Chest pain, arrhythmias, and syncope – Oh My!

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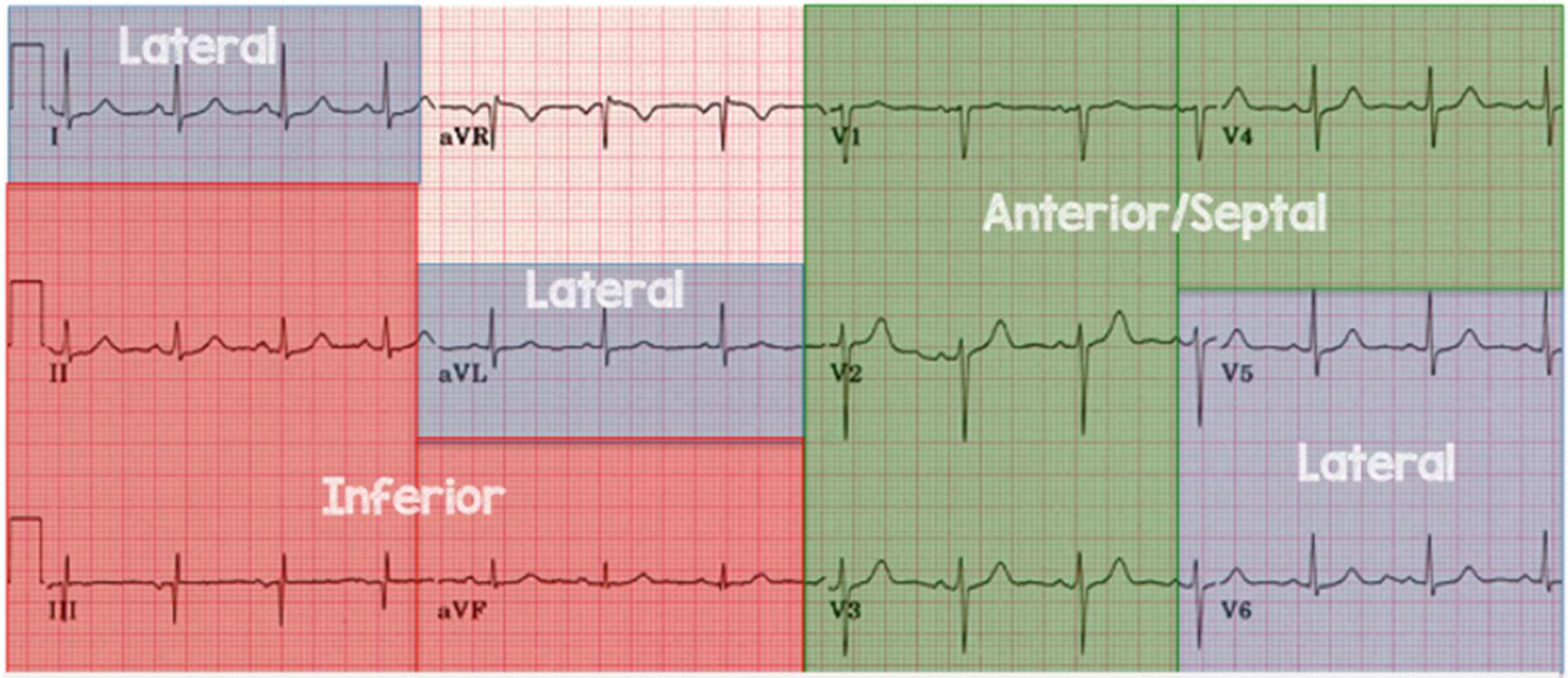
Disclosures

None ☹

Objectives

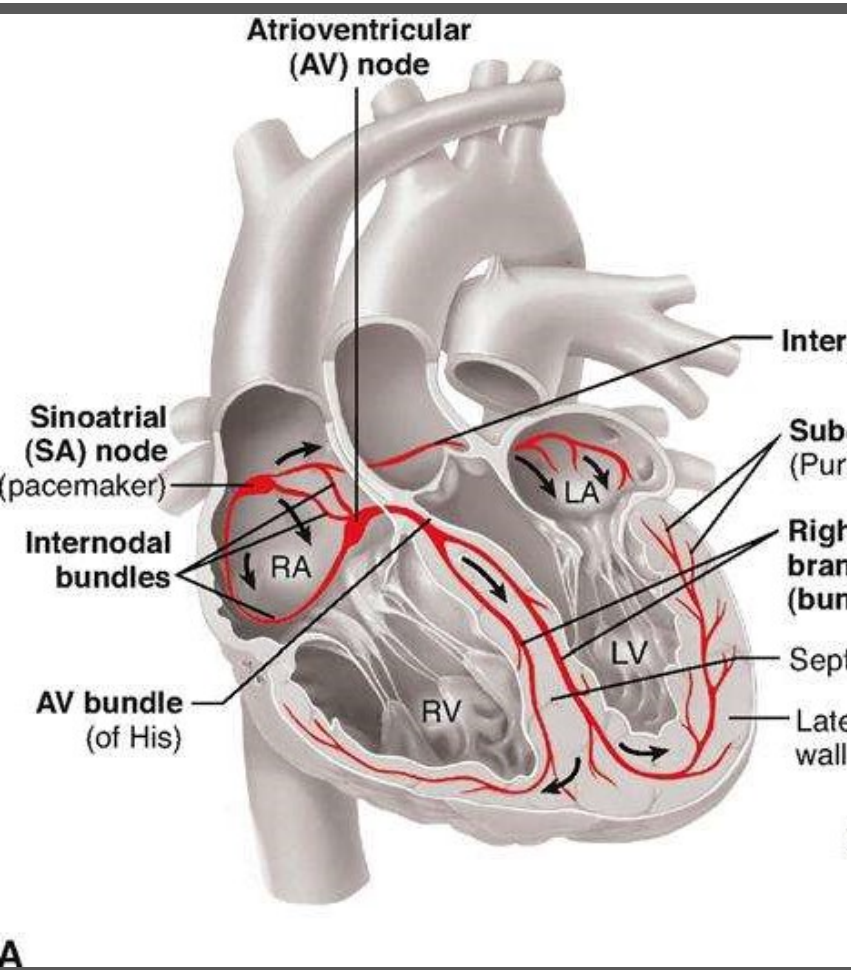
- Identify common causes of chest pain in hospitalized patients
- Differentiate between common arrhythmias seen in hospitalized patients
- Explain components needed for a complete syncope work up

Review



Coronary Anatomy & ECG Leads

Lateral Leads	I, aVL, V5 - V6	LCx or Diagonal of LAD
Inferior Leads	II, III, aVF	RCA and/or LCx
Anterior/Septal Leads	V1 - V4	LAD


Atrioventricular
(AV) node
Sinoatrial
(SA) node
(pacemaker)
Internodal
bundles
AV bundle
(of His)
RA
LA
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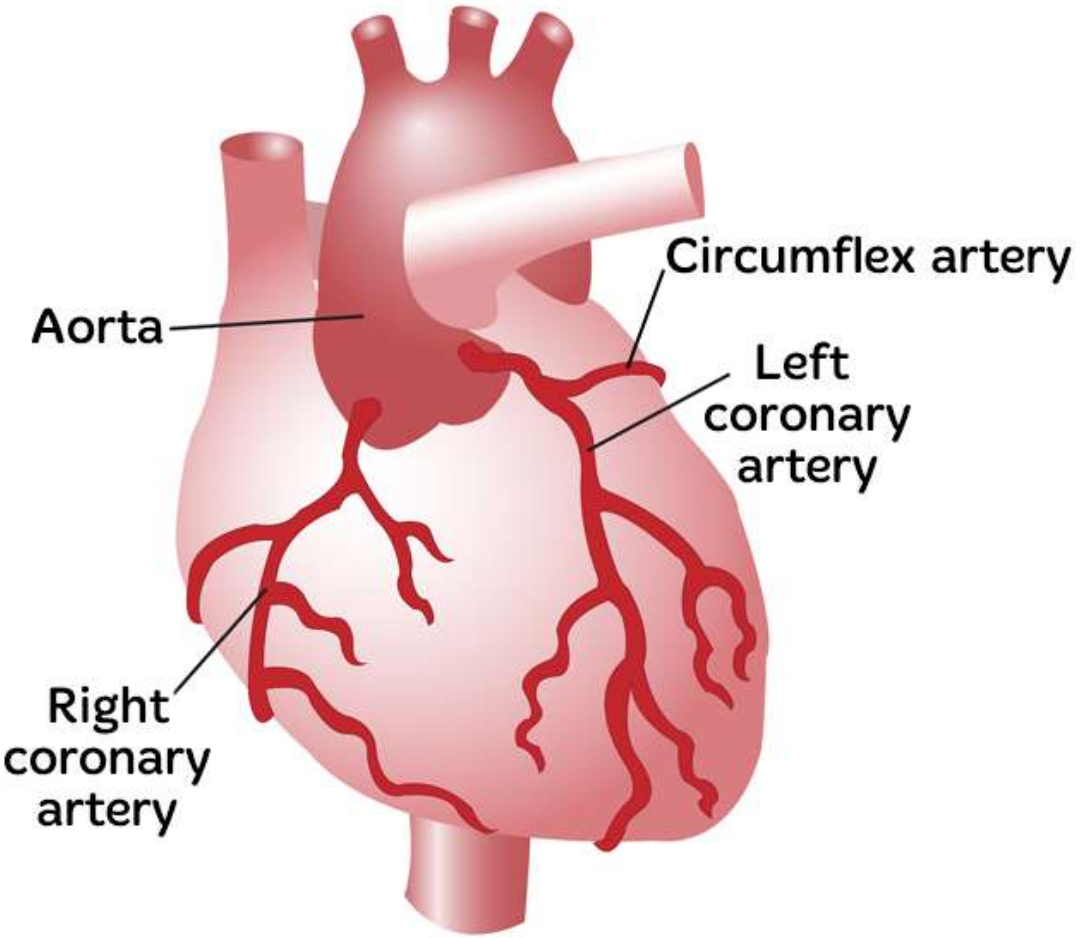
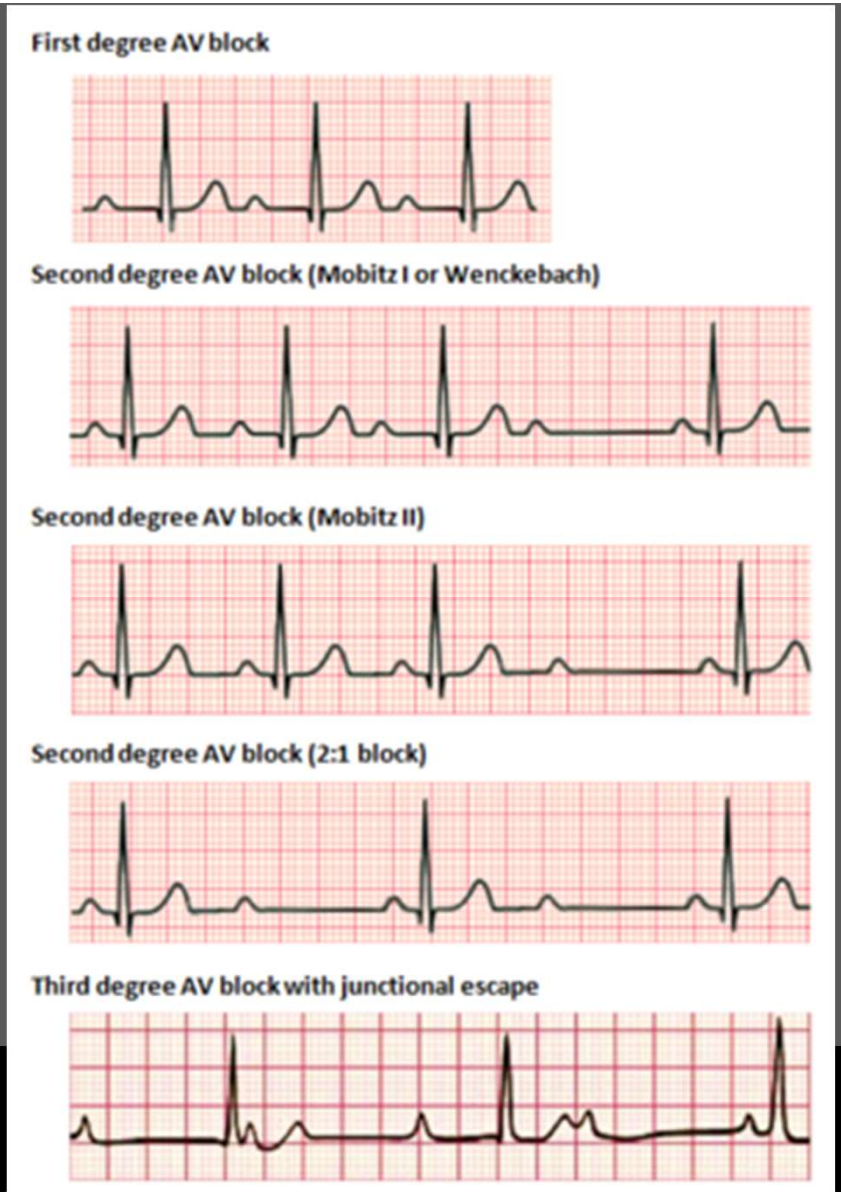
wall

A


Aorta
Circumflex artery
Left
coronary
artery
Right
coronary
artery

Review

- 1st degree
- Mobitz I (Wenckebach)
- Mobitz II
- Complete heart block



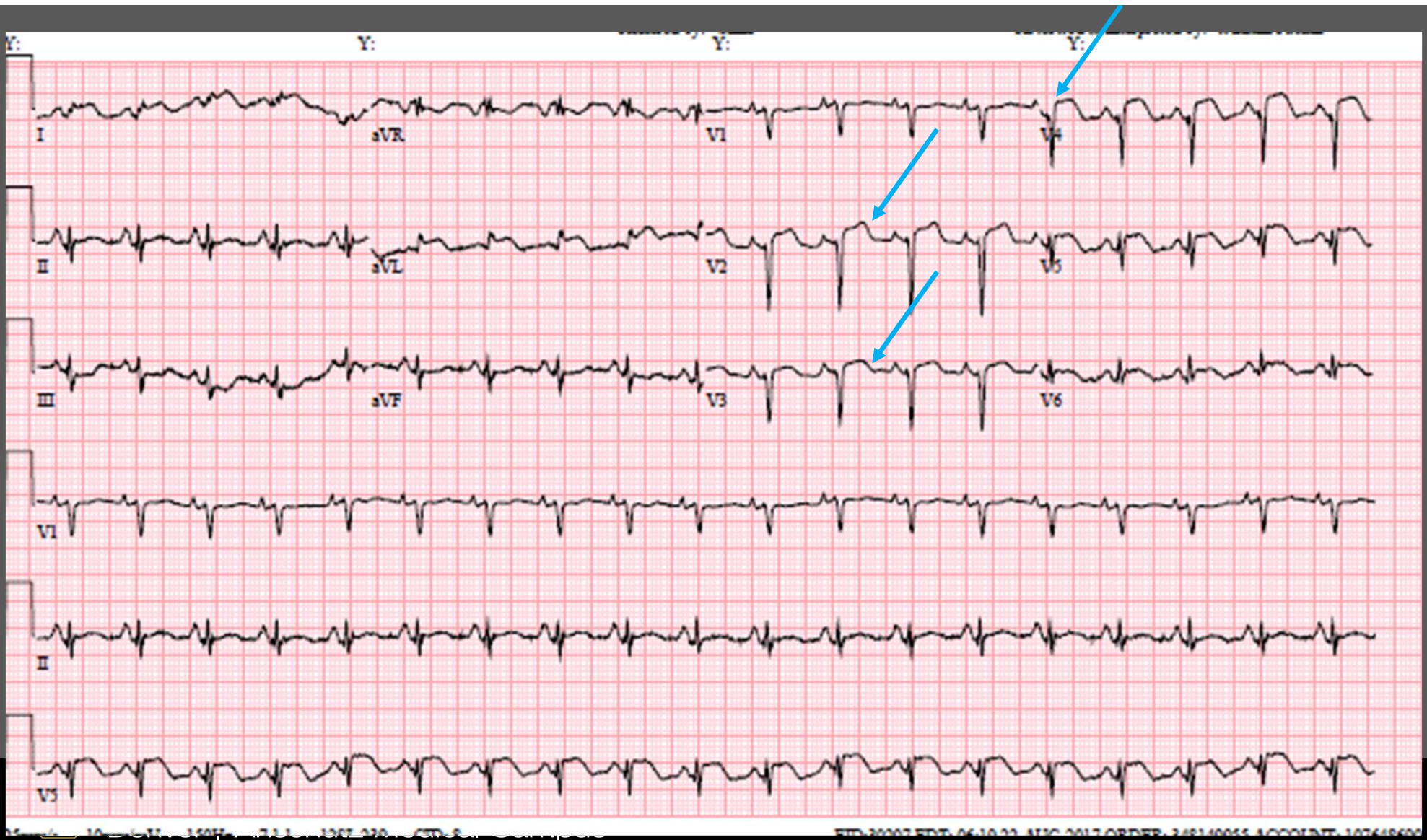
Case 1

60 M hx of CAD with PCI in 2015, HTN who is POD1 from L BKA. Tells RN he's having chest heaviness. The pain is 6/10 and started while he was in bed. It felt just like his previous chest pain.

RN finds you to share the good news. What do you do FIRST?

Case 1

1. Call cardiology consult
2. Give nitroglycerin SL
3. Check a troponin
4. Obtain a stat EKG
5. Start a heparin gtt


I
aVR
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V2
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III
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V3
V6
V1
II
V5

Case 1 – Now what?

1. Call cardiology consult
2. Start heparin gtt
3. MONA

Heparin Contraindications?

Absolute

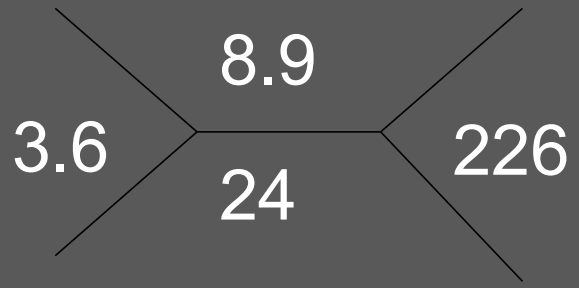
- Active bleeding
- History of heparin-induced thrombocytopenia
- Severe thrombocytopenia

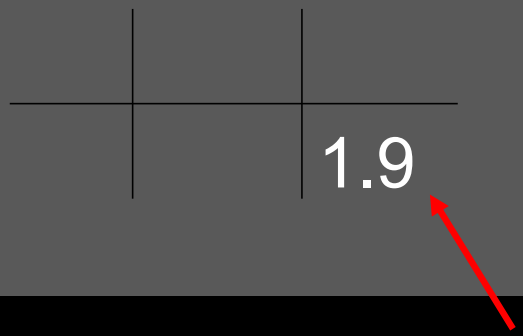
Relative

- Surgical limitations?
- Prior bleeding

Case 1 – Now what?

1. Call cardiology consult
2. Start heparin gtt
3. MONA
4. Activate cath lab?

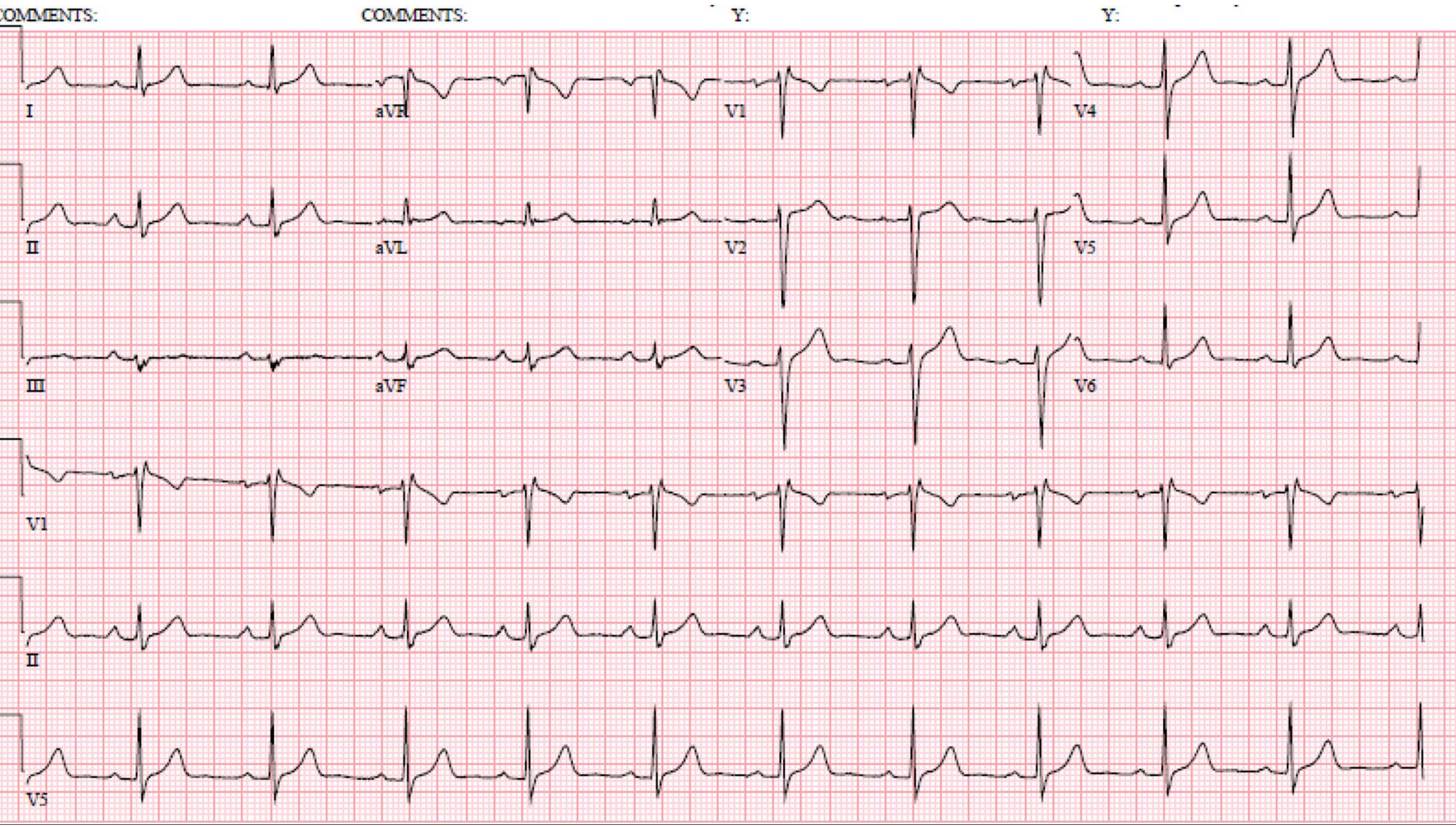




Case 2

- 78 AAM hx of 3v CAD medically managed, HTN, DM, multiple myeloma. He's admitted for complications of chemotherapy. He reports chest pain while walking with PT. The pain subsides once he sits down. This feels like his usual chest pain.
- Home meds: ASA, atenolol 100, atorvastatin 40, imdur 60, Insulin, chemotherapy agents

- Your floor nurse is a rockstar and got an EKG.


COMMENTS:
COMMENTS:
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Y:
I
aVR
V1
V4
II
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V2
V5
III
aVF
V3
V6
V1
II
V5

Case 2

- Stable angina = Not a new symptom and when there is no deterioration in frequency, severity or duration of episodes.

- Unstable angina = New (within 24 hours) onset angina, or abrupt deterioration in previously stable angina, often with prolonged episodes of rest pain.

https://www.ncbi.nlm.nih.gov/books/NBK83610/

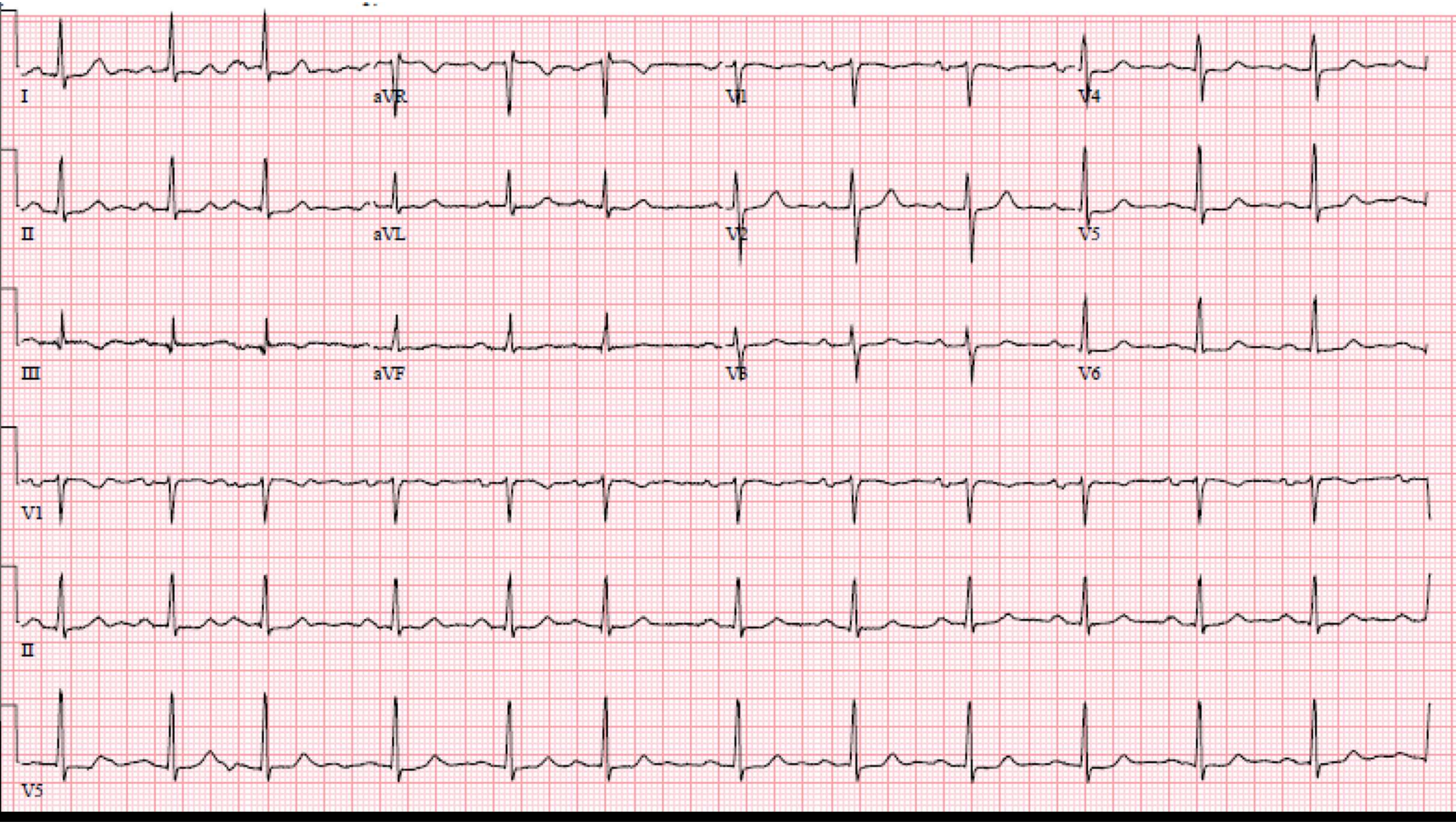
Case 2 – What do you do?

1. Start a heparin gtt
2. Cardiology consult
3. Activate the cath lab
4. Do nothing
5. Continue home medications

Case 3

72 F hx of metastatic ovarian cancer, well controlled HTN. Admitted from the ED with sepsis of unclear source. Patient has AMS so history is limited. Family reports she had been doing well at home with no complaints prior to this morning.

- Home meds: Lisinopril 20 mg qd
- hsTrop I: 168 (F nl <16, M <20)


I
aVR
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II
aVL
V2
V5
III
aVF
V3
V6
V1
II
V5

Case 3 – What do you do?

1. Start a heparin gtt
2. Cardiology consult
3. Cath lab activation
4. Do nothing
5. ASA and statin

Fourth Universal Definition of MI

Troponin

> 99th percentile of normal

"Rise and fall"

Δ 20%

Need both of these

AND

for all types of MI

Clinical

Symptoms

Ischemic ECG changes

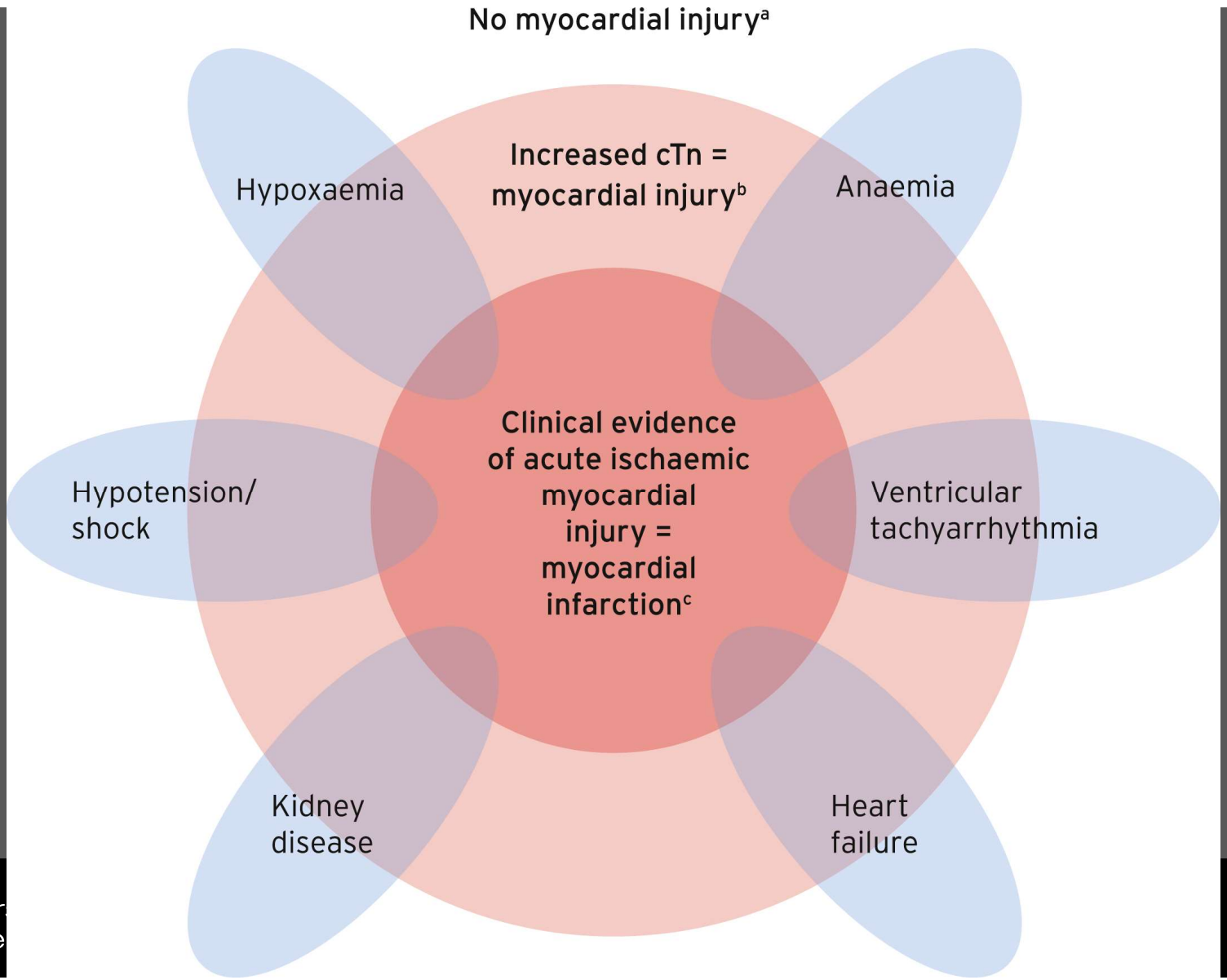
Ischemic imaging changes

New wall motion abnormality

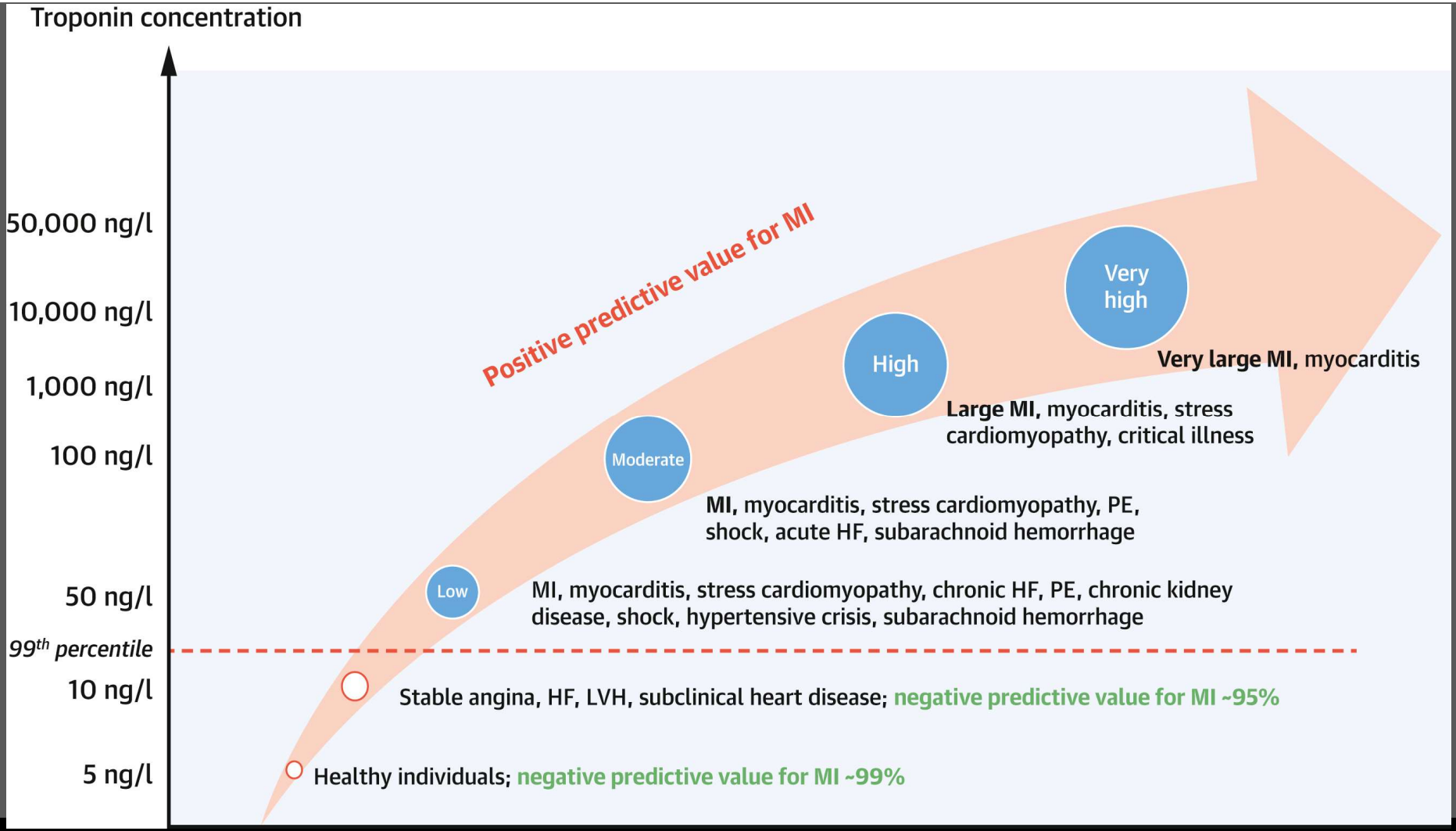
New perfusion defect

Intracoronary thrombus

Need one of these



Thygesen K, Alpert J, Jaffe A, et al. Fourth Universal Definition of Myocardial Infarction (2018). J Am Coll Cardiol. 2018 Oct, 72 (18) 2231–2264. https://doi.org/10.1016/j.jacc.2018.08.1038



Raber I, McCarthy C, Januzzi J, et al. A Test in Context: Interpretation of High-Sensitivity Cardiac Troponin Assays in Different Clinical Settings. J Am Coll Cardiol. 2021 Mar, 77 (10) 1357–1367. https://doi.org/10.1016/j.jacc.2021.01.011

Case 3 – Now what do you do?

1. Start a heparin gtt
2. Cardiology consult
3. Cath lab activation
4. Do nothing
5. ASA and statin

Case 4

54 F hx of CAD with T2DM, HTN, HLD, previous smoker. Presents with significant fatigue with heartburn and nausea that started about 2 hours ago. She has never felt this before.

- Home meds: ASA, atorvastatin 40

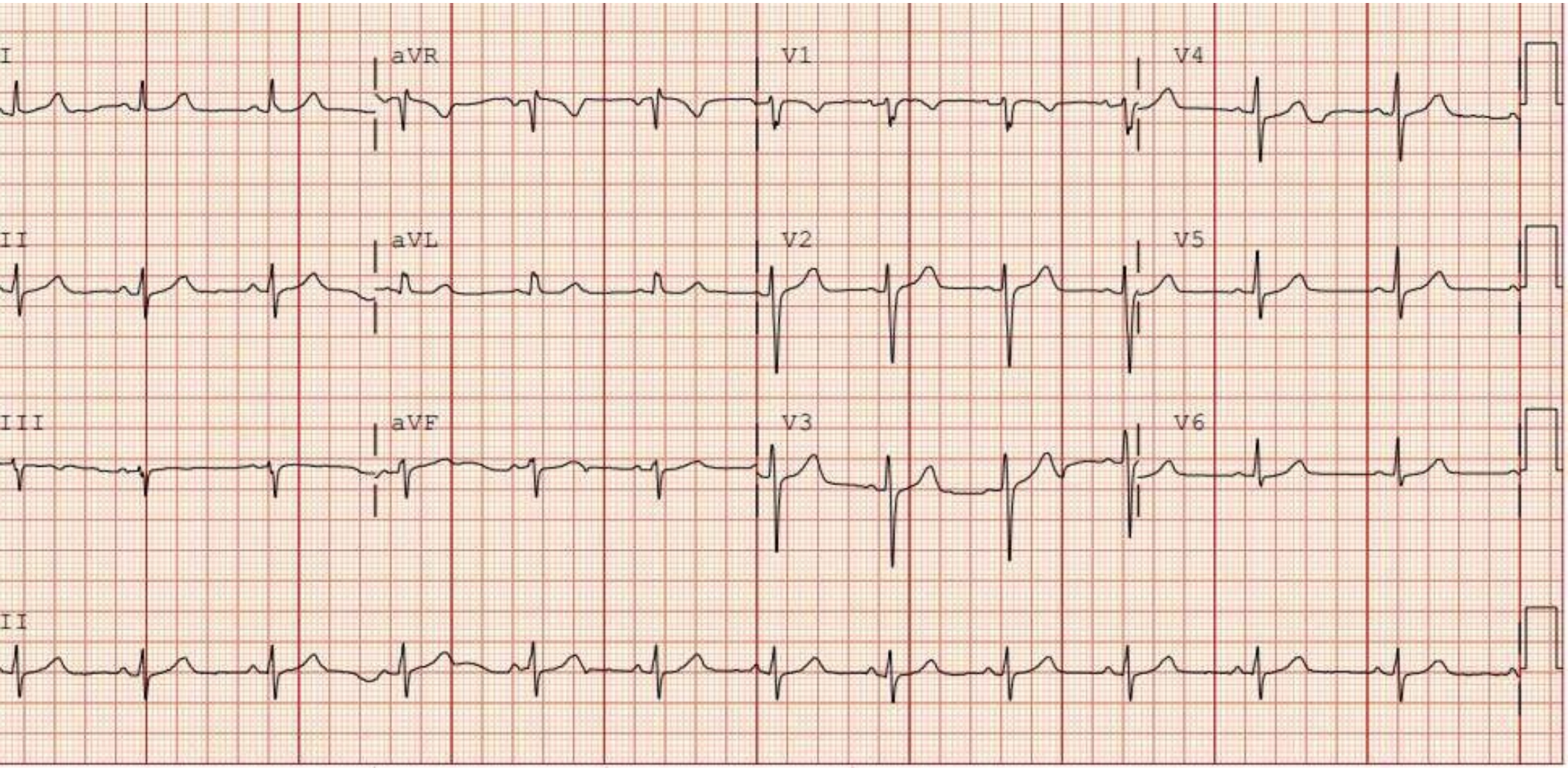
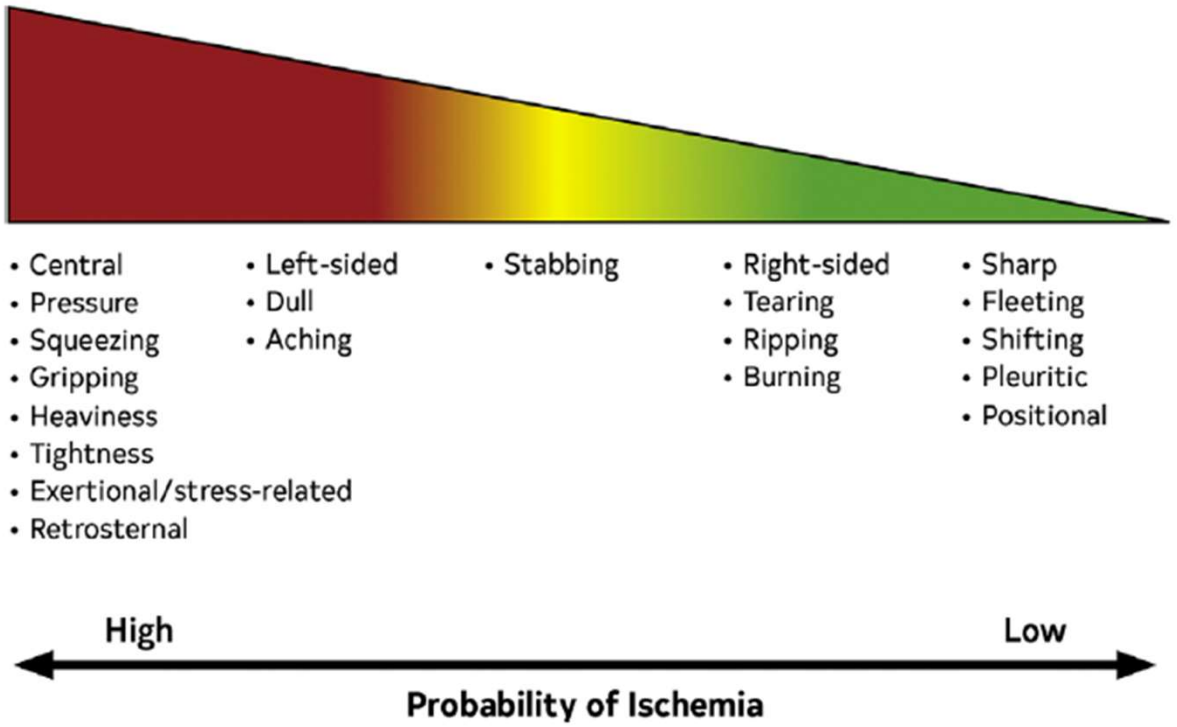

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II

FIGURE 2 Index of Suspicion That Chest "Pain" Is Ischemic in Origin on the Basis of Commonly Used Descriptors



Gulati M, Levy PD, Mukherjee D, Amsterdam E, Bhatt DL, Birtcher KK, Blankstein R, Boyd J, Bullock-Palmer RP, Conejo T, Diercks DB, Gentile F, Greenwood JP, Hess EP, Hollenberg SM, Jaber WA, Jneid H, Joglar JA, Morrow DA, O'Connor RE, Ross MA, Shaw LJ. 2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/SCMR guideline for the evaluation and diagnosis of chest pain: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. J Am Coll Cardiol. 2021

Other considerations

- Female and DM – DOE or heartburn not resolved with antacids
- Associated sx: nausea, vomiting, diaphoresis
- "felt like the last time"

Risk Factors

- Tobacco use
- Hypertension
- Hyperlipidemia
- Diabetes
- Family history of CAD <65 years (assuming patient is <65)
- ESRD
- HIV
- Autoimmune disease

Evaluation Options

- Treadmill stress
- Coronary CTA
- Stress echo
  - Exercise
  - Dobutamine
- Nuclear stress
  - Exercise
  - Regadenoson/adenosine
  - Dobutamine
- PET
- MRI

Gulati M, Levy PD, Mukherjee D, Amsterdam E, Bhatt DL, Birtcher KK, Blankstein R, Boyd J, Bullock-Palmer RP, Conejo T, Diercks DB, Gentile F, Greenwood JP, Hess EP, Hollenberg SM, Jaber WA, Jneid H, Joglar JA, Morrow DA, O'Connor RE, Ross MA, Shaw LJ. 2021 AHA/ACC/ASE/CHEST/SAEM/SCCT/SCMR guideline for the evaluation and diagnosis of chest pain: a report of the American College of Cardiology/American Heart Association Joint Committee on Clinical Practice Guidelines. J Am Coll Cardiol. 2021

Treadmill Stress

- Quick, noninvasive
- Able to ambulate well?
- Baseline EKG abnormalities?
- Betablocker use?
- High rate of false positives, women especially

Coronary CTA

- Quick and informative
- Renal function acceptable?
- HR <75
- Age <60 preferred
- Not helpful if prior PCI
- NOT a functional test – may have buildup that doesn't limit blood flow

Imaging Modalities

Stress Echocardiogram

- No radiation
- Identify areas with wall motion abnormalities
- Agile and able to ambulate well?
- Betablocker use?

Nuclear Stress Test

- Long and lots of radiation
- Functional test for ischemia
- Which method best?
- Betablocker?
- NO caffeine x 24 hours

Regadenoson

- Reactive airway dz/wheezing
- Seizure disorder – use adenosine
- PE
- >1st degree heart block

Stress Tests

- Exercise whenever possible
- Don't order it expecting it to be normal – if you are that sure it will be why get it?

Case 5

64 M farmer from rural KS and no known PMH presents with syncope. Was working on his tractor and just went down. Doesn't remember much and this is the first time it has ever happened. Was told he had a murmur a long time ago.

- BP 136/82 P 65 RR 18
- Exam notable for 4/6 systolic ejection murmur that radiates into carotids

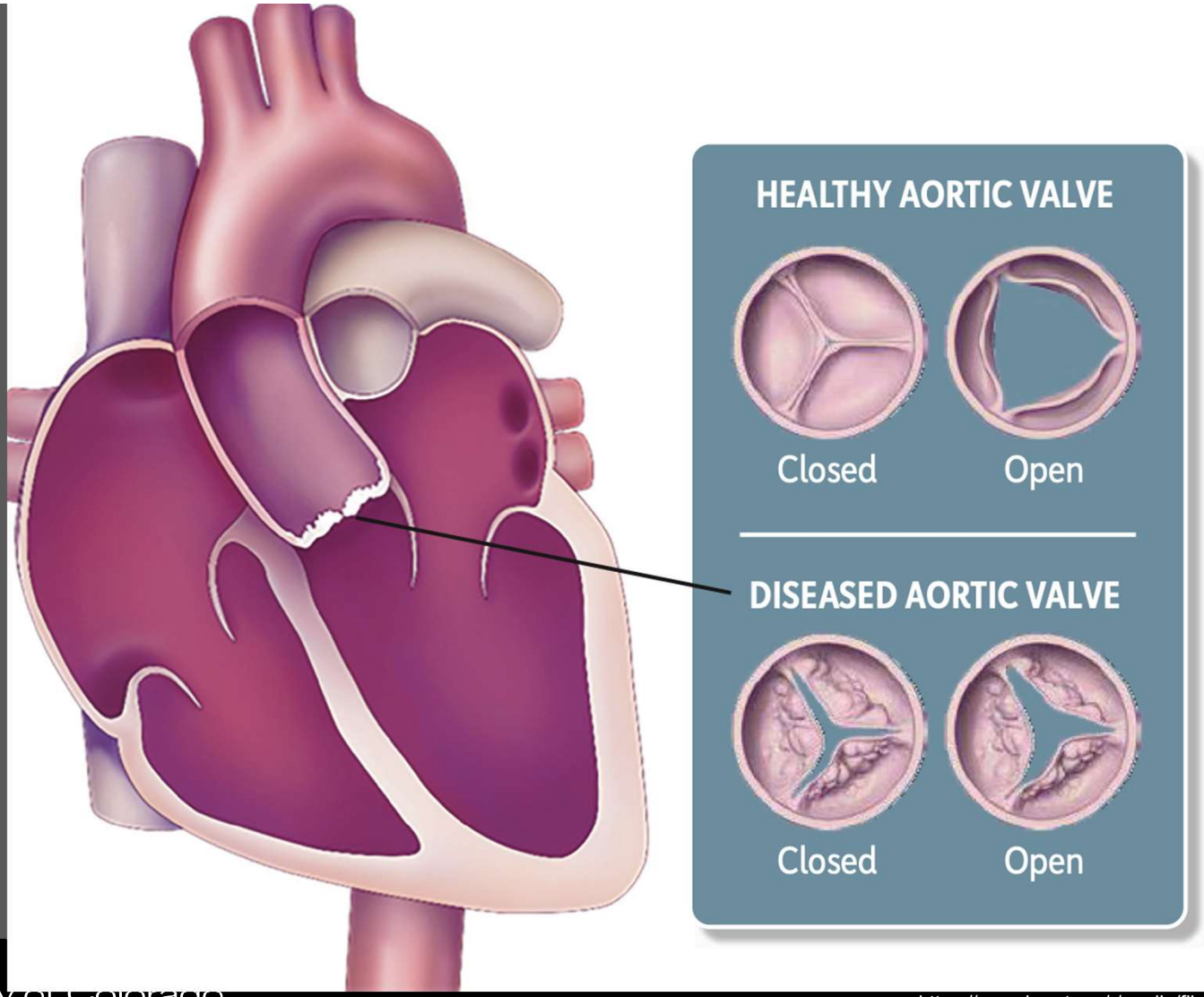
Case 5

- Further questioning he reports some mild chest heaviness and dizziness while working lately which he attributes to dehydration

- TTE: nl LV and RV function, bicuspid aortic valve with mean gradient 54 mmHg and peak velocity 4.7 m/s

Severe Aortic Stenosis

- ~5% of people >65 yo affected
- 50% will die within 2 years of symptoms without intervention
- Symptoms
  - Angina
  - Exertional dyspnea
  - Fatigue
  - Volume overload/HF
  - Syncope/near syncope



https://www.heart.org/-/media/files/health-topics/answers-by-heart/what-is-aortic-valve-stenosis.pdf?la=en&hash=55E6F9790E47DC3F27A7135D7AE79FB0

Severe Aortic Stenosis

- Criteria for intervention
  - Symptomatic
  - Asymptomatic with LVEF <50%
- SAVR vs TAVR
- Timing of intervention

Case 5 – now what?

- Outpatient referral to cardiology
- Outpatient referral to CT surgery
- Inpatient consult to cardiology
- Discharge home with cardiac monitor

Case 6

54 F presents to ED with chest pain and is found to have a blood pressure of 180/94. No headache, lightheadedness, dizziness, vision changes. Does get some dyspnea with exertion.

- BP 180/94 P 92 RR 13
- Exam notable for very loud (5/6) murmur heard in the aortic position

Transthoracic echocardiogram

Normal LV size with normal global systolic function. Severe LVH with proximal septal thickening. There is moderate LVOT obstruction at rest (33 mmHg) with significant increase in the gradient with Valsalva maneuver (104 mmHg). Spectral Doppler of pulmonary veins suggests increased LA pressures. The transmitral spectral Doppler flow pattern is suggestive of pseudonormalization.
Normal RV size and systolic function.
The left atrium is severely dilated. Injection of agitated saline documented no interatrial shunt.
There is systolic anterior motion of the mitral valve. There is mild to moderate mitral regurgitation.The mitral regurgitant jet is eccentrically directed.
Estimation of right ventricular systolic pressure is not possible due to incomplete tricuspid regurgitation envelope.
There is moderate aortic root dilatation.
The pulmonary artery is mildly dilated.
The inferior vena cava is normal in size with respiratory collapse, indicating a right atrial pressure of approximately 3 mmHg.
Small pericardial effusion.

HOCM Treatment

- Goal heart rate low 50s-40s
- CCB +/- BB
- Maintain adequate hydration
- Avoid afterload reduction!

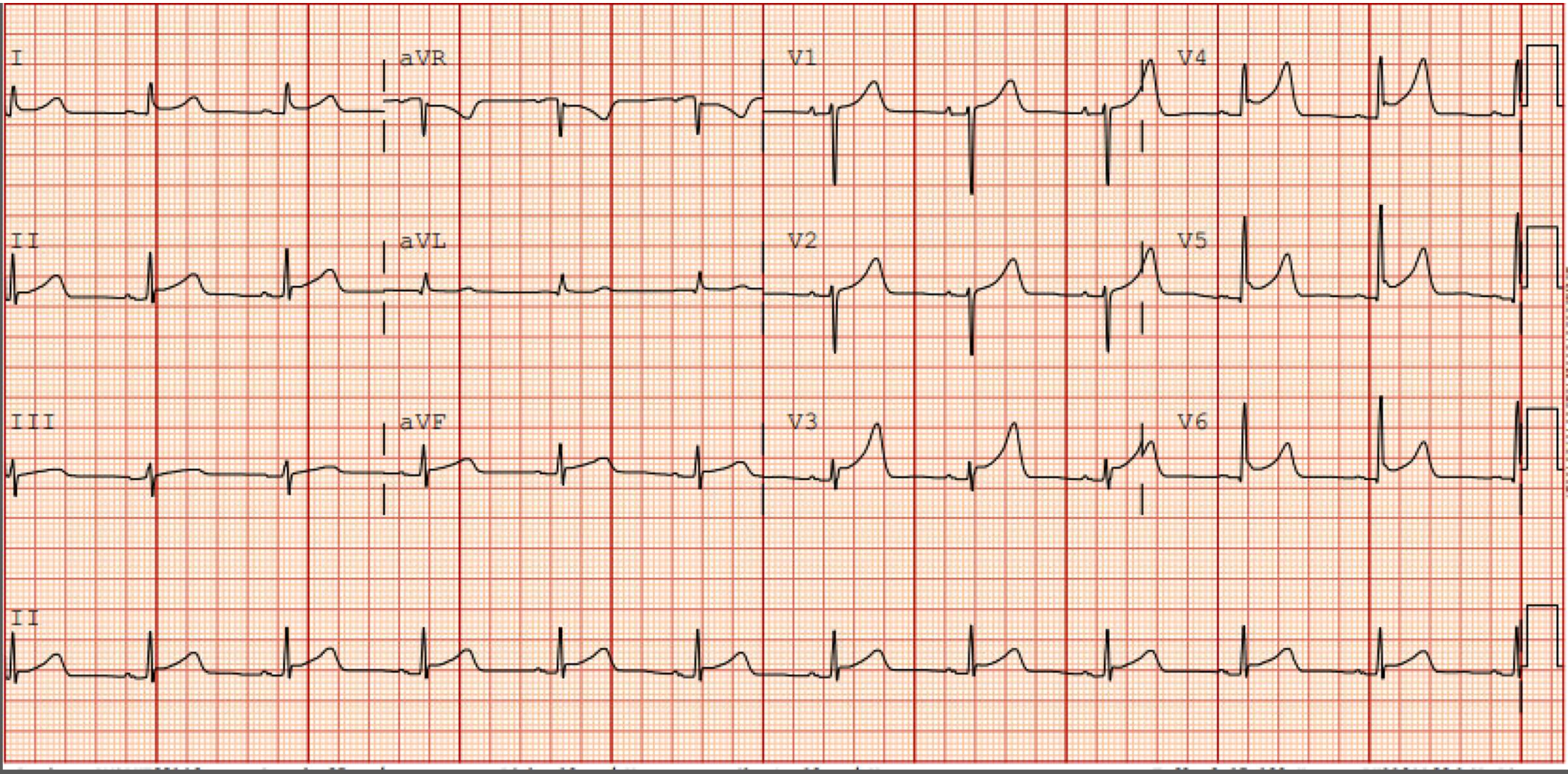
Case 6 – now what?

- Outpatient referral to cardiology
- Start verapamil and rapidly titrate up
- Give fluids
- Start metoprolol and rapidly titrate up

Case 7

23 M presents to ED with chest pain that is worse when he lays down. Recently had COVID19 but symptoms resolved. Hard to take a deep breath due to the discomfort.

- BP 116/78 P 112 RR 15
- Exam notable for tachycardia with a sternal rub
- HsTrop I: 16 (F nl <16, M <20)


I
aVR
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V4
II
aVL
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V5
III
aVF
V3
V6
II

Case 7 – what is it?

- ACS
- Myocarditis
- Pericarditis
- Myopericarditis

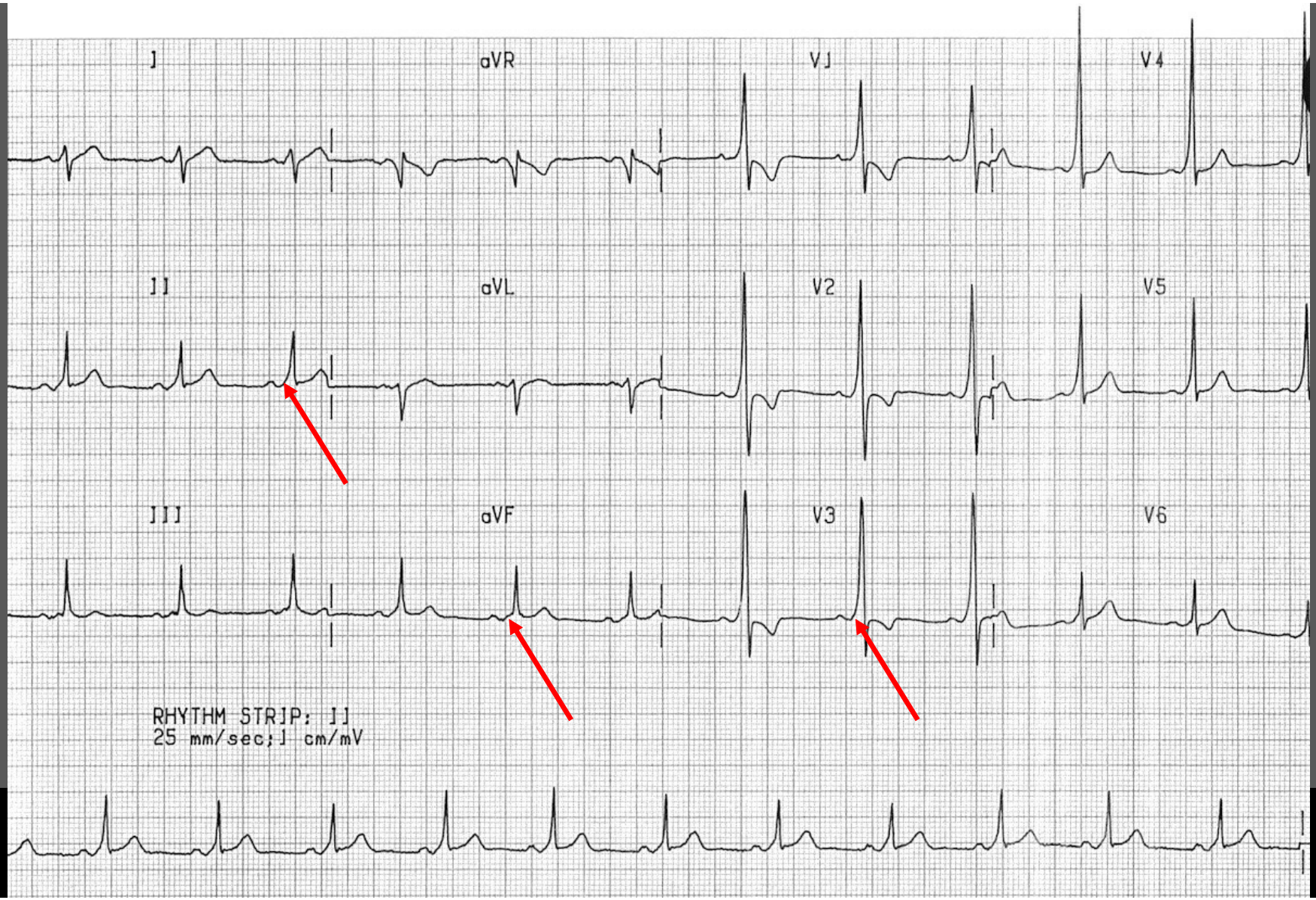
Pericarditis Treatment

- NSAIDs
- Colchicine
- Very rare steroids

- Prolonged treatment course, especially if sx recur

Case 8

25 yo M comes to ED after developing palpitations and feeling extremely tired while playing basketball. He was found to be in SVT. Since he knew exactly when it started the ED completed DCCV and he is NSR. He is now admitted to your service with an abnormal ECG and concern for recurrence.


I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
RHYTHM STRIP: II
25 mm/sec; 1 cm/mV

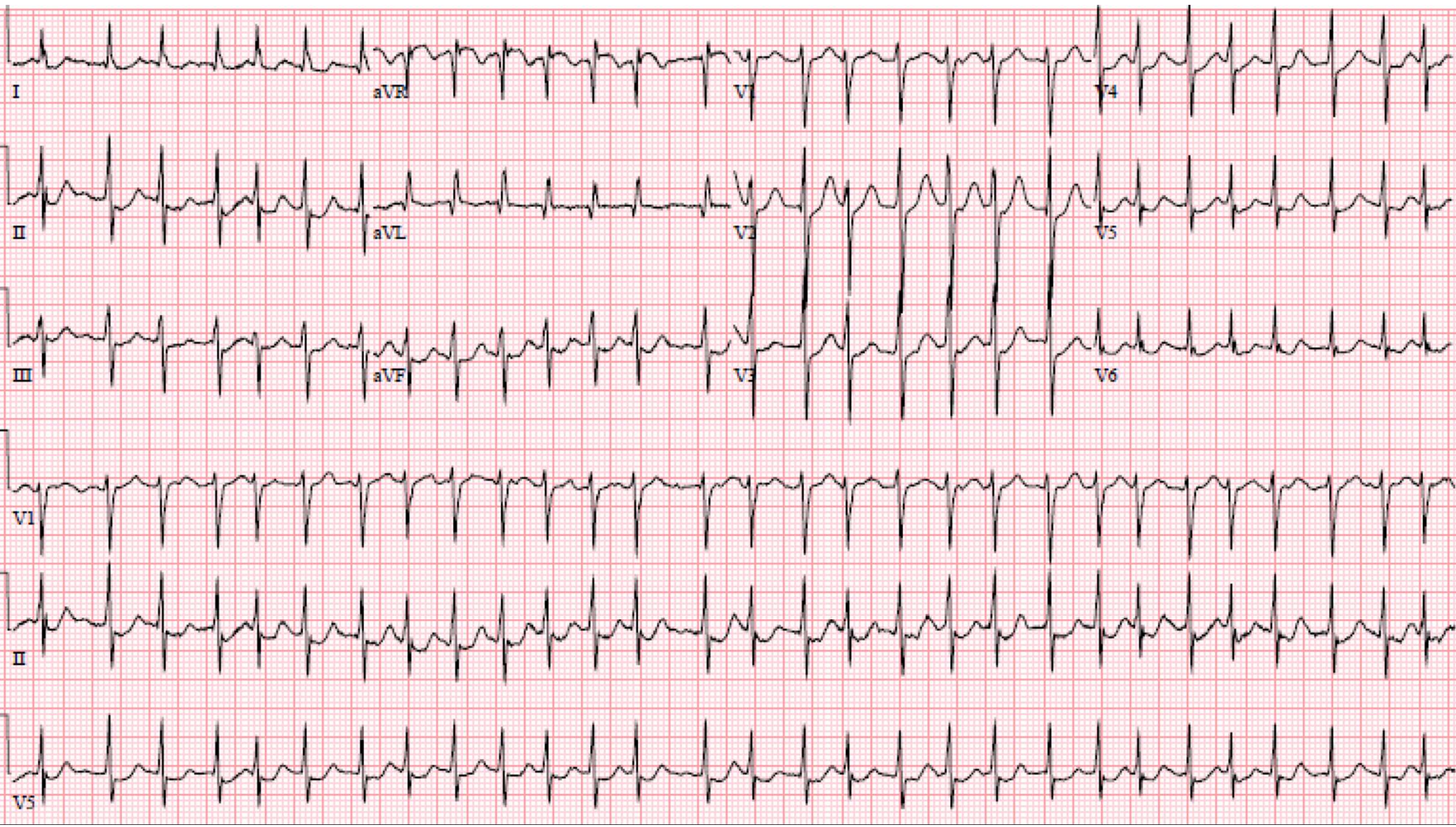
Wolff-Parkinson-White Syndrome

- Accessory pathway with pathopneumonic Delta waves
- Can present as chest pain or arrhythmias
- Typically much younger
- Require EP consultation for ablation

Case 9

72 M with hx of CAD, HTN, HLD, DM, and OSA. Admitted with osteomyelitis of the R foot. Telemetry notifies you that his heart rate has jumped up to 155 bpm and has been sustained for at least 10 minutes.

- Patient resting comfortably without any cp, pressure, tightness or palps. Feels no different than when you rounded on him earlier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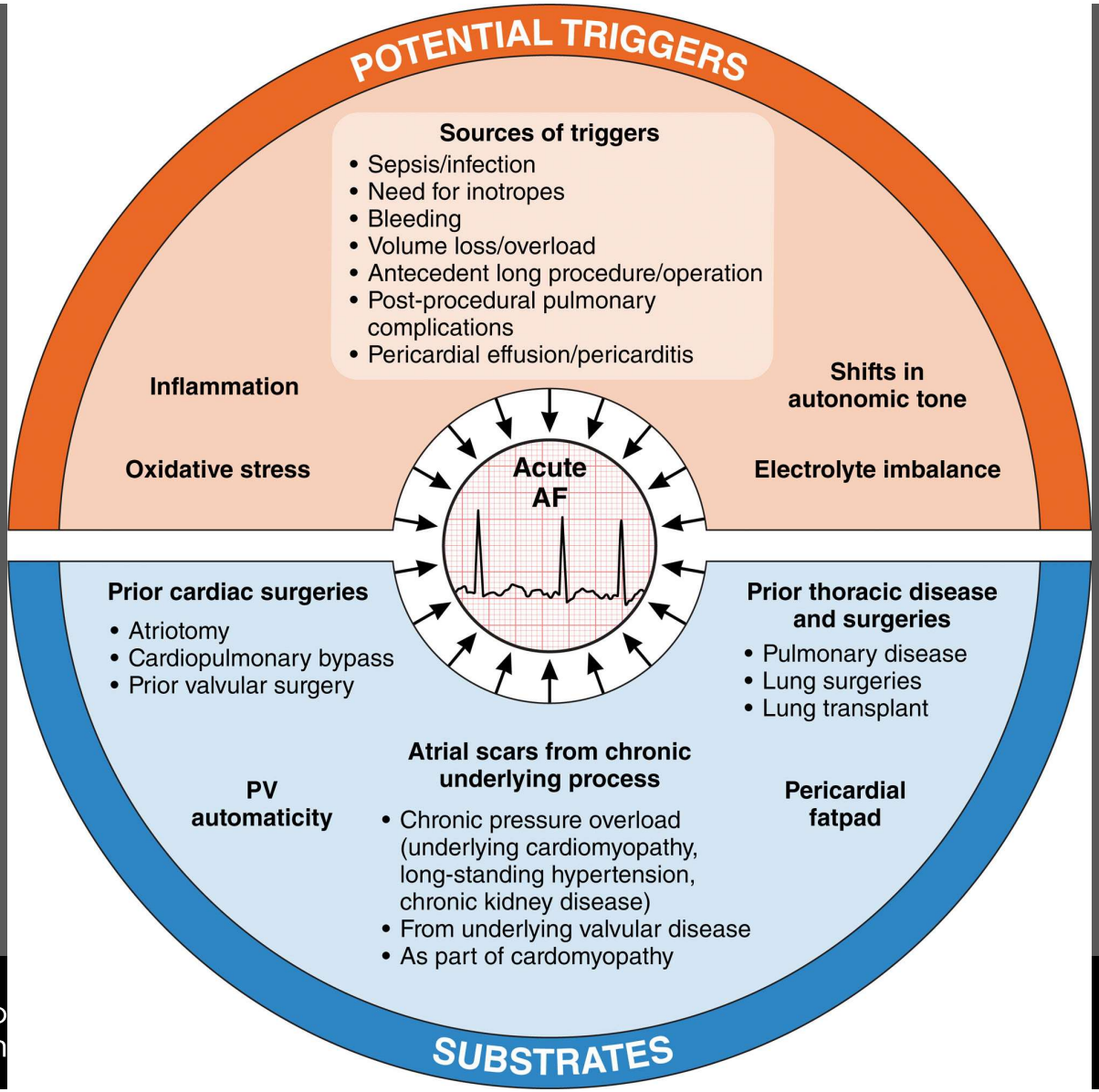
V5

TABLE 4 Definitions of AF: A Simplified Scheme

Term	Definition
Paroxysmal AF	• AF that terminates spontaneously or with intervention within 7 d of onset. • Episodes may recur with variable frequency.
Persistent AF	• Continuous AF that is sustained >7 d.
Long-standing persistent AF	• Continuous AF >12 mo in duration.
Permanent AF	• The term "permanent AF" is used when the patient and clinician make a joint decision to stop further attempts to restore and/or maintain sinus rhythm. • Acceptance of AF represents a therapeutic attitude on the part of the patient and clinician rather than an inherent pathophysiological attribute of AF. • Acceptance of AF may change as symptoms, efficacy of therapeutic interventions, and patient and clinician preferences evolve.
Nonvalvular AF	• AF in the absence of rheumatic mitral stenosis, a mechanical or bioprosthetic heart valve, or mitral valve repair.

AF indicates atrial fibrillation.

January C, Wann L, Alpert J, et al. 2014 AHA/ACC/HRS Guideline for the Management of Patients With Atrial Fibrillation. J Am Coll Cardiol. 2014 Dec, 64 (21) e1–e76. https://doi.org/10.1016/j.jacc.2014.03.022



Chyou JY, Barkoudah E, Dukes JW, Goldstein LB, Joglar JA, Lee AM, Lubitz SA, Marill KA, Sneed KB, Streur MM, Wong GC, Gopinathannair R; on behalf of the American Heart Association Acute Cardiac Care and General Cardiology Committee, Electrocardiography and Arrhythmias Committee, and Clinical Pharmacology Committee of the Council on Clinical Cardiology; Council on Cardiovascular Surgery and Anesthesia; Council on Cardiopulmonary, Critical Care, Perioperative and Resuscitation; Council on Cardiovascular and Stroke Nursing; and Stroke Council. Atrial fibrillation occurring during acute hospitalization: a scientific statement from the American Heart Association. *Circulation*. 2023;147:e676–e698. doi: 10.1161/CIR.0000000000001133

Acute Management

Rate Control

- Asymptomatic
- Hemodynamically stable
- Other medical issues

Beta block vs CCB

Rhythm Control

- Symptomatic
- Hemodynamically unstable
- Optimized

Cardioversion vs
Anti-arrhythmic

Risk factors		
C	Congestive Heart Failure	+1 point
H	Hypertension	+1 point
A_2	Age ≥75	+2 point
D	Diabetes	+1 point
S_2	Stroke/TIA History	+2 point
V	Vascular Disease	+1 point
A	Age 65-74	+1 point
S	Sex (Female)	+1 point

Stroke risk per year	
SCORE	% RATE PER YEAR
0	0%
1	1.3%
2	2.2%
3	3.2%
4	4.0%
5	6.7%
6	9.8%
7	9.6%
8	6.7%
9	15.2%

Reference: European Heart Rhythm Association. Guidelines for the management of atrial fibrillation: the Task Force for the Management of Atrial Fibrillation of the European Society of Cardiology (ESC). *Eur Heart J*. 2010;31(19):2369-2429.

Atrial Flutter

- Rates ~150, typically steady (look at graphic trends)
- Very challenging to rate control
- Usually need DCCV +/- ablation

Treating Arrhythmias

- DON'T PANIC
- Look for reversable causes
  - Bleeding
  - Electrolyte abnormalities
  - Volume issues
  - Held meds?
- Treat if hemodynamically unstable or very symptomatic

Case 10

45 yo F with no PMH but family history of heart failure presents with new onset swelling in her legs and ankles over the past 2 months. When thinks about it has been more tired over the past 6 months. Denies chest pain, pressure or discomfort.

- BP 112/68 P 93 R 15 O2 98% on RA

Transthoracic Echocardiogram

LV is normal in size and thickness with moderately reduced systolic function. EF is 34.3 %. There is a component of global hypokinesis that is more pronounced hypokinesis in the left anterior descending artery distribution (anterior wall, apex, anteroseptum, and distal inferior wall).

There is dense sludge and possibly early thrombus formation see in the left ventricular apex.

The right ventricle is not well visualized. The chamber appears borderline dilated with grossly normal function.

Estimation of RVSP not possible due to incomplete tricuspid regurgitation envelope.

There is no evidence of a pericardial effusion.

Right pleural effusion versus ascites.

New Onset HF

All Patients

- Ischemic evaluation
- Labs
  - CBC
  - CMP
  - TSH
  - BNP or pro-NT BNP

Select patients

- Labs
  - HIV
  - SPEP, UPEP
  - Iron Studies
- Cardiac MRI

Loop Diuretics

- Improves symptoms, does not reduce morbidity or mortality
- No superiority in dose response exists amount the IV loop diuretics when administered at equivalent doses
- Can add thiazide (e.g. metolazone PO) if ineffective response

- Oral bioavailability differs:

bumetanide 1 mg PO = torsemide 20 mg PO = furosemide 40 mg PO

Loop Diuretics

Drug	Bioavailability	Cash Price* (max dose)	Considerations
Furosemide	10-100%	$4	20-40 mg daily
Bumetanide	80-90%	$30-60	10-20 mg daily
Torsemide	80-100%	$10-20	160 mg BID
Ethacrynic Acid	100%	>$200	used for real sulfa-allergic patients

Guideline Directed Medical Therapy

1. Evidence based betablocker
    1. Metoprolol succinate
    2. Carvedilol
    3. Bisoprolol
2. ACEi/ARB/ARNI
3. MRA
4. SGLT2i

Guideline Directed Medical Therapy

Other options

- Digoxin
- Hydralazine/Isosorbide dinitrate
- Ivabradine

Case 11

78 yo M presents after passing out. He woke up in the middle of the night to go to the bathroom and next thing he knew he was on the ground. No chest pain or palpitations. No shortness of breath.

- BP 136/68 P 80 R 14 O2 98% on RA

TABLE 3 Historical Characteristics Associated With Increased Probability of Cardiac and Noncardiac Causes of Syncope (40,47-55)

More Often Associated With Cardiac Causes of Syncope
■ Older age (>60 y)
■ Male sex
■ Presence of known ischemic heart disease, structural heart disease, previous arrhythmias, or reduced ventricular function
■ Brief prodrome, such as palpitations, or sudden loss of consciousness without prodrome
■ Syncope during exertion
■ Syncope in the supine position
■ Low number of syncope episodes (1 or 2)
■ Abnormal cardiac examination
■ Family history of inheritable conditions or premature SCD (<50 y of age)
■ Presence of known congenital heart disease
More Often Associated With Noncardiac Causes of Syncope
■ Younger age
■ No known cardiac disease
■ Syncope only in the standing position
■ Positional change from supine or sitting to standing
■ Presence of prodrome: nausea, vomiting, feeling warmth
■ Presence of specific triggers: dehydration, pain, distressful stimulus, medical environment
■ Situational triggers: cough, laugh, micturition, defecation, deglutition
■ Frequent recurrence and prolonged history of syncope with similar characteristics

SCD indicates sudden cardiac death.

Cardiac Origin?

- Brief or no prodrome
- During exertion
- While supine or sitting
- Rare

Shen W, Sheldon R, Benditt D, et al. 2017 ACC/AHA/HRS Guideline for the Evaluation and Management of Patients With Syncope: Executive Summary. J Am Coll Cardiol. 2017 Aug, 70 (5) 620–663. https://doi.org/10.1016/j.jacc.2017.03.002

Syncope

Work up

- DETAILED history
- ECG/telemetry
- Orthostatic vitals
- Echocardiogram
- Home cardiac monitoring

Take Home Points

1. There are many different causes of chest pain, keep the differential broad
2. Always treat the patient not the numbers
3. Consider if the patient can/should be anticoagulated as most cardiac procedures involve heparin or AC
4. Be sure to rule out all of the concerning causes of syncope first

Questions??

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