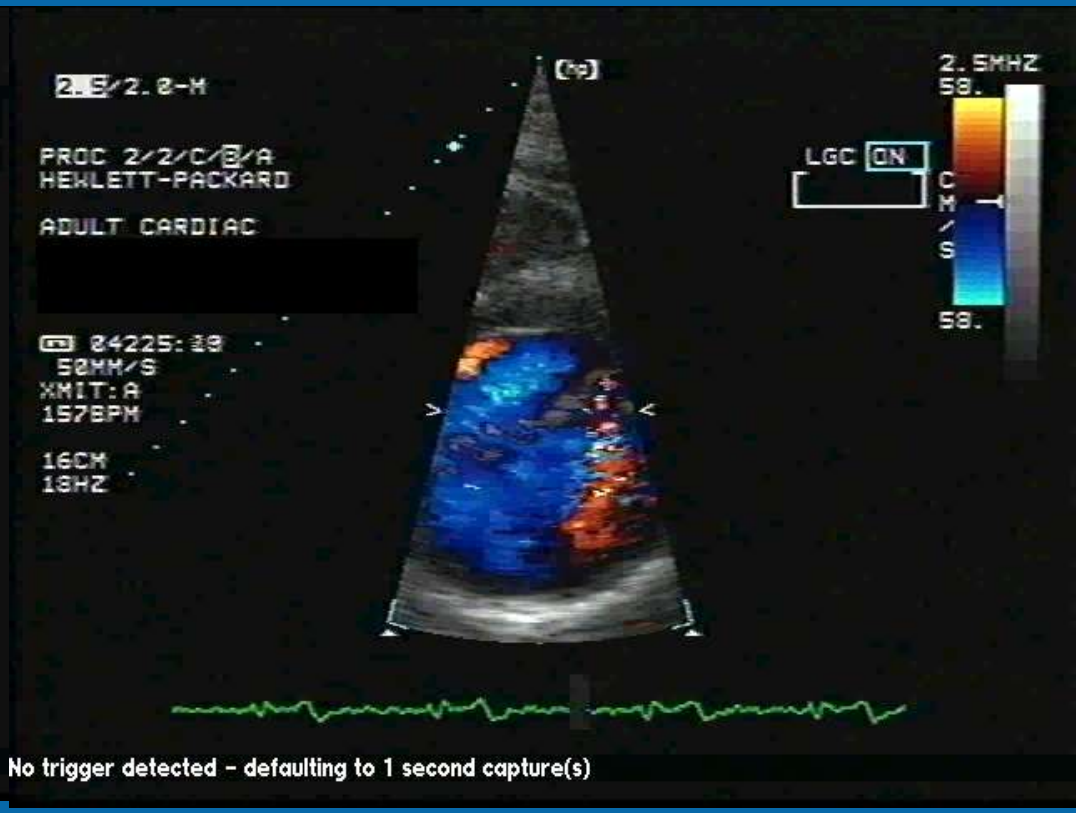
- 1. Preoperative or intraoperative TEE is indicated to establish the anatomic basis for severe MR in patients in whom surgery is recommended to assess feasibility of repair and to guide repair (Level of Evidence: B)
- 2. TEE is indicated for evaluation of MR patients in whom TTE provides non-diagnostic information regarding severity of MR, mechanism of MR and/or status of LV function. (Level of Evidence B)

TTE apical LAX



TTE


2.5/2.0-M
PROC 2/0/C
HEWLETT-PACKARD
ADULT CARDIAC
LGC ON
04172:16
50MM/S
XMIT:A
134BPM
16CM
34HZ
No trigger detected - defaulting to 1 second capture(s)


2.5/2.0-M
PROC 2/2/C/B/A
HEWLETT-PACKARD
ADULT CARDIAC
LGC ON
04225:39
50MM/S
XMIT:A
157BPM
16CM
18HZ
2.5MHZ
58.
CM/S
58.
No trigger detected - defaulting to 1 second capture(s)

Mechanisms of MR

This echo evaluation shows ?

a. Anterior lealfet prolapse due to myxomatous valve disease

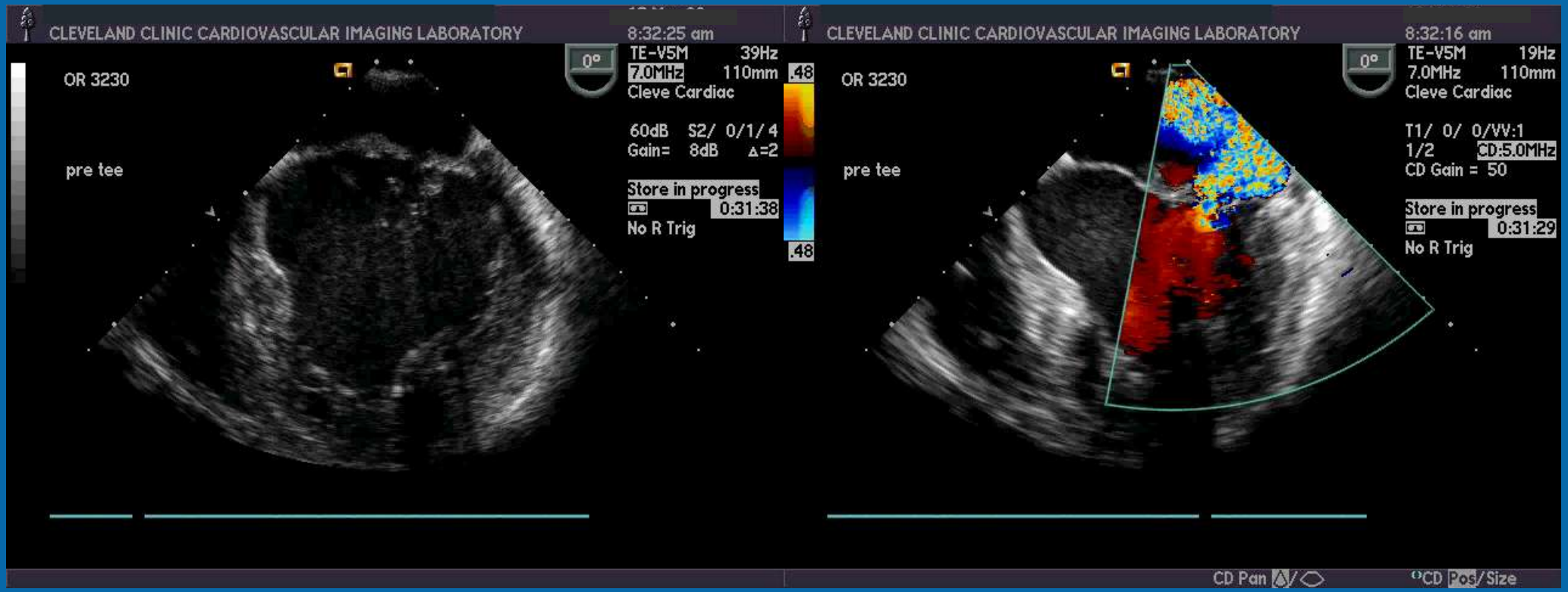
b. Restriction of posterior leaflet due to RHD

c. Restriction of posterior leaflet due to RCA scar

d. Bileaflet prolapse with anterior prolapse > posterior prolapse?

e. Restriction of posterior leaflet due to anorexigen induced valvular disease

Pre Intraoperative TEE

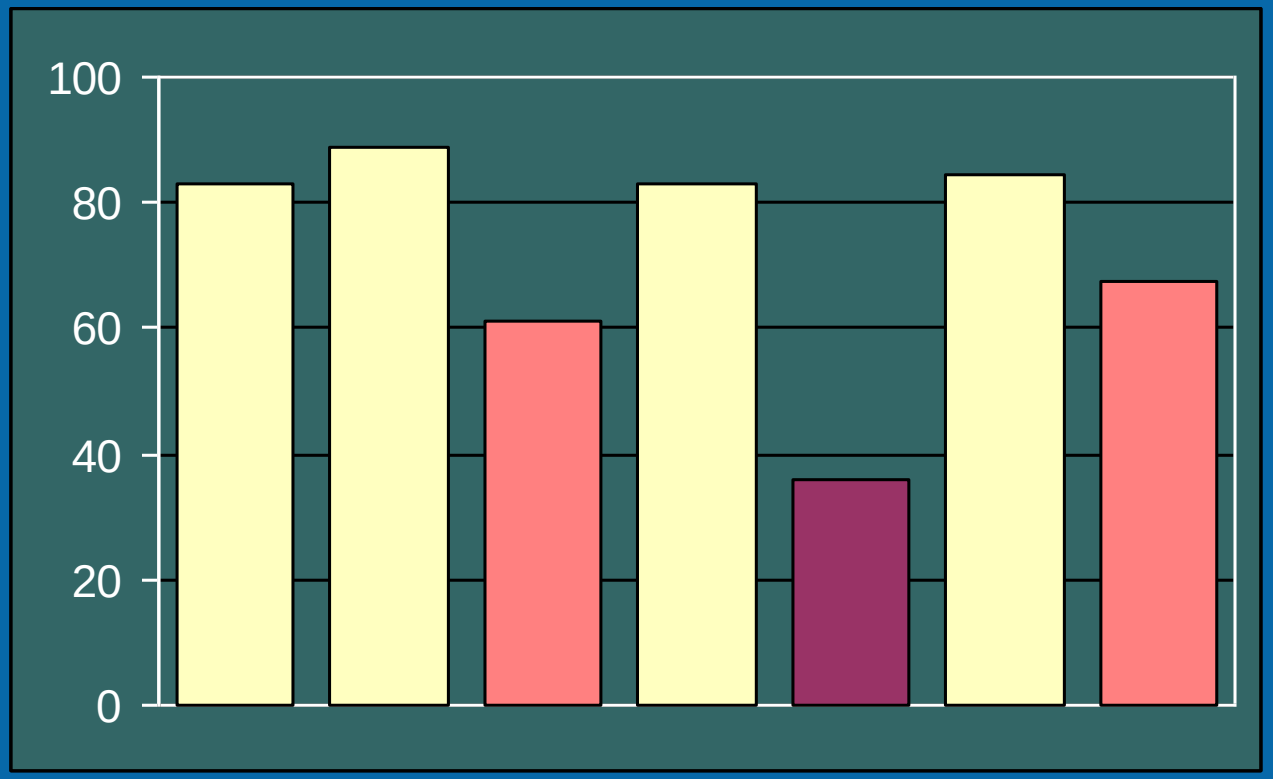


Mechanisms of Mitral Regurgitation

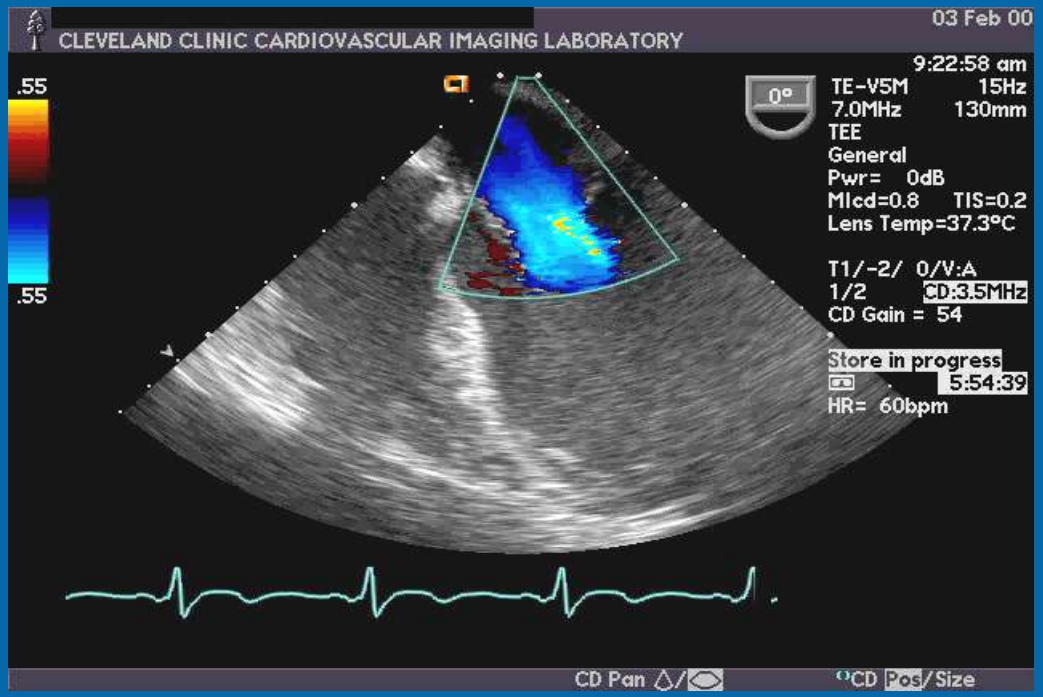
- Excessive Leaflet Motion
  - Prolapse
  - Leaflet, chordal, or papillary muscle disruption
- Normal Leaflet Motion
  - Perforation
- Restricted Leaflet Motion
  - Rheumatic
  - Ischemic
  - Anorexigen Inducd
  - Mitral annular calcification

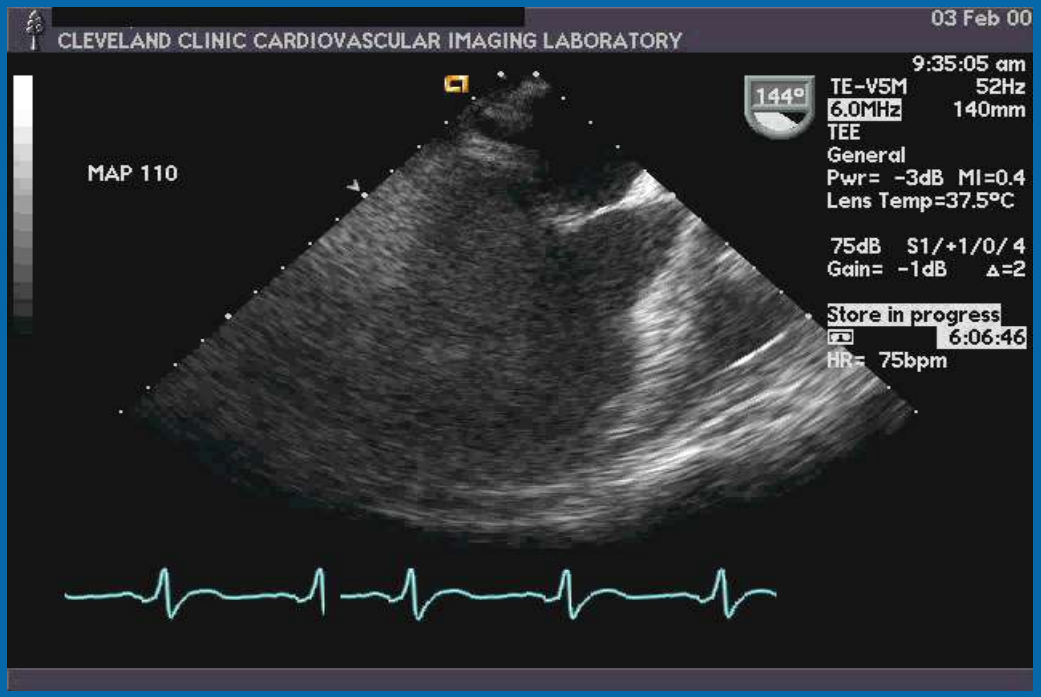
Feasibility of Repair - by MR mechanism

Stewart WJ: Intraoperative Echocardiography. Chap 54 in Topol's Cardiology Textbook

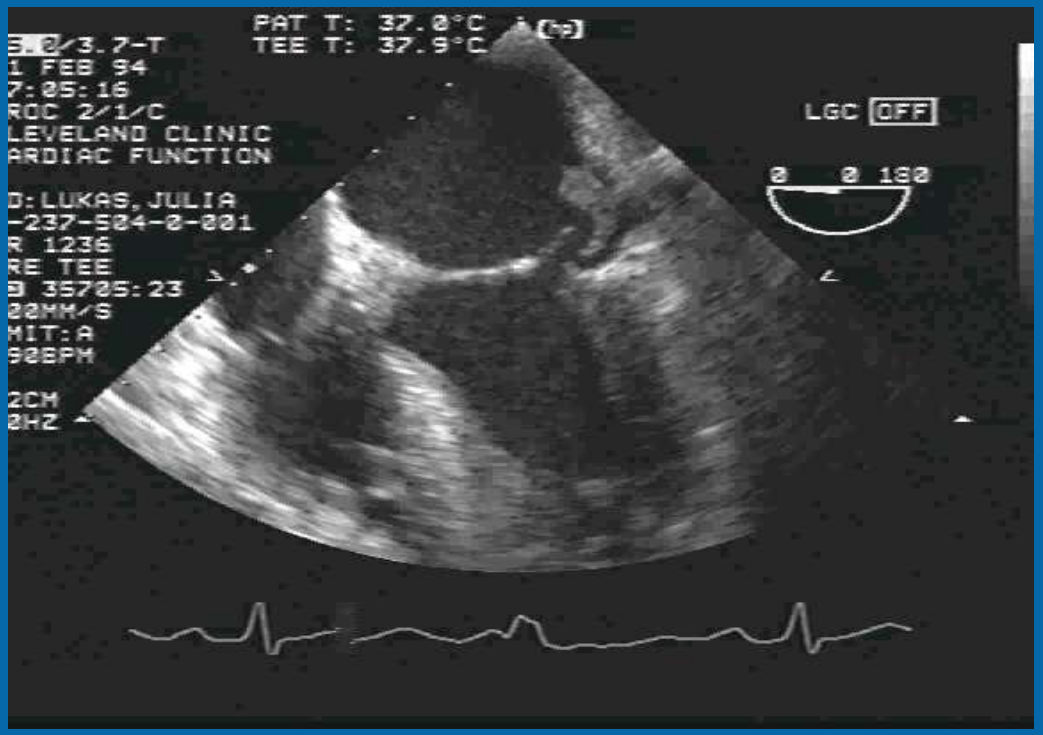


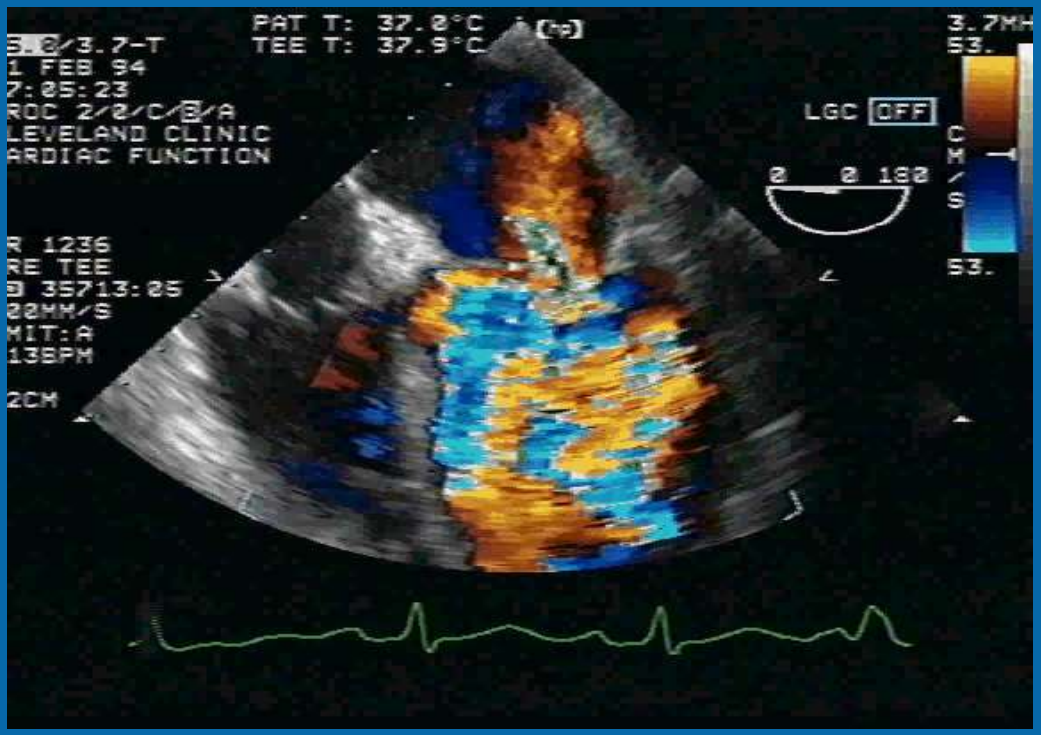
Papillary Muscle Dysfunction





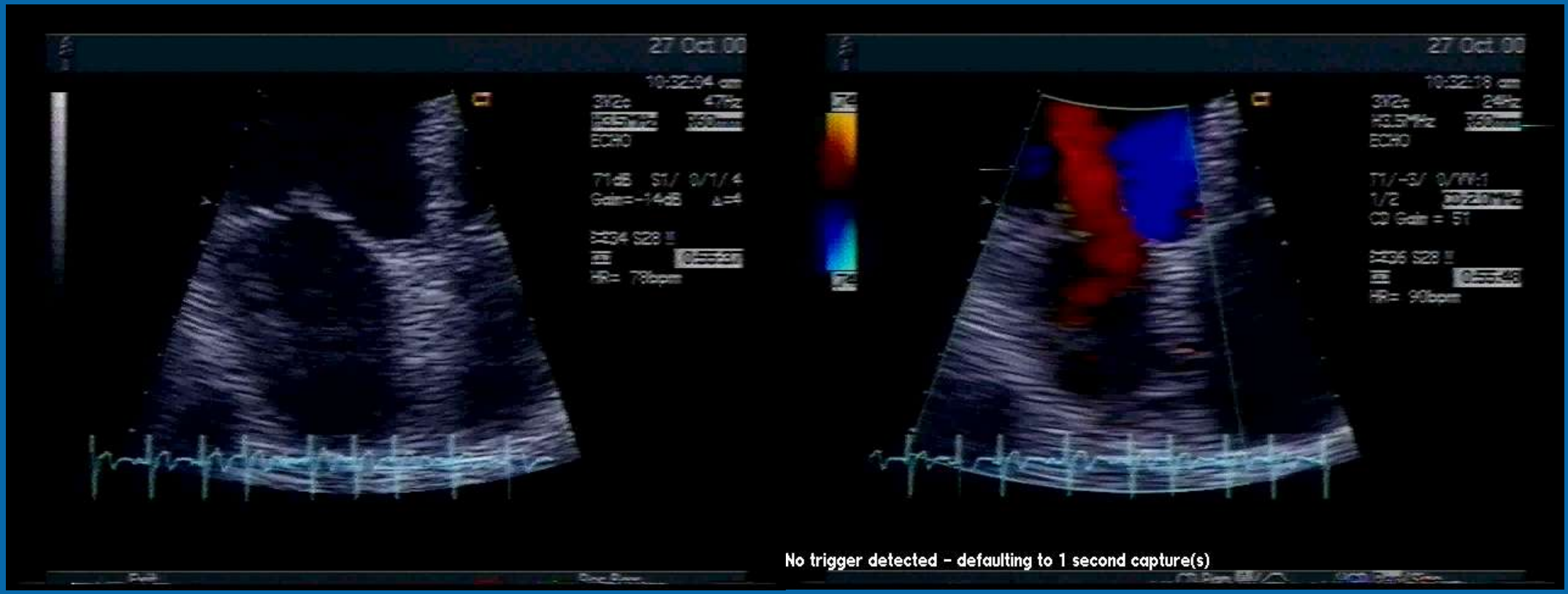
Repair or Replace?



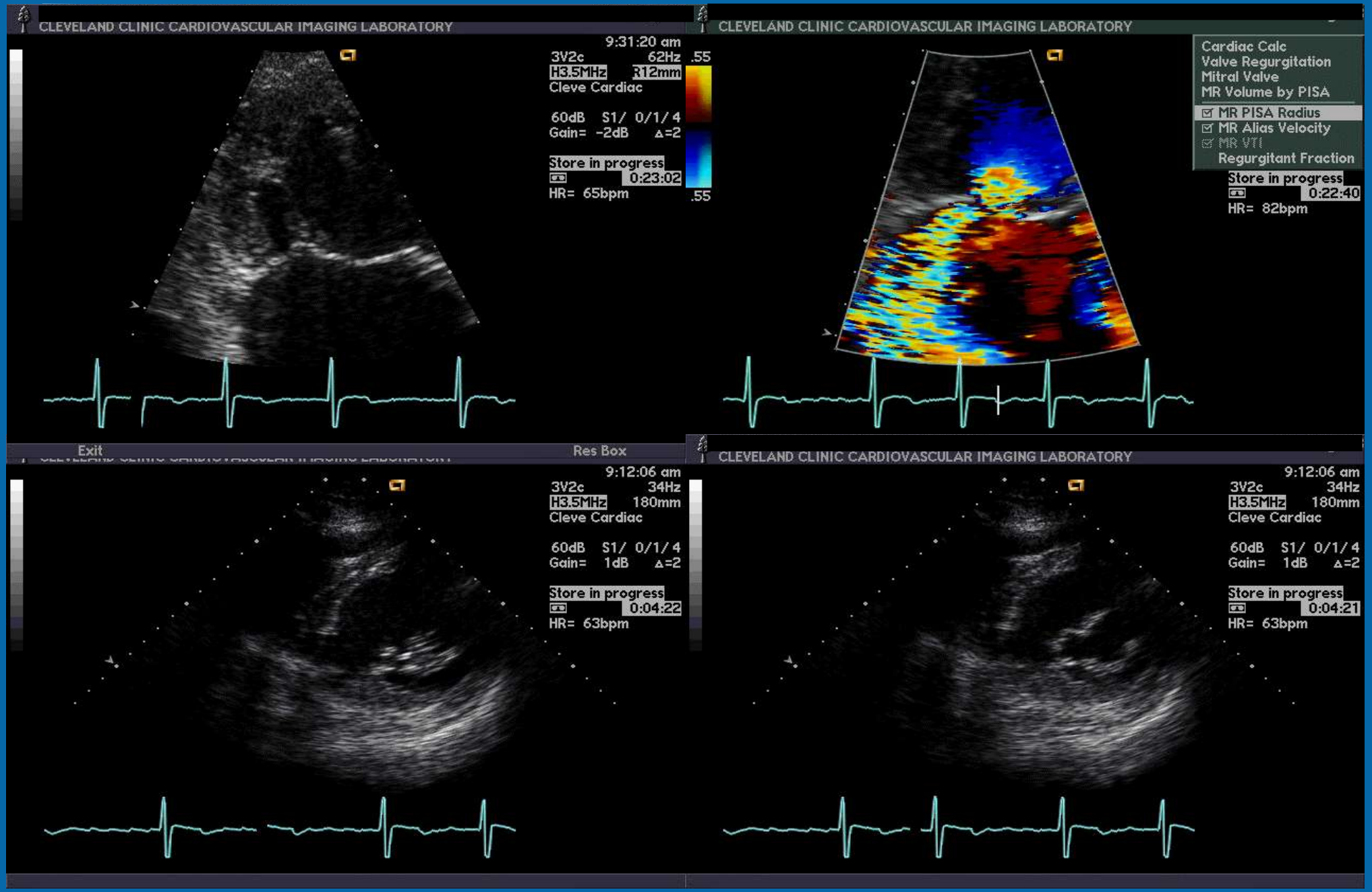


Repair or Replace?

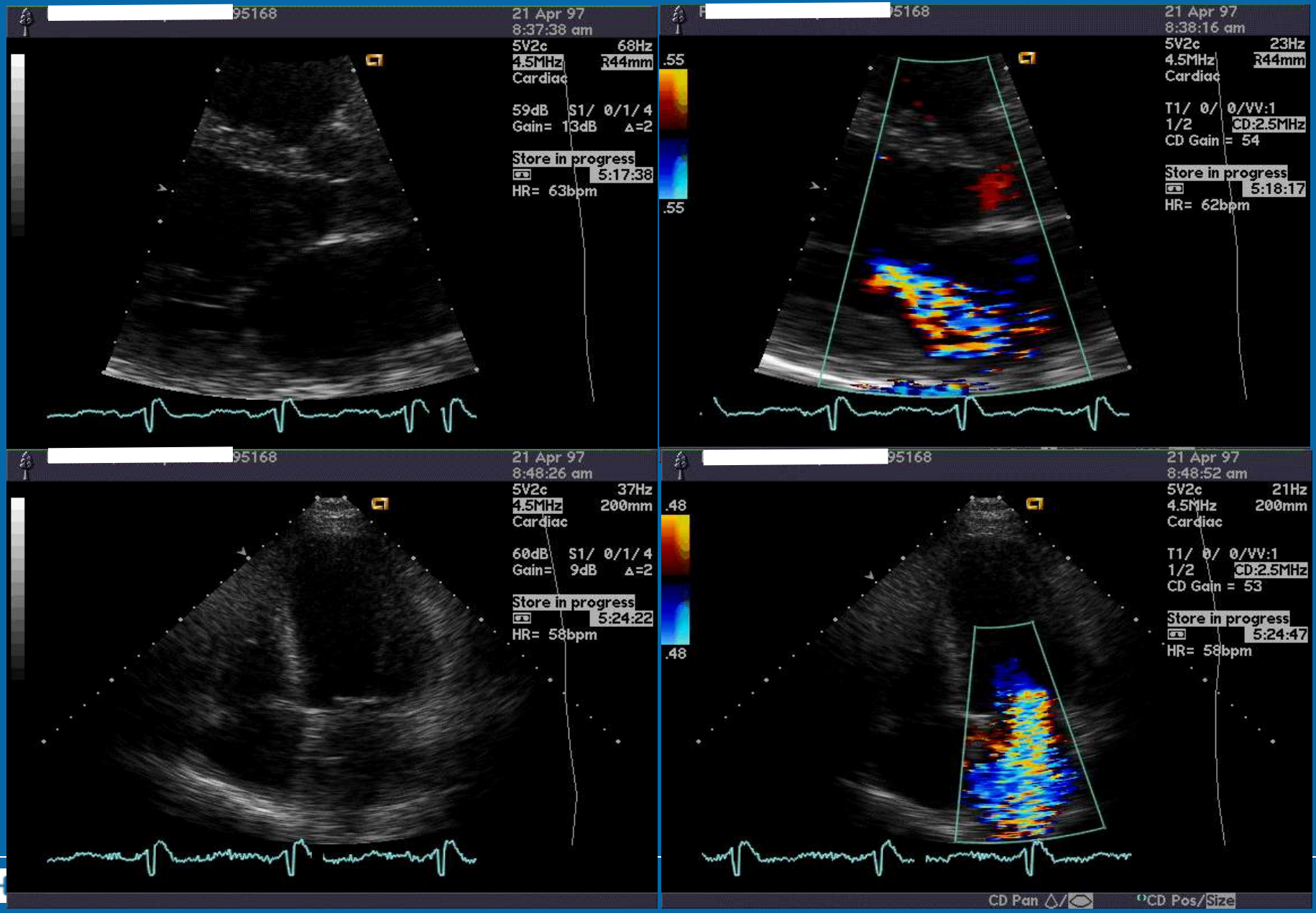
Repair or Replace



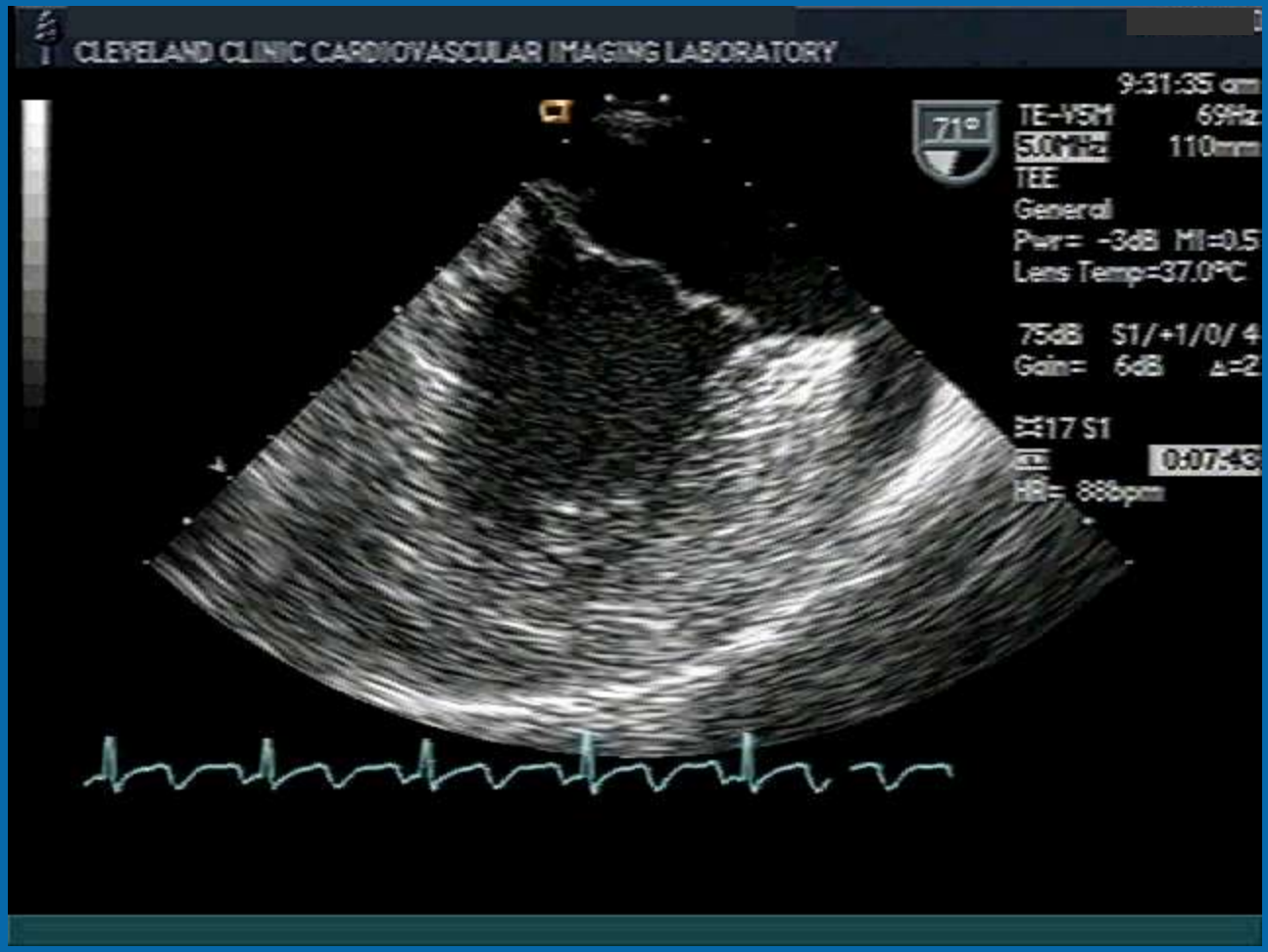
Repair or Replace?



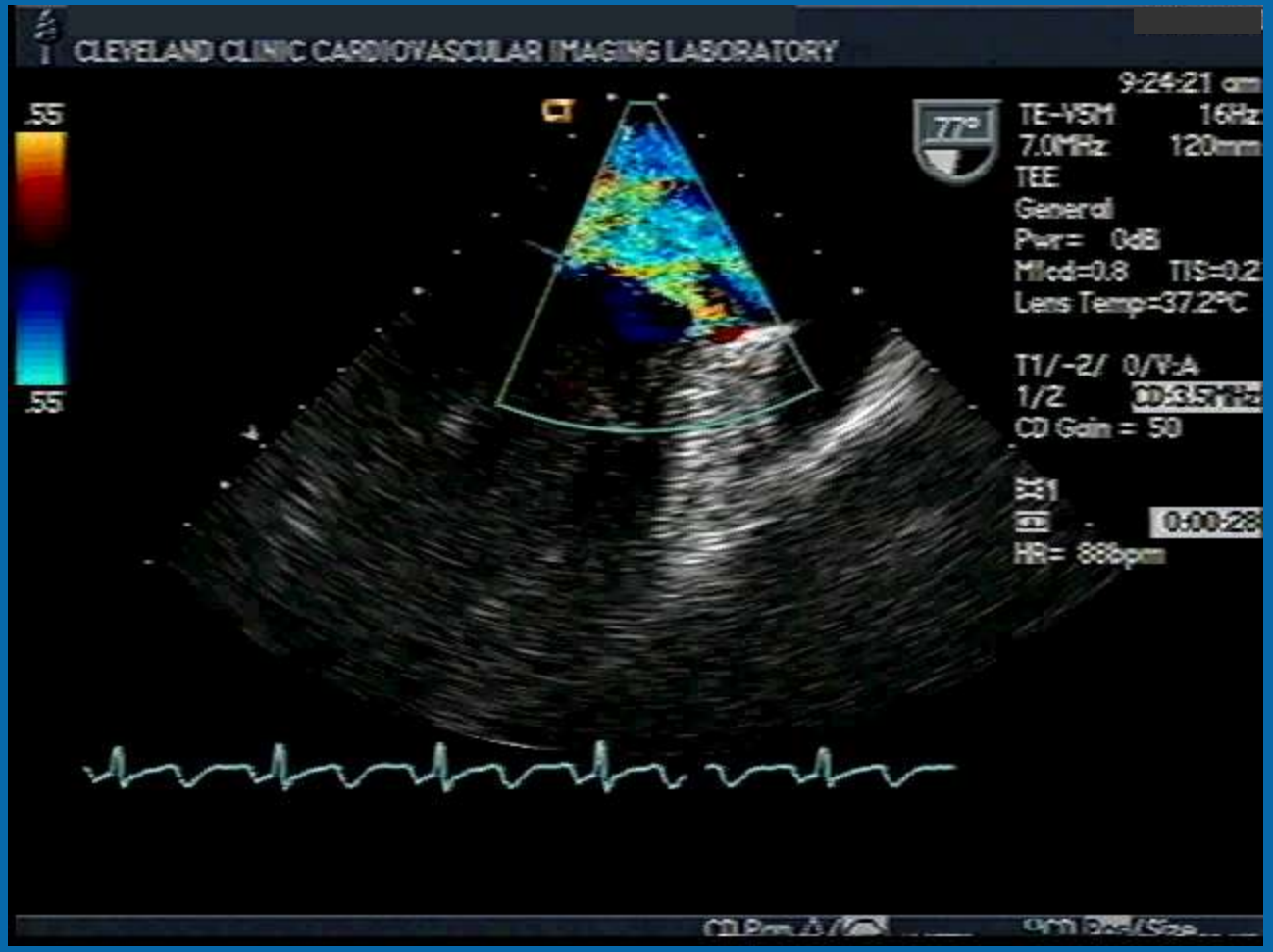
Repair or Replace?



What is the Pathology?



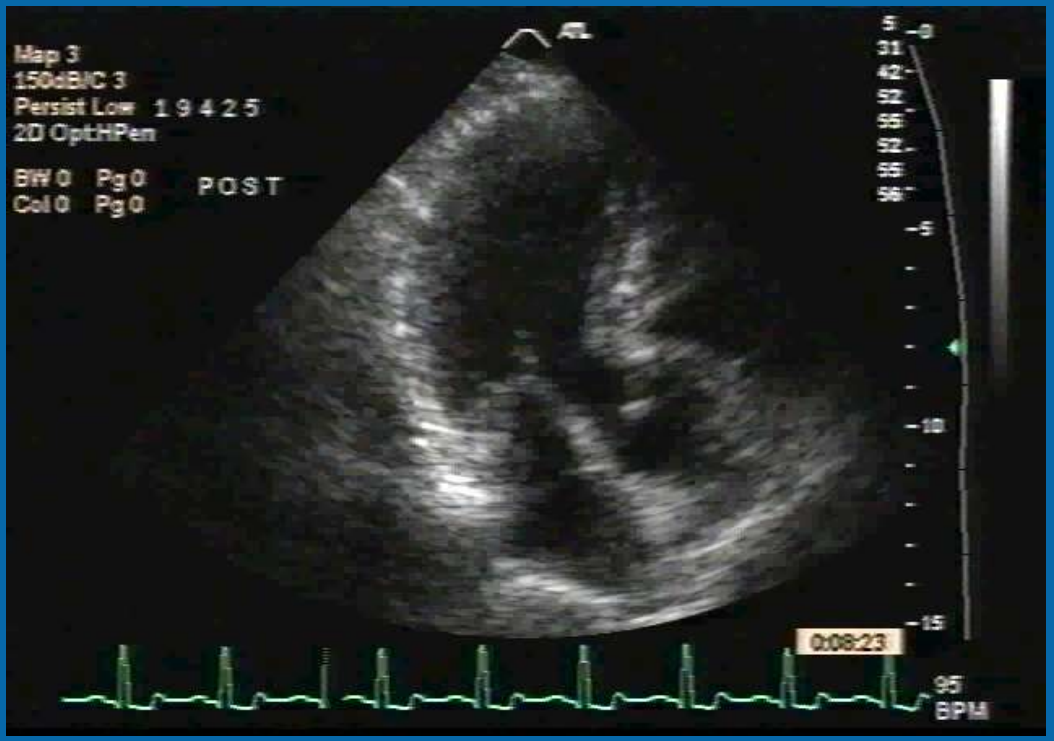
Mechanism?


CLEVELAND CLINIC CARDIOVASCULAR IMAGING LABORATORY
.55
.55
77°
TE-V5M1
7.0MHz
TEE
General
Pwr= 0dB
MI=0.8
Lens Temp=37.2°C
CD Gain = 50
HR= 88bpm

Stress Echo

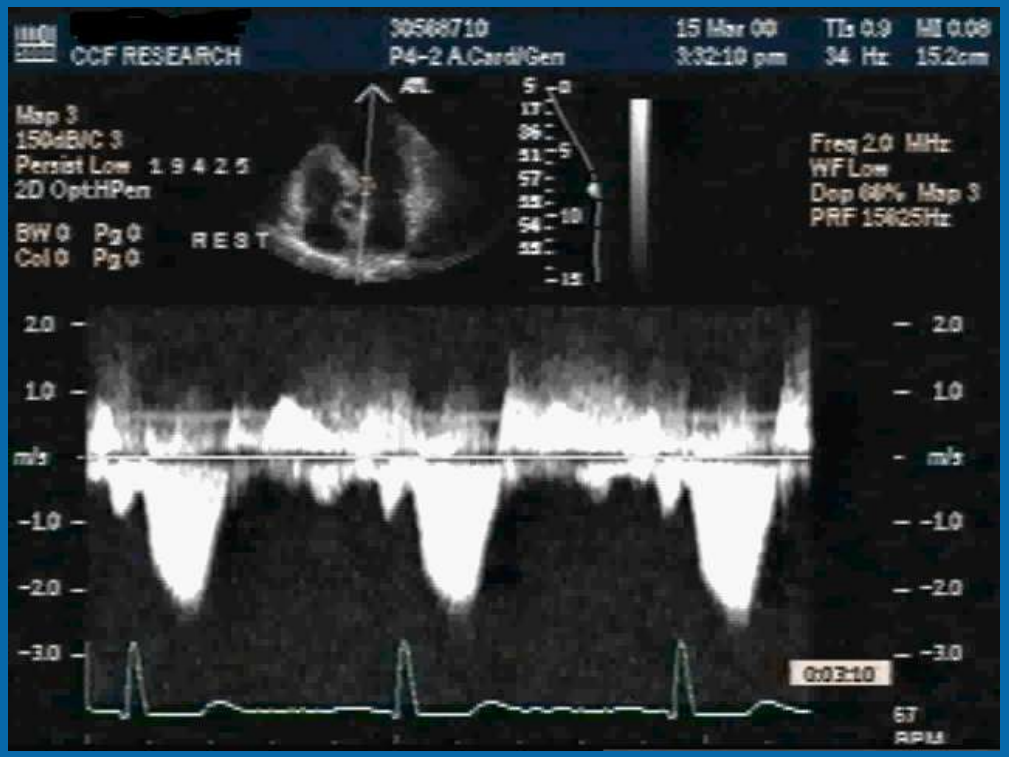
Rest

Stress



LVOT Gradients

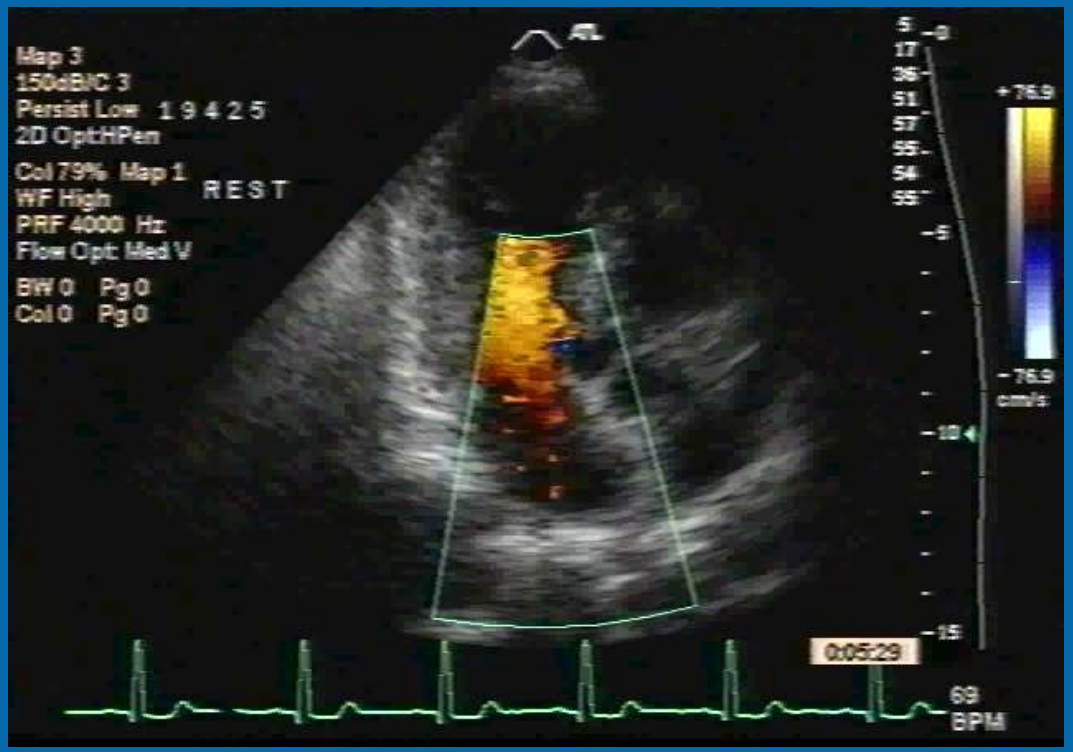
Rest



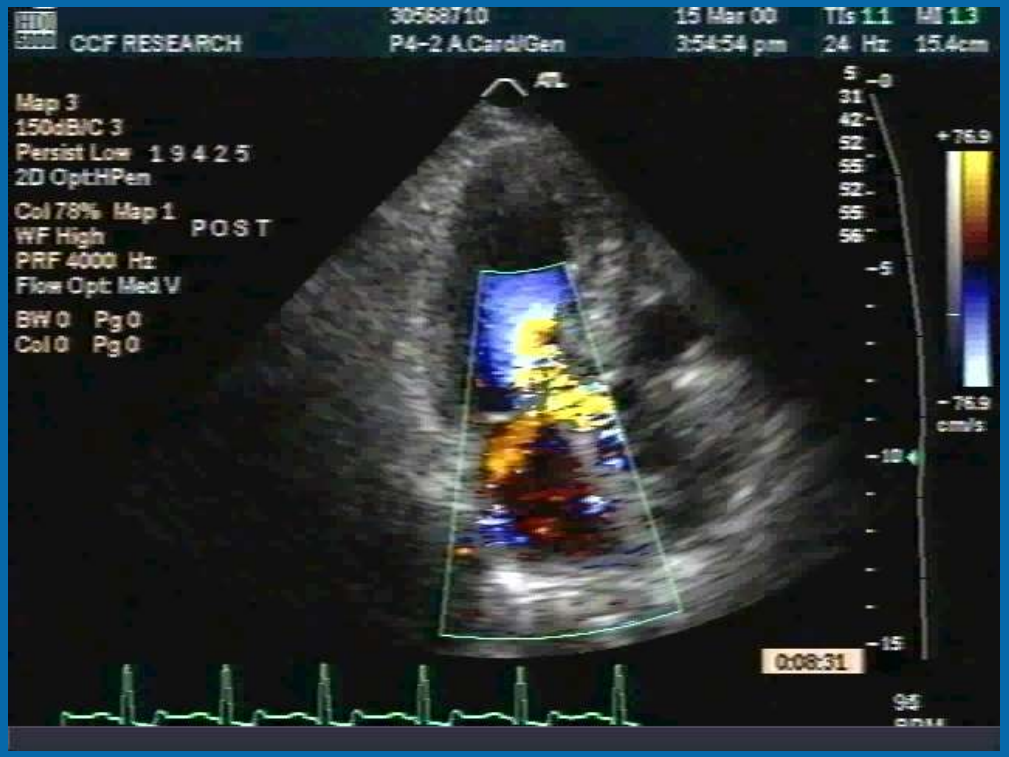
Stress

Repair or Replace?

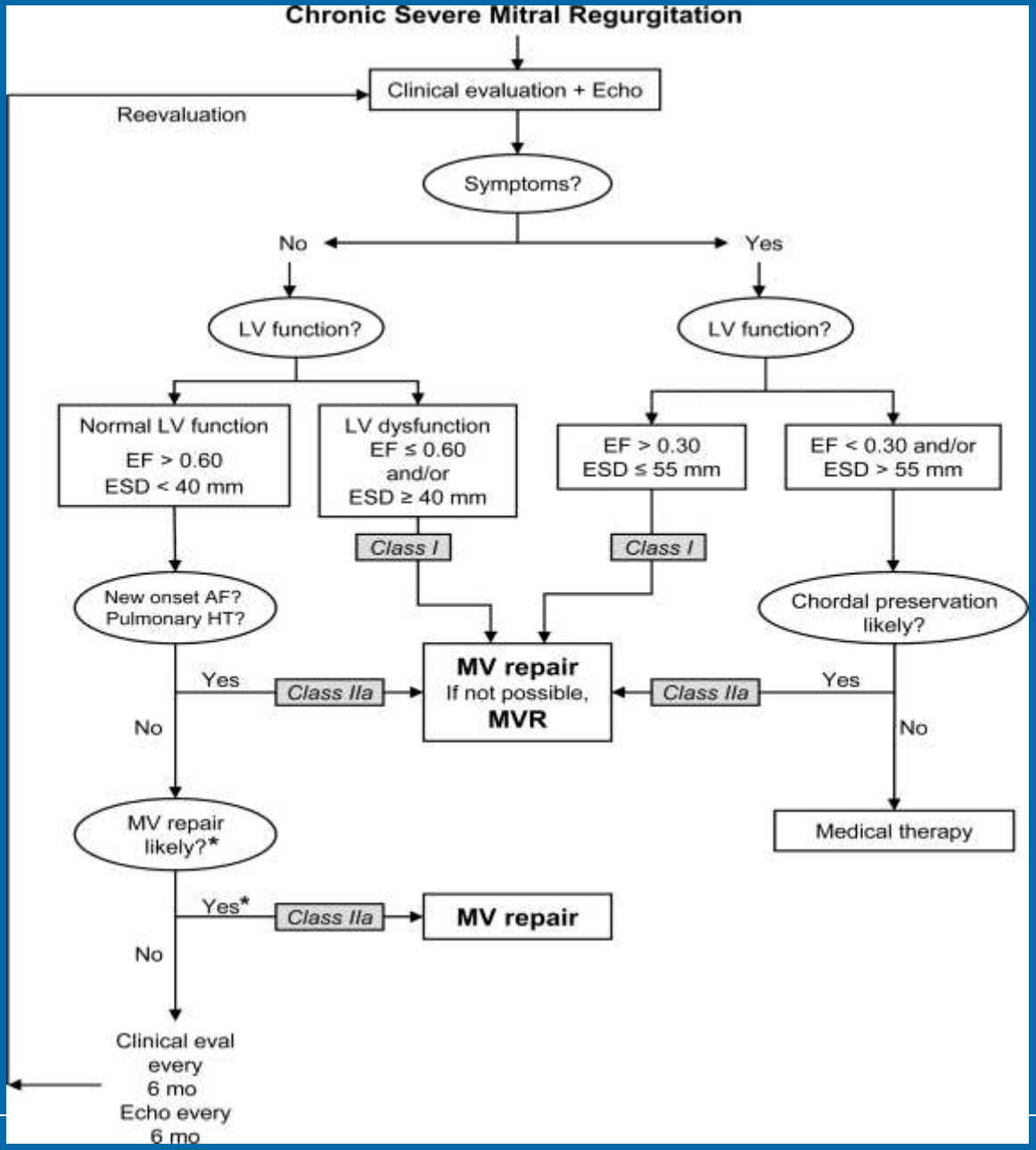
Rest



Stress



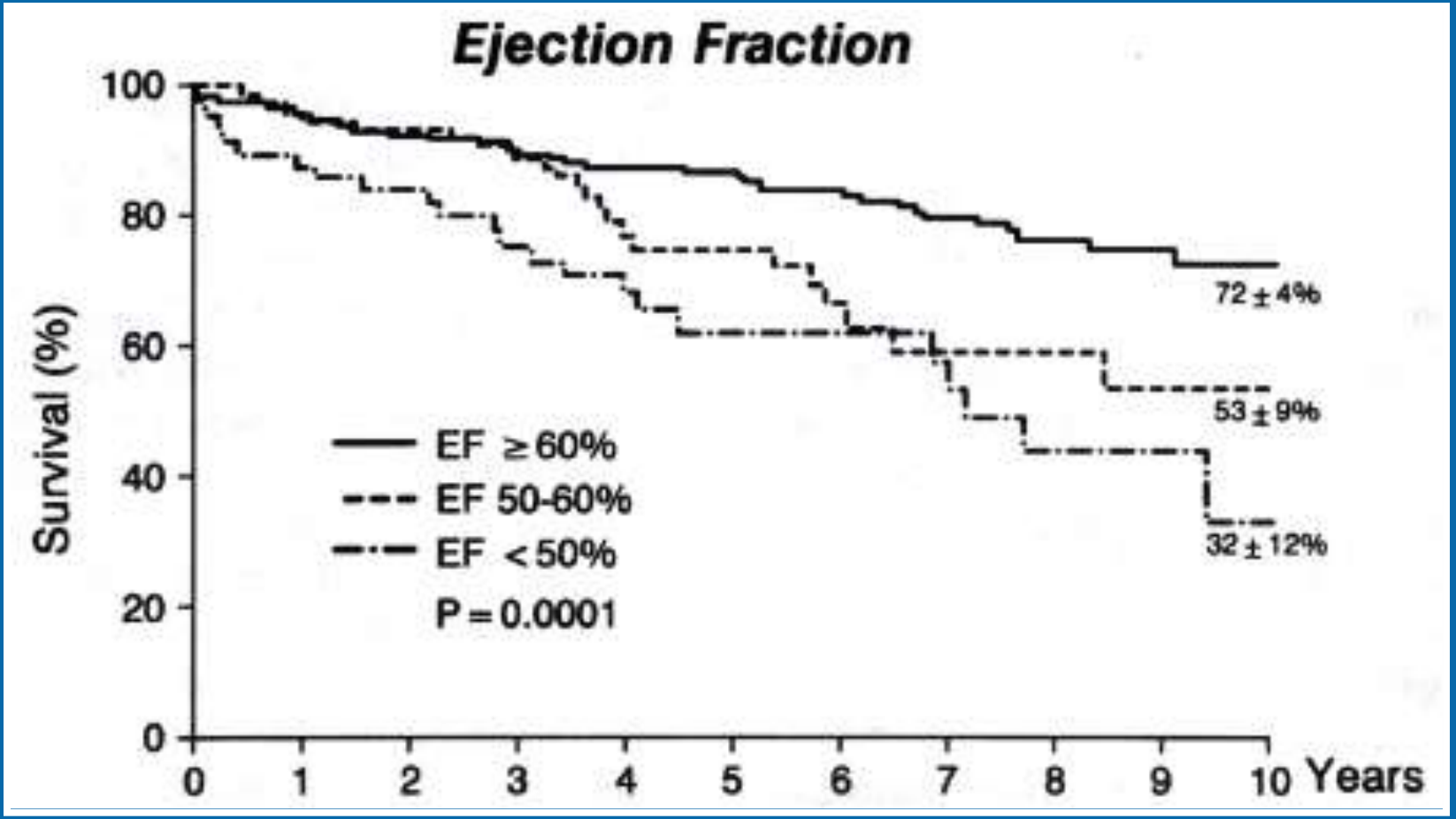
Management of Patients With Chronic Severe MR



Cleveland Clinic

Bonow, R. O. et al. J Am Coll Cardiol 2008;52:e1-e142

Timing of Surgery: LV Function



Cleveland Clinic

Enriquez-Sarano Circulation 1994; 90: 830-837

Frequency of Echo Follow-up for Mitral Regurgitation

MR Severity	LV Function	Frequency
Mild	Normal ESD & EF	Q 5 yr
Moderate	Normal ESD & EF	Q 1-2 yr
Moderate	ESD >40 mm or EF < 65%	Q1 yr
Severe	Normal ESD & EF	Q 1yr
Severe	ESD > 40 mm or EF < 65%	Q 6 mo