Aortic Stenosis and Mitral Regurgitation
Guidelines Overview

PRACTICE GUIDELINE

2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease: Full Text
A Report of the American College of Cardiology/American Heart Association Task Force on 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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2014 ACC/AHA Valve Guidelines

Core Concepts

• Valve disease stages
• Improved imaging and severity quantitation
• Timing of intervention aligned with disease stages
• Earlier intervention with trans-catheter options
• Valve Disease Centers and Heart Valve Teams
• Integrative approach to procedural risk assessment
2014 ACC/AHA Valvular Heart Disease (VHD) Guidelines

Definitions of Disease Severity

- **Patient**: Symptoms due to valve dysfunction
- **Valve**: Leaflet anatomy and pathology
- **Flow**: Valve hemodynamics
- **Ventricle**: Hypertrophy, dilation, dysfunction
AHA/ACC Valve Guidelines

Valve Disease Stages

Otto and Prendergast. NEJM 2014
### Concept of Valve Disease Stages

<table>
<thead>
<tr>
<th>Stage</th>
<th>Definition</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>At risk</td>
<td>Patients with risk factors for the development of VHD</td>
</tr>
<tr>
<td>B</td>
<td>Progressive</td>
<td>Patients with progressive VHD (mild-to-moderate severity and asymptomatic)</td>
</tr>
<tr>
<td>C</td>
<td>Asymptomatic severe</td>
<td>Asymptomatic patients who have reached the criteria for severe VHD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C1: Asymptomatic patients with severe VHD in whom the left or right ventricle remains compensated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C2: Asymptomatic patients who have severe VHD, with decompensation of the left or right ventricle</td>
</tr>
<tr>
<td>D</td>
<td>Symptomatic severe</td>
<td>Patients who have developed symptoms as a result of VHD</td>
</tr>
</tbody>
</table>
Why Measure Aortic Stenosis Severity?

Ensure AS is the cause of symptoms
## Aortic Stenosis Severity

Is AS severe enough to be the cause of symptoms?

<table>
<thead>
<tr>
<th>$V_{max}$</th>
<th>Symptoms</th>
<th>AVA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 m/s</td>
<td>Not due to AS</td>
<td>4.0 cm²</td>
</tr>
<tr>
<td>2 m/s</td>
<td>Symptoms</td>
<td>2.0 cm²</td>
</tr>
<tr>
<td>3 m/s</td>
<td>Maybe due to AS?</td>
<td>1.0 cm²</td>
</tr>
<tr>
<td>4 m/s</td>
<td>Symptoms</td>
<td>1.0 cm²</td>
</tr>
<tr>
<td>5 m/s</td>
<td>Likely due to AS</td>
<td>0.5 cm²</td>
</tr>
</tbody>
</table>

High sensitivity valued over high specificity

### Key Metrics
- **$V_{max}$**: Maximum velocity
- **AVA**: Aortic Valve Area
Aortic Stenosis Severity

**Optimal definition of severe stenosis?**

Jet velocity

$$V_{\text{max}}$$

Pressure gradient

$$\Delta P = 4v^2$$

The reference standard that defines “severe” aortic stenosis is prediction of clinical outcome.
# 2014 ACC/AHA Valvular Heart Disease (VHD) Guidelines

## Definitions of Disease Severity

### Data Supplement 5. Clinical Outcomes in Asymptomatic Adults With Aortic Stenosis (stages B and C) of Known Hemodynamic Severity (Section 3.2.3)

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Study Size (N)</th>
<th>Patient Population Inclusion Criteria</th>
<th>Exclusion Criteria</th>
<th>Pt. Age (y)</th>
<th>% Male</th>
<th>Follow-Up (mo)</th>
<th>AS Severity at Entry</th>
<th>Event-Free Survival</th>
<th>Cardiac Events</th>
<th>Multivariate Predictors of Clinical Outcome</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kelly, 1988 (39) 3317700</td>
<td>51</td>
<td>V_max &gt;3.5 m/s Asymptomatic</td>
<td>Other valve disease</td>
<td>63±19</td>
<td>75%</td>
<td>17±0</td>
<td>ΔP 60±17 mm Hg</td>
<td>60% at 2 y</td>
<td>21 AS symptom onset, 8 deaths (2 cardiac)</td>
<td>N/A</td>
</tr>
<tr>
<td>Pellika, 1990 (40) 2312954</td>
<td>113</td>
<td>V_max &gt;4.0 m/s Age&lt;40 y Asymptomatic</td>
<td>Other valve disease CAD Prior valve procedure Early aortic intervention</td>
<td>70 (40–94)</td>
<td>67%</td>
<td>20</td>
<td>V_max 4.3 (4–6) m/s</td>
<td>62% at 2 y</td>
<td>37 AS symptoms (20 with AVR) 14 deaths (6 cardiac)</td>
<td>V_max &gt;4 m/s; RR: 4.9 (1.64–14.6) LVEF &lt;50%; RR: 2.93 (0.84–10.2)</td>
</tr>
<tr>
<td>Kennedy, 1991 (41) 1991886</td>
<td>66</td>
<td>AWA 0.7–1.2 cm² at cath</td>
<td>Other valve disease Previous valve surgery</td>
<td>67±10</td>
<td>77%</td>
<td>35</td>
<td>AWA 0.92±0.13 cm²</td>
<td>59% at 4 y</td>
<td>21 AVR (13 for symptoms) 14 deaths due to AS</td>
<td>LVEF &lt;50%; RR: 1.94 (0.88–4.41) LV end-diastolic pressure &gt;18 mm Hg RR: 2.71 (1.23–5.97). AVA index &lt;0.5 cm² RR: 1.93 (0.89–4.23)</td>
</tr>
<tr>
<td>Otto, 1997 (21) 9192003</td>
<td>123</td>
<td>V_max &gt;2.5 m/s Asymptomatic</td>
<td>Severe comorbid disease</td>
<td>83±18</td>
<td>70%</td>
<td>30</td>
<td>V_max &lt;3 m/s</td>
<td>84% at 2 y</td>
<td>48 AVR for symptoms 8 deaths</td>
<td>V_max Functional status score Rate of change in V_max</td>
</tr>
<tr>
<td>Rosenhek, 2000 (24) 10690070</td>
<td>128</td>
<td>V_max &gt;4.0 m/s Asymptomatic</td>
<td>Other valve disease</td>
<td>60±18</td>
<td>54%</td>
<td>22±18</td>
<td>V_max 5.0±0.7 m/s</td>
<td>67% at 1 y</td>
<td>59 AVR for symptoms 8 deaths</td>
<td>Extent of valve calcification RR: 4.6 (1.8–14.0)</td>
</tr>
<tr>
<td>Rosenhek, 2004 (25) 14972419</td>
<td>176</td>
<td>V_max 2.5–3.3 m/s LVEF&gt;50% No AS symptoms</td>
<td>Other valve disease</td>
<td>58±19</td>
<td>59%</td>
<td>48±19</td>
<td>V_max 3.1±0.4 m/s</td>
<td>95% at 1 y</td>
<td>33 AVR for symptoms 34 deaths</td>
<td>Severe valve calcification RR: 2.0 (1.3–3.3) V_max ≥3 m/s RR: 1.6 (1.04–2.8). CAD RR: 1.7 (1.2–2.7)</td>
</tr>
<tr>
<td>Pellika, 2005 (42) 15598131</td>
<td>622</td>
<td>V_max ≥4.0 m/s No AS symptoms</td>
<td>Other valve disease CAD</td>
<td>72±11</td>
<td>62%</td>
<td>65±48</td>
<td>V_max 4.4±0.4 m/s</td>
<td>82% at 1 y</td>
<td>297 AS symptoms (AVR in 207 of these) 103 deaths without AVR or AS symptoms</td>
<td>AVA HR: 0.33 for a 1 cm² increase (95% CI: 0.15–0.71). LVH by ECG HR: 1.89 (95% CI: 1.02–1.90)</td>
</tr>
<tr>
<td>Rossebo, 2008 (26) 18765433</td>
<td>1,873</td>
<td>V_max 2.5 m/s to 4.0 m/s</td>
<td>CAD, CHF, diabetes mellitus, CVA, PVD, and other valve disease</td>
<td>88±9</td>
<td>59%</td>
<td>52 (median)</td>
<td>V_max 3.1±0.56</td>
<td>66% at 5 y</td>
<td>888 (38%) Major CV events (death, AVR, CHF, coronary events, and ischemic stroke)</td>
<td>No effect of statin therapy on major CV events</td>
</tr>
<tr>
<td>Lancellott, 2010 (43) 29483881</td>
<td>163</td>
<td>AWA ≤0.6 cm²/m² No AS symptoms LVEF ≥65%</td>
<td>Nonsinus rhythm Other valve disease</td>
<td>70±10</td>
<td>85%</td>
<td>20±19</td>
<td>≤0.6 cm²/m²</td>
<td>50% at 2 y</td>
<td>11 symptoms, but no AVR 57 AVR 8 deaths</td>
<td>V_max ≥1.4 m/s, LV longitudinal deformation ≤15.9%, valvulo-arterial impedance ≥4.9 mm Hg/m², LA area</td>
</tr>
</tbody>
</table>
Multivariate predictors of symptom onset (normal flow):

- Aortic velocity
- Not AVA
## Aortic Stenosis Disease Stages

<table>
<thead>
<tr>
<th>Stage</th>
<th>Definition</th>
<th>Valve anatomy and hemodynamics</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>At risk for AS</td>
<td>Bicuspid valve, aortic sclerosis</td>
</tr>
<tr>
<td>B</td>
<td>Progressive AS</td>
<td><strong>Mild AS</strong> $V_{\text{max}}$ 2.0–2.9 m/s, Mean ΔP &lt; 20 mm Hg &lt;br&gt;<strong>Mod AS</strong> $V_{\text{max}}$ 3.0–3.9 m/s, Mean ΔP 20-39 mm Hg  &lt;br&gt;(Typically AVA &gt;1.0 cm²)</td>
</tr>
<tr>
<td>C</td>
<td>Asymptomatic severe AS</td>
<td><strong>Severe AS</strong> $V_{\text{max}}$ ≥ 4.0 m/s, Mean ΔP ≥40 mm Hg &lt;br&gt;(Typically AVA ≤1.0 cm²)  &lt;br&gt;<strong>Very severe AS</strong> $V_{\text{max}}$ ≥ 5.0 m/s, Mean ΔP ≥60 mm Hg</td>
</tr>
<tr>
<td>D</td>
<td>Symptomatic severe AS</td>
<td><strong>D1:</strong> High gradient severe AS  &lt;br&gt;<strong>D2:</strong> Low gradient severe AS (low EF)  &lt;br&gt;<strong>D3:</strong> Low-flow low-gradient severe AS (normal EF)</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>C1:</strong> Normal LV systolic</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>C2:</strong> LV ejection fraction &lt; 50%</td>
</tr>
</tbody>
</table>
Symptomatic Severe Aortic Stenosis

- $V_{\text{max}} \geq 4 \text{ m/s}$
- $V_{\text{max}} < 4 \text{ m/s}$
  - $\text{AVA} \leq 1 \text{ cm}^2$
  - $\text{EF} < 50\%$

ECHO

D1 High Gradient

2014 ACC/AHA Valvular Heart Disease (VHD) Guidelines
Symptomatic Severe Aortic Stenosis

**ECHO**

- \( V_{\text{max}} \geq 4 \text{ m/s} \)
- \( V_{\text{max}} < 4 \text{ m/s} \)
  - AVA \( \leq 1 \text{ cm}^2 \)
  - EF \( < 50\% \)
- \( V_{\text{max}} < 4 \text{ m/s} \)
  - AVA \( \leq 1 \text{ cm}^2 \)
  - EF \( \geq 50\% \)

**D1 High Gradient**

- Low dose DSE
  - \( V_{\text{max}} \geq 4 \text{ m/s} \) with
  - AVA \( \leq 1 \text{ cm}^2 \)
  - at any flow rate

**D2 LFLG Low EF**

- Calcified valve
  - Normotensive
  - AVAi \( \leq 0.6 \text{ cm}^2/\text{m}^2 \)
  - SVi \( < 35 \text{ ml/m}^2 \)
2014 ACC/AHA Valve Guidelines

TIMING of Intervention for AS

Aortic valve stenosis

Symptoms due to AS

- $V_{\text{max}} \geq 4 \text{ m/s}$
- $V_{\text{max}} < 4 \text{ m/s}$
  - EF < 50%
    - DSE $V_{\text{max}} \geq 4 \text{ m/s}$ at any flow rate
    - AVR (I)
    - AVR (IIa)
  - No
    - AVR (IIa)

No AS symptoms

- $V_{\text{max}} \geq 5 \text{ m/s} +$ Low surgical risk
  - EF < 50%
    - AVAi $\leq 0.6 \text{ cm}^2/\text{m}^2$ and SVI <35 mL/m²
    - AVR (I)
    - AVR (IIa)
  - No
    - AVR (IIa)

- $V_{\text{max}} \geq 4 \text{ m/s}$
  - EF < 50%
    - ETT with ↓ BP or ↓ ex. capacity
    - AVR (IIa)
  - No
    - AVR (IIb)

Rapid disease progression + low surgical risk

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INTERVENTION FOR AORTIC STENOSIS

TIMING of Intervention

CHOICE of Intervention

Valve Type
Surgical vs Transcatheter
Indication for AVR

- Low-intermediate surgical risk
  - Surgical AVR (I)

- High surgical risk
  - TAVR (IIa)

Heart Valve Team (I)

- Prohibitive surgical risk
  - Predicted post-TAVR survival > 1 yr
    - YES
      - BAV (IIb)
    - NO
      - TAVR (I)

Palliative Care
Conceptual Framework
Management of Aortic Stenosis

**BENEFIT**
- Years of life
- Quality of life
- Functional status

**RISK**
- Procedural risk
- Late complications
- Pain/discomfort

**50 man**
Otherwise healthy

**Age**
**Comorbidities**

**90 woman**
Frail
Multiple comorbidities
Causes of Chronic Mitral regurgitation

- **Primary mitral valve disease**
  - Myxomatous (MVP)
  - Rheumatic

- **Secondary (functional) regurgitation**
  - Ischemic
  - Dilated cardiomyopathy

<table>
<thead>
<tr>
<th>Stage</th>
<th>Anatomy</th>
<th>Hemodynamics</th>
<th>Left ventricle</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>At risk (asymptomatic)</td>
<td>MVP</td>
<td>No to trace MR</td>
</tr>
<tr>
<td>B</td>
<td>Progressive (asymptomatic)</td>
<td>Severe MVP Rheumatic Endocarditis</td>
<td>Mild to moderate MR: Vena contracta &lt; 0.7 cm, ERO &lt; 0.4 cm², RV &lt; 60 ml, Angio 1-2+</td>
</tr>
<tr>
<td>C</td>
<td>Asymptomatic Severe MR</td>
<td>Severe MVP +/- flail Severe rheumatic Endocarditis</td>
<td>Severe MR Vena contracta ≥ 0.7 cm, ERO ≥ 0.4 cm², RV ≥ 60 ml, Angio 3-4+</td>
</tr>
<tr>
<td>D</td>
<td>Symptomatic Severe MR</td>
<td>Endocarditis Radiation</td>
<td>Severe MR Vena contracta ≥ 0.7 cm, ERO ≥ 0.4 cm², RV ≥ 60 ml, Angio 3-4+</td>
</tr>
</tbody>
</table>
Valve hemodynamics with severe primary MR

- Central jet MR >40% LA or holosystolic eccentric jet MR
- Vena contracta ≥0.7 cm
- Regurgitant volume ≥60 mL
- Regurgitant fraction ≥50%
- ERO ≥0.40 cm²
- Angiographic grade 3–4+
2014 ACC/AHA Valve Guidelines

LV Response to Chronic Volume Overload

LV Size and Systolic Function
- Echo
- MRI
2014 ACC/AHA Valve Guidelines: **Indications for Surgery**

**Primary Mitral Regurgitation**

**Severe MR (Stage C or D)**
- Symptomatic (Stage D)
  - LVEF > 30%
  - MV Surgery (IIb)
- Asymptomatic (Stage C)
  - LVEF 30-60% or LVESD ≥ 40 mm (Stage C2)
  - YES: MV Surgery (I)
  - NO: LVEF > 60% or LVESD < 40 mm (Stage C1)
    - YES: MV Surgery (I)
    - New onset AF or PASP > 50 mmHg (Stage C1)
      - Periodic Monitoring

**Progressive MR (Stage B)**
- Yes
- NO
3D Anatomy Mitral Valve

3D Echo: Leaflet anatomy
Prolapse
Chordal rupture

Amenable to: Valve repair? Transcatheter procedure?

Otto,
Textbook of Clinical Echocardiography,
5th Ed. 2013
Secondary Mitral Regurgitation
Mechanisms and outcomes

Coronary Disease
• Acute ischemia
• Regional LV dysfunction
• Global LV dilation and dysfunction

Cardiomyopathy (heart failure)
• LV dilation and dysfunction
• Leaflet tethering

<table>
<thead>
<tr>
<th>Stage</th>
<th>Anatomy</th>
<th>Hemodynamics/LV</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>At risk (asymptomatic)</td>
<td>CAD or Cardiomyopathy</td>
<td>No to trace MR---<strong>All have primary myocardial disease</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| B     | Progressive (asymptomatic) | Regional LV dysfx. Annular dilation | Mild to moderate MR: 
ERO \(< 0.2 \text{ cm}^2\)
RV\(< 30 \text{ ml}\)
RF \(< 50\%\) | Symptoms may respond to Rx for coronary ischemia or HF |
|       |         |                 |          |
| C     | Asymptomatic Severe MR | Regional or global LV dilation and dysfx. Leaflet tethering | Severe MR 
ERO \(\geq 0.2 \text{ cm}^2\)
RV \(\geq 50 \text{ ml}\)
RF \(\geq 50\%\) | Symptoms may respond to Rx for coronary ischemia or HF |
| D     | Symptomatic Severe MR | Annular dilation | Severe MR 
ERO \(\geq 0.2 \text{ cm}^2\)
RV \(\geq 50 \text{ ml}\)
RF \(\geq 50\%\) | HF symptoms persist after revascularization and medical therapy |
Secondary Mitral Regurgitation

CAD Rx
HF Rx
Consider CRT

Symptomatic Severe MR (Stage D)
MV Surgery (IIb)

Asymptomatic Severe MR (Stage C)
Periodic Monitoring

Progressive MR (Stage B)

2014 ACC/AHA Valve Guidelines
Indications for Surgery
ACC/AHA Valve Guidelines

Balance between waiting and intervention

### Watchful Waiting
- Hemodynamic severity
- Valve anatomy
- Progression rate
- Age, comorbidities
- Pt. preferences

### Intervention
- Mortality
- Complications
- Valve hemodynamics
- Valve durability
- Thrombotic risk
ACC/AHA Valve Guidelines
Balance between waiting and intervention

**Watchful Waiting**
- Hemodynamic severity
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ACC/AHA Valve Guidelines
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- Age, comorbidities
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Intervention
- Mortality
- Complications
- Valve hemodynamics
- Valve durability
- Thrombotic risk
Challenges in Assessment and Management

Aortic Stenosis

- Diagnosis of low gradient severe AS
- Intervention for asymptomatic “severe” AS
- Choice of surgical vs. trans-catheter AVR
- Benefit-risk balance in older adults with multiple comorbidities and frailty
Challenges in Assessment and Management
Mitral Regurgitation

• Optimal (outcome based) definitions of MR severity

• Centers of excellence for management of asymptomatic severe MR

• Role of trans-catheter vs surgical approaches

• Management of secondary MR