Quantification of Severity of Mitral regurgitation With the New ASE Guidelines

Case Studies

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HOUSTON Methodist LEADING MEDICINE

ASE GUIDELINES AND STANDARDS

Recommendations for Noninvasive Evaluation of Native Valvular Regurgitation

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

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JASE 30: 303, 2017

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The same day
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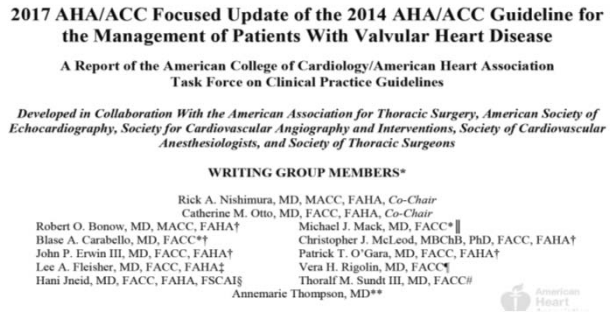

2017 AHA/ACC Focused Update of the 2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease

A Report of the American College of Cardiology/American Heart Association Task Force on Clinical Practice Guidelines

Developed in Collaboration With the American Association for Thoracic Surgery, American Society of Echocardiography, Society for Cardiovascular Angiography and Interventions, Society of Cardiovascular Anesthesiologists, and Society of Thoracic Surgeons

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New ASE Valvular Regurgitation Guidelines- *Endorsed by SCMR*

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What is New?

- Emphasis on identification of Etiology/Mechanism of regurgitation
- 2D/3D TTE--an integrative approach & algorithms to assess severity
- When is TEE needed
- Important role of CMR & CMR methodology
- The challenge of co-existing valvular lesions
- A clinical perspective…
- Library of case studies on the web: www.asecho.org/vrcases

Zoghbi W et al. JASE 30: 303, 2017

Mitral Valve Anatomy

A Complex Apparatus

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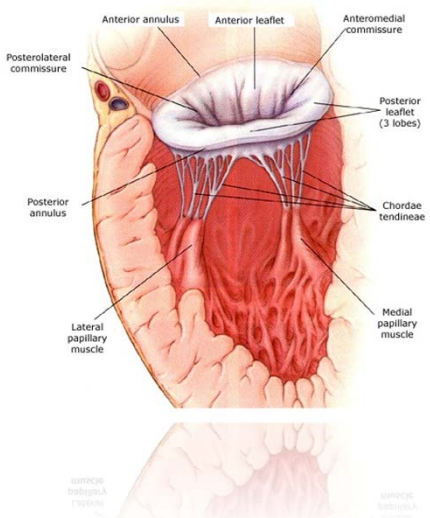
- Annulus
- Leaflets
- Chords
  - Primary, secondary& tertiary
- Papillary muscles
- Ventricular function geometry

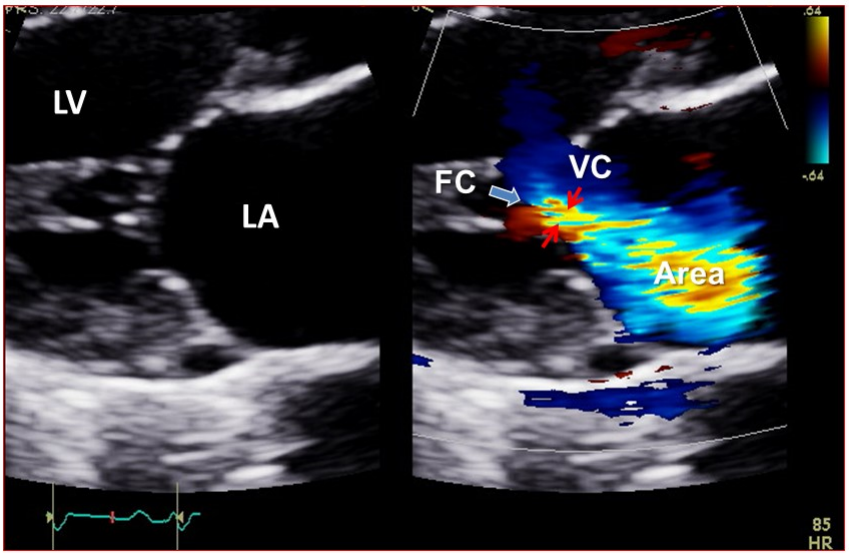


Mitral Regurgitation
Indicators of Severity

- Mitral valve pathology
- LV/ LA size
- Color Doppler:
  Vena contracta, Jet Area, Flow convergence
- Mitral E; Pulmonary vein pattern
- Regurgitant flow/fraction
- CW density and contour

Anatomy → Color Flow → Pulsed Doppler → CW Doppler

Mitral Regurgitation- Color Doppler
3 Components of the Jet



Mitral Regurgitation

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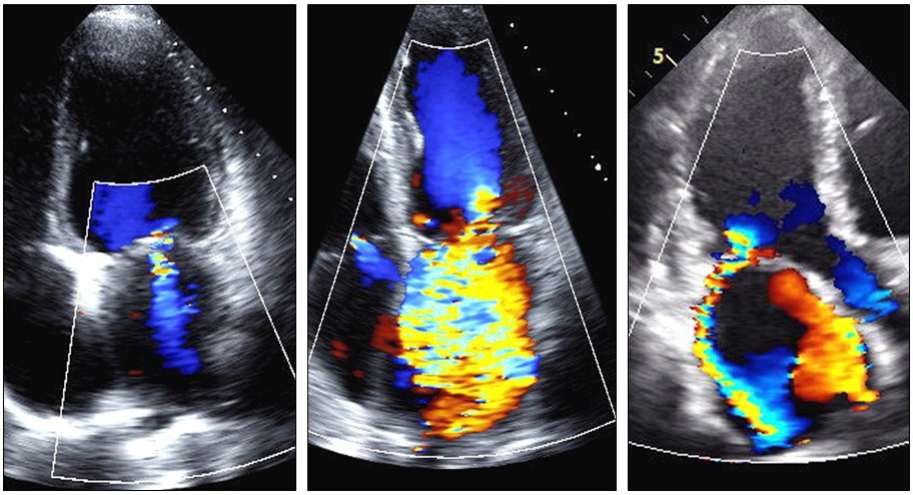
Mild Central **Severe Central** **Severe Eccentric**



Flow Convergence (PISA)

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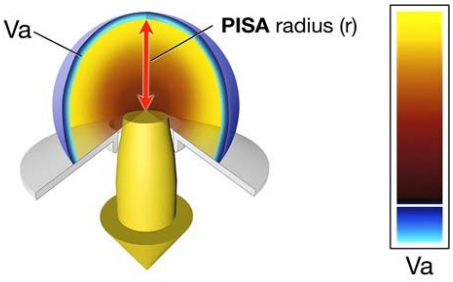
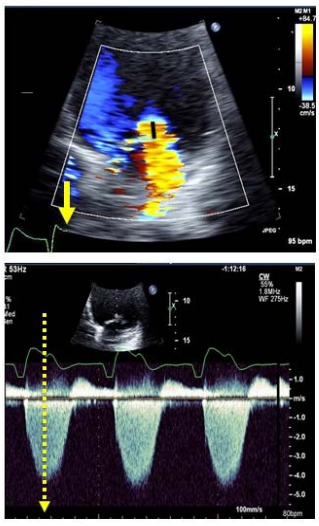
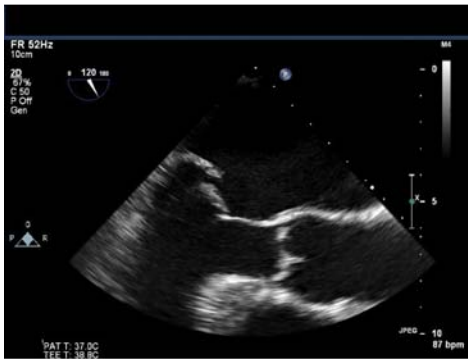
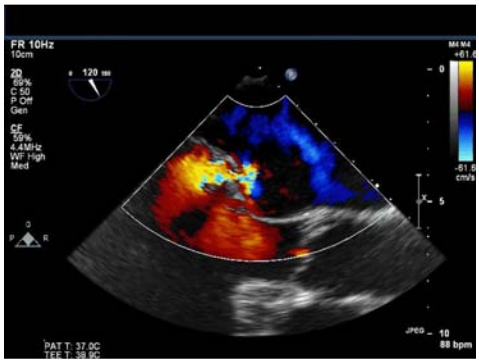
Flow Convergence Method

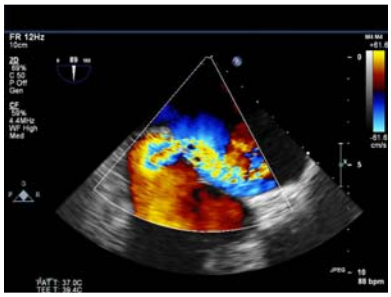


$$\text{Reg Flow} = 2\pi r^2 \times Va$$
$$EROA = \text{Reg Flow}/PKV_{Reg}$$
$$R\ Vol = EROA \times VTI_{Reg}$$









Flow Convergence

- Can be used semi-quantitatively
- Assumptions of hemispheric geometry
- EORA may be underestimated in 2^{ary} MR
- Less accurate in eccentric jets
- Variability during the cardiac cycle and limitations in non-holosystolic MR

MR is not always Holosystolic

MR Duration Needs to be Accounted for

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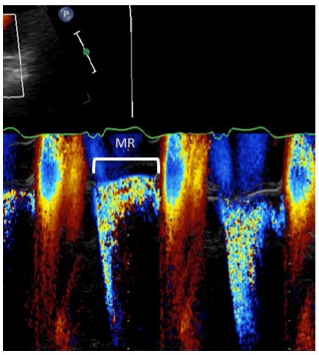
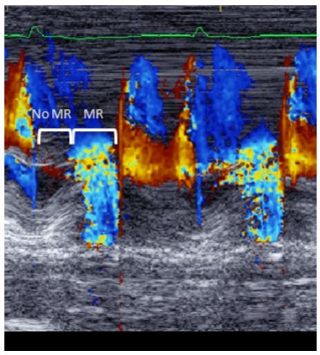
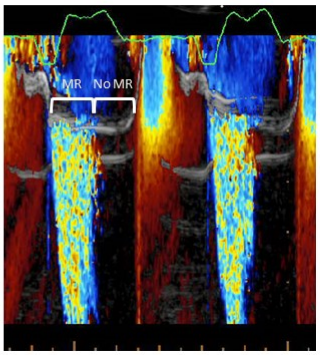
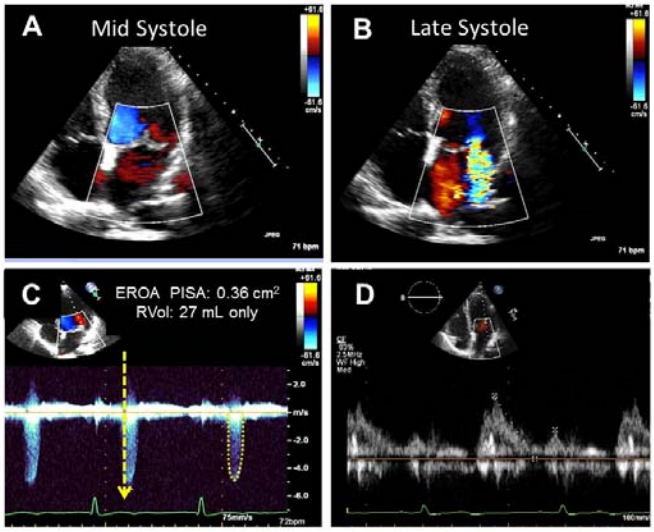
Holosystolic MR | **Late Systolic MR** | **Early Systolic MR**







Late Systolic MR



Cannot Use

Color Doppler Single frame measures of severity:

Jet area, VC, VCA, Flow Convergence, EROA

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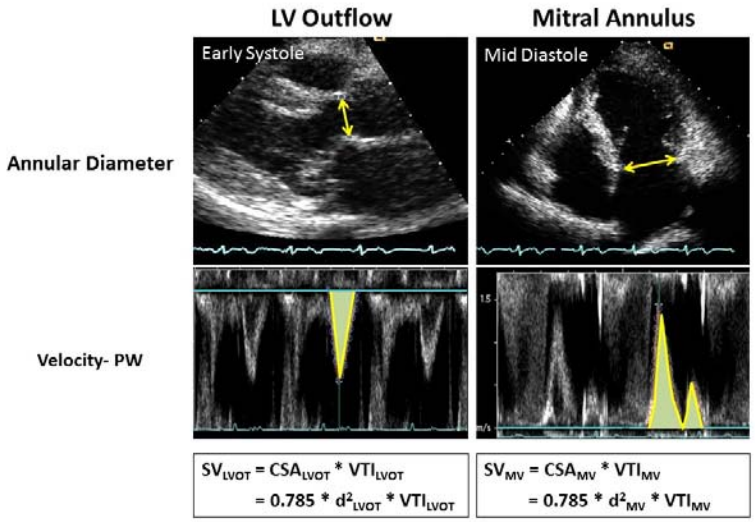
Pulsed Doppler Volumetric Quantitation



Regurgitant Volume & Fraction

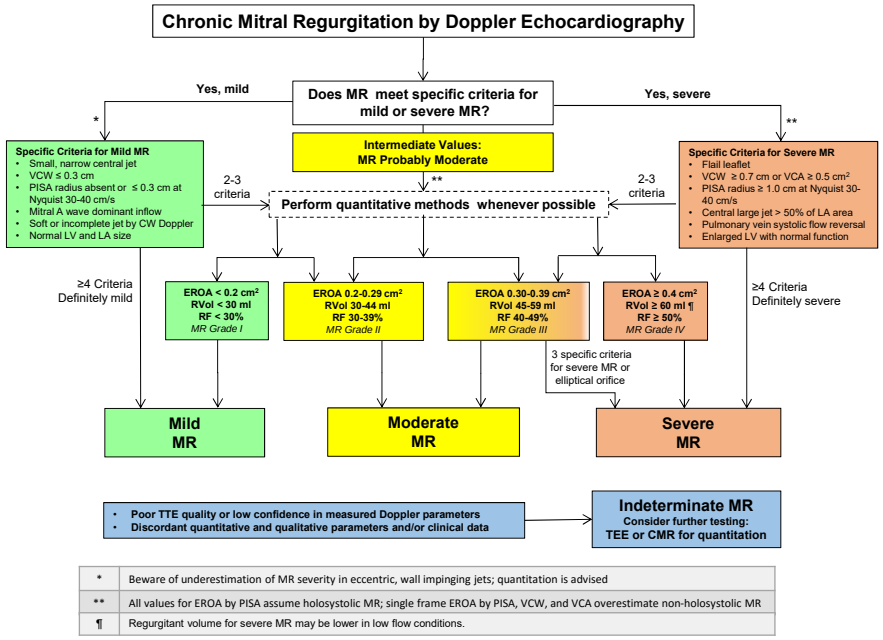
Advantages

- Quantitative, valid in multiple jets and eccentric jets
- Provides both lesion severity and volume overload

Limitations

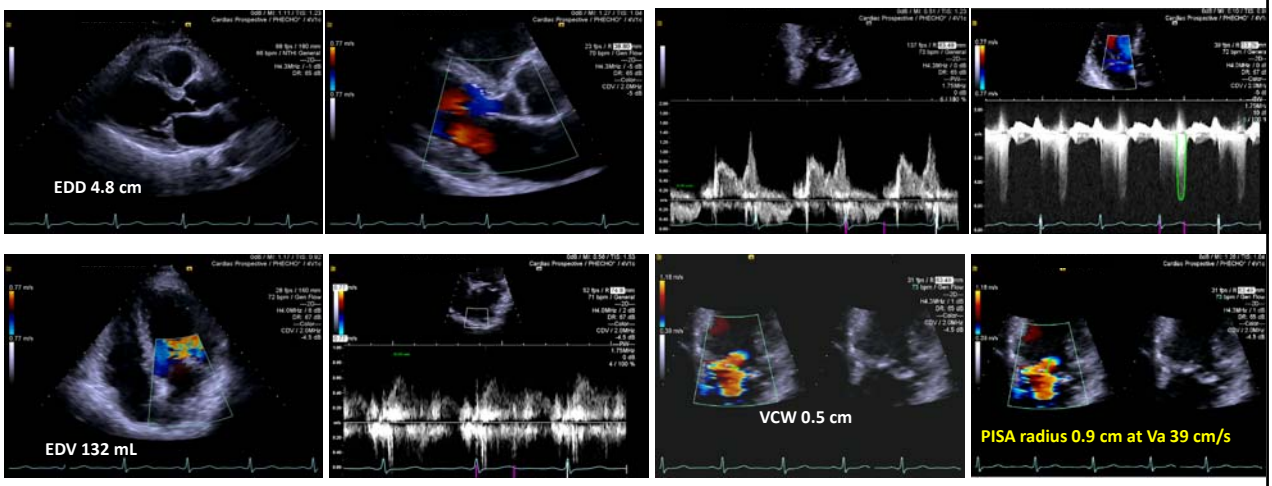
- Needs training; Cumbersome; wide (20%) confidence limits

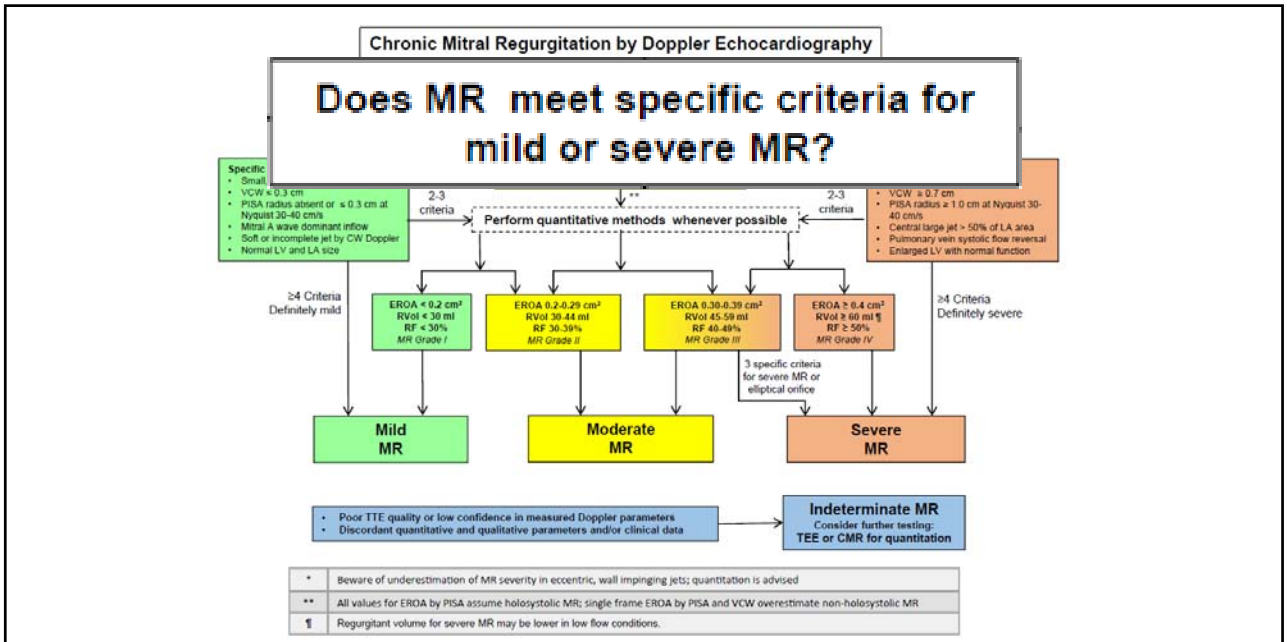
- Measurement of flow at MV annulus is less reliable in calcific MV and/or annulus

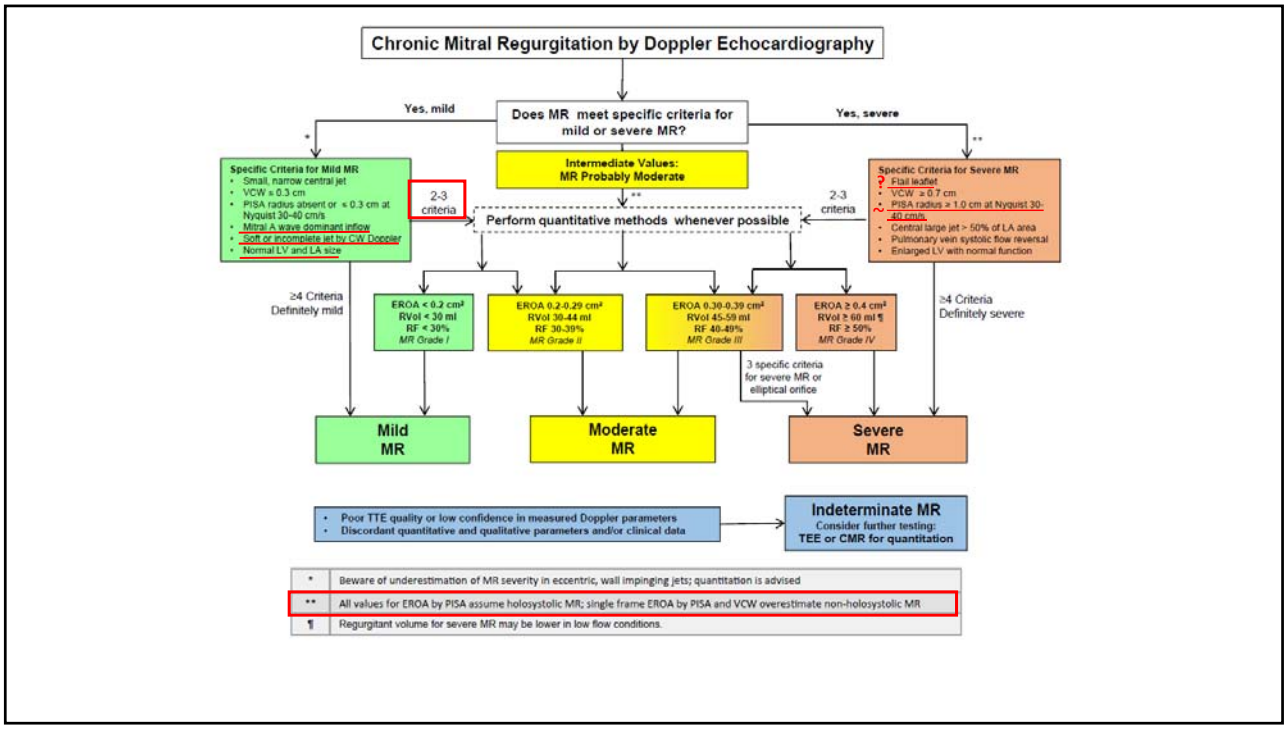

Chronic Mitral Regurgitation by Doppler Echocardiography
Does MR meet specific criteria for mild or severe MR?
Yes, mild
Yes, severe
*
**
Specific Criteria for Mild MR
• Small, narrow central jet
• VCW ≤ 0.3 cm
• PISA radius absent or ≤ 0.3 cm at Nyquist 30-40 cm/s
• Mitral A wave dominant inflow
• Soft or incomplete jet by CW Doppler
• Normal LV and LA size
Intermediate Values:
MR Probably Moderate
**
2-3 criteria
Perform quantitative methods whenever possible
2-3 criteria
Specific Criteria for Severe MR
• Flail leaflet
• VCW ≥ 0.7 cm or VCA ≥ 0.5 cm²
• PISA radius ≥ 1.0 cm at Nyquist 30-40 cm/s
• Central large jet > 50% of LA area
• Pulmonary vein systolic flow reversal
• Enlarged LV with normal function
≥4 Criteria
Definitely mild
EROA < 0.2 cm²
RVol < 30 ml
RF < 30%
MR Grade I
EROA 0.2-0.29 cm²
RVol 30-44 ml
RF 30-39%
MR Grade II
EROA 0.30-0.39 cm²
RVol 45-59 ml
RF 40-49%
MR Grade III
EROA ≥ 0.4 cm²
RVol ≥ 60 ml ¶
RF ≥ 50%
MR Grade IV
≥4 Criteria
Definitely severe
3 specific criteria for severe MR or elliptical orifice
Mild MR
Moderate MR
Severe MR
• Poor TTE quality or low confidence in measured Doppler parameters
• Discordant quantitative and qualitative parameters and/or clinical data
Indeterminate MR
Consider further testing:
TEE or CMR for quantitation
* Beware of underestimation of MR severity in eccentric, wall impinging jets; quantitation is advised
** All values for EROA by PISA assume holosystolic MR; single frame EROA by PISA, VCW, and VCA overestimate non-holosystolic MR
¶ Regurgitant volume for severe MR may be lower in low flow conditions.

Case 1

65 yo female -- BP 160/67 mmHg -- BSA 2 m^2



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EROA ≥ 0.4 cm² RVol ≥ 60 ml ¶ RF ≥ 50% MR Grade IV
≥4 Criteria Definitely severe
3 specific criteria for severe MR or elliptical orifice
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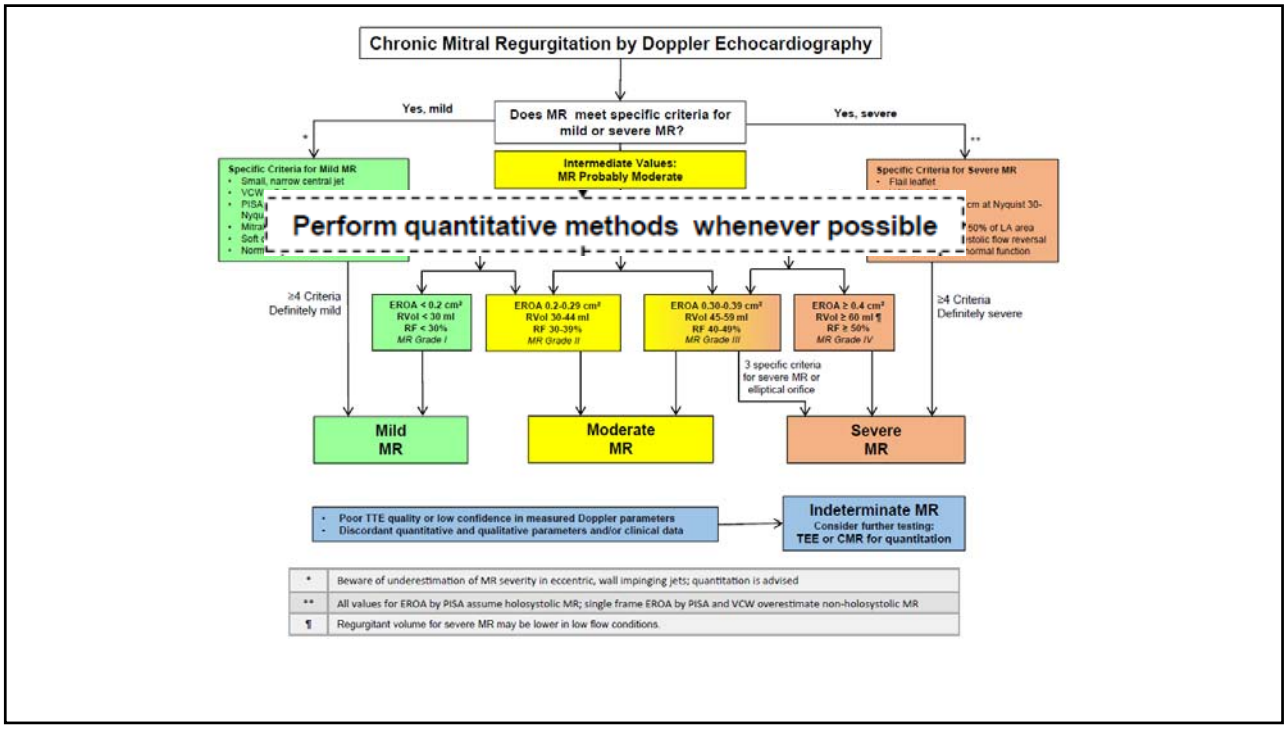
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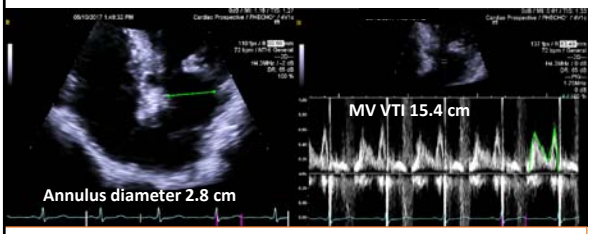
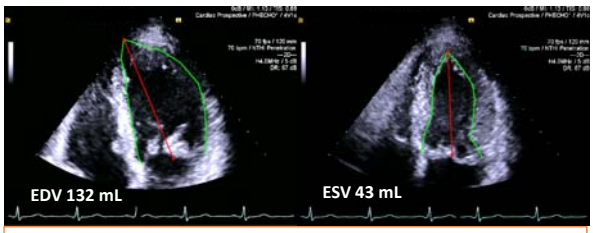
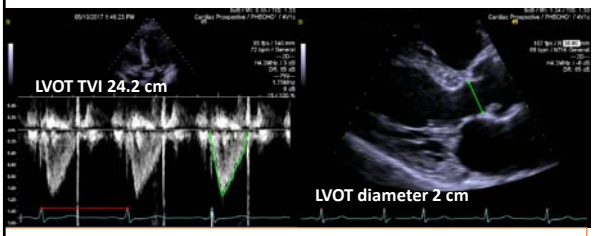


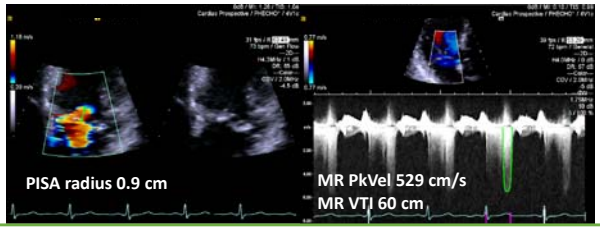
MV SV = 0.785*MV_{diam}^2*MV_{VTI} = 0.785*2.8^2*15.4 = **95 mL**



LV SV = EDV - ESV = 132 - 43= **89 mL** (LVEF 67%)



LVOT SV = 0.785*$LVOT_{diam}^2$*$LVOT_{VTI}$ = 0.785*2^2*24.2 = **76 mL**



EROA = 2*π*$PISA^2_{radius}$*Va/PkVel = 6.28*0.9^2*39/529 = 0.38 cm^2

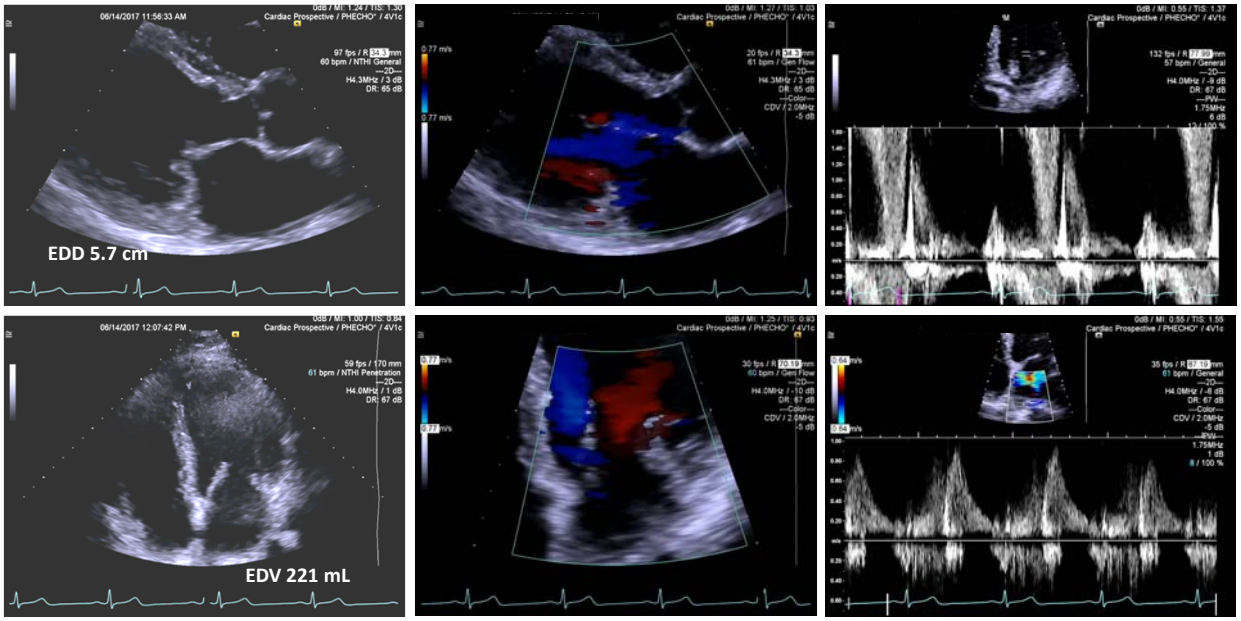
RVol = EROA*MR_{VTI} = 0.38*60 = 23 mL

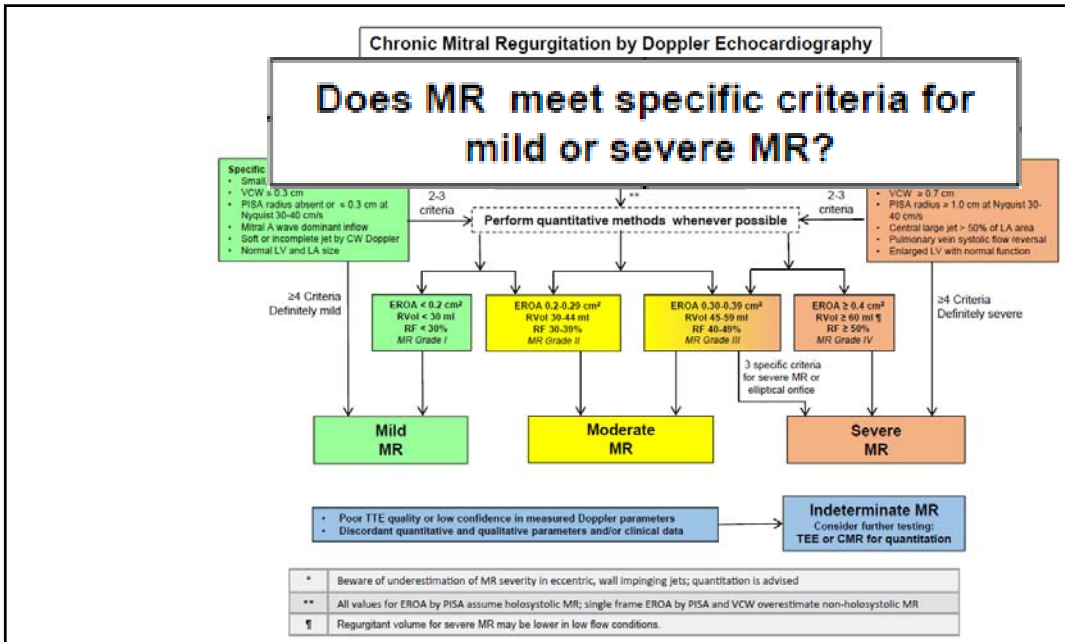
$RVol_{MVinflow}$ = MV SV – LVOT SV = 95 -76 = 19 mL --- **RF** = 19/MV SV = 20%

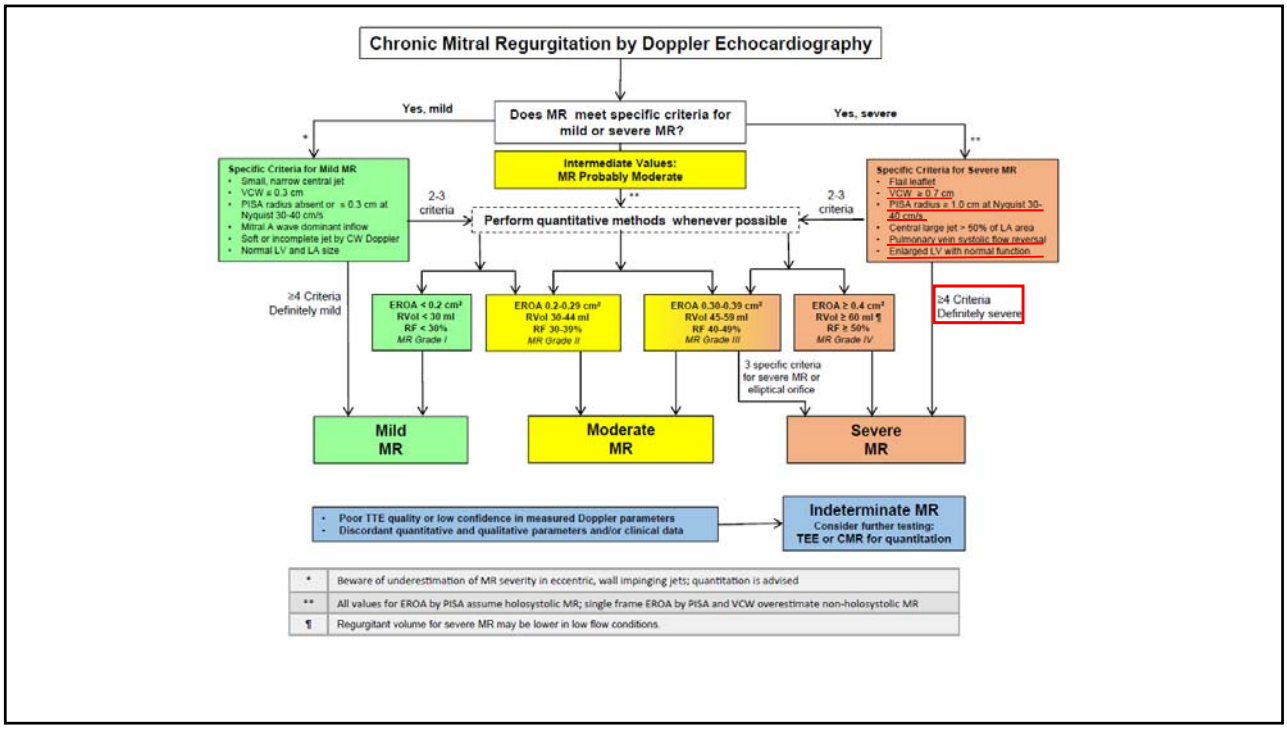
$RVol_{LV\ SV}$ = LV SV – LVOT SV = 89 -76 = 13 mL --- **RF** = 13/MV SV = 14%

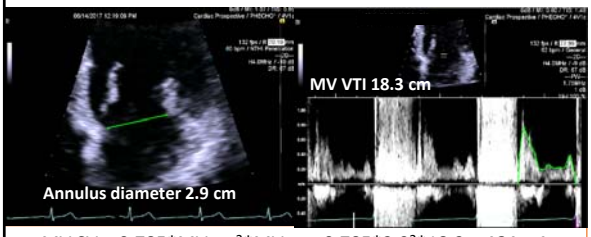
Case 2

44 yo male -- BP 128/66 mmHg -- BSA 2 m^2

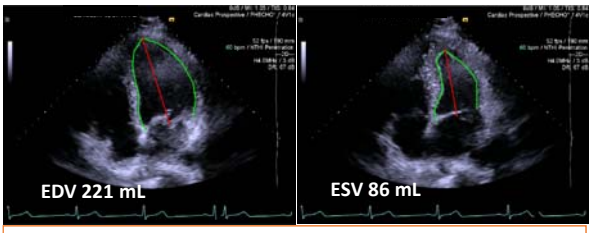




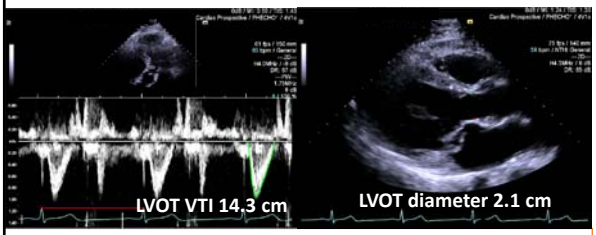




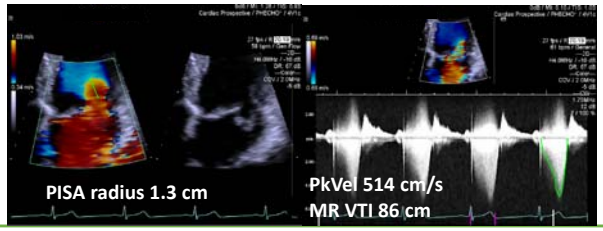
MV SV = $0.785*MV_{diam}^2*MV_{VTI}$ = $0.785*2.9^2*18.3$ = **121 mL**



LV SV = EDV - ESV = 221 - 86= **135 mL** (LVEF 61%)



LVOT SV = $0.785*LVOT_{diam}^2*LVOT_{VTI}$ = $0.785*2.1^2*14.3$ = **50 mL**



EROA = $2*\pi*PISA^2_{radius}*Va/PkVel$ = $6.28*1.3^2*34/514$ = 0.7 cm^2

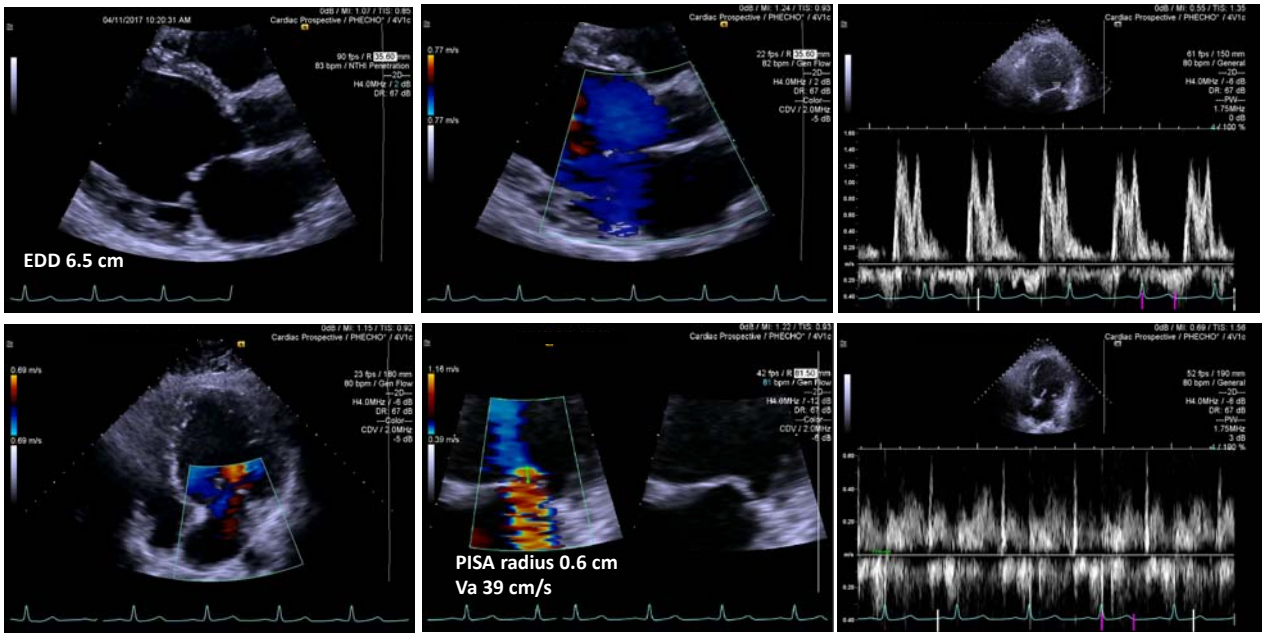
RVol = $EROA*MR_{VTI}$ = 0.7*86 = 60 mL

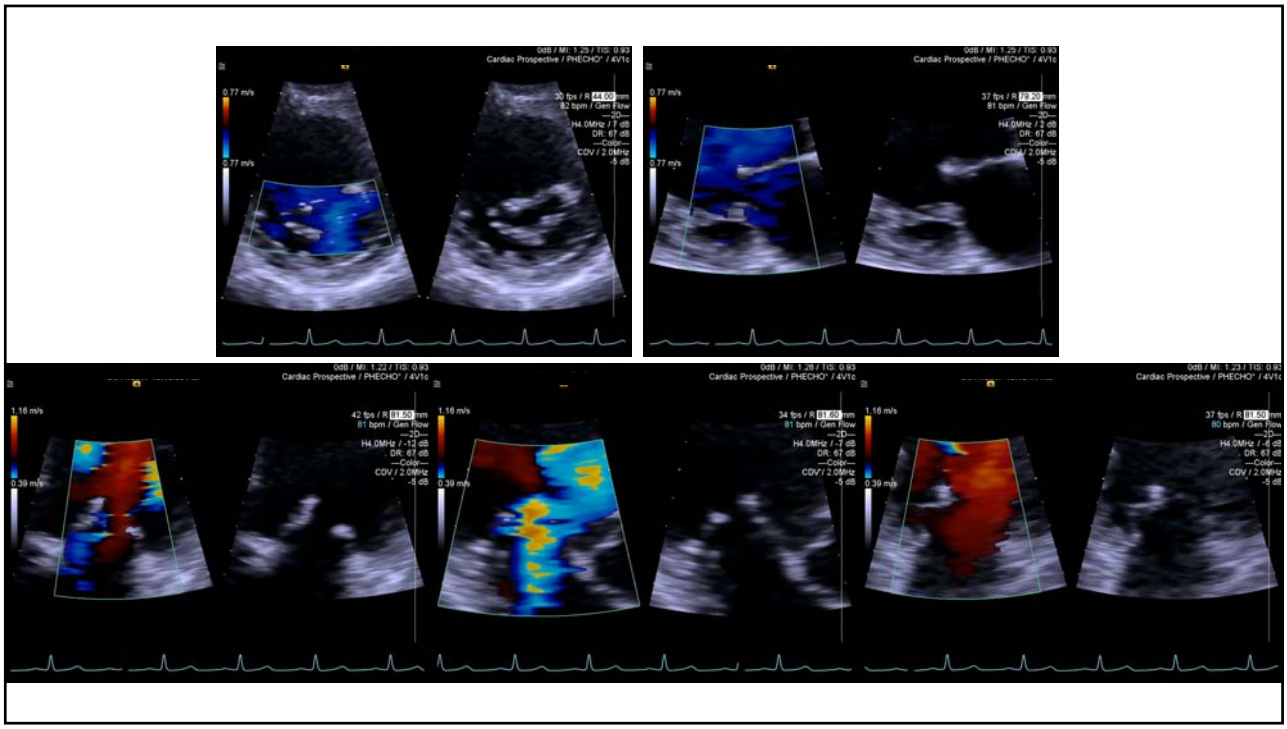
$RVol_{MVinflow}$ = MV SV – LVOT SV = 121 - 50 = 71 mL --- **RF** = 71/MV SV = 59%

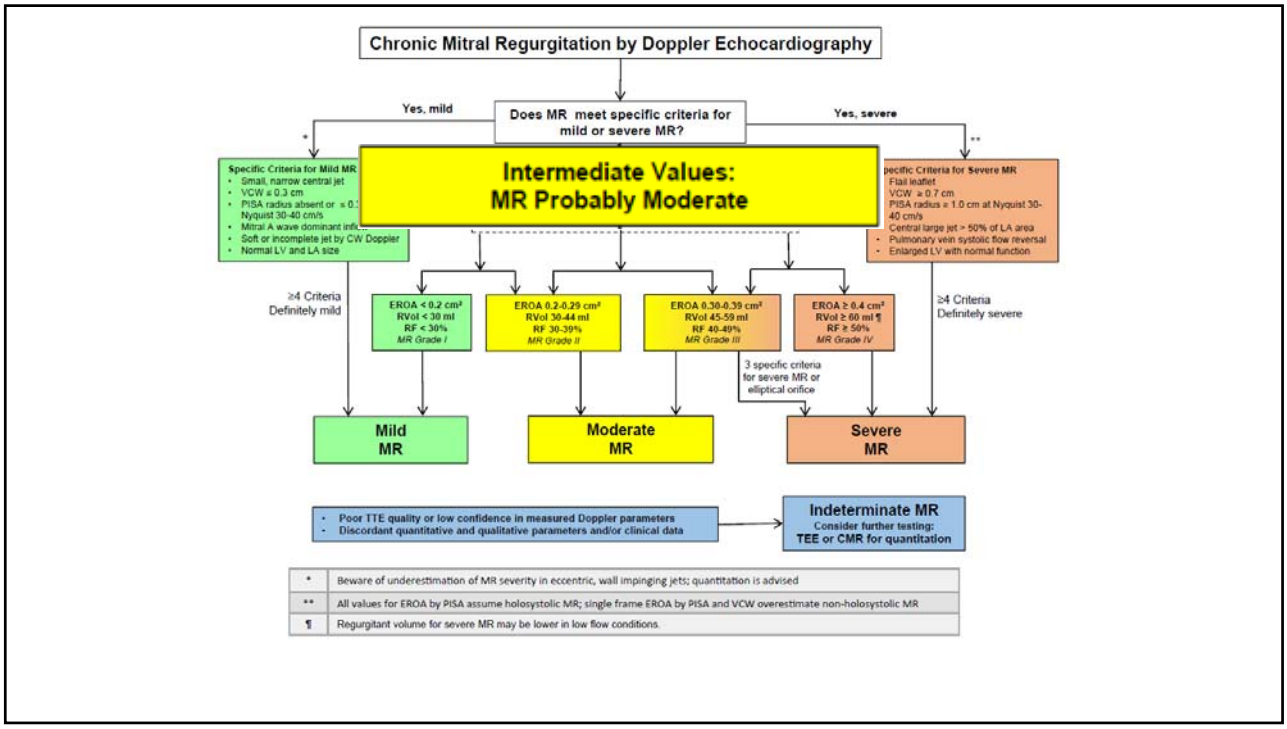
$RVol_{LV\ SV}$ = LV SV – LVOT SV = 135 -50 = 85 mL --- **RF** = 85/MV SV = 70%

Case 3

54 yo female – BP 114/62 mmHg – BSA 1.9 m^2



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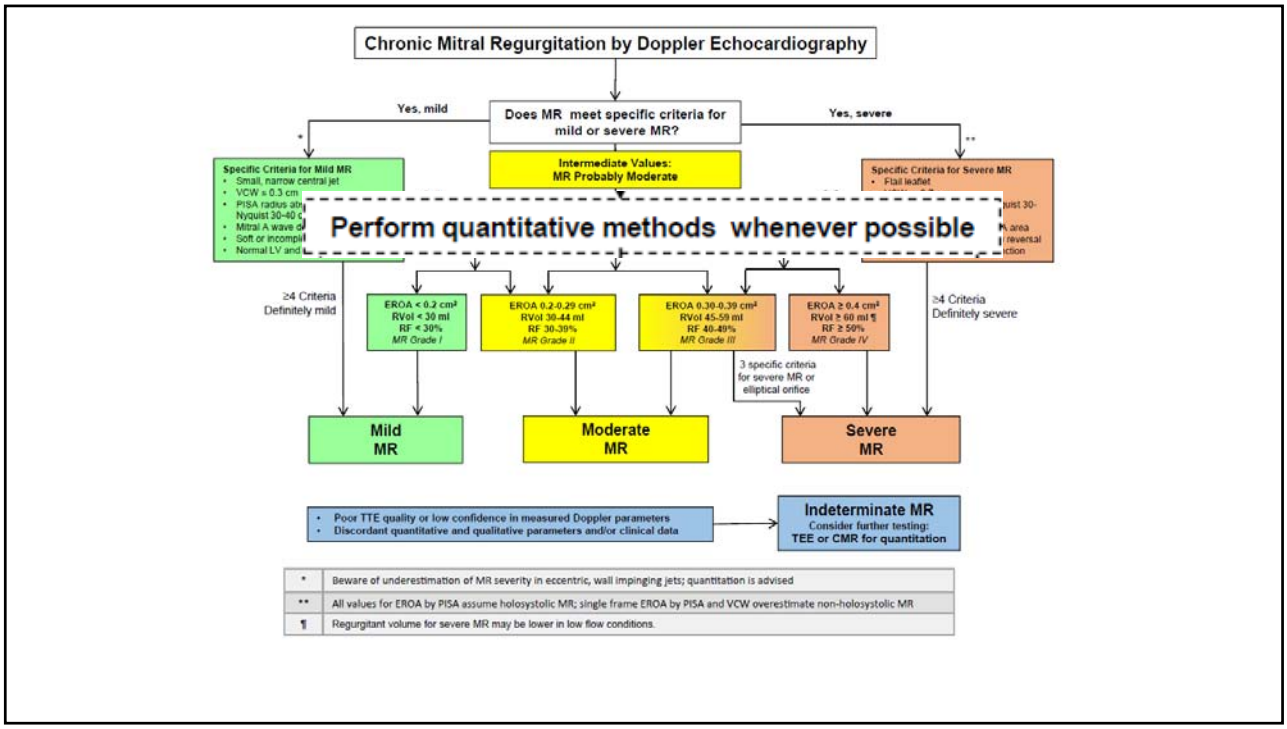
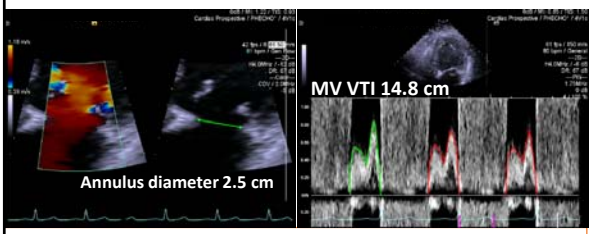
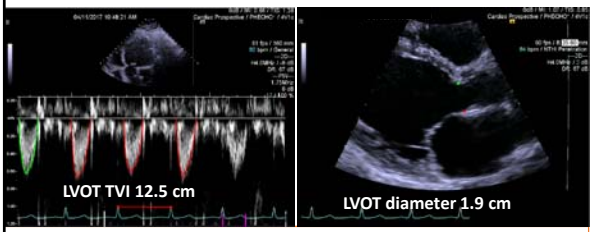
** All values for EROA by PISA assume holosystolic MR; single frame EROA by PISA and VCW overestimate non-holosystolic MR
¶ Regurgitant volume for severe MR may be lower in low flow conditions.



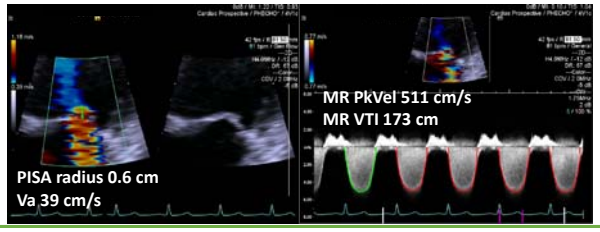


MV SV = $0.785*MV_{diam}^2*MV_{VTI}$ = $0.785*2.5^2*14.8$ = **73 mL**

LV SV = EDV - ESV = 181 - 116= **65 mL** (LVEF 36%)



LVOT SV = $0.785*LVOT_{diam}^2*LVOT_{VTI}$ = $0.785*1.9^2*12.5$ = **35 mL**



EROA = $2*\pi*PISA^2_{radius}*Va/PkVel$ = $6.28*0.6^2*39/511$ = 0.17 cm^2

RVol = $EROA*MR_{VTI}$ = 0.17*173 = 30 mL

$RVol_{MVinflow}$ = MV SV – LVOT SV = 73 - 35 = 38 mL --- **RF** = 38/MV SV = 52%

$RVol_{LV\ SV}$ = LV SV – LVOT SV = 65 -35 = 30 mL --- **RF** = 30/MV SV = 41%

New ASE Valvular Regurgitation Guidelines- *Endorsed by SCMR*

HOUSTON Methodist DEBAKEY HEART & VASCULAR CENTER

What is New?

- Emphasis on identification of Etiology/Mechanism of regurgitation
- 2D/3D TTE--an integrative approach & algorithms to assess severity
- When is TEE needed
- Important role of CMR & CMR methodology
- The challenge of co-existing valvular lesions
- A clinical perspective…
- Library of case studies on the web: www.asecho.org/vrcases

Zoghbi W et al. JASE 30: 303, 2017