

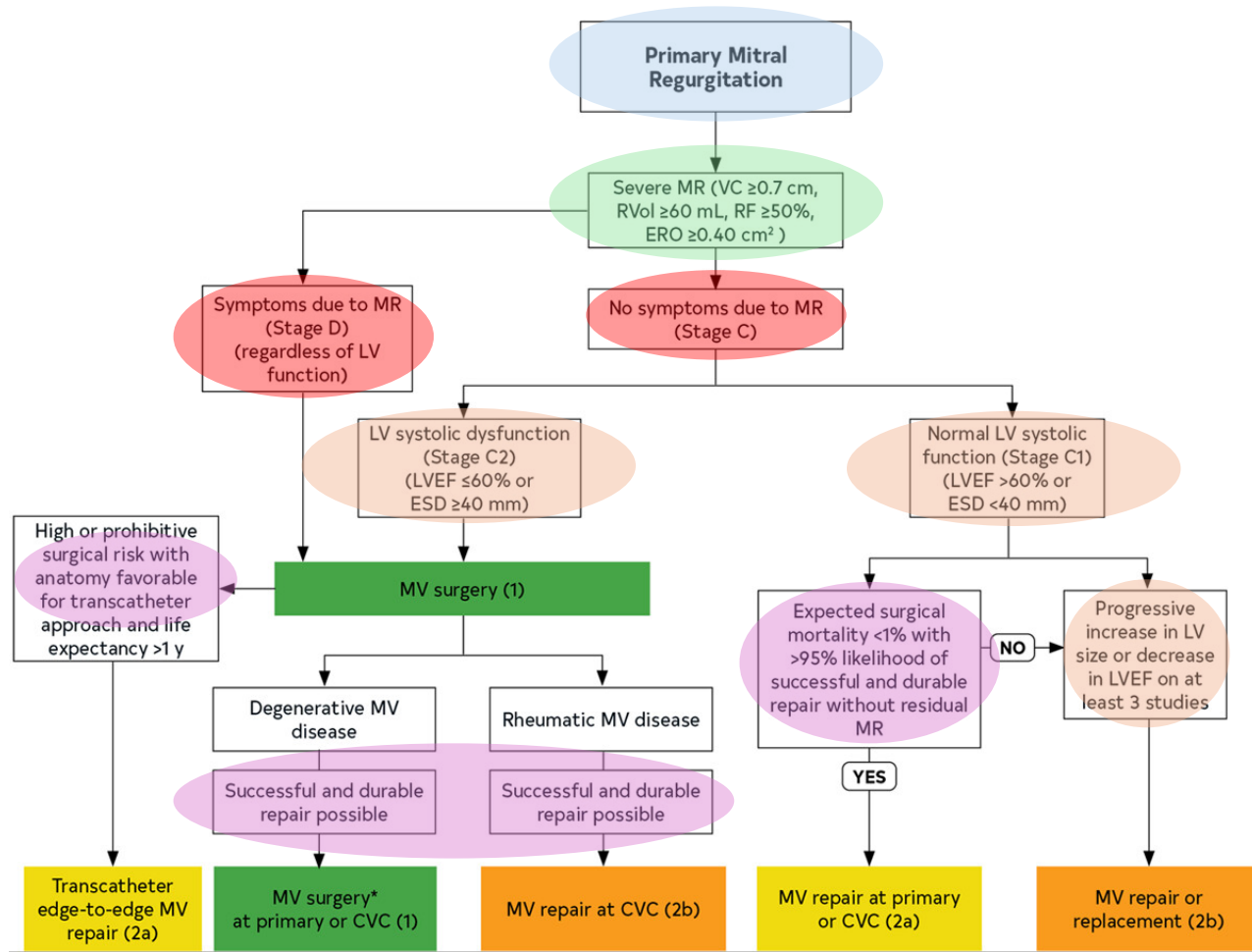
Imaging of the mitral valve for screening: Echo vs TEE vs Stress Echo

Rhonda Miyasaka, MD

Section of Cardiovascular Imaging

Cleveland Clinic

Management of Mitral Regurgitation 2020 ACC/AHA valve guidelines



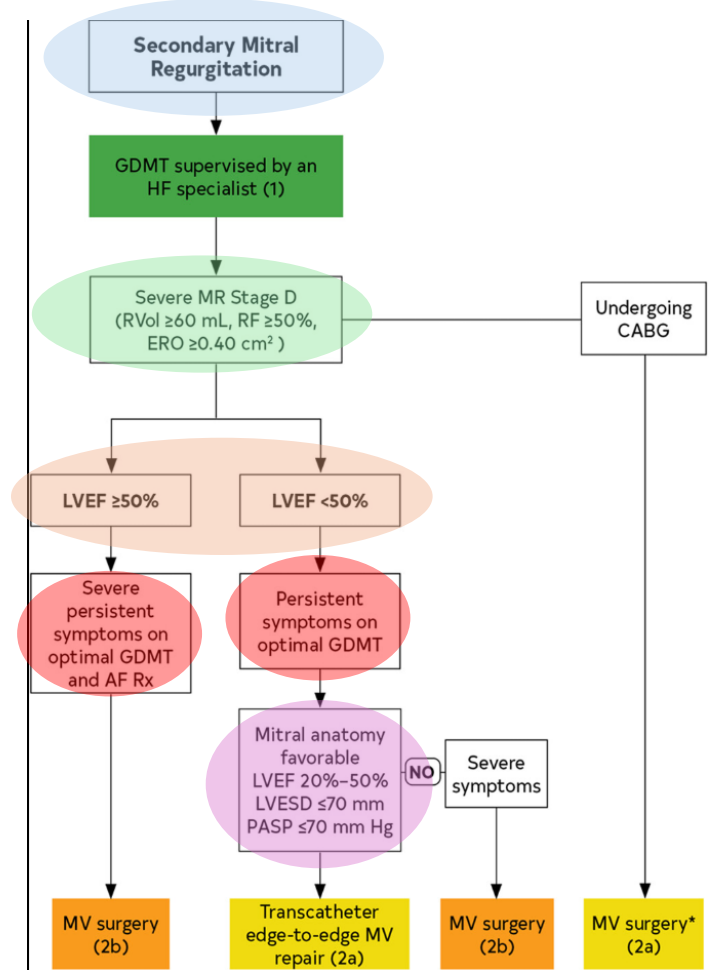
MR mechanism

MR severity

LV size/function

MV anatomy for surgical or transcatheter repair

Symptoms



TTE

TEE

Stress Echo

Evaluation of MR: TTE is your workhorse

MR severity

MR mechanism

LV size and function

Estimation of PA pressure

Recommendations for Diagnostic Testing: Initial Diagnosis of Chronic MR
Referenced studies that support the recommendations are summarized in [Online Data Supplement 25](#).

COR	LOE	Recommendations
1	B-NR	1. In patients with known or suspected primary MR, TTE is indicated for baseline evaluation of LV size and function, RV function, LA size, pulmonary artery pressure, and the mechanism and severity of primary MR (Stages A to D). ¹⁻⁵

Diagnosis

Recommendation for Diagnostic Testing: Changing Signs or Symptoms in Patients With Primary MR
Referenced studies that support the recommendation are summarized in [Online Data Supplement 26](#).

COR	LOE	Recommendation
1	B-NR	1. In patients with primary MR (Stages B to D) and new-onset or changing symptoms, TTE is indicated to evaluate the mitral valve apparatus and LV function. ^{1,2}

Change in Sx

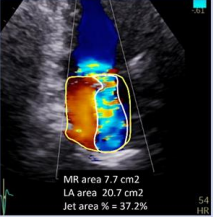
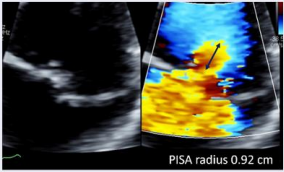
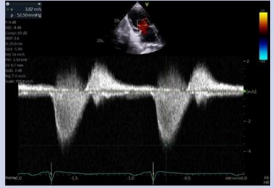
Recommendations for Diagnostic Testing: Routine Follow-Up for Chronic Primary MR
Referenced studies that support the recommendations are summarized in [Online Data Supplement 27](#).

COR	LOE	Recommendations
1	B-NR	1. For asymptomatic patients with severe primary MR (Stages B and C1), TTE is indicated every 6 to 12 months for surveillance of LV function (estimated by LVEF, LVEDD, and LVESD) and assessment of pulmonary artery pressure. ¹⁻¹¹

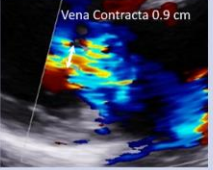
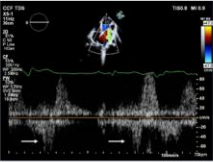
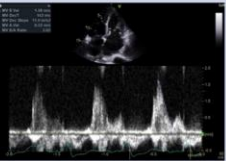
Routine follow up

MR severity

Qualitative

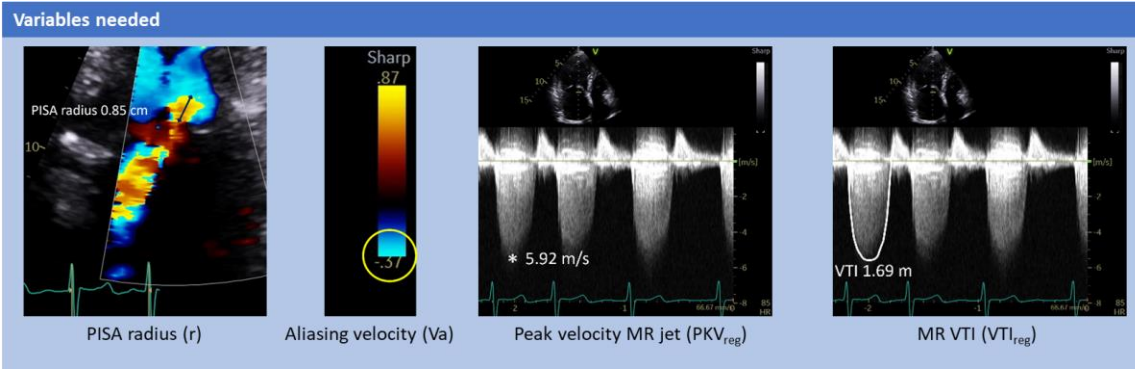
Method	Description	Example	Definition of Severe
Jet area	Apical view. Measure largest jet area compared to left atrial area		>50% LA
Flow convergence	Shift the Nyquist baseline in the direction of the regurgitant jet to see hemispheric flow convergence. Measure PISA radius from vena contracta to point of color aliasing.		Large, holosystolic
CW jet	Align CW with MR jet		Dense, holosystolic, triangular

Semi quantitative

Method	Description	Example	Definition of Severe
Vena contracta width	The narrowest segment of the color jet, typically at the level of the regurgitant orifice.		> 0.7 cm
Pulmonary vein flow	PW 1 cm into pulmonary vein		Systolic flow reversal
Mitral inflow	PW at the leaflet tips in the apical four chamber view		E velocity >1.2 m/s E wave dominant

MR severity

Quantitative

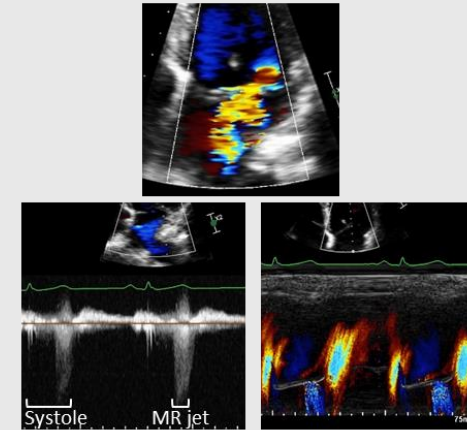


Parameter	Equation	Sample calculation
Regurgitant flow (Rflow, mL/sec)	$2\pi r^2 \times V_a$	$2\pi(0.85)^2 \times 0.37 = 1.67$ mL/sec
EROA (cm^2)	$Rflow / PKV_{reg}$	$1.67 / 5.92 = 0.28$ cm^2
Regurgitation volume (Reg vol, mL)	$EROA \times VTI_{reg}$	$0.28 \times 1.69 = 0.48$ mL

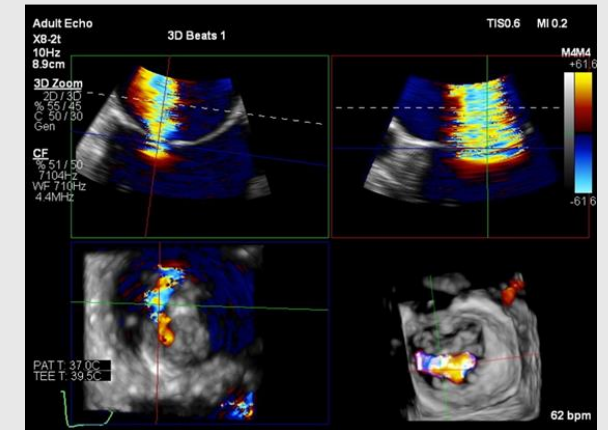
Cutoffs for severe:
 EROA > 0.40 cm^2
 Rvol > 60 mL

Inaccuracies of PISA method

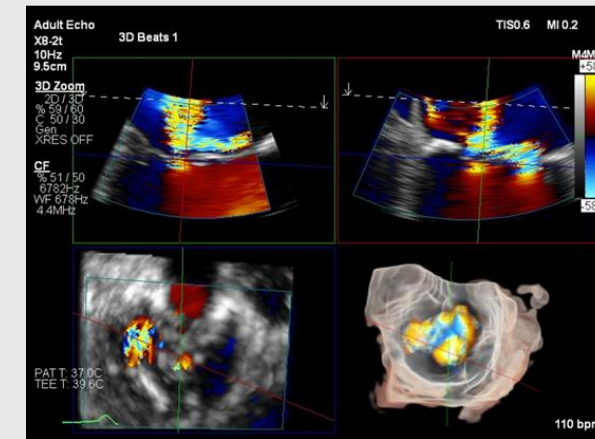
A: Non holosystolic MR



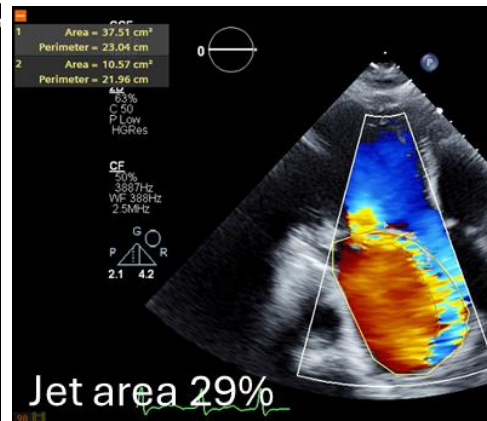
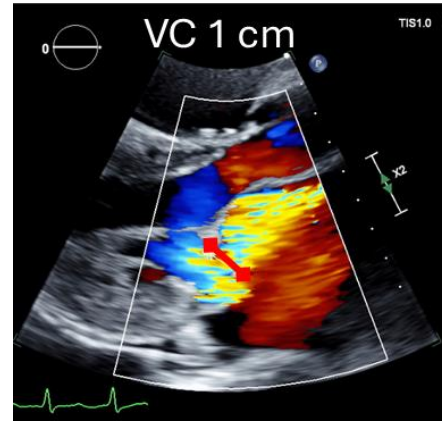
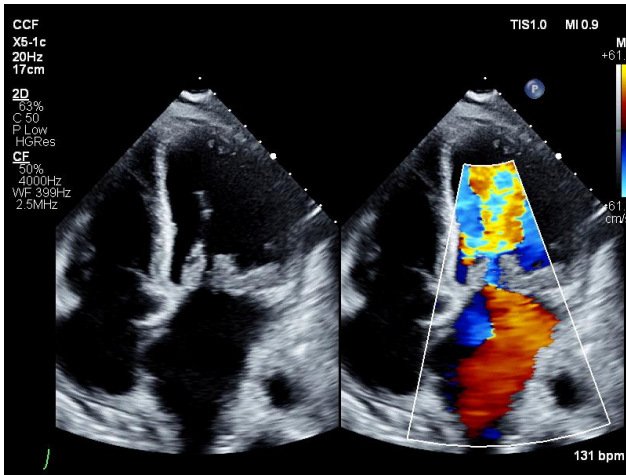
B: Non circular MR orifice



C: Multiple jets



Case: 55 yo referred for evaluation of MR



Qualitative:

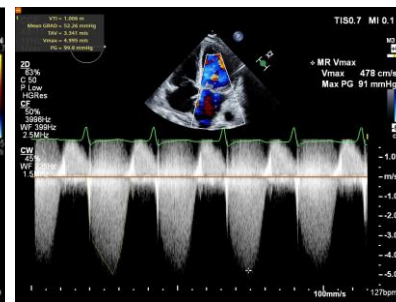
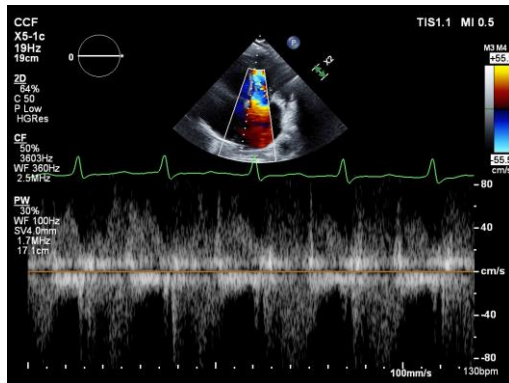
- Flail
- Large PISA
- Triangular dense CW

Semi Qualitative:

- VC 1 cm (> 0.7)
- PV reversal

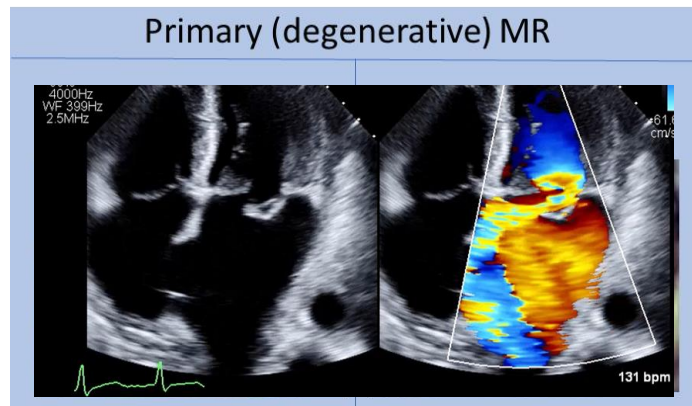
Quantitative

- EROA 2.8 cm²
- RV 280 mL/beat



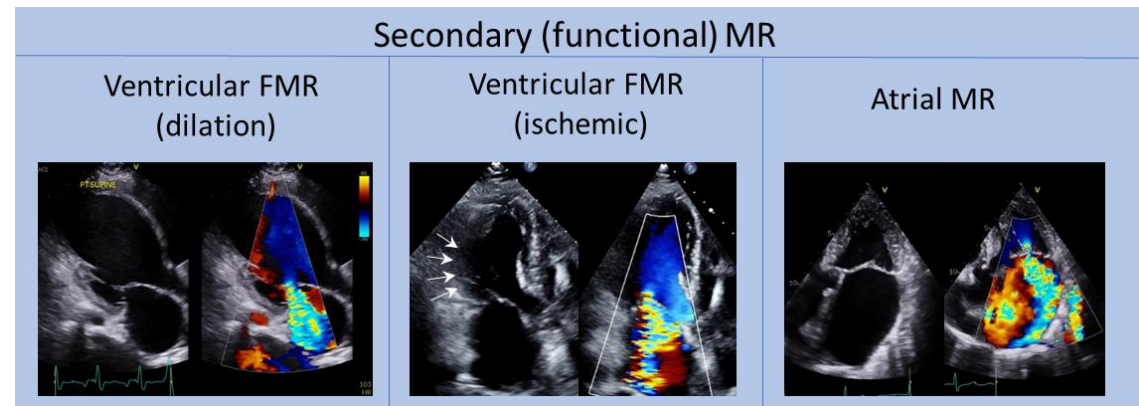
MR mechanism

Degenerative Mitral Regurgitation (DMR, Primary MR)



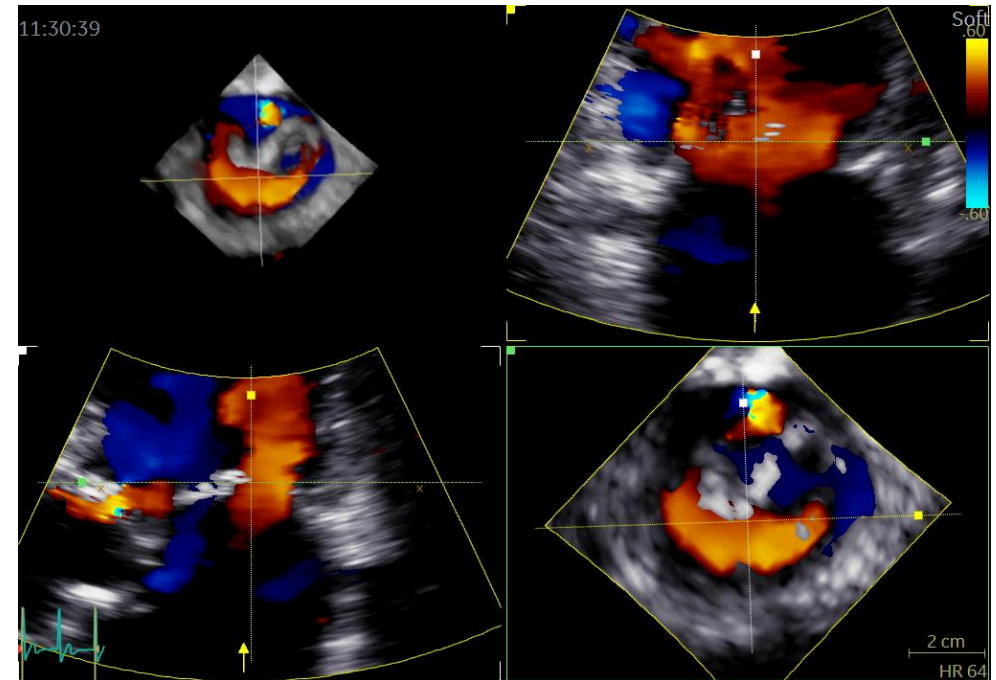
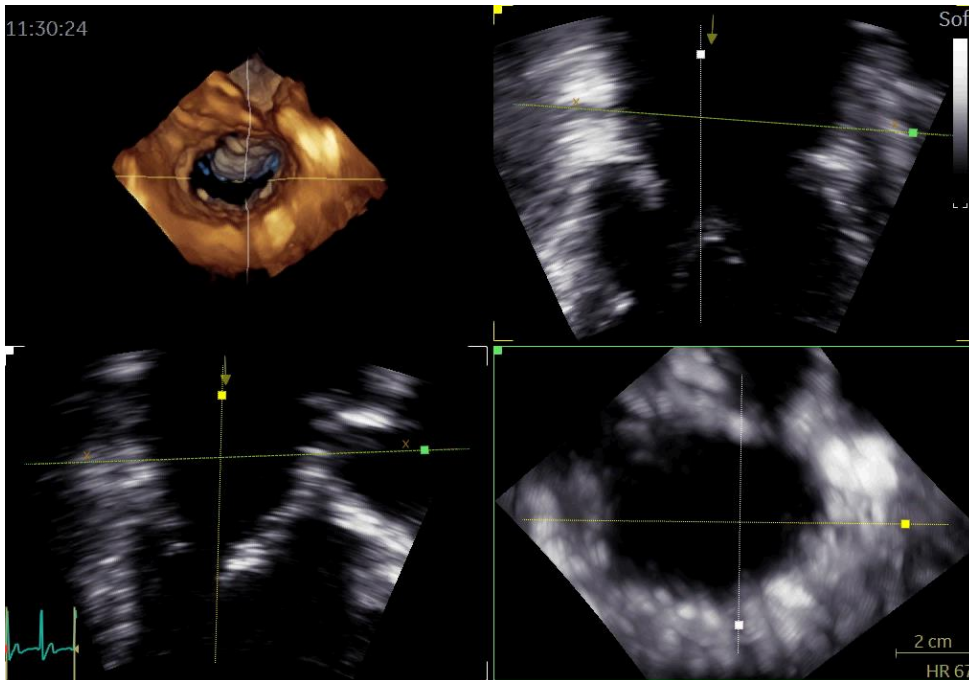
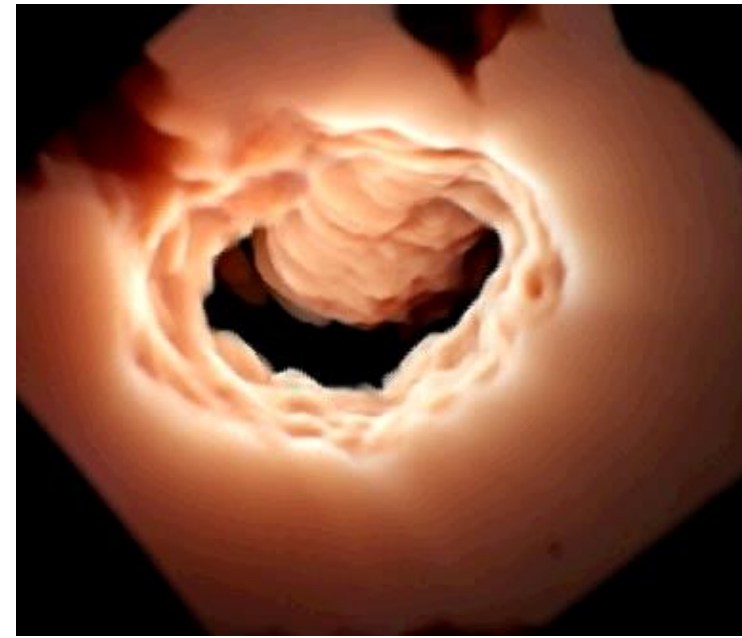
- Prolapse
- Flail
- Papillary muscle rupture
- Perforation
- Calcific changes
- Endocarditis
- Rheumatic

Functional Mitral Regurgitation (FMR, Secondary MR)

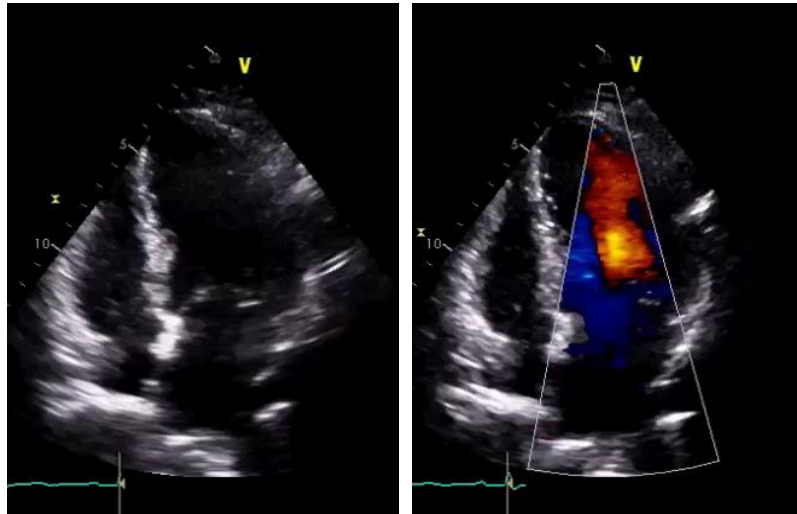


- Normal mitral leaflets but other forces cause dysfunction
- Several subtypes of FMR, and etiology may be mixed

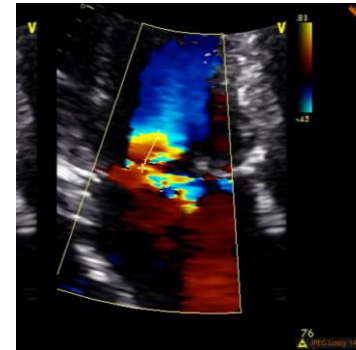
3D TTE: Anterior leaflet prolapse and flail



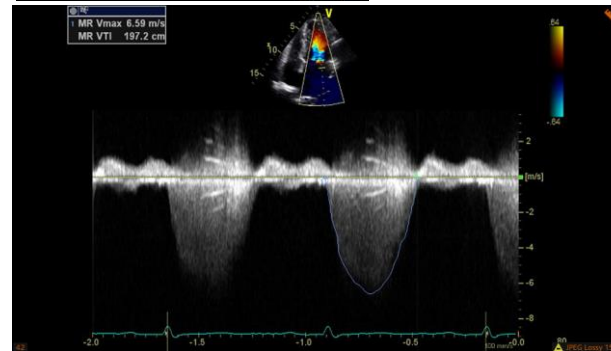
Case: 65 yo patient presents with newly diagnosed, severe primary mitral regurgitation. Overall she feels well but she's noticed some dyspnea with her favorite activity – Jazzercise.



- Normal LV size and function, EF 65%
- Severe MR 2/2 posterior prolapse



ERO 0.46 cm²
RV 90 mL/beat



1	B-NR	1. In symptomatic patients with severe primary MR (Stage D), mitral valve intervention is recommended irrespective of LV systolic function. ^{269,302}
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Should Patients With Severe Degenerative Mitral Regurgitation Delay Surgery Until Symptoms Develop?

A. Marc Gillinov, MD, Tomislav Mihaljevic, MD, Eugene H. Blackstone, MD, Kristopher George, MD, Lars G. Svensson, MD, Edward R. Nowicki, MD, MS, Joseph F. Sabik III, MD, Penny L. Houghtaling, MS, and Brian Griffin, MD

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

Methods. From January 1985 to January 2008, 4,586 patients had primary isolated mitral valve surgery for degenerative mitral regurgitation; 4,253 (93%) underwent repair. Preoperatively, 30% were in New York Heart Association (NYHA) class I (asymptomatic), 56% in class II, 13% in class III, and 2% in class IV. Multivariable analysis and propensity matching were used to assess association of symptoms (NYHA class) with cardiac structure and function and postoperative outcomes.

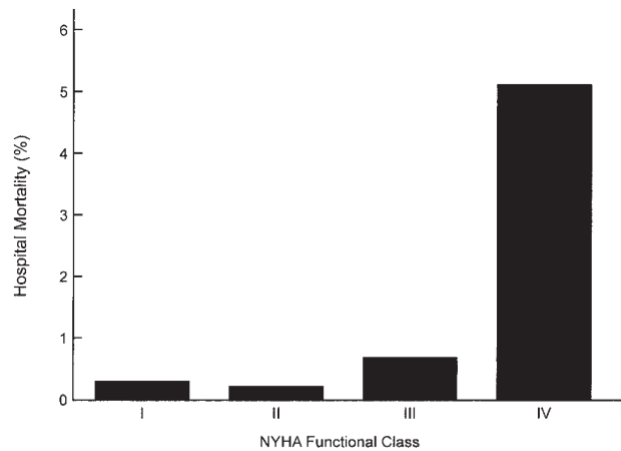


Fig 2. Hospital mortality according to preoperative New York Heart Association (NYHA) functional class.

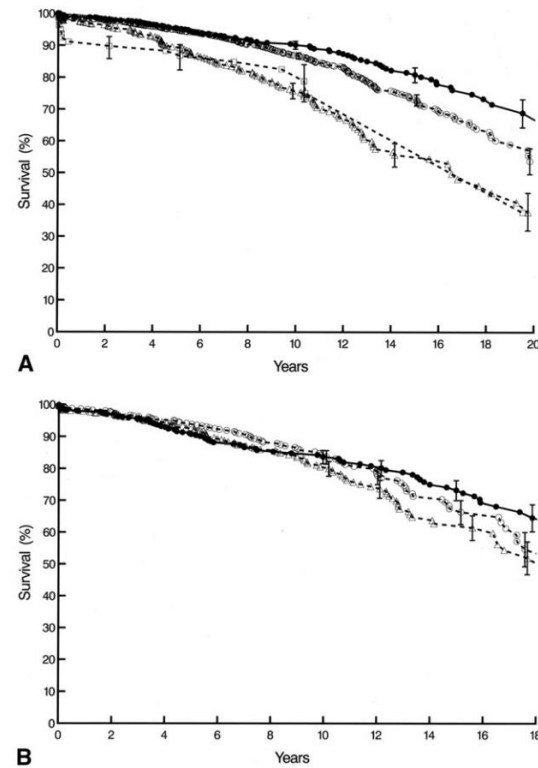


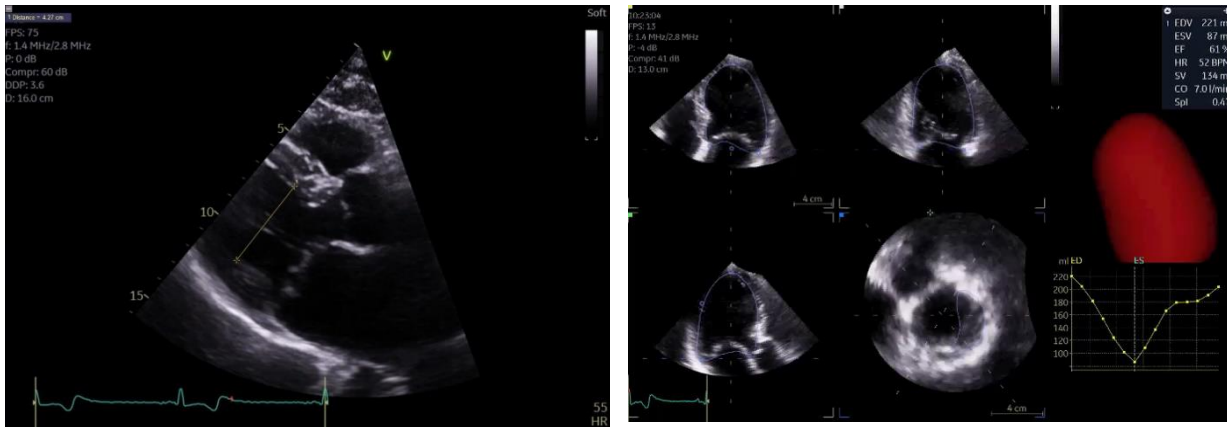
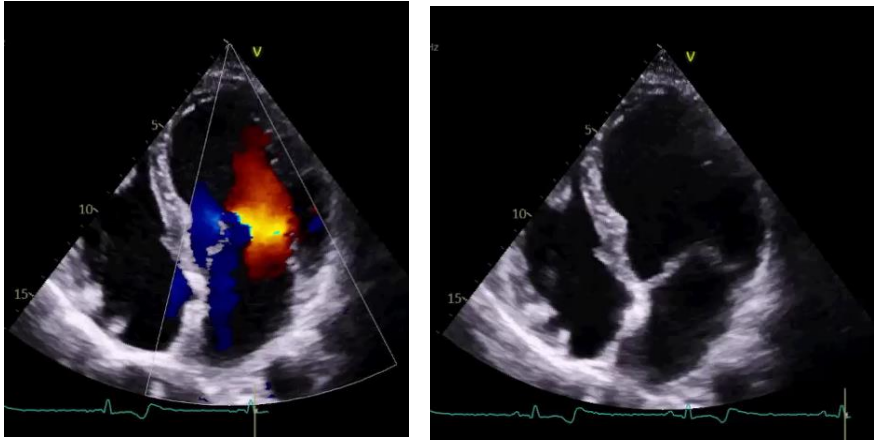
Fig 3. Survival according to New York Heart Association (NYHA) functional class. (A) Unadjusted survival. (Solid circles = class I; open circles = class II; triangles = class III; squares = class IV.) (B) Survival in propensity-matched groups. (Solid circles = class I; open circles = class II; triangles = class III/IV.)

Increasing NYHA functional class was associated with:

- Reduction in LV function
- Left atrial enlargement
- Atrial fibrillation
- Tricuspid regurgitation

Case:

68 yo incidentally diagnosed with severe MR after a murmur was heard on exam.
Asymptomatic.



Normal EF. But LV is dilated (LVESD > 40).

1	B-NR	2. In asymptomatic patients with severe primary MR and LV systolic dysfunction (LVEF \leq 60%, LVESD \geq 40 mm) (Stage C2), mitral valve surgery is recommended. ^{261,262,272,273,275,303-305}
2b	C-LD	5. In asymptomatic patients with severe primary MR and normal LV systolic function (LVEF >60% and LVESD <40 mm) (Stage C1) but with a progressive increase in LV size or decrease in EF on \geq 3 serial imaging studies, mitral valve surgery may be considered irrespective of the probability of a successful and durable repair. ³¹⁰



Survival Implication of Left Ventricular End-Systolic Diameter in Mitral Regurgitation Due to Flail Leaflets

A Long-Term Follow-Up Multicenter Study

Christophe Tribouilloy, MD, PhD,* Francesco Grigioni, MD, PhD,† Jean François Avierinos, MD,‡ Andrea Barbieri, MD,§ Dan Rusinaru, MD,* Catherine Szymanski, MD,* Marinella Ferlito, MD,† Laurence Tafaneli, MD,‡ Francesca Bursi, MD,§ Faouzi Trojette, MD,* Angelo Branzi, MD,† Gilbert Habib, MD,‡ Maria G. Modena, MD,§ Maurice Enriquez-Sarano, MD,||
 on behalf of the MIDA Investigators

Amiens and Marseille, France; Bologna and Modena, Italy; and Rochester, Minnesota

Lower survival with LVESD > 40 mm

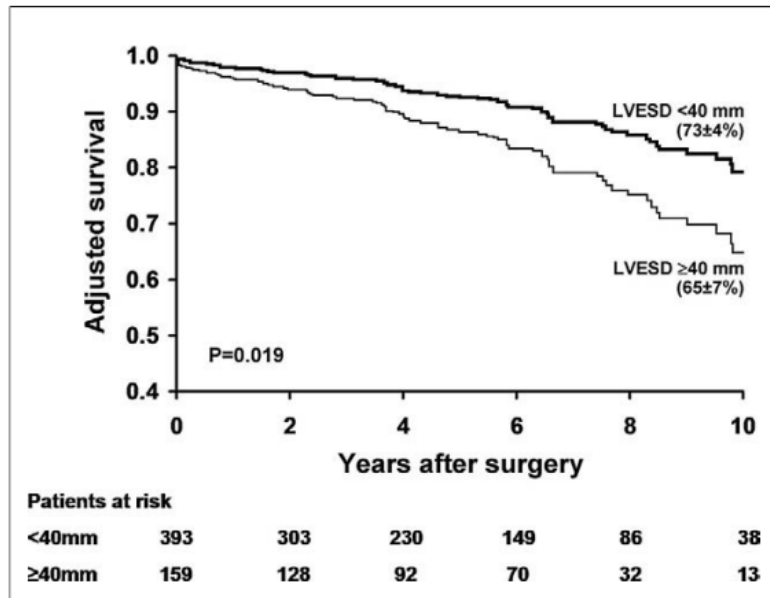


Figure 4 Adjusted Post-Operative Overall Survival According to LVESD in Operated Patients With Organic MR

Adjusted post-operative overall survival according to LVESD in operated patients with organic MR. Abbreviations as in Figure 1.

Echocardiographic Prediction of Survival After Surgical Correction of Organic Mitral Regurgitation

(*Circulation*. 1994;90:830-837.)

Maurice Enriquez-Sarano, MD; A. Jamil Tajik, MD; Hartzell V. Schaff, MD; Thomas A. Orszulak, MD; Kent R. Bailey, PhD; Robert L. Frye, MD

Methods and Results The survival of 409 patients operated on between 1980 and 1989 for pure, isolated, organic mitral regurgitation and with a preoperative echocardiogram (within 6 months of operation) was analyzed. The overall survival was 75% at 5 years (90% of expected), 58% at 10 years (88% of

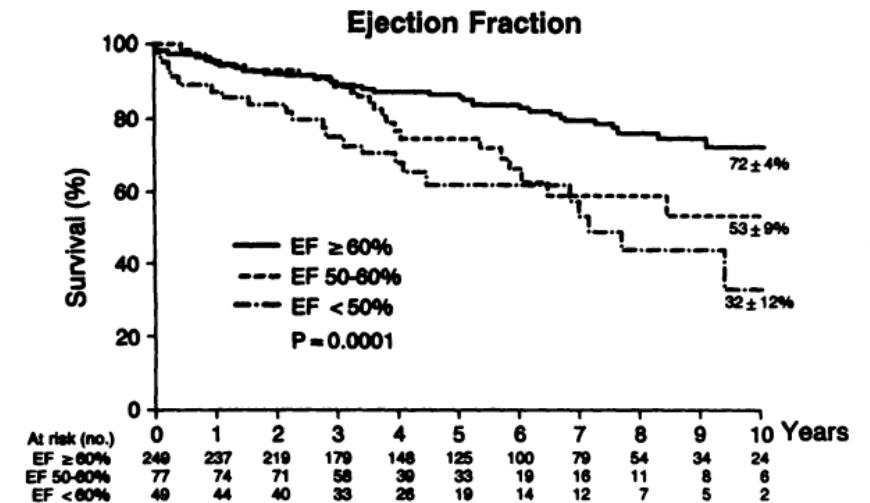
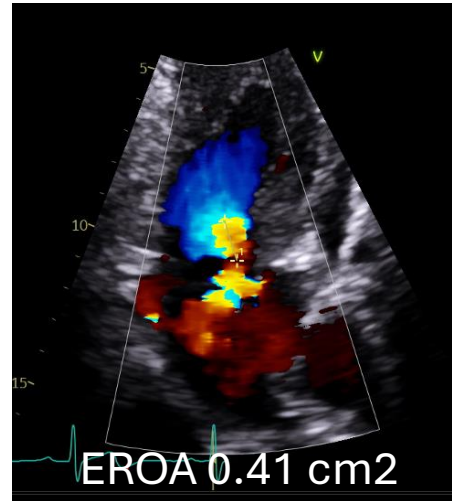
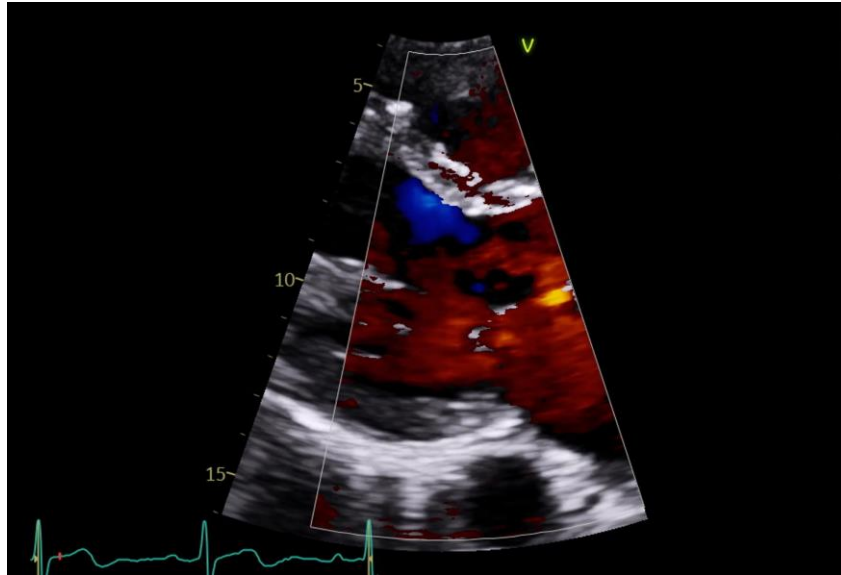


FIG 2. Graph of late survival of operative survivors according to preoperative echocardiographic ejection fraction (EF). Number at risk for each interval is indicated at bottom.

Case:

58 yo with mitral valve prolapse followed for years. Last echo showed severe MR. Asymptomatic, good exercise tolerance. Biplane EF 65%.



P2 prolapse



2a	B-NR	4. In asymptomatic patients with severe primary MR and normal LV systolic function (LVEF $\geq 60\%$ and LVESD ≤ 40 mm) (Stage C1), mitral valve repair is reasonable when the likelihood of a successful and durable repair without residual MR is $>95\%$ with an expected mortality rate of $<1\%$, when it can be performed at a Primary or Comprehensive Valve Center. ^{273,308,310}
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Original Investigation

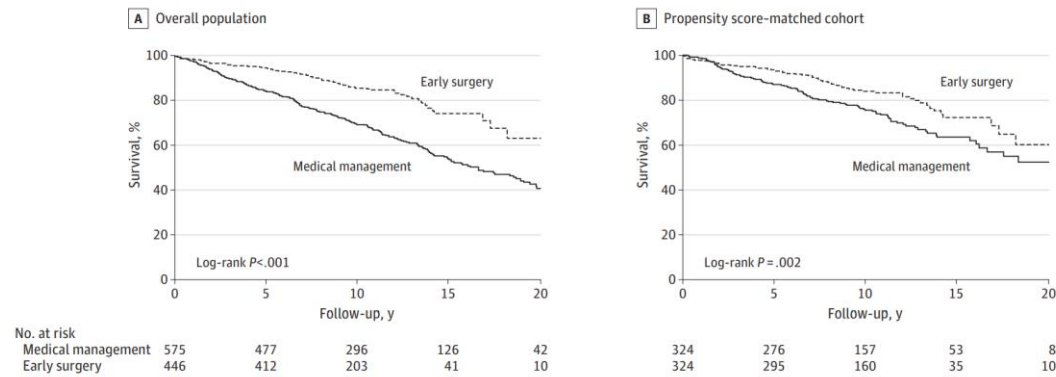
Association Between Early Surgical Intervention vs Watchful Waiting and Outcomes for Mitral Regurgitation Due to Flail Mitral Valve Leaflets

Rakesh M. Suri, MD, DPhil; Jean-Louis Vanoverschelde, MD; Francesco Grigioni, MD, PhD; Hartzell V. Schaff, MD; Christophe Tribouilloy, MD; Jean-Francois Avierinos, MD; Andrea Barbieri, MD; Agnes Pasquet, MD; Marianne Huebner, PhD; Dan Rusinaru, MD; Antonio Russo, MD; Hector I. Michelena, MD; Maurice Enriquez-Sarano, MD *JAMA*. 2013;310(6):609-616. doi:10.1001/jama.2013.8643

DESIGN, SETTING, AND PARTICIPANTS The Mitral Regurgitation International Database (MIDA) registry includes 2097 consecutive patients with flail mitral valve regurgitation (1980-2004) receiving routine cardiac care from 6 tertiary centers (France, Italy, Belgium, and the United States). Mean follow-up was 10.3 years and was 98% complete. Of 1021 patients with mitral regurgitation without the American College of Cardiology (ACC) and the American Heart Association (AHA) guideline class I triggers, 575 patients were initially medically managed and 446 underwent mitral valve surgery within 3 months following detection.

Early surgery better survival

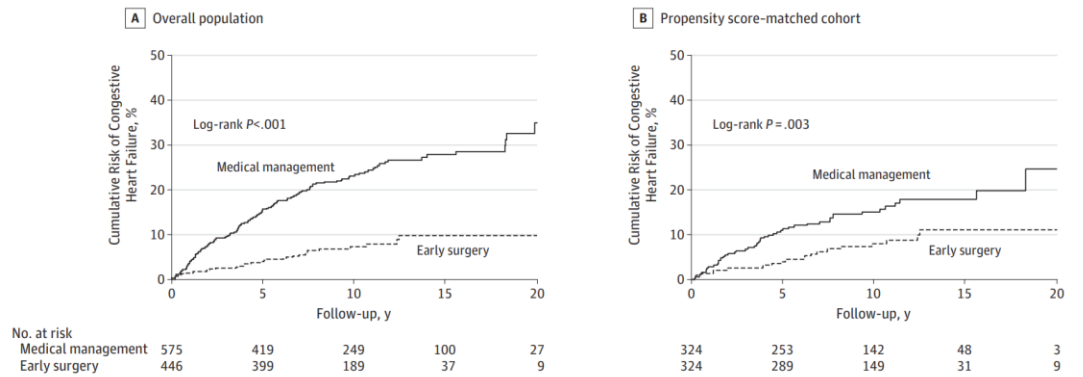
Figure 1. Survival After Diagnosis of Mitral Regurgitation Due to Flail Mitral Leaflet According to Initial Treatment Strategy



Long-term survival following early surgery vs initial medical management overall population (A) and in the propensity score-matched cohort (B).

Early surgery less CHF

Figure 2. Heart Failure Incidence After Diagnosis of Mitral Regurgitation Due to Flail Mitral Leaflet According to Initial Treatment Strategy



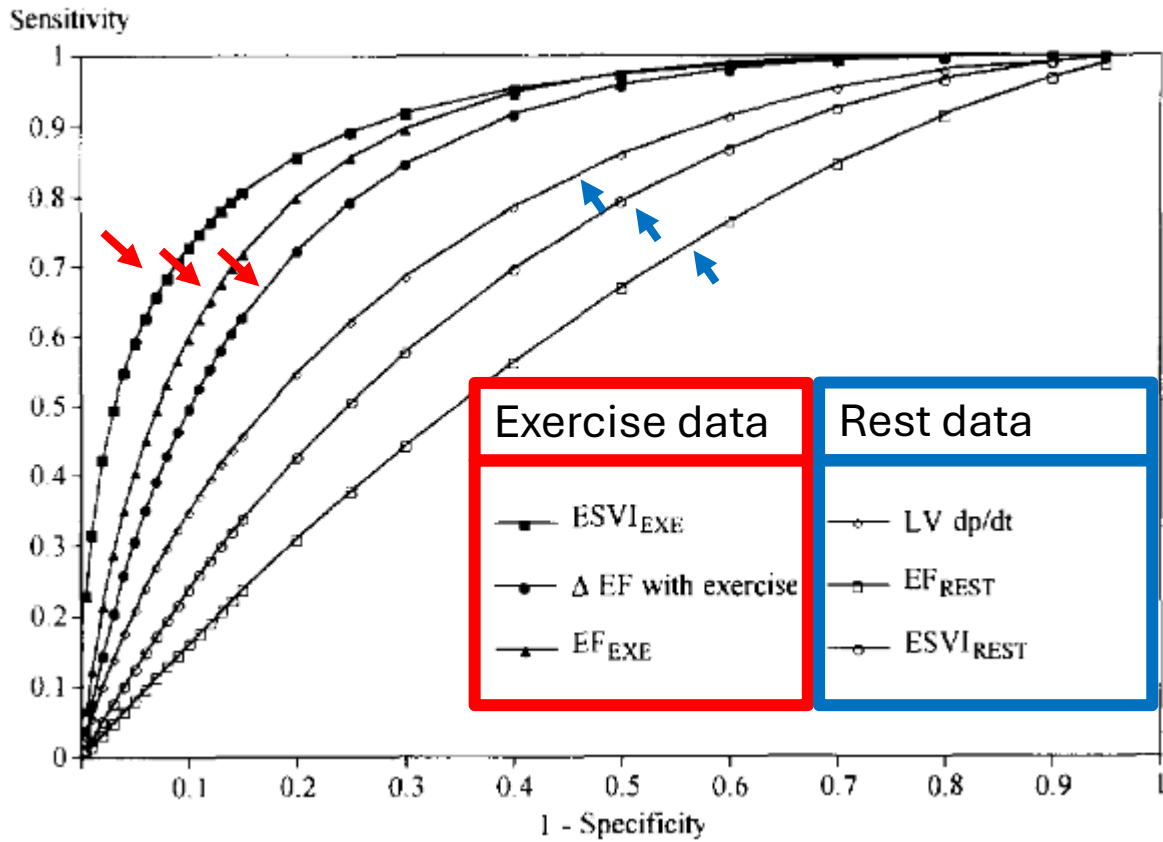
Long-term heart failure risk following early surgery vs initial medical management overall (A) and in the propensity score-matched cohort (B).

Thus far, all of the cases have been determined by TTE and clinical findings, when do we need further testing like exercise echo?

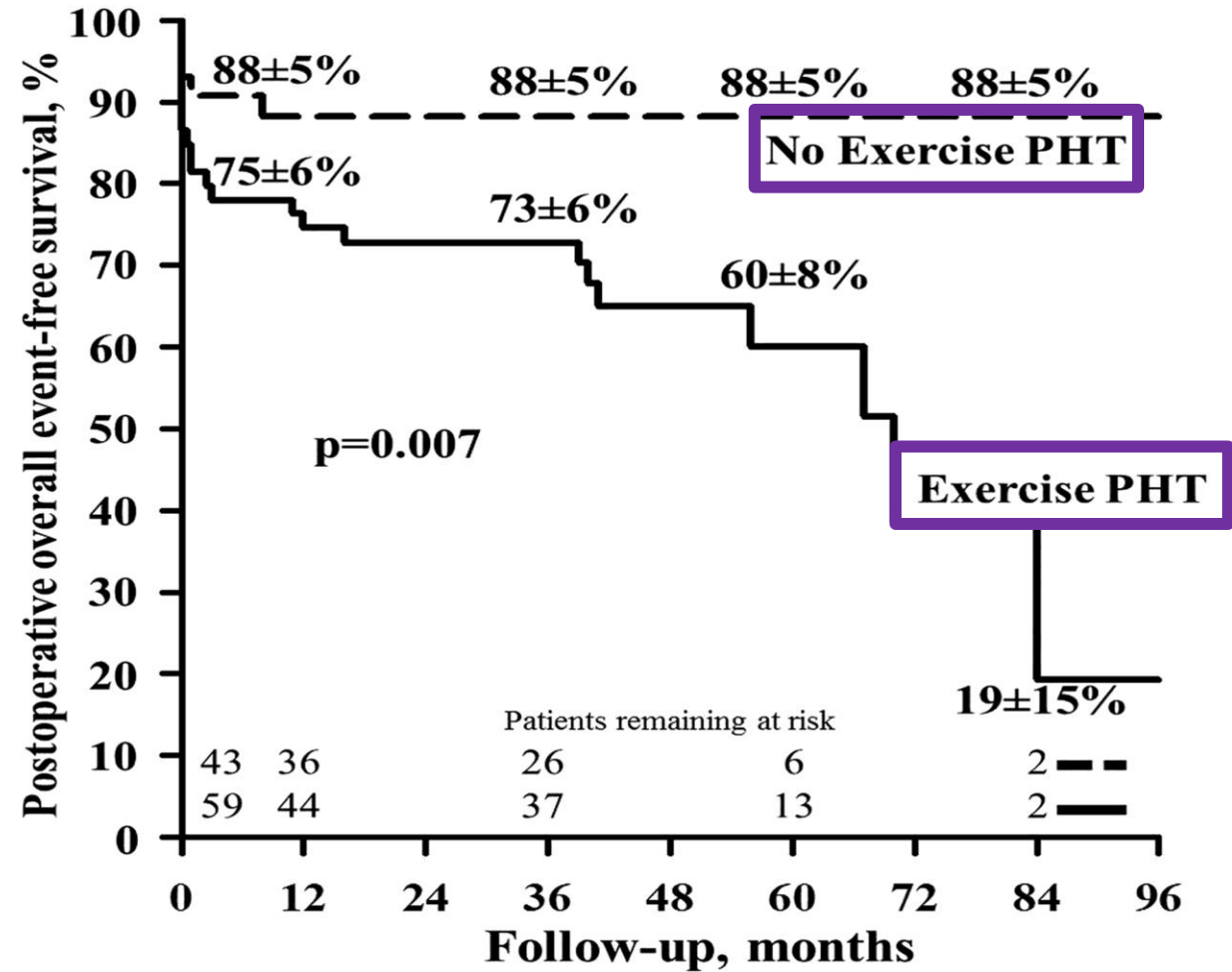
Exercise Echo

- Clarify symptoms/functional status
- Evaluate for change in MR severity
- Evaluate for development of pulmonary hypertension
- Evaluate for contractile reserve

2a	B-NR	1. In patients with primary MR (Stages B and C) and symptoms that might be attributable to MR, hemodynamic exercise testing using Doppler echocardiography or cardiac catheterization or cardiopulmonary exercise testing is reasonable. ²⁹⁰⁻²⁹³
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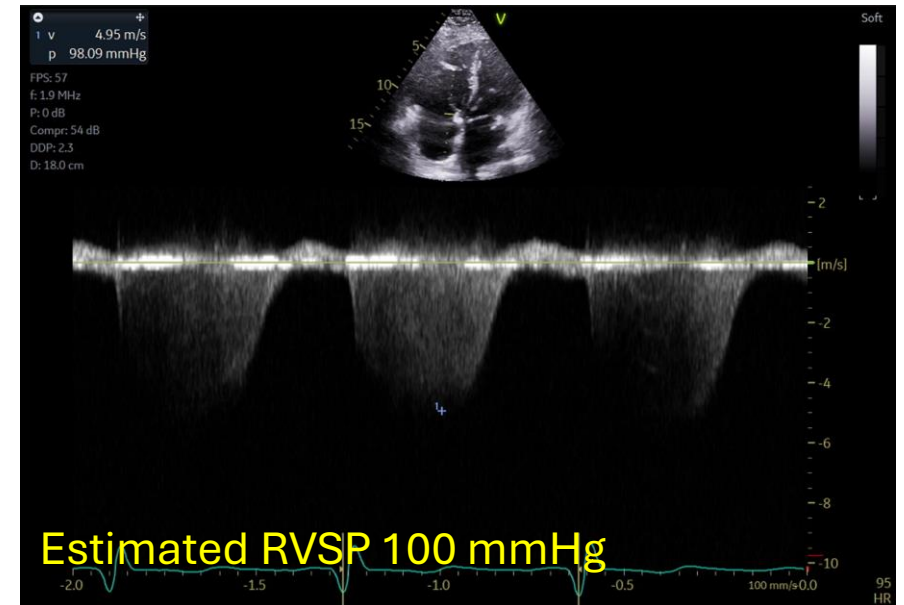
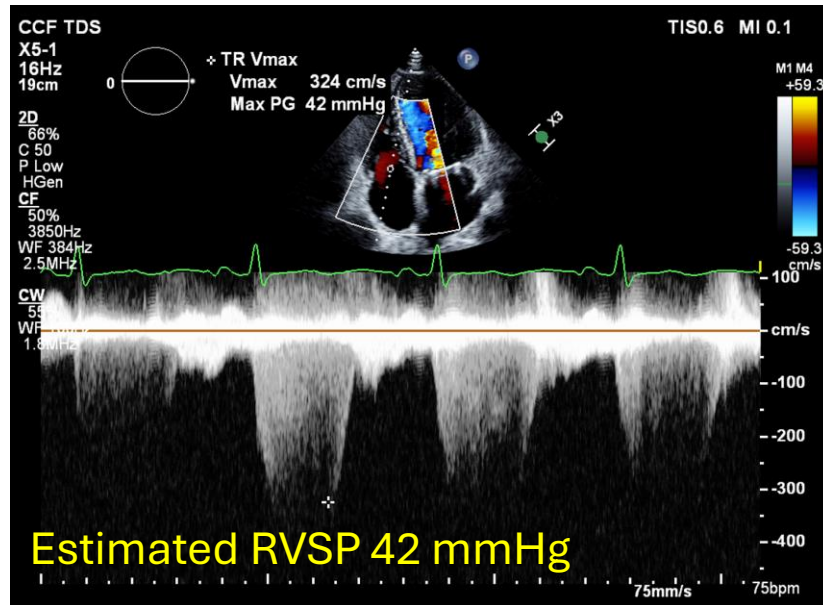
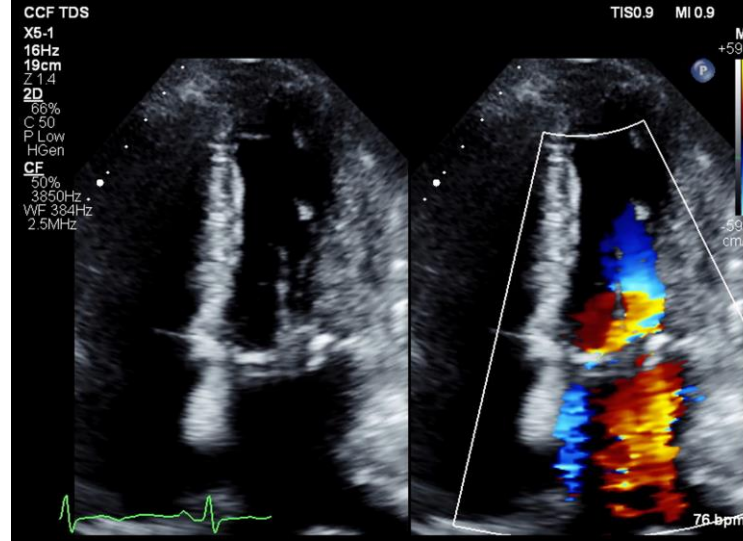


Leung DY, Griffin BP et al. Left ventricular function after valve repair for chronic mitral regurgitation: predictive value of preoperative assessment of contractile reserve by exercise echocardiography. J Am Coll Cardiol 1996;28:1198-205.



Magne J et al. Impact of exercise pulmonary hypertension on postoperative outcome in primary mitral regurgitation. Heart 2015;101:391-6.

Case: 61-year-old gentleman with asymptomatic severe primary mitral regurgitation after a failed MV repair



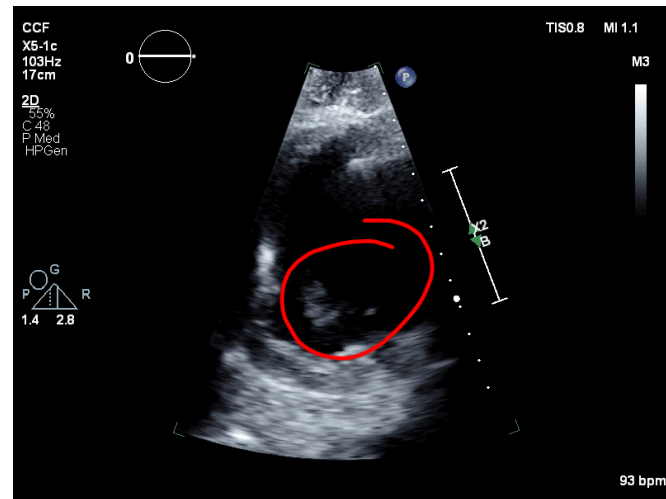
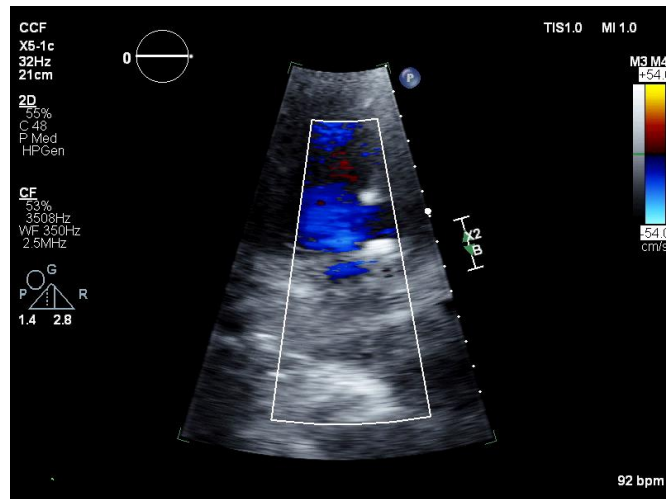
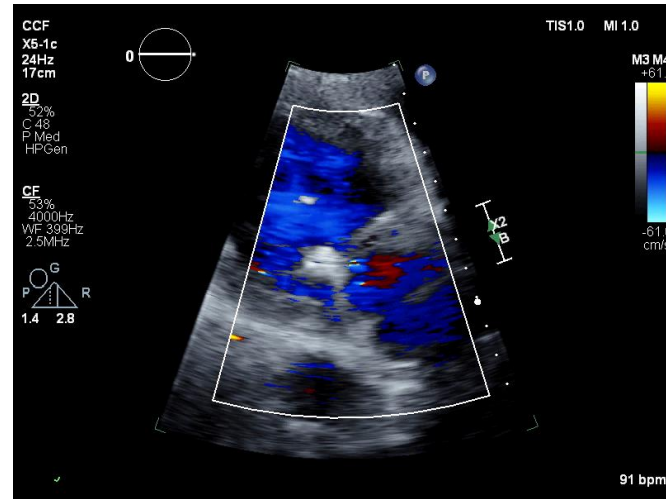
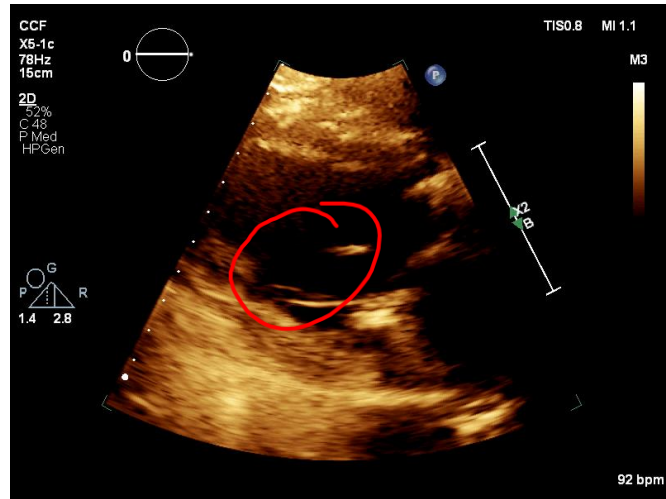
When do we need TEE?

1	C-EO	2. In patients with primary MR, when TTE provides insufficient or discordant information, TEE is indicated for evaluation of the severity of MR, mechanism of MR, and status of LV function (Stages B to D).
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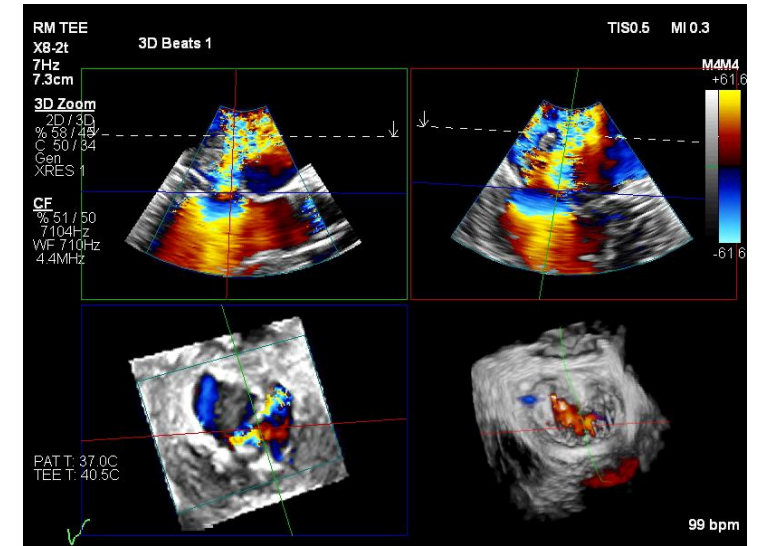
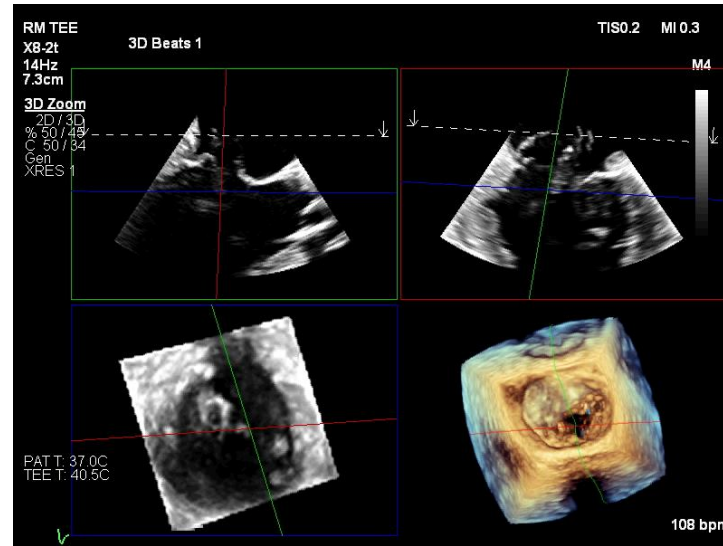
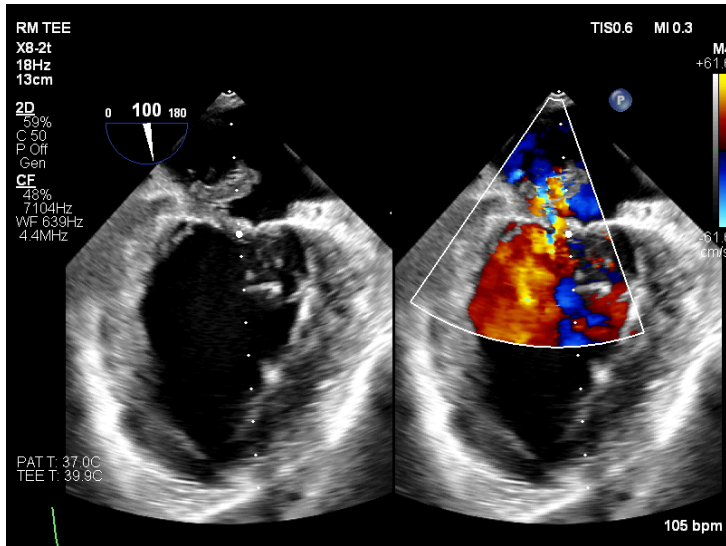
1	B-NR	3. In patients with chronic secondary MR with severe symptoms (Stage D) that are unresponsive to GDMT who are being considered for transcatheter mitral valve interventions, TEE is indicated to determine suitability for the procedure. ³⁻⁸
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- To clarify MR severity
- To clarify MR mechanism
- To determine intervention

Case: 61 yo transferred to the cardiac ICU with respiratory failure after a late presenting STEMI



TEE: Severe MR 2/2 ruptured pap muscle



TEE to clarify procedural candidacy

Transcatheter interventions

Surgical interventions

Leaflet (TEER)

MitraClip



Abbott.com


Pascal



Edwards.com


Annulus

Carillon



Mitral annulus dilation before implantation of Carillon device

Cardioband




Mitral annulus remodelled with Carillon device


Edwards.com

TMVR


Innovalve (TWIST)



Cephea (Abbott)



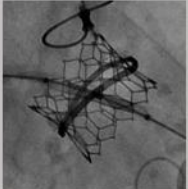
M3 (Edwards)



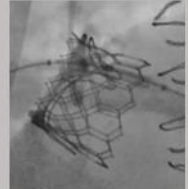
Edwards.com

"Valve in"

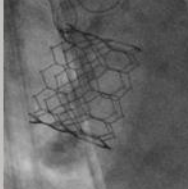
Valve in Ring



Valve in valve



Valve in MAC



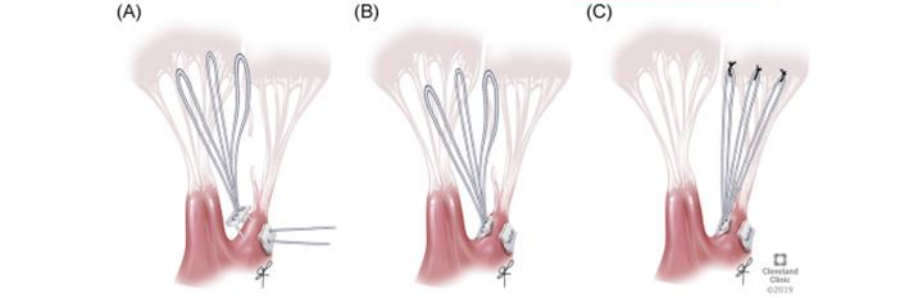
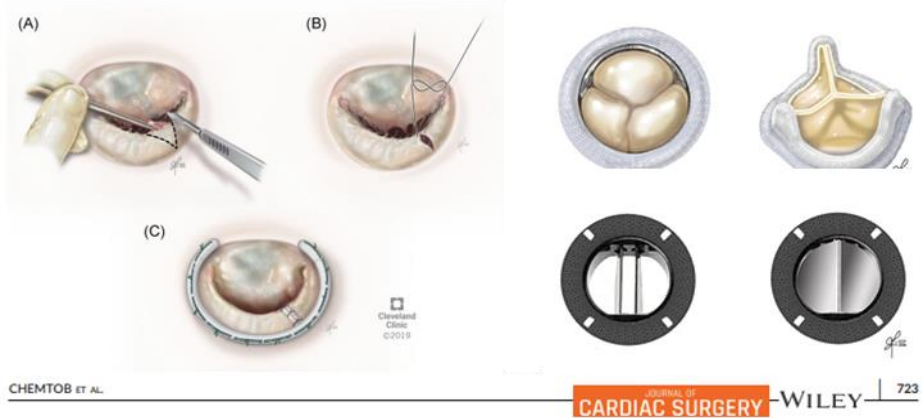
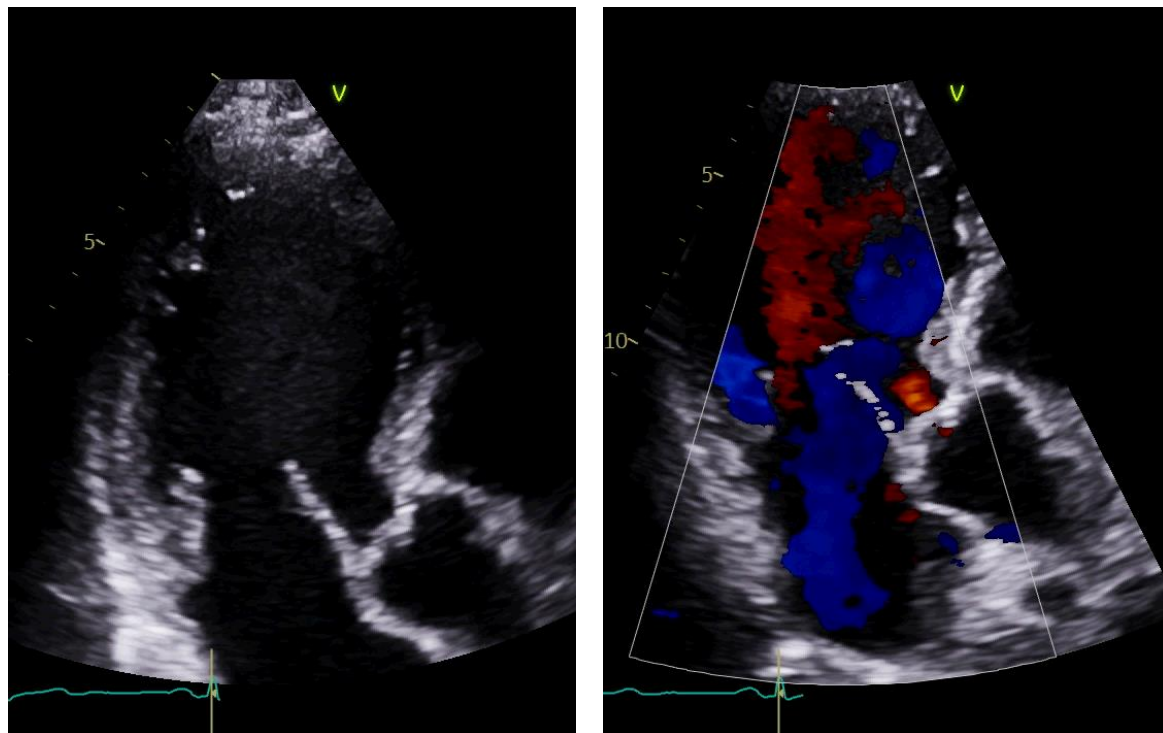


FIGURE 6 Nonresectional mitral valve repair using premeasured chordal loops. A normal chord adjacent to the area of prolapse is measured with a caliper, establishing the desired length of the neochordal loops. The premeasured chordal loops are attached to the papillary muscle (A-B). Separate sutures are used to attach the loops to the leaflet edge in the area of the prolapse (C)

J Card Surg. 2019;34:717-727.

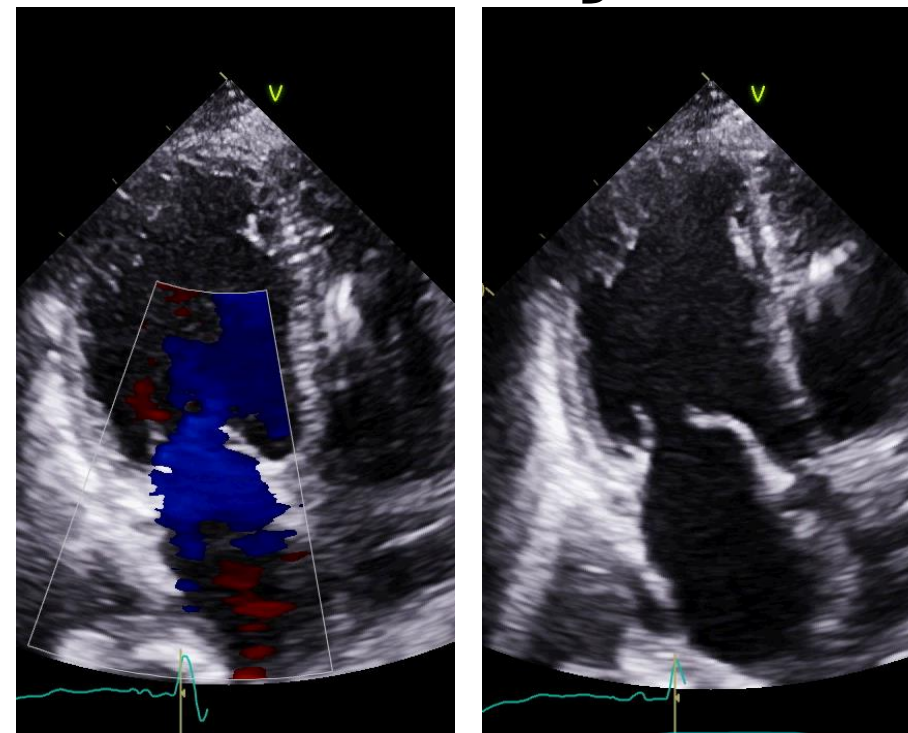
When do we consider mitral TEER?

Primary MR



2a	B-NR	6. In severely symptomatic patients (NYHA class III or IV) with primary severe MR and high or prohibitive surgical risk, transcatheter edge-to-edge repair (TEER) is reasonable if mitral valve anatomy is favorable for the repair procedure and patient life expectancy is at least 1 year. ^{311,312}
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Secondary MR



2a	B-R	1. In patients with chronic severe secondary MR related to LV systolic dysfunction (LVEF <50%) who have persistent severe symptoms (NYHA class II, III, or IV) while on optimal GDMT for HF (Stage D), TEER is reasonable in patients with appropriate anatomy as defined on TEE and with LVEF between 20% and 50%, LVESD ≤70 mm, and pulmonary artery systolic pressure ≤70 mm Hg. ^{318,338-344}
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How do we determine favorable anatomy?


ASE guidelines

Table 4 MV Imaging protocol

Imaging level: ME view 0-20°

Acquisition protocol:

- From the ME 4Ch view focused on the MV (0-20°) multiple plane angle may be necessary to eliminate the AV and the LVOT.
- To better align the MV, slight probe retroflexion may be necessary. Use tilt plane to illustrate simultaneous biplane image.



Planar imaging **Volumetric imaging** **Functional imaging**

A ME 4Chamber/2Chamber

B ME 4-Chamber View

Degenerative Mitral Stenosis

C Rheumatic Mitral Stenosis

MVOA = 1.2 cm²

A From a 3D volume, the mitral annulus can be measured using dedicated software (shown) or direct planimetry using multiplane reconstruction.

B Three-dimensional en face view from the degenerative MS case in planar image **B** shows the mitral annular calcium on the base of the A3

C CW Doppler of the mitral regurgitant jet is required for quantitation; peak velocity is used for PISA effective orifice area calculation, and the MRVTI is used to quantify regurgitant volume.

D PW Doppler at the MV annulus is used to quantify diastolic SV; in this case, 162 mL/beat.

E CW Doppler of transmitral diastolic flow allows quantitation of peak/mean gradient.

(Continued)

Table 4 (Continued)

Imaging level: ME mitral commissural view 50-70°

B. Four-chamber view of degenerative MS with mitral annular calcium on the base of the anterior leaflet (yellow asterisk) and posterior leaflet (red asterisk) with the latter protruding into the MV orifice.

C. Three-dimensional multiplane reconstruction of a rheumatic MS patient, used to planimeter the MV orifice area.

scallops (yellow asterisk) and P2 scallops (red asterisk).

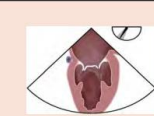
pressure half-time, and VTI. In this example from a patient with rheumatic MS, the VTI was used in the continuity equation to calculate a MV area of 1.28 cm².

Note: Although not shown for every level of imaging, PW and CW Doppler as well as color Doppler assessment could be performed from any imaging plane of the MV that aligns the ultrasound beam with flow. These imaging planes will typically result in the most accurate Doppler spectral profiles.

Imaging level: ME mitral commissural view 50-70°

Acquisition protocol:

- Identify the mitral commissural view anatomically optimized to the MV plane (-50-70°).
- Systematic biplane through MV leaflets permits sweeping interrogation of MV coaptation (central, lateral, and medial tilts) with 2D color Doppler by maintaining the biplane tilt angle.



Planar imaging **Volumetric imaging** **Functional imaging**

A ME Commissural/3Ch A2/P2

B ME Commissural/3Ch A1/P1

C ME Commissural/3Ch A3/P3

(Continued)

Table 4 (Continued)

Imaging level: ME mitral commissural view 50-70°

A. Mitral commissural view images the anterior leaflet in the center (A2) and the posterior leaflet on either side (P2 left/medial and P1 right/lateral). Simultaneous biplane image shows MV long-axis view with anterior (A2) and posterior (P2) leaflets.

B. Mitral commissural view with the simultaneous biplane tilt through lateral portion of the MV leaflets (A1/P1 coaptation zone).

C. Mitral commissural view with the simultaneous biplane tilt through medial portion of the MV leaflets (A3/P3 coaptation zone).

A. Three-dimensional live imaging (narrow volume) may be particularly useful to verify appropriate multiplane angle for commissural view.

B. Three-dimensional en face view of the MV during systole with the AV at 12 o'clock. The imaging planes of the lateral scallops (A1/P1, red line), midline scallops (A2/P2, green line) and medial scallops (A3/P3, blue line) are shown. In this patient the AV may be seen from all three commissural imaging planes (see planar imaging views) given the size/orientation of the aorta in this patient.

A. Mitral commissural view with 2D color Doppler illustrating the broad-based MR jet in the simultaneous biplane images. Central tilt plane denotes cutting plane through anterior and posterior leaflets (A2/P2).


B. Mitral commissural view with 2D color Doppler and lateral tilt plane that denotes cutting plane through anterior and posterior leaflets (A1/P1).

C. Simultaneous biplane imaging based on mitral commissural view with the tilt plane moved medially denotes cutting plane through anterior and posterior leaflets (A3/P3).

Imaging level: ME mitral view 80-100°

Acquisition protocol:

- From the ME 2Ch view focused on the MV. To better align the MV, slight probe retroflexion may be necessary. Use tilt plane to illustrate simultaneous biplane images.
- Three-dimensional acquisitions with and without color benefit from multibeam acquisition (improved temporal resolution).



Planar imaging **Volumetric imaging** **Functional imaging**

A ME 2Ch/4Ch

A 3D en face View

B PW RUPV

B PW LUPV

A The long-axis view, which usually images the anterior leaflet (A2) and posterior leaflet (P2), is useful for imaging leaflet morphology (rheumatic doming in this example) but also the LVOT and AV.

A. New 3D rendering modes may allow more rapid assessment of valve morphology and function. In this example of a transparency rendering of 3D color Doppler, the origin of the wide regurgitant jet of functional MR is easily seen.

A. To calculate the EROA by PISA method, the color Doppler baseline is shifted in the direction of regurgitant flow, and the radius of the PISA shell is measured from the vena contracta to the color shift from (in this case) yellow to blue (yellow arrow).

(Continued)

Table 4 (Continued)

Imaging level: ME mitral view 80-100°

A. Biplane imaging from the ME 2Ch view with orthogonal inverted 4Ch view.

A. Three-dimensional rendering of the MV from the standard surgical en face view with the AV at 12 o'clock. The anterior leaflet is on top, posterior leaflet at the bottom.

B. Three-dimensional rendering of the MV from a nonstandard view, obtained without z rotation. The AV is at 6 o'clock and the posterior leaflet is on top. This view may improve imaging of posterior leaflet pathology.


A. Reversal of flow in the pulmonary veins is a specific sign for hemodynamically significant MR. Flow in all four pulmonary veins can be assessed by PW Doppler. This is an example of late systolic flow reversal (yellow arrows) in the RUPV in the patient with fall P2 scallops.

B. Late systolic reversal of flow (yellow arrows) is also seen in the LUPV.

Imaging level: ME mitral view 120-140°

Acquisition protocol:

- From the ME long-axis view focused on the MV. To better align the MV, slight probe rotation, clockwise or counterclockwise, may be necessary. Use tilt plane to illustrate simultaneous biplane image.



Planar imaging **Volumetric imaging** **Functional imaging**

A TG Left Ventricle

B TG Mitral Valve

A 3D en face View

B 3D Lateral View

A Proximal Isovelocity Surface Area (PISA)

B Flail P2 Scallop

A Secondary MR

B VCA = 1.0 cm²

(Continued)

Table 4 (Continued)

Imaging level: ME mitral view 120-140°

B. The systolic mitral-aortic annular angle (α), which is used to assess the risk of LVOT obstruction.

C. Degenerative MV leaflet measurements include flail gap, anterior leaflet length, and the C-sept distance.

D. Measurements of tethered leaflets include coaptation length and depth.

Imaging level: TG views

Acquisition protocol:

- Following insertion of the probe past the lower esophageal sphincter into the stomach, antelexion results in imaging of the left ventricle.
- Further antelexion from a midventricular view brings the imaging plane to the base of the left ventricle and images the MV.
- Further retroflexion from the midventricular view images the LV apex.

B. The same α volume is measured from the anterior valve and posterior view.

(Continued)

- Very comprehensive. Details every possible view of the mitral valve.

The key to structural imaging is understanding what questions are being asked and... *answer them.*

Key Questions for M-TEER

Can we adequately **reduce the MR?**

- **Where is the MR?**
 - Central vs medial or lateral
 - Focal origin vs broad or multiple jets
- **Are the leaflets graspable?**

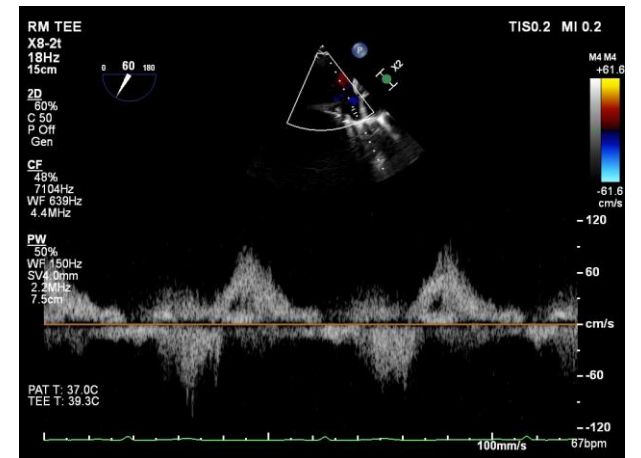
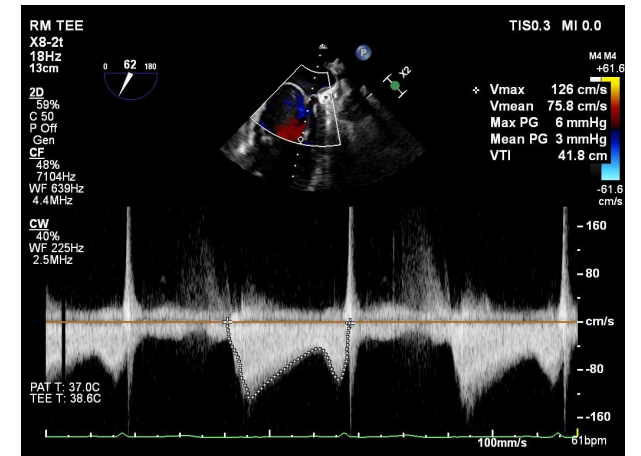
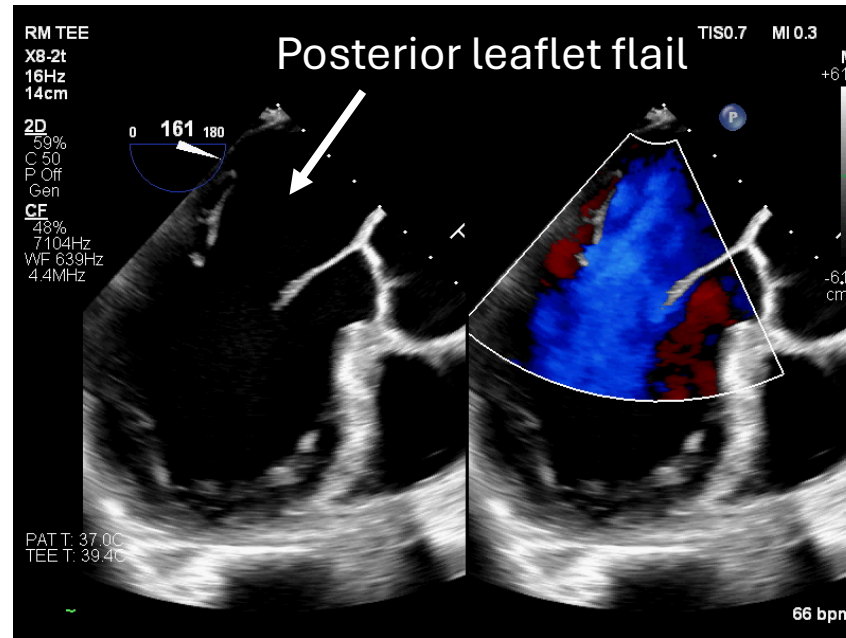
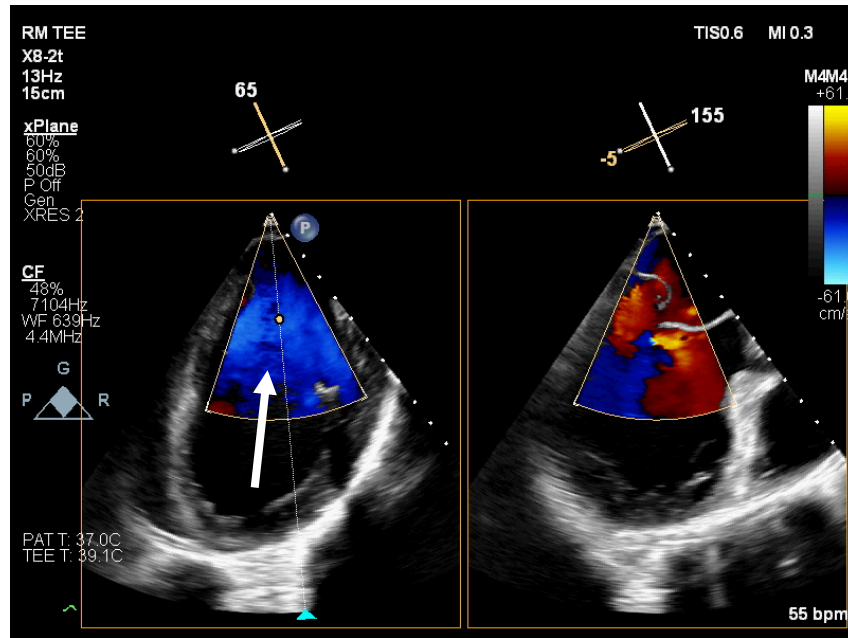
Will we cause **mitral stenosis?**

- Ideal mean gradient (<5 mmHg)
- Ideal MVA >4 cm²
- Rheumatic, radiation or calcific disease higher risk

Other **procedural challenges?**

- Complex anatomy?
- Transseptal puncture?
- Imaging challenges?

Case: 91 yo with dyspnea on exertion, can no longer golf without stopping to catch his breath

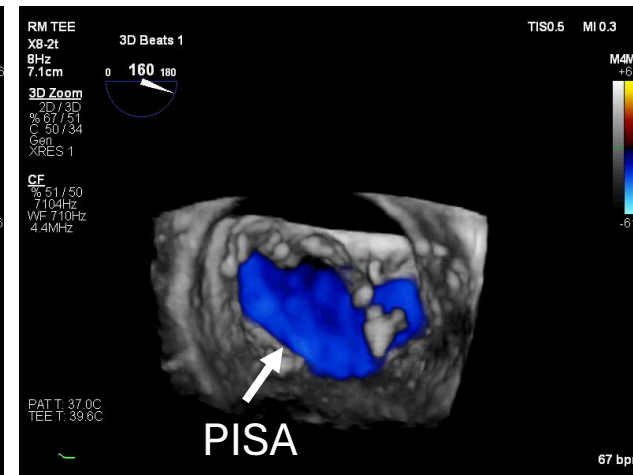
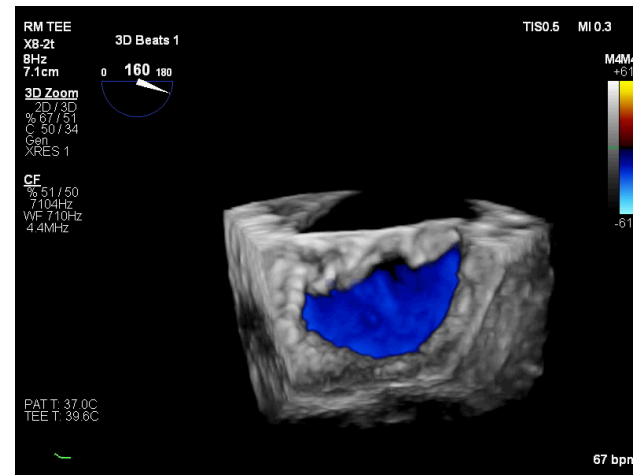
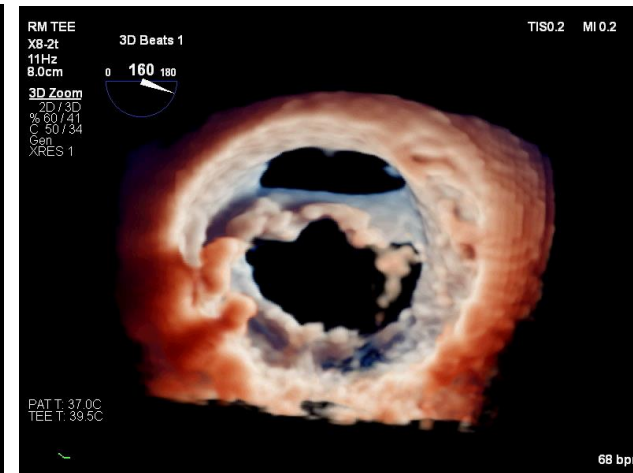
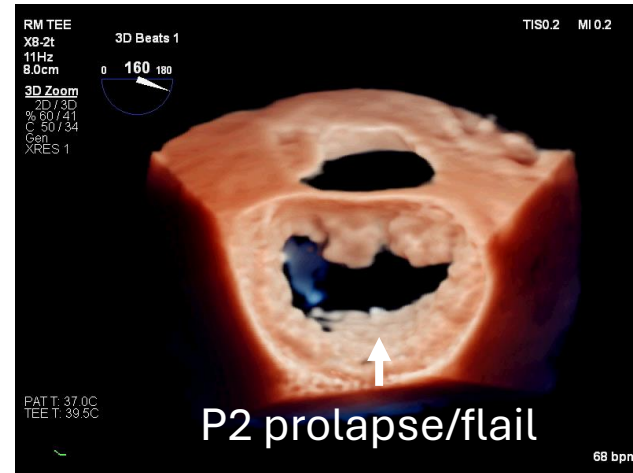


P2 prolapse and flail

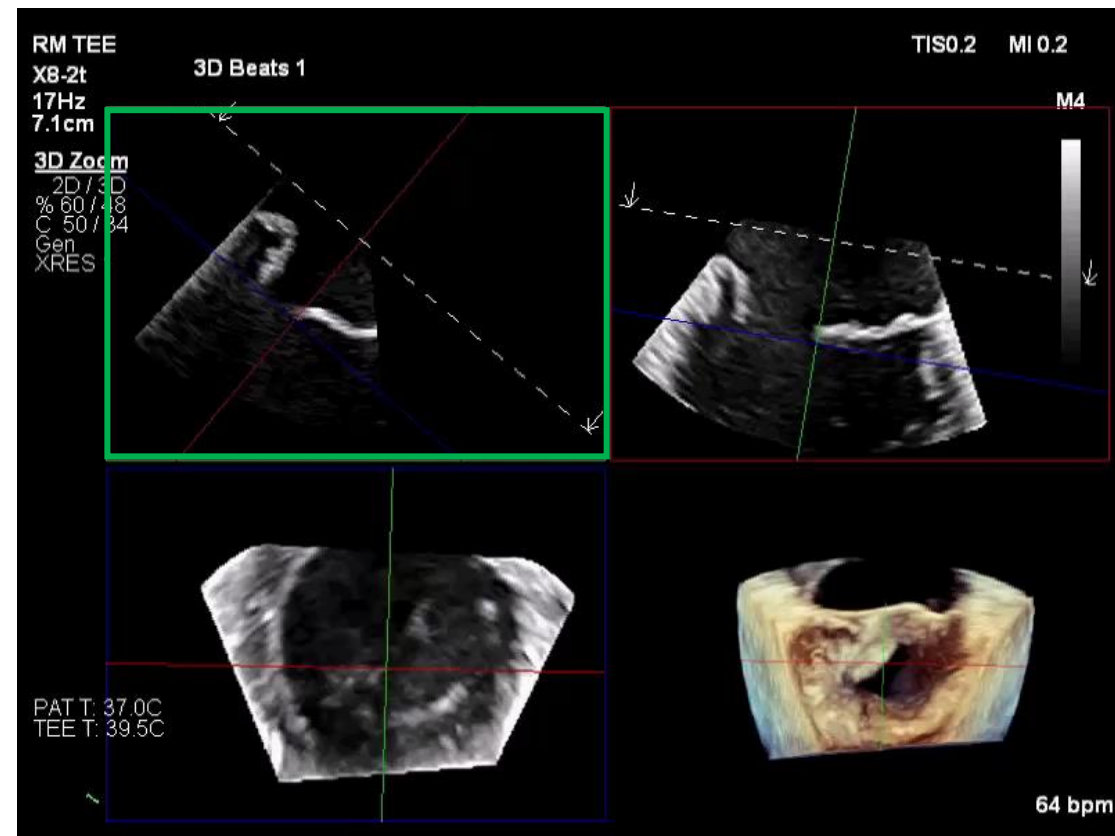
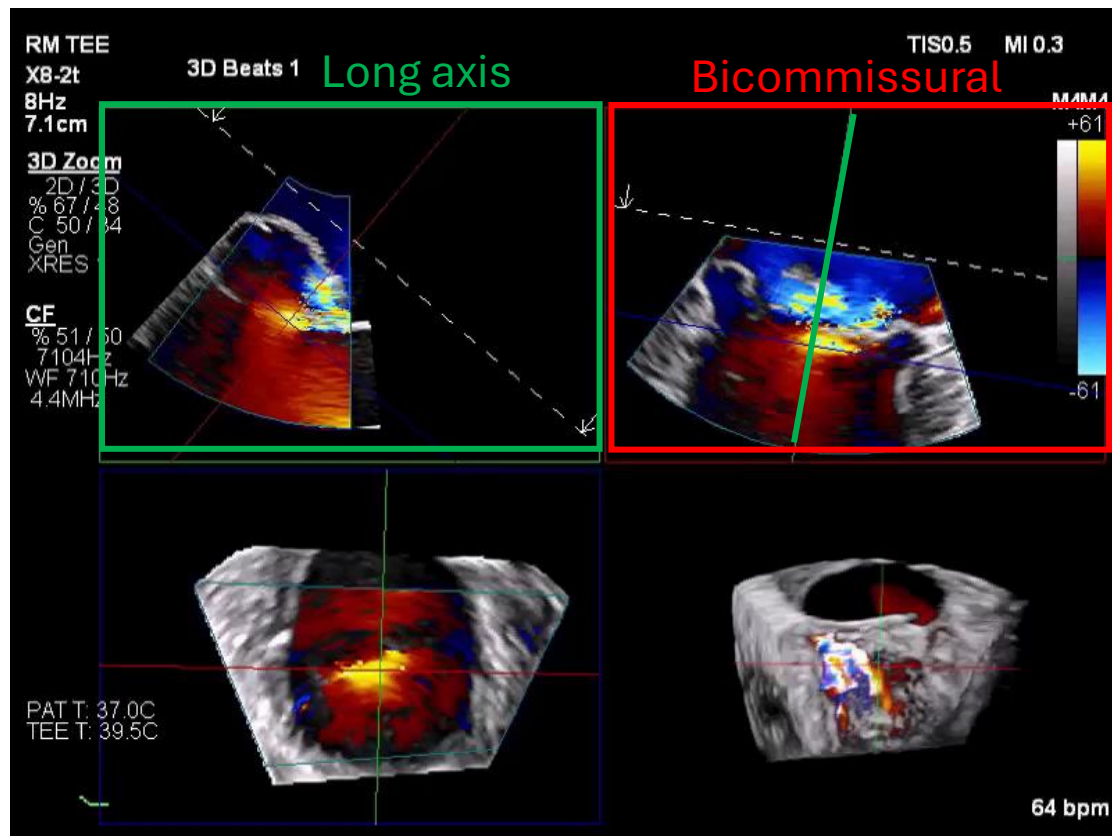
3D imaging

Atrial view

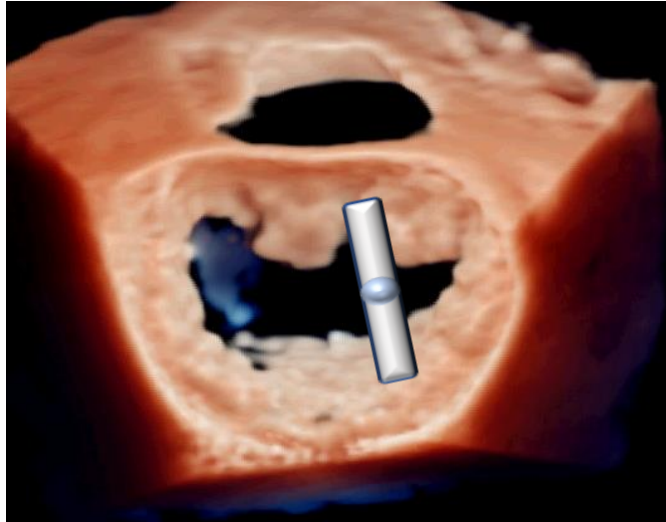
Ventricular view



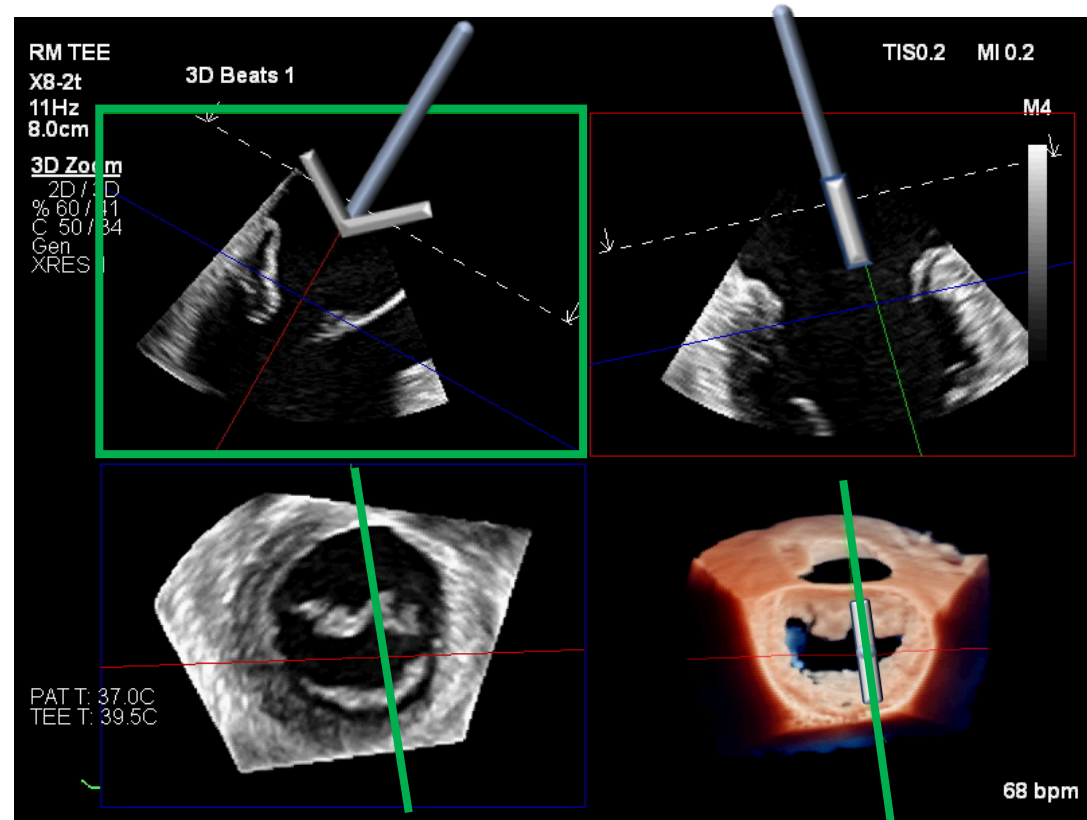
3D MPR



Are the leaflets graspable at P2?



What would our grasping view look like if we placed the clip like this?

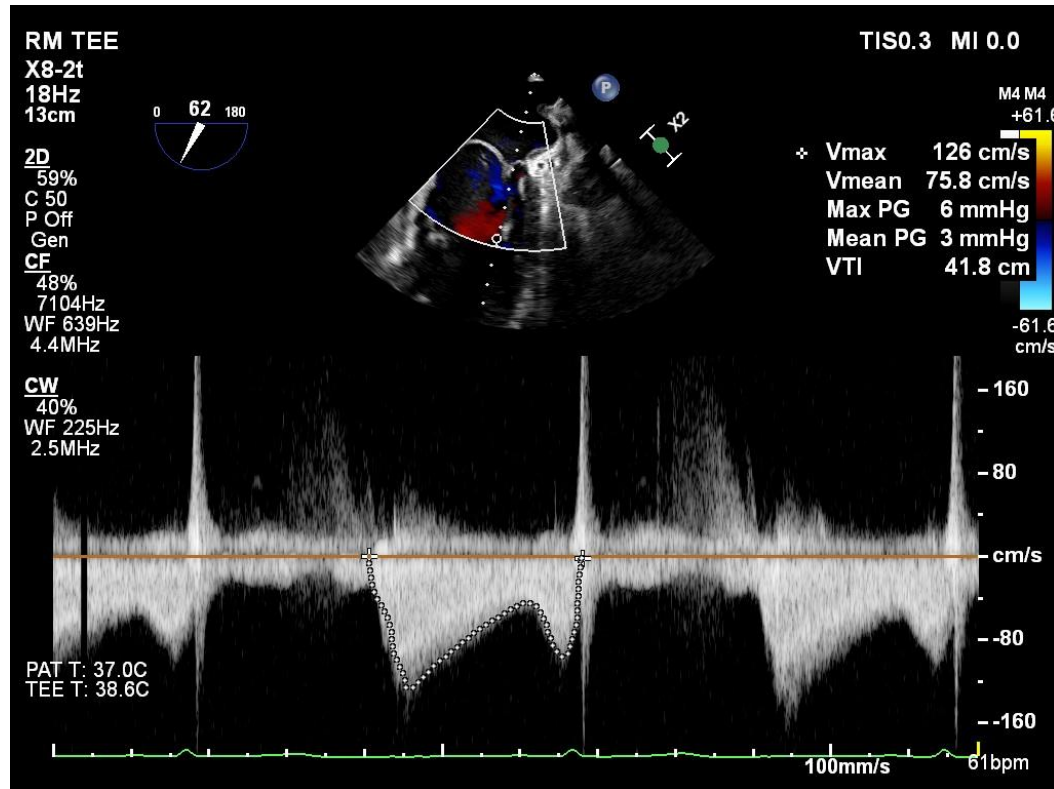


We can then analyze this specific plane for “graspability”

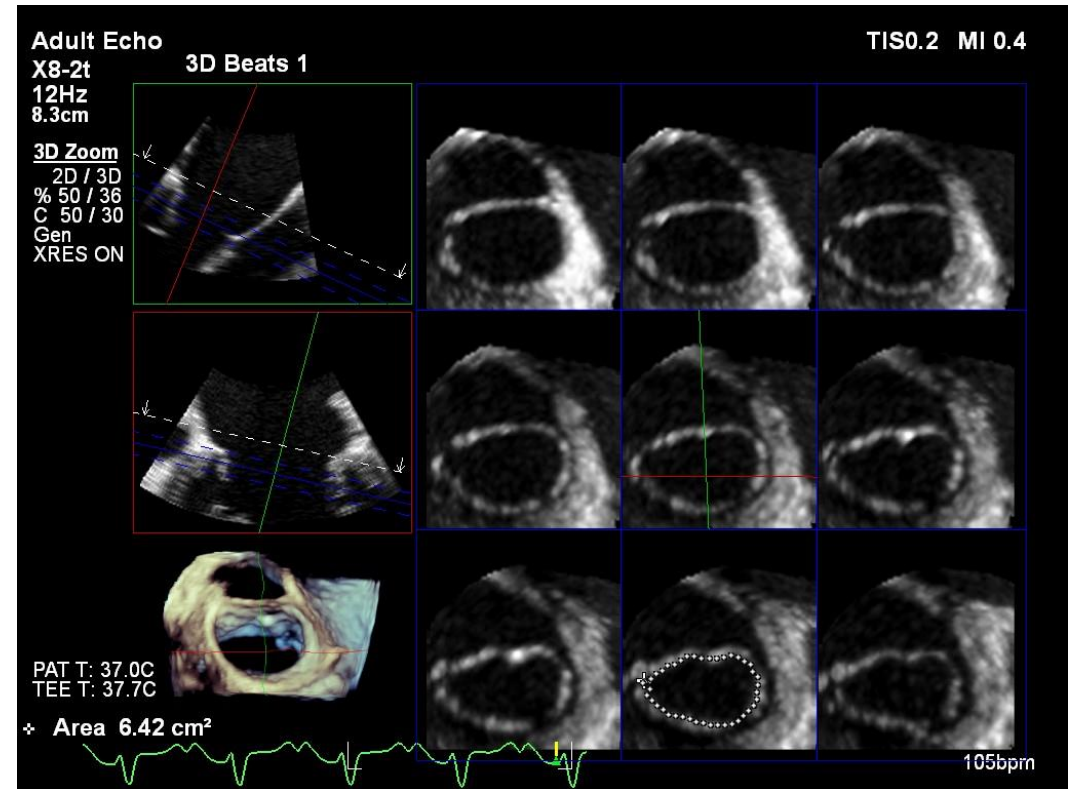
- Leaflet length
- Chords
- Coaptation gap

Will we cause mitral stenosis?

Goal MG < 5 mmHg



Goal MVA > 4 cm²



Should we offer TEER?

Can we adequately reduce the MR?

- ✓ Focal MR origin
- ✓ Central pathology
- ✓ Adequate leaflet length



Risk of Mitral Stenosis?

- ✓ MG < 5 mmHg
- ✓ MVA > 4 cm²



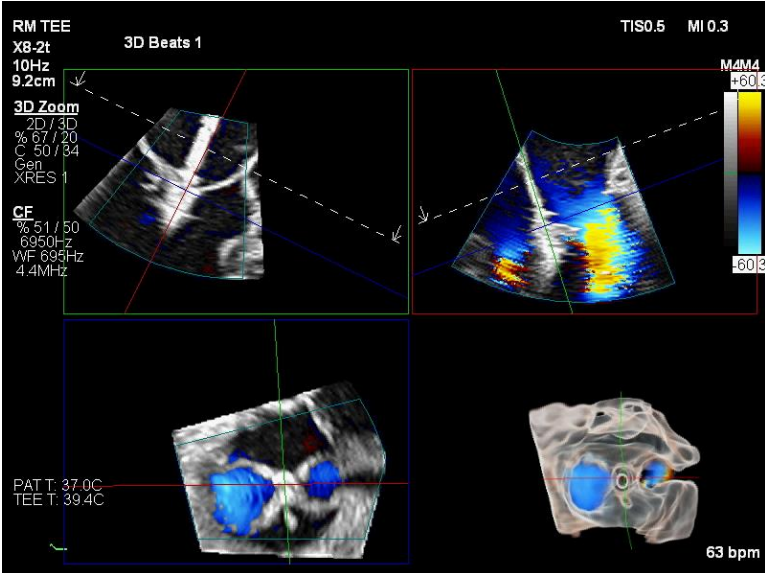
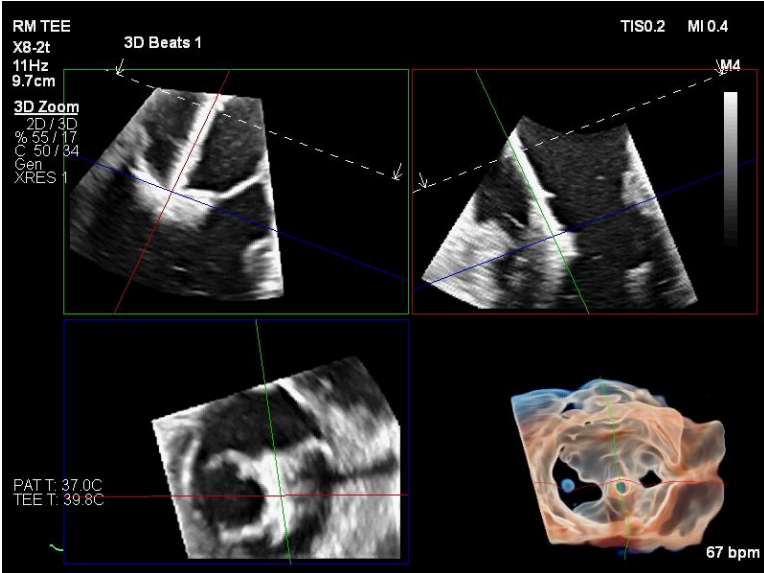
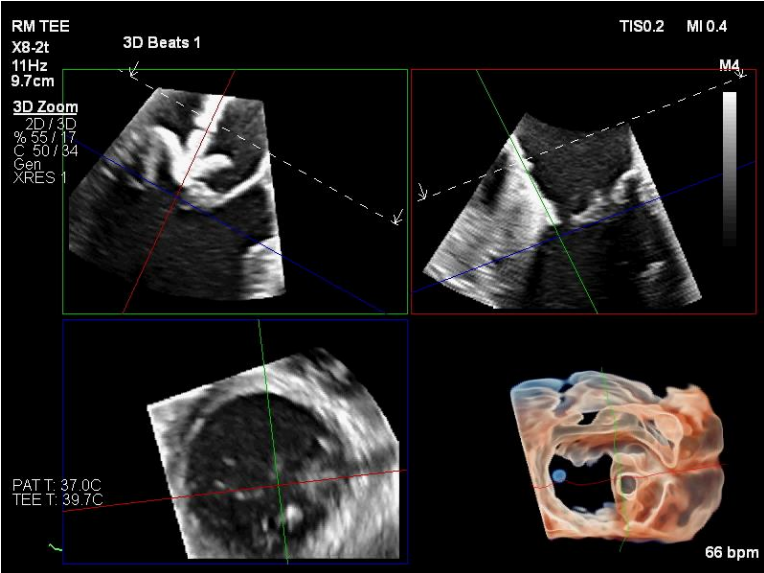
Proceed with Mitral TEER A2-P2

- ✓ MitraClip XTW chosen

Align device in the LA

Cross the valve
Leaflet insertion

Close the clip
Reduction in MR



FMR : patient selection is key

Medical therapy

GDMT
Revascularization
CRT



LV size/function may improve
Symptoms may improve
MR may improve

MitraClip

Optimal therapy
EF 20-50%
Severe MR
NYHA III-IV



Treat the MR

Advanced therapy

Ventricle is too sick
MR is not primary issue

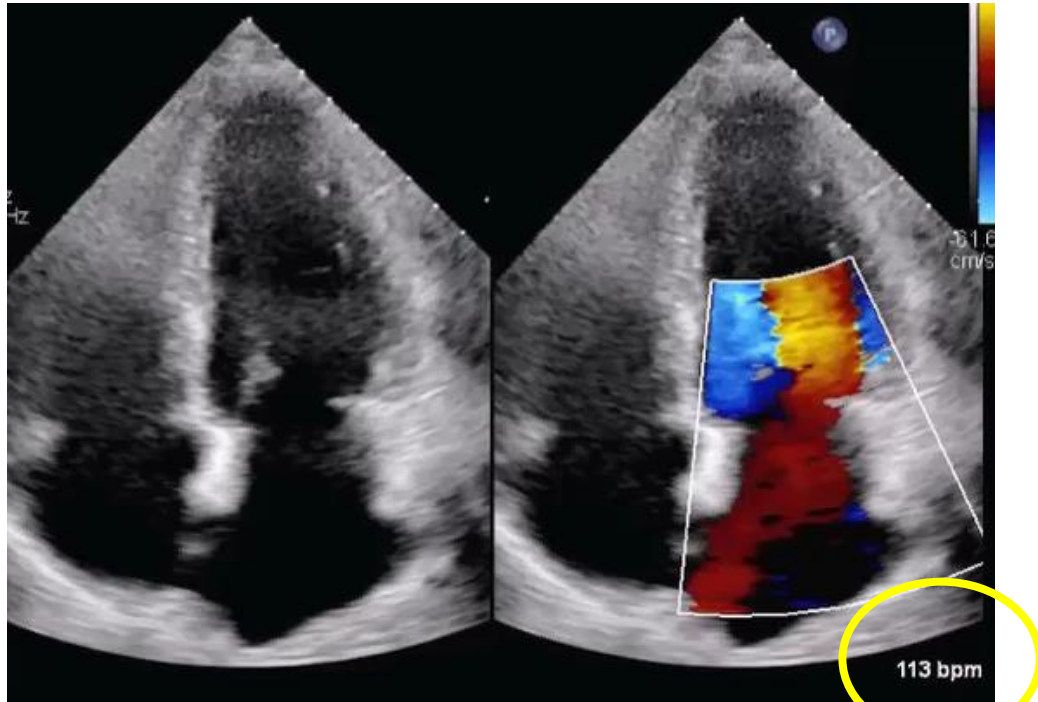


Transplant
LVAD



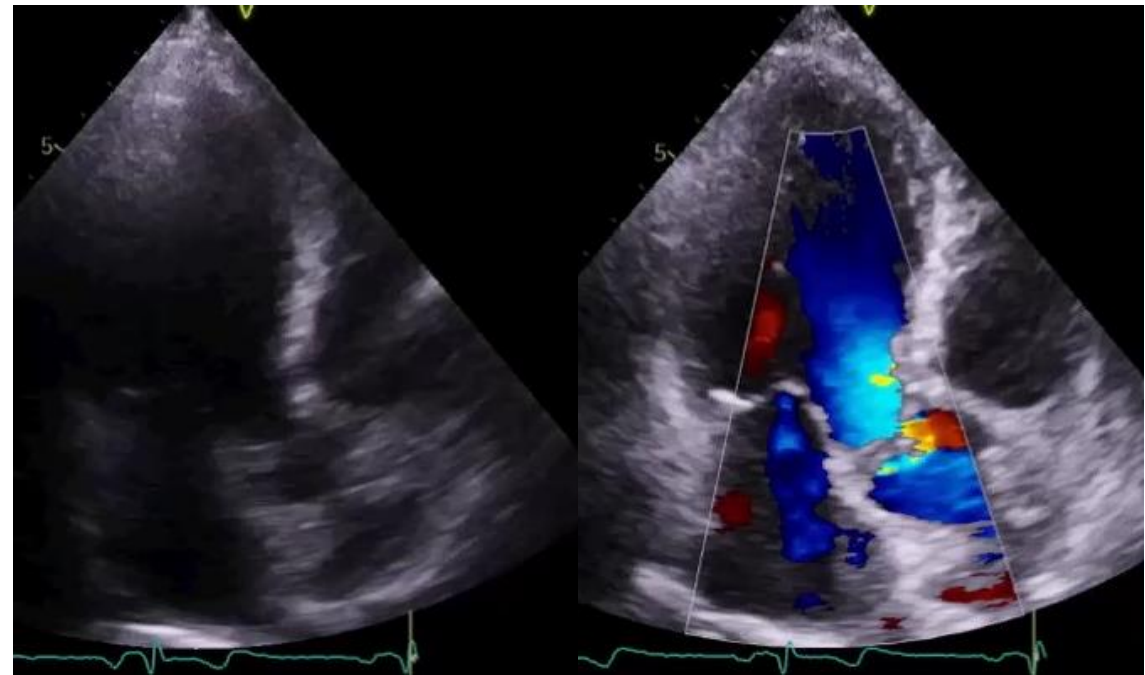
FMR related to atrial fibrillation

78 yo admitted to outside hospital with CHF, found to be in afib with RVR. TTE with severe MR. Referred to for mitral valve intervention..

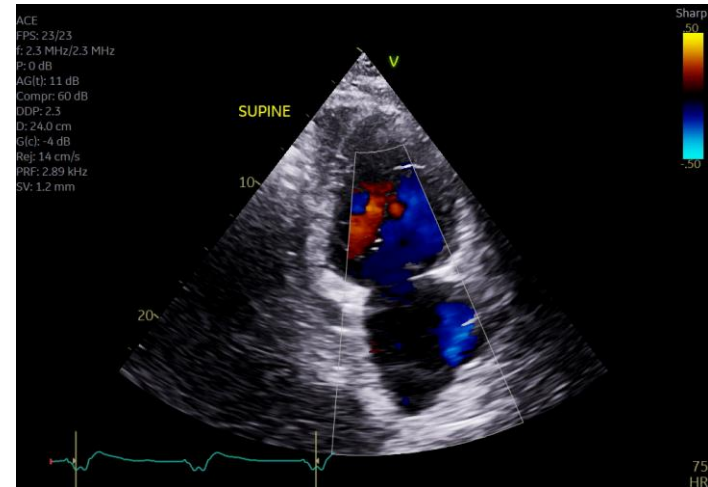
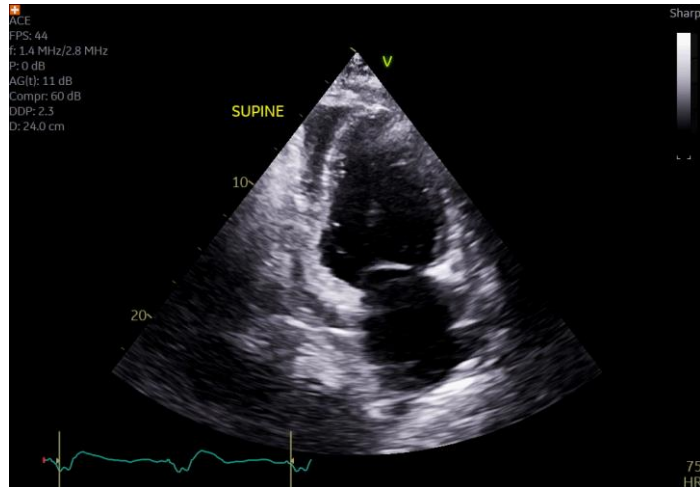
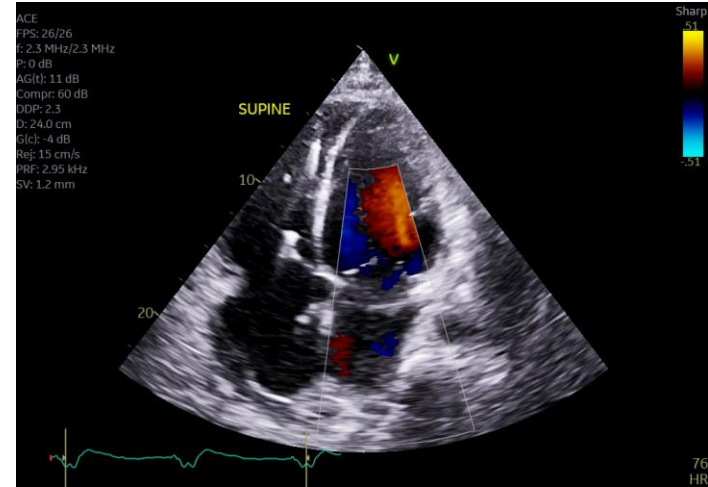
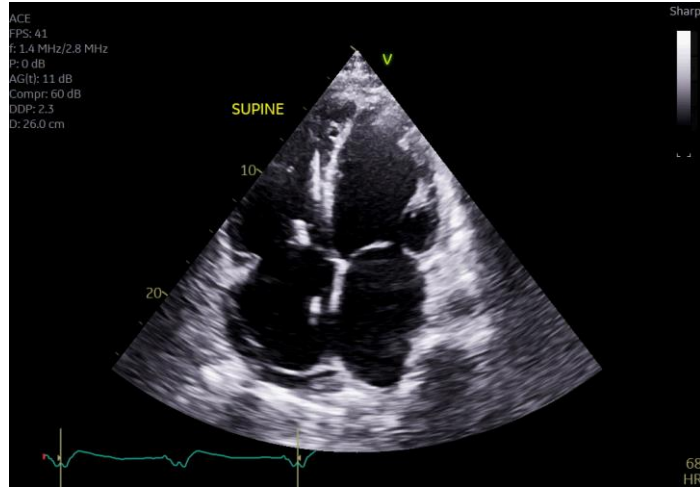


Afib with RVR

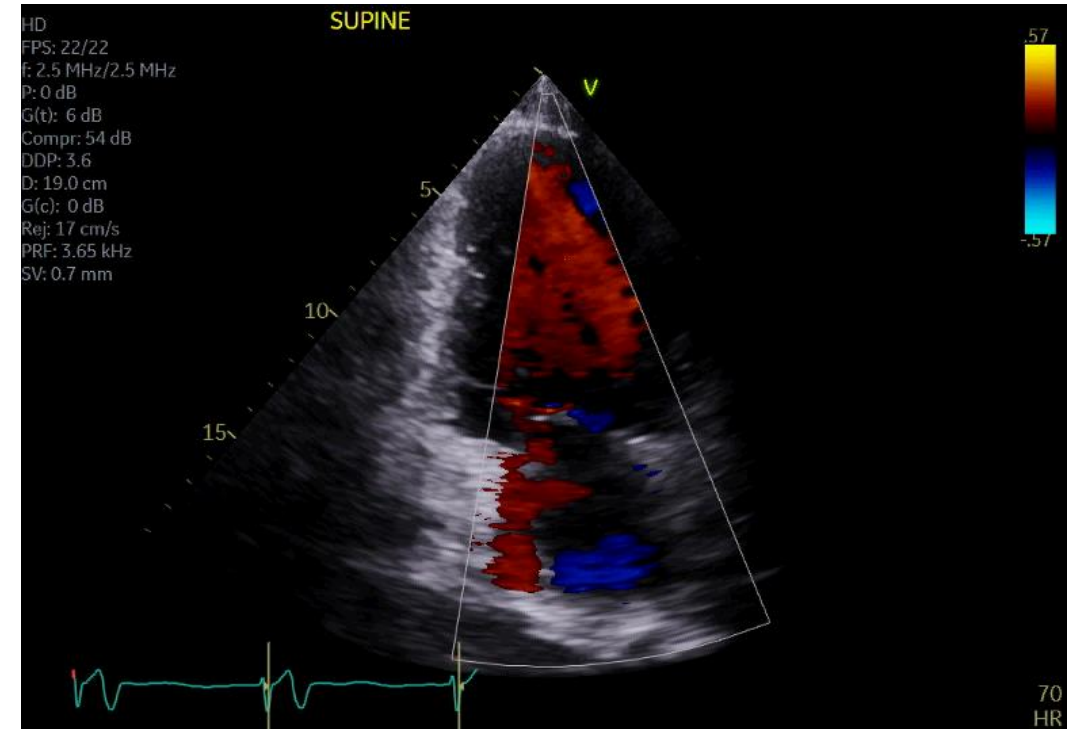
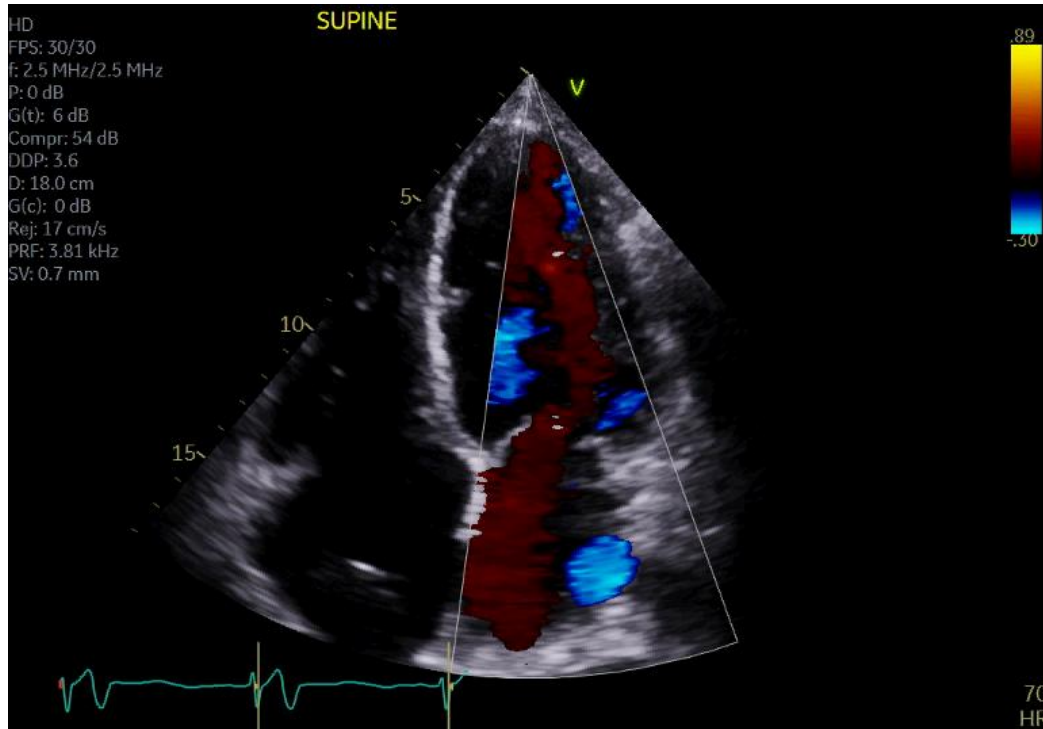
DCCV, diuresis → trivial MR



Severe LV dysfunction



65 yo with ischemic cardiomyopathy and severe functional MR. Symptomatic despite optimization.



Medical therapy

GDMT
Revascularization
CRT



LV size/function may improve
Symptoms may improve
MR may improve

MitraClip

Optimal therapy
EF 20-50%
Severe MR
NYHA III-IV



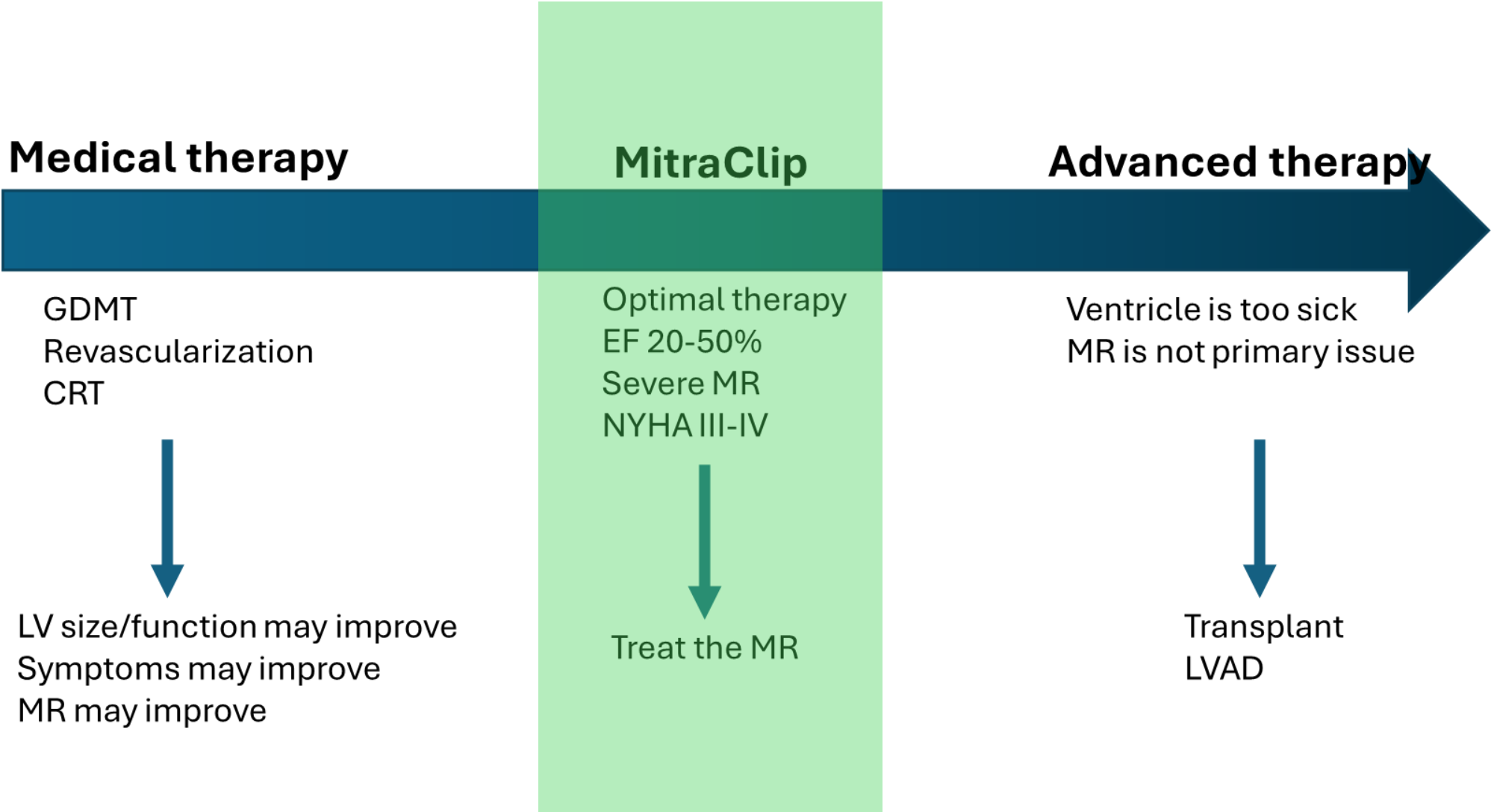
Treat the MR

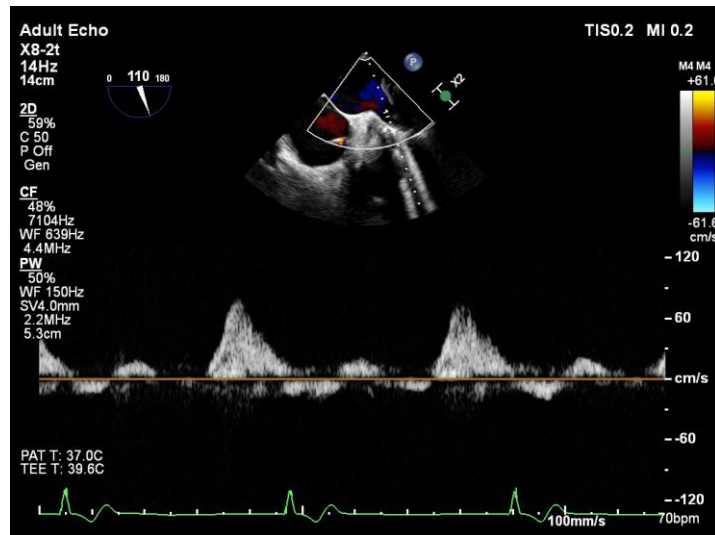
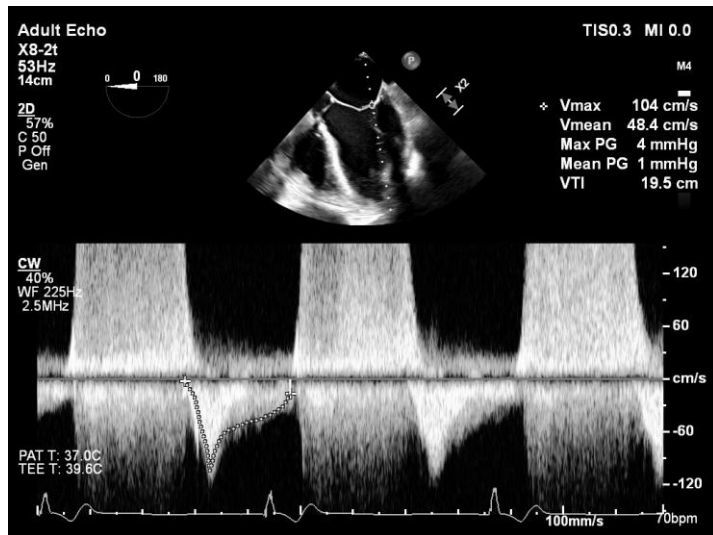
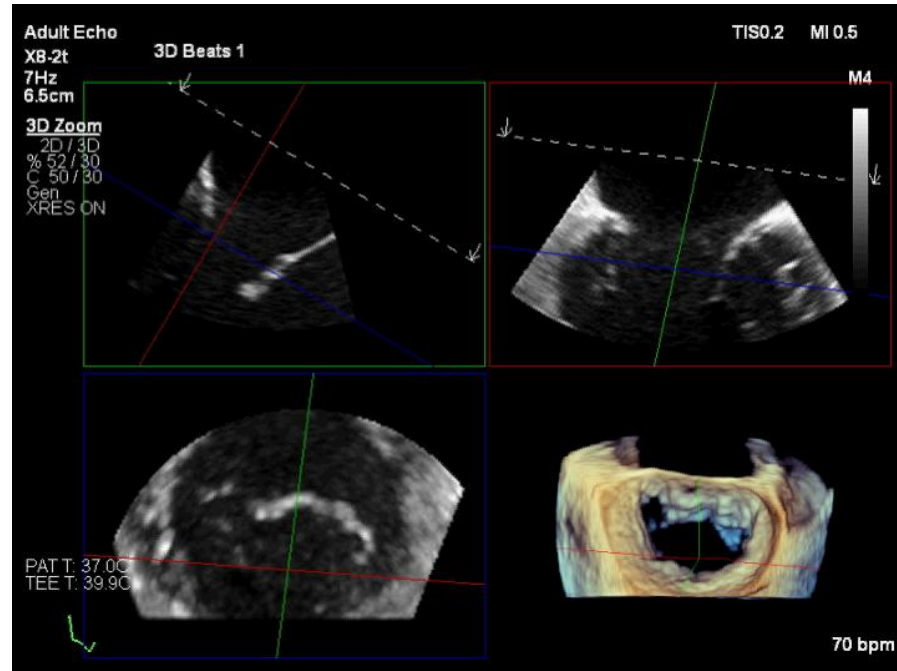
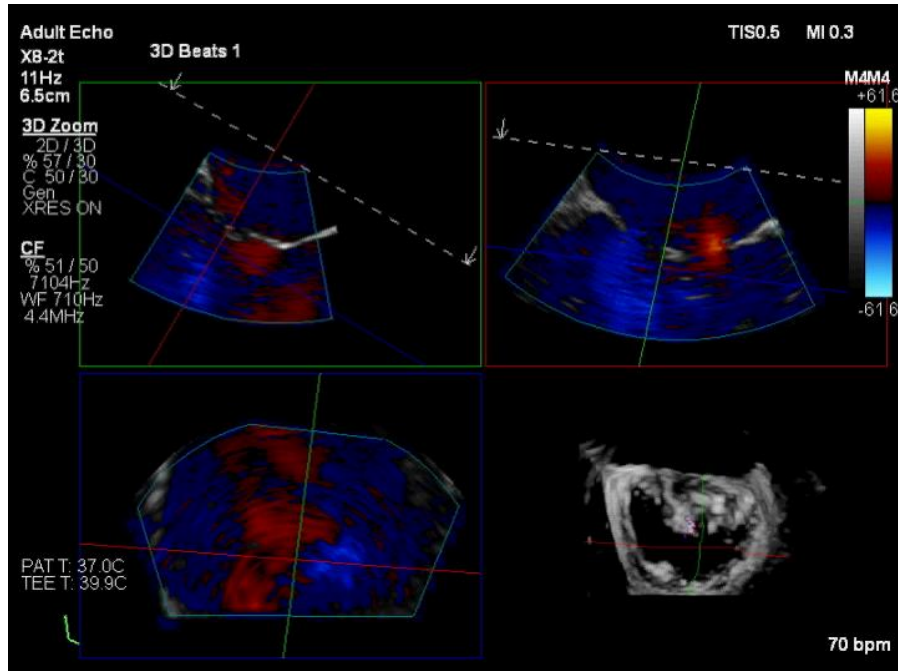
Advanced therapy

Ventricle is too sick
MR is not primary issue



Transplant
LVAD



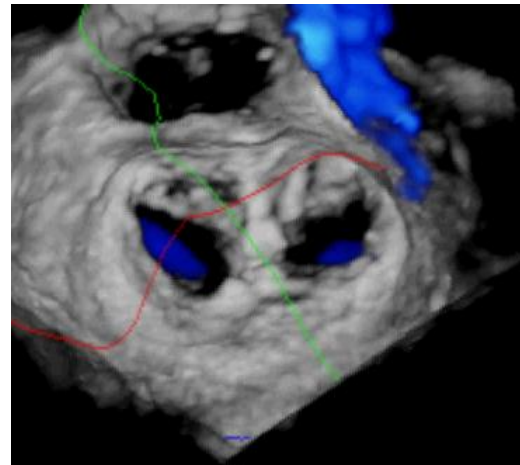
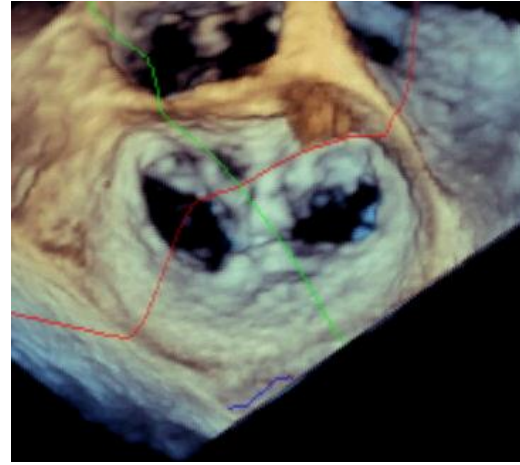
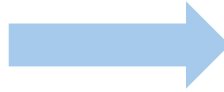
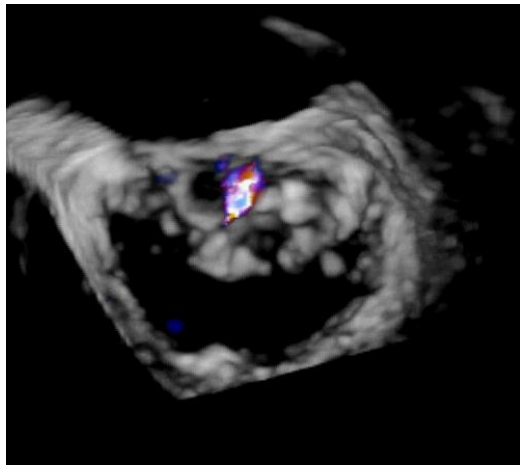
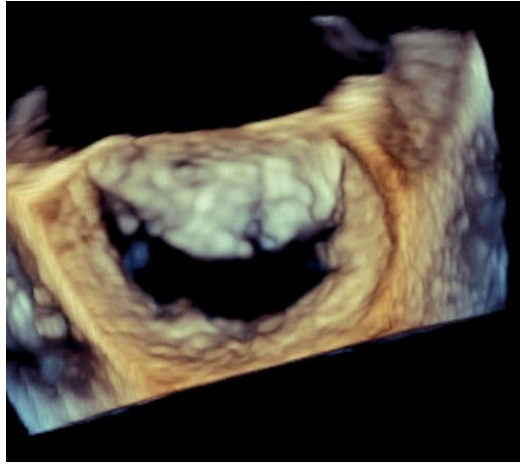


Central MR
Good leaflet length
Large valve, MG 1



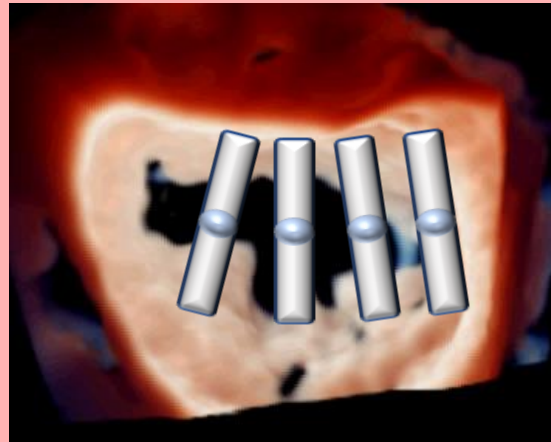
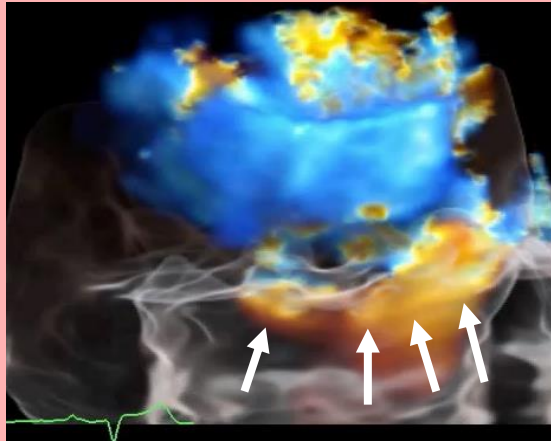
Good anatomy for M-TEER

Successful MitraClip at A2/P2



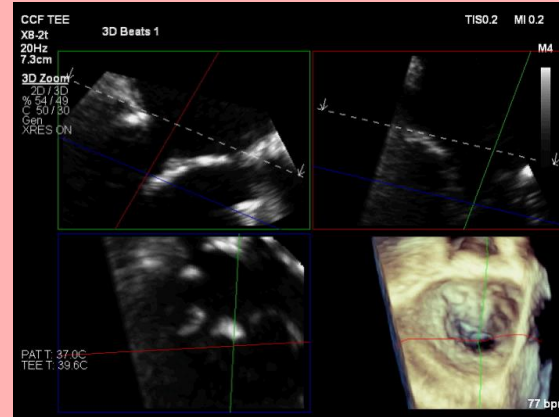
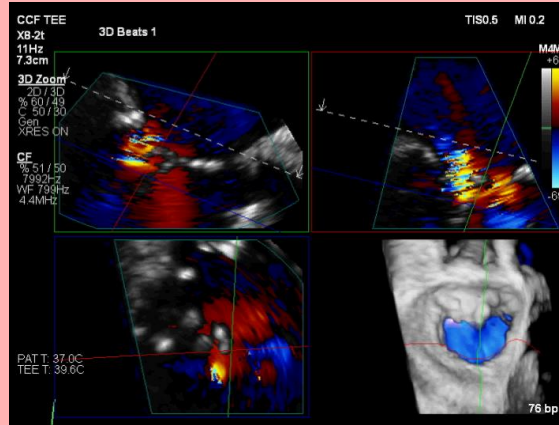
Why might a patient not be a candidate for TEER?

MR origin too wide



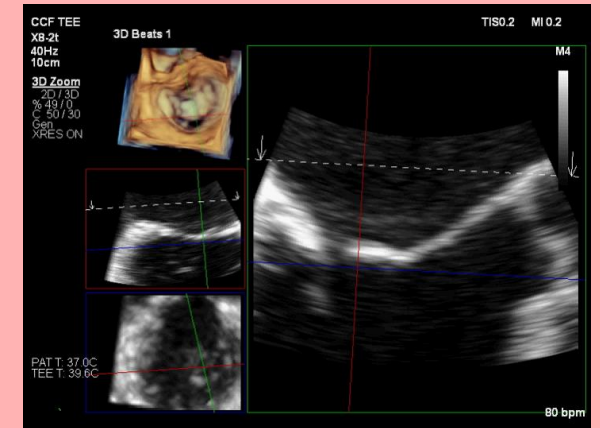
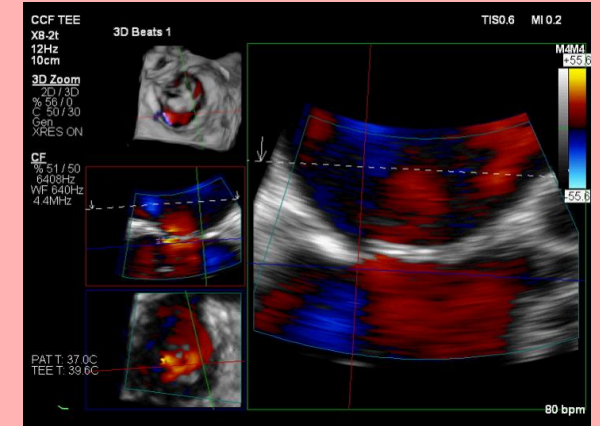
Can't zipper the valve shut

Mitral stenosis



If MS present preprocedurally, TEER will only make worse

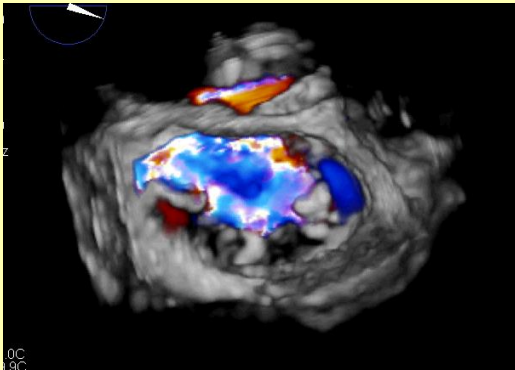
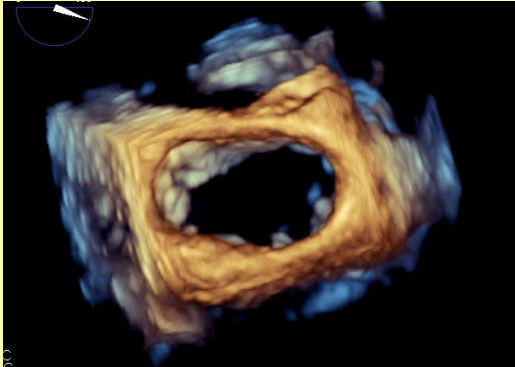
Posterior leaflet too short



Goal, leaflet length > 7 mm

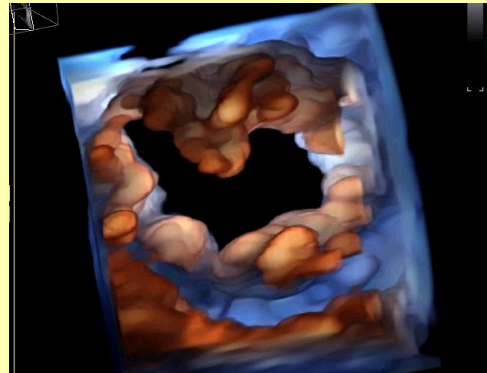
Anatomic considerations that may increase procedural complexity

Commissures



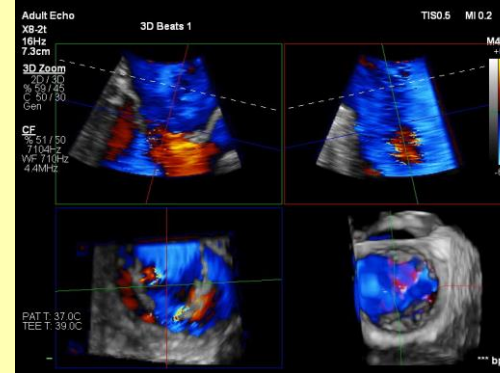
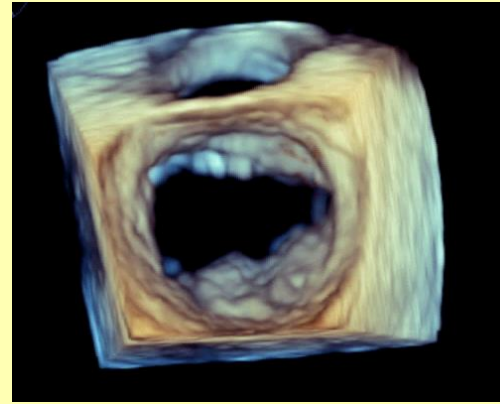
Commissural pathology more difficult to image in 2D
More chordal interactions

Chords



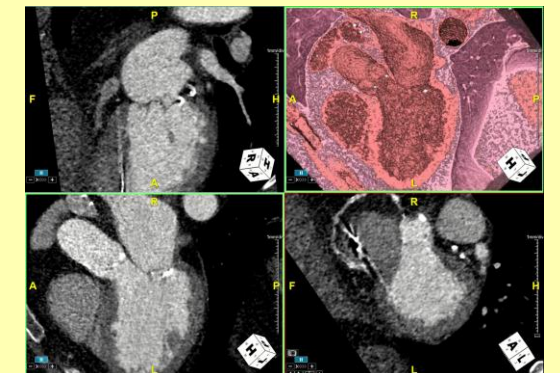
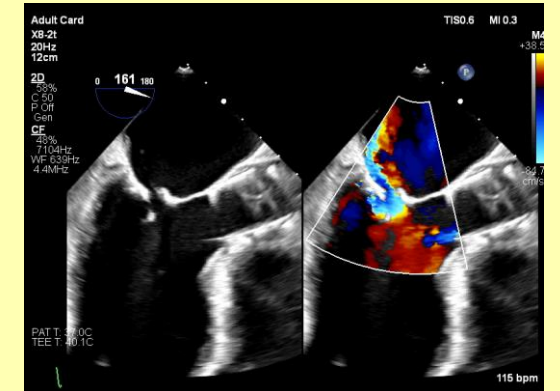
Prevent leaflet insertion
Device can become tangled

Clefts



Avoid opening cleft, distorting valve

Calcification



Risk of mitral stenosis
Risk of leaflet tear

Summary

- TTE is the primary imaging modality used to diagnose and monitor mitral regurgitation
- Treadmill echo is useful when there's a discrepancy between clinical symptoms and MR severity
- TEE is useful to further define MR severity, MR mechanism and plan for intervention

Thank You