Πρακτικός οδηγός εκτίμησης και ποσοτικοποίησης της ανεπάρκειας της αορτικής βαλβίδας.

Δημήτριος Μαραγιάννης, MD, FESC, FASE, FACC, FAHA

401 Γενικό Στρατιωτικό Νοσοκομείο Αθηνών
Nothing to disclose
Labs sharing their secrets
## Aortic Regurgitation Mechanisms

<table>
<thead>
<tr>
<th>Type I</th>
<th>Type II</th>
<th>Type III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal Cusp Motion with Aortic Dilation or Cusp Perforation</td>
<td>Cusp Prolapse</td>
<td>Cusp Restriction</td>
</tr>
</tbody>
</table>

- **Type I**: Normal cusp motion with aortic dilation or cusp perforation
- **Type II**: Cusp prolapse
- **Type III**: Cusp restriction
Echocardiography in patients with aortic regurgitation

- Aortic regurgitation detection
- Etiology assessment (Aortic root dilatation, bicuspid/unicuspid/quadracuspid valve, calcific disease, inflammatory disease, connective tissue disease, endocarditis, radiation, aortic dissection, hypertension, trauma)
- Hemodynamic consequences
- Severity evaluation
Why do we need quantitation of aortic regurgitation?

How bad is the aortic regurgitation?
## Indications for surgery

<table>
<thead>
<tr>
<th>Indications for surgery</th>
<th>Class</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>A. Severe aortic regurgitation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Surgery is indicated in symptomatic patients.</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Surgery is indicated in asymptomatic patients with resting LVEF ≤50%</td>
<td>I</td>
<td>B</td>
</tr>
<tr>
<td>Surgery is indicated in patients undergoing CABG or surgery of the ascending aorta or of another valve.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Heart Team discussion is recommended in selected patients in whom aortic valve repair may be a feasible alternative to valve replacement.</td>
<td>I</td>
<td>C</td>
</tr>
<tr>
<td>Surgery should be considered in asymptomatic patients with resting ejection fraction &gt;50% with severe LV dilatation: LVEDD &gt;70 mm or LVESD &gt;50 mm (or LVESD &gt;25 mm/m² BSA in patients with small body size).</td>
<td>IIa</td>
<td>B</td>
</tr>
</tbody>
</table>
Aortic Regurgitation Guidelines 2017

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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### Grading the severity of chronic Aortic Regurgitation

<table>
<thead>
<tr>
<th>Structural parameters</th>
<th>Mild AR</th>
<th>Moderate AR</th>
<th>Severe AR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aortic leaflets</td>
<td>Normal or abnormal</td>
<td>Normal or abnormal</td>
<td>Abnormal/flail, or wide coaptation defect</td>
</tr>
<tr>
<td>LV size</td>
<td>Normal$^\ast$</td>
<td>Normal or dilated</td>
<td>Usually dilated$^\dagger$</td>
</tr>
</tbody>
</table>

-LVEDV\(=85\)ml

-LVEDV\(=241\)ml
Grading the severity of chronic Aortic Regurgitation

**Qualitative Doppler parameters**

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mild AR</th>
<th>Moderate AR</th>
<th>Severe AR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jet width in LVOT, color flow</td>
<td>Small in central jets</td>
<td>Intermediate</td>
<td>Large in central jets; variable in eccentric jets</td>
</tr>
<tr>
<td>Flow convergence, color flow</td>
<td>None or very small</td>
<td>Intermediate</td>
<td>Large</td>
</tr>
<tr>
<td>Jet density, CW</td>
<td>Incomplete or faint</td>
<td>Dense</td>
<td>Dense</td>
</tr>
<tr>
<td>Jet deceleration rate, CW (PHT, msec)‡</td>
<td>Incomplete or faint Slow, &gt;500</td>
<td>Medium, 500-200</td>
<td>Steep, &lt;200</td>
</tr>
<tr>
<td>Diastolic flow reversal in descending aorta, PW</td>
<td>Brief, early diastolic reversal</td>
<td>Intermediate</td>
<td>Prominent holodiastolic reversal</td>
</tr>
</tbody>
</table>
Grading the severity of Aortic Regurgitation

Patient with severe Aortic Bioprosthetic Valve regurgitation and heart failure symptoms
Grading the severity of Aortic Regurgitation

### Semi-Quantitative Doppler parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mild AR</th>
<th>Moderate AR</th>
<th>Severe AR</th>
</tr>
</thead>
<tbody>
<tr>
<td>VCW (cm)</td>
<td>&lt;0.3</td>
<td>0.3-0.6</td>
<td>&gt;0.6</td>
</tr>
<tr>
<td>Jet width/LVOT width, central jets (%)</td>
<td>&lt;25</td>
<td>25-45</td>
<td>≥65</td>
</tr>
<tr>
<td>Jet CSA/LVOT CSA, central jets (%)</td>
<td>&lt;5</td>
<td>5-20</td>
<td>≥60</td>
</tr>
</tbody>
</table>
Grading the severity of Aortic Regurgitation

Patient with moderate Aortic Valve regurgitation
Grading the severity of chronic Aortic Regurgitation

Quantitative parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Mild AR</th>
<th>Moderate AR</th>
<th>Severe AR</th>
</tr>
</thead>
<tbody>
<tr>
<td>RVol (mL/beat)</td>
<td>&lt;30</td>
<td>30-44</td>
<td>45-59</td>
</tr>
<tr>
<td>RF (%)</td>
<td>&lt;30</td>
<td>30-39</td>
<td>40-49</td>
</tr>
<tr>
<td>EROA (cm²)</td>
<td>&lt;0.10</td>
<td>0.10-0.19</td>
<td>0.20-0.29</td>
</tr>
</tbody>
</table>
Grading the severity of chronic Aortic Regurgitation

Regurgitant Volume = Aortic SV - Mitral annulus SV (or Pulmonic SV)

Regurgitant Fraction = \( \frac{\text{Aortic Regurgitant volume} \times 100}{\text{Aortic Stroke volume}} \) %
Grading the severity of chronic Aortic Regurgitation

Effective Regurgitant Orifice Area = \frac{\text{Regurgitant volume}}{\text{Regurgitant TVI}}
Chronic Aortic regurgitation Quantitation
Chronic Aortic Regurgitation Quantitation

PHF=337msec  Forward flow TVI=11cm  Vena Contracta=0,6cm
Chronic Aortic Regurgitation Quantitation

LVOTd = 2.4 cm
LVOTTVI = 21 cm
LVOTSV = 95 ml
LVSV = LVEDV x EF = 310 x 0.3 = 93 ml
Chronic Aortic Regurgitation Quantitation

RVOTd = 2.6 cm
RVOTTVI = 9.1 cm
RVOTSV = 48 ml
MAnd = 3.0 cm
RVOTTVI = 7.4 cm
MANSV = 52 ml

Aortic Regurgitant volume = 43-47 ml
Aortic Regurgitant Fraction = 45-49%

Effective Regurgitant Orifice Area = 0.2-0.22 cm²
RegTVI = 219 cm
Chronic Aortic Regurgitation by Doppler Echocardiography

- Does AR meet specific criteria of mild or severe AR?
  - Yes, mild
    - VC width < 0.3 cm
    - Echocardiographic color flow convergence
    - Color jet width < 0.3 cm
  - Yes, severe
    - VC width > 0.3 cm
    - Echocardiographic color flow convergence
    - Color jet width > 0.3 cm

- Intermediate Values: AR Probably moderate
  - Performed quantitative methods whenever possible to refine assessment

- Specific Criteria for Mild AR
  - VC width < 0.3 cm
  - Echocardiographic color flow convergence
  - Color jet width < 0.3 cm
- Specific Criteria for Severe AR
  - VC width > 0.3 cm
  - Echocardiographic color flow convergence
  - Color jet width > 0.3 cm

- Mild AR
  - Performed 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 quantification

- ≥ 4 criteria
  - Definitively mild (quantitation not needed)

- RVol < 40 mL
  - RF < 36%
  - EROA < 6.1 cm²
  - AR Grade I
- RVol > 40 mL
  - RF > 36%
  - EROA > 10-15 cm²
  - AR Grade II
- RVol > 50 mL
  - RF > 36%
  - EROA > 16-20 cm²
  - AR Grade III
- RVol > 60 mL
  - RF > 36%
  - EROA > 20 cm²
  - AR Grade IV

* Beware of limitations of color flow assessment in eccentric AR jets; volumetric quantification and integration of other parameters is advised
When do we need quantitation of aortic regurgitation?

- In moderate or severe aortic regurgitation
- In patients with depressed Ejection Fraction
- In patients with eccentric jets
- In studies with color Doppler quality issues
Indeterminate Aortic Regurgitation

- 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
Acute vs Chronic Aortic Regurgitation

• Acute aortic regurgitation due to type A dissection, trauma or endocarditis
• Patient is severely ill
• Wide pulse pressure
• Normal or low blood pressure

• Not as much aliasing with color Doppler
• Usually rapid PHT
• Premature closure of mitral valve
Conclusions

• Integration of multiple parameters is required to quantify aortic regurgitation.
• Important to assess LV size/volume.
• By color Doppler evaluate the three components of the jet.
• Perform quantitation when indicated.
• Additional testing with TEE, CMR or CT when discrepancy between methods and/or clinical data is present.