Valvular Heart Disease: overview and 2014 diagnosis and management update

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CONFLICTS OF INTEREST

- No financial conflicts of interest
- Supported by NIH K23HL116652
LEARNING OBJECTIVES

- To review the pathophysiology, diagnosis, and treatment of valvular heart disease (VHD)

- To describe the new 2014 classification of VHD stages

- To understand the complexity of trans-catheter aortic valve replacement (TAVR) with regard to patient selection and timing of intervention
2014 AHA/ACC Guideline for the Management of Patients With Valvular Heart Disease: Executive Summary: A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines
Rick A. Nishimura, Catherine M. Otto, Robert O. Bonow, Blase A. Carabello, John P. Erwin III, Robert A. Guyton, Patrick T. O'Gara, Carlos E. Ruiz, Nikolaos J. Skubas, Paul Sorajja, Thoralf M. Sundt III and James D. Thomas

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# New Classification of Valvular Heart 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>Risk factors for development of VHD</td>
</tr>
<tr>
<td>B</td>
<td>Progressive</td>
<td>Progressive VHD (mild-moderate severity and asymptomatic)</td>
</tr>
<tr>
<td>C</td>
<td>Asymptomatic severe</td>
<td>Asymptomatic + criteria for severe VHD</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C1: LV or RV remain compensated</td>
</tr>
<tr>
<td></td>
<td></td>
<td>C2: decompensation of LV or RV</td>
</tr>
<tr>
<td>D</td>
<td>Symptomatic severe</td>
<td>Symptoms as a result of VHD</td>
</tr>
</tbody>
</table>
CASE 1

- 78 year old male with severe COPD presenting to your office with worse shortness of breath with exertion

- On exam BP 100/60, HR 83, no change in chronic oxygen requirements (98% 2L), JVP difficult to assess due to body habitus, RRR, late peaking systolic ejection murmur with soft S2 and radiation to both carotids, lung exam with poor air movement, no crackles, abdomen soft/NT, 1-2+ LEE
YOU DECIDE TO

- Prescribe Lasix 80 mg daily and have him return in follow-up
- Obtain an echocardiogram in the next 1-2 days
- Refer to cardiology
YOU DECIDE TO

- Prescribe Lasix 80 mg daily and have him return in follow-up

- Obtain an echocardiogram in the next 1-2 days

- Refer to cardiology
AORTIC STENOSIS
Valvular Aortic Stenosis - Etiology

a. Normal valve
b. Bicuspid
   1.8% population
   sx present < 60 years
c. Degenerative-calcific
   Most common
   > 70 years
d. Rheumatic
AORTIC STENOSIS - PATHOPHYSIOLOGY

Aortic stenosis

Increased afterload

LVH

LVH inadequate (afterload mismatch)

↑ O2 demand  ↓ coronary perfusion pressure

Compression of intramyocardial arteries

↓ CBF per unit of mass

Myocardial ischemia

Reduced myocardial contractility
Valvular aortic stenosis — symptoms

- Dyspnea
- Angina
- Syncope
Moderate Aortic Stenosis — Physical Exam

Crescendo Decrescendo Murmur

- Hypertrophy
- Stiffness
- LV
- S1
- S4
- A2
- P2
- Peaks later
SEVERE AORTIC STENOSIS — PHYSICAL EXAM

Murmur

Expiration

Stiff LV

S4 S1

Inspiration

S4 S1

Soft, Single Delayed A2

P2

A2
AORTIC STENOSIS - 2D ECHOCARDIOGRAPHY
AORTIC STENOSIS - 2D ECHOCARDIOGRAPHY
AORTIC STENOSIS - Doppler

- Max aortic velocity
- Mean trans-valvular gradient
- Aortic valve area by continuity equation
# Aortic Stenosis

- **Etiology**

  **Severe AS:**
  - $V_{\text{max}} \geq 4 \text{ m/s}$
  - Mean $P_G \geq 40 \text{ mmHg}$

---

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{\text{max}}$</td>
<td>5.17 m/s</td>
</tr>
<tr>
<td>$V_{\text{mean}}$</td>
<td>3.29 m/s</td>
</tr>
<tr>
<td>Max $P_G$</td>
<td>104.87 mmHg</td>
</tr>
<tr>
<td>Mean $P_G$</td>
<td>49.72 mmHg</td>
</tr>
<tr>
<td>VTI</td>
<td>94.9 cm</td>
</tr>
<tr>
<td>Env.Ti</td>
<td>288 ms</td>
</tr>
</tbody>
</table>
AORTIC STENOSIS - DOPPLER

- Aortic valve area by continuity equation
  - Volume flow proximal to valve = volume flow thru orifice
  - \( \text{CSA}_{\text{LVOT}} \times V_{\text{LVOT}} = \text{AVA} \times V_{\text{AV}} \)
  - \( \text{AVA} = \frac{\text{CSA}_{\text{LVOT}} \times V_{\text{LVOT}}}{V_{\text{AV}}} \)

Otto, Textbook of Clinical Echocardiography, 5th Ed
# AORTIC STENOSIS STAGES

<table>
<thead>
<tr>
<th>Stage</th>
<th>Definition</th>
<th>Valve Hemodynamics</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>At risk for AS (bicuspid or sclerotic)</td>
<td>$V_{\text{max}} &lt; 2 \text{ m/s}$</td>
</tr>
</tbody>
</table>
| B     | Progressive AS | Mild AS: $V_{\text{max}}$ 2-2.9 m/s or mean $\Delta P < 20 \text{ mmHg}$  
Moderate AS: $V_{\text{max}}$ 3.0-3.9 m/s or mean $\Delta P$ 20-39 mmHg |
| C     | Asymptomatic severe AS | |
| C1    | Without LV dysfunction | $V_{\text{max}} \geq 4 \text{ m/s or mean } \Delta P \geq 40 \text{ mmHg (AVA } \leq 1.0 \text{ cm}^2)$ |
| C2    | With LV dysfunction | $V_{\text{max}} \geq 4 \text{ m/s or mean } \Delta P \geq 40 \text{ mmHg (AVA } \leq 1.0 \text{ cm}^2)$ |
| D     | Symptomatic severe AS | |
| D1    | High trans-aortic gradient | $V_{\text{max}} \geq 4 \text{ m/s or mean } \Delta P \geq 40 \text{ mmHg (AVA } \leq 1.0 \text{ cm}^2)$ |
| D2    | Low-flow/low-gradient with reduced LVEF | $\text{AVA } \leq 1.0 \text{ cm}^2$ with $V_{\text{max}} < 4 \text{ m/s or mean } \Delta P < 40 \text{ mmHg}$  
(with dobutamine $\text{AVA } \leq 1.0 \text{ cm}^2$ and $V_{\text{max}} \geq 4 \text{ m/s}$) |
| D3    | Low-gradient with norm LVEF | $\text{AVA } \leq 1.0 \text{ cm}^2$ with $V_{\text{max}} < 4 \text{ m/s and mean } \Delta P < 40 \text{ mmHg (but stroke volume index } < 35 \text{ mL/m2 and indexed } \text{AVA } \leq 0.6 \text{ cm}^2)$ |

AS: aortic stenosis, LV: left ventricular, $\Delta P$: mean gradient. AVA: aortic valve area
# Aortic Stenosis Follow-up

<table>
<thead>
<tr>
<th>Aortic Stenosis Stage</th>
<th>Follow-up</th>
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<tbody>
<tr>
<td>Progressive (Stage B)</td>
<td>Every 3-5 y for mild severity; every 1-2 years for moderate severity</td>
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<tr>
<td>Severe (Stage C)</td>
<td>Every 6-12 months</td>
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</table>

Brener et al. JACC 1995;25:305-10  
Palta et al. Circulation 2000;101:2497-502
# Aortic Stenosis: Medical Therapy

<table>
<thead>
<tr>
<th>Class</th>
<th>Therapy Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>Standard treatment of hypertension for stages A, B, C</td>
</tr>
<tr>
<td>Class IIb</td>
<td>Vasodilator therapy only with invasive hemodynamic monitoring in severe decompensated AS (stage D)</td>
</tr>
<tr>
<td>Class III (no benefit)</td>
<td>Statins not indicated for prevention of progression of AS</td>
</tr>
</tbody>
</table>

Rieck et al. Hypertension 1995;25:305-10  
Palta et al. Circulation 2000;101:2497-502  
Rajammanan et al. Circulation. 2011;124:1783-91
SEVERE AORTIC STENOSIS — TIMING OF INTERVENTION

Severe AS
$V_{\text{max}} \geq 4 \text{ m/s}$
$\Delta P_{\text{mean}} \geq 40 \text{ mm Hg}$

Symptomatic (stage D1)

Asymptomatic (stage C)

LVEF <50% (stage C2)

Other cardiac surgery

$V_{\text{max}} \geq 5 \text{ m/s}$
$\Delta P_{\text{mean}} \geq 60 \text{ mm Hg}$
Low surgical risk

Abnormal ETT

$\Delta V_{\text{max}} > 0.3 \text{ m/s/y}$
Low surgical risk

AVR (I)

AVR (IIa)

AVR (IIb)

MODERATE AORTIC STENOSIS – TIMING OF INTERVENTION

- $V_{max}$ 3 m/s–3.9 m/s
- $\Delta P_{mean}$ 20–39 mm Hg

- Symptomatic
  - LVEF <50%
    - YES
      - DSE with AVA ≤1 cm$^2$ and $V_{max}$ ≥4 m/s (stage D2)
    - NO
      - AVA ≤1 cm$^2$ and LVEF ≥50% (stage D3*)
      - AS likely cause of symptoms

- Asymptomatic (stage B)
  - Other cardiac surgery

AVR (IIa)
SURGICAL OR TRANSCATHETER INTERVENTION?
Transcatheter Aortic Valve Replacement (TAVR)

A: SAPIEN THV  
B: SAPIEN XT THV  
C: COREVALVE
TRANSCATHETER AORTIC VALVE REPLACEMENT (TAVR)
Transcatheter Aortic Valve Replacement (TAVR)

- In appropriately screened patients with inoperable symptomatic AS, TAVR provides better outcomes compared to medical therapy (PARTNER multicenter trial cohort B. NEJM 2010)

- TAVR and surgical AVR are associated with similar rates of one-year survival (PARTNER trial cohort A)

- However, stroke or TIA and vascular complications are more frequent with TAVR. Major bleeding and atrial fibrillation more common with surgical AVR (PARTNER trial cohort A)
TYPE OF INTERVENTION FOR AORTIC STENOSIS

Surgical AVR

Indication for AVR with low or intermediate surgical risk*

TAVR

Indication for AVR with prohibitive surgical risk* and predicted post-TAVR survival > 12 months

Not recommended if comorbidities preclude expected benefit from correction of AS

* Surgical risk assessed based on STS, frailty indices, major organ system compromise, and procedure-specific impediment

IMPORTANCE OF A HEART VALVE TEAM IN THE SELECTION AND CARE OF TAVR PATIENTS
Case 2

- 65 year old female with known severe aortic regurgitation from prior endocarditis presents in follow-up

- She is asymptomatic

- Heart rate is 73 bpm and blood pressure is 160/95 mmHg. Diastolic decrescendo murmur, otherwise normal exam

- On amlodipine 10 mg daily

- Her cardiologist is out of town and next f/u in 1 year
YOU DECIDE TO

- Order repeat echo in 1-2 years
- Add metoprolol succinate 25 mg daily
- Add losartan 25 mg daily
YOU DECIDE TO

- Order repeat echo in 1-2 years
- Add metoprolol succinate 25 mg daily
- Add losartan 25 mg daily
AORTIC REGURGITATION
Aortic regurgitation - etiology

Intrinsic Valvular
- Degenerative/calcific
- Bicuspid
- Endocarditis
- Rheumatic fever
- Valvulitis (CTD)
- Anorectic drugs

Ascending Aortic
- Degenerative
- Type A Dissection
- Marfan syndrome
- Inflammatory
  (Reiter, Behcet, Ankylosing Spondylitis, Relapsing Polychondritis, Psoriatic arthritis)
- Giant cell arteritis
AORTIC REGURGITATION - PATHOPHYSIOLOGY

<table>
<thead>
<tr>
<th>Pathophysiology</th>
<th>MR: Pure volume overload</th>
<th>AR: Volume &amp; pressure overload</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preload</td>
<td>↑</td>
<td>↑</td>
</tr>
<tr>
<td>Afterload</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>EF after OR</td>
<td>↓</td>
<td>=</td>
</tr>
</tbody>
</table>
AORTIC REGURGITATION - SYMPTOMS

- May have prolonged asymptomatic interval
- Incipient dyspnea
AORTIC REGURGITATION – PHYSICAL EXAM

Short SEM Murmur

Diastolic decrescendo Murmur

S1
Ejection Click (if bicuspid)

S2
Austin Flint

S1
AORTIC REGURGITATION - ECHOCARDIOGRAPHY

- Regurgitant jet width/LVOT diameter

- Vena contracta

- Proximal isovelocity surface area (PISA) → effective regurgitant orifice (ERO) area

- Regurgitant volume

- Regurgitant fraction

Otto, Textbook of Clinical Echocardiography, 5th Ed
Aortic regurgitation color jet width/LVOT diameter (> 65% severe)
Aortic regurgitation vena contracta is the narrowest width of the color jet (severe > 0.6 cm)
## Aortic Regurgitation Stages

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<tr>
<th>Stage</th>
<th>Definition</th>
<th>Valve Hemodynamics</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>At risk of AR (bicuspid, sclerotic, endocarditis or rheumatic)</td>
<td>No or trace AR</td>
</tr>
</tbody>
</table>
| B     | Progressive AR | Mild AR: Jet width < 25% of LVOT; vena contracta <0.3 cm  
Moderate AR: Jet width 25%-64% of LVOT; vena contracta 0.3-0.6 cm |
| C: Asymptomatic severe AR | | |
| C1    | Normal LVEF (> 50%) and mild-moderate LV dilatation (LVESD < 50 mm) | Jet width > 65% of LVOT; vena contracta > 0.6 cm |
| C2    | LVEF < 50% or severe LV dilatation (LVESD > 50 mm or indexed LVESD > 25 mm/m2) | |
| D: Symptomatic severe AR | Any systolic function | Jet width > 65% of LVOT; vena contracta > 0.6 cm |

AR: aortic regurgitation, LVOT: left ventricular outflow tract, LVESD: LV endsystolic dimension
AORTIC REGURGITATION — ECHO FOLLOW-UP

<table>
<thead>
<tr>
<th>Aortic Regurgitation Stage</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Progressive (Stage B)</td>
<td>Every 3-5 y for mild severity; every 1-2 y for moderate severity</td>
</tr>
<tr>
<td>Severe (Stage C)</td>
<td>Every 6-12 months. Dilated LV: more frequently</td>
</tr>
</tbody>
</table>

## Aortic Regurgitation — Medical Therapy

<table>
<thead>
<tr>
<th>Class</th>
<th>Treatment of hypertension for stages B and C preferably with dihydropyridine CCB or ACE-I/ARB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class IIb</td>
<td>ACE-I/ARBs and beta-blockers reasonable for severe AR who have symptoms and/or LV dysfunction (stages C2 and D) when surgery is NOT PERFORMED due to comorbidities</td>
</tr>
</tbody>
</table>

Elder et al. JACC 2011;58:2084-91  
AORTIC REGURGITATION – TIMING OF INTERVENTION

Aortic Regurgitation

Severe AR
(stages C and D)
Vena contracta > 0.6 cm
Holodiastolic aortic flow reversal
RVol ≥ 60 mL/beat
RF ≥ 50%
ERO ≥ 0.3 cm²
LV dilation

Symptomatic
(stage D)

Asymptomatic
(stage C)

LVEF < 50%
(stage C2)

Other cardiac surgery

LVEF ≥ 50%
LVESD > 50 mm
(stage C2)

LVEF ≥ 50%
LVESD > 65 mm
Low surgical risk

LVEF ≥ 50%
LVESD ≤ 50 mm
LVEDD ≤ 65 mm

AVR (I)

AVR (IIa)

AVR (IIb)

Periodic Monitoring

Progressive AR
(stage B)
Vena contracta ≤ 0.6 cm
RVol < 60 mL/beat
RF < 50%
ERO < 0.3 cm²

Other cardiac surgery

NO

YES

Class I

Class IIa

Class IIb
CASE 3

- 85 year old female with known “progressive” or stage B rheumatic mitral stenosis (MVA > 1.5 cm²)

- She is asymptomatic at rest and with exercise

- Euvolemic on exam

- NSR on ECG
YOU DECIDE TO

- Order repeat echo in 1-2 years
- Order repeat echo in 3-5 years
- Add warfarin as her left atrium is enlarged on echocardiogram and you fear atrial fibrillation
- Add metoprolol succinate 25 mg daily as patients with MS do better when bradycardic
YOU DECIDE TO

- Order repeat echo in 1-2 years
- Order repeat echo in 3-5 years
- Add warfarin as her left atrium is enlarged on echocardiogram and you fear atrial fibrillation
- Add metoprolol succinate 25 mg daily as patients with MS do better when bradycardic
MITRAL STENOSIS
Mitral stenosis - etiology

- Almost always rheumatic

- Less common causes:
  - Congenital
  - Mitral annular calcification
  - Obstruction from left atrial myxoma
RHEUMATIC MITRAL STENOSIS
**Rheumatic Mitral Stenosis - Pathophysiology**

- Hallmark is commissural fusion

- Elevation of left atrial pressure
  - Reflected back to pulmonary bed
  - Atrial arrhythmias
  - Right sided failure
  - Left ventricle is spared
Mitral stenosis - symptoms

- Dyspnea, PND, orthopnea
- Hemoptysis
- Palpitations
- Emboli
Mitral Stenosis – Physical Exam

- Palpation RV lift
- Loud P2
- Loud S1
- Opening snap
- Diastolic rumble

What heart sound can’t you get with significant MS?

S1, A2, P2, OS, S3
RHEUMATIC MITRAL STENOSIS – 2D ECHOCARDIOGRAPHY
Mitral stenosis – mitral valve area by planimetry
MITRAL STENOSIS — MEAN TRANSMITRAL PRESSURE GRADIENT

Mean and peak transmitral pressure gradients derived from transmitral Velocities using the Bernoulli equation
Mitral stenosis — Doppler
Calculation of mitral valve area by pressure half time

Pressure half time = time from $V_{max}$ to $V_{max}/\sqrt{2}$
Mitral valve area = $220/\text{pressure half time}$
## Rheumatic Mitral Stenosis Stages

<table>
<thead>
<tr>
<th>Stage</th>
<th>Definition</th>
<th>Valve Hemodynamics</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>At risk of MS (mild rheumatic involvement)</td>
<td>Normal transmitral flow velocities</td>
</tr>
</tbody>
</table>
| B     | Progressive MS | - Increased transmitral flow velocities  
- MVA > 1.5 cm²  
- PHT < 150 ms |
| C     | Asymptomatic severe MS | - MVA ≤ 1.5 cm²  
- (MVA ≤ 1.0 cm² with very severe)  
- PHT ≥ 150 ms  
- (PHT ≥ 220 ms with very severe)  
- PASP > 30 mmHg |
| D     | Symptomatic severe | - MVA ≤ 1.5 cm²  
- (MVA ≤ 1.0 cm² with very severe)  
- PHT ≥ 150 ms  
- (PHT ≥ 220 ms with very severe)  
- PASP > 30 mmHg |

MS: mitral stenosis, MVA: mitral valve area, PHT: pressure half time. PASP: pulmonary arterial systolic pressure
Mitral stenosis — echo follow-up

<table>
<thead>
<tr>
<th>Mitral Stenosis Stage</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Progressive (Stage B)</td>
<td>Every 3-5 y (MVA &gt; 1.5 cm²)</td>
</tr>
<tr>
<td>Severe (Stage C)</td>
<td>Every 1–2 y (MVA 1.0–1.5 cm²)</td>
</tr>
<tr>
<td></td>
<td>Once every year (MVA &lt;1.0 cm²)</td>
</tr>
</tbody>
</table>

Sagie et al. JACC 1996;28:472-9
MITRAL STENOSIS - MEDICAL THERAPY

<table>
<thead>
<tr>
<th>Class</th>
<th>Warfarin for</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1) MS and AF, or</td>
</tr>
<tr>
<td></td>
<td>2) MS and a prior embolic event, or</td>
</tr>
<tr>
<td></td>
<td>3) MS and a left atrial thrombus</td>
</tr>
</tbody>
</table>

Class IIa
---
Heart rate control is beneficial for MS and RVR AF

Class IIb
---
Consider heart rate control for MS in normal sinus rhythm and symptoms associated with exercise

Perez-Gomez et al. JACC. 2004;44:1557-66
Mitral stenosis — percutaneous Mitral balloon commissurotomy (PMBC)

Superb results with 1) PLIABLE VALVES (mobile leaflets, thin, and free of calcium) and 2) less than moderate MR
Severe Mitral Stenosis - Treatment

Rheumatic MS

Very severe MS
MVA ≤1 cm²
T½ ≥220 ms

Asymptomatic (stage C)

Favorable valve morphology
No LA clot
No or mild MR

NO YES

Asymptomatic (stage C)

Severe MS
MVA ≤1.5 cm²
T½ ≥150 ms

Symptomatic (stage D)

Favorable valve morphology
No LA clot
No or mild MR

YES NO

New onset AF

YES

NYHA class III-IV symptoms with high surgical risk

NO YES

Favorable valve morphology
No LA clot
No or mild MR

YES NO

Periodic Monitoring PMBC (IIa) PMBC (I) MVR (I) PMBC (IIb) Periodic Monitoring
PROGRESSIVE MITRAL STENOSIS - TREATMENT

Progressive MS
MVA > 1.5 cm²
T½ < 150 ms

Symptomatic with no other cause

PCWP > 25 mm Hg with exercise

YES NO

PMBC (IIb)
Periodic Monitoring

Case 4

- 50 year old male with known mitral valve prolapse and severe mitral regurgitation

- Asymptomatic

- Normal LVEF and LV size on echocardiogram

- Last seen his cardiologist prior to new guidelines and no follow-up for another year

- Upcoming dental cleaning, is requesting antibiotic prophylaxis
You decide to

- Order repeat echo in 3-5 years
-Prescribe antibiotic prophylaxis
-Refer back to cardiology for consideration of mitral valve repair at BIDMC (likelihood of successful repair > 95%, mortality < 1%)
YOU DECIDE TO

- Order repeat echo in 3-5 years
- Prescribe antibiotic prophylaxis
- Refer back to cardiology for consideration of mitral valve repair
MITRAL REGURGITATION
Mitral regurgitation — mitral valve anatomy

- Subvalvular apparatus (papillary muscles with their supporting left ventricular walls and chordae tendineae)
- Mitral annulus
- Mitral valve leaflets
**Mitral regurgitation - etiology**

- **Primary:**
  - Myxomatous
  - Endocarditis
  - Rheumatic
  - Trauma
  - Congenital
  - Drugs (ergotamines, methysergide, pergolide, fen fen)

- **Secondary:**
  - Non-ischemic dilated CMP
  - Ischemic heart disease
**Mitral regurgitation - pathophysiology**

<table>
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<tr>
<th>Pathophysiology</th>
<th>MR</th>
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<td>Afterload</td>
<td>↓</td>
<td>↑</td>
</tr>
</tbody>
</table>

**EF after OR**

- MR: Pure volume overload
- AR: Volume & pressure overload

=
Mitral regurgitation - Symptoms

- May have prolonged asymptomatic interval
- Low output, pulmonary congestive symptoms
Mitral regurgitation — physical exam

- Holosystolic Murmur
- Early diastolic Filling sound
- Loud P2

Timeline:
- S1
- S2
- S1
Mitral regurgitation - echocardiography

- Etiology of mitral regurgitation
- Quantification of mitral regurgitation
- Effects on left ventricle
  - LVEF
  - End-systolic diameter
Mitral valve prolapse
MITRAL REGURGITATION
SECONDARY MITRAL REGURGITATION: INCOMPLETE LEAFLET CLOSURE

NORMAL

LV

LA

AO

IMI or global LVD

Papillary Muscle Displacement

Mitral Valve Tethering

IMLC

MR
SECONDARY MITRAL REGURGITATION: INCOMPLETE LEAFLET CLOSURE
SECONDARY MITRAL REGURGITATION: INCOMPLETE LEAFLET CLOSURE
MITRAL REGURGITATION - ECHOCARDIOGRAPHY

- Regurgitant jet area
- Vena contracta
- Proximal isovelocity surface area (PISA)$\rightarrow$ effective regurgitant orifice (ERO) area
- Regurgitant volume
- Regurgitant fraction

Otto, Textbook of Clinical Echocardiography, 5th Ed
QUANTIFICATION OF MITRAL REGURGITATION: VENA CONTRACTA

Mild: < 0.3 cm

Severe ≥ 0.7 cm
QUANTIFICATION OF MITRAL REGURGITATION: PISA AND ERO

Flow Convergence Method

\[ \text{Reg Flow} = 2\pi r^2 \times V_a \]
\[ \text{EROA} = \frac{\text{Reg Flow}}{\text{PkV}_{\text{Reg}}} \]

Mild MR: EROA < 0.40 cm²

Severe MR: EROA ≥ 0.40 cm²
# Primary Mitral Regurgitation Stages

<table>
<thead>
<tr>
<th>Stage</th>
<th>Definition</th>
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</thead>
<tbody>
<tr>
<td>A</td>
<td>At risk of MR (mild MVP or mild leaflet thickening/restriction from radiation, connective tissue disorders, etc)</td>
<td>No MR jet or small jet area &lt; 20% LA Vena contracta &lt; 0.3 cm</td>
</tr>
</tbody>
</table>
| B     | Progressive MR | • Jet area 20-40% LA  
    • Vena contracta < 0.7 cm  
    • ERO < 0.40 cm² |
| C     | Asymptomatic severe MR | • Jet area > 40% LA  
    • Vena contracta ≥ 0.7 cm  
    • ERO ≥ 0.40 cm²  
    • PHTN may be present |
| C1    | LVEF > 60% and LVESD < 40 mm | • Jet area > 40% LA  
    • Vena contracta ≥ 0.7 cm  
    • ERO ≥ 0.40 cm²  
    • PHTN may be present |
| C2    | LVEF ≤ 60% and LVESD ≥ 40 mm | • Jet area > 40% LA  
    • Vena contracta ≥ 0.7 cm  
    • ERO ≥ 0.40 cm²  
    • PHTN present |
| D     | Symptomatic severe MR | • Jet area > 40% LA  
    • Vena contracta ≥ 0.7 cm  
    • ERO ≥ 0.40 cm²  
    • PHTN present |

MR = mitral regurgitation, LA = left atrium, ERO: effective regurgitant orifice, LVEF: left ventricular Ejection fraction, LVESD: LV end-systolic diameter, PHTN: pulmonary hypertension
Mitral regurgitation: echo follow-up

<table>
<thead>
<tr>
<th>Mitral Regurgitation Stage</th>
<th>Follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Progressive (Stage B)</td>
<td>Every 3-5 y for mild severity; every 1-2 y for moderate severity</td>
</tr>
<tr>
<td>Severe (Stage C)</td>
<td>Every 6-12 months. Dilated LV: more frequently</td>
</tr>
</tbody>
</table>

Rosenhek R. Circulation. 2006;113:2238-44
**Primary Mitral Regurgitation — Medical Therapy**

<table>
<thead>
<tr>
<th>Class IIA</th>
<th>Standard heart failure regimen for symptomatic patients with severe MR (stage D) and LVEF &lt; 60% <em>in whom surgery is not contemplated</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>Class III (no benefit)</td>
<td>Vasodilator therapy <em>not indicated</em> for normotensive asymptomatic patients with severe MR and normal LV systolic function (stages D and C1)</td>
</tr>
</tbody>
</table>
### Secondary Mitral Regurgitation — Medical Therapy

<table>
<thead>
<tr>
<th>Class</th>
<th>Treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class I</td>
<td>Standard heart failure regimen for symptomatic patients with severe MR (stage D) and reduced LVEF</td>
</tr>
<tr>
<td>Class I</td>
<td>Cardiac resynchronization therapy with biventricular pacing for symptomatic patients with severe MR (stages B to D) who meet the indication for device therapy</td>
</tr>
</tbody>
</table>

Mitral regurgitation – timing of intervention

Role of transcatheter mitral valve repair in primary MR: the MitraClip

Reasonable for stage D patients with:

- Favorable anatomy
- Symptomatic despite optimal medical tx
- Reasonable life expectancy BUT
- Prohibitive surgical risk

**Take Home Points**

- Physical exam is an essential tool in the primary care setting for early identification of asymptomatic severe valvular heart disease (VHD) and initiation of adequate follow-up.

- New VHD guidelines categorize four progressive stages from "at risk" to "symptomatic severe"- and lower the threshold for intervention in select patient populations.

- Transcatheter aortic valve replacement (TAVR) and other catheter-based procedures have expanded patient options but increased the difficulty of discerning the risk-benefit ratio.
THANK YOU
**Endocarditis prophylaxis (2008 update)**

**CLASS IIa**

1. Prophylaxis against infective endocarditis is reasonable for the following patients at highest risk for adverse outcomes from infective endocarditis who undergo dental procedures that involve manipulation of either gingival tissue or the periapical region of teeth or perforation of the oral mucosa (1070):

   - Patients with prosthetic cardiac valve or prosthetic material used for cardiac valve repair. *(Level of Evidence: B)*
   - Patients with previous infective endocarditis. *(Level of Evidence: B)*
   - Patients with CHD. *(Level of Evidence: B)*
     - Unrepaired cyanotic CHD, including palliative shunts and conduits. *(Level of Evidence: B)*
     - Completely repaired congenital heart defect repaired with prosthetic material or device, whether placed by surgery or by catheter intervention, during the first 6 months after the procedure. *(Level of Evidence: B)*
     - Repaired CHD with residual defects at the site or adjacent to the site of a prosthetic patch or prosthetic device (both of which inhibit endothelialization). *(Level of Evidence: B)*
<table>
<thead>
<tr>
<th>LEVEL A</th>
<th>LEVEL B</th>
<th>LEVEL C</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>Multiple populations evaluated</em>&lt;br&gt;Data derived from multiple randomized clinical trials or meta-analyses</td>
<td><em>Limited populations evaluated</em>&lt;br&gt;Data derived from a single randomized trial or nonrandomized studies</td>
<td><em>Very limited populations evaluated</em>&lt;br&gt;Only consensus opinion of experts, case studies, or standard of care</td>
</tr>
</tbody>
</table>

**Suggested phrases for writing recommendations**
- Should be performed/administered
- It is reasonable to perform procedure/administer treatment
- May/might be considered

**Comparative effectiveness phrases**
- Treatment/strategy A is recommended/indicated in preference to treatment B
- Treatment B should be chosen over treatment A

**Estimate of certainty (precision) of treatment effect**

- **CLASS I**<br>Benefit >> Risk<br>Procedure/Treatment SHOULD be performed/administered
- **CLASS IIa**<br>Benefit > Risk<br>Additional studies with focused objectives needed<br>IT IS REASONABLE to perform procedure/administer treatment
- **CLASS IIb**<br>Benefit ≥ Risk<br>Additional studies with broad objectives needed; additional registry data would be helpful<br>Procedure/Treatment MAY BE CONSIDERED
- **CLASS III No Benefit or CLASS III Harm**

**Correlation (COR III):**
- No Benefit<br>- Not Helpful<br>- No Proven Benefit
- Harm<br>- Excess Cost<br>- Harmful to Patients

**Remarks:**
- Recommendation that procedure or treatment is not useful/effective and may be harmful
- Sufficient evidence from multiple randomized trials or meta-analyses
- Recommendation that procedure or treatment is not useful/effective and may be harmful
- Evidence from single randomized trial or nonrandomized studies
- Recommendation that procedure or treatment is not useful/effective and may be harmful
- Evidence from single randomized trial or nonrandomized studies
- Recommendation that procedure or treatment is not useful/effective and may be harmful
- Only expert opinion, case studies, or standard of care

**Additional notes:**
- Treatment/strategy A is probably recommended/indicated in preference to treatment B
- It is reasonable to choose treatment A over treatment B
- Treatment/strategy A is probably recommended/indicated in preference to treatment B
- Should not be performed/administered/other
- It is not useful/beneficial/effective
Calcific Mitral Stenosis

- Calcification of the mitral annulus that extends into the leaflets (but no commissural fusion)
- Mean pressure gradient accurate but use of MVA from PHT is uncertain
- No role of PBMC (no commissural fusion)
- Mitral annular calcification can be challenging for the surgeon because attaching the prosthetic valve is difficult