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
### 2014 ACC/AHA Valve Guidelines

#### 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>C1: Asymptomatic patients</td>
<td>C1: Asymptomatic patients with severe VHD in whom the left or right ventricle remains compensated</td>
</tr>
<tr>
<td></td>
<td>C2: Asymptomatic patients</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>$V_{\text{max}}$</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>Not due to AS</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>Maybe due to AS?</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

AVA
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

<table>
<thead>
<tr>
<th>Author, Year</th>
<th>Study Size (N)</th>
<th>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)</td>
<td>33</td>
<td>V&lt;sub&gt;max&lt;/sub&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 68±19 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)</td>
<td>213</td>
<td>V&lt;sub&gt;max&lt;/sub&gt; ≥ 4.0 m/s Age≥40 y Asymptomatic</td>
<td>Other valve disease</td>
<td>70 (40–94)</td>
<td>67%</td>
<td>20</td>
<td>V&lt;sub&gt;max&lt;/sub&gt; 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&lt;sub&gt;max&lt;/sub&gt; ≥ 4.5 m/s; RR: 4.9 (1.64–14.6) LVEF &lt;50%; RR: 2.93 (0.84–10.2)</td>
</tr>
<tr>
<td>Kennedy, 1981 (41)</td>
<td>199</td>
<td>AWA 0.7–1.2 cm&lt;sup&gt;2&lt;/sup&gt; at cath</td>
<td>Other valve disease</td>
<td>67±10</td>
<td>77%</td>
<td>35</td>
<td>AWA 0.92±0.13 cm&lt;sup&gt;2&lt;/sup&gt;</td>
<td>59% at 4 y</td>
<td>21 AVR (13 for symptomatic); 14 deaths due to AS</td>
<td>LVEF &lt;50%; RR: 1.94 (0.88–4.41) LV end diastolic pressure &gt;16 mm Hg RR: 2.71 (1.23–5.97). AWA index &lt;0.5 cm&lt;sup&gt;2&lt;/sup&gt; RR: 1.93 (0.89–4.23)</td>
</tr>
<tr>
<td>Otto, 1997 (21)</td>
<td>91</td>
<td>V&lt;sub&gt;max&lt;/sub&gt; ≥ 2.5 m/s Asymptomatic</td>
<td>Severe comorbid disease</td>
<td>83±18</td>
<td>70%</td>
<td>30</td>
<td>V&lt;sub&gt;max&lt;/sub&gt; &lt;3 m/s</td>
<td>84% at 2 y</td>
<td>48 AVR for symptoms; 8 deaths</td>
<td>V&lt;sub&gt;max&lt;/sub&gt; Functional status score Rate of change in V&lt;sub&gt;max&lt;/sub&gt;</td>
</tr>
<tr>
<td>Rosenhek, 2004 (25)</td>
<td>149</td>
<td>V&lt;sub&gt;max&lt;/sub&gt; ≥ 2.0 m/s Asymptomatic</td>
<td>Other valve disease</td>
<td>60±18</td>
<td>54%</td>
<td>22±18</td>
<td>V&lt;sub&gt;max&lt;/sub&gt; 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 (1.8–14.6)</td>
</tr>
<tr>
<td>Rosenhek, 2004 (25)</td>
<td>149</td>
<td>V&lt;sub&gt;max&lt;/sub&gt; ≥ 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&lt;sub&gt;max&lt;/sub&gt; 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&lt;sub&gt;max&lt;/sub&gt; ≥ 3 mm/s RR: 1.6 (1.04–2.8). CAD RR: 1.7 (1.2–2.7)</td>
</tr>
<tr>
<td>Pellika, 2005 (42)</td>
<td>159</td>
<td>V&lt;sub&gt;max&lt;/sub&gt; ≥ 4.0 m/s No AS symptoms</td>
<td>Other valve disease</td>
<td>72±11</td>
<td>62%</td>
<td>65±48</td>
<td>V&lt;sub&gt;max&lt;/sub&gt; 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 cm&lt;sup&gt;2&lt;/sup&gt; increase (95%CI: 0.15–0.71). LVH by EGG HR: 1.39 (95%CI: 1.02–1.89)</td>
</tr>
<tr>
<td>Rossebo, 2008 (28)</td>
<td>187</td>
<td>V&lt;sub&gt;max&lt;/sub&gt; ≥ 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&lt;sub&gt;max&lt;/sub&gt; 3.1±0.56</td>
<td>86% at 5 y</td>
<td>88 (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>Lancellotti, 2010 (43)</td>
<td>294</td>
<td>AWA ≤ 0.6 cm&lt;sup&gt;2&lt;/sup&gt;/m&lt;sup&gt;2&lt;/sup&gt; No AS symptoms LVEF ≥55%</td>
<td>Nonsinus rhythm Other valve disease</td>
<td>70±10</td>
<td>65%</td>
<td>20±19</td>
<td>≤0.6 cm&lt;sup&gt;2&lt;/sup&gt;/m&lt;sup&gt;2&lt;/sup&gt;</td>
<td>50% at 2 y</td>
<td>11 symptoms, but no AVR 57 AVR; 8 deaths</td>
<td>V&lt;sub&gt;max&lt;/sub&gt; ≥ 1.4 m/s, LV longitudinal deformation ≤15.9%, valvulo-arterial impedance ≤4.9 mm Hg/m&lt;sup&gt;2&lt;/sup&gt;, 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>
</tbody>
</table>
| B     | Progressive AS                  | Mild AS  $V_{max} \geq 2.0-2.9$ m/s, Mean $\Delta P < 20$ mm Hg  
|       |                                 | Mod AS  $V_{max} 3.0-3.9$ m/s, Mean $\Delta P 20-39$ mm Hg  
|       |                                 | (Typically  AVA $>1.0$ cm$^2$)                                                                  |
| C     | Asymptomatic severe AS          | Severe AS  $V_{max} \geq 4.0$ m/s, Mean $\Delta P \geq 40$ mm Hg  
|       |                                 | (Typically  AVA $\leq 1.0$ cm$^2$)                                                              |
|       |                                 | Very severe AS  $V_{max} \geq 5.0$ m/s, Mean $\Delta P \geq 60$ mm Hg                           |
|       | C1: Normal LV systolic          |                                                                                                |
|       | C2: LV ejection fraction $< 50\%$|                                                                                                |
| D     | Symptomatic severe AS           | D1: High gradient severe AS  
|       |                                 | D2: Low gradient severe AS (low EF)                                                               |
|       |                                 | D3: Low-flow low-gradient severe AS (normal EF)                                                 |
Symptomatic Severe Aortic Stenosis

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

D1 High Gradient

**ECHO**
2014 ACC/AHA Valvular Heart Disease (VHD) Guidelines

Symptomatic Severe Aortic Stenosis

**ECHO**

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

**D1 High Gradient**

- $V_{\text{max}} \geq 4 \text{ m/s}$ with $\text{AVA} \leq 1 \text{ cm}^2$ at any flow rate

**D2 LFLG Low EF**

- Low dose DSE
- $V_{\text{max}} \geq 4 \text{ m/s}$ with $\text{AVA} \leq 1 \text{ cm}^2$

**D3 LFLG Normal EF**

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

TIMING of Intervention for AS

Aortic valve stenosis

Symptoms due to AS

- $V_{\text{max}} \geq 4 \text{ m/s}$
  - EF < 50%
    - DSE $V_{\text{max}} \geq 4 \text{ m/s}$ at any flow rate
      - AVR (I)
    - AVR (IIa)

- $V_{\text{max}} < 4 \text{ m/s}$
  - AVR (I)

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 $< 35 \text{ mL/m}^2$
      - AVR (I)
    - AVR (IIa)

- $V_{\text{max}} \geq 4 \text{ m/s}$
  - EF < 50%
    - ETT with ↓ BP or ↓ ex. capacity
      - Rapid disease progression + low surgical risk
    - AVR (IIa)
  - AVR (IIa)
  - AVR (IIb)
TIMING of Intervention

CHOICE of Intervention

Valve Type

Surgical vs Transcatheter
2014 ACC/AHA Valve Guidelines

**CHOICE of Intervention for AS**

**Indication for AVR**
- Low-intermediate surgical risk
  - Surgical AVR (I)

**Heart Valve Team (I)**
- High surgical risk
  - TAVR (IIa)

**Prohibitive surgical risk**
- Bridge to SAVR or TAVR for severe symptoms
  - BAV (IIb)
  - Predicted post-TAVR survival > 1 yr
    - YES
    - TAVR (I)
    - NO
      - Palliative Care
Conceptual Framework
Management of Aortic Stenosis

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

RISK
- Procedural risk
- Late complications
- Pain/discomfort

SAVR
TAVR

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

# 2014 ACC/AHA Valve Guidelines

## Stages of Chronic **Primary** Mitral Regurgitation

<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>Normal</td>
</tr>
<tr>
<td></td>
<td></td>
<td>No to trace MR</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Progressive (asymptomatic)</td>
<td>Severe MVP Rheumatic Endocarditis</td>
<td>Normal LV volumes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mild to moderate MR: Vena contracta &lt; 0.7 cm</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>ERO &lt; 0.4 cm&lt;sup&gt;2&lt;/sup&gt;, RV&lt; 60 ml, Angio 1- 2+</td>
<td>Normal LV EF</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mild LA, Normal PAP</td>
</tr>
<tr>
<td>C</td>
<td>Asymptomatic Severe MR</td>
<td>Severe MVP +/- flail Severe rheumatic</td>
<td>C1: LV EF &gt; 60% with LV ESD &lt; 40 mm</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Endocarditis Radiation</td>
<td>C2: LV EF ≤60% or LV ESD ≥40 mm</td>
</tr>
<tr>
<td>D</td>
<td>Symptomatic Severe MR</td>
<td>Endocarditis Radiation</td>
<td>LV dilation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Severe MR Vena contracta ≥ 0.7 cm</td>
<td>Pulmonary hypertension</td>
</tr>
<tr>
<td></td>
<td></td>
<td>ERO ≥ 0.4 cm&lt;sup&gt;2&lt;/sup&gt;, RV ≥ 60 ml, Angio 3-4+</td>
<td>Moderate to severe LA</td>
</tr>
</tbody>
</table>

*Stages of Chronic Primary Mitral Regurgitation*
2014 ACC/AHA Valve Guidelines

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+
LV Response to Chronic Volume Overload

LV Size and Systolic Function
- Echo
- MRI
Primary Mitral Regurgitation

Severe MR (Stage C or D)

Symptomatic (Stage D)

LVEF > 30%

MV Surgery (IIb)

Progressive MR (Stage B)

Asymptomatic (Stage C)

LVEF 30-60% or LVESD ≥ 40 mm (Stage C2)

LVEF > 60% or LVESD < 40 mm (Stage C1)

New onset AF or PASP > 50 mmHg (Stage C1)

Periodic Monitoring

2014 ACC/AHA Valve Guidelines: Indications for Surgery

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
Primary Mitral Regurgitation

**Severe MR (Stage C or D)**
- **Symptomatic (Stage D)**
  - LVEF > 30%
  - YES: MV Surgery (IIb)
  - NO: Asymptomatic (Stage C)

**Progressive MR (Stage B)**
- **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 Repair (IIa)
    - NO: New onset AF or PASP > 50 mmHg (Stage C1)
      - YES: Periodic Monitoring
      - NO: Likelihood of successful repair >95% and Expected mortality < 1%

2014 ACC/AHA Valve Guidelines: Indications for Surgery
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

### 2014 ACC/AHA Valve Guidelines

#### Stages of Chronic Secondary MR

<table>
<thead>
<tr>
<th>Stage</th>
<th>Anatomy</th>
<th>Hemodynamics/LV</th>
<th>Symptoms</th>
</tr>
</thead>
</table>
| **A** | At risk (asymptomatic) | CAD or Cardiomyopathy | No to trace MR---
*All have primary myocardial disease* | Due to coronary ischemia or heart failure |
| **B** | Progressive (asymptomatic) | Regional LV dysfx. Annular dilation | Mild to moderate MR:
ERO < 0.2 cm²
RV < 30 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 ≥ 0.2 cm²
RV ≥ 50 ml
RF ≥ 50% | Symptoms may respond to Rx for coronary ischemia or HF |
| **D** | Symptomatic Severe MR | Annular dilation | Severe MR
ERO ≥ 0.2 cm²
RV ≥ 50 ml
RF ≥ 50% | HF symptoms persist after revascularization and medical therapy |
Secondary Mitral Regurgitation

CAD Rx
HF Rx
Consider CRT

Symptomatic
Severe MR
(Stage D)

Asymptomatic
Severe MR
(Stage C)

MV Surgery
(IIb)

Progressive
MR
(Stage B)

Periodic Monitoring

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
- Valve anatomy
- Progression rate
- Age, comorbidities
- Pt. preferences

Intervention
- Mortality
- Complications
- Valve hemodynamics
- Valve durability
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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
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