ECG Clues that Really Matter: *STEMI and STEMI Equivalents*

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Disclosure

I have no financial interests or relationships to disclose.

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Basic Categories of Diagnostic Test Interpretation

- **Binary "YES or NO"**
  - **Qualitative urinary pregnancy test**
  - **PCR respiratory virus swabs**

3

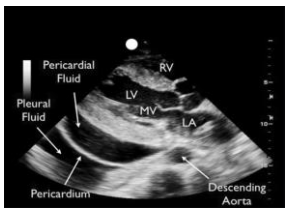
Basic Categories of Diagnostic Test Interpretation

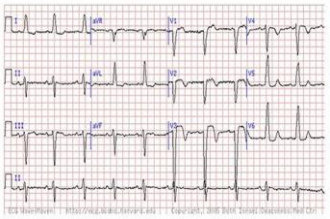
- **Quantitative**
  - **Quantitative pregnancy test**
  - **D-dimer**
  - **CBC**

4

Basic Categories of Diagnostic Test Interpretation

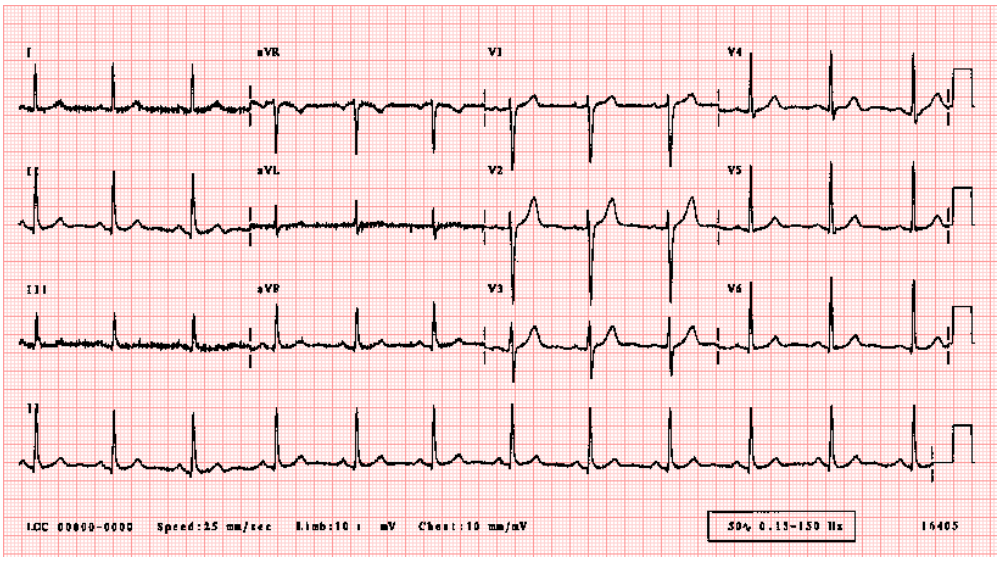
- **Pattern Recognition**
  - **Chest Xray**
  - **Abdominal CT**
  - **Bedside ultrasound**
  - **ECG**





5

After All These Years, The Good Old ECG Still Rocks!



6

High Praise for the Incredible Bedside ECG

- ❑ Easily mastered technique
- ❑ Available in minutes
- ❑ No adverse effects or radiation
- ❑ Cheap
- ❑ Immediately available results
- ❑ Provides clues that drive point-of-care actions
- ❑ Can save lives

7

American College of Cardiology

2022 ACC Expert Consensus Decision Pathway on the Evaluation and Disposition of Acute Chest Pain in the Emergency Department: A Report of the American College of Cardiology Solution Set Oversight Committee

Kontos MC, de Lemos JA, et al.
J Am Coll Cardiology 2022

8

American College of Cardiology

"Timely ECG acquisition and accurate interpretation are essential in the evaluation of patients presenting with undifferentiated chest discomfort"

Kontos MC, de Lemos, JA, et al.
J Am Coll Cardiology

9

European Society of Cardiology

ESC European Society of Cardiology
European Heart Journal (2023) **44**, 3720–3826
https://doi.org/10.1093/eurheartj/ehad191

ESC GUIDELINES

2023 ESC Guidelines for the management of acute coronary syndromes

Developed by the task force on the management of acute coronary syndromes of the European Society of Cardiology (ESC)

Byrne RA, Rossello X, et al.
European Heart Journal 2023

10

European Society of Cardiology

"The resting 12-lead ECG is the first-line diagnostic tool in the assessment of patients with suspected ACS. It is recommended that an ECG is obtained immediately upon first medical contact and interpreted by a qualified clinician."

Byrne RA, Rossello X, et al.
European Heart Journal 2023

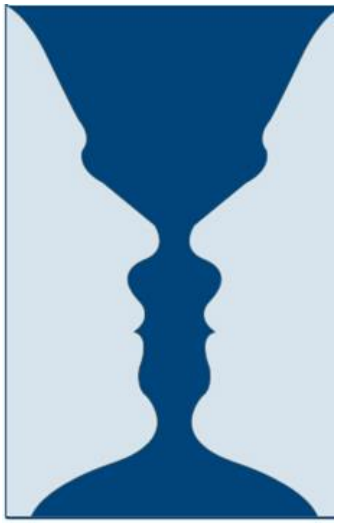
11

Learning Objectives

- ❑ **Review clinically actionable ECG patterns associated with Acute Coronary Syndrome**
- ❑ **Briefly discuss the conditions that are associated with these ECG patterns**

12

Sharpening Our ECG Pattern Recognition Skills in ACS



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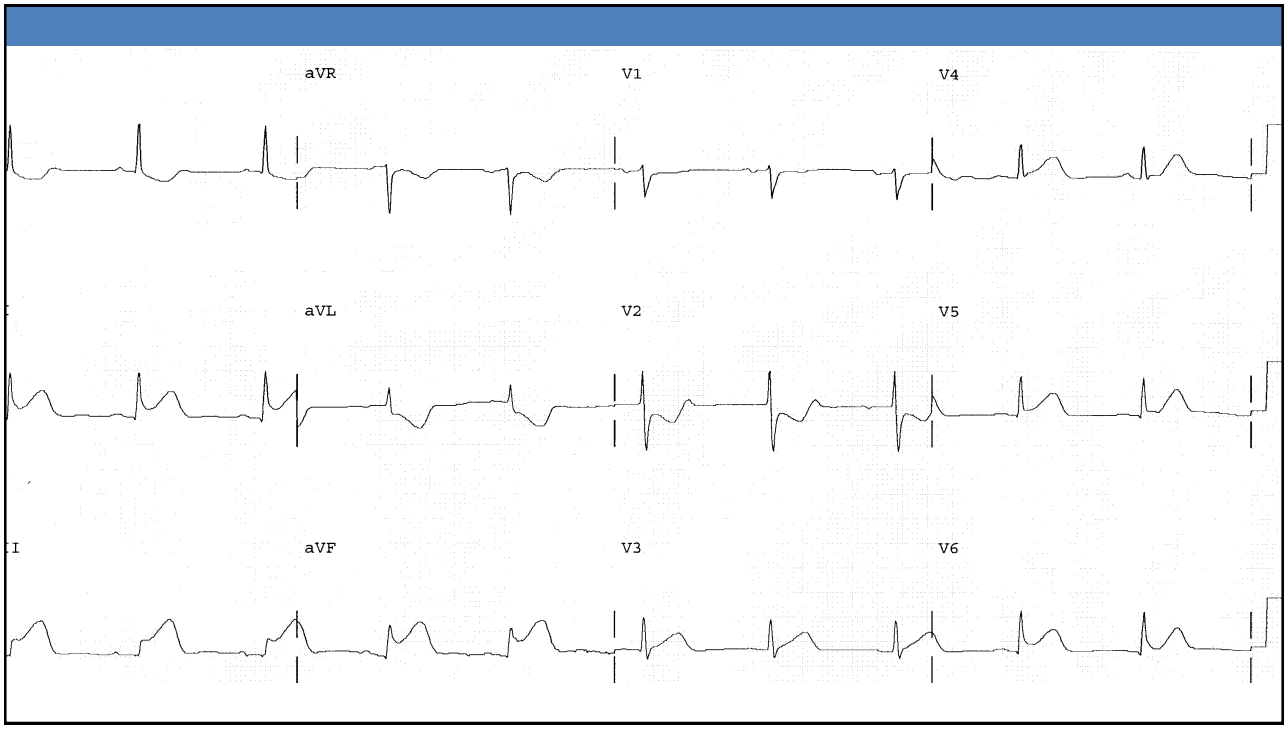

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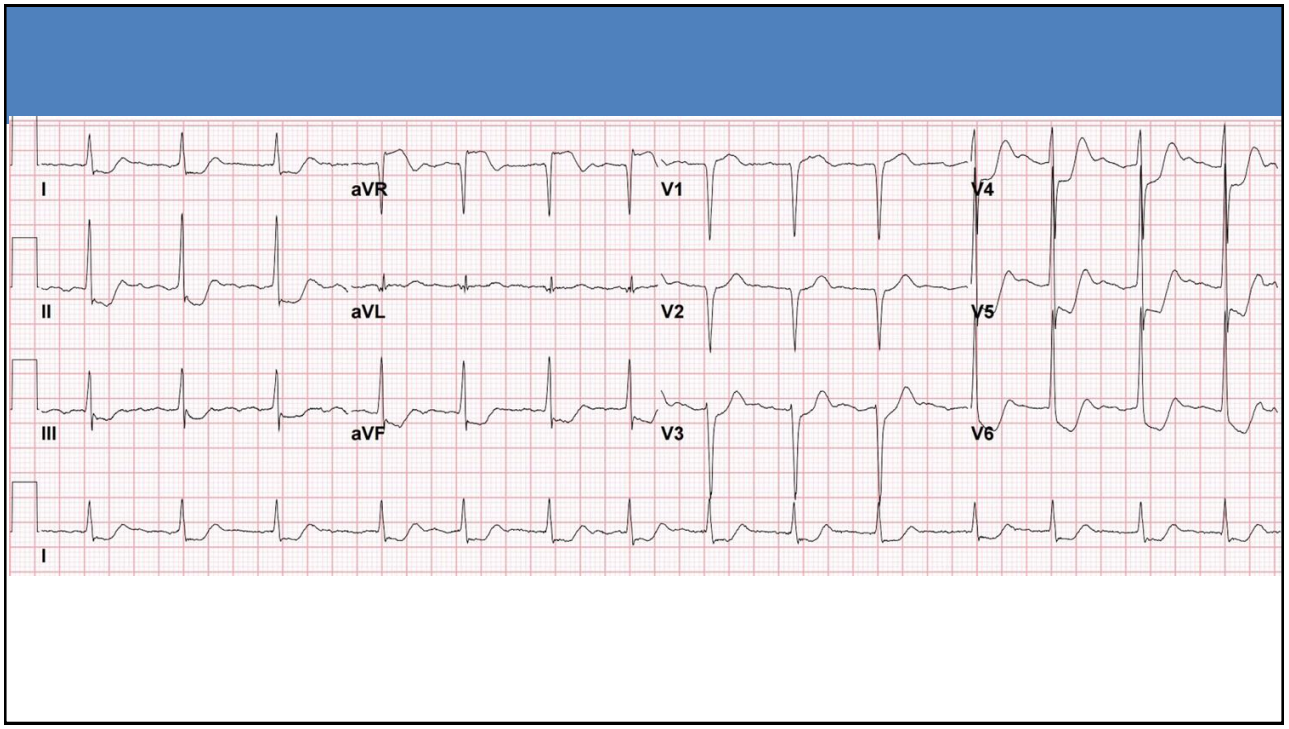
I
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V5
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V3
V6
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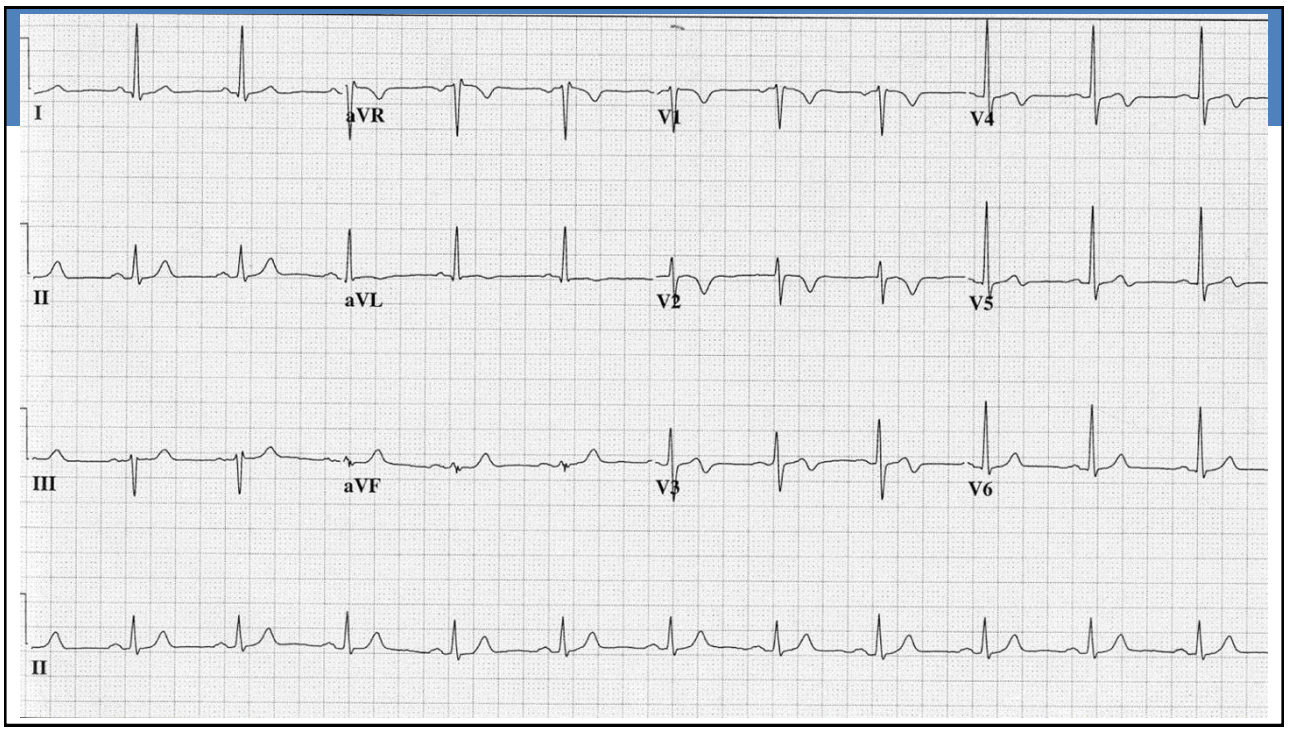
15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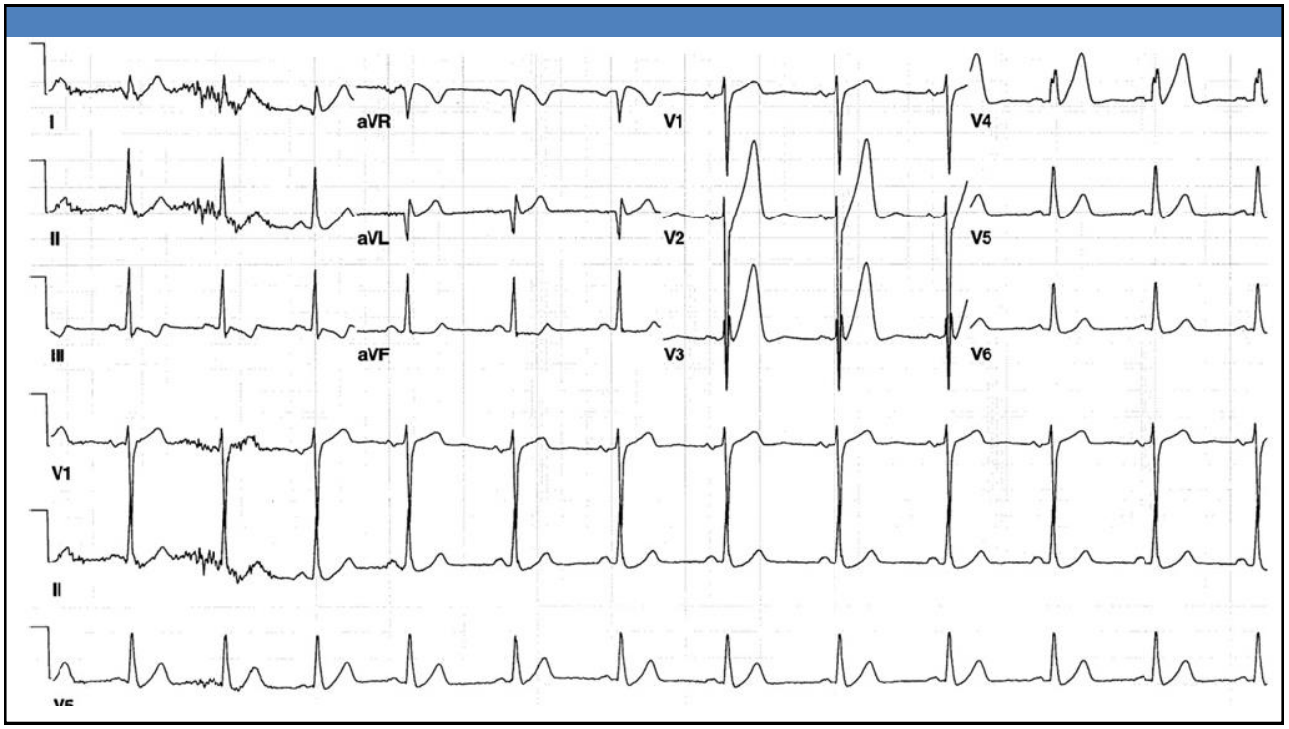
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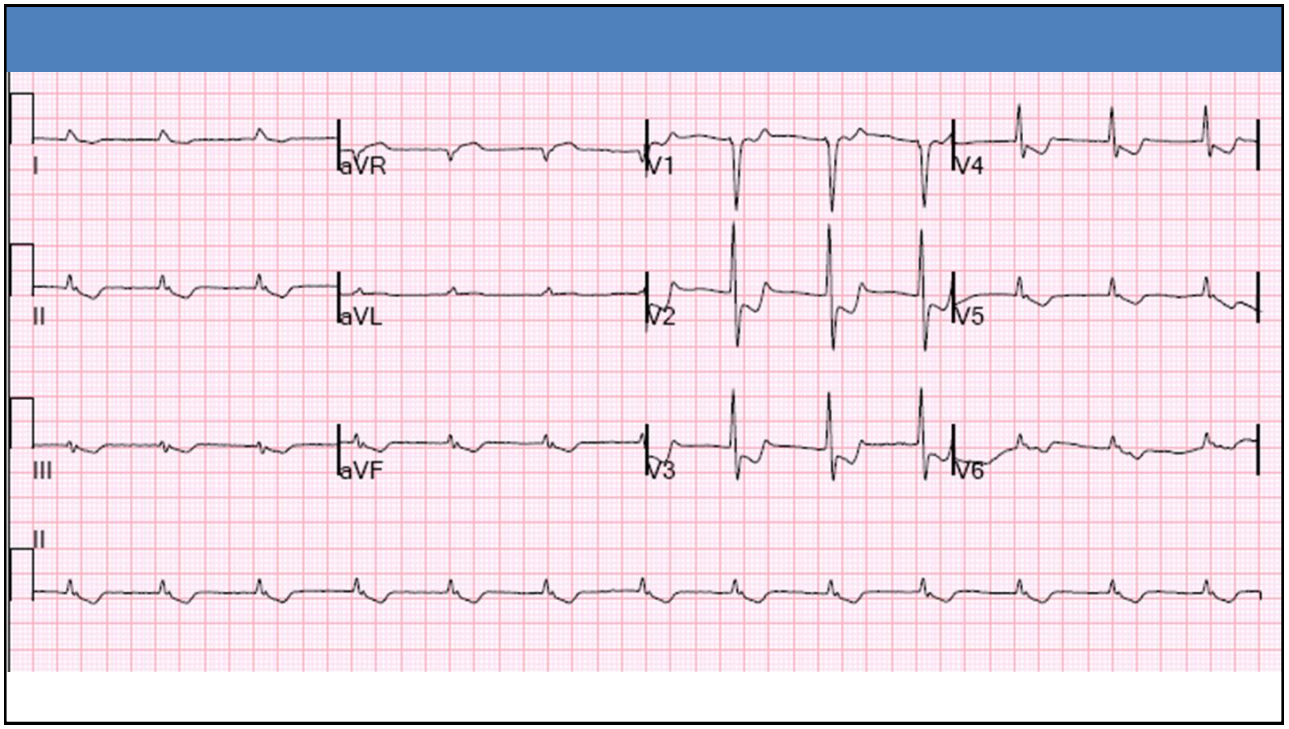
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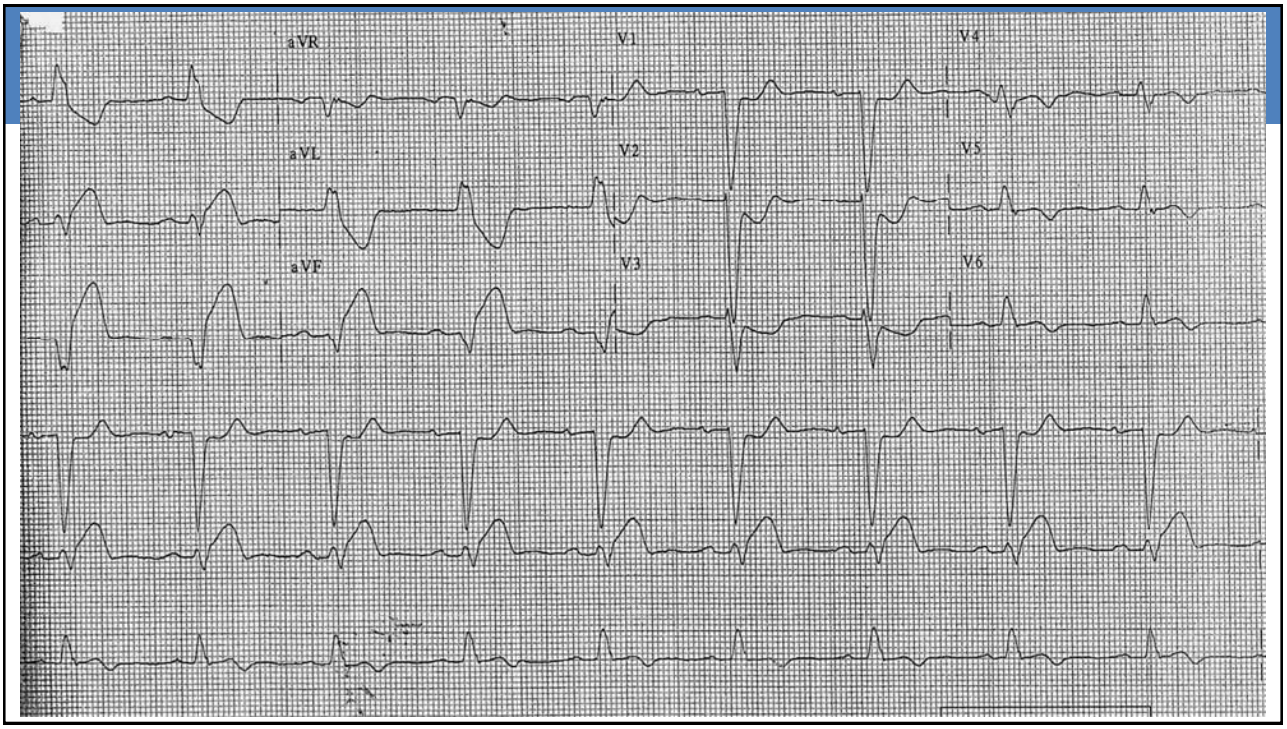

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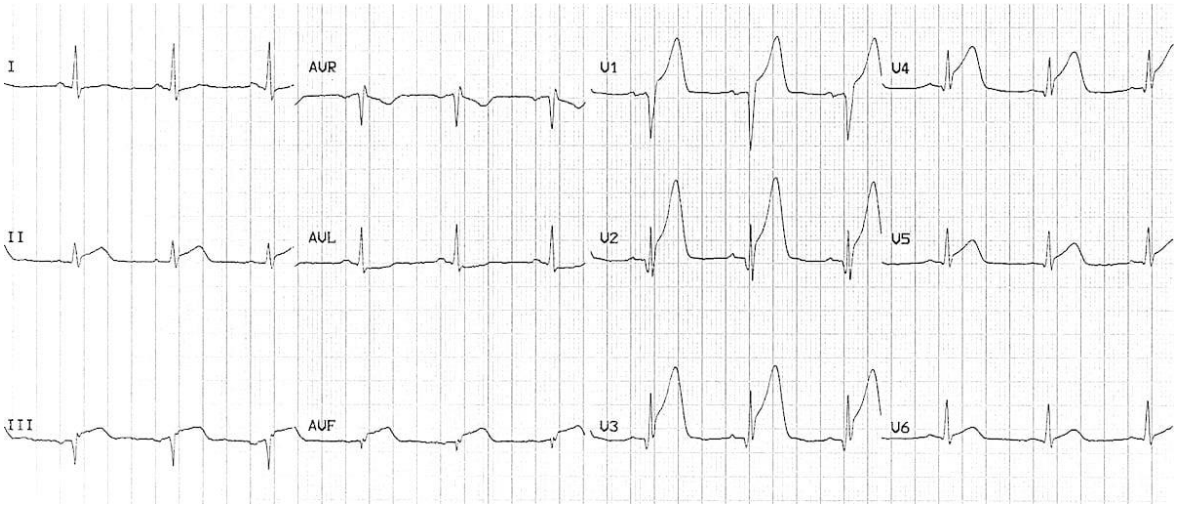
Sharpening Our ECG Pattern Recognition Skills in ACS

ST-Elevation Myocardial Infarction

STEMI

20

STEMI ECGs Are Old Friends:
Anterior STEMI



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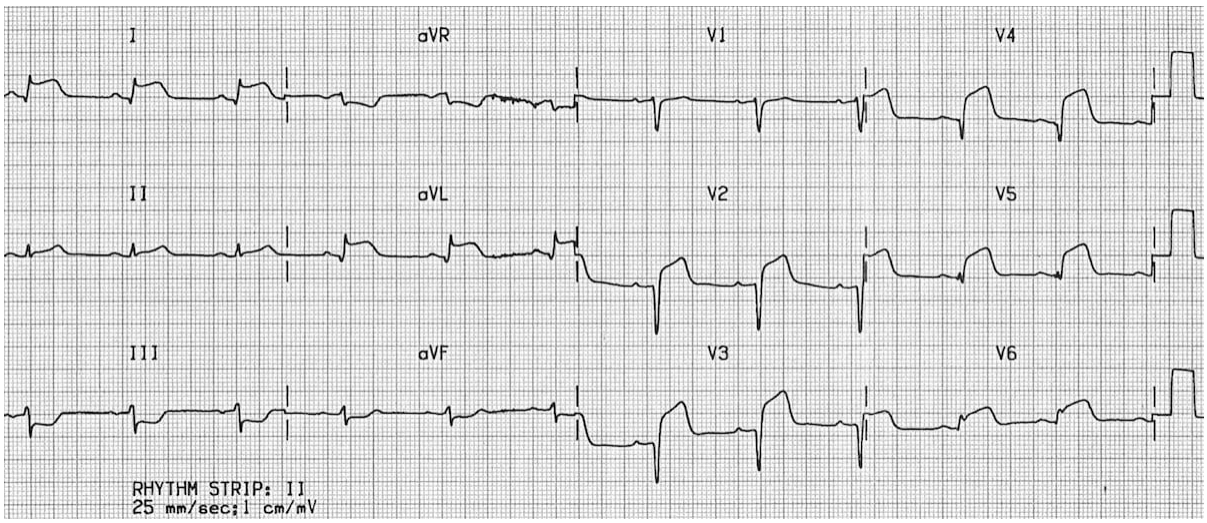
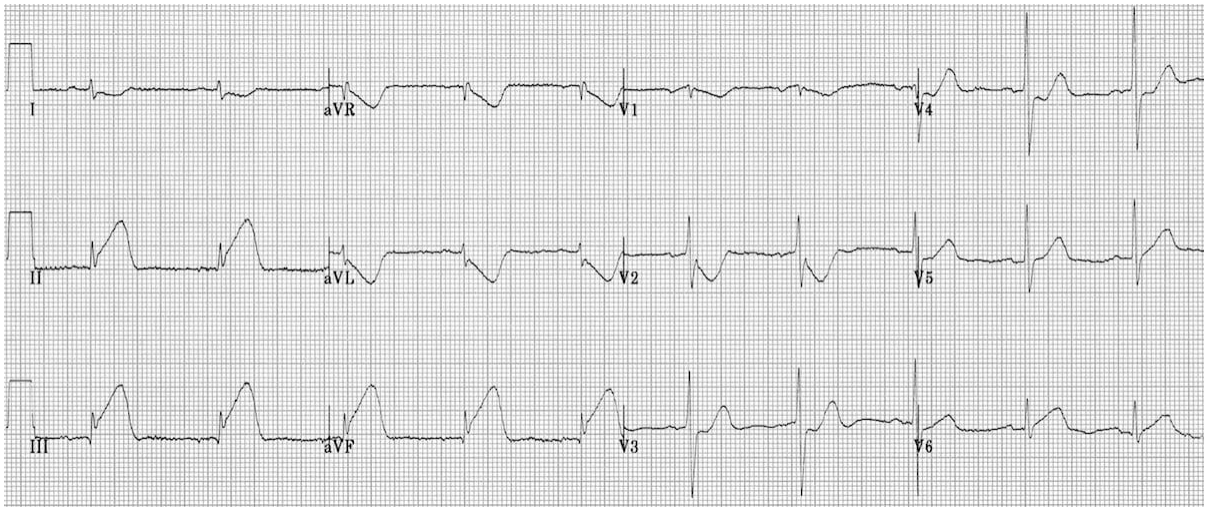
STEMI ECGs Are Old Friends:
Lateral STEMI



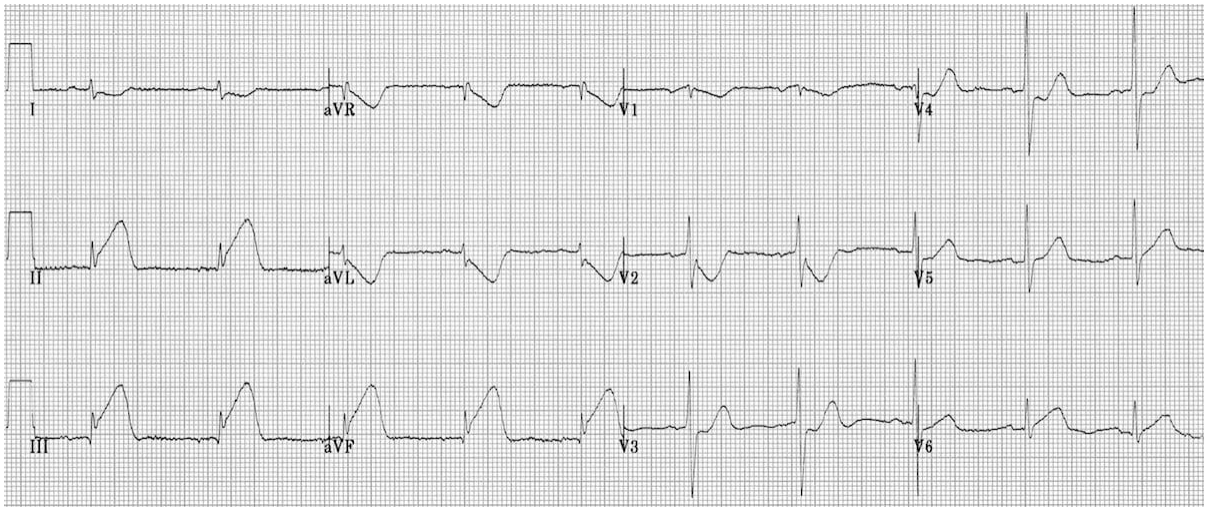
22

STEMI ECGs Are Old Friends: But a New Twist for **Inferior STEMI**



23

Inferior STEMI = Bedside Action



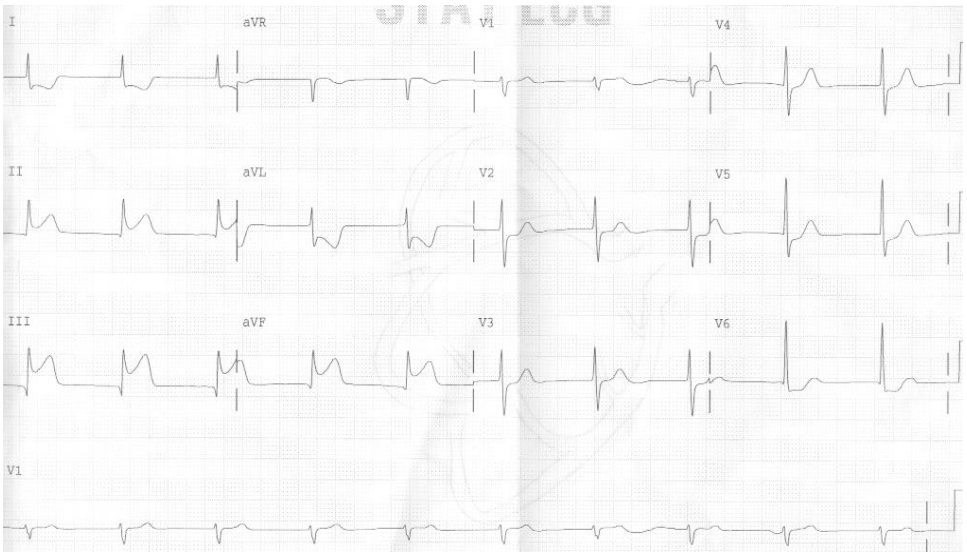
24

A 55-year-old Man Presents to Your Acute Care Clinic. He Complains that He Has Been Experiencing Severe Sub-sternal Chest Pain for the Past Hour.

As part of your emergent evaluation you obtain this ECG.

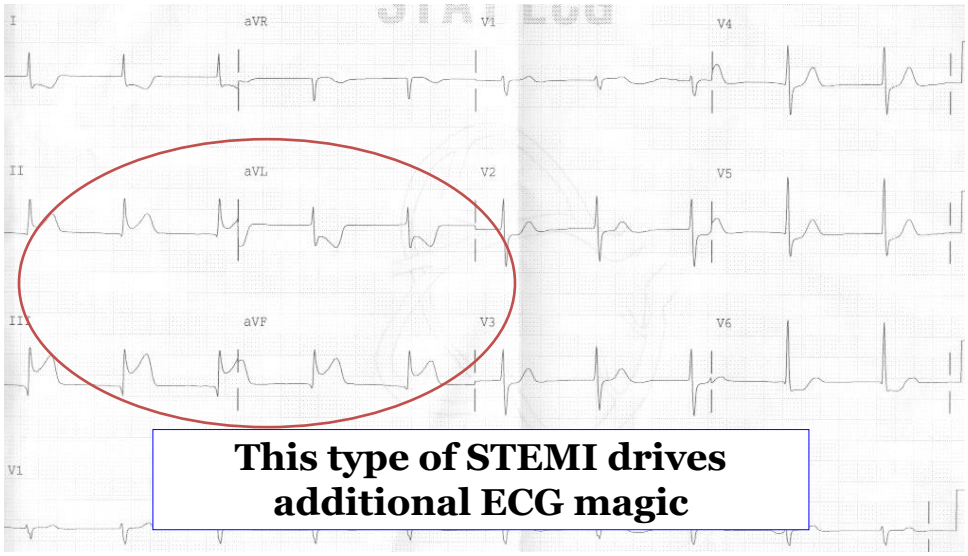
25

Any Clues Here?



26

Acute Inferior Myocardial Infarction



27

Right Ventricular Infarction

Think RVI when encountering a patient with an inferior AMI

28

Right Ventricular Infarction: ECG Changes

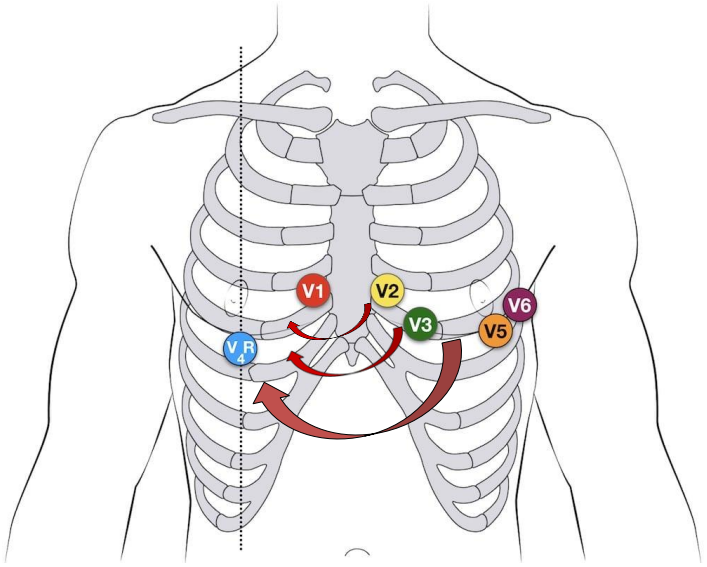
1.0 mm ST-segment elevation in lead R4V…

- **the most sensitive (70-100%)**
- **and specific (78 -100%)**

Kinch, J.W., et al, *Right Ventricular Infarction* NEJM, 330(17), 28 April, 1994

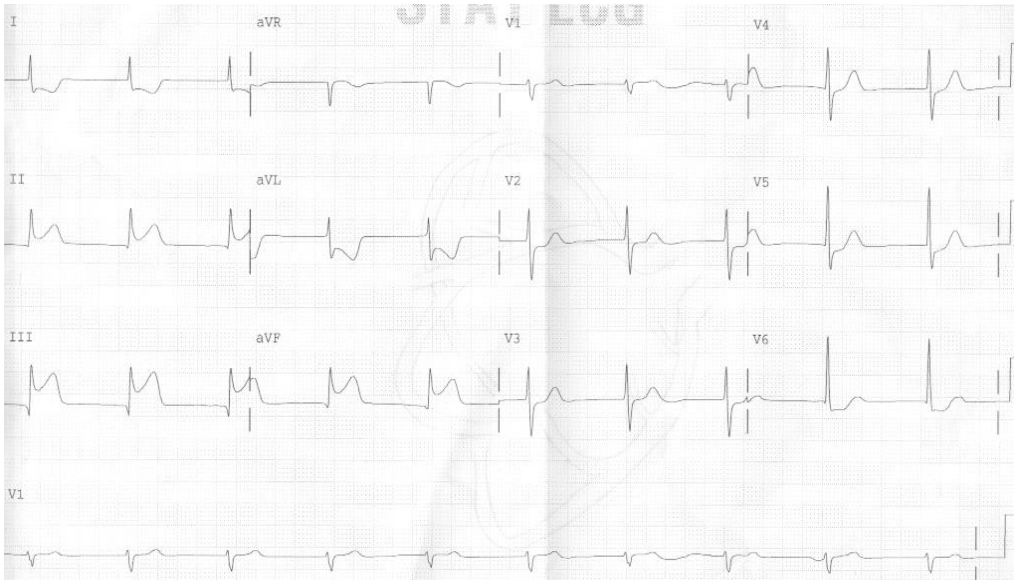
29

Simply Relocate Leads V2, V3 & V4 from Left to Right



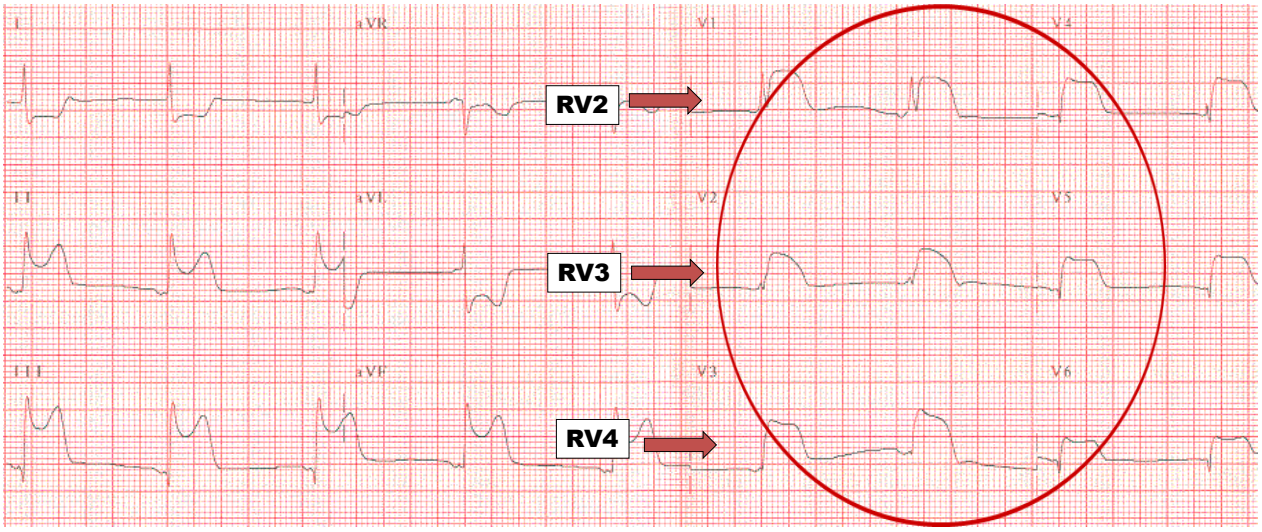
30

Back to Our Man with an Inferior STEMI



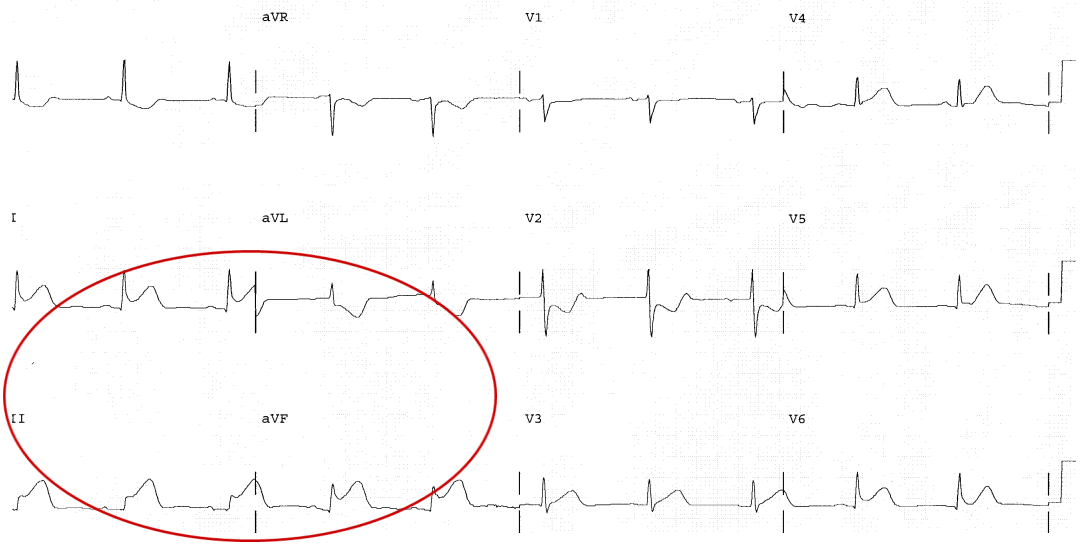
31

His Right Sided Leads Demonstrate RVI



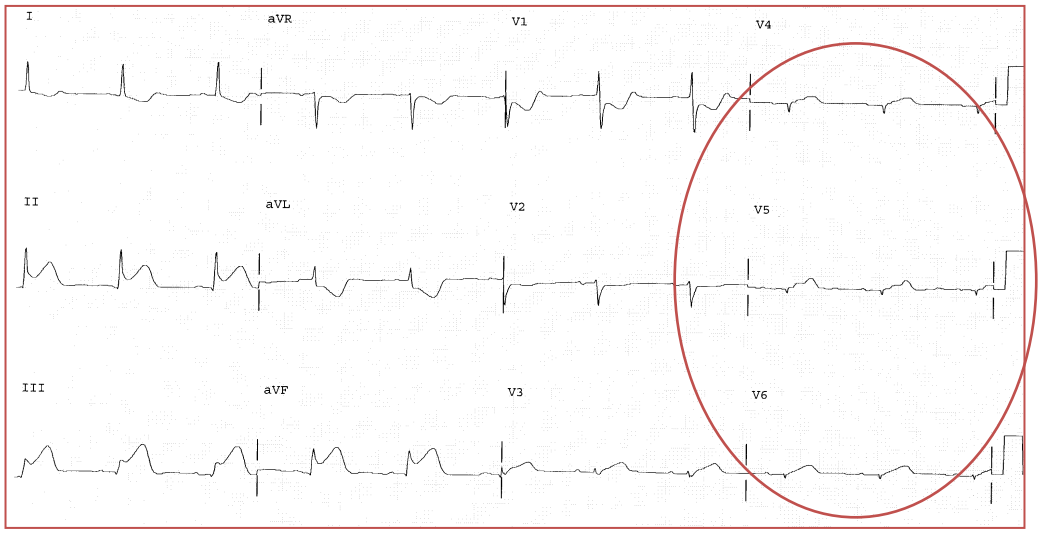
32

A 60-yo Man with an Inferior STEMI



33

His Right Sided Leads Do Not Demonstrate an RVI

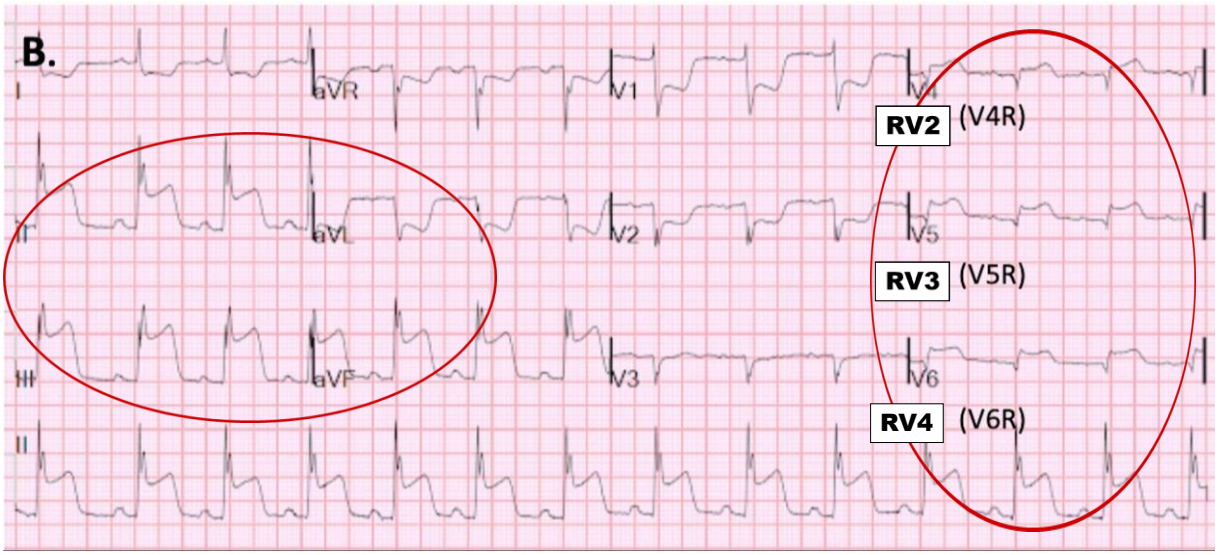


34

A 46-yo Man with an Infero-lateral STEMI

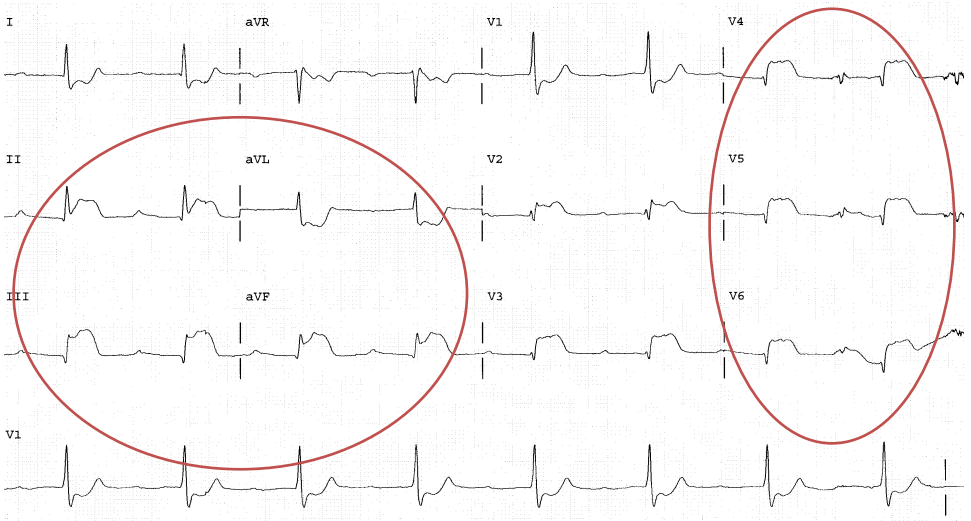
35

+RVI, But Avoid Confusing Descriptors: Use RV2, RV3 & RV4



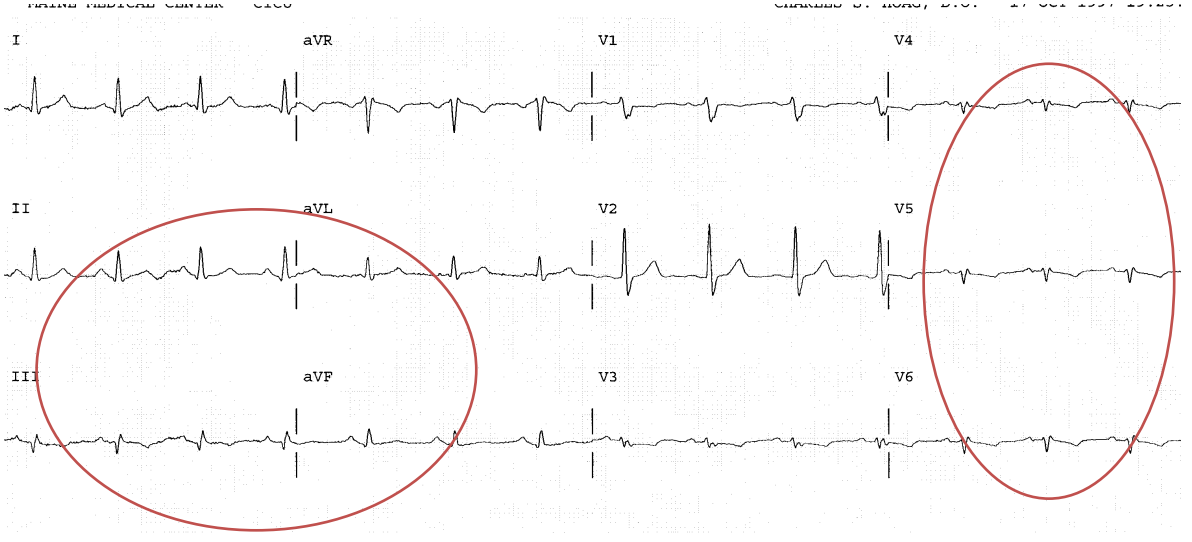
36

47-yo Man with an Inferior STEMI and RVI



37

Same Patient After Successful Thrombolysis



38

A Clue to a RV Infarction: Look for Subtle ST-segment Elevation in V1

39

Right Ventricular Infarction: Rx

- **Focus on augmenting pre-load and decreasing after-load**
  - **Cautious fluid administration**
  - **Supporting contractility: e.g. dobutamine**
- **Be vigilant if agents that can decrease pre-load or contractility are required**
  - **Nitrates, morphine, beta-blockers and diuretics**

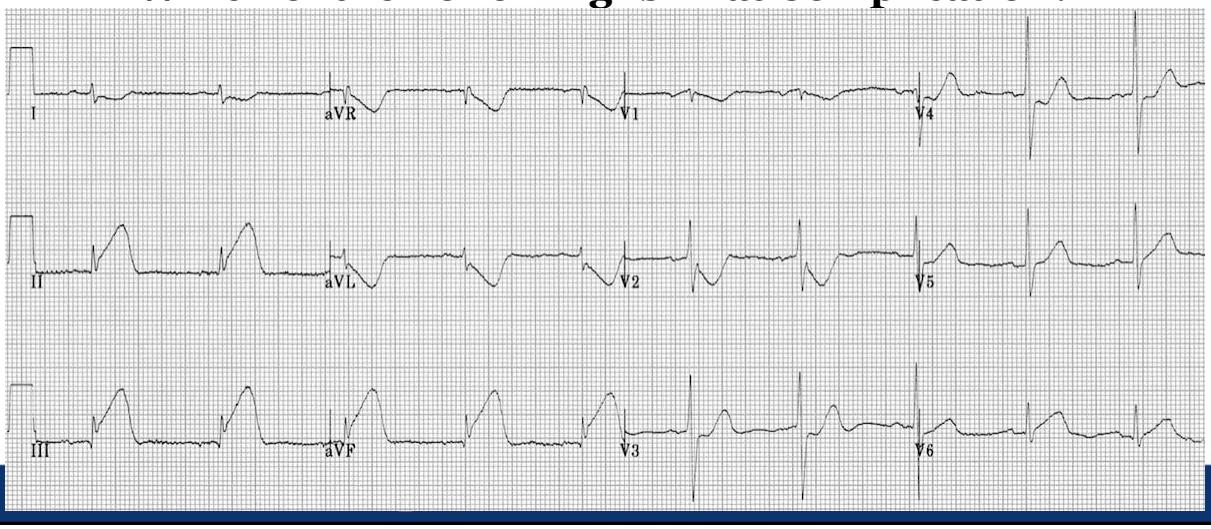
40

Right Ventricular Infarction: Take-to-Work Points

- **Always consider the possibility of a right ventricular infarction when a patient presents with an acute inferior wall STEMI**
- **The simple act of obtaining right-sided chest leads will answer this question**

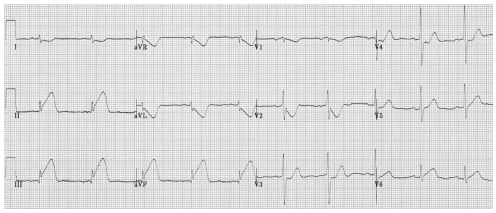
41

This Specific STEMI Is Associated with a Critical Complication Impacting Initial Management That Can Be Quickly Identified at the Bedside. Which of the Following Is That Complication?



42

This Specific STEMI Is Associated with a Critical Complication Impacting Initial Management That Can Be Quickly Identified at the Bedside.



Which of the Following Is That Complication?

A. Acute tricuspid valve insufficiency
B. Right ventricular infarction
C. Acute ventricular septal rupture

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Sharpening Our ECG Pattern Recognition Skills in ACS

Deserved Spotlight on Lead aVR

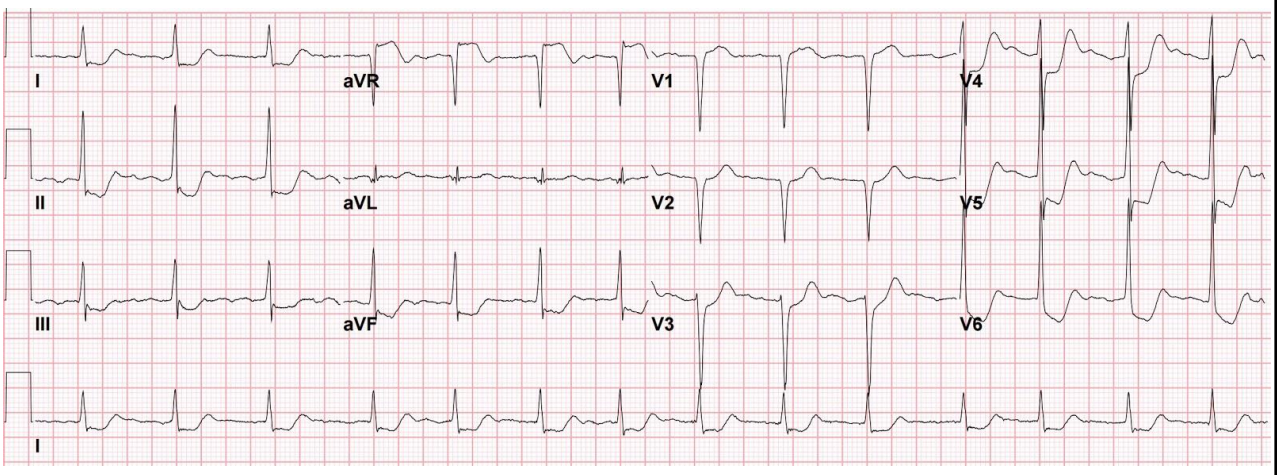
44

A 59-year-old Man Presents with 1-hour of Anterior Central Chest Discomfort

As Part of Your Emergent Evaluation, You Obtain an ECG

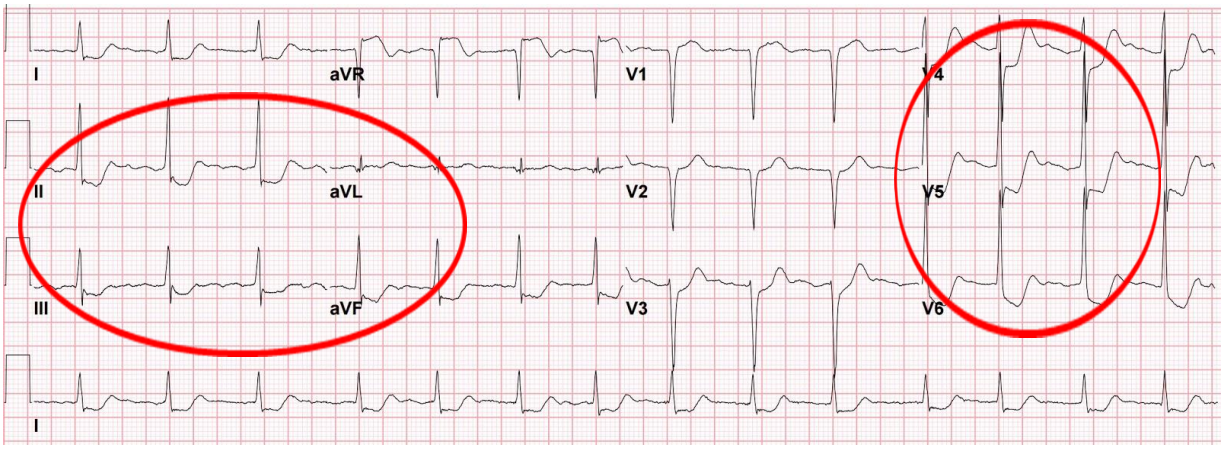
45

Let's Examine His ECG



46

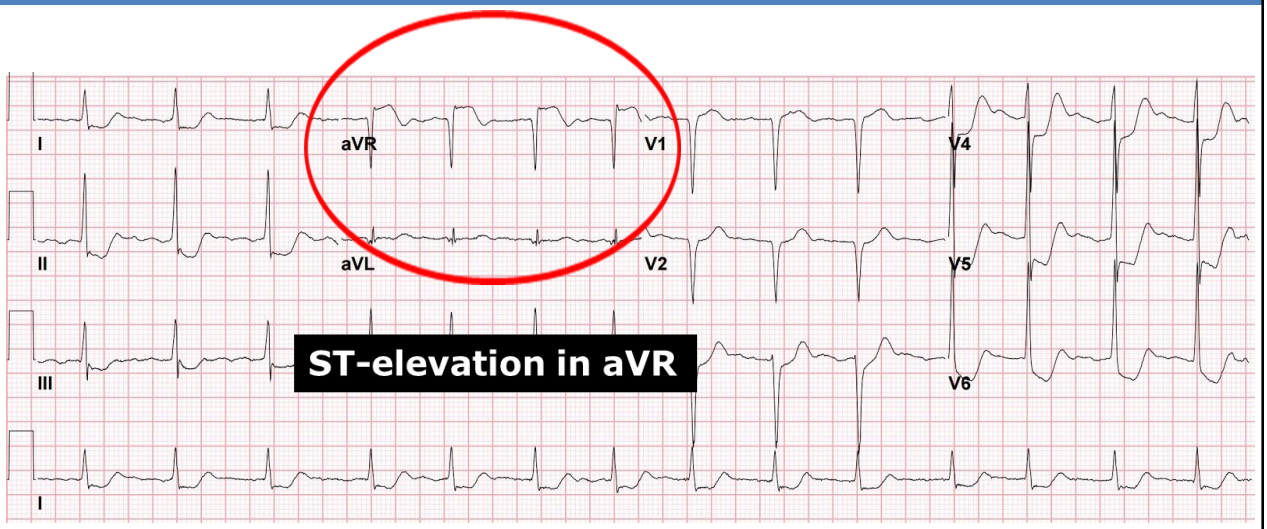
Let's Examine His ECG



Diffuse Reciprocal Changes

47

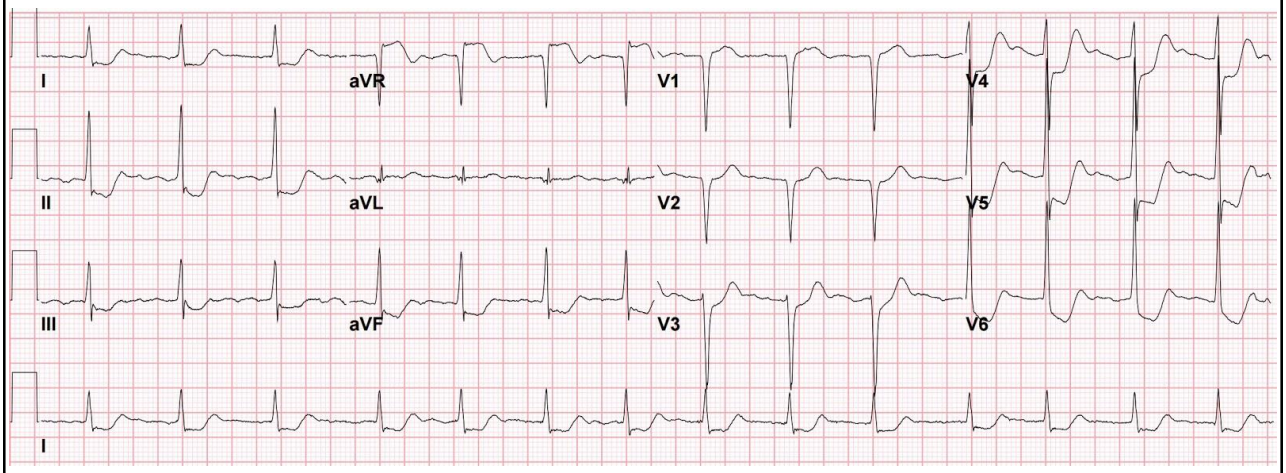
Let's Examine His ECG



ST-elevation in aVR

48

Let's Examine His ECG Again



49

ST-elevation in Lead aVR = STEMI

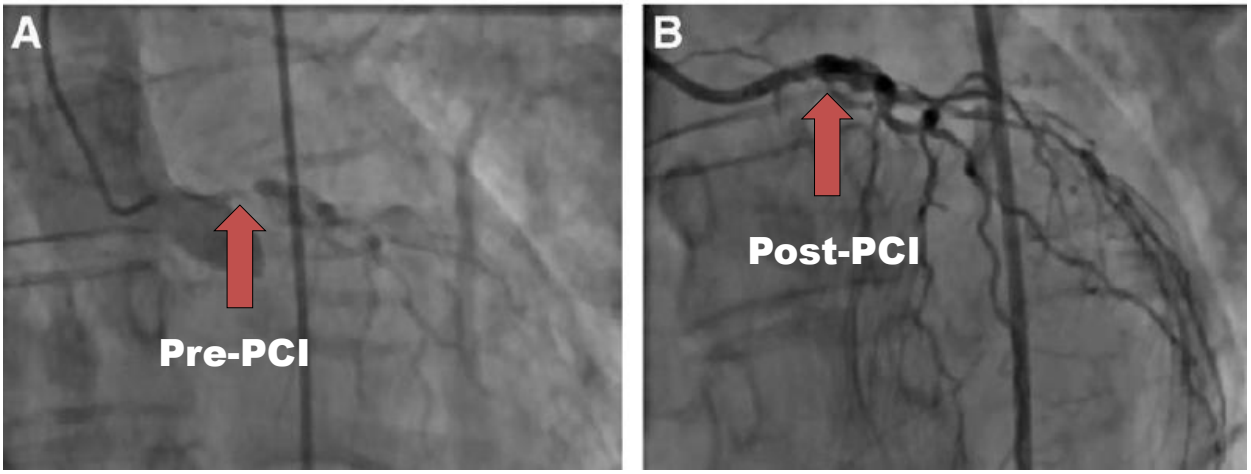
Isolated ST-elevation of >0.5mm in lead aVR is associated with…

Occlusion or critical stenosis of:
- **Left main coronary artery**
- **LAD coronary artery**
- **Three vessel coronary arteries**

This may be the only lead suggesting a STEMI in the appropriate clinical context

50

His Left Main CA on Cath



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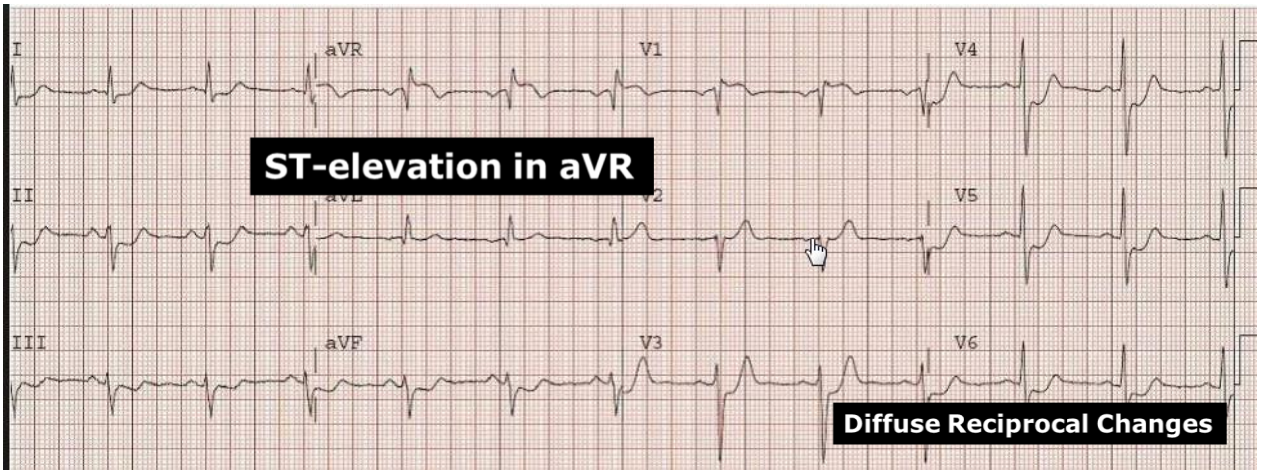
Another Case of ACS with Isolated ST-elevation in aVR



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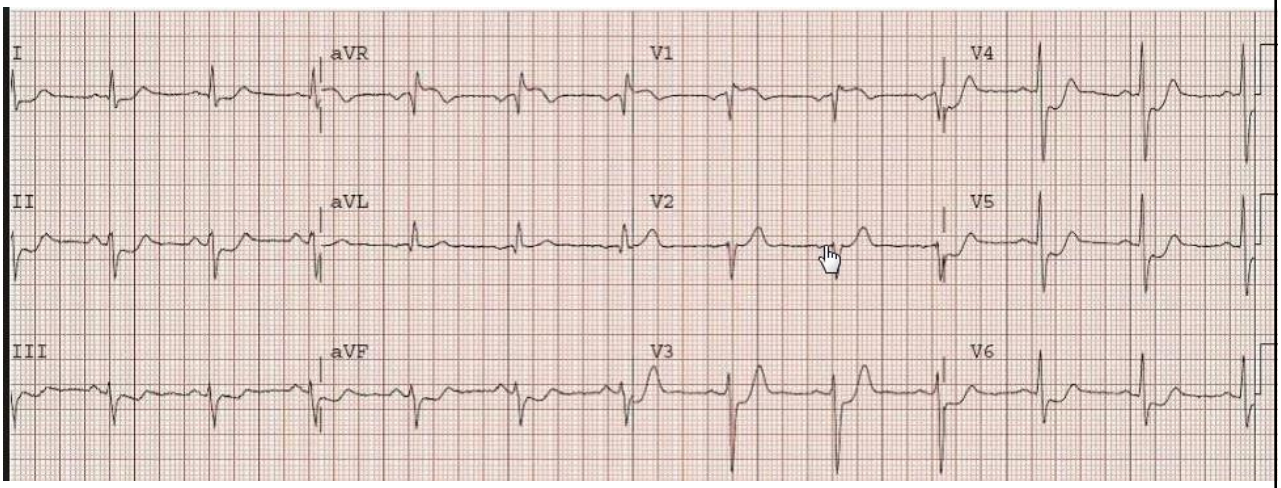
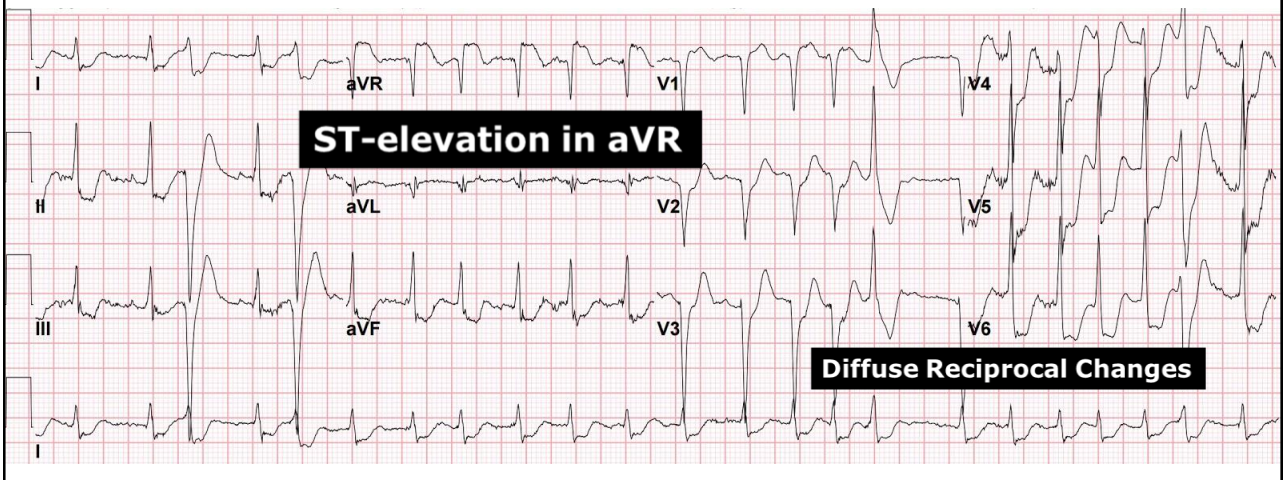
Another Look



53

Another Case of ACS with Isolated ST-elevation in aVR



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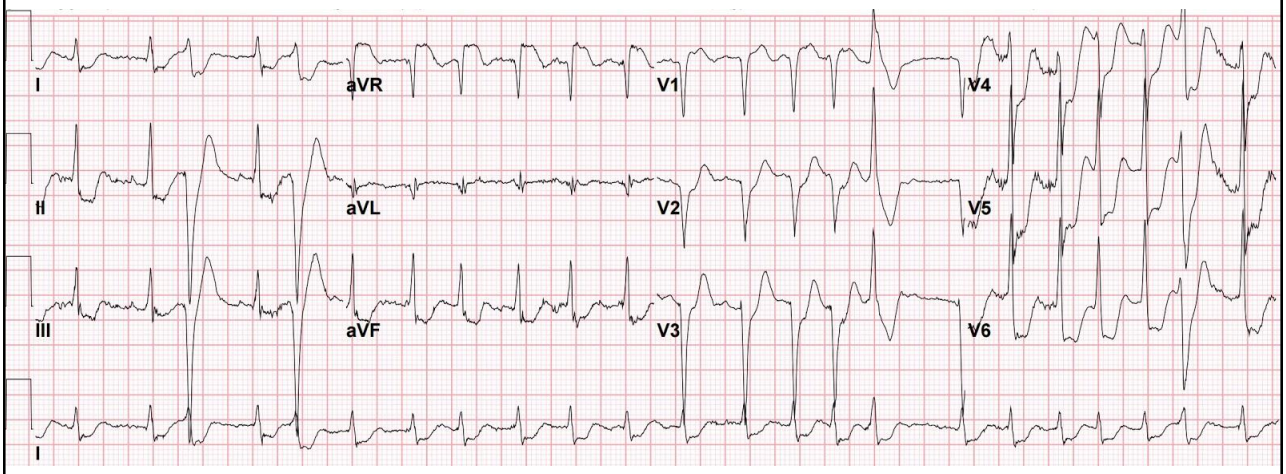
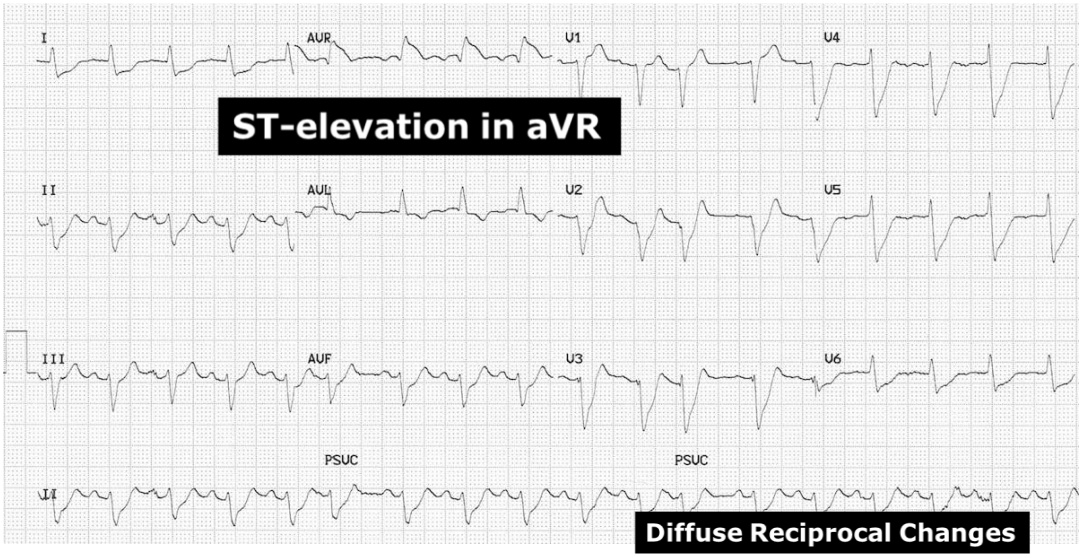
Another Look



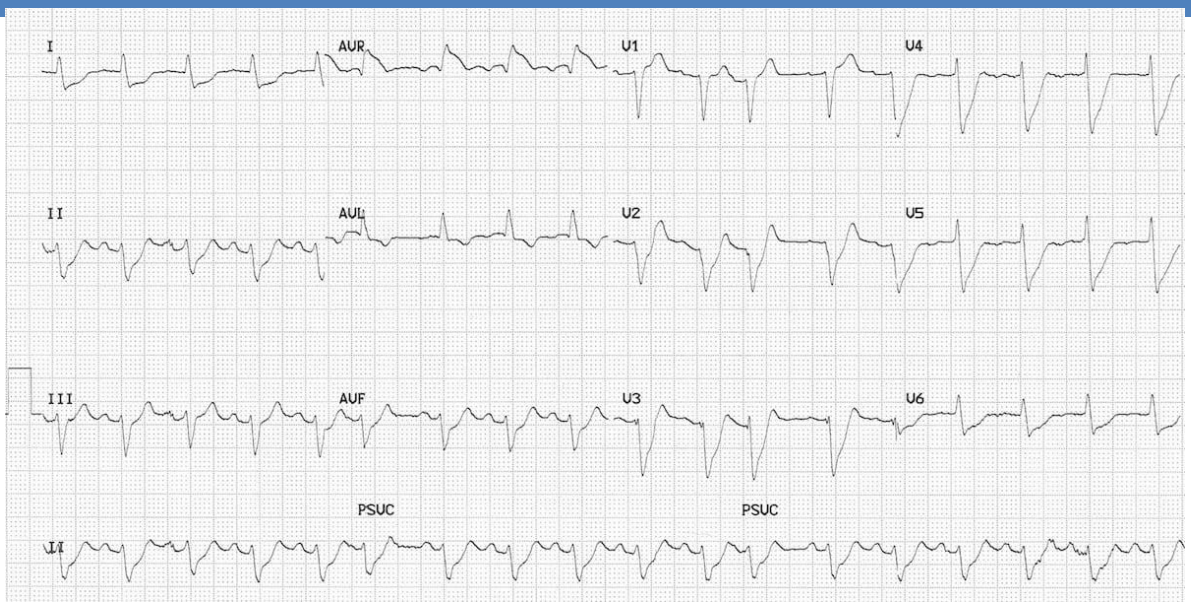
55

Another Case of ACS with Isolated ST-elevation in aVR



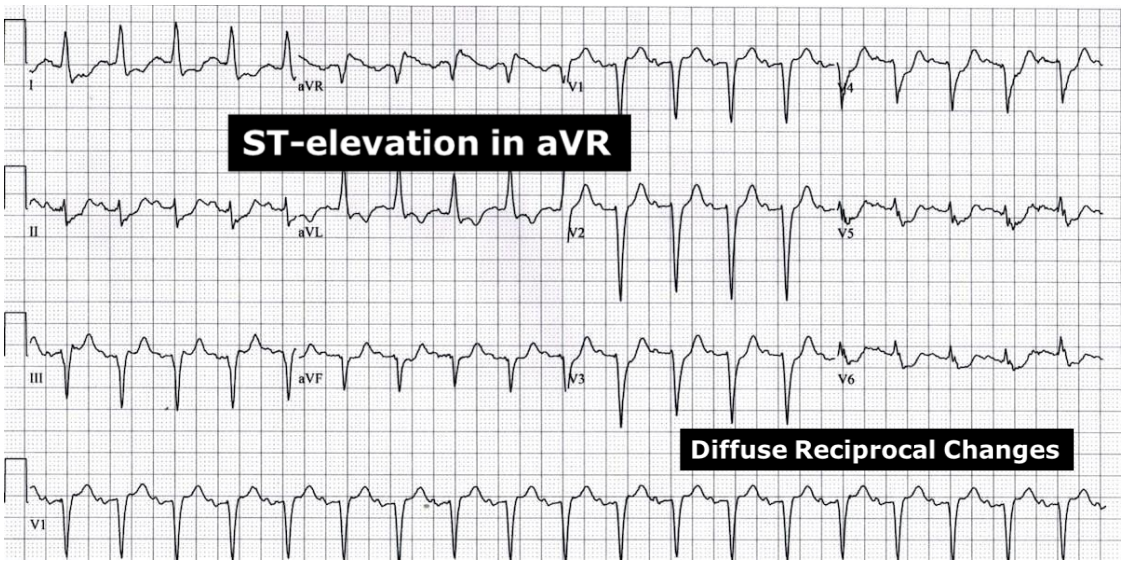
56

Another Look



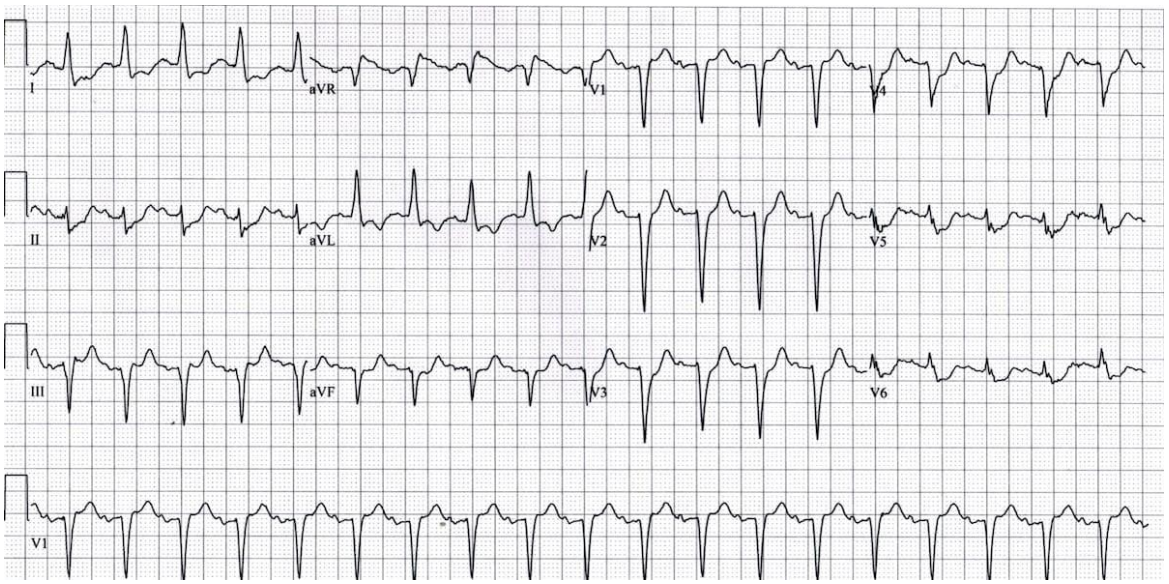
57

Another Case of ACS with Isolated ST-elevation in aVR



58

Another Look



59

ST-elevation in Lead aVR = STEMI

Take-to-Work Points

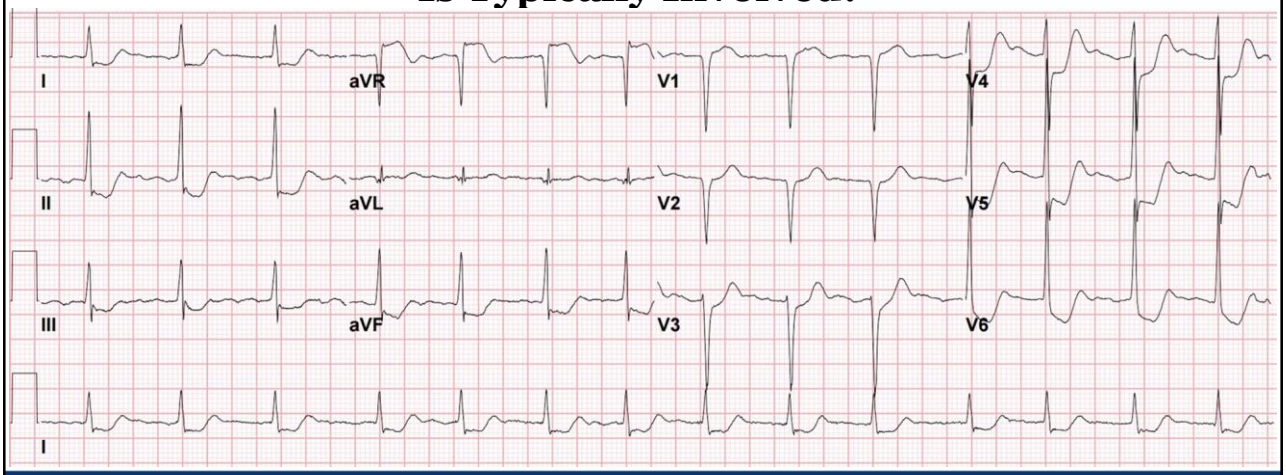
Always examine lead aVR for ST-segment elevation in patients being evaluated for possible ACS

It may be the only lead with STE

It can be associated with acute LMCA/LADCA occlusion

60

This ECG Contains a STEMI-equivalent Clue Associated with Occlusion or Critical Stenosis of a Coronary Artery. Which of the Following Coronary Arteries Is Typically Involved?



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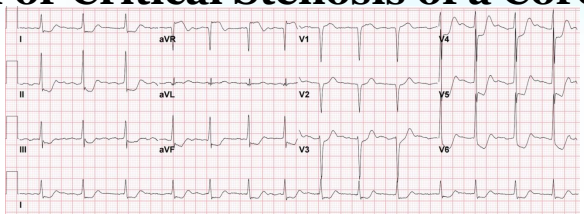
This ECG Contains a STEMI-equivalent Clue Associated with Occlusion or Critical Stenosis of a Coronary Artery.



Which of the Following Coronary Arteries Is Typically Involved?

A. Right Main Coronary Artery
B. Circumflex Coronary Artery
C. Left Main Coronary Artery

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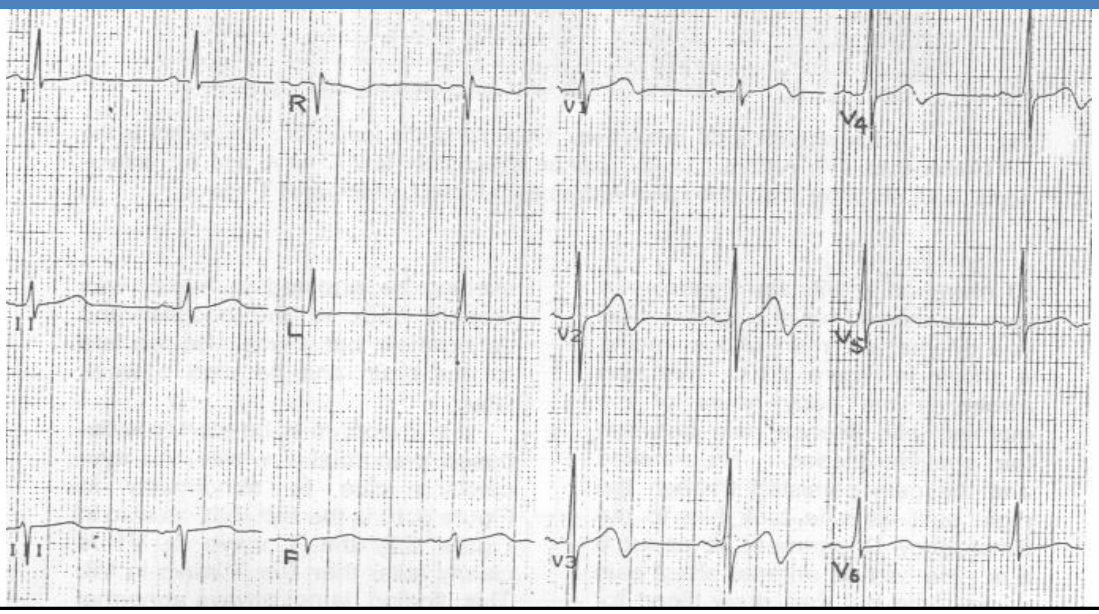
Additional ECG Clues for Critical Stenosis of the Left Anterior Descending Coronary Artery

63

What's the Funky Clue?



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Wellen's Syndrome: LAD T-wave Inversion Syndrome

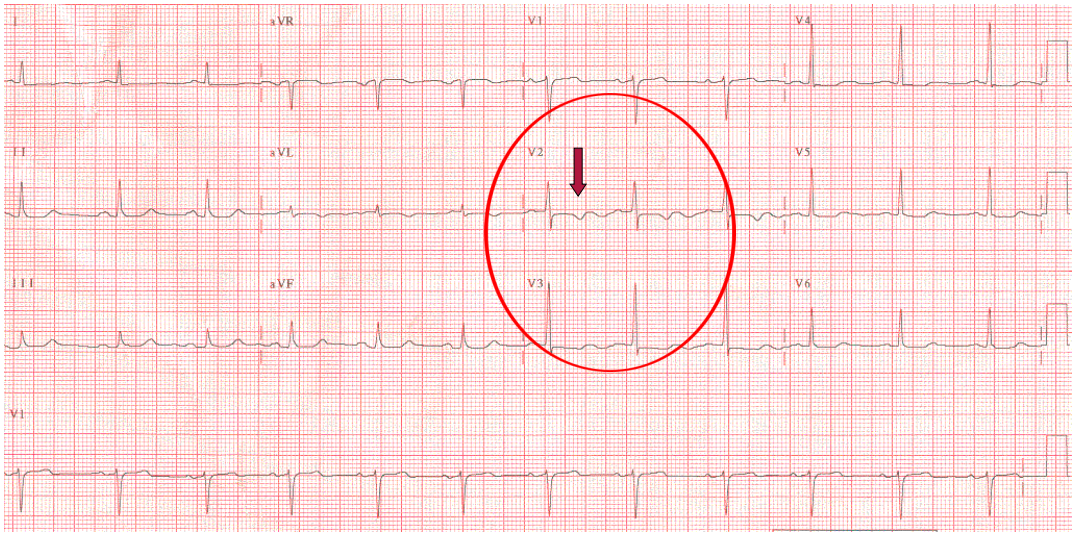
65

Wellen's Syndrome

- **Chest pain, but…**
  - **Little or no cardiac enzyme rise**
- **ECG findings:**
  - **No pathologic Q-waves**
  - **Little or no ST-segment elevation**
  - **Biphasic T-waves or deeply inverted T-waves in leads V2 & V3**
- **Specific for a critical LAD lesion**

66

54-year-old Man with CP and Critical LAD Lesion



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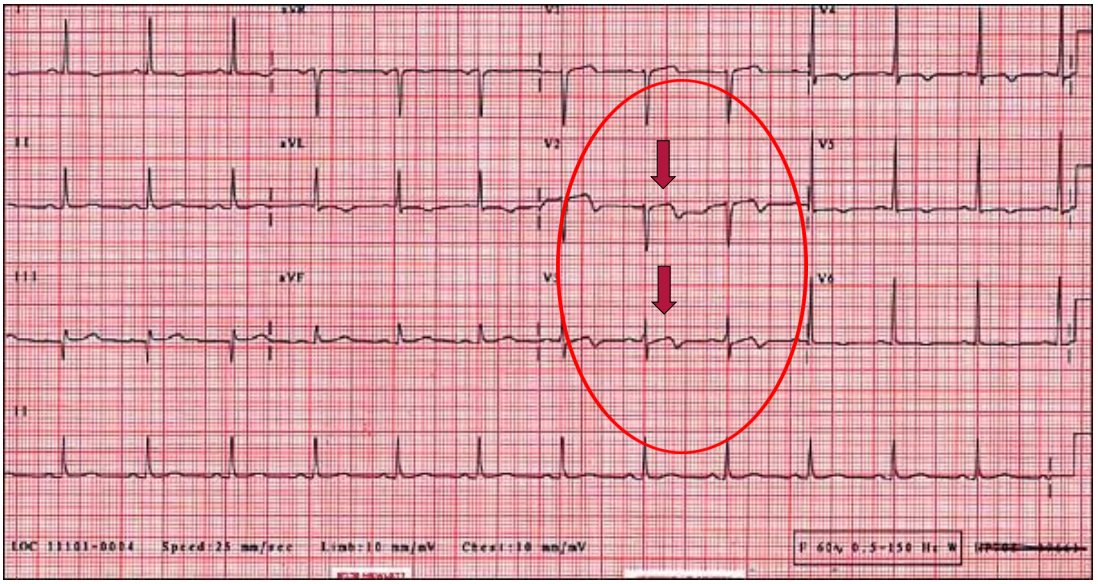
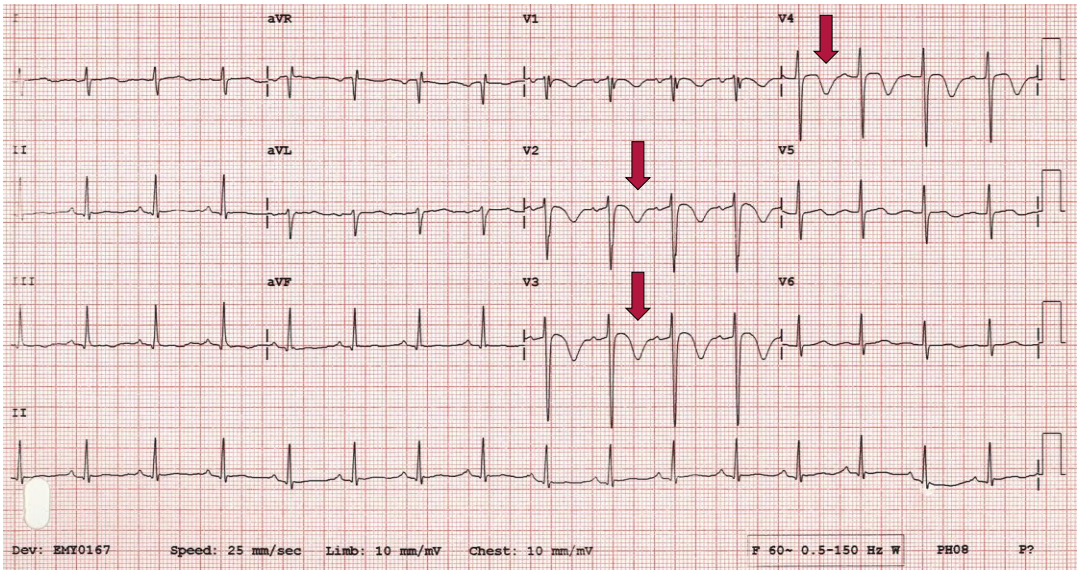
Wellen's Syndrome



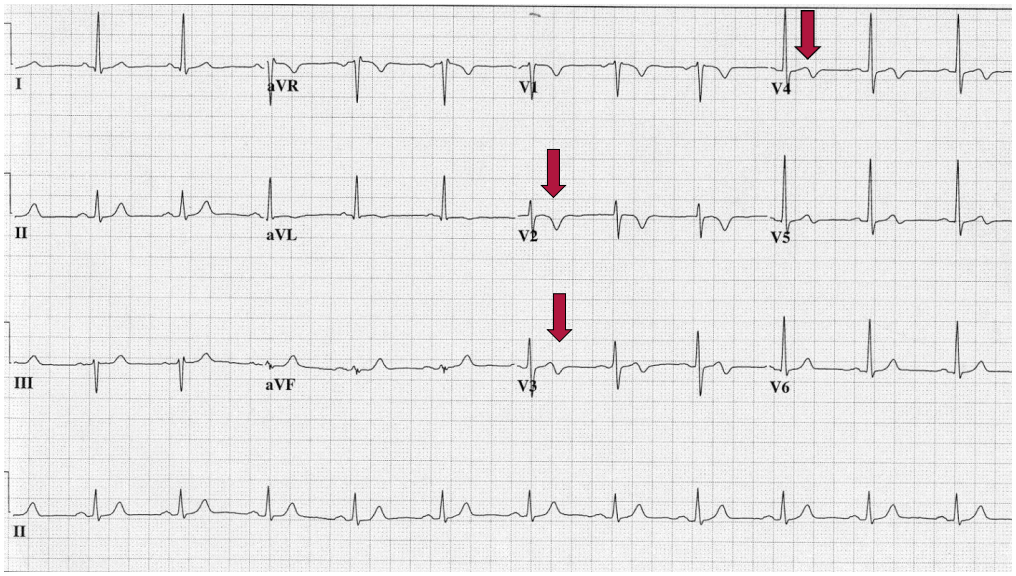
68

Wellen's Syndrome



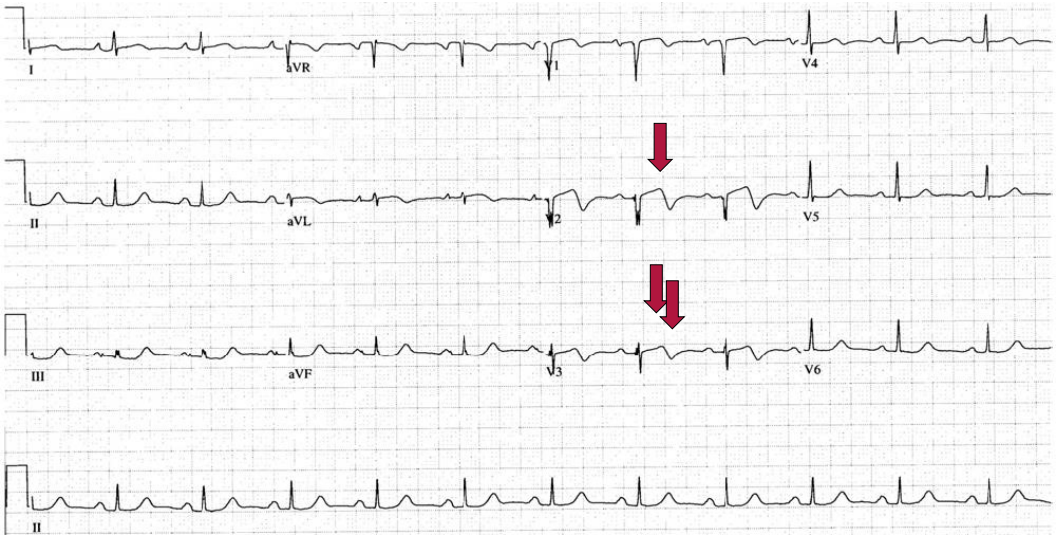
69

Wellen's Syndrome



70

Wellen's Syndrome



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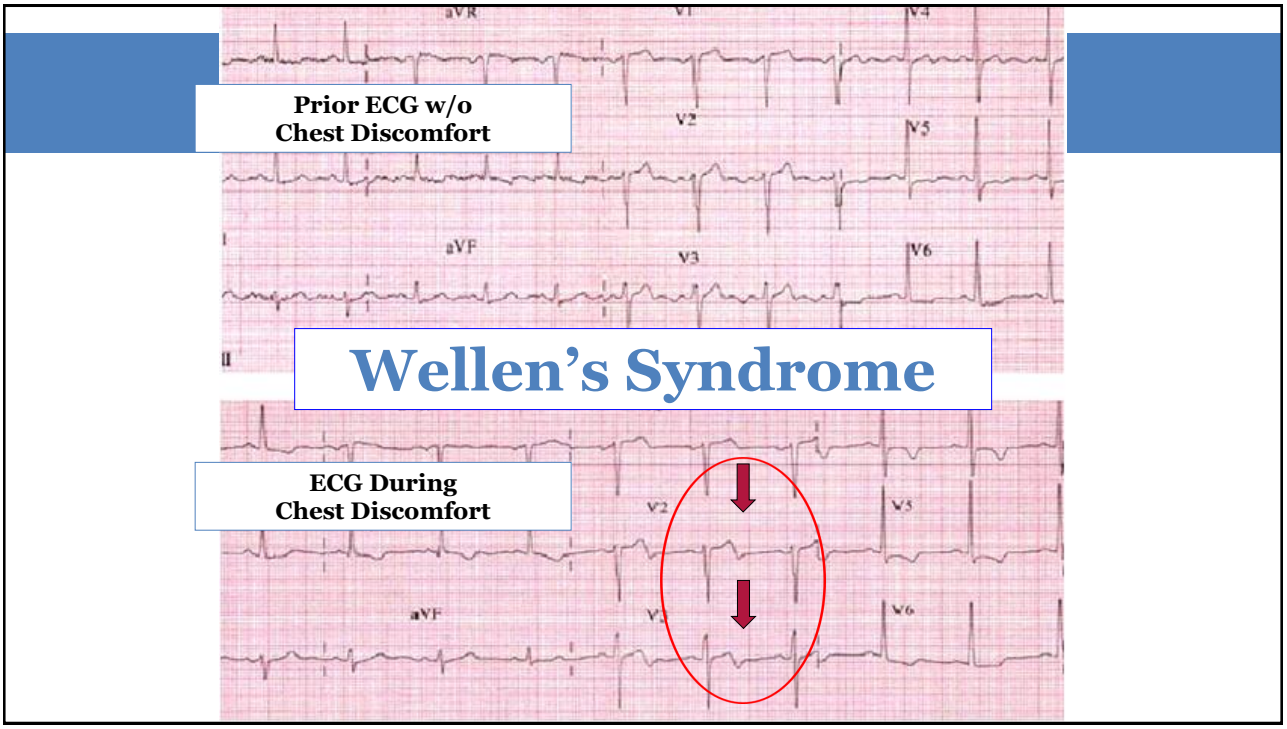
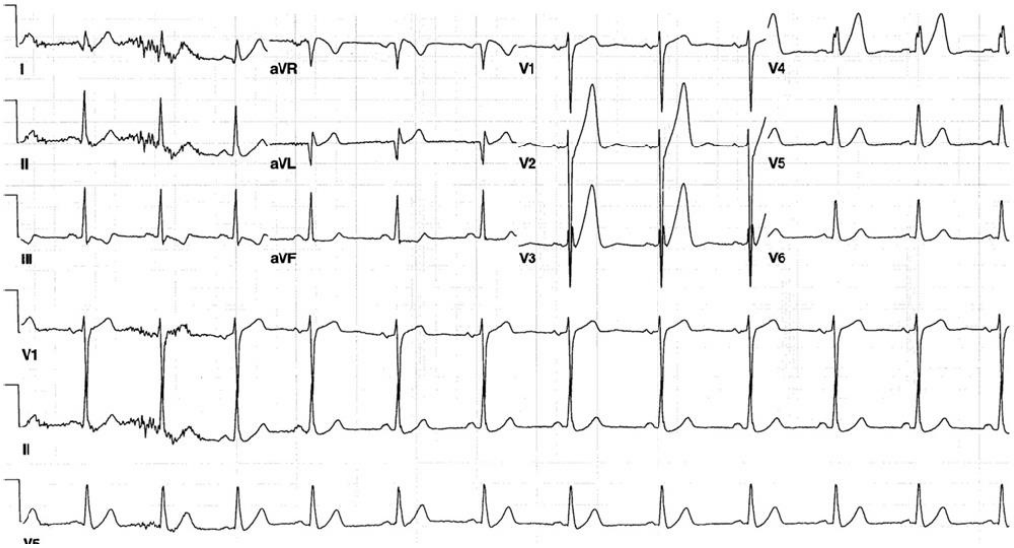


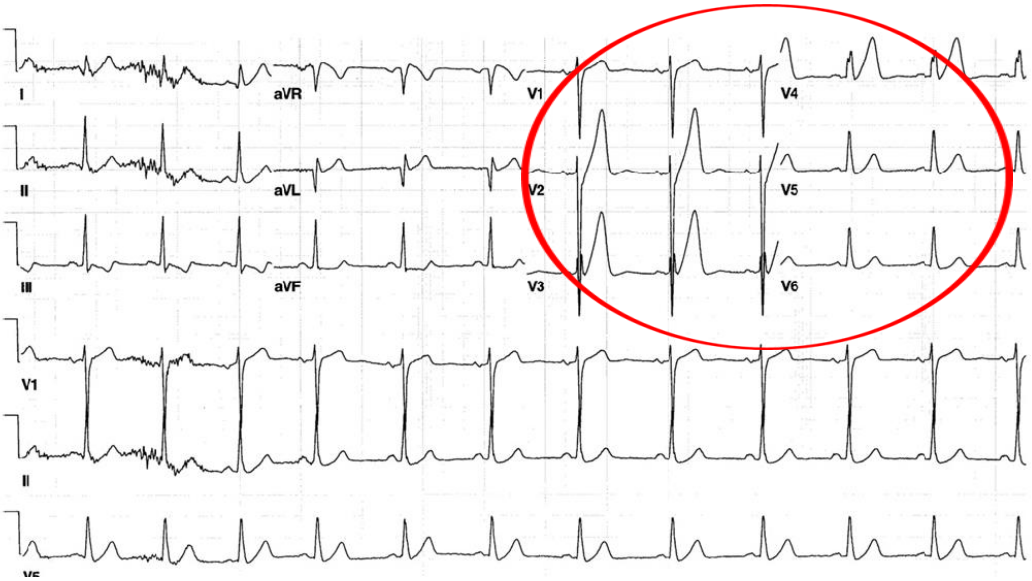
72

What's the Funky Clue?



73

De Winter Syndrome

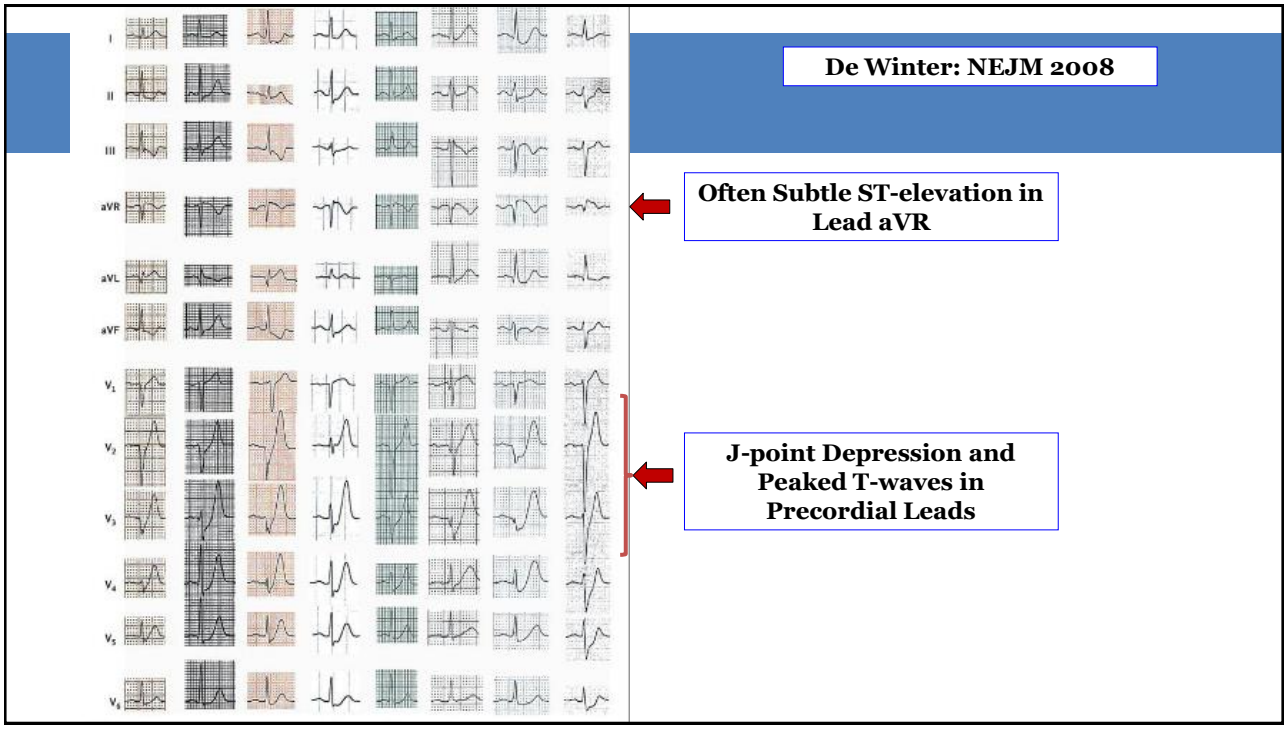


74

De Winter Syndrome

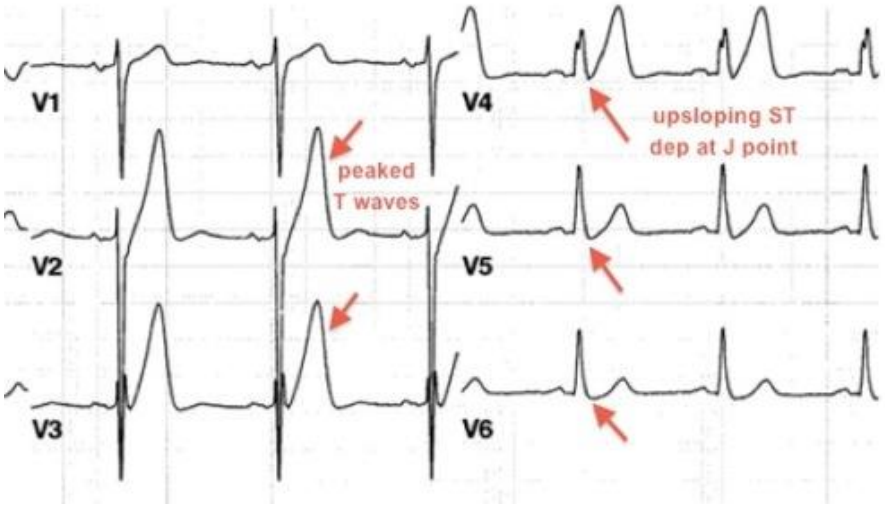
- **Chest pain, but…**
  - **Little or no cardiac enzyme rise**
- **ECG findings:**
  - **J-point depression with peaked T-waves in precordial leads**
  - **Subtle ST-elevation in lead aVR**
- **Specific for a critical LAD lesion**

75



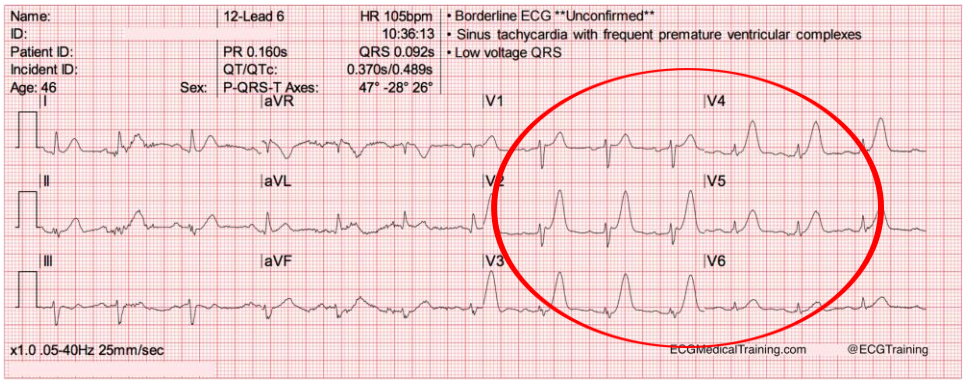
76

De Winter Syndrome



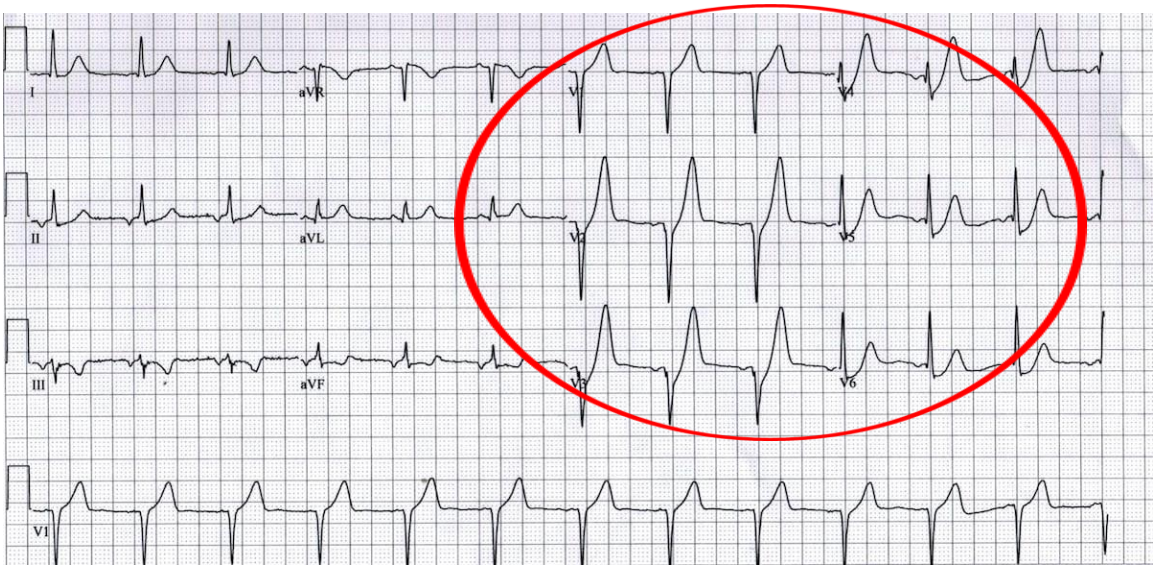
77

De Winter Syndrome



78

De Winter Syndrome



79

Take-to-Work Points

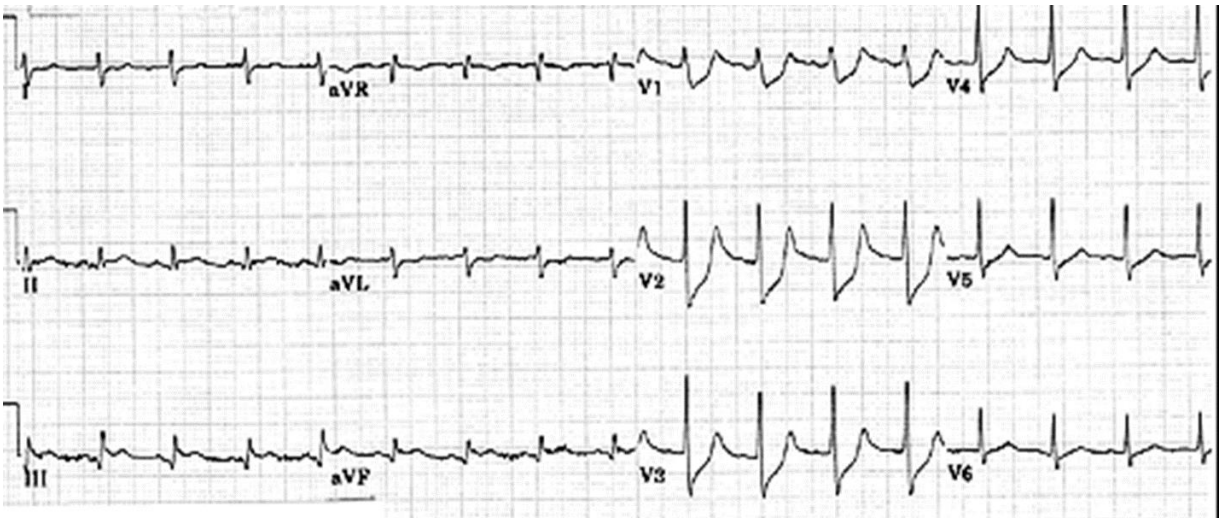
- **You'll only diagnose Wellen's or De Winter Syndrome if you search for ECG clues**
- **Patients may be asymptomatic at the time of your evaluation**
- **Once you make the diagnosis, consider yourself to be conducting a medical emergency**

80

A STEMI that Hides

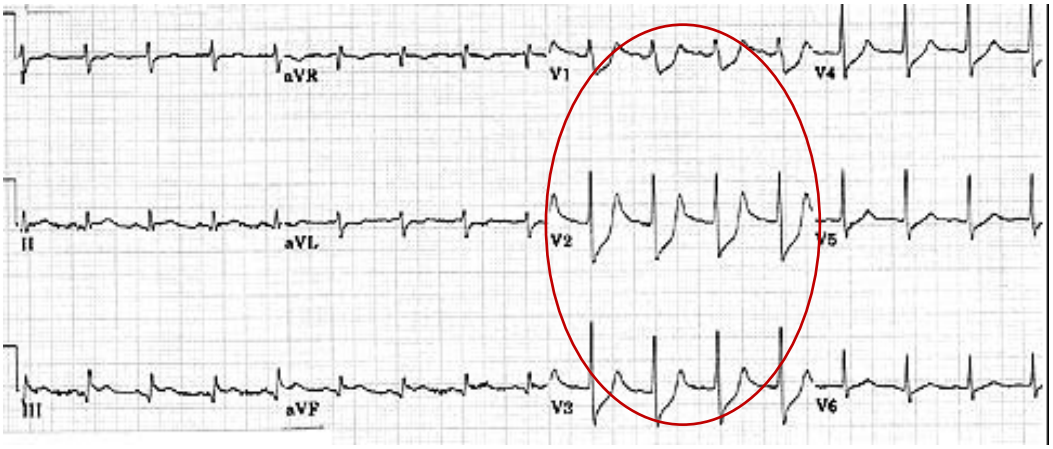
81

What's the Funky Clue?



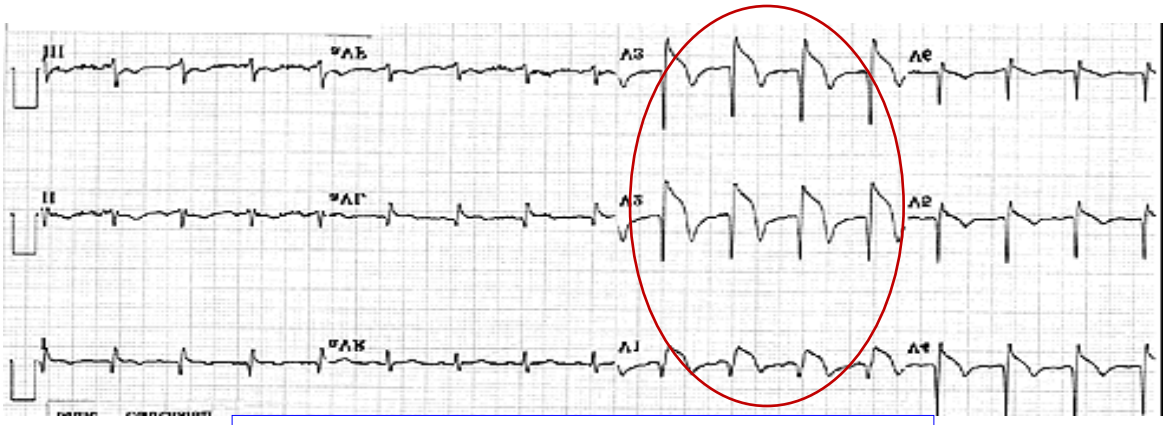
82

Think Posterior STEMI When You Discover Deep ST-depression in the Precordial Leads



83

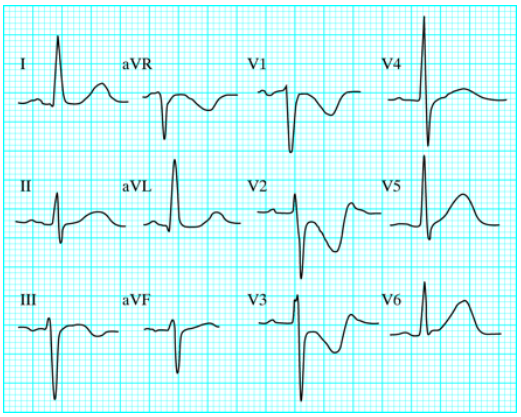
Envision Turning the ECG Upside Down to Appreciate the ST-elevation



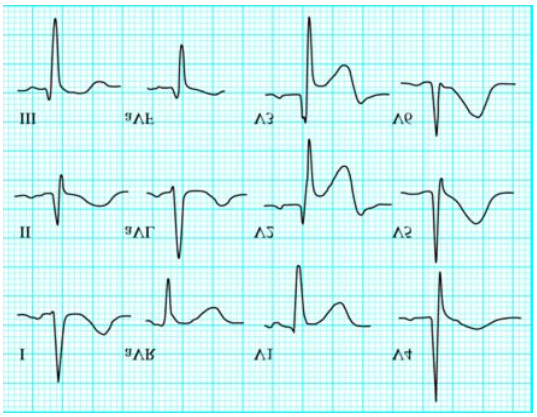
Posterior Myocardial Infarction

84

Posterior AMI



Right-side Up



Upside Down

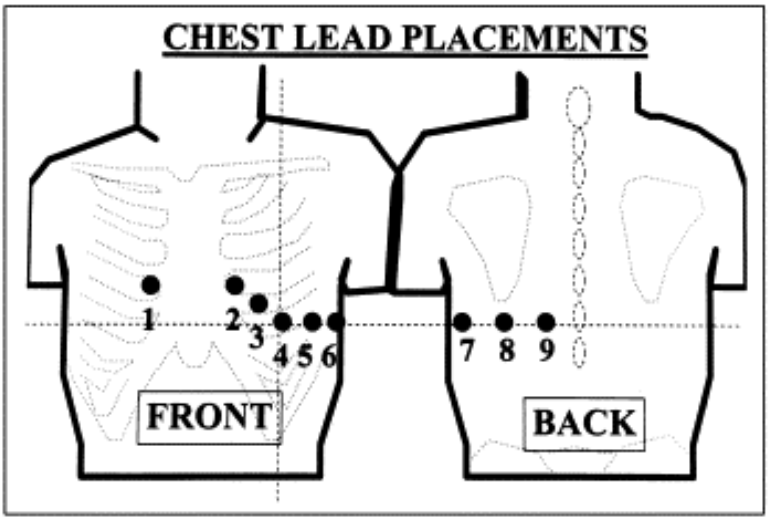
85

Posterior AMI

- **The posterior surface of the heart "hides" from the traditional 12-lead ECG**
- **Deep ST-segment depression in the anterior pre-cordial leads should raise the possibility of a posterior AMI**
- **Add leads V8 and V9 to view the posterior surface**

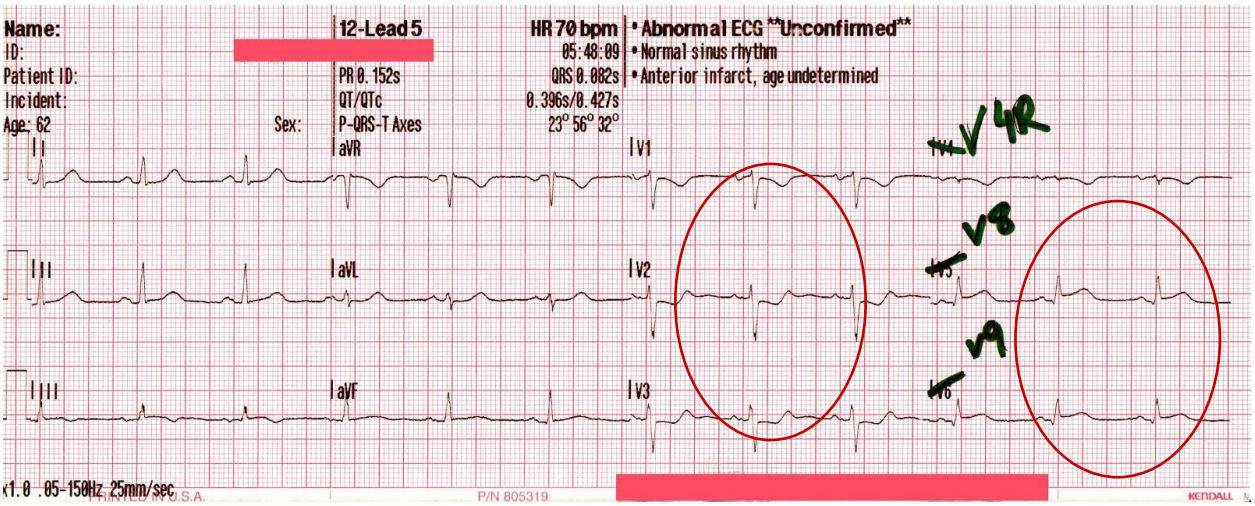
86

Posterior AMI: V8 & V9 Placements



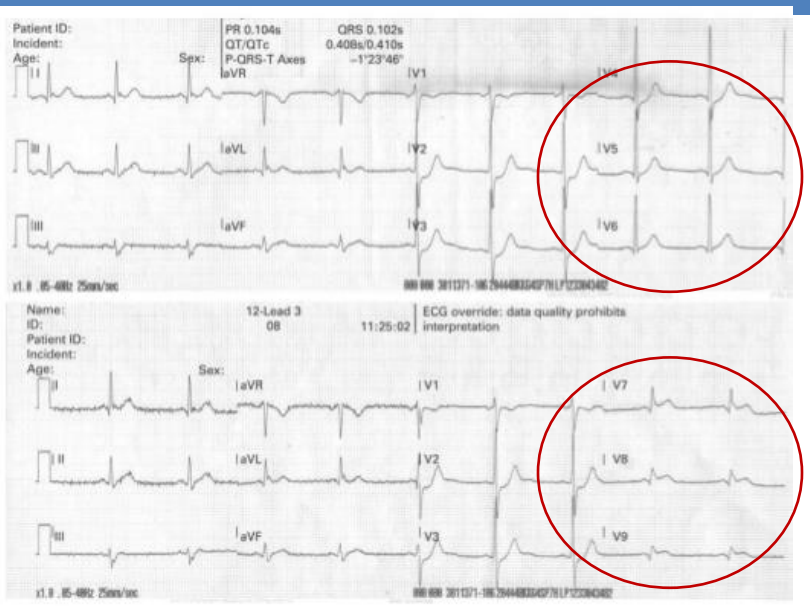
87

Posterior AMI: Posterior Leads



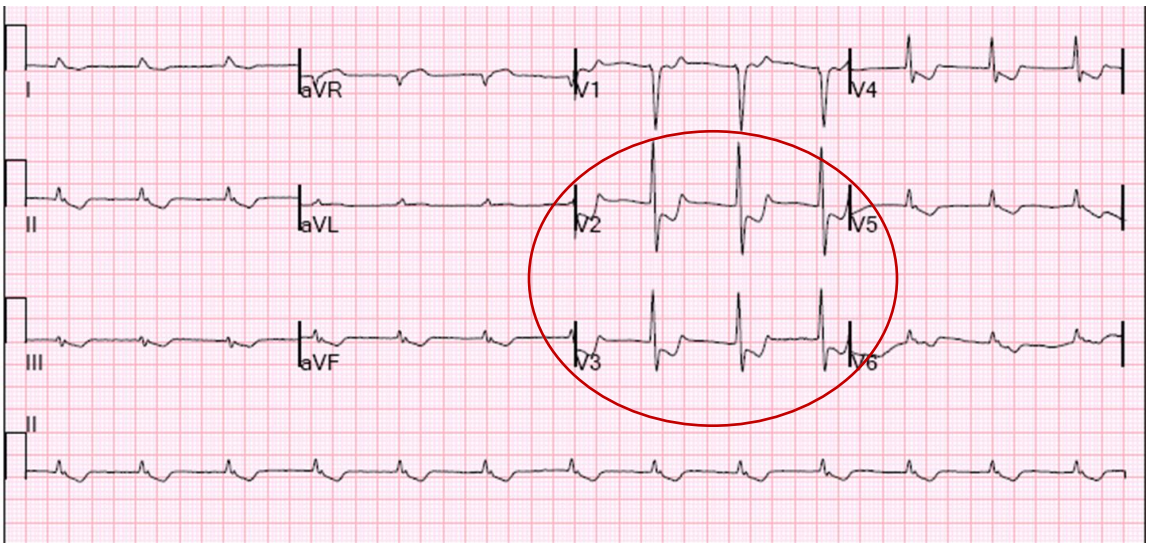
88

Posterior AMI: Posterior Leads



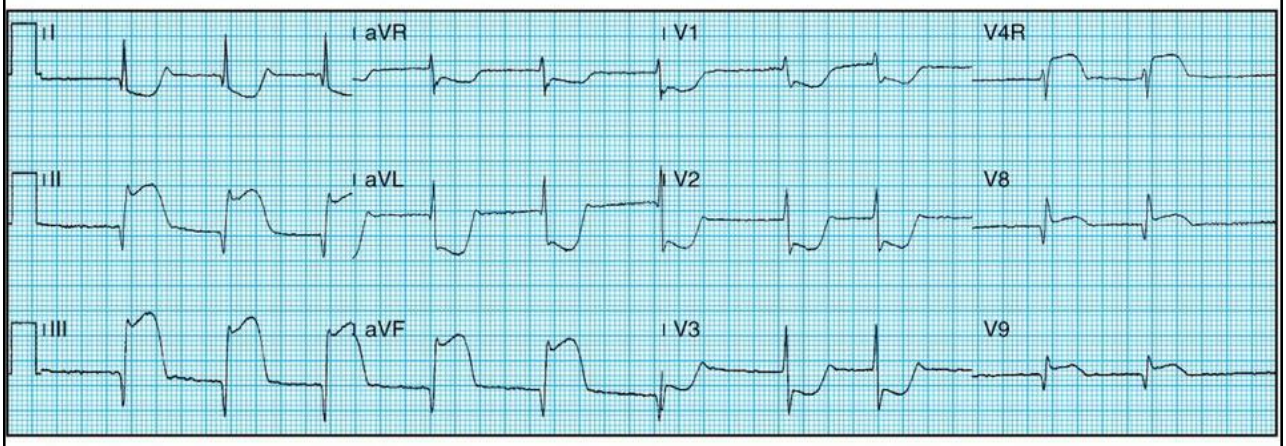
89

Posterior AMI



90

Posterior & Inferior STEMIs Can Coexist



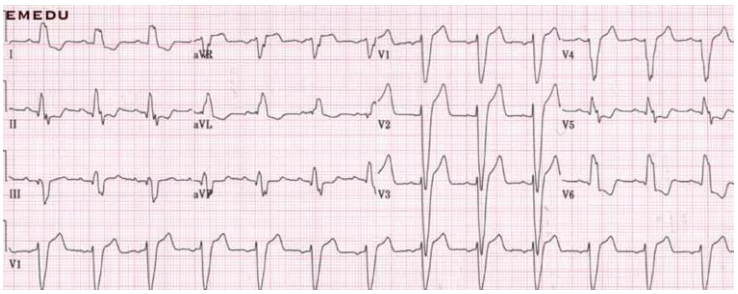
91

Take-to-Work Points

- **Think of an acute posterior STEMI when the chest pain patient's ECG reveals deep ST-segment depression in the anterior pre-cordial leads**
- **Obtain posterior lead information to confirm**

92

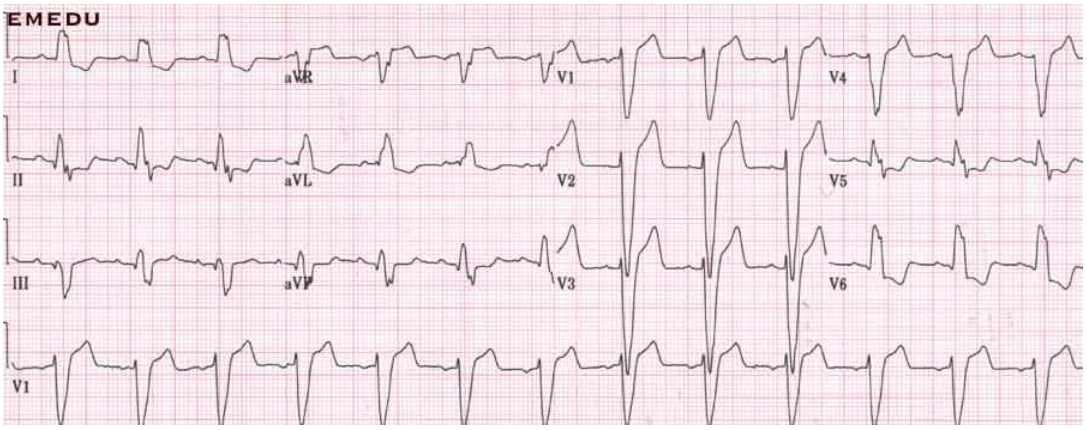
Sharpening Our ECG Pattern Recognition Skills in ACS



Befriending the Dreaded LBBB or Paced Rhythm ECG

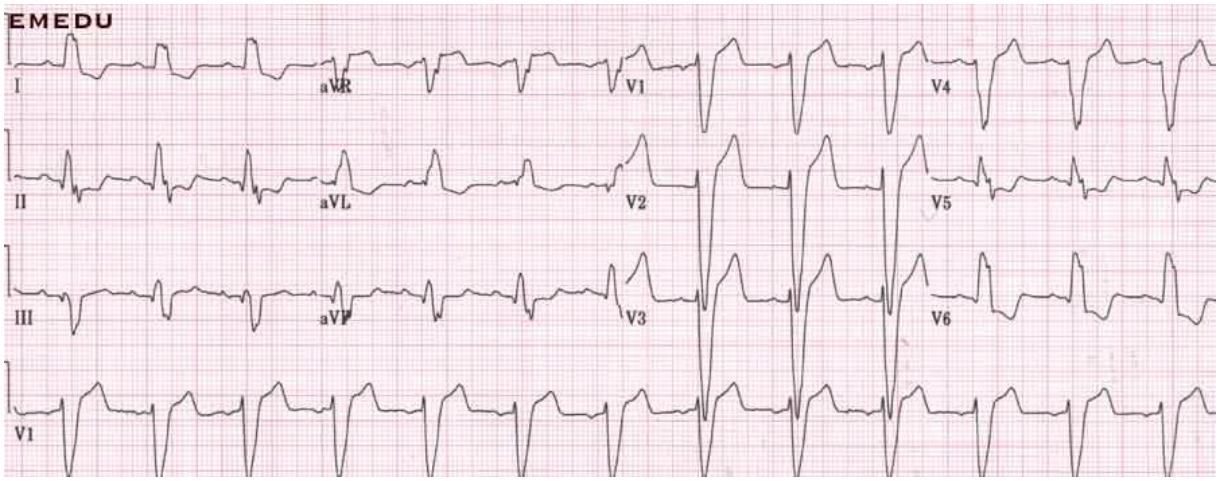
93

Sgarbossa Criteria for Diagnosing Acute Myocardial Infarction in the Presence of LBBB or Paced Rhythm



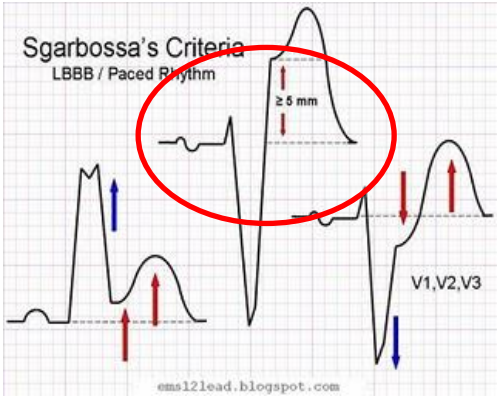
94

Diagnosing AMI in the Presence of Native or Paced LBBB Is Challenging



95

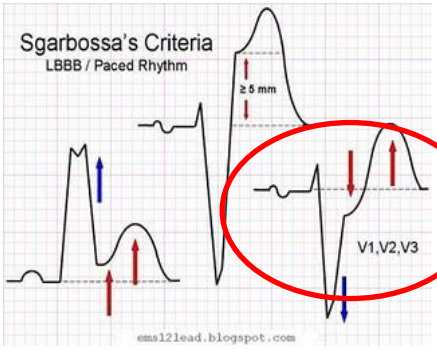
Weighted Sgarbossa Criteria



Discordant ST-segment Elevation of 5+mm in V1, 2 or 3
2 Points

96

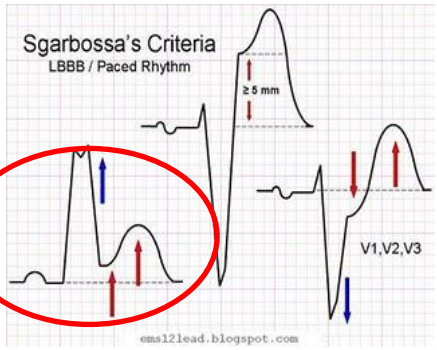
Weighted Sgarbossa Criteria



ST-segment Depression of 1+mm in V1, 2 or 3
3 Points

97

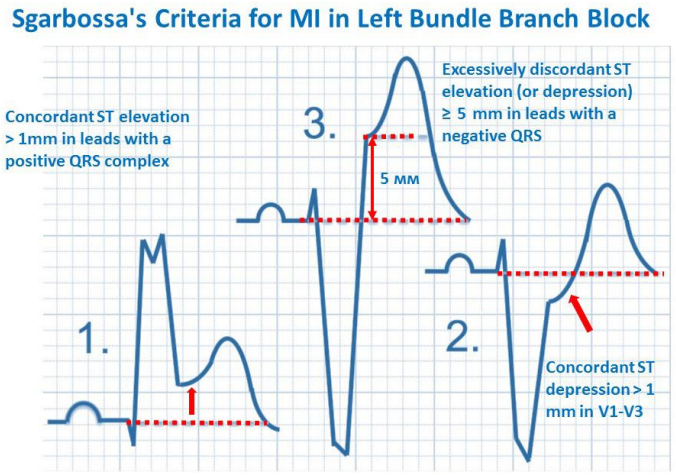
Weighted Sgarbossa Criteria



Concordant ST-segment Elevation of 1+mm
5 Points

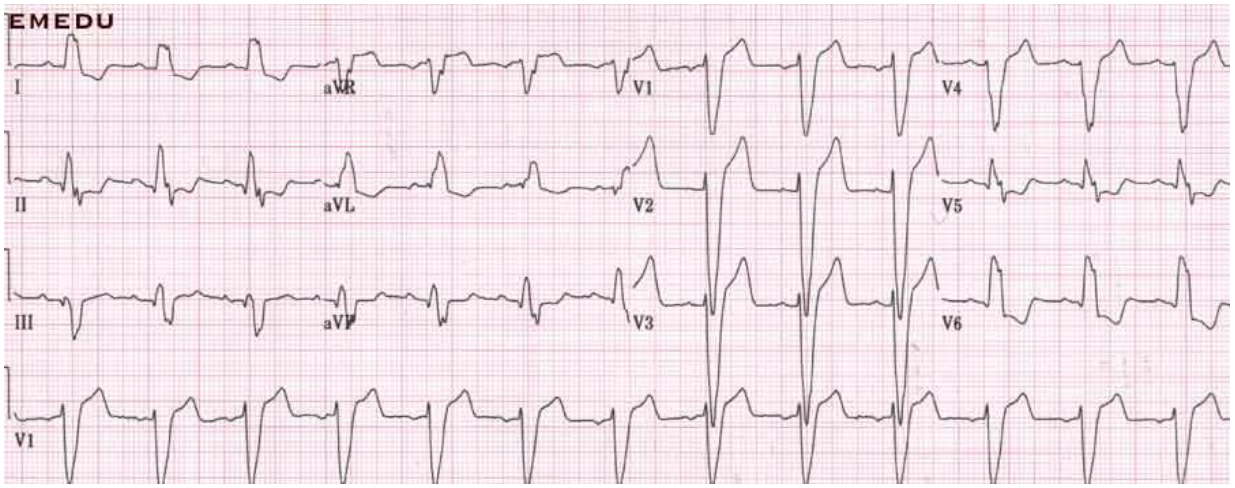
98

As We Examine These Next ECG's, Look for These Patterns



99

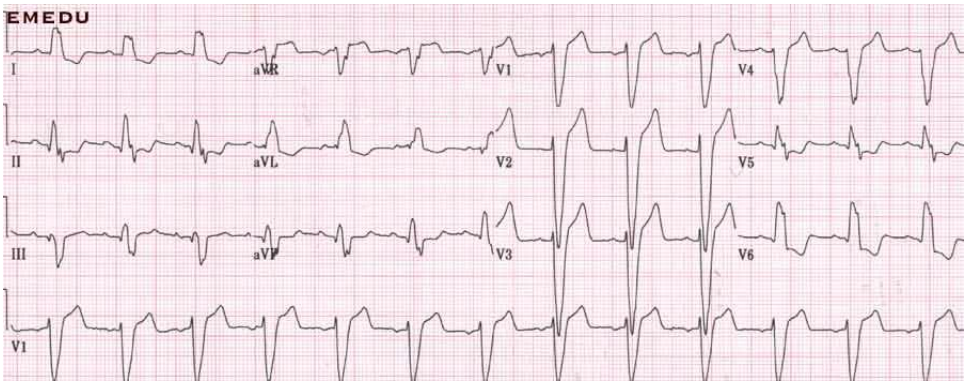
LBBB: ?? AMI



100

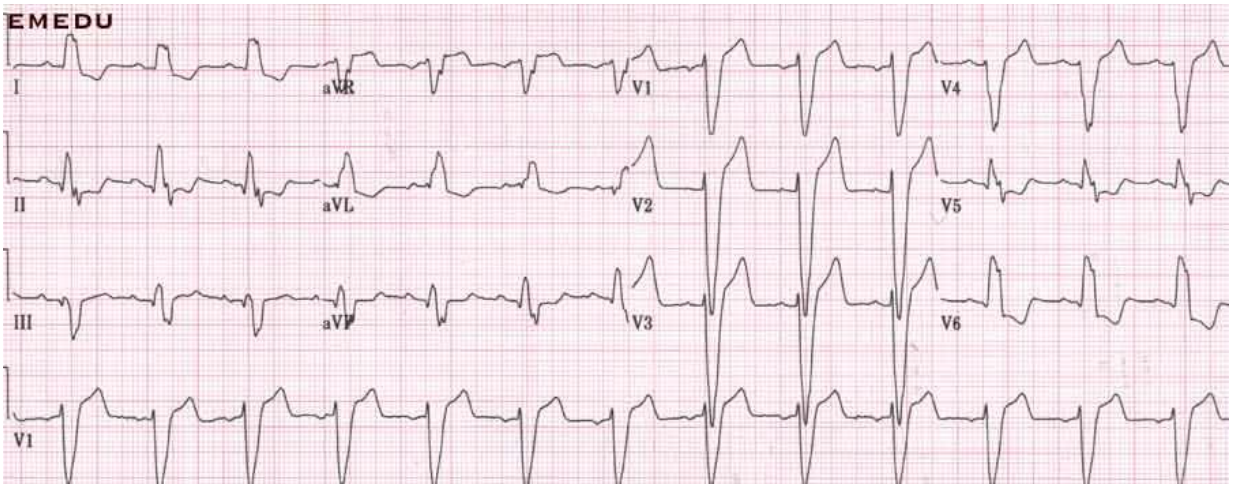
LBBB: ?? AMI: The Answer Isn't Here

- **No concordant ST-elevation**
- **Less than 5mm (25%) discordant ST-elevation**
- **No ST-depression V1-V3**



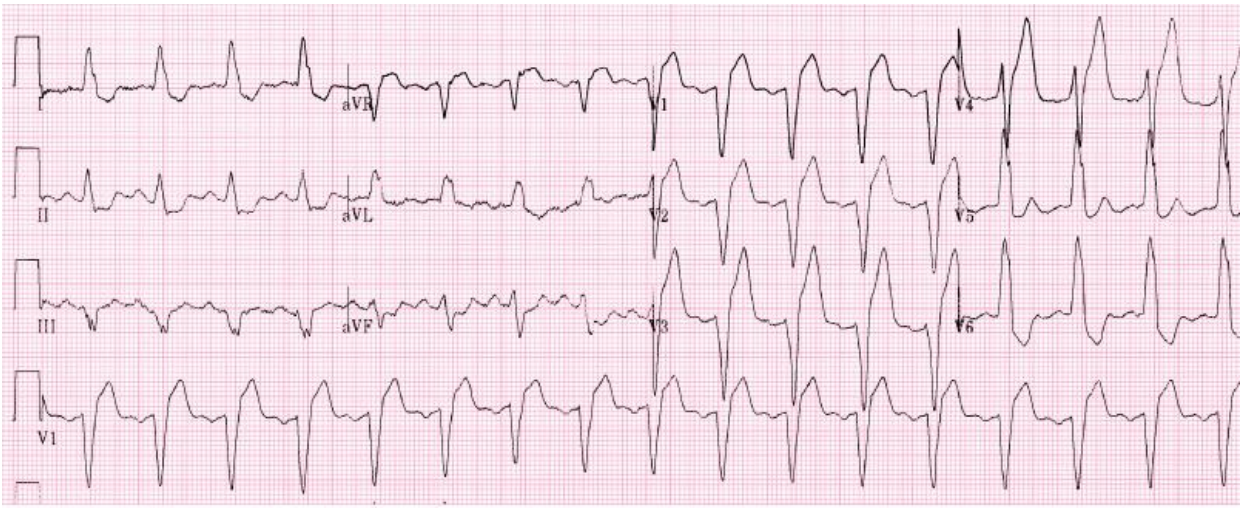
101

LBBB: Another Look



102

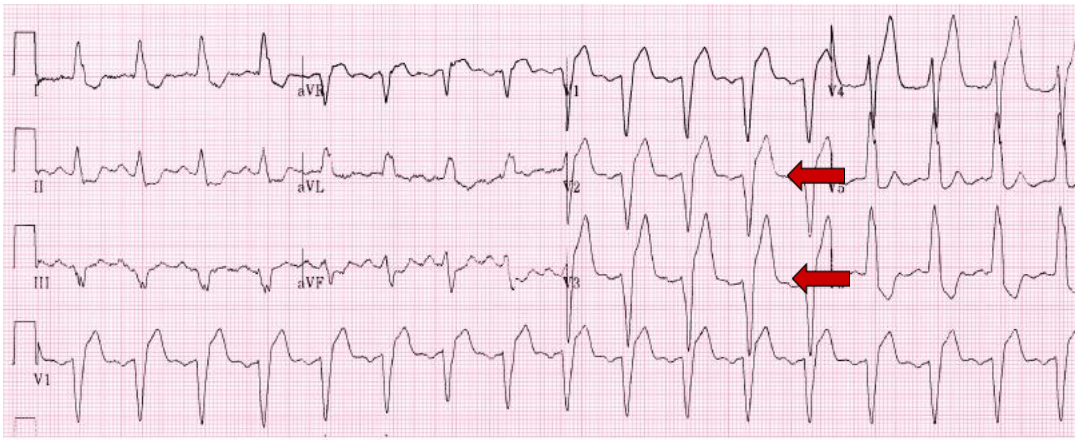
LBBB: ?? AMI



103

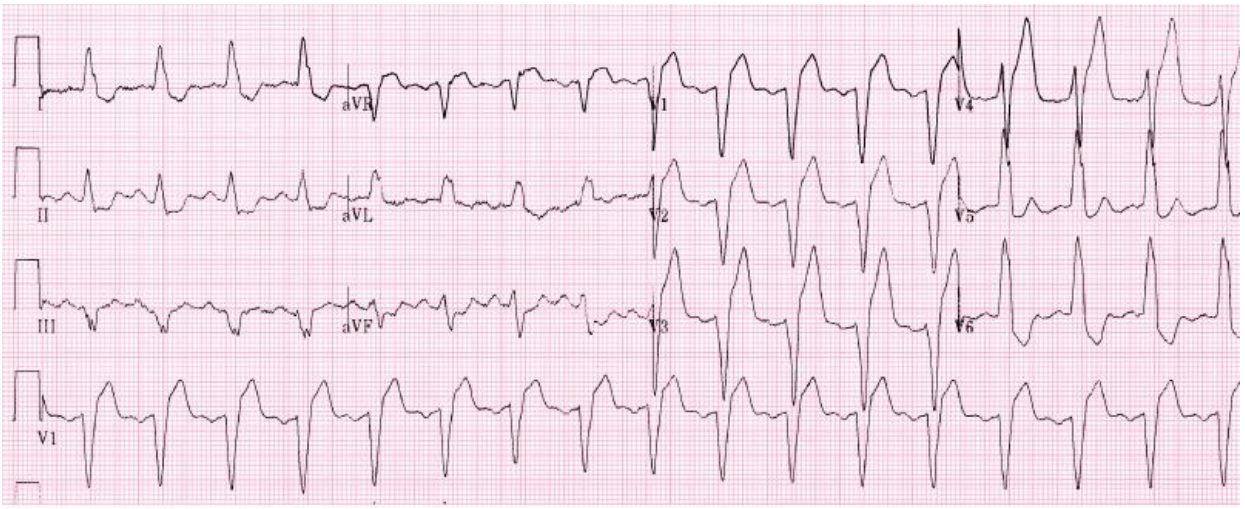
LBBB: ?? AMI: Suspicious

- **No concordant ST-elevation**
- **Greater than 5mm (25%) discordant ST-elevation**
- **No ST-depression V1-V3**



104

LBBB: Another Look



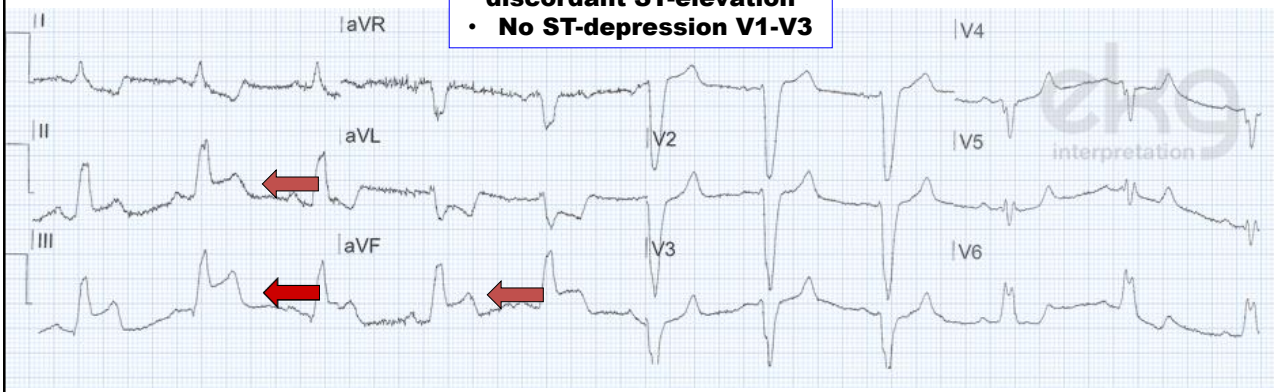
105

LBBB: ?? AMI

106

LBBB: ?? AMI: YES

- **Concordant ST-elevation**
- **Less than 5mm (25%) discordant ST-elevation**
- **No ST-depression V1-V3**

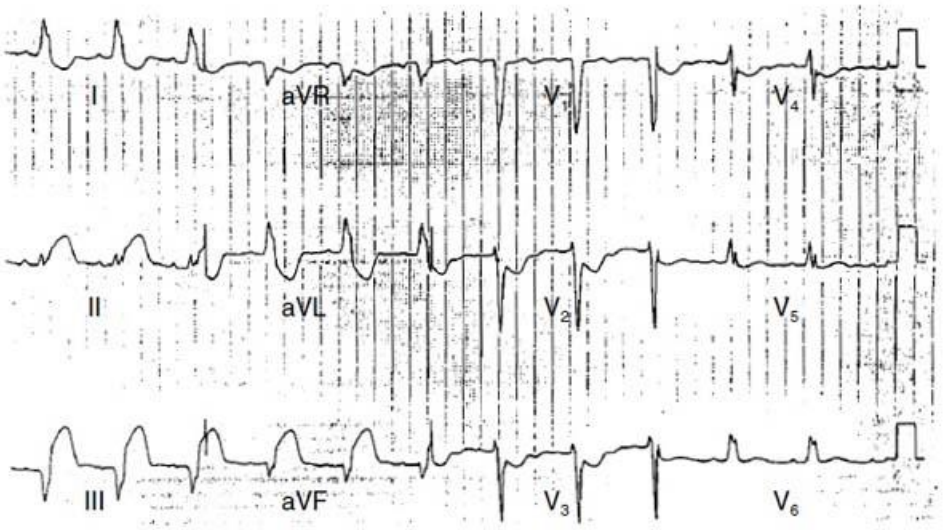


107

LBBB: Another Look

108

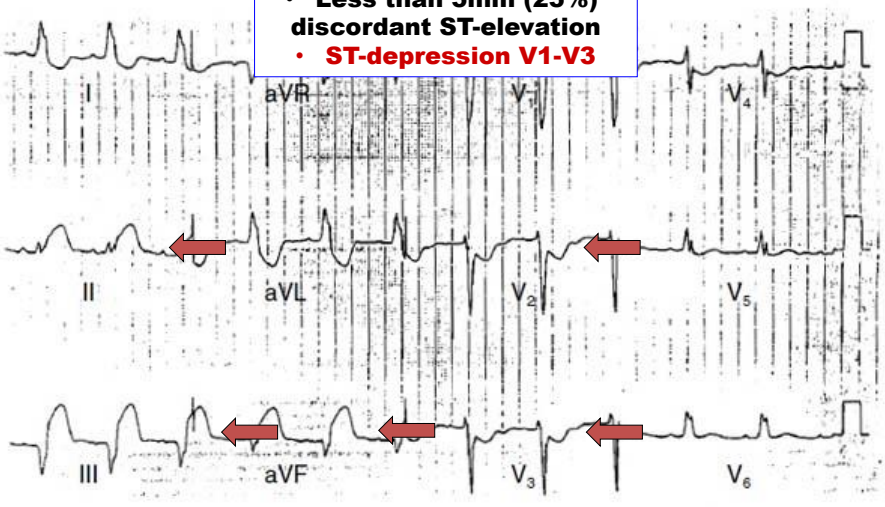
LBBB: ?? AMI



109

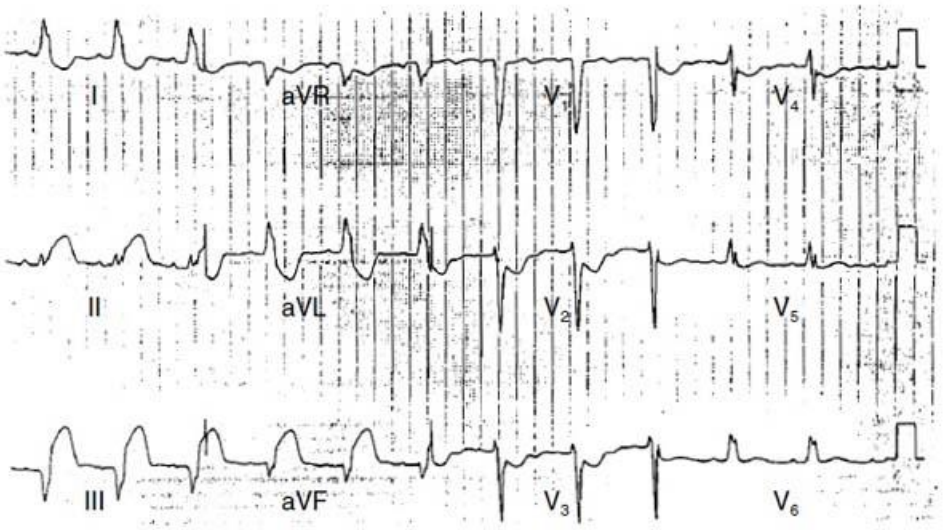
LBBB: ?? AMI: YES

- **Concordant ST-elevation**
- **Less than 5mm (25%) discordant ST-elevation**
- **ST-depression V1-V3**



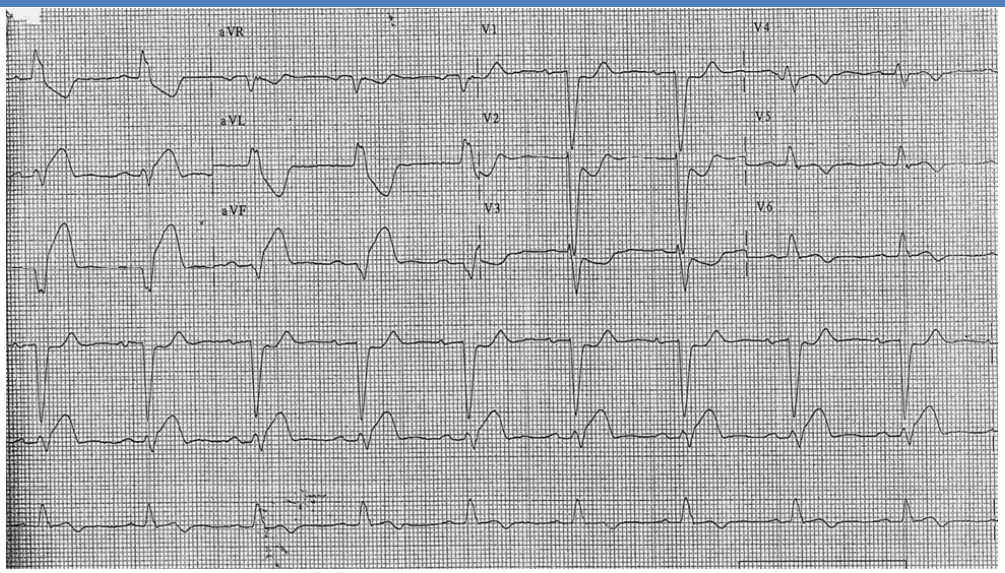
110

LBBB: Another Look



111

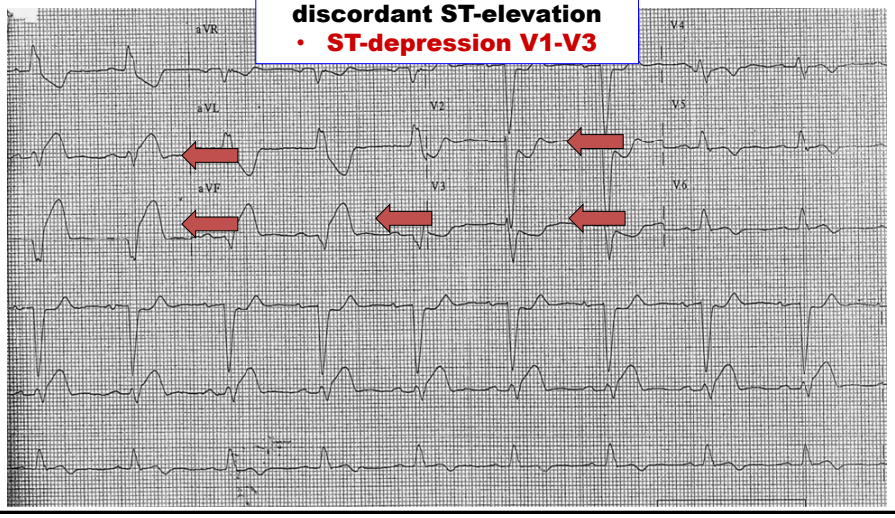
LBBB: ?? AMI



112

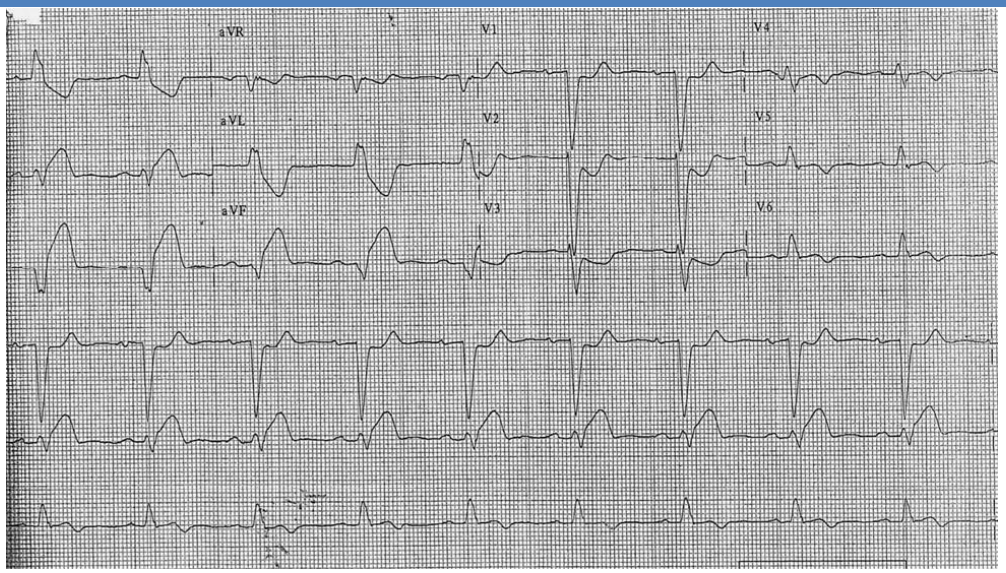
LBBB: ?? AMI: YES

- **Concordant ST-elevation**
- **Less than 5mm (25%) discordant ST-elevation**
- **ST-depression V1-V3**



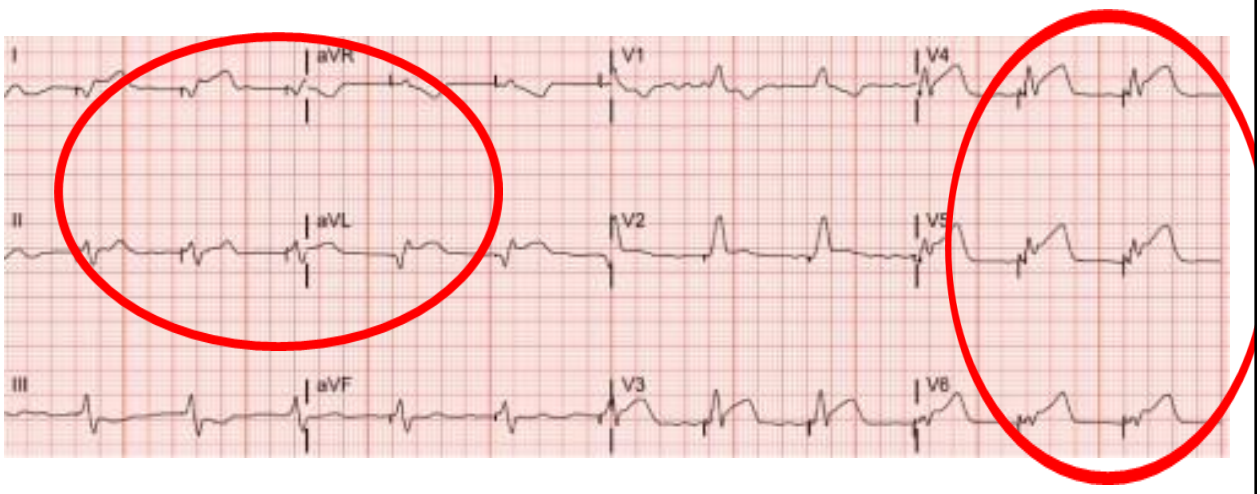
113

LBBB: Another Look



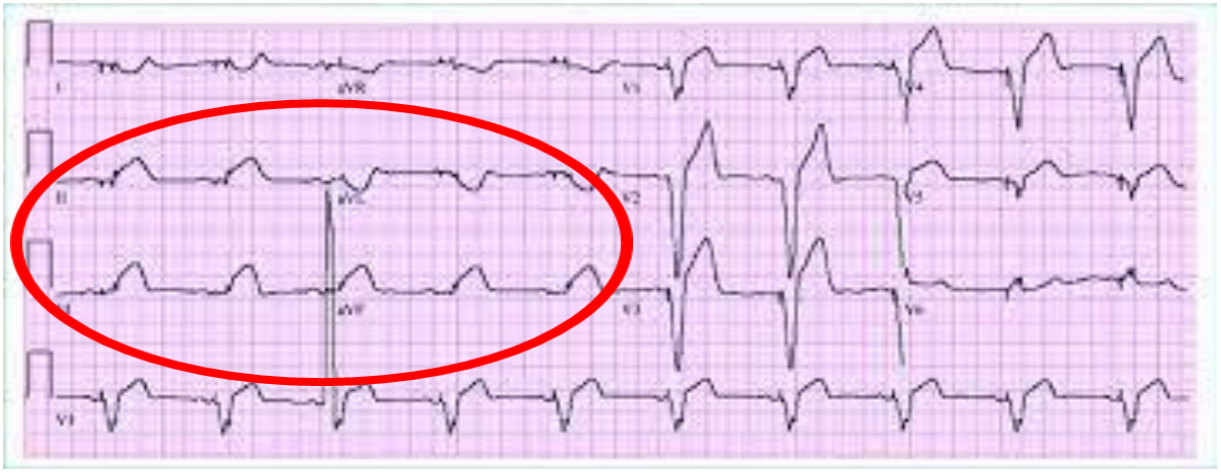
114

Paced Rhythm with AMI



115

Paced Rhythm with AMI



116

Take-to-Work Points

- **When the patient with chest pain presents with an ECG demonstrating LBBB, analyze with the Sgarbossa criteria in mind**
- **This also helps when evaluating paced rhythms**

117

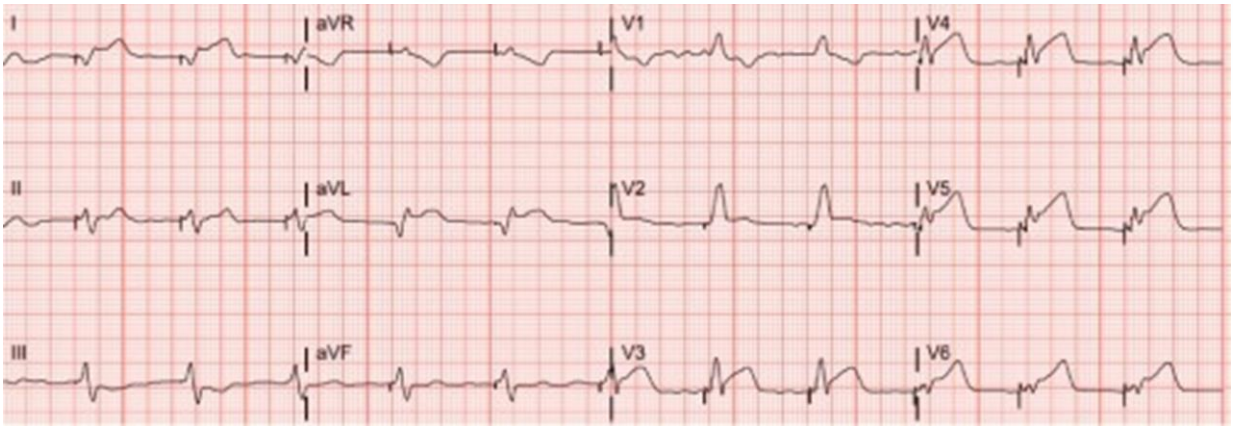
Weighted Sgarbossa Criteria in LBBB and Paced Rhythm

- ☐ **Concordant ST-segment elevation*****
  - ■ **Treat like AMI**
- ☐ **Significant ST-segment depression in the anterior pre-cordial leads**
  - ■ **Be highly suspect of AMI**
- ☐ **Discordant ST-segment elevation in the anterior pre-cordial leads of 5-mm+**
  - ■ **Keep looking**

***The Most Important:
Kontos: Am Heart J 2011
Jain: Am J Cardiol 2011

118

This Paced Rhythm ECG Suggests Which of the Following Actionable Conditions?



CONTINUING EDUCATION COMPANY

119

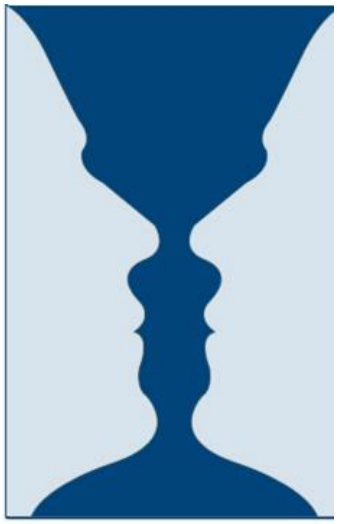
This Paced Rhythm ECG Suggests Which of the Following Actionable Conditions?

A. Acute Myocardial Infarction
B. Lead-associated Myopericarditis
C. Inconsistent Lead Capture

CONTINUING EDUCATION COMPANY

120

Sharpening Our ECG Pattern Recognition Skills in ACS



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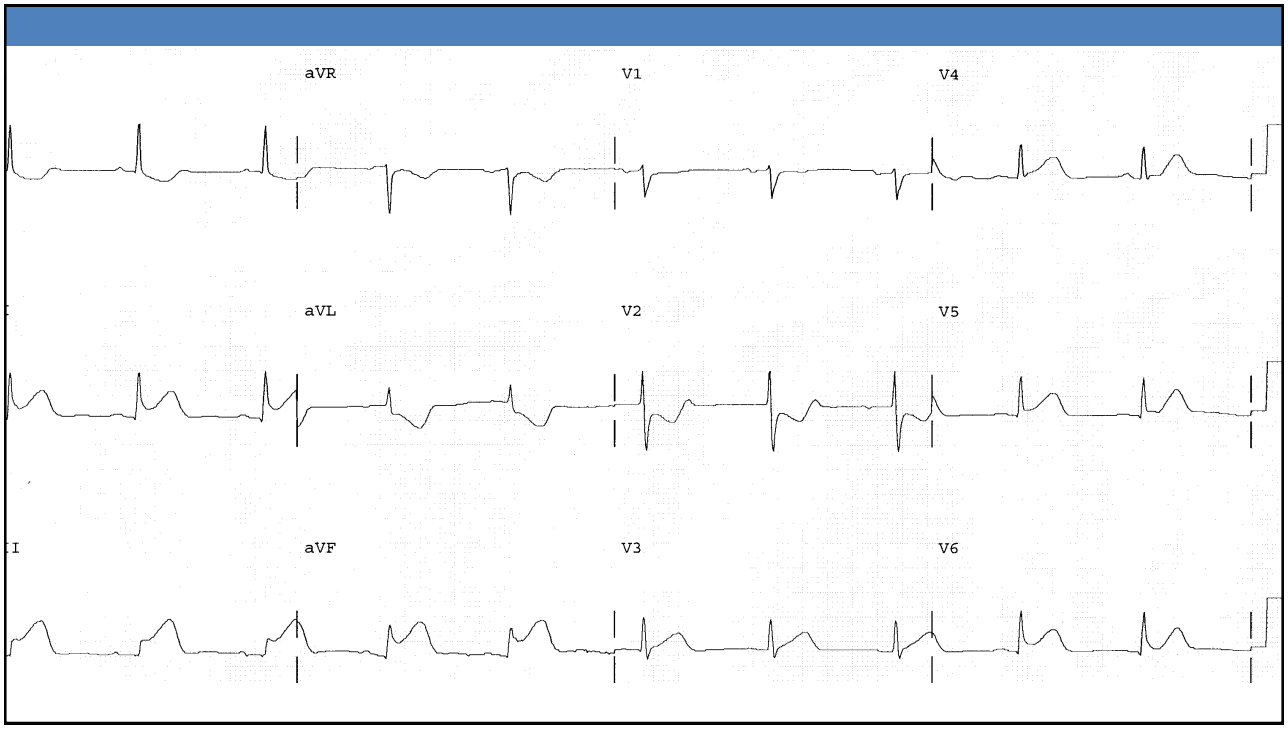

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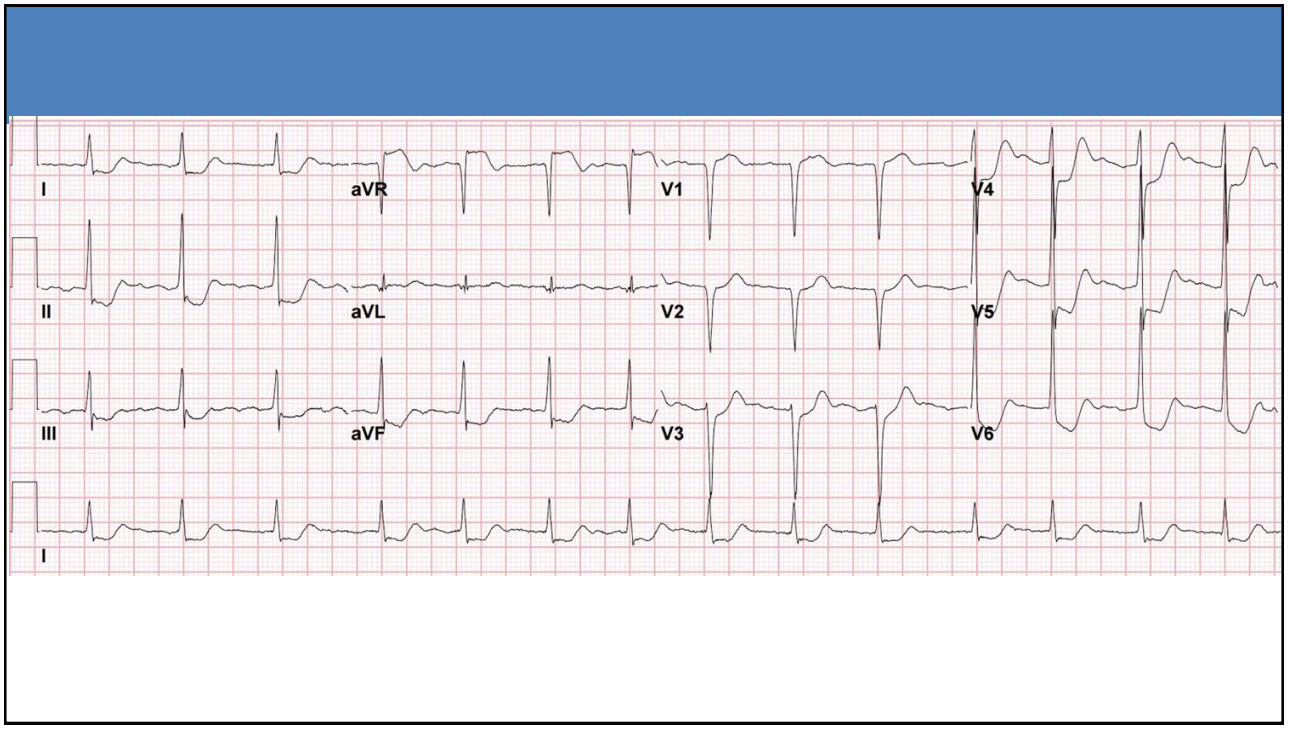
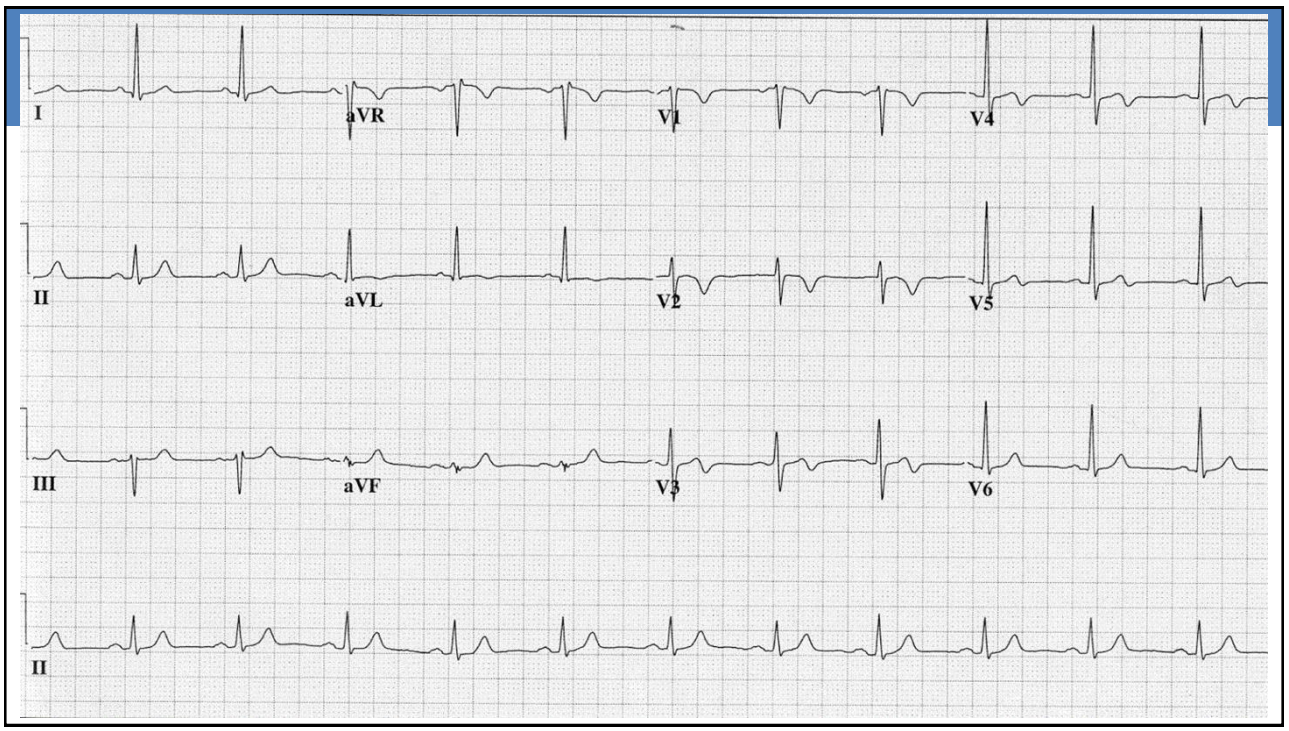
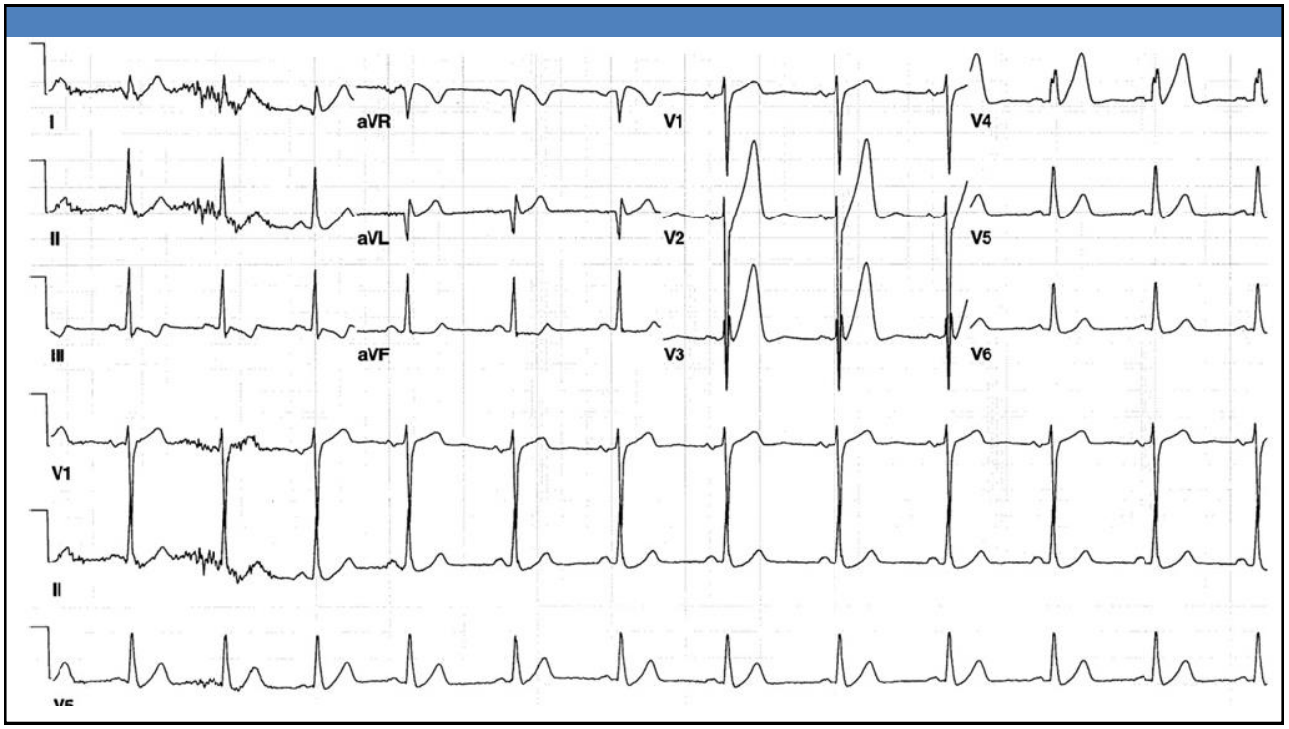

I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
I

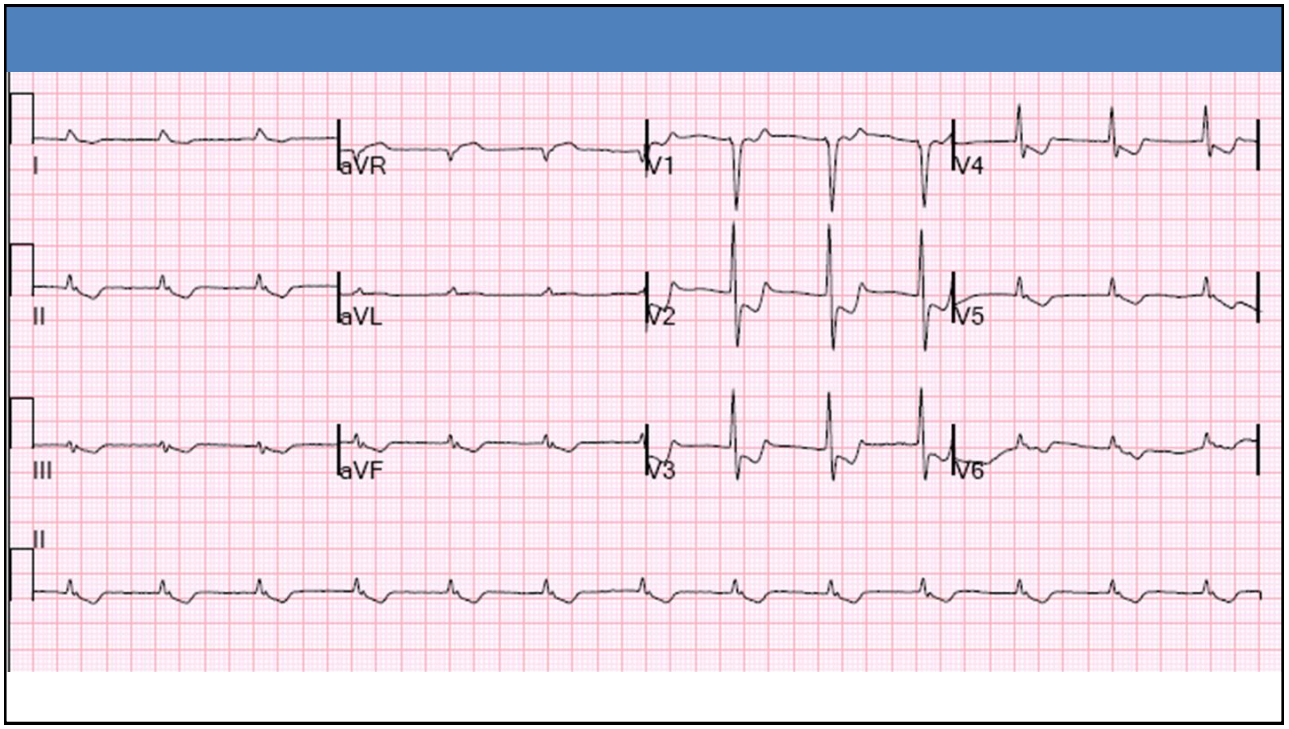
123


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

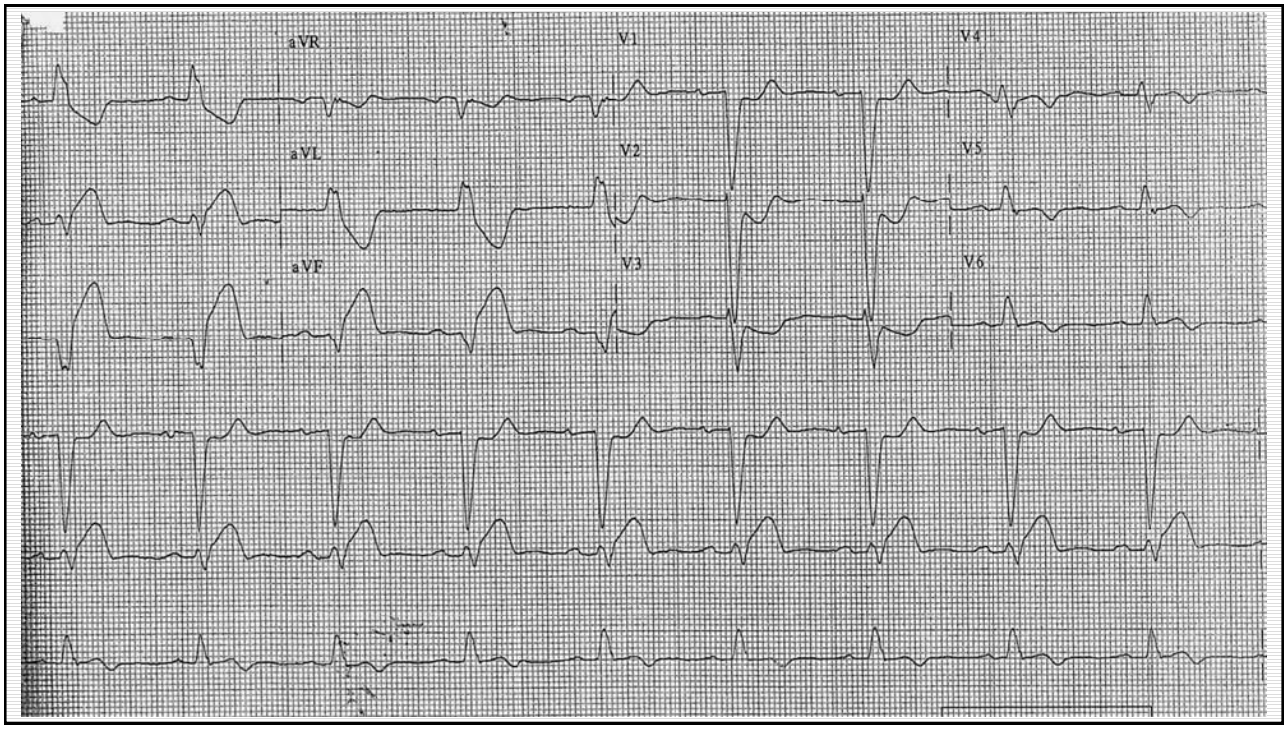
124


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

125


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

126



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