

Functional MR - Percutaneous Treatment Considerations

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When to Treat Functional MR with Percutaneous Therapies?

- **Functional MR = Heart failure management**
- **Treatment of underlying problems**
 - **AF**
 - **Conduction abnormality**
 - **CAD**
 - **Optional GDMT**
- **Still severe symptomatic MR then consider percutaneous therapies**

FMR Treatment Considerations

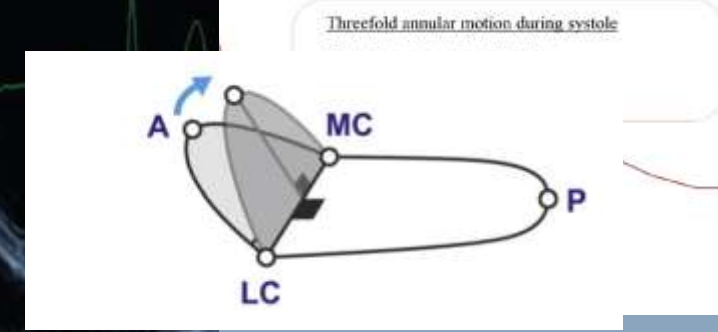
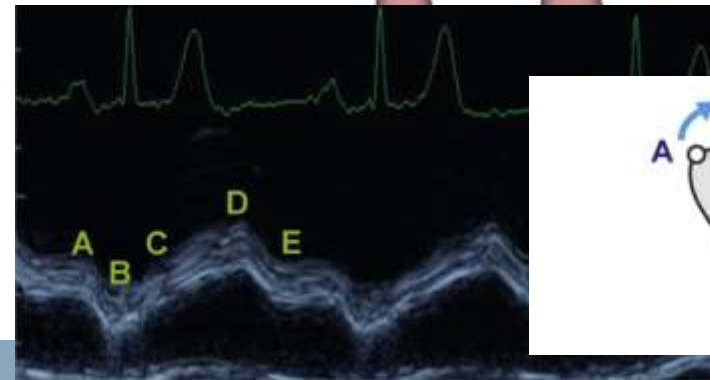
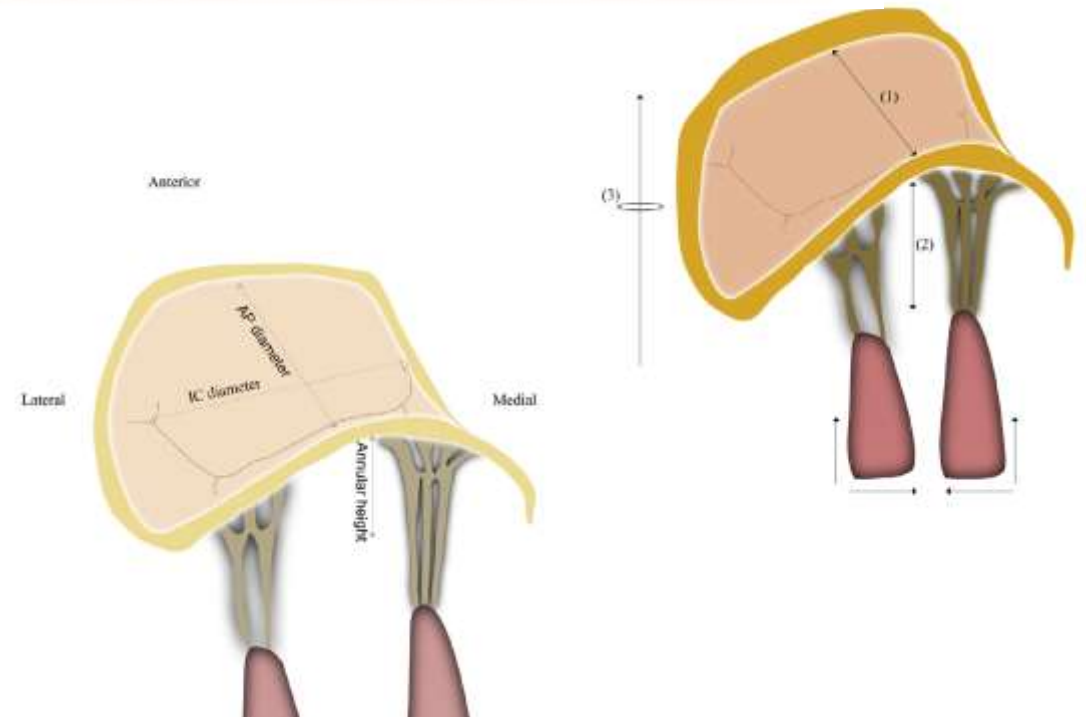
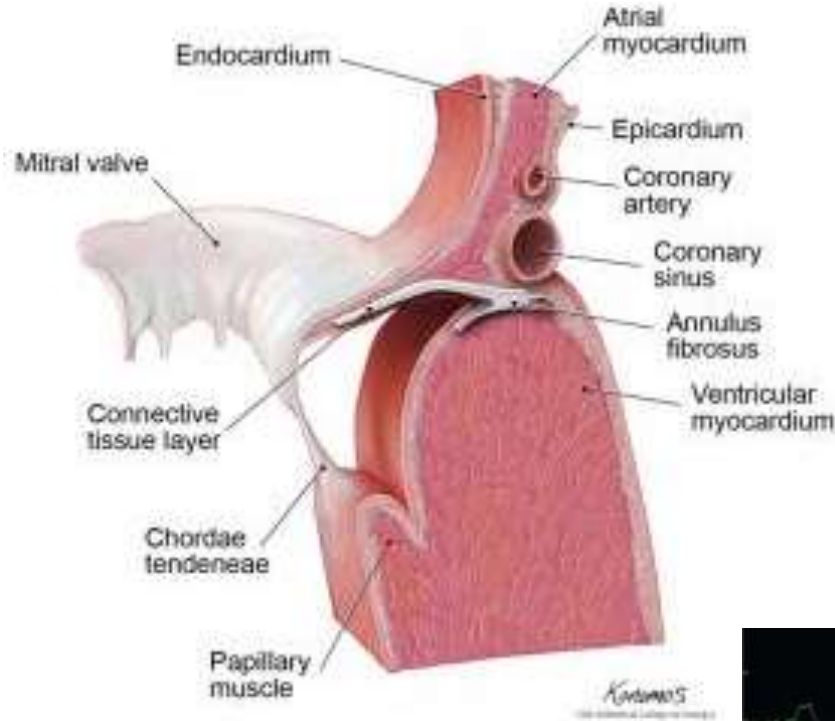
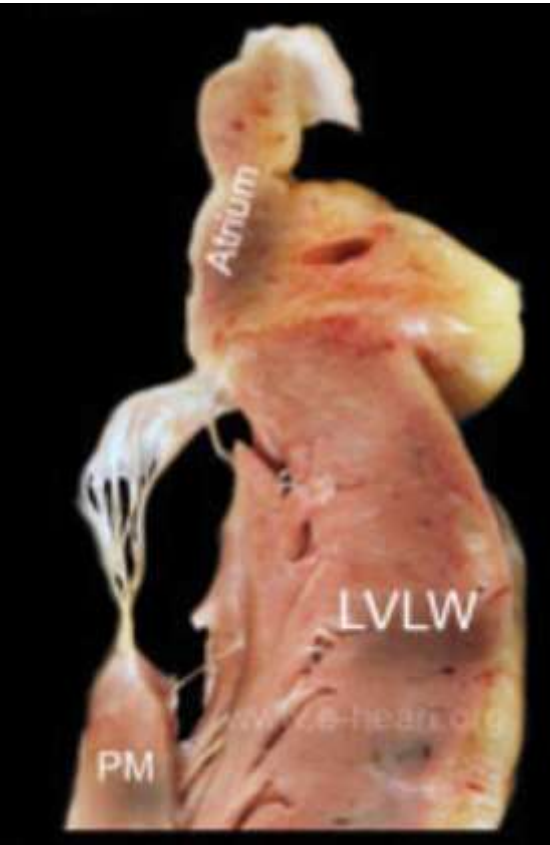
- **Different types of FMR**
- **Clinical significance of FMR**
- **How severe is FMR**
- **Treatment options for FMR**

“Function of MV”

Threefold annular motion during systole

- (1) Anteroposterior contraction
- (2) Annular height & saddle-shape ↑
- (3) Translational motion during systole

Sphincter like
Folding
Translational motion



Threefold annular motion during systole

CLINICAL PRACTICE

THE CLINICAL PROBLEM

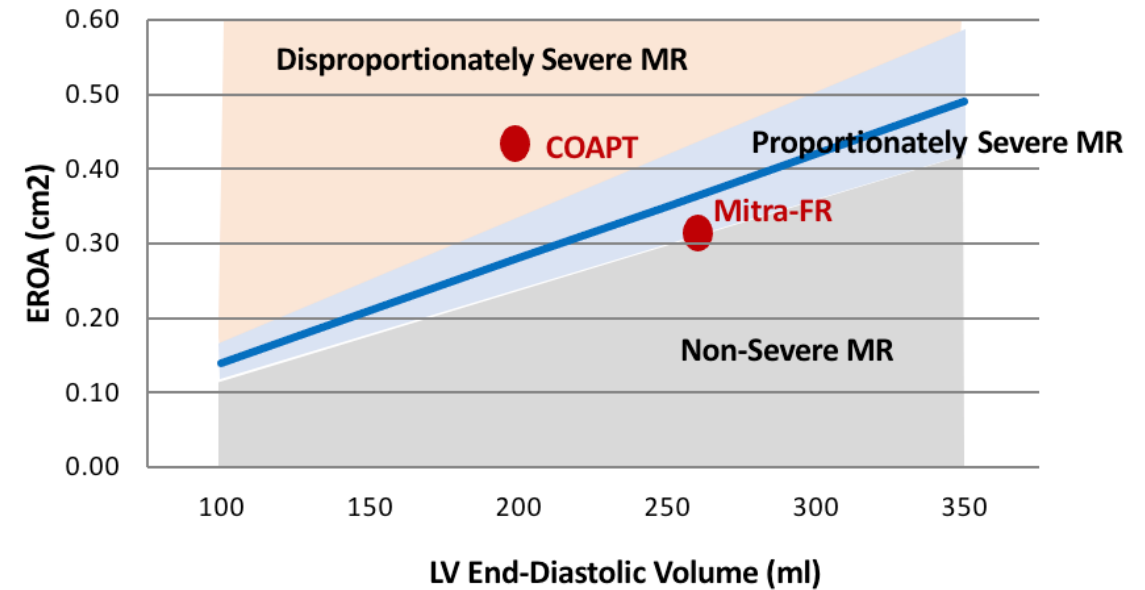
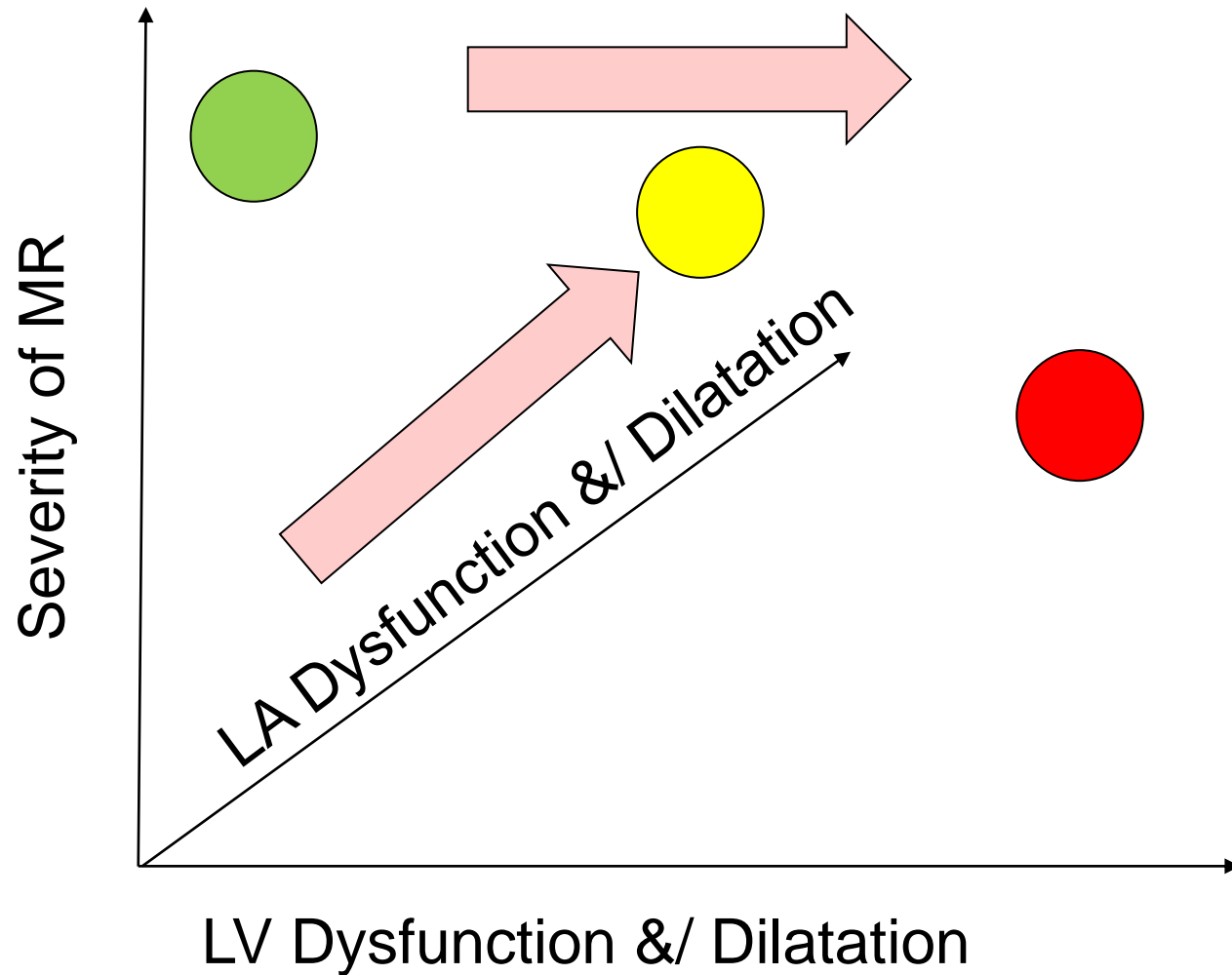
MITRAL REGURGITATION DERIVES FROM ANATOMICAL OR FUNCTIONAL impairment of one or more components of the mitral apparatus that are necessary for normal valve function, including the left ventricle, papillary muscles, chordae tendineae, leaflets, and annulus.¹ The two broad categories of mitral regurgitation are primary (or degenerative) mitral regurgitation, which is most commonly caused by leaflet prolapse or flail, and secondary (or functional) mitral regurgitation. Primary mitral regurgitation is a disease of the valve (or chordae), and secondary mitral regurgitation is a disease of the left ventricle or left atrium.

“Secondary mitral regurgitation is a disease of the left ventricle and/or left atrium and/or mitral annulus without adequate compensatory changes in the mitral valve leaflets”

FMR Treatment Considerations

- Different types of FMR
- **Clinical significance of FMR**
- How severe is FMR
- Treatment options for FMR

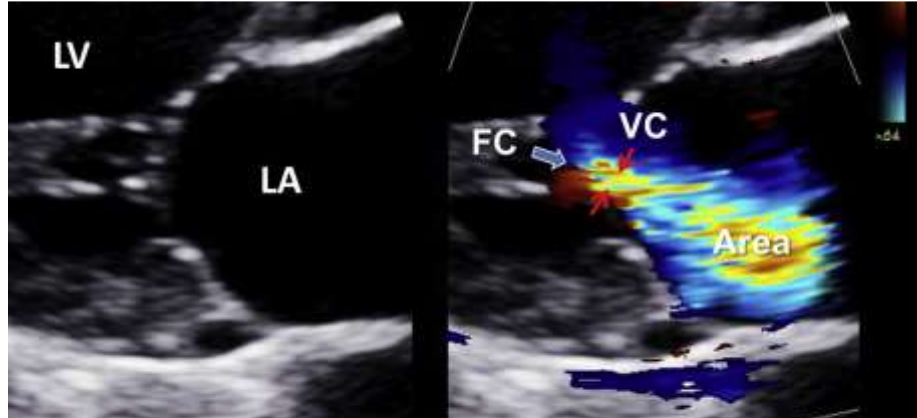
MR and CHF has at Least 3 Determinants



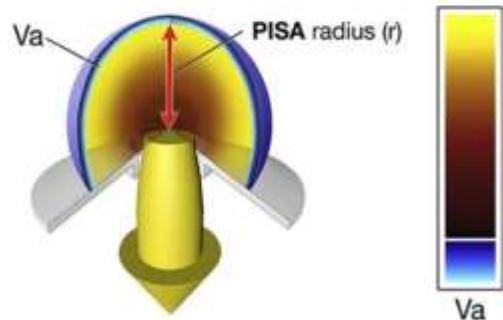
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Severity of FMR



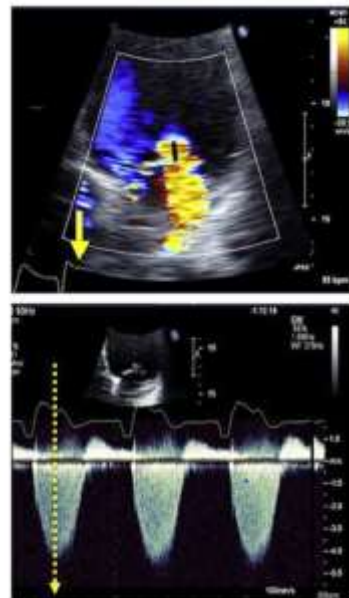
Flow Convergence Method



$$\text{Reg Flow} = 2\pi r^2 \times Va$$

$$\text{EROA} = \text{Reg Flow} / \text{PKV}_{\text{Reg}}$$

$$\text{R Vol} = \text{EROA} \times \text{VTI}_{\text{Reg}}$$



Specific Criteria for Mild MR

- Small, narrow central jet
- $\text{VCW} \leq 0.3 \text{ cm}$
- PISA radius absent or $\leq 0.3 \text{ cm}$ at Nyquist 30-40 cm/s
- Mitral A wave dominant inflow
- Soft or incomplete jet by CW Doppler
- Normal LV and LA size

Specific C
 • Small, n
 • $\text{VCW} \leq$
 • PISA ra
 Nyquist
 • Mitral A
 • Soft or i
 • Normal

Specific Criteria for Severe MR

- Flail leaflet
- $\text{VCW} \geq 0.7 \text{ cm}$
- PISA radius $\geq 1.0 \text{ cm}$ at Nyquist 30-40 cm/s
- Central large jet $> 50\%$ of LA area
- Pulmonary vein systolic flow reversal
- Enlarged LV with normal function

vere MR

at Nyquist 30-

0% of LA area
 tolic flow reversal
 rmal function

eria
 ly severe

Judging Severity is an Art

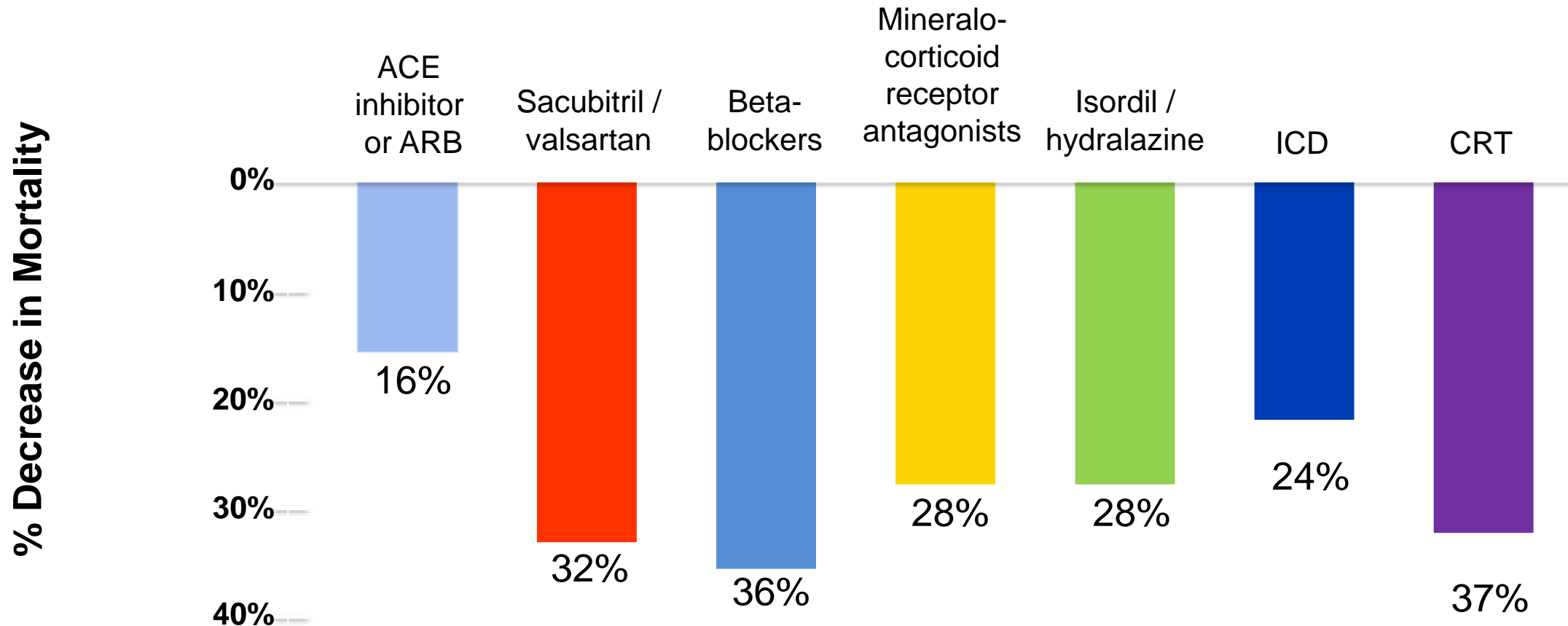
- History
- Anatomy
 - Valve leaflets
 - Annulus
 - Mechanism
- Doppler (Function)
- LV, LA, RV
- Response to exercise and treatment

Clinical information	Symptoms and related clinical findings
	Height/weight/body surface area
	Blood pressure and heart rate
Imaging of the valve	Motion of leaflets: prolapse, flail, restriction, tenting of atrioventricular valves, valve coaptation
	Structure: thickening, calcifications, vegetations
	Annular size/dilatation
Doppler echocardiography of the valve	Site of origin of regurgitation and its direction in the receiving chamber by color Doppler
	The three color Doppler components of the jet: flow convergence, VC, and jet area
	Density of the jet velocity signal, CW
	Contour of the jet in MR and TR, CW
	Deceleration rate or pressure half-time in AR and PR, CW
	Flow reversal in pulmonary/hepatic veins (MR, TR); in aorta/PA branches (AR, PR)
	LV and RV filling dynamics (MR, TR)
Quantitative parameters for regurgitation	PISA optimization for calculation of RVol and EROA
	Valve annular diameters and corresponding pulsed Doppler for respective SV calculations and derivation of RVol and RF
	Optimization of LV chamber quantitation (contrast when needed)
3D echocardiography*	Localization of valve pathology, particularly with TEE
	LV/RV volumes calculation
	Measured EROA
	Automated quantitation of flow and RVol by 3D color flow Doppler [†]
Other echocardiographic data	LV and RV size, function, and hypertrophy
	Left and right atrial size
	Concomitant valvular disease
	Estimation of PA pressure

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Treatment of HFrEF



Surgical Indications for FMR

Heart Failure Guidelines	ACC/AHA	The effectiveness of mitral valve repair or replacement is not established for severe secondary mitral regurgitation in refractory end-stage HF. <i>Class of recommendation IIb, level of evidence C</i>
	HFSA	Isolated mitral valve repair or replacement for severe mitral regurgitation secondary to ventricular dilatation in the presence of severe left ventricular systolic dysfunction is not generally recommended <i>Class of recommendation IIb, level of evidence C</i>
	ESC	Surgery may be considered in selected patients with severe functional MR and severely depressed LV function, who remain symptomatic despite optimal medical therapy. <i>Class of recommendation IIb, level of evidence C</i>
Valvular Heart Disease Guidelines	ACC/AHA	MV repair may be considered for patients with chronic severe secondary MR due to severe LV dysfunction (LVEF < 30%) who have persistent NYHA functional class III–IV symptoms despite optimal therapy for heart failure, including biventricular pacing. <i>Class of recommendation IIb, level of evidence C</i>
	ESC	Patients with severe MR, LVEF .30%, no option for revascularization, refractory to medical therapy, and low comorbidity. <i>Class of recommendation IIb, level of evidence C</i>
Other	ISHLT	In patients with heart failure and low LVEF, ventricular restoration surgery or mitral valve repair may be considered <i>Class of recommendation IIb, level of evidence C</i>

What is the Landscape in US Transcatheter MV therapies for FMR

- MitraClip
 - Primary MR and who are at high risk for surgery
 - Secondary MR after GDMT, high risk for surgery
- **What do we have under investigation in US?**
 - Indirect Annuloplasty
 - Carillon (coronary sinus device) - Pivotal
 - Spacer and Leaflet - PASCAL - Pivotal
 - TMVR
 - Early feasibility - M3, Cephia
 - Pivotal - Intrepid, Tendyne, EVOQUE
 - Direct annuloplasty
 - Cardioband – Pivotal
 - Millipede - Feasibility

HUGE INVESTMENT

In general investors are visionary
(that is why they have money to
invest!)



4 Different Sizes of MitraClip

MitraClip™ G4 NT and XT



MitraClip™ G4 NTW and XTW



G4 NT &
G4 NTW

Clip Length



Coaptation Length



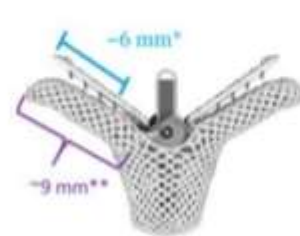
Clip Arms at 120°



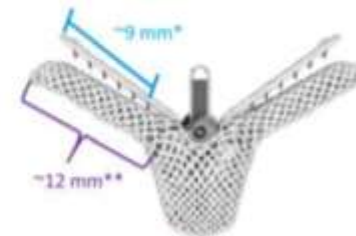
Clip Arms at 180°



G4 XT &
G4 XTW



G4 NT & G4 NTW



G4 XT & G4 XTW

- * Leaflet insertion needed to engage all frictional elements
- ** Clip Arm length



The NEW ENGLAND JOURNAL of MEDICINE

ORIGINAL ARTICLE

Transcatheter Mitral-Valve Repair in Patients with Heart Failure

G.W. Stone, J.A. Lindenfeld, W.T. Abraham, S. Kar, D.S. Lim, J.M. Mishell,
B. Whisenant, P.A. Grayburn, M. Rinaldi, S.R. Kapadia, V. Rajagopal,
I.J. Sarembock, A. Brieke, S.O. Marx, D.J. Cohen, N.J. Weissman, and M.J. Mack,
for the COAPT Investigators*

ORIGINAL ARTICLE

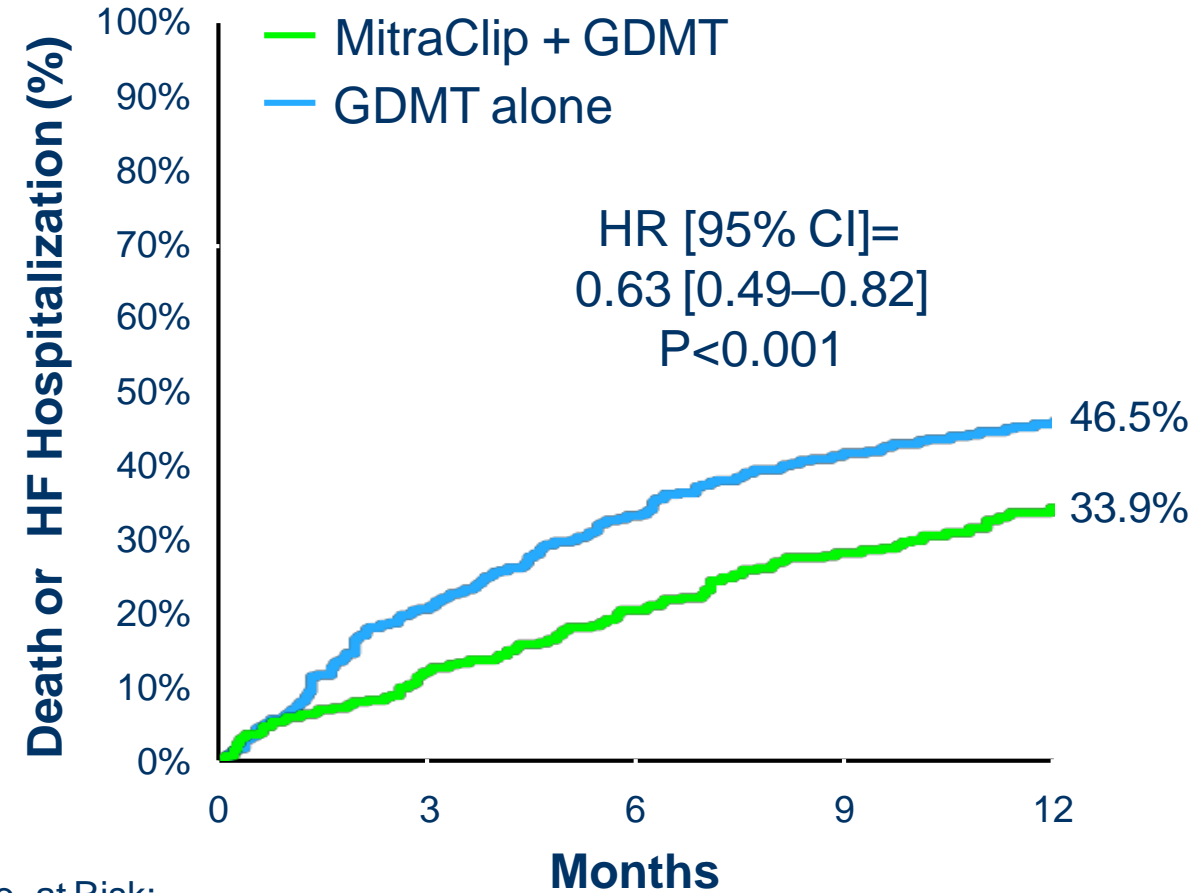
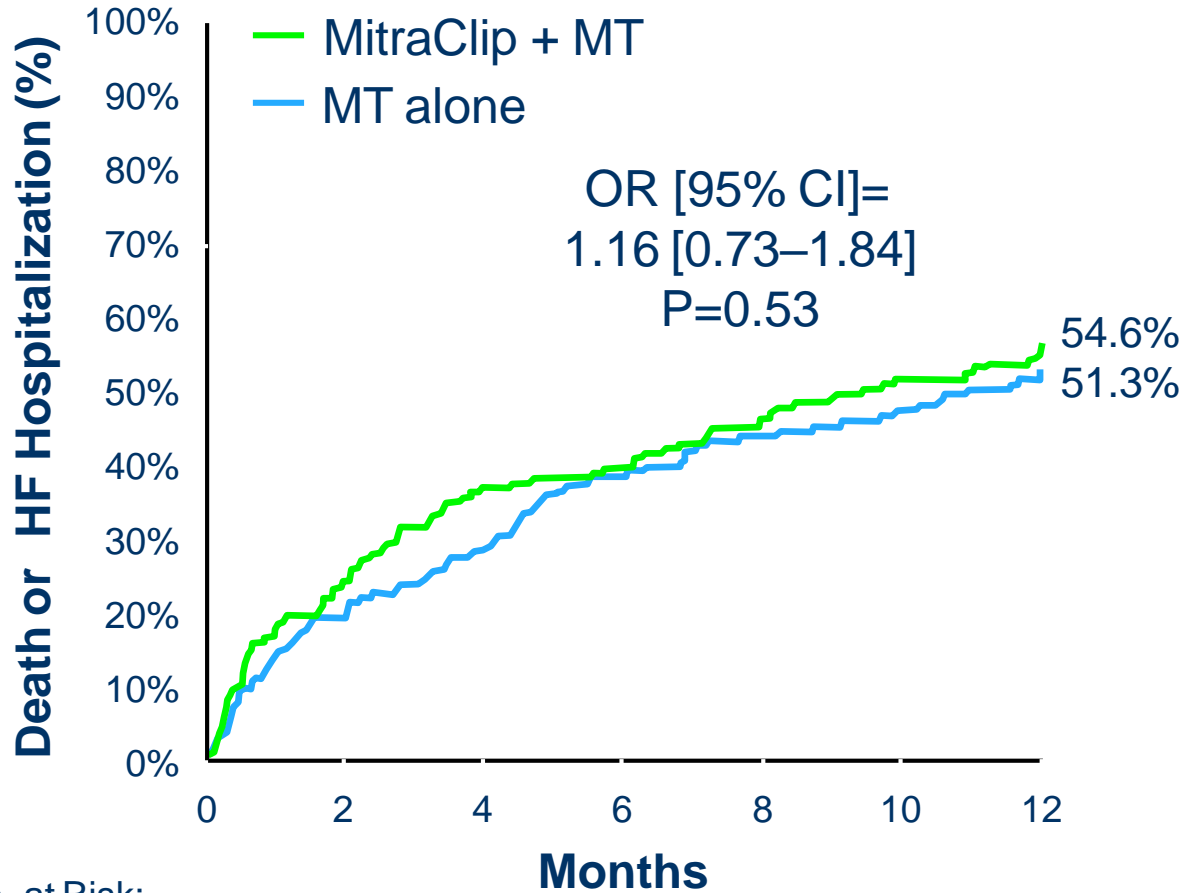
Percutaneous Repair or Medical Treatment for Secondary Mitral Regurgitation

J.-F. Obadia, D. Messika-Zeitoun, G. Leurent, B. Lung, G. Bonnet, N. Piriou,
T. Lefèvre, C. Piot, F. Rouleau, D. Carrié, M. Nejjari, P. Ohlmann, F. Leclercq,
C. Saint Etienne, E. Teiger, L. Leroux, N. Karam, N. Michel, M. Gilard, E. Donal,
J.-N. Trochu, B. Cormier, X. Armoiry, F. Boutitie, D. Maucort-Boulch, C. Banel,
G. Samson, P. Guerin, A. Vahanian, and N. Mewton, for the MITRA-FR Investigators*

COAPT vs. MITRA-FR: 12-Month Death or HF Hosp

MITRA-FR

COAPT



No. at Risk:

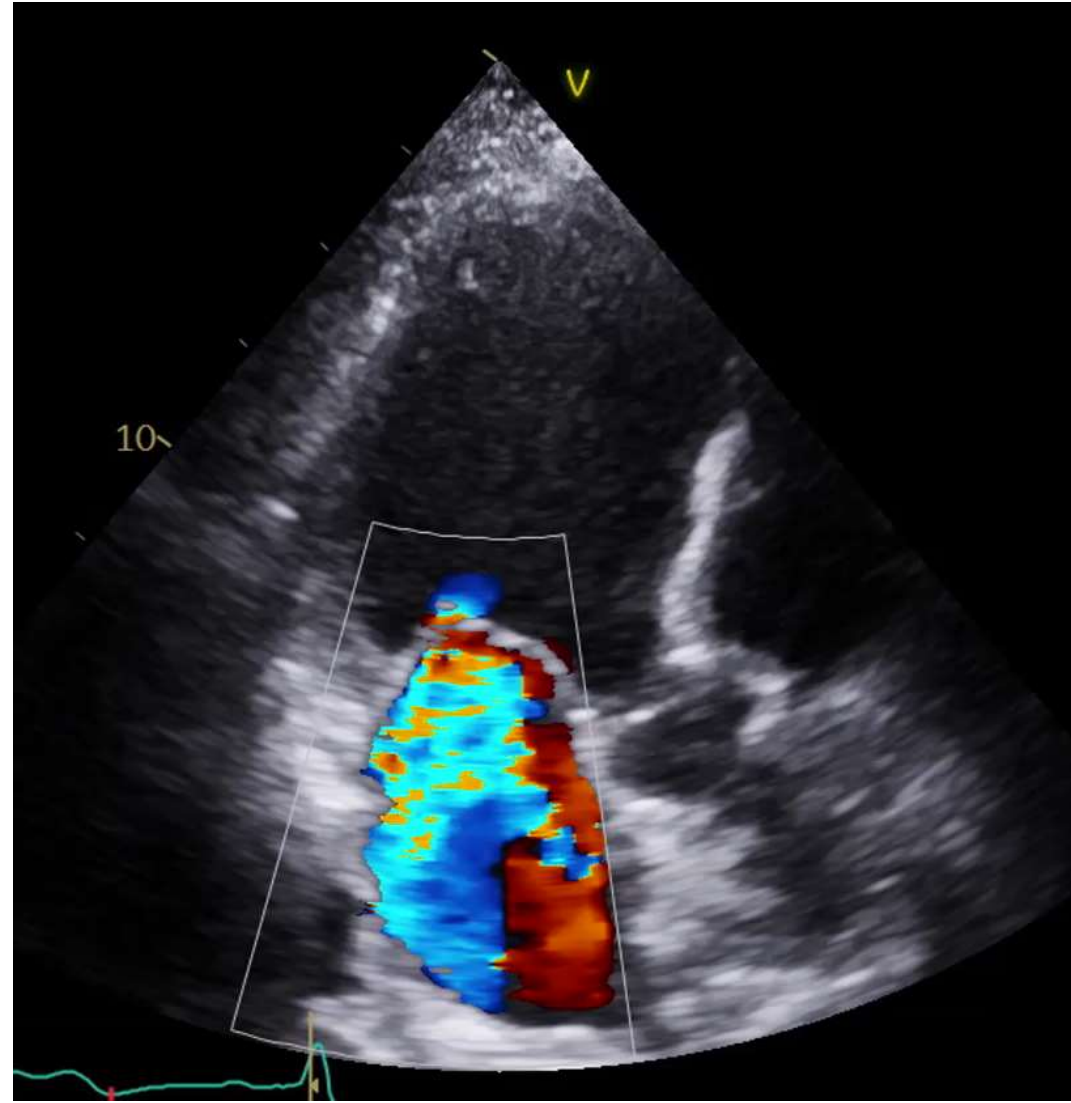
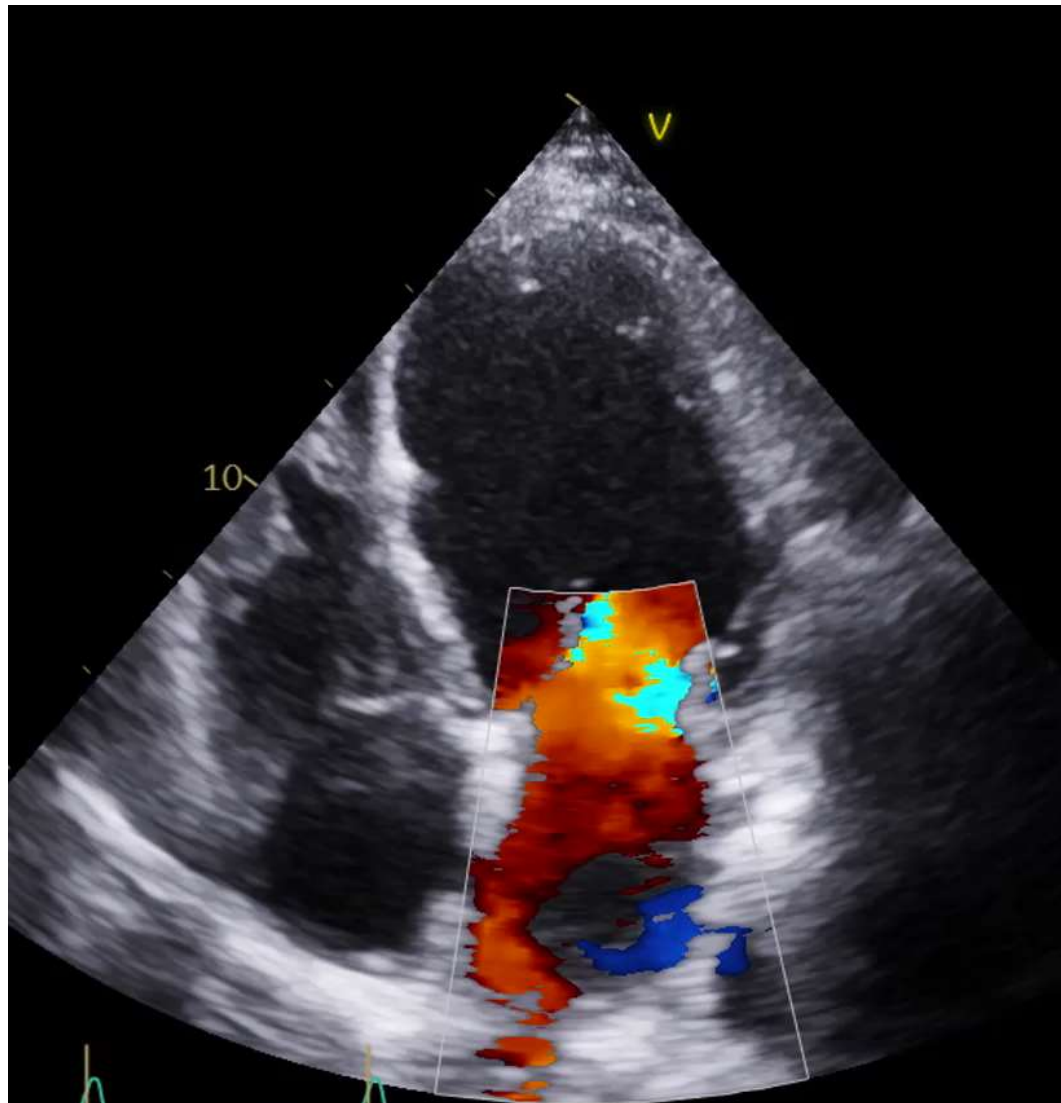
Control Group	152	123	109	94	86	80	73
Device Group	151	114	95	91	81	73	67

No. at Risk:

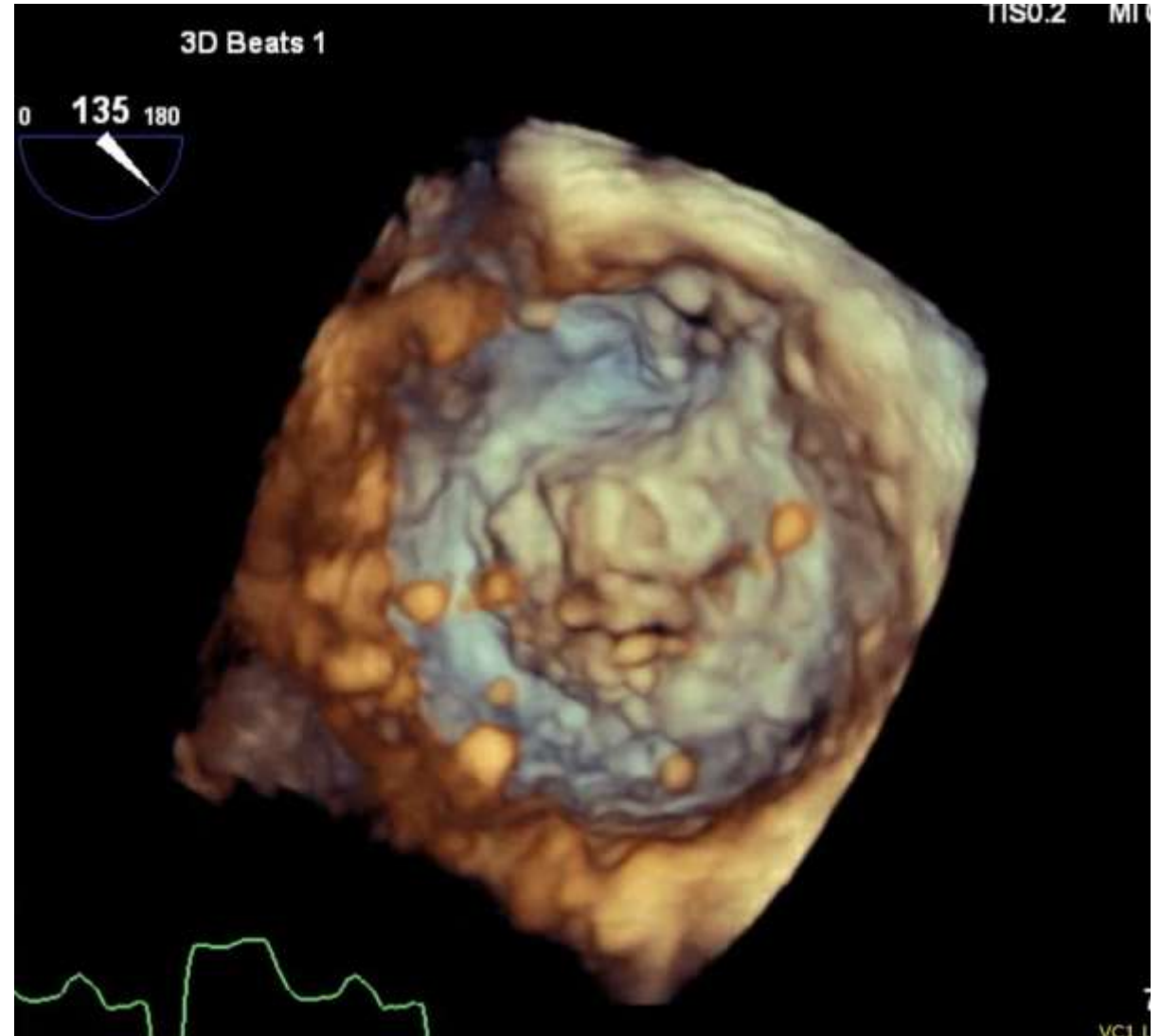
Control Group	312	244	205	174	153
Device Group	302	264	238	215	194

Patient with FMR

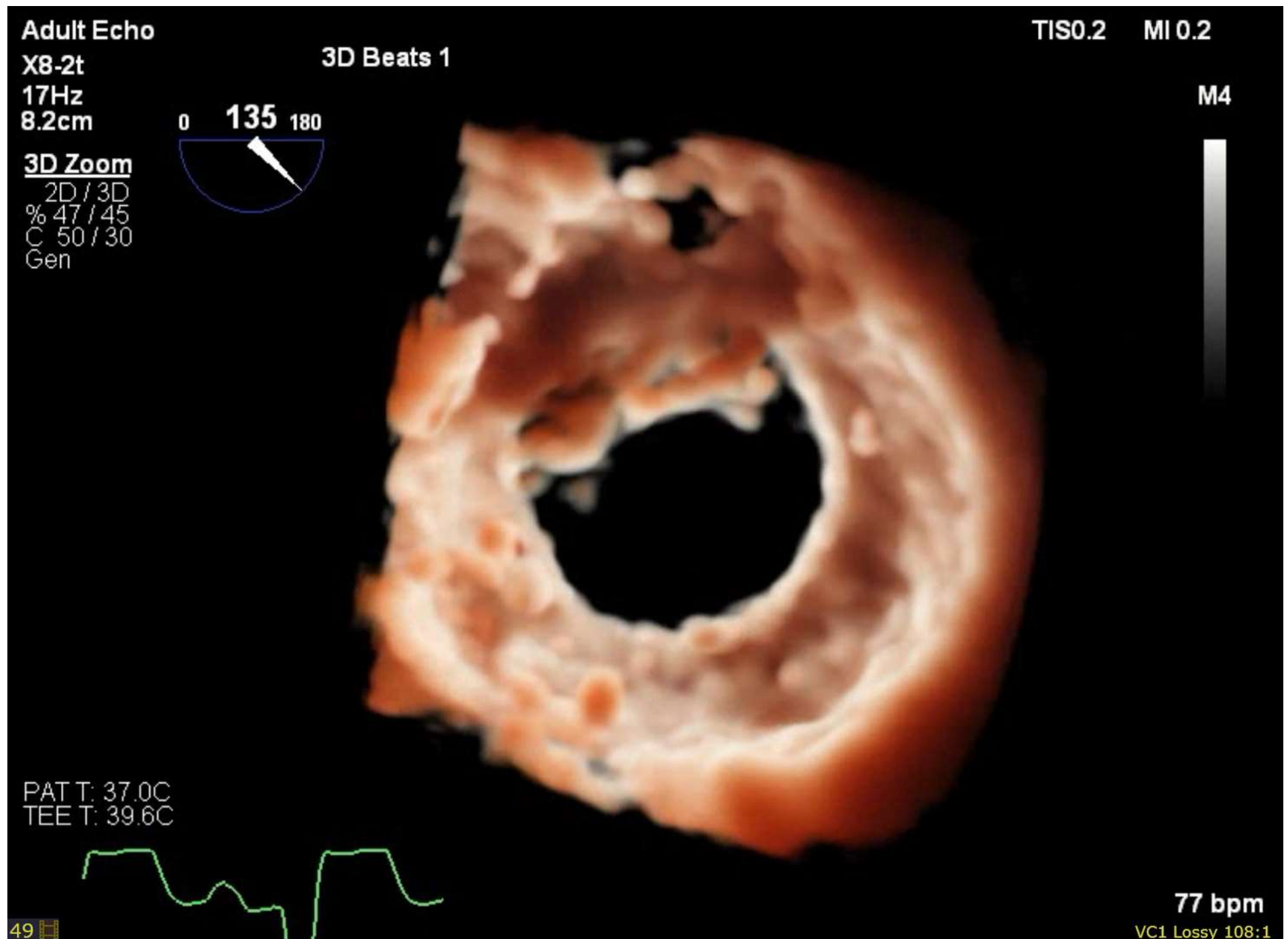
- 68 year old male with a history of multi-vessel coronary disease
- S/P multi-vessel PCI in 2007, DES to RCA in 2017
- hypertension, hyperlipidemia, diabetes, ischemic cardiomyopathy
status post primary prevention single-chamber ICD placement 8/2018
- Paroxysmal A. fib on anticoagulant therapy
- CKD stage III and severe mitral regurgitation



3D Imaging



Details



MPR

Adult Echo

X8-2t

20Hz

7.6cm

3D Zoom

2D / 3D

% 50 / 45

C 50 / 30

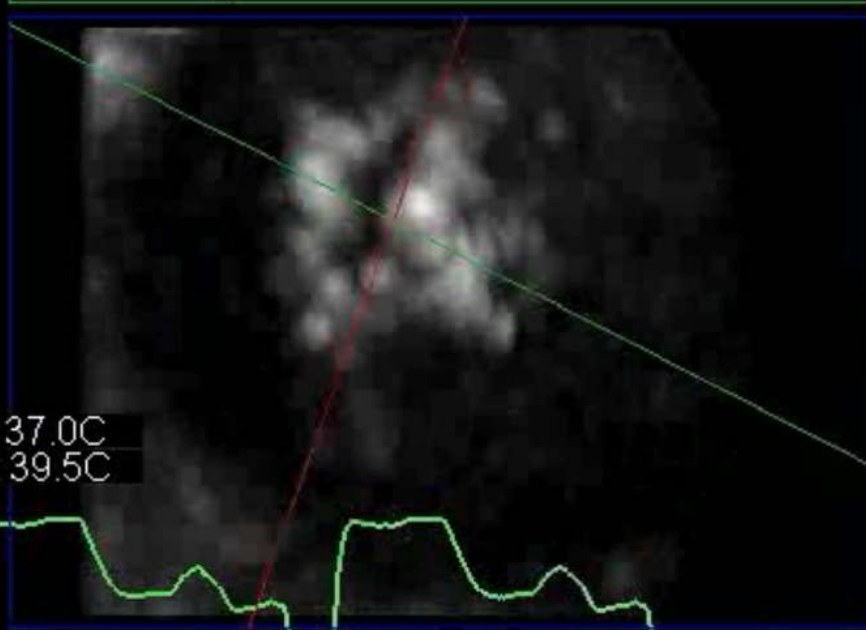
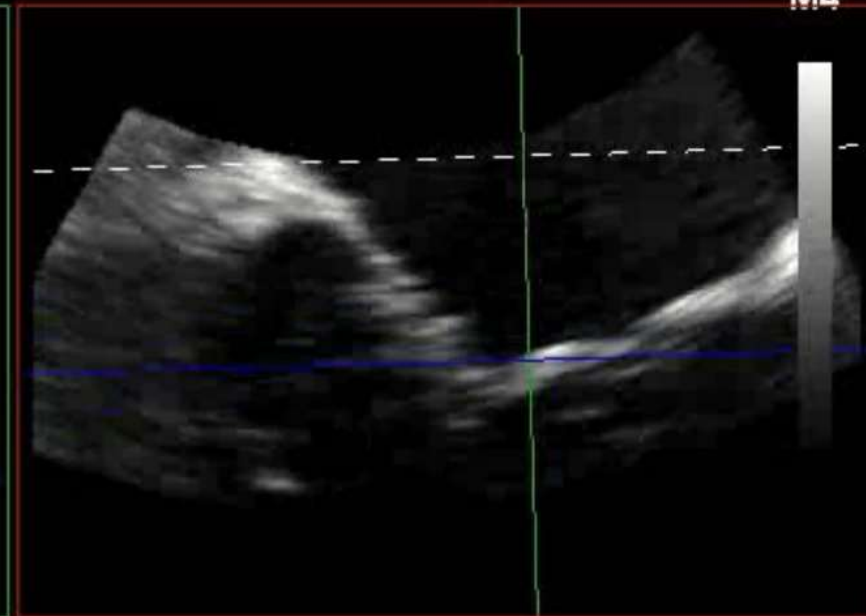
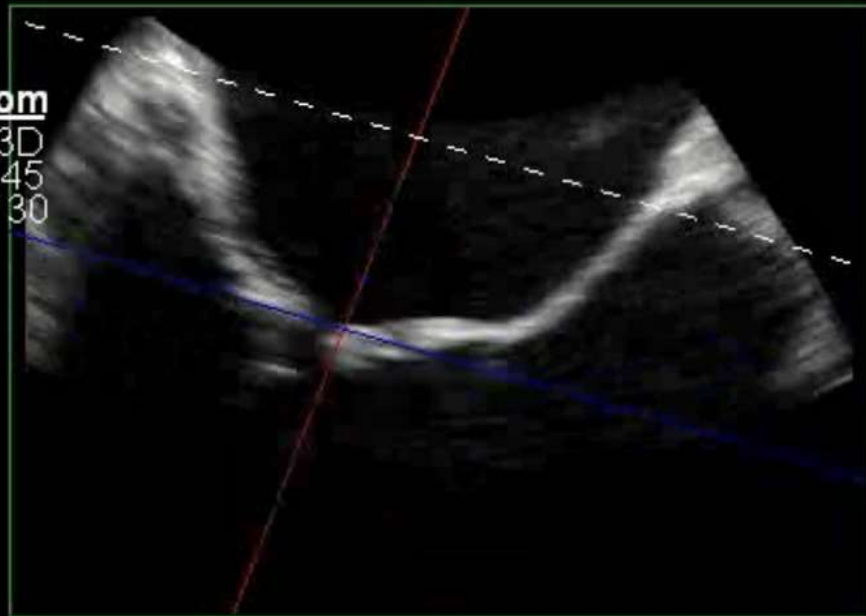
Gen

3D Beats 1

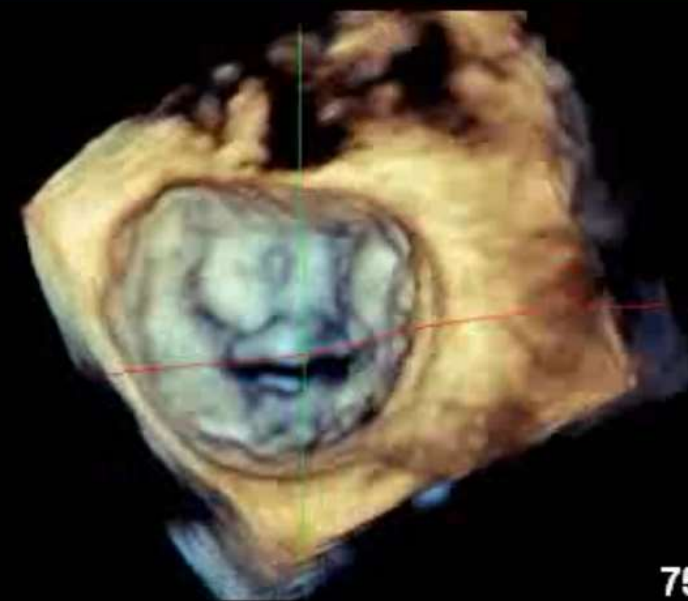
TISO.2

MI 0.2

M4



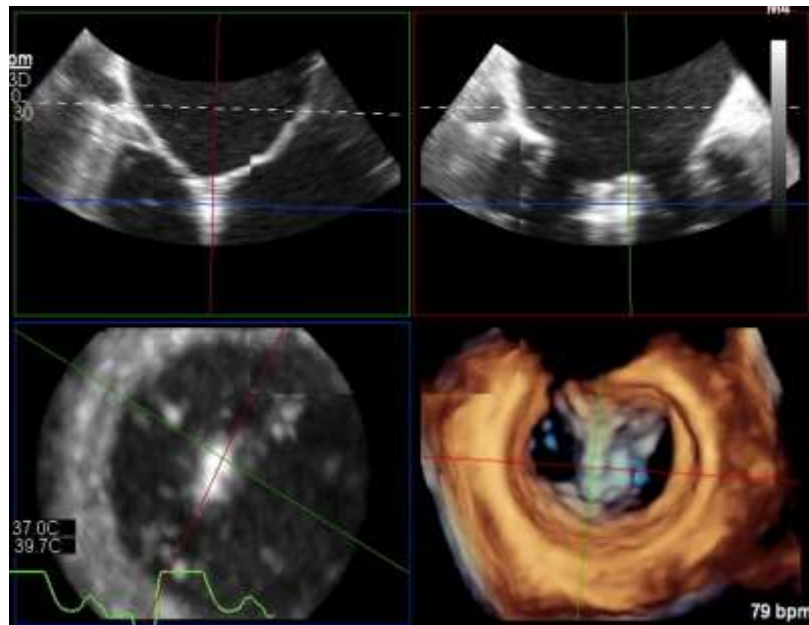
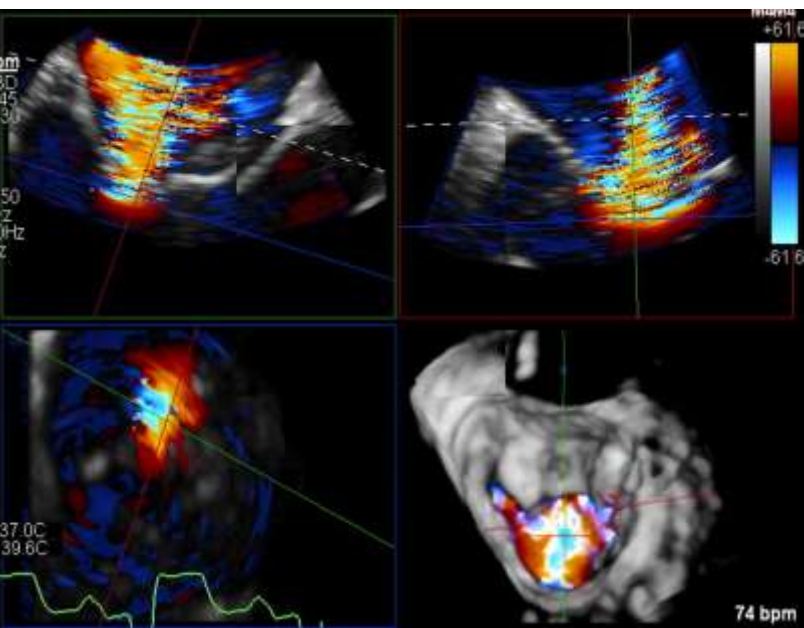
PAT T: 37.0C
TEE T: 39.5C



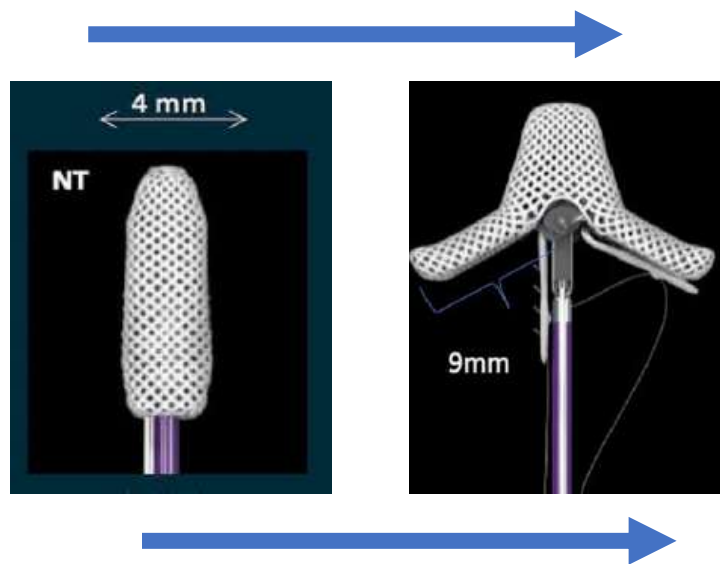
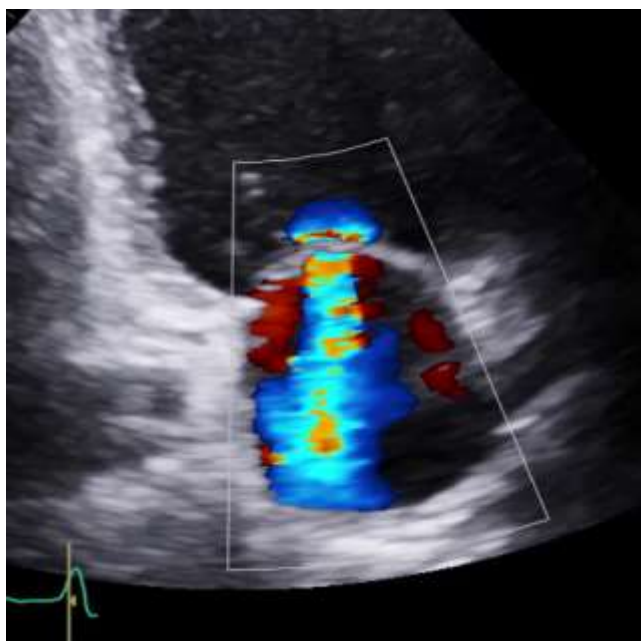
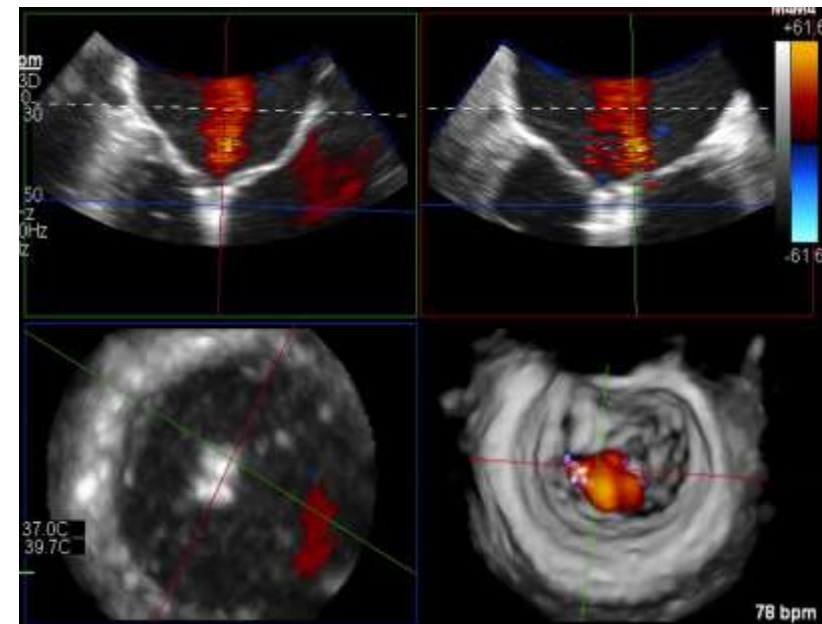
75 bpm

VC1 Lossy 92:1

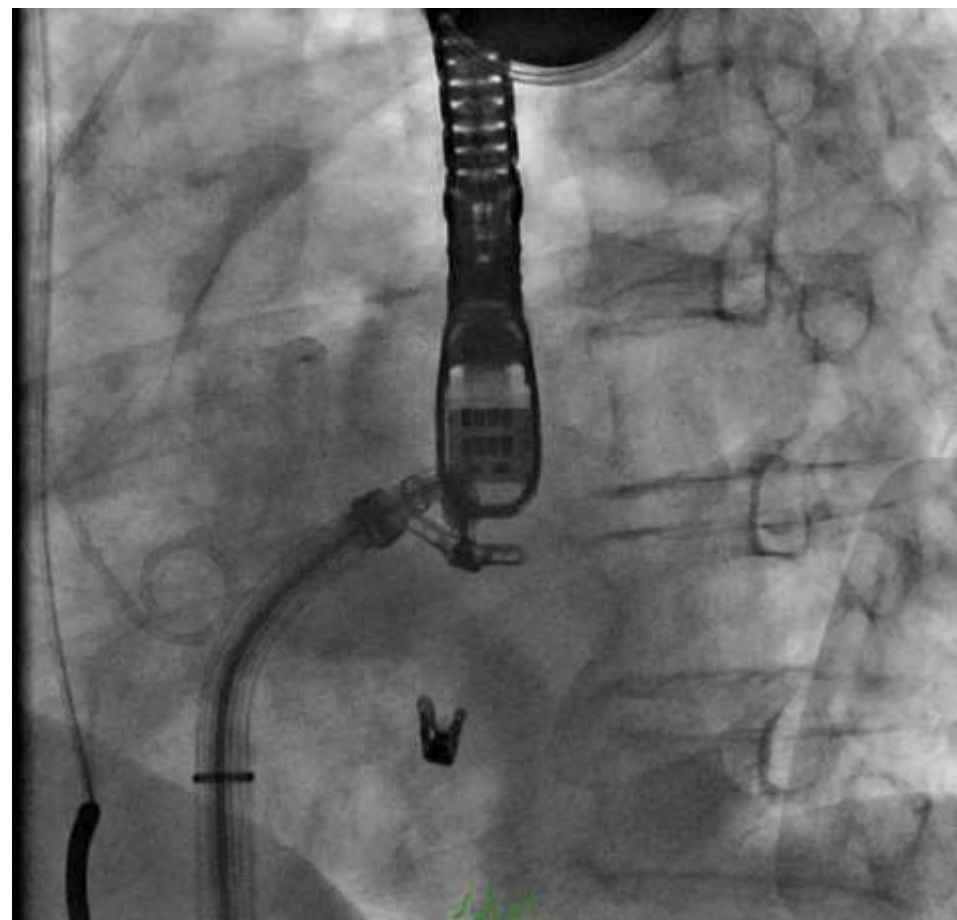
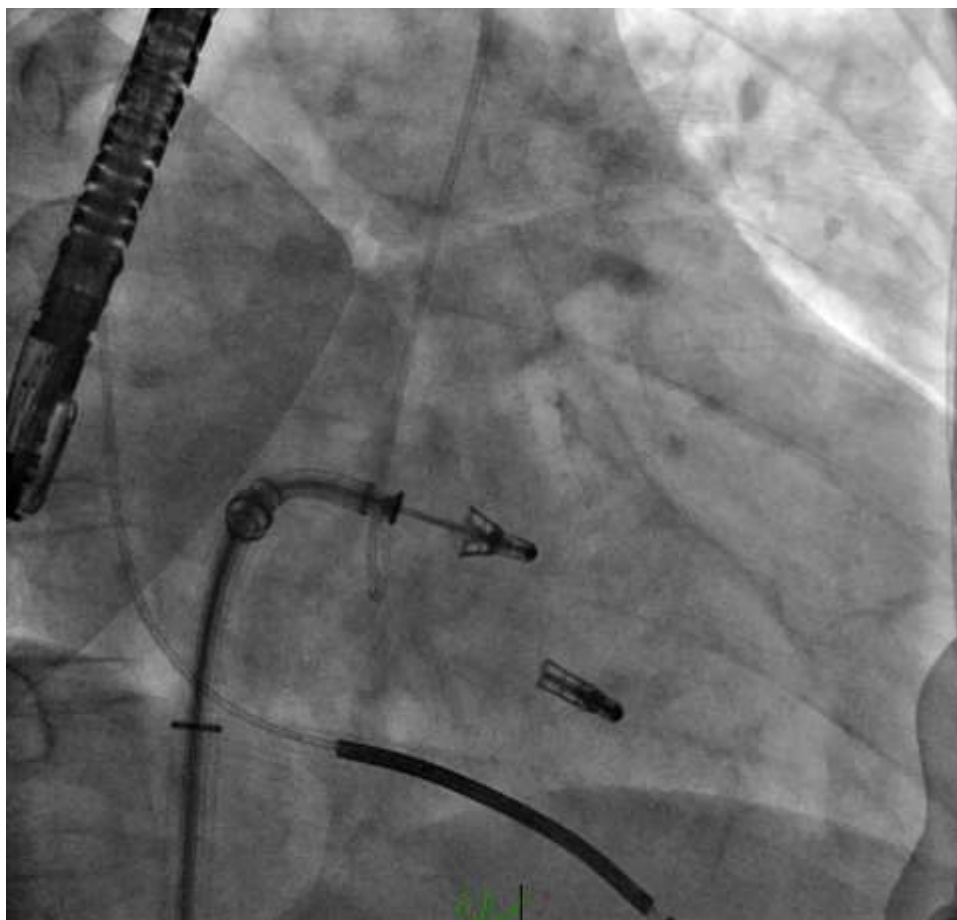
NTR for FMR



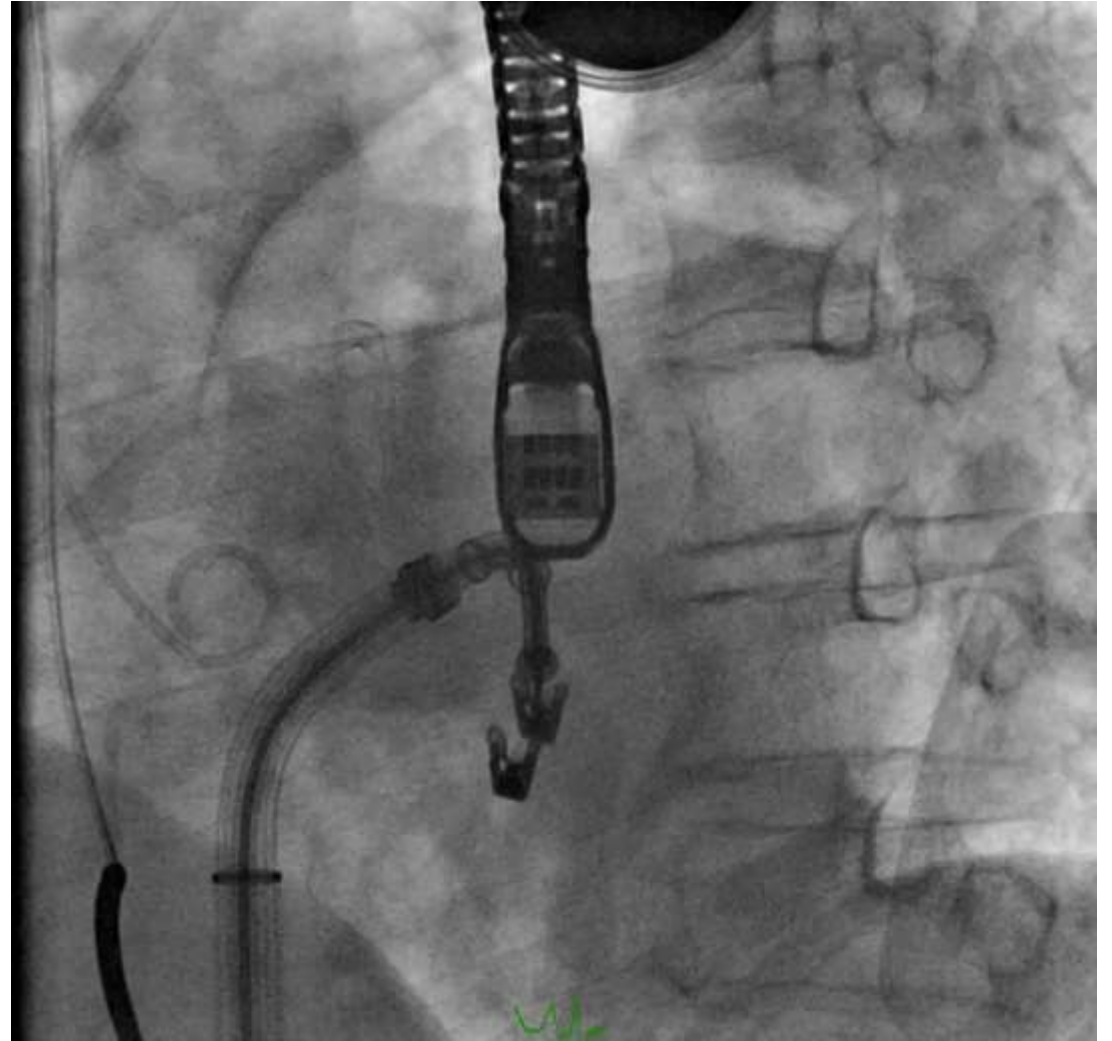
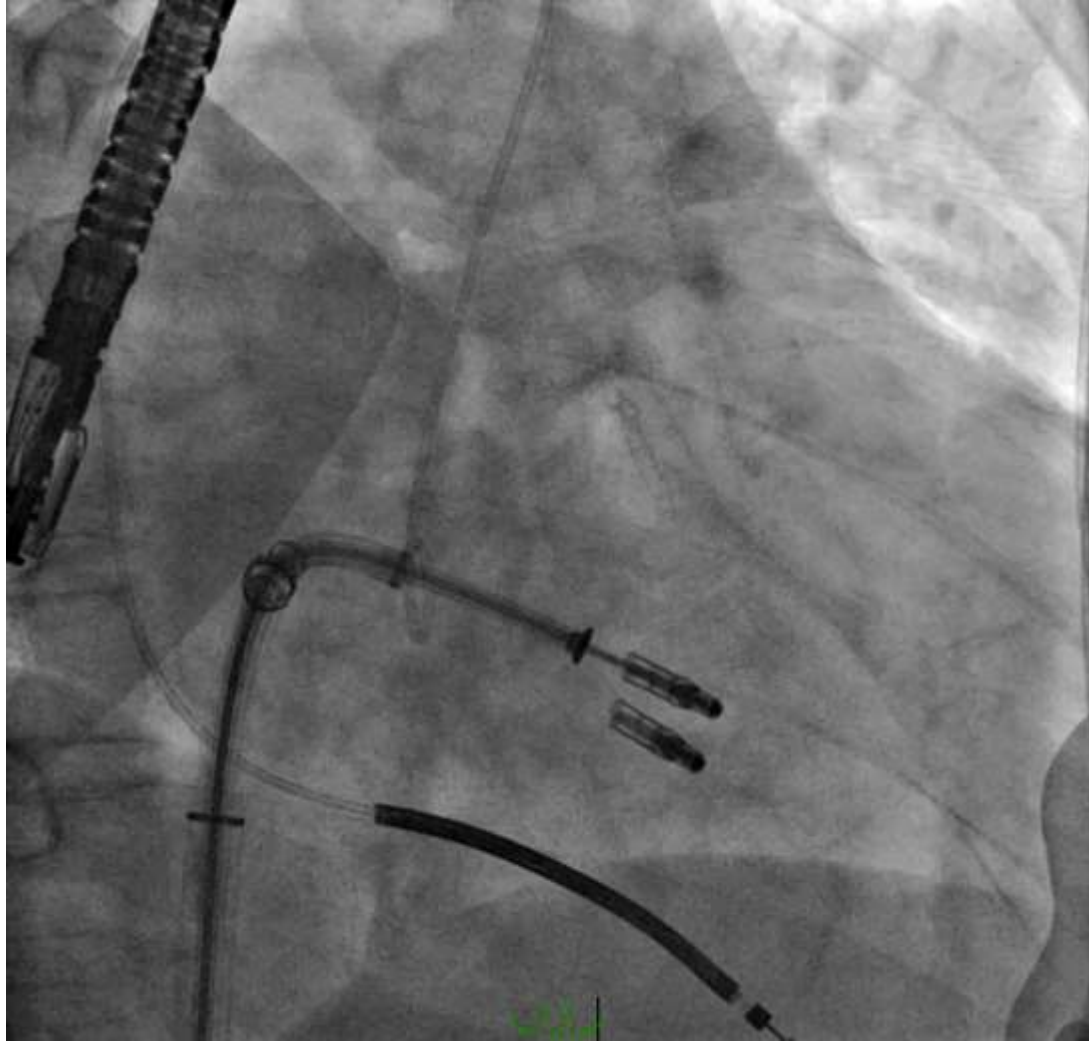
2 clips NTR



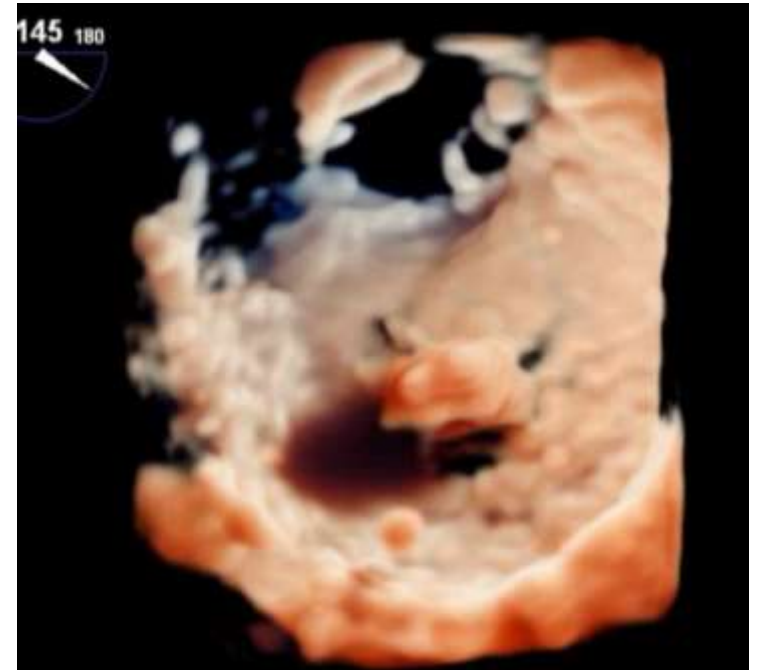
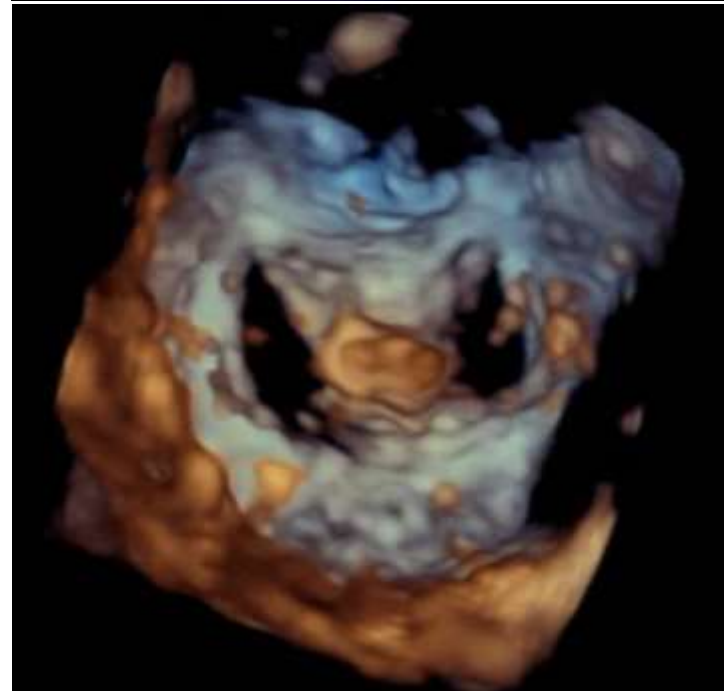
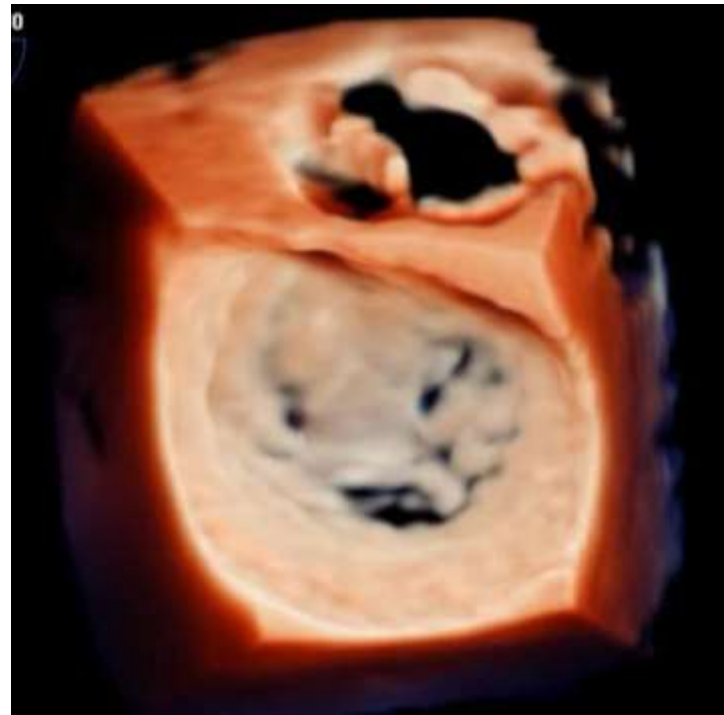
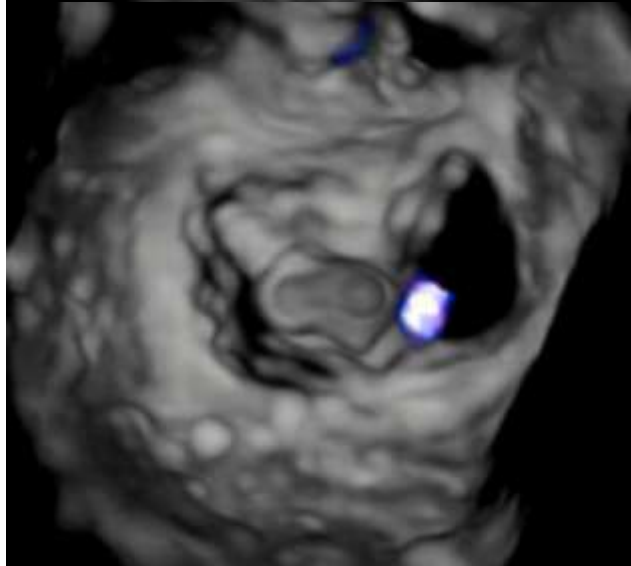
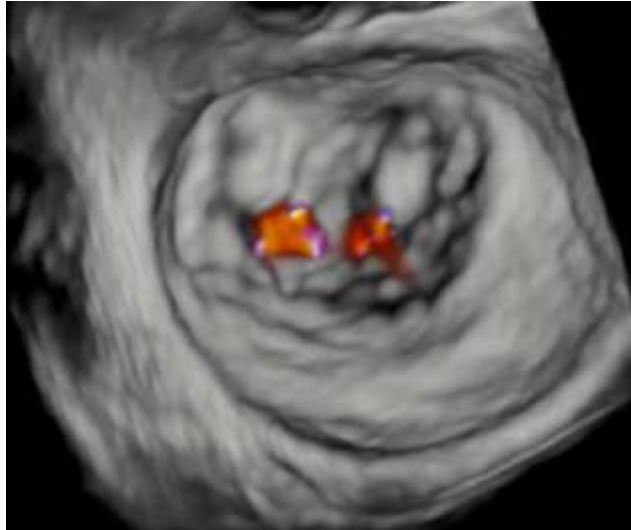
Placing a Second Clip



Close and Parallel



Result Analysis



Take Home Messages

- **FMR is a complex disease that requires very careful evaluation**
 - **Clinical**
 - **Echo**
 - **Therapy**
- **Appropriate patient and therapy selection can potentially alter not just how patient feel but how long and how well they live!**