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

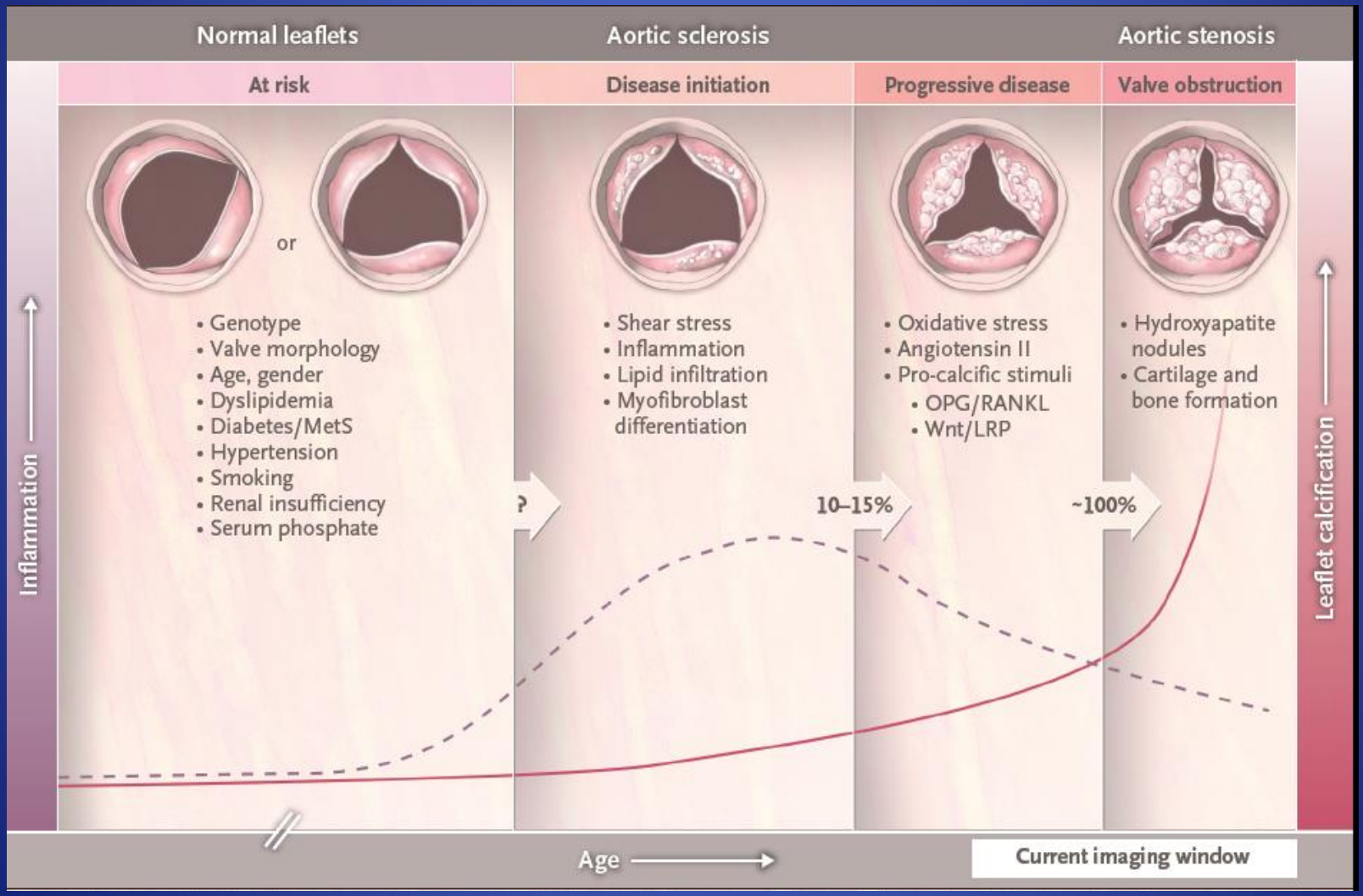
2014 ACC/AHA Valvular Heart Disease (VHD) Guidelines

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

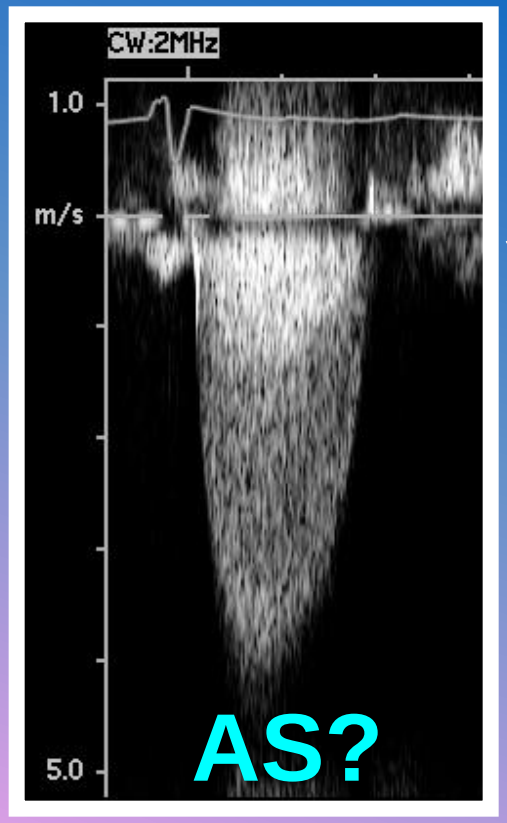
2014 ACC/AHA Valve Guidelines

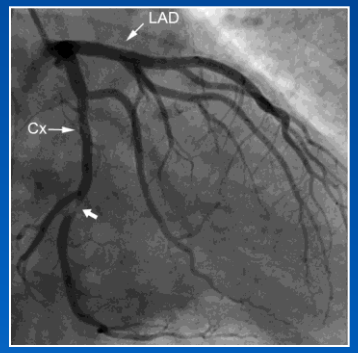
Concept of Valve Disease Stages

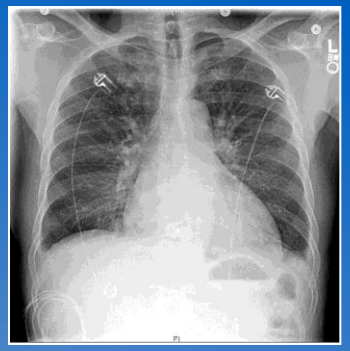
Stage	Definition	Description
A	At risk	Patients with risk factors for the development of VHD
B	Progressive	Patients with progressive VHD (mild-to-moderate severity and asymptomatic)
C	Asymptomatic severe	Asymptomatic patients who have reached the criteria for severe VHD
		C1: Asymptomatic patients with severe VHD in whom the left or right ventricle remains compensated
		C2: Asymptomatic patients who have severe VHD, with decompensation of the left or right ventricle
D	Symptomatic severe	Patients who have developed symptoms as a result of VHD

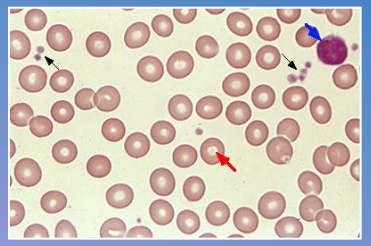
Why Measure Aortic Stenosis Severity ?

Ensure AS is the cause of symptoms



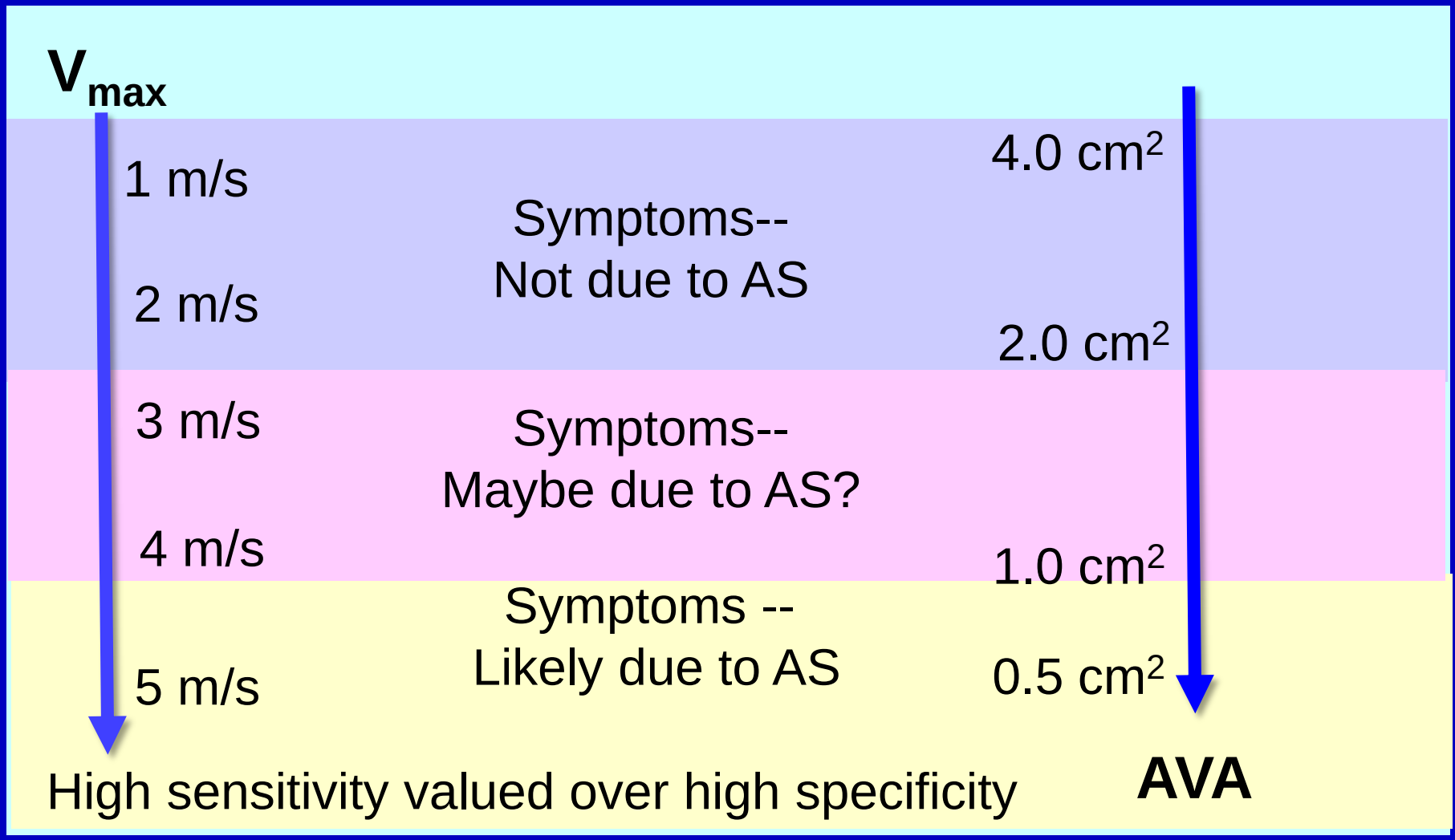




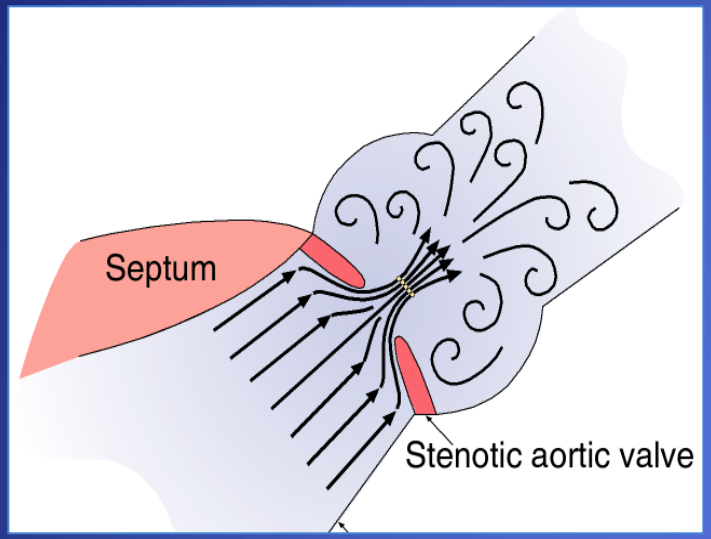


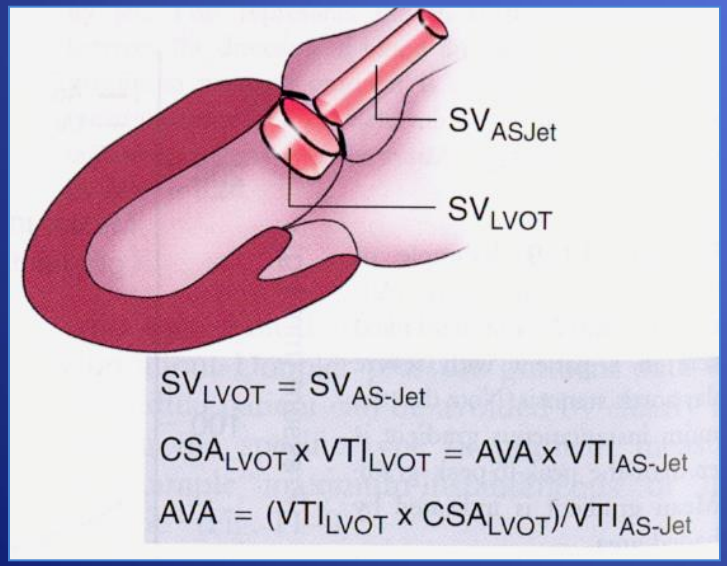
Aortic Stenosis Severity

Is AS severe enough to be the cause of symptoms?



Aortic Stenosis Severity





Optimal definition of severe stenosis ?

Jet velocity

V_{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)

Author, Year	Study Size (N)	Patient Population Inclusion Criteria	Exclusion Criteria	Pt. Age (y)	% Male	Follow-Up (mo)	AS Severity at Entry	Event-Free Survival	Cardiac Events	Multivariate Predictors of Clinical Outcome
Kelly, 1988 (39) 3337000	51	V_{max} ≥3.5 m/s Asymptomatic	Other valve disease	63±19	75%	17±0	ΔP 68±19 mm Hg	60% at 2 y	21 AS symptom onset 8 deaths (2 cardiac)	N/A
Pellikka, 1990 (40) 2312954	113	V_{max} ≥4.0 m/s Age≥40 y Asymptomatic	Other valve disease CAD Prior valve procedure Early aortic intervention	70 (40–94)	67%	20	V_{max} 4.3 (4–6) m/s	62% at 2 y	37 AS symptoms (20 with AVR) 14 deaths (6 cardiac)	V_{max} ≥4.5 m/s; RR: 4.9 (1.64–14.6) LVEF <50%; RR: 2.93 (0.84–10.2)
Kennedy, 1991 (41) 1991886	66	AVA 0.7–1.2 cm² at cath	Other valve disease Previous valve surgery	67±10	77%	35	AVA 0.92±0.13cm²	59% at 4 y	21 AVR (13 for symptoms) 14 deaths due to AS	LVEF <50%; RR: 1.94 (0.86–4.41). LV-end diastolic pressure >18 mm Hg RR: 2.71 (1.23–5.97). AVA index <0.5 cm² RR: 1.93 (0.89–4.23).
Otto, 1997 (21) 9142003	123	V_{max} >2.6 m/s Asymptomatic	Severe comorbid disease	63±16	70%	30	V_{max} <3 m/s V_{max} 3–4 m/s V_{max} >4 m/s	84% at 2 y 66% at 2 y 21% at 2 y	48 AVR for symptoms 8 deaths	V_{max} Functional status score Rate of change in V_{max}
Rosenhek, 2000 (24) 10965007	128	V_{max} ≥4.0 m/s Asymptomatic	Other valve disease	60±18	54%	22±18	V_{max} 5.0±0.7 m/s	67% at 1 y 56% at 2 y 33% at 4 y	59 AVR for symptoms 8 deaths	Extent of valve calcification RR: 4.6 (1.6–14.0).
Rosenhek, 2004 (25) 14972419	176	V_{max} 2.5–3.9 m/s LVEF >50% No AS symptoms	Other valve disease	58±19	59%	48±19	V_{max} 3.1±0.4 m/s	95% at 1 y 75% at 2 y 60% at 5 y	33 AVR for symptoms 34 deaths	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).
Pellikka, 2005 (42) 15956131	622	V_{max} ≥4.0 m/s No AS symptoms	Other valve disease CAD	72±11	62%	65±48	V_{max} 4.4 ±0.4 m/s	82% at 1 y 67% at 2 y 33% at 5 y	297 AS symptoms (AVR in 207 of these) 103 deaths without AVR or AS symptoms	AVA HR: 0.33 for a 1 cm² increase (95%CI: 0.15–0.71). LVH by ECG HR: 1.39 (95% CI: 1.02–1.89).
Rossebo, 2008 (26) 18765433	1,873	V_{max} 2.5 m/s to 4.0 m/s	CAD, CHF, diabetes mellitus, CVA, PVD, and other valve disease	68±9	59%	52 (median)	V_{max} 3.1±0.55	65% at 5 y	668 (36%) Major CV events (death, AVR, CHF, coronary events, and ischemic stroke)	No effect of statin therapy on major CV events.
Lancellotti, 2010 (43) 20483891	163	AVAi ≤0.6 cm²/m² No AS symptoms LVEF ≥55%	Nonsinus rhythm Other valve disease	70±10	65%	20±19	≤0.6 cm²/m²	50% at 2 y 44% at 4 y	11 symptoms, but no AVR 57 AVR 6 deaths	V_{max} ≥4.4 m/s, LV longitudinal deformation ≤15.9%, valvulo-arterial impedance ≥4.9 mm Hg/m², LA area

2014 ACC/AHA Valvular Heart Disease (VHD) Guidelines

Definitions of Disease Severity

Author, Year	Study Size (N)	Patient Population Inclusion Criteria	Exclusion Criteria	Pt. Age (y)	% Male	Follow-Up (mo)	AS Severity at Entry	Event-Free Survival	Cardiac Events	Multivariate Predictors of Clinical Outcome
										≥12.2 cm²/m²
Kang, 2010 (44) 20308614	95	AVA 0.75 cm² plus V_{max} ≥4.5 m/s or ΔP_{mean} ≥50 mm Hg No AS symptoms	LVEF <50% Other valve disease Age >85 y Malignancy Known CAD	63±12	46%	50	V_{max} 4.9±0.4	71±5% at 2 y 47±5% at 4 y 28±6% at 6 y	18 cardiac deaths 10 noncardiac deaths 46 AVR for symptoms	V_{max} ≥5 m/s age, male sex, EuroScore, degree of valve calcification.
Stewart, 2010 (45) 20513730	183	V_{max} >3 m/s LVEF >50% No AS symptoms	Other valve disease, ACS in previous 6 mo, LVOT obstruction, Respiratory disease, Renal dysfunction	70	65%	31 (median)	AVA 0.81 (IQR: 0.62–1.01) cm² V_{max} 3.8 (IQR: 3.3–4.4) m/s	Probability of symptom free survival at 3 y (95% CI) V_{max} <3.5 m/s 0.72 (0.61–0.84). V_{max} 3.5–4.0 m/s 0.46 (0.30 □ 0.62). V_{max} >4.0 m/s 0.32 (0.20–0.44).	103 AS symptoms 3 sudden death	V_{max} HR: 1.43 for each 0.5 m/s increase (95% CI: 1.25–1.64). AVA HR: 1.23 for each -0.1 cm² (95% CI: 1.12–1.35).
Rosenhek, 2010 (46) 20026771	116	V_{max} ≥5.0 m/s No AS symptoms	Other valve disease	67±15	49%	41 (median)	V_{max} 5.0–5.5 m/s V_{max} ≥5.5 m/s	43% at 2 y 25% at 2 y	90 AVR 6 cardiac deaths	V_{max}, but not AVA predicted outcome
Jander, 2011 (47) 21321152	435								183 AVR 17 HF 34 CV death	gradient "severe" AS defined as an AVA <1 cm² with ΔP_{mean} ≤40 mm Hg was **NOT** a predictor of clinical outcome
	184								82 AVR 4 HF death	
Saito, 2012 (48) 22497679	103								31 AVR 20 cardiac deaths	AVAi <0.6 cm²/m² (HR: 2.6; 95% CI: 11.1–6.3). V_{max} >4.0 m/s (HR: 2.6; 95% CI: 1.2–5.8). (AVA<0.75 cm² did not predict outcome) (Mean BSA 1.50±0.15 m²).

ACS indicates acute coronary sy…; CAD, coronary artery disease; CHF, congestive heart failure; CV, cardiovascular; CVA, cerebral va…, left atrium; LV, left ventricular, LVEF, left ventricular ejection fraction; LVOT, left ventricular outflow tract; N/A, not…sk; SEAS, Simvastatin Ezetimibe in Aortic Stenosis study; V_{max}, maximum velocity.

Multivariate predictors

of symptom onset (normal flow):

- Aortic velocity
- Not AVA

2014 ACC/AHA Valvular Heart Disease (VHD) Guidelines

Aortic Stenosis Disease Stages

Stage	Definition	Valve anatomy and hemodynamics
A	At risk for AS	Bicuspid valve, aortic sclerosis
B	Progressive AS	Mild AS V_{max} 2.0–2.9 m/s, Mean ΔP < 20 mm Hg Mod AS V_{max} 3.0–3.9 m/s, Mean ΔP 20-39 mm Hg (Typically AVA >1.0 cm^2)
C	Asymptomatic severe AS	Severe AS V_{max} ≥ 4.0 m/s, Mean ΔP ≥40 mm Hg (Typically AVA ≤1.0 cm^2) Very severe AS V_{max} ≥ 5.0 m/s, Mean ΔP ≥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)

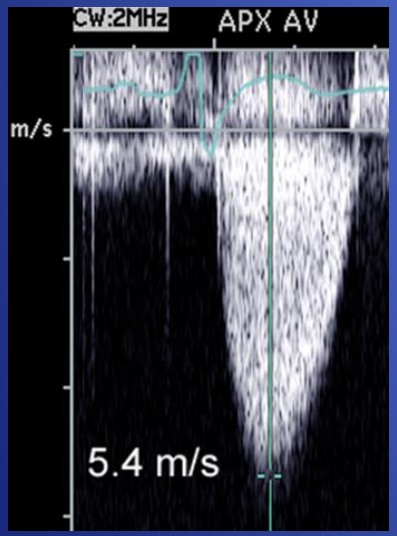
2014 ACC/AHA Valvular Heart Disease (VHD) Guidelines

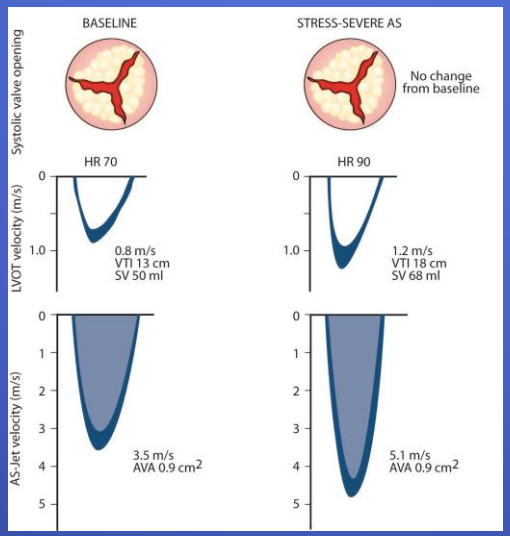
Symptomatic Severe Aortic Stenosis

ECHO

$V_{max} \geq 4$ m/s

$V_{max} < 4$ m/s
AVA ≤ 1 cm2
EF < 50%





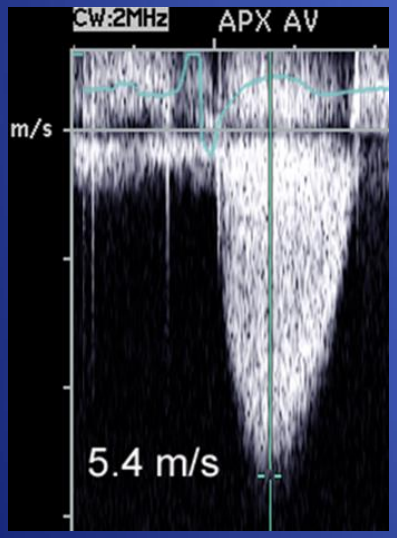
D1 High Gradient

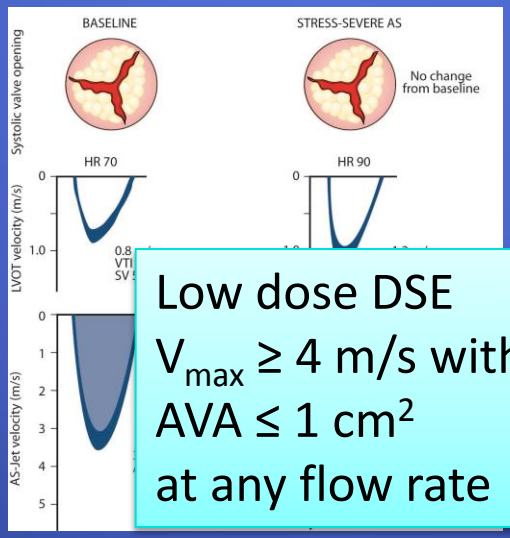
2014 ACC/AHA Valvular Heart Disease (VHD) Guidelines

Symptomatic Severe Aortic Stenosis

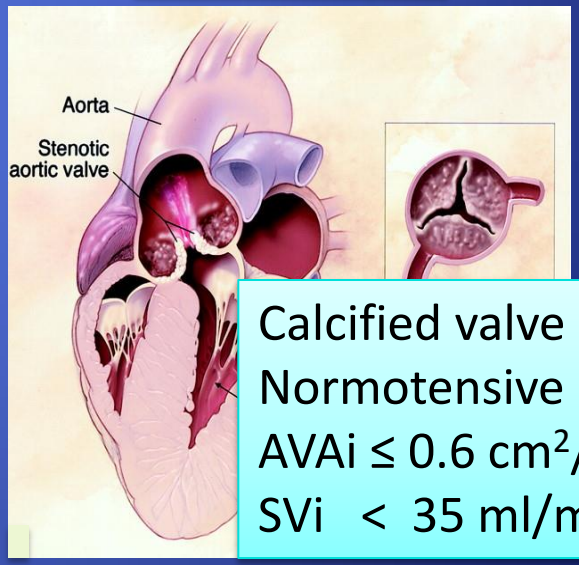
ECHO

$V_{max} \geq 4$ m/s	$V_{max} < 4$ m/s AVA ≤ 1 cm2 EF < 50%	$V_{max} < 4$ m/s AVA ≤ 1 cm2 EF ≥ 50%





Low dose DSE
$V_{max} \geq 4$ m/s with
AVA ≤ 1 cm^2
at any flow rate

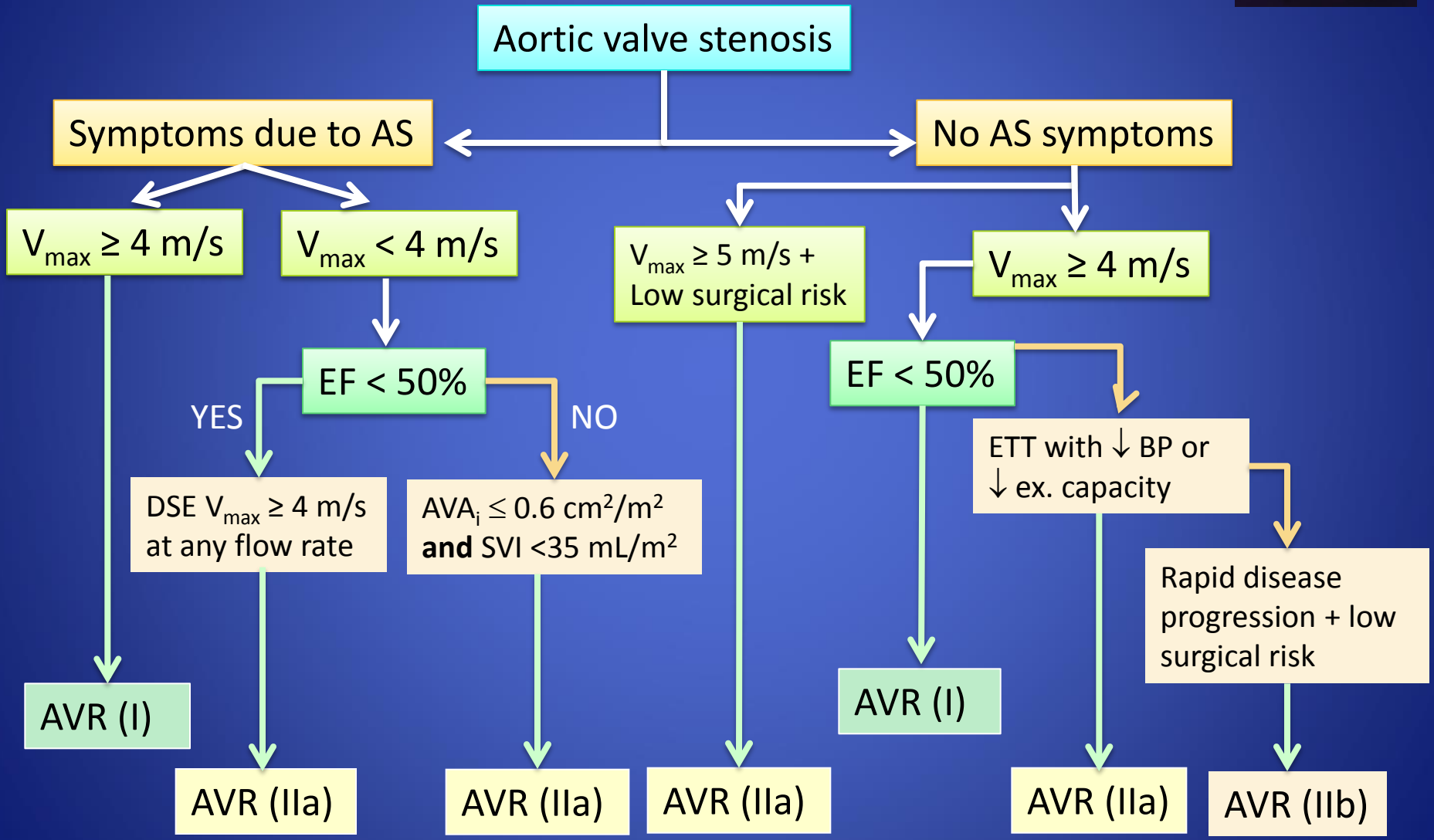


Calcified valve
Normotensive
AVAi ≤ 0.6 cm^2/m^2
SVi < 35 ml/m^2

D1 High Gradient **D2 LFLG Low EF** **D3 LFLG Normal EF**

2014 ACC/AHA Valve Guidelines

TIMING of Intervention for AS



2014 ACC/AHA Valve Guidelines

INTERVENTION FOR AORTIC STENOSIS

TIMING of Intervention

↓

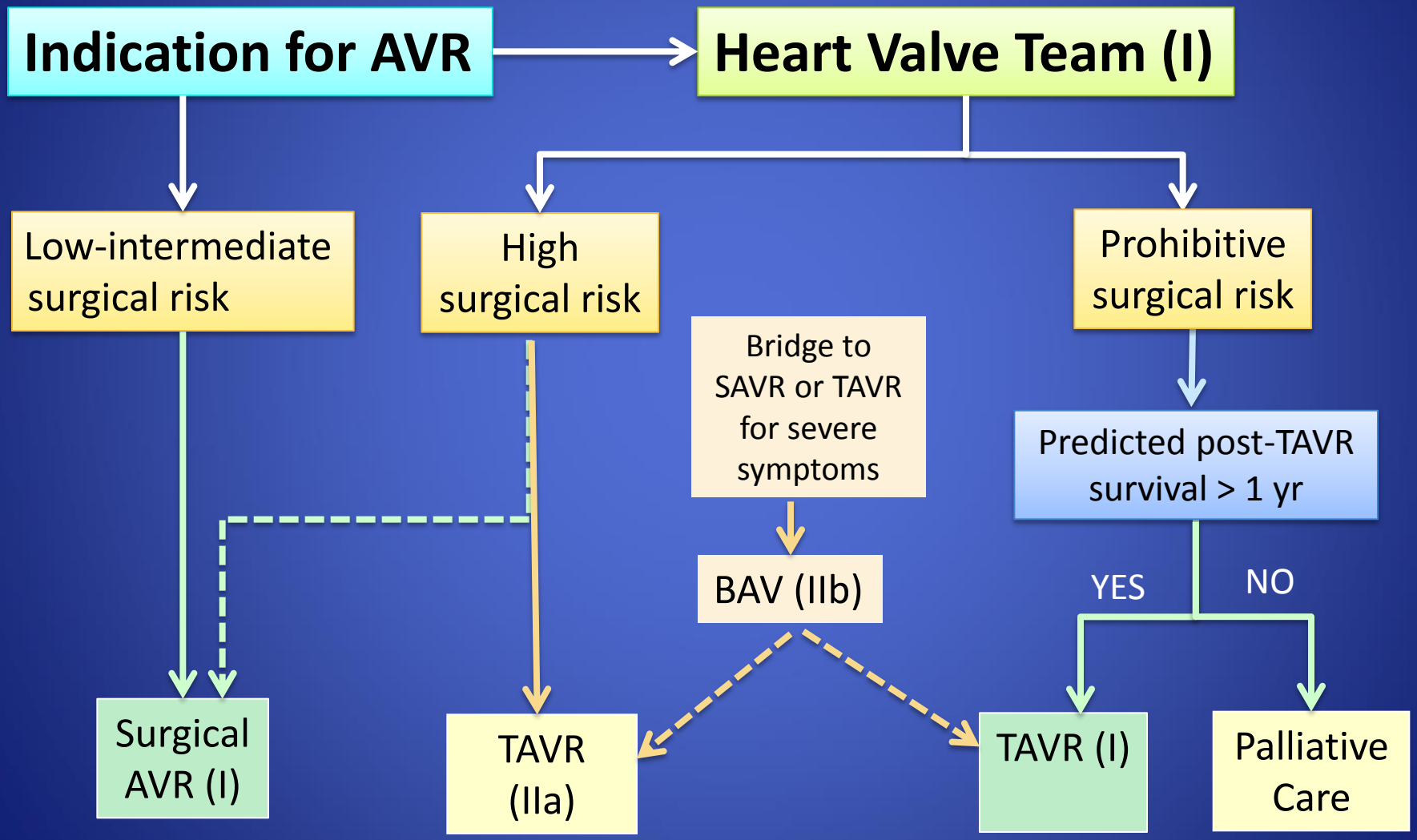
CHOICE of Intervention

Valve Type

Surgical vs Transcatheter

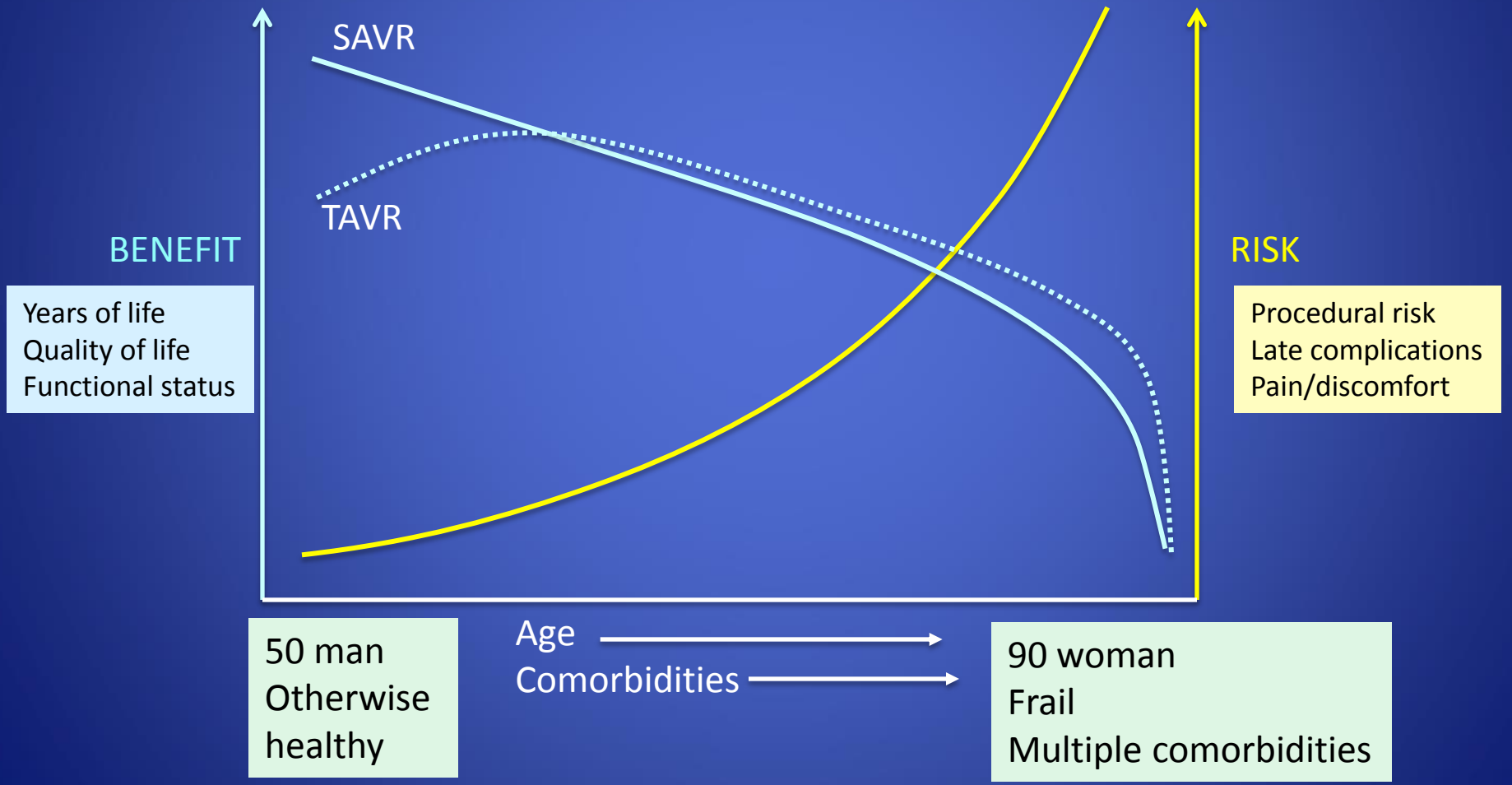
2014 ACC/AHA Valve Guidelines

CHOICE of Intervention for AS



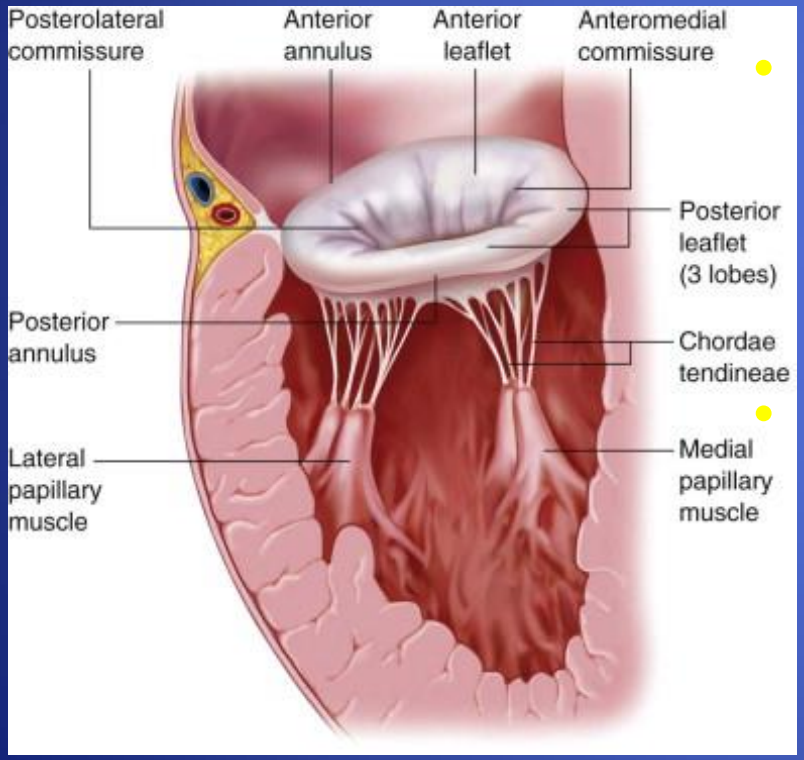
Conceptual Framework

Management of Aortic Stenosis



2014 ACC/AHA Valve Guidelines

Causes of Chronic Mitral regurgitation



- **Primary mitral valve disease**
  - Myxomatous (MVP)
  - Rheumatic
- **Secondary (functional) regurgitation**
  - Ischemic
  - Dilated cardiomyopathy

Otto CM Textbook of Clinical Echocardiography, 5th Edition, 2013.

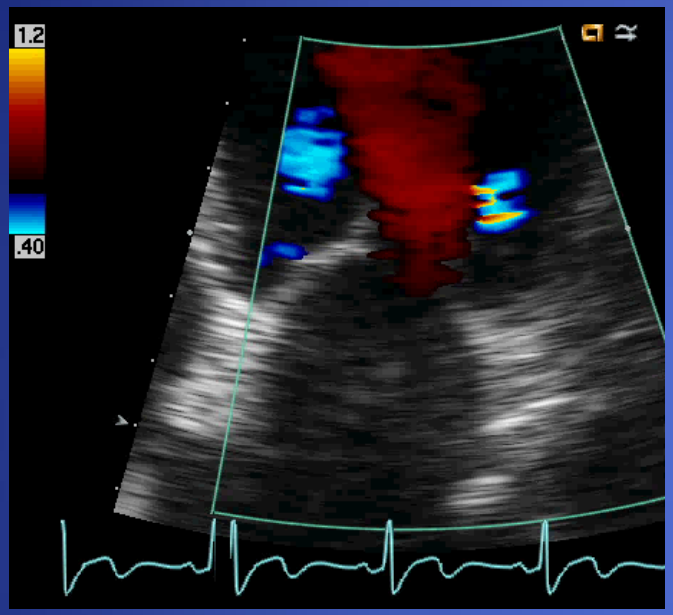
2014 ACC/AHA Valve Guidelines

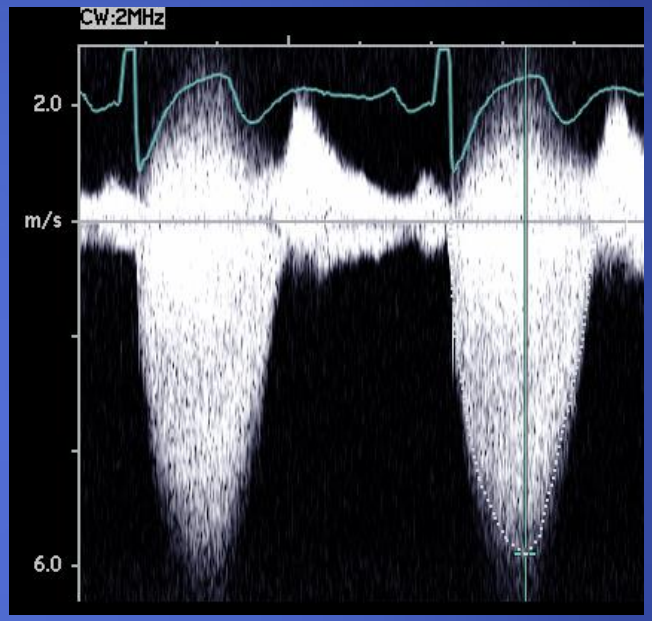
Stages of Chronic **Primary** Mitral Regurgitation

Stage		Anatomy	Hemodynamics	Left ventricle
A	At risk (asymptomatic)	MVP	No to trace MR	Normal
B	Progressive (asymptomatic)	Severe MVP Rheumatic Endocarditis	Mild to moderate MR: Vena contracta < 0.7 cm ERO < 0.4 cm^2, RV< 60 ml, Angio 1- 2+	Normal LV volumes Normal LV EF Mild LA, Normal PAP
C	Asymptomatic Severe MR	Severe MVP +/- flail Severe rheumatic Endocarditis Radiation	Severe MR Vena contracta ≥ 0.7 cm ERO ≥ 0.4 cm^2, RV ≥ 60 ml, Angio 3-4+	**C1:** LV EF > 60% with LV ESD < 40 mm **C2:** LV EF ≤60% or LV ESD ≥40 mm
D	Symptomatic Severe MR		Severe MR Vena contracta ≥ 0.7 cm ERO ≥ 0.4 cm^2, RV ≥ 60 ml, Angio 3-4+	LV dilation Pulmonary hypertension Moderate to severe LA

2014 ACC/AHA Valve Guidelines

Valve hemodynamics with severe primary MR

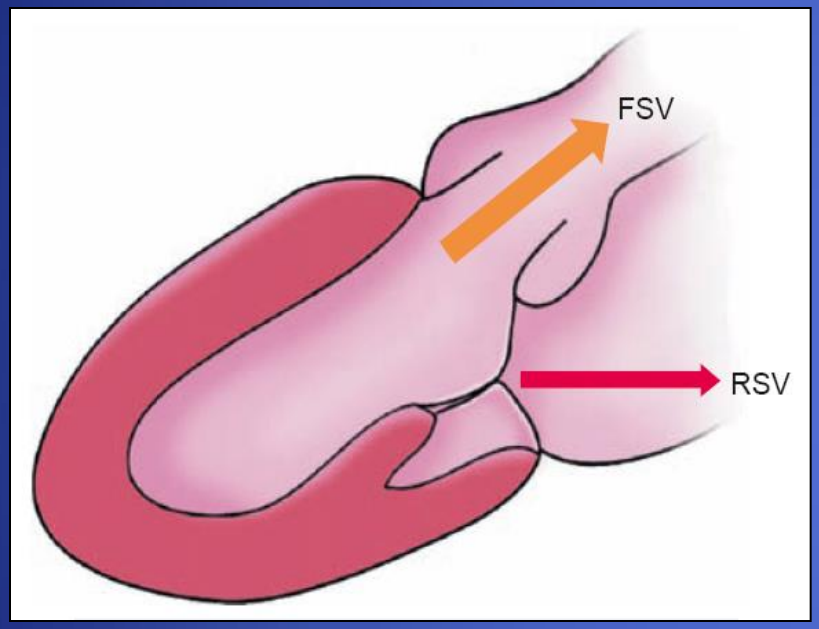


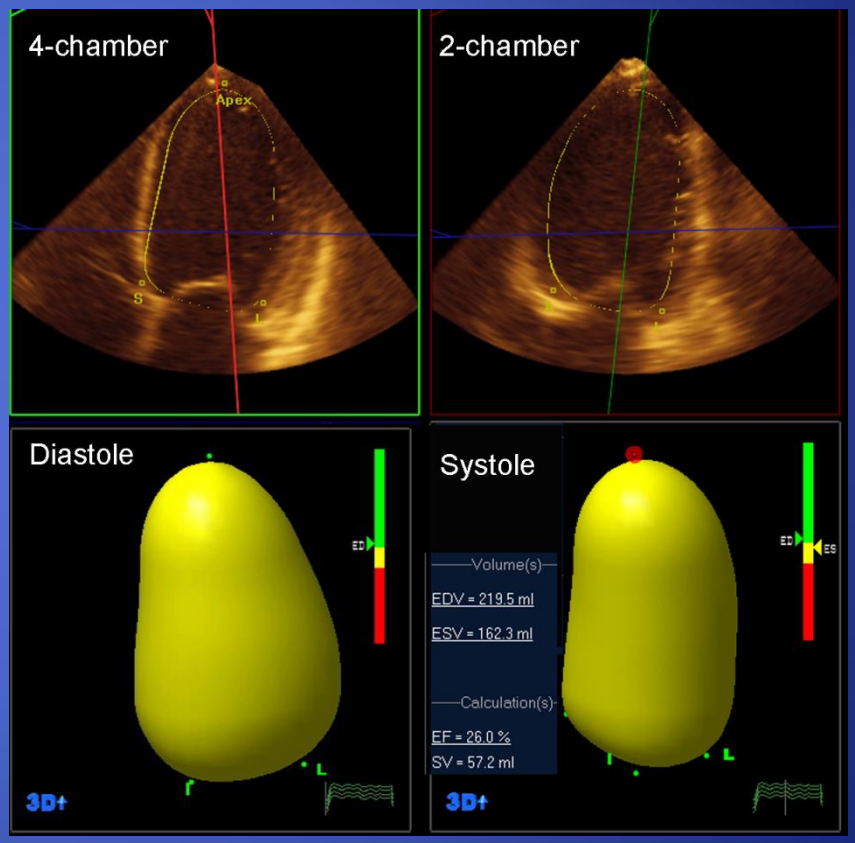


- Central jet MR >40% LA or holosystolic eccentric jet MR
- Vena contracta ≥0.7 cm
- Regurgitant volume ≥60 mL
- Regurgitant fraction ≥50%
- ERO ≥0.40 cm^2
- Angiographic grade 3–4+

2014 ACC/AHA Valve Guidelines

LV Response to Chronic Volume Overload

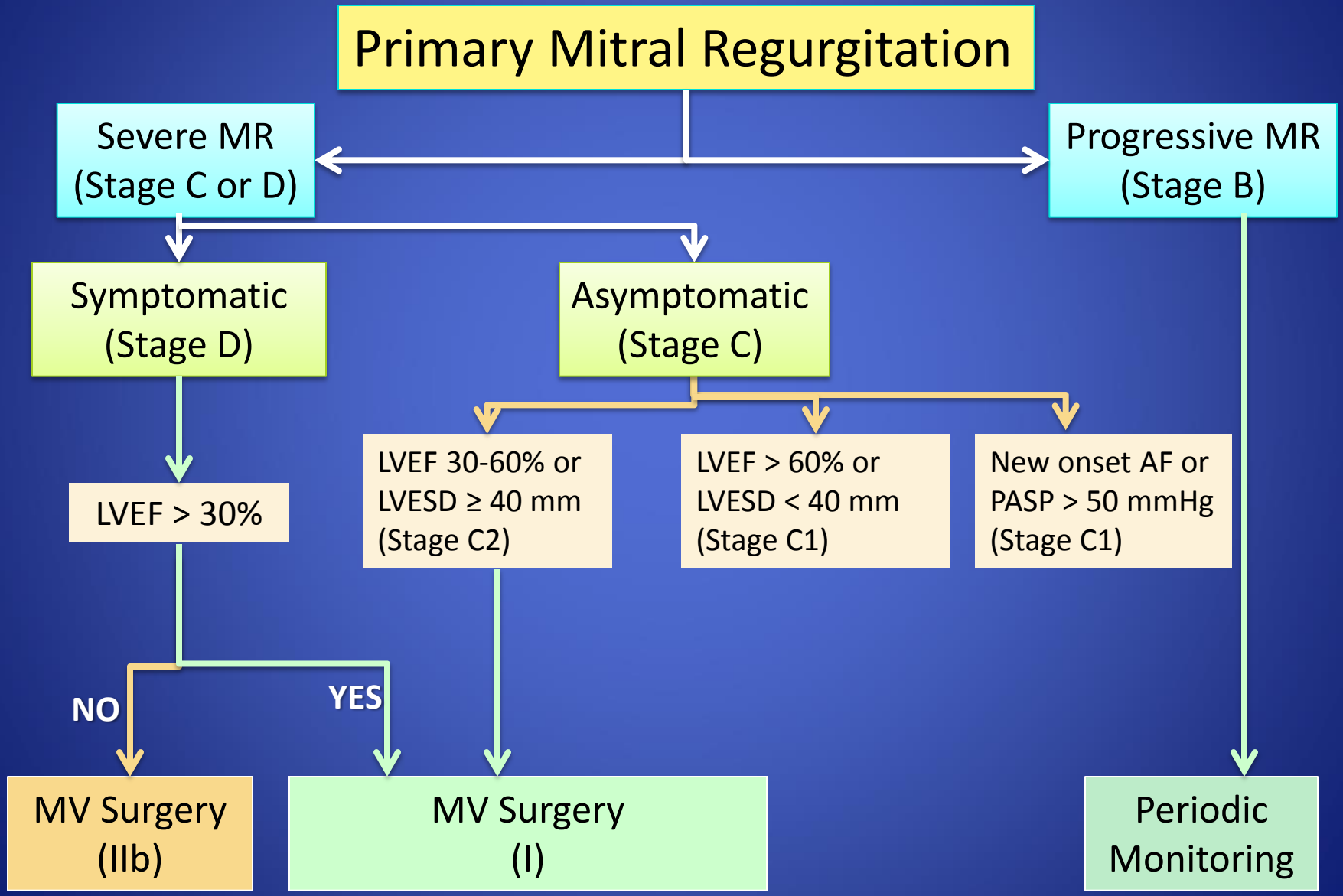




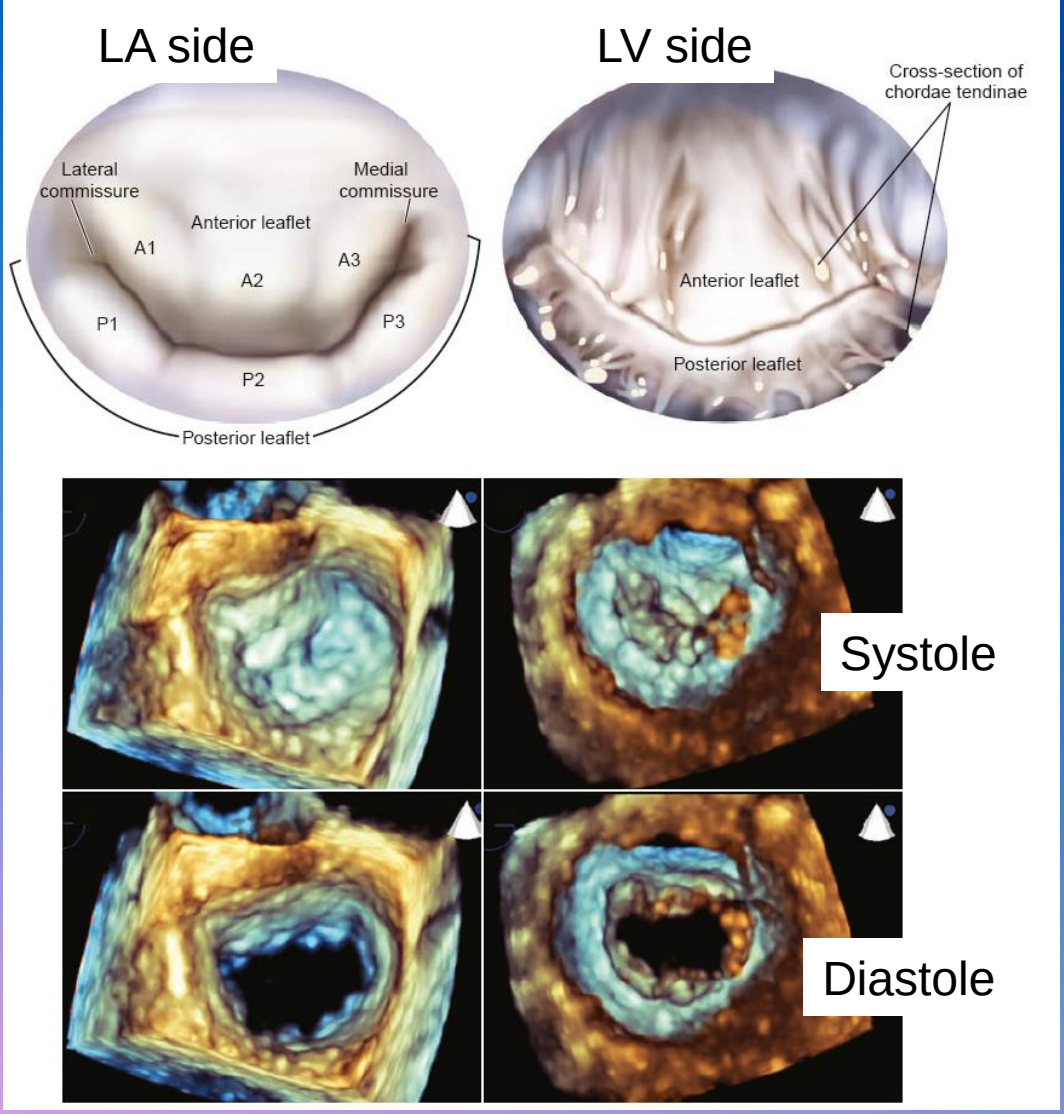
LV Size and Systolic Function

- Echo
- MRI

2014 ACC/AHA Valve Guidelines: Indications for Surgery



3D Anatomy Mitral Valve

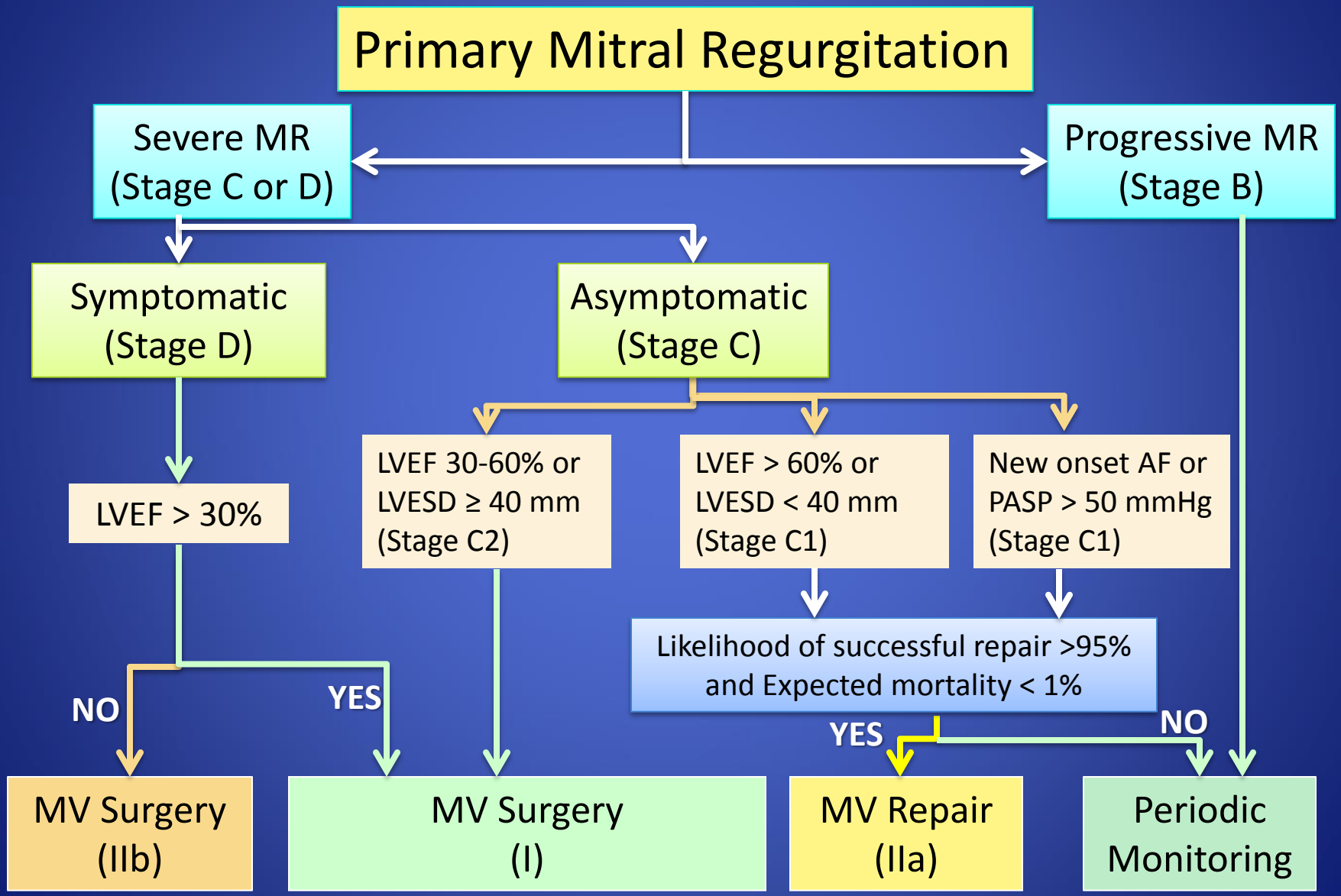


3D Echo:
Leaflet anatomy
Prolapse
Chordal rupture

Amenable to:
Valve repair?
Transcatheter procedure?

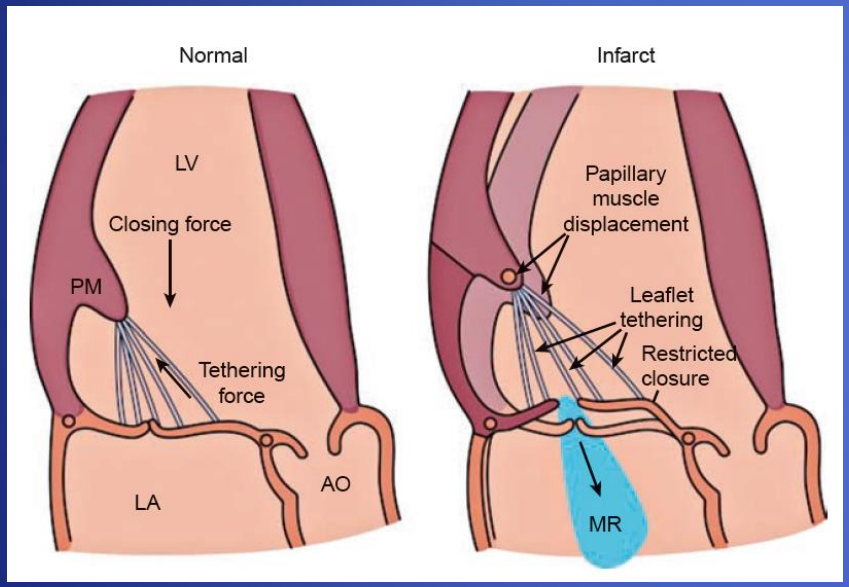
Otto,
Textbook of Clinical Echocardiography,
5th Ed. 2013

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

Liel-Cohen N, Guerrero JL, Otsuji Y, et al: Circulation 101[23]:2756-2763, 2000.

2014 ACC/AHA Valve Guidelines

Stages of Chronic **Secondary** MR

Stage		Anatomy	Hemodynamics/LV	Symptoms
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 cm^2 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 Annular dilation	Severe MR ERO ≥ 0.2 cm^2 RV ≥ 50 ml RF ≥ 50%	Symptoms may respond to Rx for coronary ischemia or HF
D	Symptomatic Severe MR		Severe MR ERO ≥ 0.2 cm^2 RV ≥ 50 ml RF ≥ 50%	HF symptoms persist after revascularization and medical therapy

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Indications for Surgery

Secondary Mitral Regurgitation

CAD Rx
HF Rx
Consider CRT

Symptomatic Severe MR (Stage D)	Asymptomatic Severe MR (Stage C)	Progressive MR (Stage B)
MV Surgery (IIb)	Periodic Monitoring	

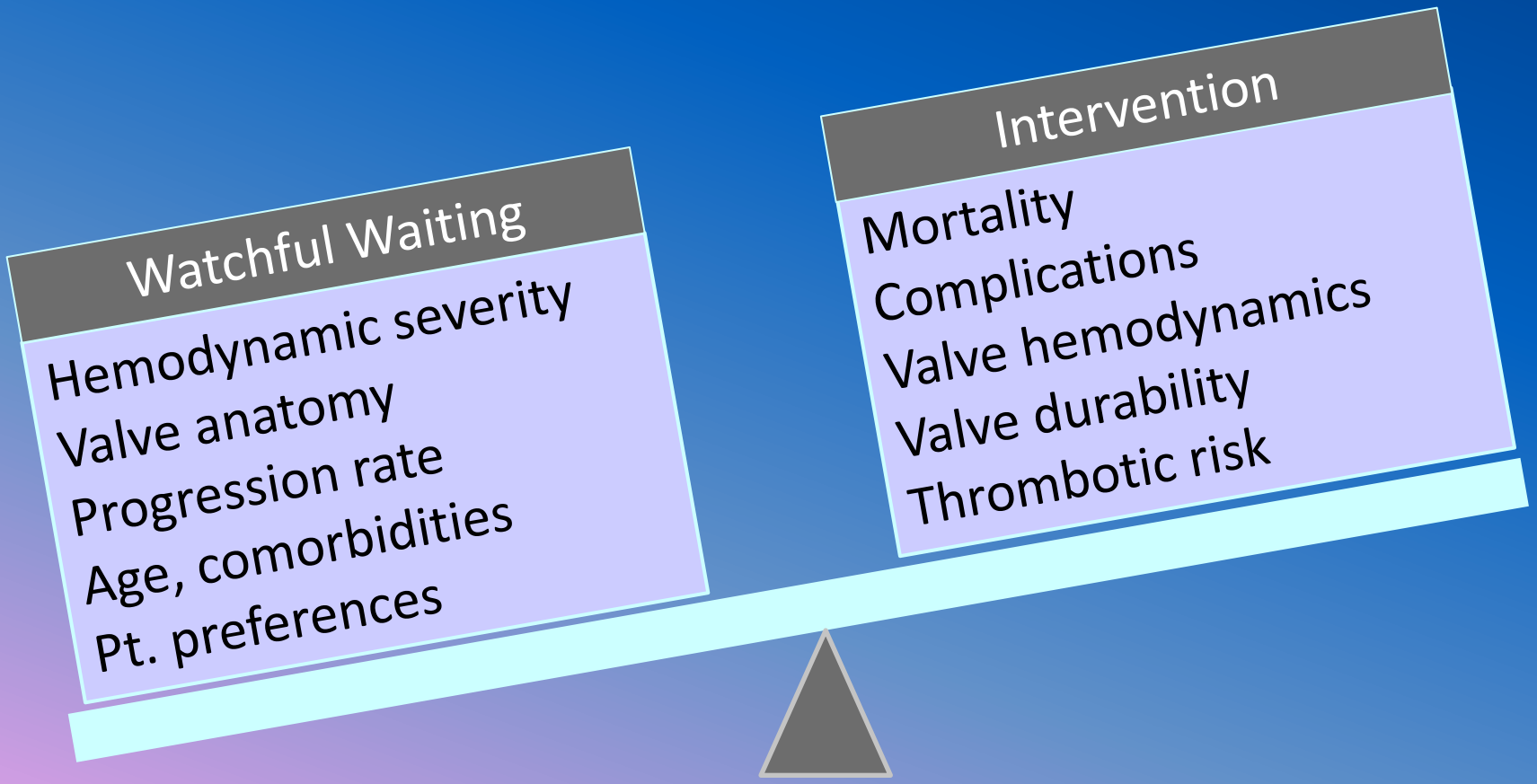
ACC/AHA Valve Guidelines

Balance between waiting and intervention

Watchful Waiting	Intervention
Hemodynamic severity	Mortality
Valve anatomy	Complications
Progression rate	Valve hemodynamics
Age, comorbidities	Valve durability
Pt. preferences	Thrombotic risk

ACC/AHA Valve Guidelines

Balance between waiting and intervention



ACC/AHA Valve Guidelines

Balance between waiting and intervention

Watchful Waiting	Intervention
Hemodynamic severity	Mortality
Valve anatomy	Complications
Progression rate	Valve hemodynamics
Age, comorbidities	Valve durability
Pt. preferences	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