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ACP Board Review Course

Cardiology Board Review: Valve Disease

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Adult Congenital Heart Disease Program

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UW Medicine
HEART INSTITUTE

UNIVERSITY of WASHINGTON

Seattle Children's
HOSPITAL • RESEARCH • FOUNDATION

Disclosures

- No related disclosures

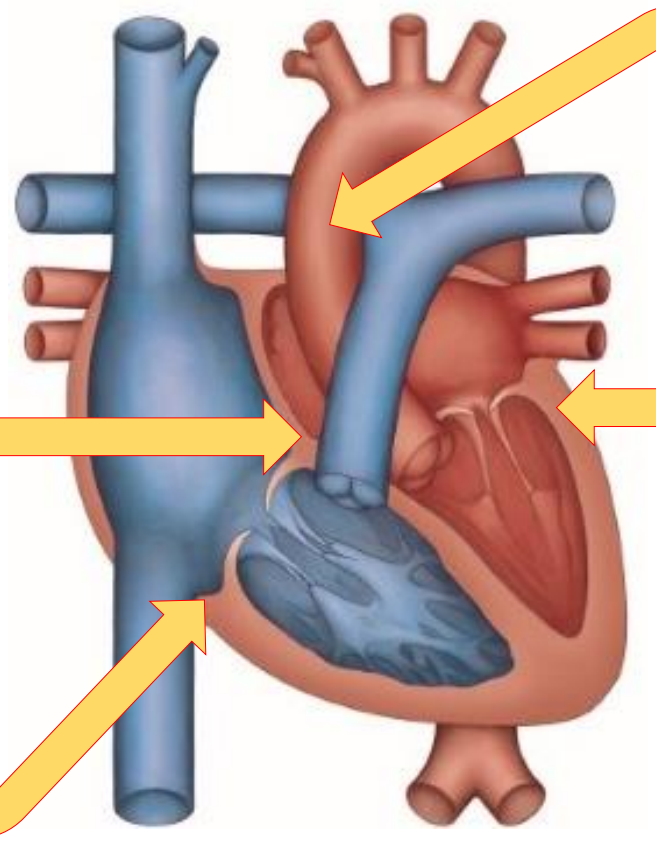
Objectives

- Review major types of valve disease
- Discuss impacts of infective endocarditis
- Considerations for prosthetic valves

Objectives

Infective Endocarditis

Prosthetic Valves



Aortic Stenosis

Aortic Regurgitation

Pulmonic Disease

Tricuspid Disease

Mitral Stenosis

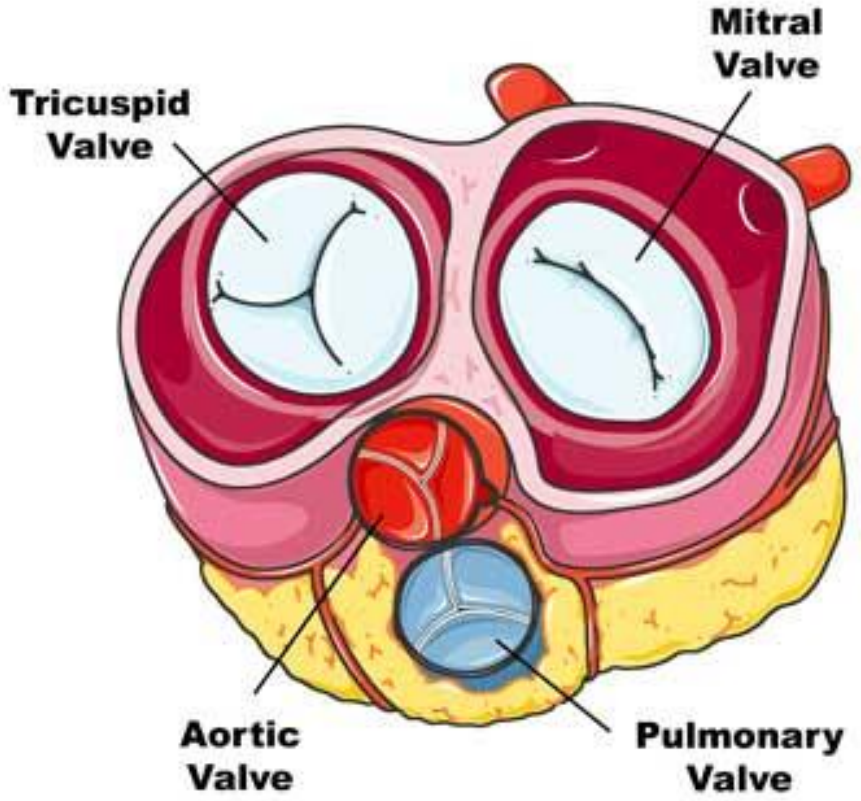
Mitral Regurgitation

Childrensmercy.org

Valve Disease: Assessment

- Physical exam
- ECG
- Echocardiogram: TTE +/- TEE

- Chest X-ray
- Exercise testing
- Cardiac catheterization
- CT or MRI



Heart-valve-surgery.com

A 79 yo patient arrives for a wellness visit. They have no significant past medical history and no specific concerns today. They deny angina or dyspnea on exertion. On physical exam, a grade 3/6 systolic murmur is noted on the right upper sternal border. There is a delayed carotid upstroke. Echo reveals severe aortic stenosis with a valve area of 0.6cm^2 and normal LVEF. What would you recommend?

A) Begin ACE inhibitor
B) Begin beta blocker
C) Repeat echo in 6-12 months
D) Refer for coronary angiogram (only)
E) Refer for aortic valve replacement

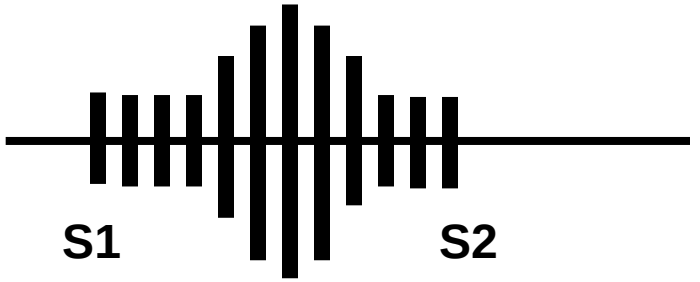
Q1

Aortic Stenosis: Clinical Presentation

Symptoms	Stage	Prognosis
No symptoms (most common)	A (at risk for AS)	Varies
	B (mild/moderate AS)	Progression of ~0.3m/s per year
	C1 (severe AS)	With onset of severe AS, event-free survival rate of 30 - 50% at 2 yrs 5-3-1
	C2 (severe + LV dysfn)	
Exertional symptoms	D1 (high gradient)	
Rest symptoms -Angina -Syncope -Heart Failure	D2 (low gradient)	
	D3 (low gradient+)	

Severe Aortic Stenosis: Physical Exam

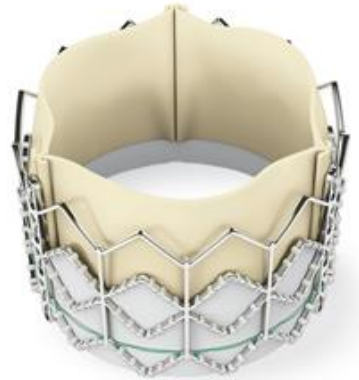
- Late-peaking systolic murmur
  - May be soft if low cardiac output
- Loudest RUSB
- Radiation to carotid arteries
- Delayed/diminished carotid upstroke



Severe AS unlikely if normal split S2 & murmur is soft

Aortic Stenosis: Treatment

- Medical management
- Symptomatic severe AS +/- LV dysfunction:
  - Valve replacement (surgery vs TAVR)
- Asymptomatic severe AS:
  - Consider valve replacement
- Avoid: vasodilators



Surgery.arizona.edu; myheart.net

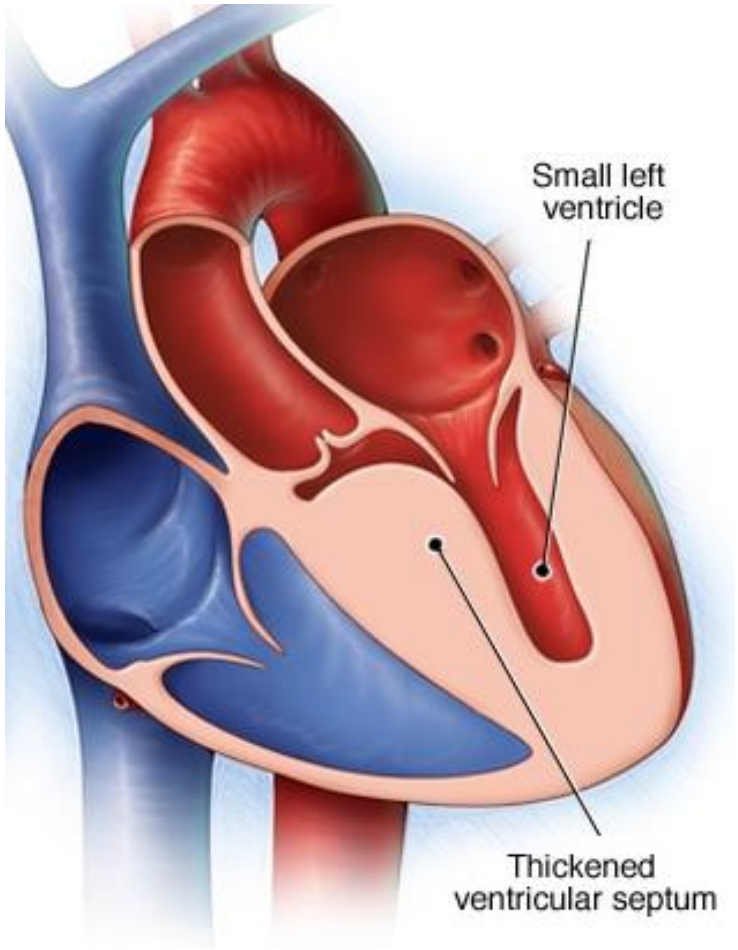
A 29 yo patient is evaluated for syncope. They were playing basketball with friends when they collapsed. They report a prior episode of syncope one year ago while working outside in 90-degree heat. On physical exam, blood pressure is 128/90, pulse 88. There is a systolic ejection murmur which increases with Valsalva. The carotid pulse is short and brisk. What diagnosis is most likely?

A) Hypertrophic cardiomyopathy
B) Aortic stenosis (bicuspid valve)
C) Rheumatic heart disease
D) Constrictive pericarditis
E) Right ventricular dysplasia

Q2

Hypertrophic Cardiomyopathy

- Presentation can mimic AS!!!
- Clinical manifestations:
  - Palpitations, angina, syncope, sudden death, heart failure
- Systolic ejection murmur,
  - Loudest with preload-reducing maneuvers (Valsalva), softer with increased preload (stand-to-squat)
- May also have a mitral regurgitation murmur (SAM)



Mayoclinic.org

Hypertrophic Cardiomyopathy

- Familial (autosomal dominant) vs sporadic
  - Most common genes: beta myosin heavy chain 7 (MYH7) & myosin-binding protein C3 (MYBPC3)
- Equal sex distribution, but more common dx in men
- Management:
  - Avoid volume depletion
  - B-blockers, Ca++ channel blockers, disopyramide
  - Surgery
  - Defibrillator
  - <novel therapeutics>

A 46 yo patient presents for a physical exam. They feel well and report no symptoms. On exam, there is a diastolic murmur at the right upper sternal border. BP 105/48. An echo reveals aortic insufficiency with left ventricular end diastolic dimension 66mm, end systolic dimension 52mm, and systolic ejection fraction of 58%. What do you recommend?

A) Repeat echo in 1 year
B) Aortic valve replacement
C) Begin digoxin
D) Begin ACE Inhibitor
E) Cardiac catheterization

Q3

Aortic Insufficiency (Regurgitation): Etiology

- Bicuspid aortic valve
- Aortic root disorders
- Rheumatic disease
- Infection
- Degeneration (myxomatous)

Connective tissue diseases
Aortic dissection
Cystic medial necrosis
Syphilis

Aortic Insufficiency: Clinical Presentation

Symptoms	Stage	Prognosis
No symptoms	A (at risk for AI)	Varies
	B (mild/moderate AI)	
	C (severe AI)	
Symptoms	D (severe AI)	

Aortic Insufficiency: Physical Exam

- Wide pulse pressure
- Bounding peripheral pulse
- Head bob/nodding
- Capillary pulsation (Quincke's pulse)
- Early, high-pitched diastolic murmur (LSB)
  - Systolic flow murmur
  - Apical diastolic murmur (Austin-Flint)

Aortic Insufficiency: Treatment

- Medical management
- Symptomatic severe AI +/- LV dysfunction:
  - Valve replacement (surgery vs TAVR)
- Asymptomatic severe AI:
  - Consider valve replacement

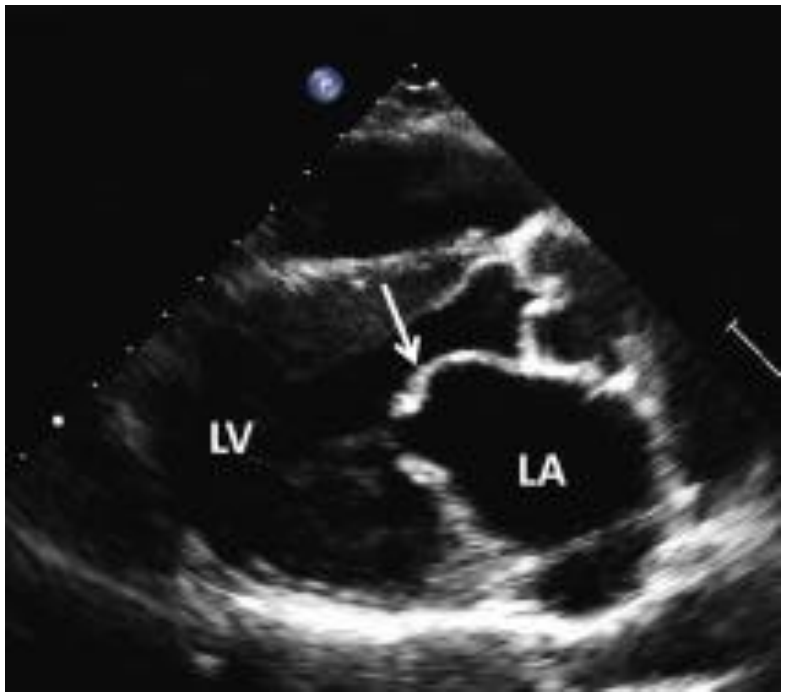
A 52 yo patient presents for evaluation for mitral valve calcification, left atrial enlargement, and pulmonary venous congestion identified on a chest x-ray done for a positive PPD. They deny any infectious symptoms. Which cardiac finding is most likely present?

A) Rumbling, apical diastolic murmur that intensifies just before S1
B) Systolic murmur at the right sternal border radiating to the right carotid
C) Mid-systolic click followed by a 1/6 systolic murmur
D) Diastolic decrescendo murmur at the left sternal border
E) Early systolic murmur at the right sternal border

Q4

Mitral Stenosis: Etiology

- (Rare, but) usually due to rheumatic disease
- Most cases in US are in immigrant populations and/or in people over age 50
- Identified during pregnancy or periods of stress
- Atrial fibrillation is common
  (elevated left atrial pressure)



Saxena. *Global Heart*. 2013.

Mitral Stenosis: Signs & Symptoms

- Same A/B/C/D staging as AI
- Left heart failure: dyspnea on exertion, PND
- Pulmonary hypertension
- Loud S2 with opening snap, rumbling diastolic murmur (can be pre-systolic)
- Left atrial enlargement on ECG (“p mitrale”)

Mitral Stenosis: Treatment

- Medical management
  - Heart rate control, anticoagulation
- Symptomatic, severe rheumatic MS
  - Percutaneous balloon valvuloplasty
  - Surgery (repair, replacement)
- Asymptomatic, severe rheumatic MS + AF or PH
  - Consider intervention
- Nonrheumatic calcific MS: consider valvuloplasty

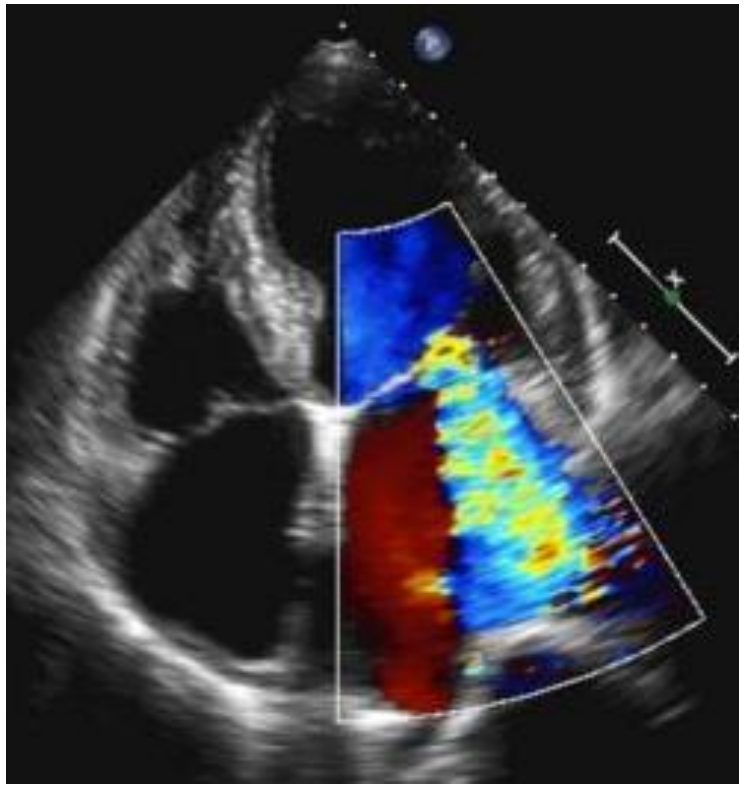
A 50 yo patient with diabetes presents to the ER with chest pain x 1 day. ECG reveals inferior STEMI. They receive urgent percutaneous coronary intervention with placement of 2 stents in the RCA. Forty-eight hours later, the patient becomes acutely dyspneic, with pulmonary edema requiring biPAP. HR 120bpm, BP 90/60mmHg, JVP 8cm. What is the most likely cause of this patient's decompensation?

A) Pneumothorax
B) Pericardial tamponade
C) Ruptured papillary muscle
D) Severe aortic stenosis

Q5

Mitral Regurgitation: Etiology

- Acute: Infection, chordal or papillary muscle rupture
- Chronic:
  - Primary: Degeneration, mitral valve prolapse, connective tissue disease, rheumatic disease
  - Secondary: LV dilation, coronary disease



Myheart.net

Mitral Regurgitation: Signs & Symptoms

- Same A/B/C/D staging as AI, MR
- Left heart failure: dyspnea on exertion, PND
- Pulmonary hypertension
- Blowing holosystolic murmur, radiates to the axilla
- Left atrial enlargement on CXR, ECG (“p mitrale”)

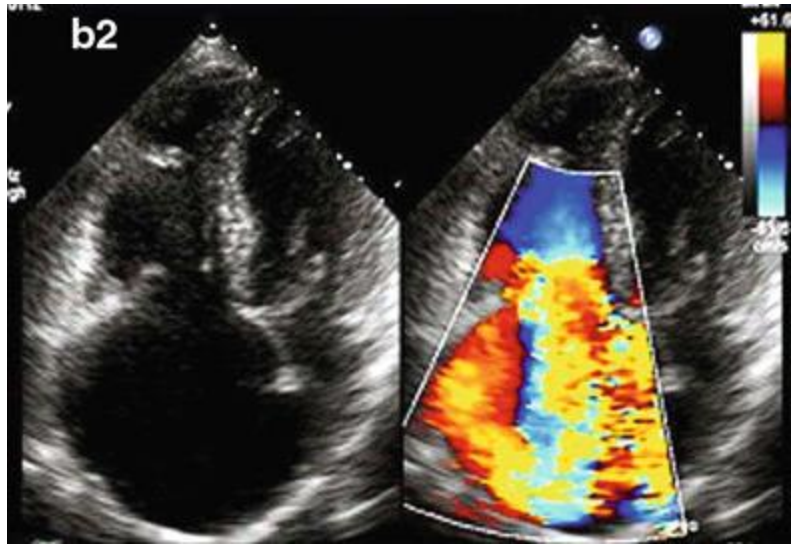
Mitral Regurgitation: Treatment

- Medical management
- Symptomatic, severe 1’ MR +/- LV dysfn
  - Surgery (repair > replacement)
- Asymptomatic, severe 1’ MR + LV dysfn
  - Surgery (repair > replacement)
- Consider transcatheter edge-to-edge repair (clip) if 2’ MR or surgery unfavorable

Tricuspid Valve Disease

- 1’: rheumatic, infection, congenital
- 2’: PHTN, cardiomyopathy, shunts
- Stages of tricuspid regurgitation:

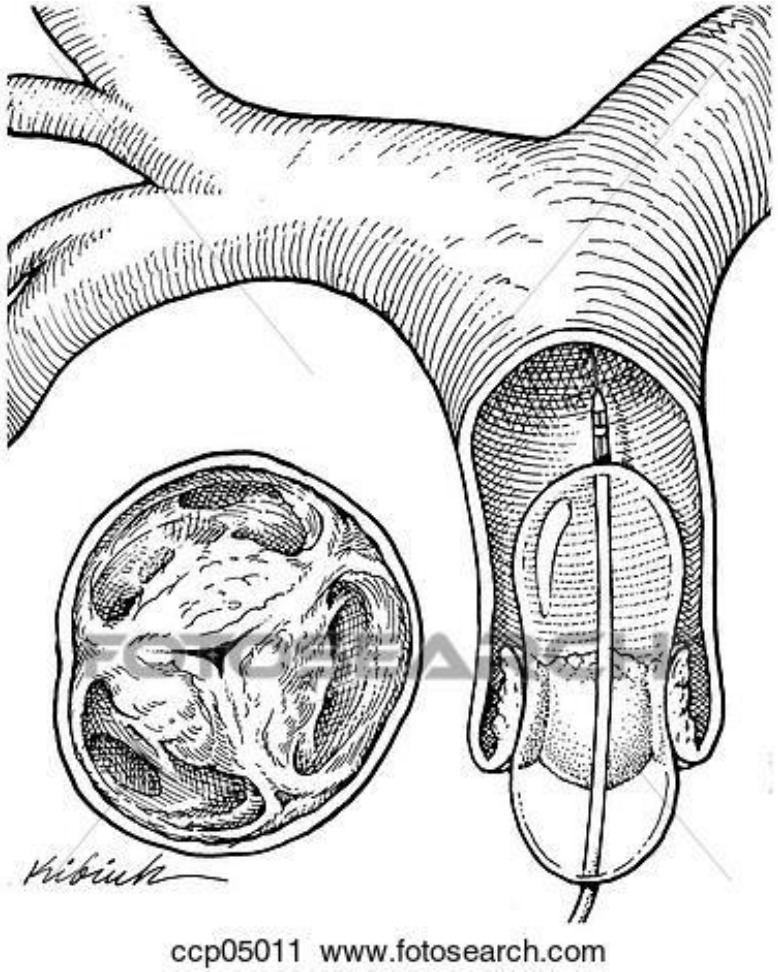
  B, C, D (no A)
- Diuretics, treat underlying cause
- Symptomatic, severe: consider surgery (repair vs replacement)



Researchgate.net

Pulmonic Valve Disease

- Not addressed in Valve guidelines
- Congenital (most common), infection
- Symptomatic, severe stenosis:
  - Balloon valvuloplasty
  - Surgical repair
- Otherwise, intervention depends on specific circumstance

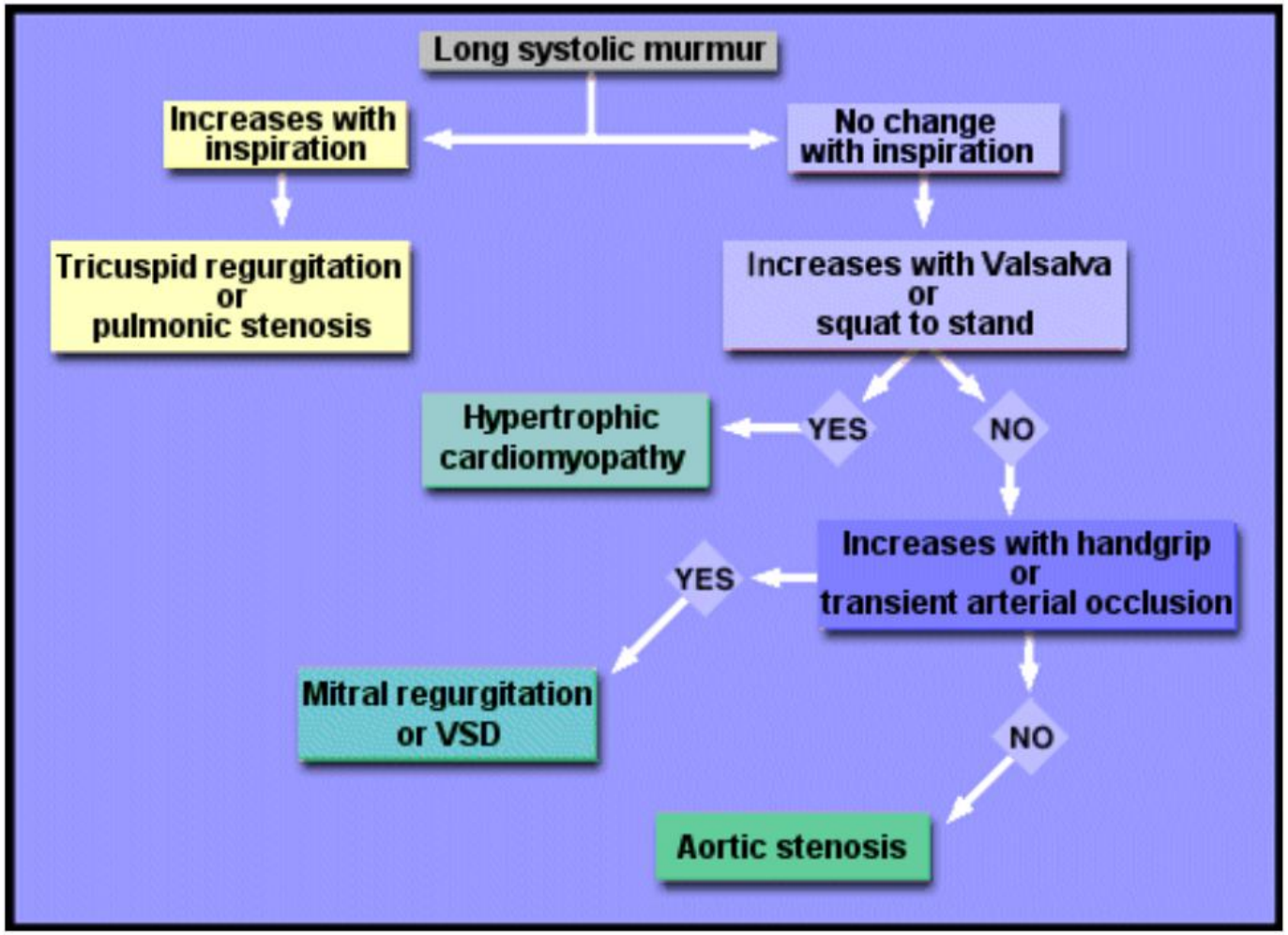


A 26 yo patient comes to clinic for a physical exam. They report having a murmur since childhood which they were told was normal. They have no symptoms. On exam there is a harsh, holosystolic murmur at the left sternal border, which increases slightly with hand grip and transient arterial occlusion. No clicks are appreciated, and there is no radiation. What murmur is most consistent with these findings?

A) Mitral stenosis
B) Hypertrophic cardiomyopathy
C) Aortic stenosis
D) Ventricular septal defect
E) Tricuspid regurgitation

Q6

“Dynamic Auscultation”



https://depts.washington.edu/physdx/heart/teaching.html

A 72 yo patient is evaluated for chest pain. They report chest heaviness with walking up hills. Other medical problems include type 2 diabetes, kidney disease, and hypertension. On physical exam there is a grade 2/6 holosystolic murmur at the lower sternal border. The S_2 splits with inspiration. What is the most likely cause of the patient's symptoms?

A) Coronary artery disease
B) Mitral stenosis
C) Aortic stenosis
D) Hypertrophic cardiomyopathy
E) Mitral valve prolapse

Q7

A 54 yo patient presents for physical exam. They report increased exertional dyspnea over the past year. On exam there is a grade 1/6 systolic ejection murmur and a paradoxically split S_2 . Which of the following is the **least** likely cause of a paradoxically split S_2?

A) Hypertrophic cardiomyopathy
B) Mitral regurgitation
C) Aortic stenosis
D) Left bundle branch block

Q8

Abnormalities of S2 Splitting

- Paradoxical (delayed A_2)
  - Hypertrophic cardiomyopathy
  - Aortic stenosis
  - LBBB
- Fixed splitting
  - Atrial septal defect
- Wide splitting (delayed P_2)
  - Pulmonic stenosis
  - RBBB
  - Mitral regurgitation
  - VSD/PDA

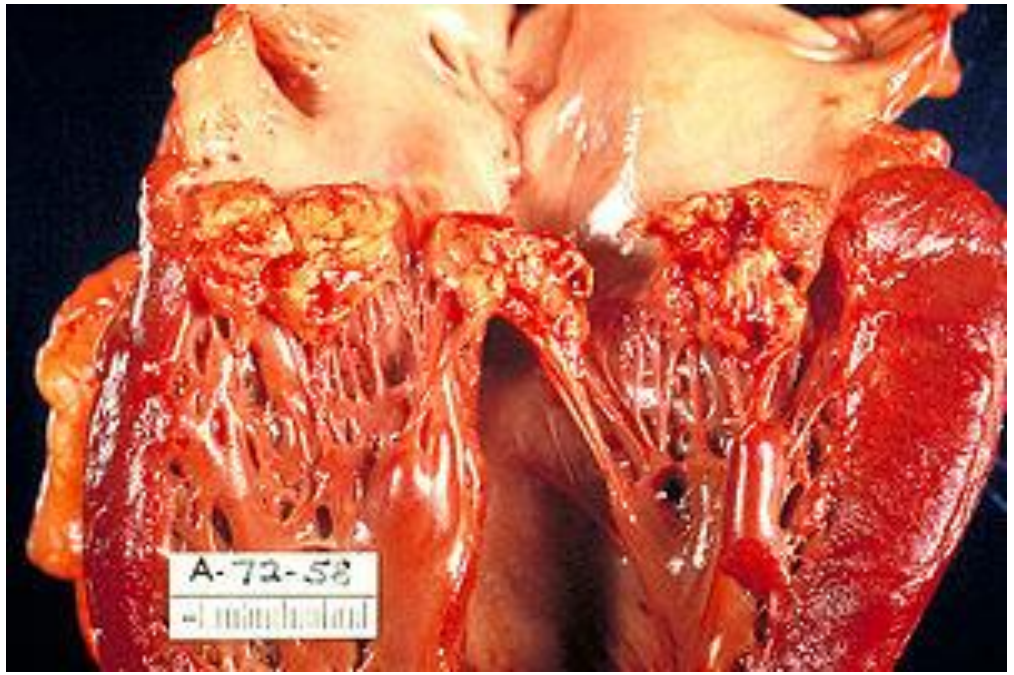
A 43yo patient presents to the ED with 2 weeks of fevers, chills, and lethargy. A few days ago they developed a cough and now also report shortness of breath. On exam, there is a 2/6 holosystolic murmur at the LSB which varies with respiration. Lungs are dull at the bases with crackles. Evaluation reveals infective endocarditis. Given this clinical presentation, what valve is most likely affected?

A. Aortic
B. Mitral
C. Pulmonic
D. Tricuspid

Q9

Infective Endocarditis

- In-hospital mortality rate 15 - 20%, with 1-year mortality rate approaching 40%
- Risk Factors:
  - Pre-existing valve disease
  - Systemic infection
  - IV drug use
  - Prior endocarditis
  - Immunodeficiency
  - Dental/surgical procedure



https://en.wikipedia.org/wiki/Infective_endocarditis

Infective Endocarditis

- Common Organisms
  - S. Aureus 30%
  - Viridans strep 20%
  - Coag (-) staph 10%
  - Enterococcus 10%
  - HACEK <5%
  - Culture negative 10%
- IV drug use:
  - S. Aureus – MSSA & MRSA
  - Gram negative rods
  - Streptococcal species
  - Fungi

%s from UptoDate

Infective Endocarditis: Clinical Features

- Fever / systemic infectious symptoms
- New murmur, change in murmur
- Vascular & immunologic phenomena
- Pulmonary symptoms, if right-sided
  - Cough, SOB, pleuritic chest pain <septic emboli>
- If IVDU, suspect tricuspid valve

Infective Endocarditis: Diagnosis

Modified Duke Criteria

- Definite IE
  - Pathological Criteria: + microorganisms
  - Clinical Criteria
- Possible IE
  - 1 major & 1 minor, or
  - 3 minor criteria
- Rejected
  - Firm alternative
  - Resolution <4d abx
  - No pathologic evidence

Major Criteria
+ blood culture(s)
Evidence of endocardial involvement (mass, abscess, new valve disease)
Minor Criteria
Predisposition or injection drug use
Fever
Vascular phenomena (emboli, hemorrhage, Janeway lesions)
Immunological phenomena (glomerulonephritis, Osler nodes, Roth spots)
Microbiological evidence

Infective Endocarditis: Treatment

- Medical Management
  - Antibiotics (after cultures!) x weeks
  - Consider stopping anticoagulation
  - Addiction therapy
- Surgery
  - Early (before completed abx course): large and/or mobile vegetation, heart block/abscess, severe HF, emboli
  - Delay if intracranial hemorrhage

Prosthetic Valves

- Biological vs mechanical
  - Considerations: age, anticoagulation, risk of reintervention
  - Periodic echo surveillance
- Thromboembolic events & valve thrombosis concerns!
- Antithrombotic therapy
  - Biologic: aspirin 81mg daily
  - Mechanical: vitamin K antagonist for INR 2-3.5, depending on valve type & location

Prosthetic Valve Endocarditis

- Early
  - Contamination in peri-op period (rare)
  - S. epidermidis
  - Valve dysfunction, high mortality
- Late (after endothelialization)
  - Transient bacteremia
  - Viridans strep
  - S. aureus

For which of the following patients is antibiotic prophylaxis most appropriate?

A) 42 yo with hypertrophic cardiomyopathy undergoing dental cleaning
B) 42 yo with history of a repaired VSD undergoing colonoscopy
C) 37 yo with history of endocarditis undergoing dental cleaning
D) 40 yo with aortic regurgitation undergoing colonoscopy
E) 50 yo with rheumatic mitral disease disease undergoing colonoscopy

Q10

Antibiotic Prophylaxis for IE

- "Reasonable for" dental procedures in setting of:

1. Prosthetic heart valves
2. Prosthetic materials used for valve repair (rings, clips)
3. Prior episode of endocarditis
4. Unrepaired cyanotic congenital heart disease, or repaired with residual shunts / valve regurgitation nearby prosthetic material
5. Cardiac transplant with valve regurgitation from a structurally abnormal valve

- NOT recommended for: non-dental procedures in the absence of active infection

Antibiotic Prophylaxis for IE

	Agent	Regimen
Standard	Amoxicillin	2gm 30-60 min before
Penicillin allergy	Cephalexin or Azithro/Clarithromycin or Doxycycline	2gm 30-60 min before 500mg 30-60 min before 100mg 30-60min before
Unable to take oral meds	Ampicillin or Cefazolin/CTX	2gm IM or IV, ~30min before 1gm IM or IV, ~30min before

***Clindamycin no longer recommended!

UptoDate

References

- Valve Guidelines: Otto CM, et al. *Circulation.* 2021.
- HCM Guidelines: Ommen S, et al. *Circulation.* 2020.
- ACHD Guidelines: Stout K, et al. *Circulation*. 2019.

Thank You!

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Answer Key

Q1. C

Q2. A

Q3. B

Q4. A

Q5. C

Q6. D

Q7. A

Q8. B

Q9. D

Q10. C