

Challenges in Assessment of Primary MR

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Conflict of Interest:

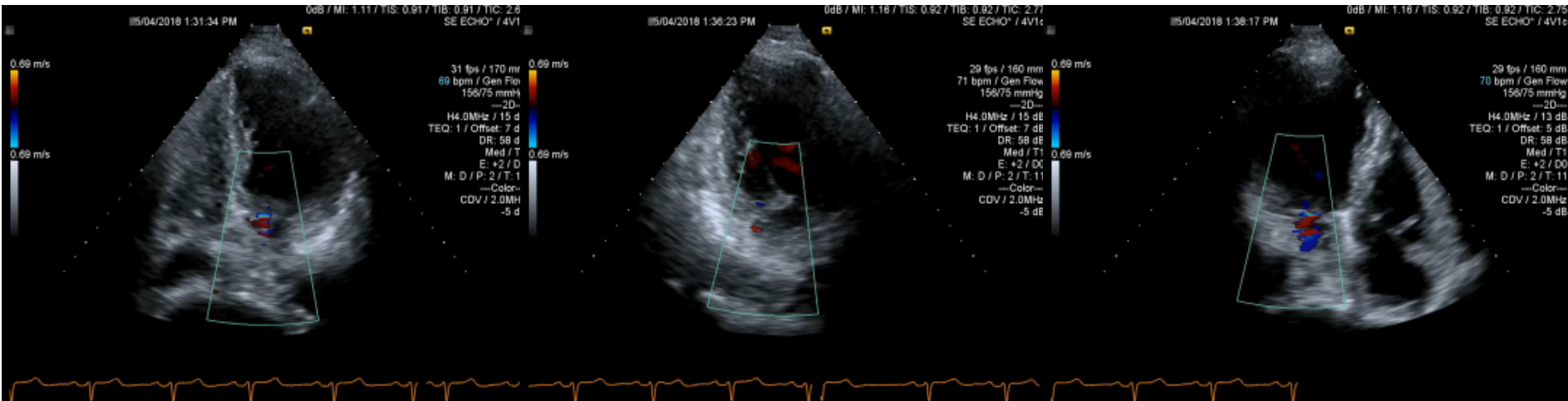
Siemens, Abbott, GE, Philips, Medtronic – Speakers Honorarium and Research Support

History

- 76 yr old woman
- h/o 'moderate' MR
 - 2015 Echo: moderate-severe MR
 - 2017 Echo: moderate MR
- Asymptomatic, but worried
- Referred for possible intervention
- Remote h/o breast cancer, hyperlipidemia, CVA – hearing loss
- Echo at the Valve Center

Mitral Regurgitation

2D Color Flow Doppler



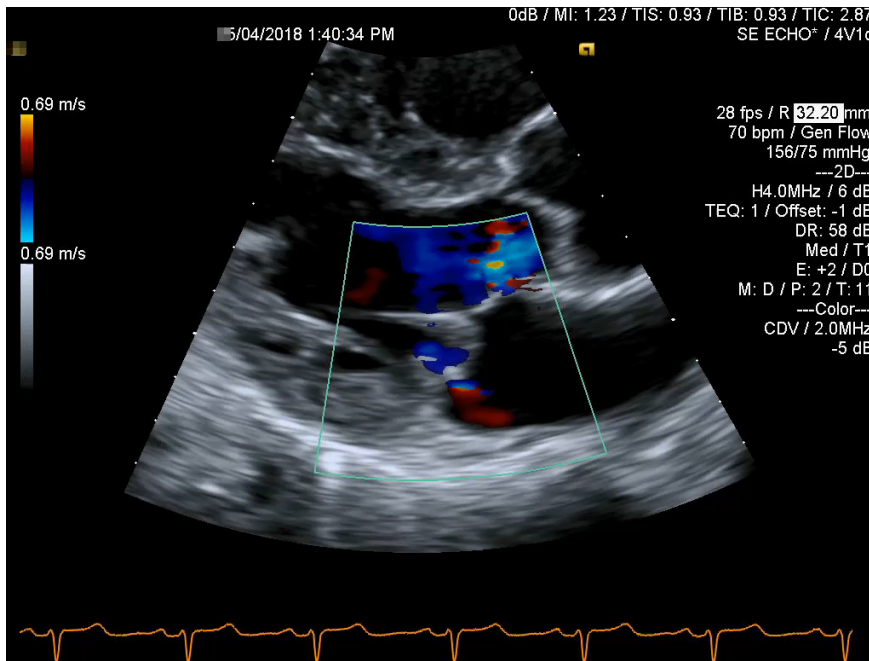
A4C

A2C

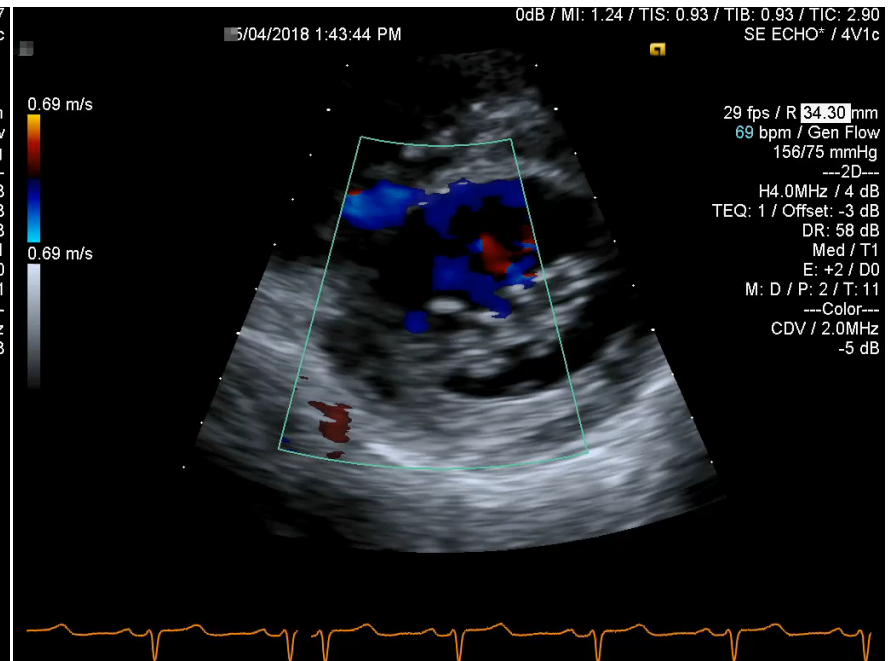
APLAX

Mitral Regurgitation

2D Color Flow Doppler



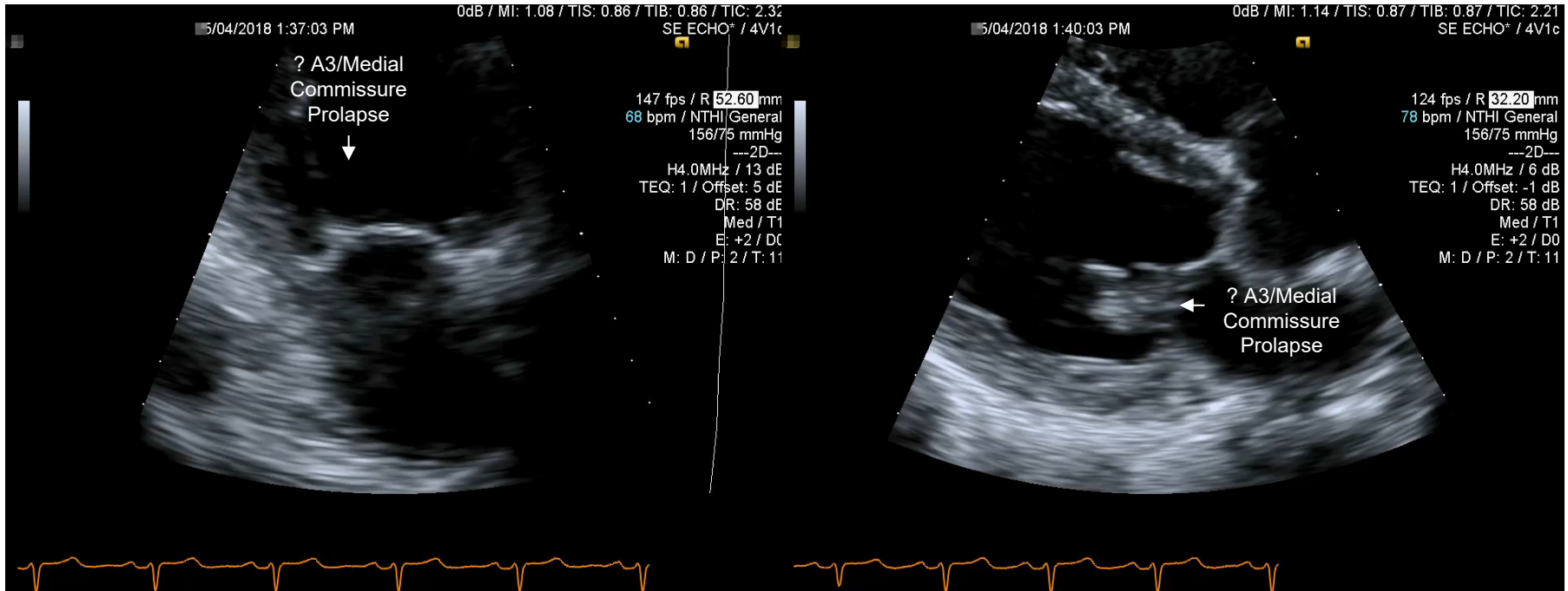
APLAX



SAX

Mitral Regurgitation

2D Morphology of The Mitral Valve

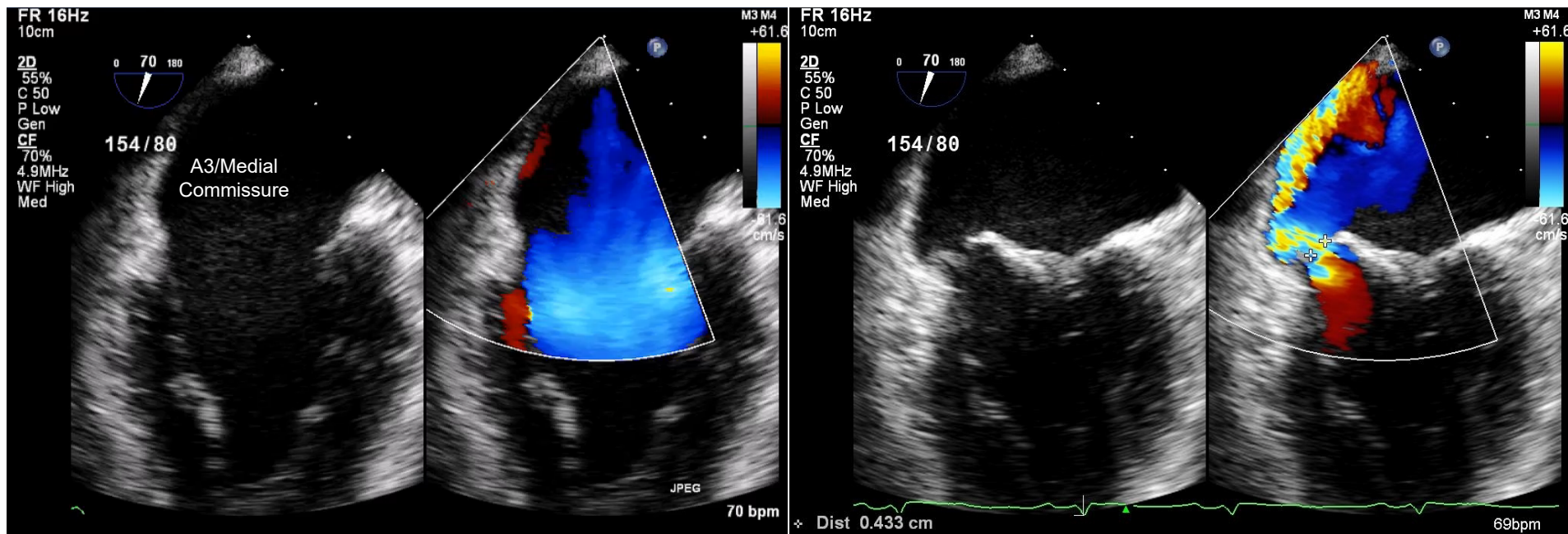


A2C

APLAX

Mitral Regurgitation

2D Morphology of The Mitral Valve - TEE

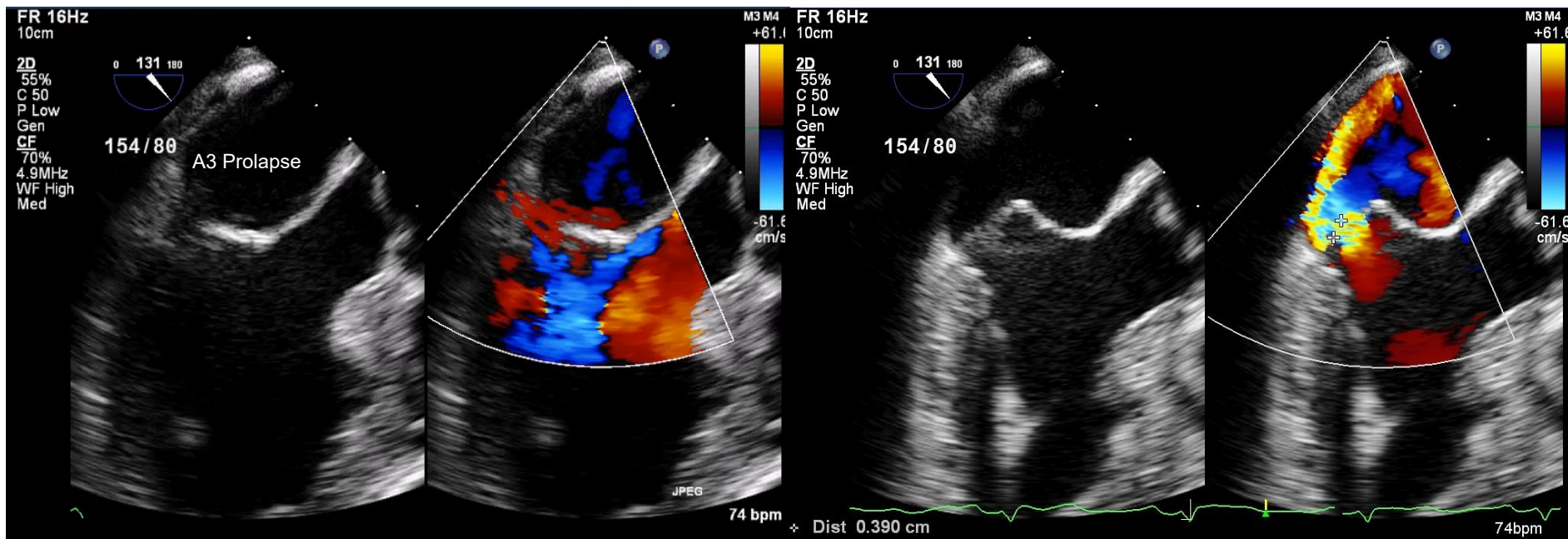


Inter-Commissural View

MR jet,
medially
directed

Mitral Regurgitation

2D Morphology of The Mitral Valve - TEE



Long-Axis View

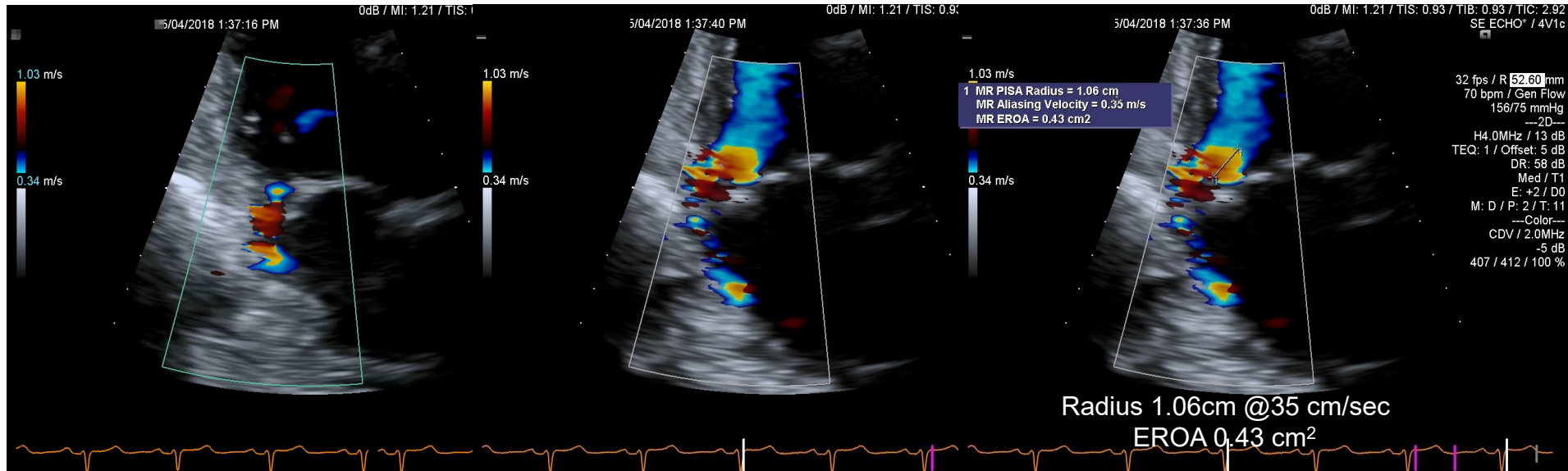
MR jet,
posteriorly
directed

What Next?

- **Complex Anatomy:** A3/Medial Commissural prolapse
- Asymptomatic: **Severity of MR?**

Mitral Regurgitation

2D PISA EROA - APLAX



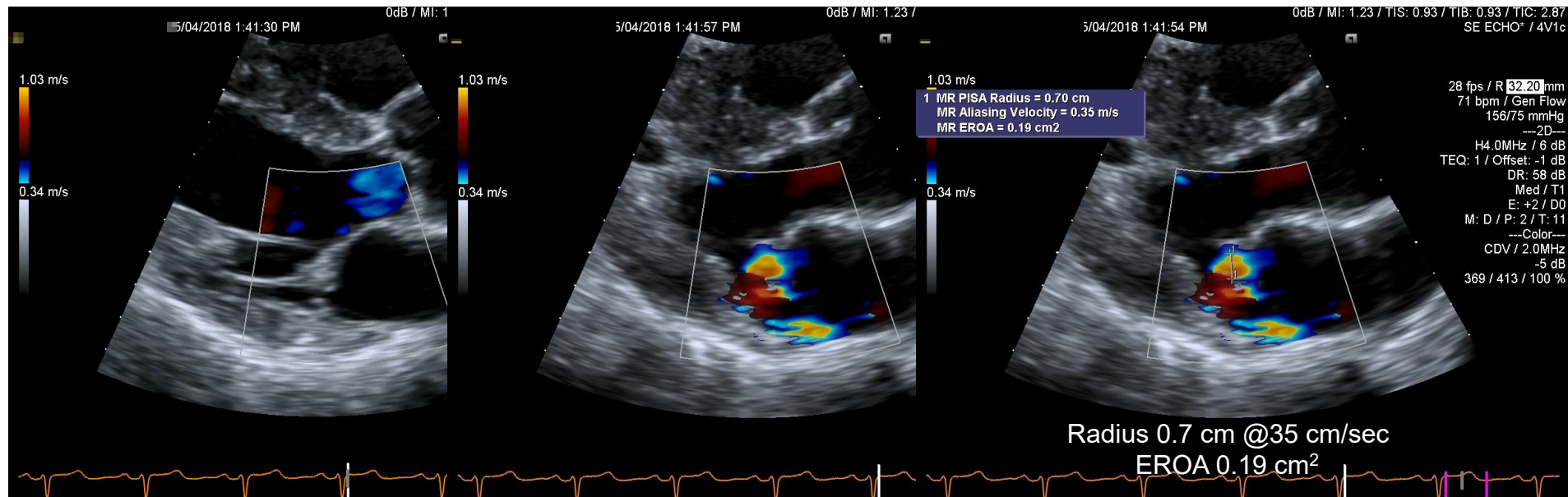
A2C

PISA

A2C - PISA EROA

Mitral Regurgitation

2D PISA EROA - PLAX



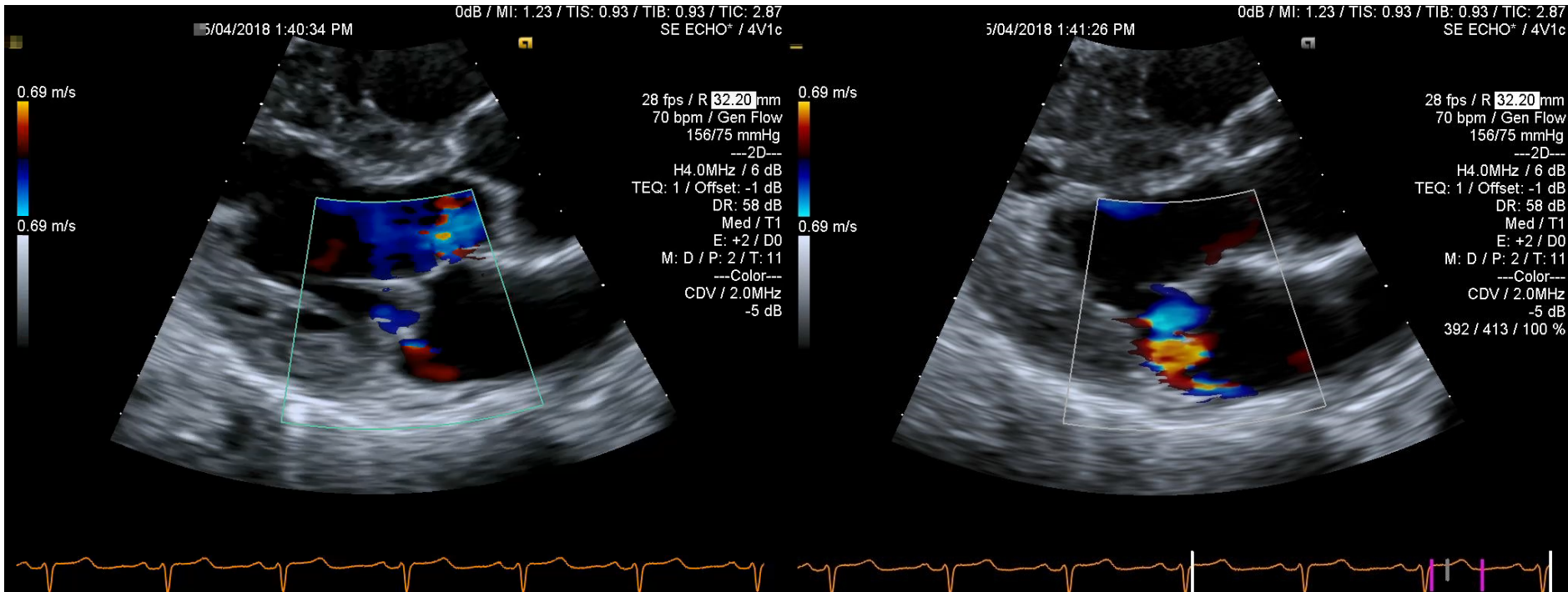
PLAX

PISA

PLAX - PISA EROA

Mitral Regurgitation

2D Vena Contracta- PLAX

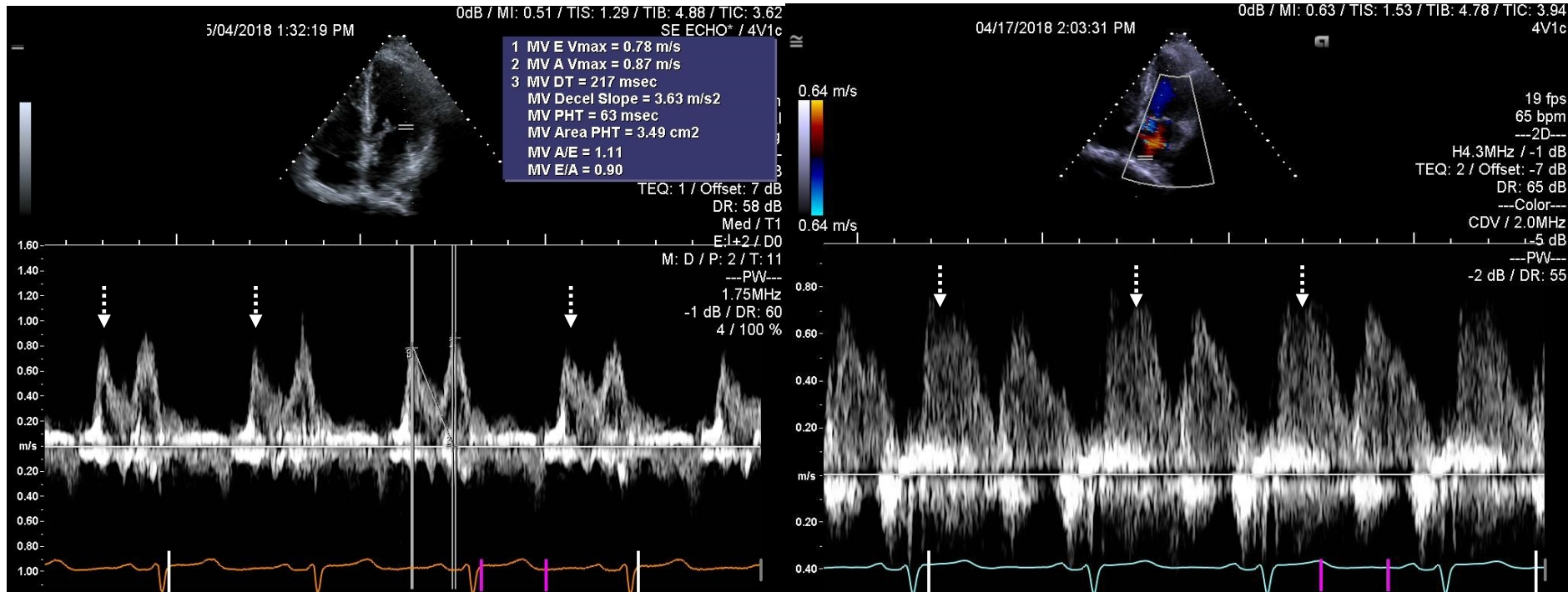


PLAX

VC 0.7 cm

Mitral Regurgitation

Mitral Inflow and PV Spectral Doppler

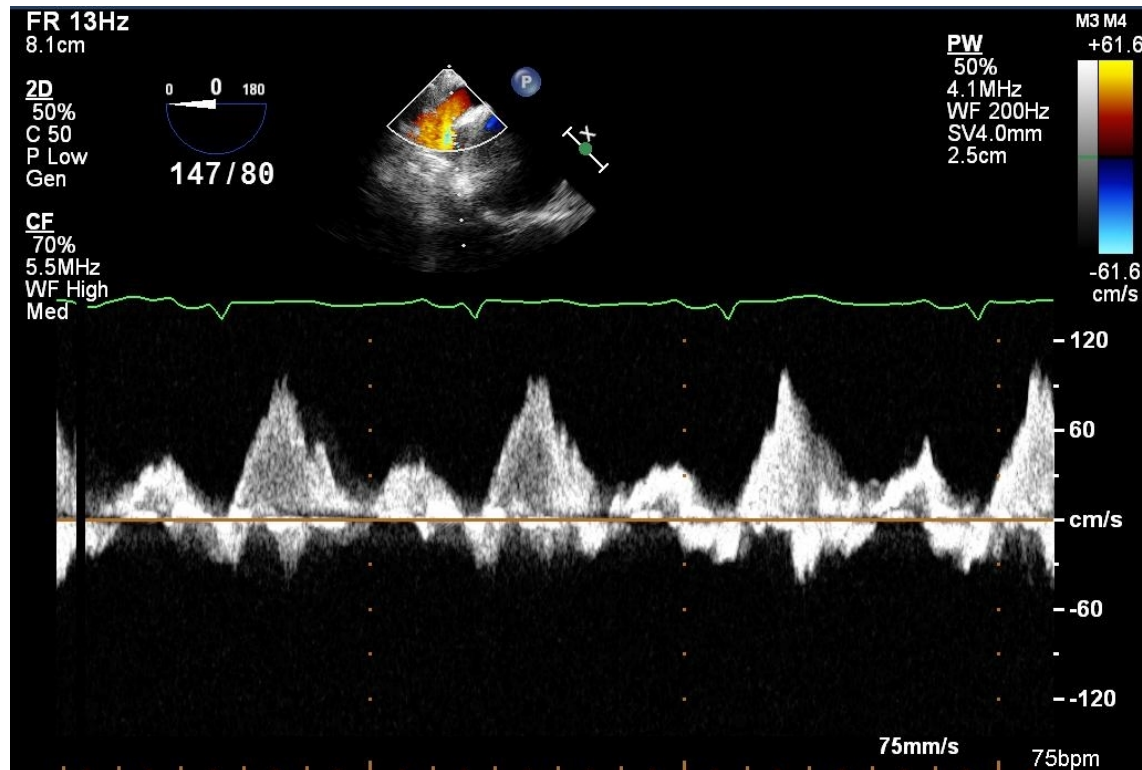


MV Inflow – non E dominant flow

RUPV – normal systolic flow

Mitral Regurgitation

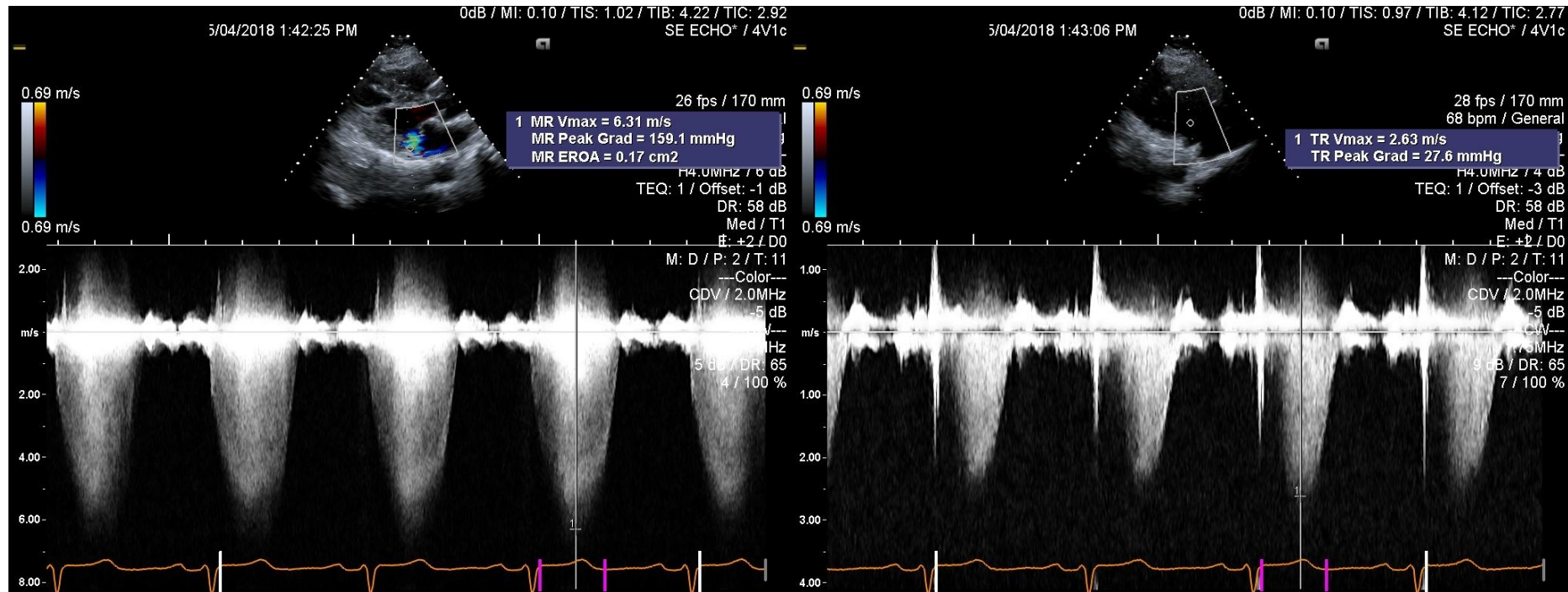
Pulmonary Vein Flow - TEE



LUPV – normal systolic flow
(RUPV, RLPV also showed
the same Doppler finding)

Mitral Regurgitation

MR and TR Spectral Doppler

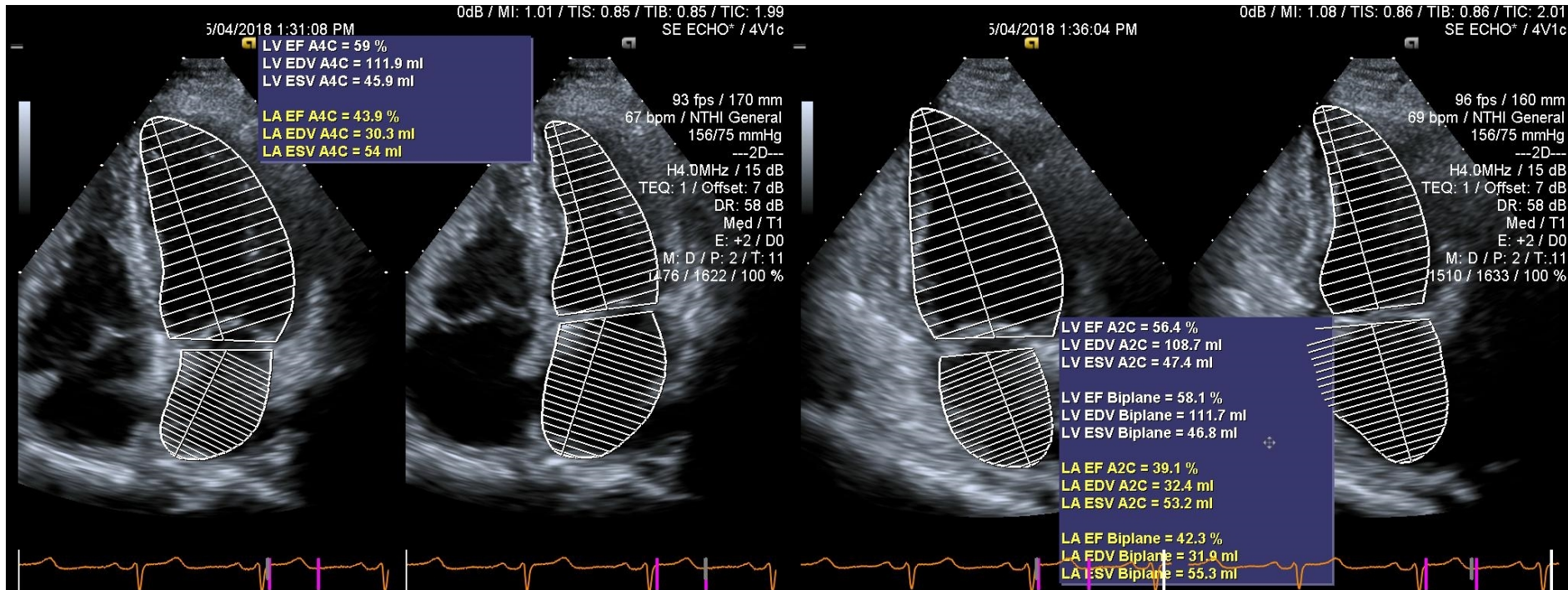


MR – “moderate intensity spectrum but not optimally aligned (difficult to align)

TR – peak velocity 2.63 m/sec, normal IVC, estimated RAP 5 mmHg, calculated RVSP ~33 mmHg

Mitral Regurgitation

LV EF and LA Volume



LV EF 58.1%

LA volume 34 ml/m² (Normal/Mildly dilated)

Mitral Regurgitation

ASE Recommendations 2017

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

Complex Lesion

Moderate MR

Severe MR

Summary

- Echo shows **moderate or moderate to severe MR or severe MR**
- She is **asymptomatic but worried** and here for **expert opinion**
- **Complex mitral valve morphology** (A3/medial commissural prolapse) – we do not know much about the natural history of MR in these compared to classic MV prolapse

Options

- **Exercise Echo** to assess symptoms and MR – bicycle would be best
- But, we also have **another resting TTE option** before Exercise Echo

Mitral Regurgitation

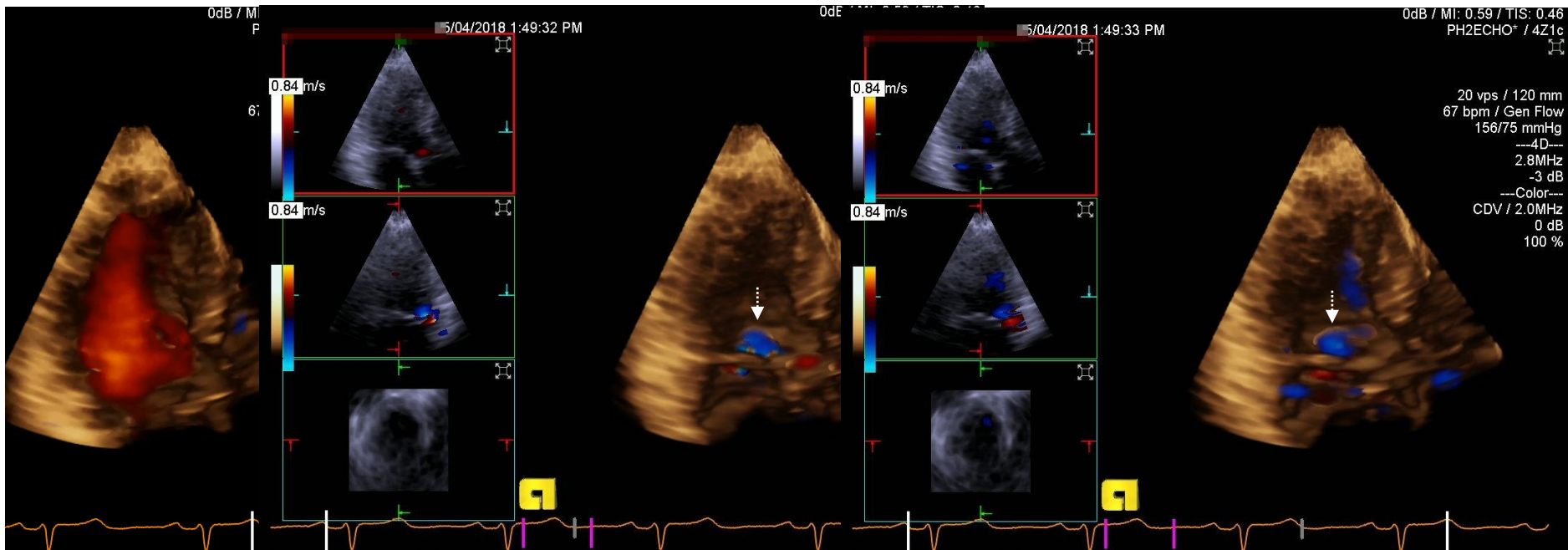
Additional TTE Options - ASE

Table 1 Echocardiographic parameters in the comprehensive evaluation of valvular regurgitation

	Parameters
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)
Quantitative parameters for regurgitation	LV and RV filling dynamics (MR, TR)
	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

Mitral Regurgitation

Real-Time Volume CFD – 3D PISA

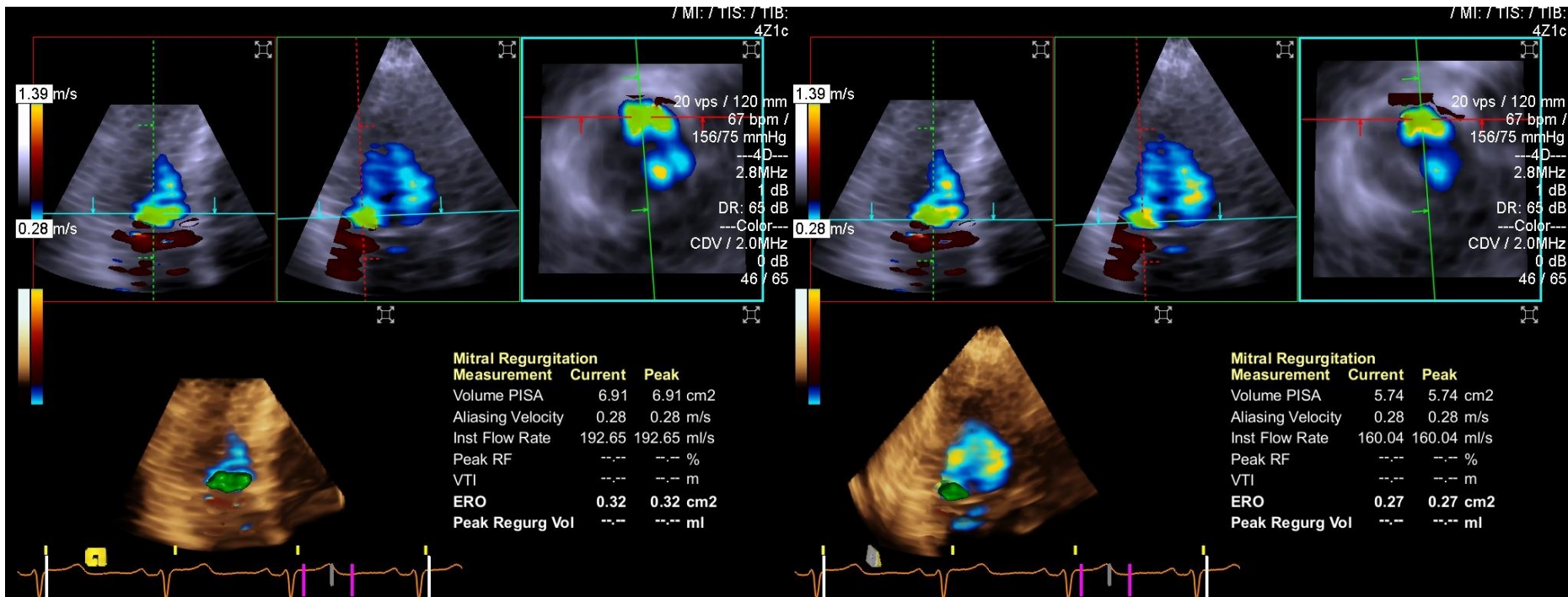


Flat PISA

Small Round PISA

Mitral Regurgitation

Real-Time Volume CFD – 3D PISA



Unreliable 3D PISA EROAs
 (3D PISA EORA correctly done is always equal to or bigger than correctly done 2D PISA EORA)

3D PISA

- **3D PISA EROA is better than 2D PISA EROA but may not be possible (multiple jets, AF) or inaccurate** in constrained flow convergence
- Even if possible, **Single Frame (Largest PISA)** 3D PISA EROA does not necessarily reflect the total systolic burden of MR; it may overestimate MR, especially in dynamic MR

Mitral Regurgitation

Another Quantitative Option - ASE

Grading the severity of chronic MR by echocardiography

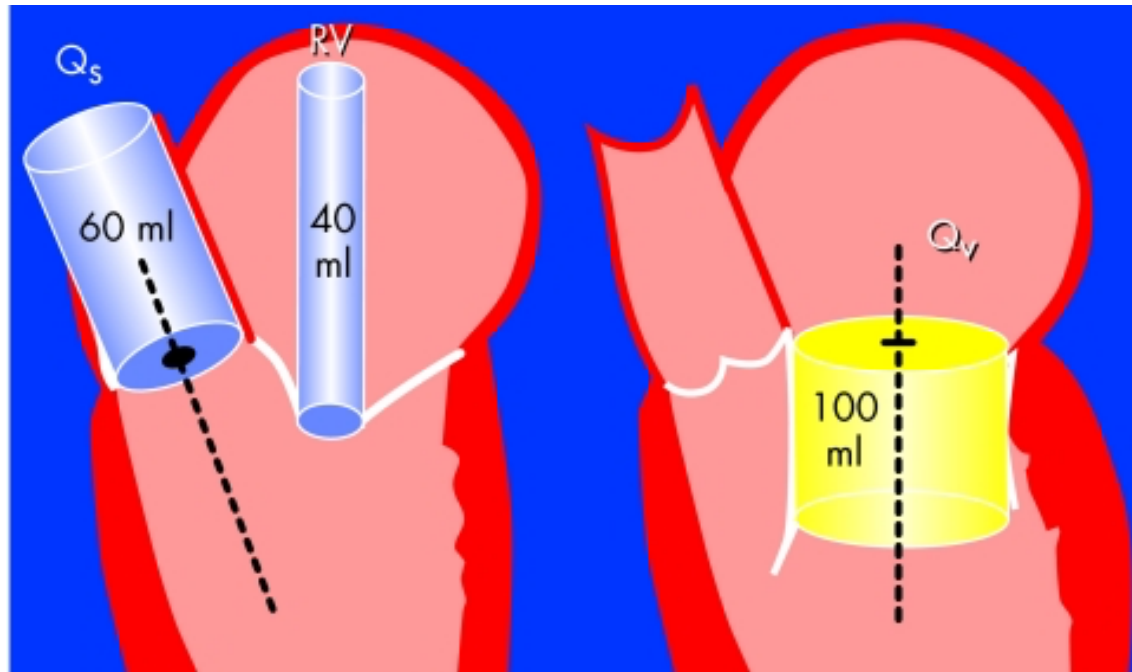
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Mitral Regurgitation

2D RV and RF

$Q_v - Q_s$ (100 ml - 60 ml) = 40 ml (Regurgitant Volume, RV)

$RV/Q_s = 40/100 = 25\%$ (Regurgitant Fraction, RF)



Multiple measurements, Errors, Time consuming

Mitral Regurgitation

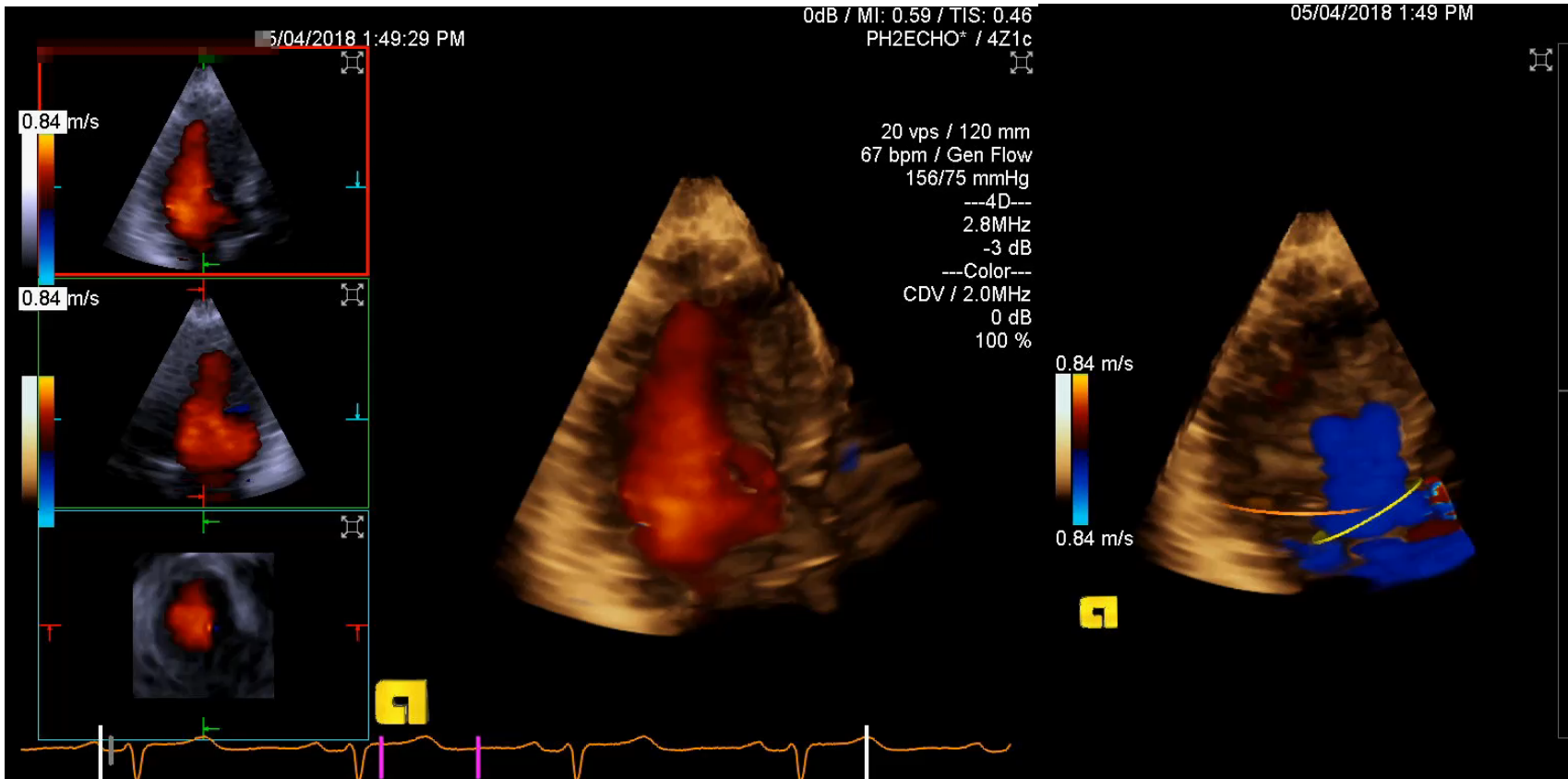
ASE Recommendations

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Mitral Regurgitation

Real-Time Volume CFD – 3D RV/RF

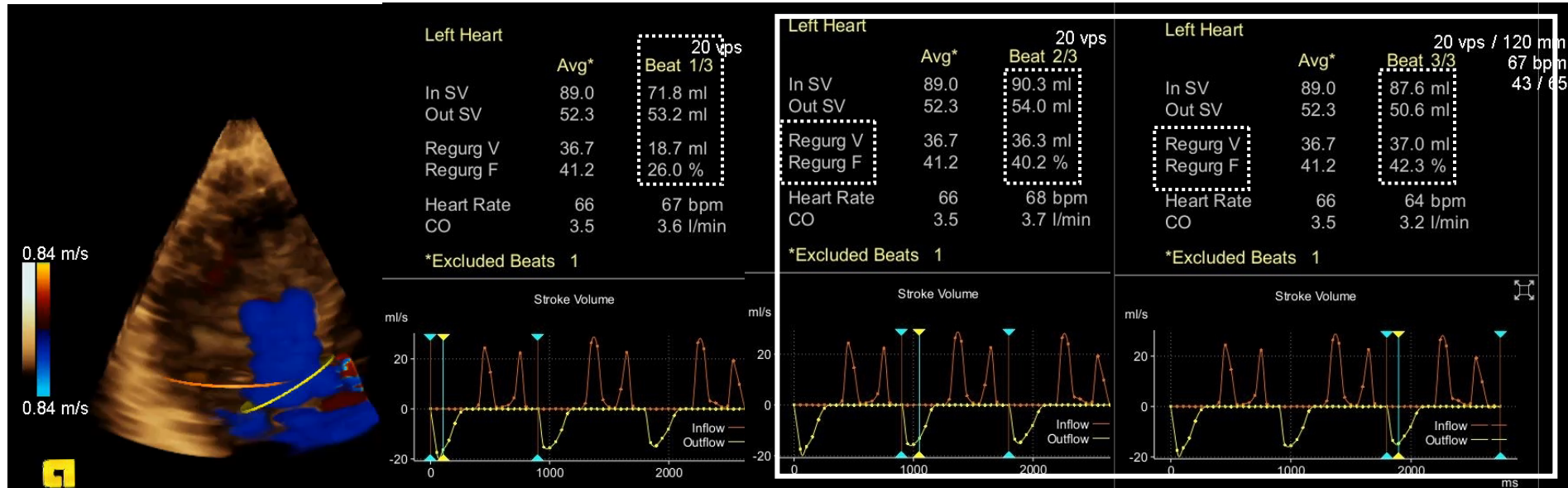


3D Mitral and Aortic CFD

Automated Mitral and Aortic Flow
Computation

Mitral Regurgitation

Real-Time Volume CFD – 3D RV/RF



First beat Mitral SV is smaller than the second and third beat, so we exclude the data from the first beat for computing RV/RF

Mitral SV = 89 ml
Aortic SV = 52.3ml
RV = 36.7ml
RF = 41.2%

(Average of second and and third beats)

Mitral Regurgitation

Putting All The Echo Data Together

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			≥50

Complex Lesion

Moderate MR

Severe MR

Moderate MR

Mitral Regurgitation

CMR Report

Vitals

Height	66.00 in 167.64 cm	BSA	1.72 m ²	Baseline HR	65 BPM
Weight	141.01 lbs 63.96 kgs	BP	130 / 73 mmHg	Heart Rhythm	Sinus Rhythm

Summary

1. Mild LA enlargement. NO thrombus in LA or RA appendages.
2. Normal LV systolic function without wall motion abnormalities (LVEF 62%). Normal RV systolic function (RVEF 56%).
3. NO myocardial infarction or scarring.
4. There is prolapse of A3 and postero-medial commissure. Mitral insufficiency jet is located in the postero-medial commissure. There is moderate mitral regurgitation. Mitral Regurgitant Volume 41 ml. Mitral Regurgitant Fraction 39%.

3D CFD Regurgitant Volume

- Preliminary data: **good agreement with CMR data**
(We have previously validated this compared to CMR; Circ Imaging 2013;6:125-33)
- **Primary MR:** Useful when **PISA EROA is unreliable** or not possible, **multiple jets abnormal LV in “moderate MR”**, or when quantitative data and qualitative data don't agree
- **Secondary MR:** **almost always useful** beyond mild MR because PISA EROA may under or overestimate MR

Thank you
