



# Annual Internal Medicine Review

## CARDIOLOGY

Valvular Heart Disease

Pericardial Disease

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## Question CV-1

A 54-year-old male is evaluated for a heart murmur. There is grade 3/6 systolic murmur along the right upper sternal border with a mid systolic click radiating to the apex.

**Which of the following is the most likely diagnosis?**

- A. Mitral Regurgitation
- B. Bicuspid aortic stenosis
- C. Hypertrophic cardiomyopathy
- D. Mitral valve prolapse

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# Question CV-1 Key Point

- Aortic Stenosis
  - Best heard in the RUSB; single or absent S2
  - Crescendo-decrescendo murmur
  - Radiation to the carotids
  - Pulsus parvus et tardus - delayed carotid upstroke
  - Gallavardin phenomenon: loud, harsh, blowing murmur at apex associated with AS (often confused with HCM or MR)
  - Bicuspid valves have aortic ejection clicks.

# Question CV-1 Key Point

## Mitral Regurgitation

- Blowing, holosystolic murmur best heard at apex
- Radiates anteriorly (posterior leaflet) or to axilla (anterior leaflet)
- Increases murmur
  - Expiration
  - Handgrip/Squatting
- Decreases murmur
  - Inspiration
  - Amyl nitrate
  - Standing or Valsalva

# Question CV-1 Key Point

## Hypertrophic Cardiomyopathy

- Crescendo-decrescendo, harsh, mid-systolic murmur best heard at L parasternal border
- Pulsus bisferiens
- Brockenbrough sign/Post PVC sign
  - Pause after PVC → ↑ LV filling time (↑ preload) but also ↑ LVOT obstruction (↑ contractility) → leads to ↑ LV peak-systolic pressure + ↓ aortic pulse pressure)
- Increases Murmur
  - Expiration, Amyl Nitrate, Standing, Valsalva
- Decreases Murmur
  - Inspiration, Hand grip, Squatting

# Question CV-1 Key Point

## Mitral Valve Prolapse

- Late-systolic, crescendo murmur best heard at apex
- Mid-systolic click (non-ejection)
- Extracardiac features on vignette
  - Muscular dystrophy, Marfan syndrome, Turner syndrome, Autosomal dominant polycystic kidney disease
- Increases Murmur
  - Expiration, Amyl Nitrate, Standing, Valsalva
- Decreases Murmur
  - Inspiration, Hand grip, Squatting

Type	Descriptors	Quality	Timing	Loc?	B or D	Increase	Decrease	Radiation
<b>Innocent</b>	Musical, vibratory	Musical, vibratory	Systolic	LSB	Bell	Supine	Valsalva	N/A; Apex
<b>AS</b>	Obstruction of L ventricular outflow of blood	Systolic ejection crescendo-decrescendo	Mid-systolic	RUSB	Diaphragm	Squatting	- Valsalva - Standing - Sitting up & leaning forward	Carotid
<b>MR</b>	MV should be closed, but does not fully close causing volume overload	Blowing holosystolic	Pan-systolic	Apex	Diaphragm	-LLD -Handgrip -Squatting	-Standing -Valsalva	Left axilla
<b>HOCM</b>	Hypertrophied interventricular septum	Harsh crescendo-decrescendo	Mid-systolic	LLSB	Diaphragm	-Standing -Valsalva	-Handgrip -Squatting	NO CAROTID RADIATION (sounds like AS)
<b>VSD</b>	Hole in the ventricular septum, smaller the defect louder the murmur	Loud, high-pitched, <u>harsh</u>	Holo-systolic	LLSB	Either	-Squatting	-Standing -Valsalva	Can be assoc w/ palpable thrill
<b>MVP</b>	Ballooning of part of the mitral valve back into the left atrium	Mid-late systolic ejection click	Systolic	Apex	Diaphragm	-Valsalva -Standing (standing moved click closer to S1)	-Hand grip -Squatting (Squatting and handgrip delay click)	

## Question CV-2

A 20-year-old woman who had recently immigrated from India is evaluated during a routine examination. Blood pressure is 110/60 mm Hg (both arms). There is rumbling, late diastolic murmur best heard at apex

**Which of the following is the most likely diagnosis?**

- A. Mitral Stenosis
- B. Tricuspid Stenosis
- C. Aortic Regurgitation
- D. Atrial Myxoma

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# Question CV-2 Keypoint

## Mitral Stenosis

- Rumbling, late diastolic murmur best heard at apex
- Severe MS - decreased S1 and OS, short A2-OS interval (longer duration of murmur)
- Unique to MS - increase in murmur with handgrip and amyl nitrate
- Associated with rheumatic fever

# Question CV-2 Keypoint

## Tricuspid Stenosis

- Rumbling, late diastolic murmur best heard at LLSB
- Hepatic pulsations
- Opening snap
- Atrial Myxoma
  - Mid- to late diastolic murmur due to obstruction of valve by myxoma
  - Similar in character to MS murmur, often difficult to distinguish
- Ventricular Septal Defect
  - Holosystolic murmur best heard at L parasternal border; palpable thrill at left parasternal border
  - Inverse relationship with size of murmur and sound of murmur
  - Eisenmenger syndrome there is an absence of holosystolic murmur
    - Look for signs of R sided CHF and Pulmonary HTN

# Question CV-2 Keypoint

## Aortic Regurgitation

- High-pitched, blowing, early diastolic decrescendo murmur, can be heard along the upper sternal border
- Paradoxical splitting of S2 due to delayed closure of AV
- Decreased S1 due to early close of mitral valve
- Mid-systolic flow murmur simulating AS
- Increased murmur with expiration, hand grip, squatting, leg raises
- Decreased murmur with inspiration, amyl nitrate, standing

## Question CV-3

An 80-year-old male presents to her PCP's office for annual physical exam. He reports having a sedentary lifestyle since retiring. He reports no symptoms. There is a harsh systolic ejection murmur radiating to the apex. Echocardiogram shows normal LV systolic function with severe aortic stenosis.

**Which of the following should be done?**

- A. Exercise Stress Test
- B. Aortic Valve Surgery
- C. Coronary angiography
- D. Periodic follow-up and evaluation

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# Question CV-3 Key Point

## Aortic Stenosis Management

- Symptomatic severe AS with low/intermediate/high risk - SAVR
- Severe AS with prohibitive risk for SAVR - TAVR only
- Symptomatic severe AS with intermediate/high risk for SAVR - TAVR
- Asymptomatic severe AS with HFrEF - AVR
- Asymptomatic severe AS
  - **Supervised** Exercise treadmill testing (ETT)
    - Limiting symptoms (dyspnea, angina, syncope) on ETT are an indication for AVR
    - Decreased exercise tolerance, abnormal systolic blood pressure response (drop or  $< 20$  mm Hg rise)
- There are **no** medical therapies to prevent or slow the progression of AS

# Severe Aortic Stenosis

- Echocardiographic findings
  - Valve area  $<1 \text{ cm}^2$
  - Mean transvalvular gradient  $>40 \text{ mm Hg}$
  - Peak Velocity  $> 4 \text{ m/s}$
- Low Flow Low Gradient AS
  - Low stroke volume from reduced CO or small LV
  - Dobutamine Echo is used to differentiate between pseudostenosis vs. true aortic stenosis
- Bicuspid AV
  - Associated with with Coarctation of the Aorta and Aortic aneurysms

## Question CV-4

24-year-old with hx of IV drug abuse presents to office for evaluation for dyspnea. Patient had endocarditis of the aortic valve which was medically managed. He has a known history of aortic regurgitation. His vitals are BP 150/90 HR 74 RR16. On exam, he has a loud blowing diastolic murmur in the upper sternal border. Echocardiogram shows biatrial enlargement with preserved EF and moderate aortic regurgitation.

**What is the next best step in the management of his aortic regurgitation?**

- A. Aortic Valve Surgery
- B. Cardiac Catheterization
- C. Amlodipine
- D. Dobutamine Echo

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- D. Dobutamine Echo

## Question CV-4

### Aortic Regurgitation

- Most common cause is bicuspid aortic valve
  - Also consider aortic aneurysm, Marfan syndrome
- Typical symptoms
  - Angina
  - Orthopnea
  - Exertional dyspnea
- Typical Findings
  - Widened pulse pressure
  - Early diastolic murmur along left sternal border

# Aortic Regurgitation Management

## Chronic Aortic Regurgitation

- Medical Therapy - ACEi, dihydropyridine CCB
- Surgical AVR
  - Symptomatic patients with severe AR regardless of LV systolic function
  - Asymptomatic patients with severe AR and LV systolic dysfunction (LVEF <50%)
  - Asymptomatic patients with severe AR undergoing cardiac surgery
  - Asymptomatic patients with severe AR with normal LV systolic function and severe LV dilatation ( LV ESD > 50 mm)
  - Patients with moderate AR undergoing cardiac surgery
  - Asymptomatic patients with severe AR and normal LV systolic function (LVEF ≥50%) with severe LV dilatation (EDD > 65 mm) if surgical risk is low

# Acute Aortic Regurgitation

- Short, soft (sometimes inaudible) diastolic murmur
- Medical therapy - mains hemodynamics while awaiting SAVR
  - Afterload Reduction - Nitroprusside
  - IV diuretics
  - Inotropes ?
- Immediate aortic valve replacement

Avoid  $\beta$ -blockers unless there is concomitant acute aortic dissection.

Avoid intra-aortic balloon pumps for acute aortic regurgitation which may worsen regurgitation

## Question CV-5

48-year-old female presents to the office for evaluation of her dyspnea for 4 weeks. She is not on any medications. She has a soft diastolic murmur with an opening snap best heard at the apex. Her echocardiogram reveals normal left ventricular systolic function (LVEF >60%) and mitral stenosis is noted with a MV area is measured at 1.3 cm<sup>2</sup>. Her EKG shows atrial fibrillation.

**What is the best next step in her management?**

- A. Percutaneous mitral balloon commissurotomy
- B. Mitral Valve Repair
- C. Coumadin
- D. Apixaban

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- B. Mitral Valve Repair
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- D. Apixaban

# Question CV-5 Key Point

Mitral stenosis (MS) can be due to:

- Rheumatic disease, Senile calcific disease, Congenital

Mitral Stenosis symptoms arise from:

- Rising LA pressures -> reduced flow across MV -> decreased CO -> compensatory tachycardia

Criteria for Severe MS

- Valve Area less than 1.5cm<sup>2</sup>
- Mean gradient more than 10 mm Hg.

# Mitral Stenosis Management

## Medical Therapy

- Coumadin or Heparin indicated in patients with MS and AFib. Avoid direct oral anticoagulants
- Heart rate control for AFIB
- Heart rate control for patients in SR with exertional symptoms
- **Surgical Therapy**
  - Symptomatic Severe MS
    - Percutaneous mitral balloon commissurotomy for severe MS with favorable valve morphology
    - Mitral Valve Surgery for failed PMBC or not candidates for PMBC
  - Asymptomatic Severe MS
    - New onset AFIB with favorable MS
    - Very severe MS with favorable morphology

## Question CV-6

65-year-old male with a history of non ischemic cardiomyopathy presents to the office for dyspnea. He is on carvedilol, sacubitril-valsartan, spironolactone and furosemide. He reports increasing dyspnea with exertion and LE edema. EKG shows NSR with LBBB. Echocardiogram shows dilated LV with EF of 30% with severe mitral regurgitation. Nuclear stress test shows no reversible ischemia

**What is next best step in the management of his mitral regurgitation?**

- A. Annuloplasty Repair
- B. Transcatheter Mitral Valve Replacement
- C. Cardiac Resynchronization Therapy
- D. Add Lisinopril

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# Mitral Regurgitation

- Primary
  - Leaflet, Chordae, Papillary Muscle, Annulus
  - Endocarditis
  - Rheumatic heart disease
  - Congenital
- Secondary - structurally normal mitral valve
  - Ischemic
  - Nonischemic
- Presentation
  - Symptoms of CHF
  - Look for symptoms with exertion
- Echo criteria
  - $>40\%$  LA or holosystolic eccentric jet MR
  - Vena contracta  $\geq 0.7$  cm
  - Regurgitant volume  $\geq 60$  mL
  - Regurgitant fraction  $\geq 50\%$
  - ERO  $\geq 0.4$  cm<sup>2</sup>

# Mitral Valve Regurgitation Management

## Primary MR

- Symptomatic Severe MR with EF more than 30% - MV Surgery
- Asymptomatic Severe MR
  - EF 30-60% or LVESD >40mm - MV surgery
  - EF >60% and LVESD <40mm - MV surgery
  - New onset AF or PASP > 50 mmHg - MV repair
- Secondary MR - improves QOL, does not prolong it
  - Treat underlying cause - CAD/CHF
  - LVEF >50% - MV Surgery
  - LVEF <50%, Favorable anatomy, EF 20-50% LVESD <70mm and PASP <70mmHg - Transcatheter Edge-edge MV repair
  - LVEF <50%, does not meet above criteria - MV surgery

# Tricuspid Diseases

## Tricuspid Stenosis

- Etiology - Rheumatic, also may have mitral involvement
- Signs/presentation
  - Mid diastolic rumble, increases with inspiration
  - R sided CHF - JVD, abdominal fullness, fatigue
- Management
  - Volume status / CHF management
  - Isolated severe TS only or at the time of L heart surgery - TV surgery
  - Percutaneous balloon tricuspid commissurotomy in symptomatic severe TS without TR

# Tricuspid Diseases

## Tricuspid Regurgitation

- Primary
  - Congenital - Ebstein's, ASD, PFO, VSD
  - Rheumatic
  - Catheters/Leads
  - Carcinoid - assoc with flushing/diarrhea
- Secondary - dilation of RV cavity
  - LV dysfunction
  - Pulmonary HTN
  - RV infarction
  - Mitral valve disease
  - Cor Pulmonale
  - Atrial Fibrillation
- Signs/Presentation
  - R sided CHF - edema/ascites
  - JVD
  - Holosystolic murmur LSB, increases with inspiration
  - Parasternal heave
  - S3
- Management
  - Diuretics in R sided CHF
  - Medical therapies to reduced pulmonary artery pressures
  - Surgery
    - Unresponsive to medical treatment
    - Tricuspid Valve Repair at time of L sided valve surgery
      - if evidence of R sided CHF
      - Tricuspid annulus is > 40mm

# Prosthetic Valves

- Mechanical Valve
    - Aortic Valve prosthesis - INR goal 2.5
    - Aortic Valve prosthesis with risk factors\* or Mitral valve prosthesis - INR 3.0
    - Aspirin 81mg if there is an indication (2B)
  - Bioprosthetic Valve
    - Aspirin 81mg lifelong (2a)
    - Warfarin with INR goal of 2.5 for 3-6 months (2a)
  - Bridging
    - Not needed for Mechanical AVR without any risk factors\*
    - Bridging recommended for Mechanical AVR with risk factors\* or Mechanical Mitral Valve
- 
- \* Risk Factors - LV dysfunction, Atrial Fibrillation, History of embolization, Hypercoagulable state

## Question CV-7

36-year-old male with prior history of endocarditis from IV drug use presents to the office for preoperative clearance. Patient is due to undergo colonoscopy with possible biopsy for persistent diarrhea. He has an allergy to clindamycin.

**What would be the recommended endocarditis prophylaxis?**

- A. Clindamycin
- B. Amoxicillin
- C. Cefazolin
- D. None

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- C. Cefazolin
- D. None**

# Question CV-7 Key Point

- Cardiac Conditions with highest risk for IE
  - Prosthetic Cardiac Valves or prosthetic material in valve repair
  - Hx of prior endocarditis
  - Unrepaired cyanotic congenital heart disease
  - Repaired congenital heart disease with residual defects
  - Completely repaired congenital heart disease or device was placed within the last 6 months
  - Cardiac transplant with valvulopathy
- Which procedures needs prophylaxis
  - Dental procedure - manipulation of gingival tissues, tooth extraction, periodontal surgery
  - Respiratory procedure if incision or biopsy will be performed.
  - Gastrointestinal - none
  - Genitourinary - none

## Question CV-8

48-year-old male recovering from lower respiratory infection presents to the office with complaints of recurrent chest pain and fever. He was recently discharged from the hospital. He has been taking Ibuprofen 600 mg TID for 2 weeks without any relief since being discharged. Chest pain is worse while supine and better with leaning forward, not reproducible with exertion. EKG shows diffuse ST elevations and PR elevation in AVR.

**What is the next best step in the management of his symptoms?**

- A. Change to high dose Aspirin
- B. Add Colchicine 0.6mg BID
- C. Add Prednisone 40 mg daily
- D. Pericardiectomy

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# Acute Pericarditis

- Signs/Symptoms:
  - Pericardial friction rub
  - Sharp pain, not related to exertion, relieved with rest or NTG
    - Worse with supine position. Better with sitting and leaning forward
- Finding
  - EKG: ST elevation in multiple leads. Not correlating with single coronary artery distribution. PR elevation/depression
  - ECHO: possible effusion
  - MRI: pericardial enhancement
  - Labs: Elevated CRP/ESR, Troponins
- Management:
  - 1st line therapy
    - High dose Aspirin / NSAIDs for 2 weeks
    - Colchicine as adjunctive therapy
  - Recurrent
    - Add Colchicine if not already on
    - Longer duration of above therapy
    - Prednisone 0.25-0.5mg/kg tapering dose
  - Follow CRP to help guide taper
  - Steroids reserved for recurrent, incessant pericarditis and chronic pericarditis
  - Limit physical activity until pericarditis resolves

## Question CV-9

60-year-old male is post CABG surgery in PACU. 4 hours post procedure he is found to have BP of 70/40s. Exam shows distended neck veins, clear lungs. He was started on pressors by the on-call resident physician, repeat BPs have been in the 90/50s

**What is the next best step in the management ?**

- A. Start Milrinone for cardiogenic shock
- B. Observation now that he is hemodynamically stable
- C. Emergent transthoracic echocardiogram
- D. Swan Ganz Catheter

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# Cardiac Tamponade

- Physiology
  - Impaired cardiac filling - intrapericardial pressures increase
  - Ventricular Interdependence
- Signs:
  - Beck's Triad - elevated JVP, Hypotension, Distant HS
  - Tachycardia, Dyspnea
- Finding
  - Pulsus Paradoxus - > 10-12 mmHg fall in SBP with inspiration
  - Elevated RA pressure
  - Blunting of Y descent - RV filling impaired
  - Equalization of RA pressure, RVEDP and LVEDP
  - EKG: electrical alternans
  - Echo
    - RV diastolic collapse
    - RV mitral inflow impaired during inspiration > 30%
    - IVC dilation
    - D shaped septum
  - Narrow pulse pressure

# Cardiac Tamponade Management

## CLINICAL DIAGNOSIS

- **STABILIZE THE PATIENT**
- ECHOCARDIOGRAM and right heart catheterization are there to support diagnosis
- Percutaneous drainage
- Surgical drainage recommended for tamponade with aortic dissection and post op
- Serial echo within 48 hrs of drainage
  - Remove drain if in place after output is less than 50cc/hr
- Anti-inflammatory therapy - ASA, Colchicine, Steroids
- Evaluate pericardial fluid
  - Leukocytes, HCT, Protein, Cultures, Gram Stain
  - Cytology/flow cytometry,
  - May need to be repeated as the yield is low

## Question CV-10

54-year-old male with history of CABG is here for an annual exam. He reports having increased ascites and edema since undergoing CABG. His cardiologist has escalated his diuretic therapy and anti-inflammatory therapies. He underwent cardiac MRI which revealed pericardial thickening and late gadolinium enhancement of the pericardium without effusion. This finding was suggestive of constrictive pericarditis.

**Which of the following is true?**

- A. Patient will require cardiac transplant
- B. Diuretic refractory condition will require pericardiectomy
- C. Impaired tissue dopplers on echocardiogram will be present.
- D. There will be NO respiratory septal shift

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# CV-10 Keypoints

- Board exams love questions on Constrictive Pericarditis vs. Restrictive Cardiomyopathy
- Constrictive Pericarditis
  - Similar finding to Tamponade
  - Findings
    - Elevated RA pressures, elevated pressure with inspiration
    - Pulsus paradoxus > 10-12 mmHg inspiratory fall in SBP
    - Diastolic septal bounce
    - Exaggerated respiratory variation across MV and TV without pericardial effusions
    - Elevated tissues doppler
    - IVC dilated and Hepatic vein flow reversal
    - Echocardiogram, cardiac MRI and cardiac catheterization can help confirm diagnosis
  - Management
    - Anti-inflammatory for at least 3 months
    - Diuretics
    - Diuretic refractory or end organ damage -> pericardiectomy
- Restrictive CM
  - Findings: L sided CHF, pulmonary HTN, decreased tissue doppler, no pulsus paradoxus or septal deviation

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