Mitral Regurgitation

The New ASE Guidelines: Role of 2D/3D and CMR

ASE Guidelines on Aortic Regurgitation

What Do I Measure?

Case Studies

William A. Zoghbi MD, FASE, MACC
Professor and Chairman, Department of Cardiology
Elkins Family Distinguished Chair in Cardiac Health
Houston Methodist Hospital

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

Released
The same day in March 2017!

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

Writing Group Members*

Rick A. Nishimura, MD, MACC, FAHA, Co-Chair
Catherine M. Otto, MD, FACC, FAHA, Co-Chair

Robert O. Bonow, MD, MACC, FACC
Blase A. Carabello, MD, FACC
John F. Erwin III, MD, FACC, FAHA
Lee A. Fleisher, MD, FACC, FAHA
Hani Massri, MD, FACC, FAHA, FSCAI

Michael J. Mack, MD, FACC
Christopher J. McDowell, MBCHB, PhD, FACC, FAHA
Patrick T. O’Gara, MD, FACC, FAHA
Vera H. Rigolot, MD, FACC
Thaddeus M. Sundt III, MD, FACC
Armstrong Thompson, MD**
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
Aortic Regurgitation

Assessment of AR Severity

**Echo/Doppler Indicators of Severity**

- Aortic Valve/ Root/Mechanism
- LV enlargement
- Color Doppler: jet width; vena Contracta
- Pressure half-time
- Regurgitant Volume/Fraction
- Diastolic retrograde flow in aorta

Zoghbi W et al. JASE 30: 303, 2017
Aortic Regurgitation - Color Doppler

Mild AR

Severe AR
Chronic Aortic Regurgitation by Doppler Echocardiography

**Does AR meet specific criteria of mild or severe AR?**

- Yes, mild
- Intermediate Values: AR—probably moderate
- Yes, severe

**Specific Criteria for Mild AR**
- VC width < 0.3 cm
- Central Jet, width < 25% of LVOT
- Small or no flow convergence
- Soft or incomplete jet by CW
- Normal LV size

**Intermediate Values: AR—probably moderate**
- Perform quantitative methods whenever possible to refine assessment

**Specific Criteria for Severe AR**
- Flail Valve
- VC width > 0.6 cm
- Central Jet, width > 30% of LVOT
- Large flow convergence
- PHT < 200 ms
- Prominent holodiastolic flow reversal in the descending aorta
- Enlarged LV with normal function

**Chronic AR Severity- Color Doppler**

Central AR Jet

Eccentric AR Jet

Jet Width

Flow Convergence

VC

AR Severity - Color Doppler

- Poor TTE quality or low confidence in measured Doppler parameters
- Discordant quantitative and qualitative parameters and/or clinical data

Indeterminate AR

Consider further testing: TEE or CMR for quantitation

* Beware of limitations of color flow assessment in eccentric AR jets; volumetric quantitation and integration of other parameters is advised.
• 59-year-old male with a PMH significant for IV drug abuse
• He presented to the ED with a recent history of chest pain, SOB, fever & chills
• BP 158/66, HR 56, RR 16, SpO2 97% RA
• Loud 3/6 diastolic murmur heard at LLSB
• Bibasilar rales on lung auscultation
Faint Doppler reversal signal in the descending aortic arch

PHT 412 ms

Diminished RVOT flow

EDD 6.4 cm

EDV 254 mL (143 ml/m²) = Severely enlarged

LVEF 62%

Chronic Aortic Regurgitation by Doppler Echocardiography

Does AR meet specific criteria of mild or severe AR?

Specific Criteria for Mild AR:
- VC width ≤ 0.3 cm
- Control jet, width = 22% of LVOT
- Slow or no flow convergence
- Soft or incomplete jet by CW
- PHT > 500 ms
- Normal LV size

Intermediate Values:
AR Probably moderate

Perform quantitative methods whenever possible to refine assessment

Specific Criteria for Severe AR:
- Flat Valve
- VC width ≥ 0.8 cm
- PHT ≥ 100 ms
- Prominent holodiastolic flow reversal in the descending aorta
- Enlarged LV with normal function

≥ 4 criteria
Definitely severe
(may still quantify)

Mild AR

Moderate AR

Severe AR

Indeterminate AR

Consider further testing:
TEE or CMR for quantification

Vena contracta ≤ 0.3 mL, AVF > 30% ERGA 5.10-14.19 cm² AR Grade I
Vena contracta 0.3-0.6 mL, AVF 30-50% ERGA 1.20-6.39 cm² AR Grade II
Vena contracta 0.6-1.5 mL, AVF 50-69% ERGA 1.20-6.39 cm² AR Grade IV
Vena contracta > 1.5 mL, AVF ≥ 70% ERGA > 10.3 cm² AR Grade V

Vena contracta = cross-sectional area of the to aorta
AVF = area of valve opening

2-3 criteria
Definitely mild
(quantification not needed)

3 specific criteria
To severe AR

4 criteria
Definitely severe
(may still quantify)

* Beware of limitations of color flow assessment in eccentric AR jets; volumetric quantitation and integration of other parameters is advised
SV METHOD (LVOT SV – RVOT SV)

Pulsed Doppler RVOT

RVOT TVI 14 cm

RVOT diam 2.3 cm

RVOT SV = 0.785*2.3^2*14 = 58 mL

Pulsed Doppler LVOT

LVOT TVI 41 cm

LVOT diam 2.2 cm

LVOT SV = 0.785*2.2^2*41 = 156 mL

RVol = 156 – 58 = 98 mL
RF = 98/156 = 63%

Internal Check of Volumes

Pulsed Doppler LVOT

LVOT TVI 41 cm

LVOT diam 2.2 cm

LVOT SV = 0.785*2.2^2*41 = 156 mL

RVol = ~90-95 mL
RF = RVol/SV_{LVOT} = ~60%

LV SV = EDV – ESV = 254 – 95 = 159 mL
Case

- 72-year-old male with 3V CAD admitted for CABG.
- An echo was performed.
- Aortic insufficiency (AI) was noted on color Doppler.
- The importance of AI grading here lies in the possibility of changing the management (ie, AVR) should significant regurgitation be present.
WHAT IS YOUR ASSESSMENT OF THE AORTIC REGURGITATION?

Based on these views only...

Is AR mild, moderate, severe or Indeterminate?
Faint Doppler reversal signal in the descending arch

Prominent RVOT VTI

Dense AI jet signal

EDV 139 mL (79 ml/m²) = upper limit of normal size

EDD 4.5 cm

LVEF 63%

Vena Contracta width 0.4 cm

PHT 311 ms

Jet/LVOT 0.4

PISA radius 0.5 cm

EDD 4.5 cm
**SV METHOD**

**Pulsed Doppler RVOT**
- RVOT TVI 13.3 cm
- RVOT diam 2.4 cm
- RVOT SV = 0.785*2.4*13.3 = 60 mL

**Pulsed Doppler LVOT**
- LVOT TVI 23.7 cm
- LVOT diam 2.2 cm
- LVOT SV = 0.785*2.2*23.7 = 90 mL

**Mitral Annulus**
- MV annulus inflow VTI 9 cm
- MV annulus diam 3 cm
- MV SV = 0.785*3*9 = 63 mL

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**Figure 26: Algorithm for the integration of multiple parameters of AR severity.** Good-quality echocardiographic imaging and complete data acquisition are assumed. If imaging is technically difficult, consider TEE or CMR. AR severity may be indeterminate due to poor image quality, technical issues with data, internal inconsistency among echo findings, or discordance with clinical findings. PHT - Pressure half-time.
Internal Check of Volumes

Pulsed Doppler LVOT

LVOT TVI 23.7 cm
LVOT diam 2.2 cm

LVOT SV = 0.785 * 2.2 * 23.7 = 90 mL

LV SV = EDV – ESV = 139 – 51 = 88 mL

SV METHOD

RVol = SV_{LVOT} – SV_{MV} = 90 – 63 = 26 mL
RVol = SV_{LVOT} – SV_{RVOT} = 90 – 60 = 30 mL
RF = RVol/SV_{LVOT} = 30/90 = 33%
Case

- 24 year old female
- History of urticarial rash.
- Adequate functional capacity with no limiting SOB
- P/E: ?murmur, clear lung fields
- ANA panel on 2/16/2016 was positive
Faint Doppler reversal signal in the descending arch

Dense AI jet signal

EDD 5.4 cm

EDV 141 mL
(80 ml/m²) = Dilated

LVEF 63%
Vena Contracta width 0.4 cm

PHT 278ms

PISA Radius 0.4 cm

Chronic Aortic Regurgitation by Doppler Echocardiography

Does AR meet specific criteria of mild or severe AR?

- **Intermediate Values:** AR: Probable moderate
  - Perform quantitative methods whenever possible to refine assessment

Specific Criteria for Mild AR
- VC width < 0.3 cm
- Control jet width > 25% of LVOT
- Small or no flow convergence
- Soft or incomplete jet by CW
- PHT < 200 ms
- Normal LV size

Specific Criteria for Severe AR
- Flat valve
- EF < 40% > 0.8 cm
- Control jet width > 65% of LVOT
- Large flow convergence
- PHT < 200 ms
- Prominent pre-dilatation flow reversal in the descending aorta
- Extensive LV dilatation

2-3 Criteria

Definitely mild (quantification not needed)

AR Grade I

3-4 Criteria

Definitely severe (may still quantitate)

AR Grade IV

3 specific criteria for severe AR

Indeterminate AR
Consider further testing: TEE or CMR for quantification

- Poor TTE quality or low confidence in assessed Doppler parameters
- Discordant quantitative and qualitative parameters and/or clinical data

* Beware of limitations of color flow assessment in ascending aortic volumetric quantification and integration of other parameters is advised.*
TIME FOR SOME QUANTIFICATION

SV method

Pulsed Doppler RVOT

RVOT SV = $0.785 \times 2.3^2 \times 14.3 = 59$ mL

Pulsed Doppler LVOT

LVOT SV = $0.785 \times 2.4^2 \times 19.3 = 87$ mL

Mitral Annulus

MV SV = $0.785 \times 3^2 \times 8.1 = 57$ mL

PISA method

$Q_{PISA} = Q_{PISA}$

$A_1 V_1 = A_2 V_2$

$(2\pi r^2) \times V_a = EROA \times P_{V_{Max}}$

SV METHOD

MV annulus inflow VTI 9 cm
Internal Check of Volumes

LVOT TVI = 23.7 cm

LVOT SV = 0.785 * 2.4^2 * 19.3 = 87 mL

LV SV = EDV – ESV = 141 – 51 = 90 mL

LV SV METHOD

RVol = 28 mL
RF = RVol/SV_{LVOT} = 28/90 = 33%
What is your best initial assessment of Severity of Aortic regurgitation?

A. Mild
B. Mild to moderate
C. Moderate
D. Moderate to severe
E. Severe

Eccentric AI jets

Reliable indicators of severity

- Vena Contracta- if clearly defined
- Regurgitant flow and regurgitant fraction
- Flow reversal in aorta
- LV size –always look at the scale!

Less reliable indicators of severity:

- Jet width/LVOT diameter
- Area of jet in Short axis
- Adequate CW jet recording may be difficult- “bidirectional”
LV Dimensions - 2D

**End- Diastole**

D_{ed} = 7 cm

**End- Systole**

D_{es} = 4.3 cm

Vena Contracta

VC = 1 cm!
Aortic diastolic Flow Reversal

LVOT Flow

D = 3 cm

SV_{LVOT} = 240 ml

TVI = 34 cm

RVOT Flow

D = 2.5 cm

SV_{RVOT} = 69 ml

Reg V = 240-69 = 171 mL

RF = 171/240 = 71%
What is New?

- Emphasis on identification of Etiology/Mechanism of regurgitation
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