STEMI

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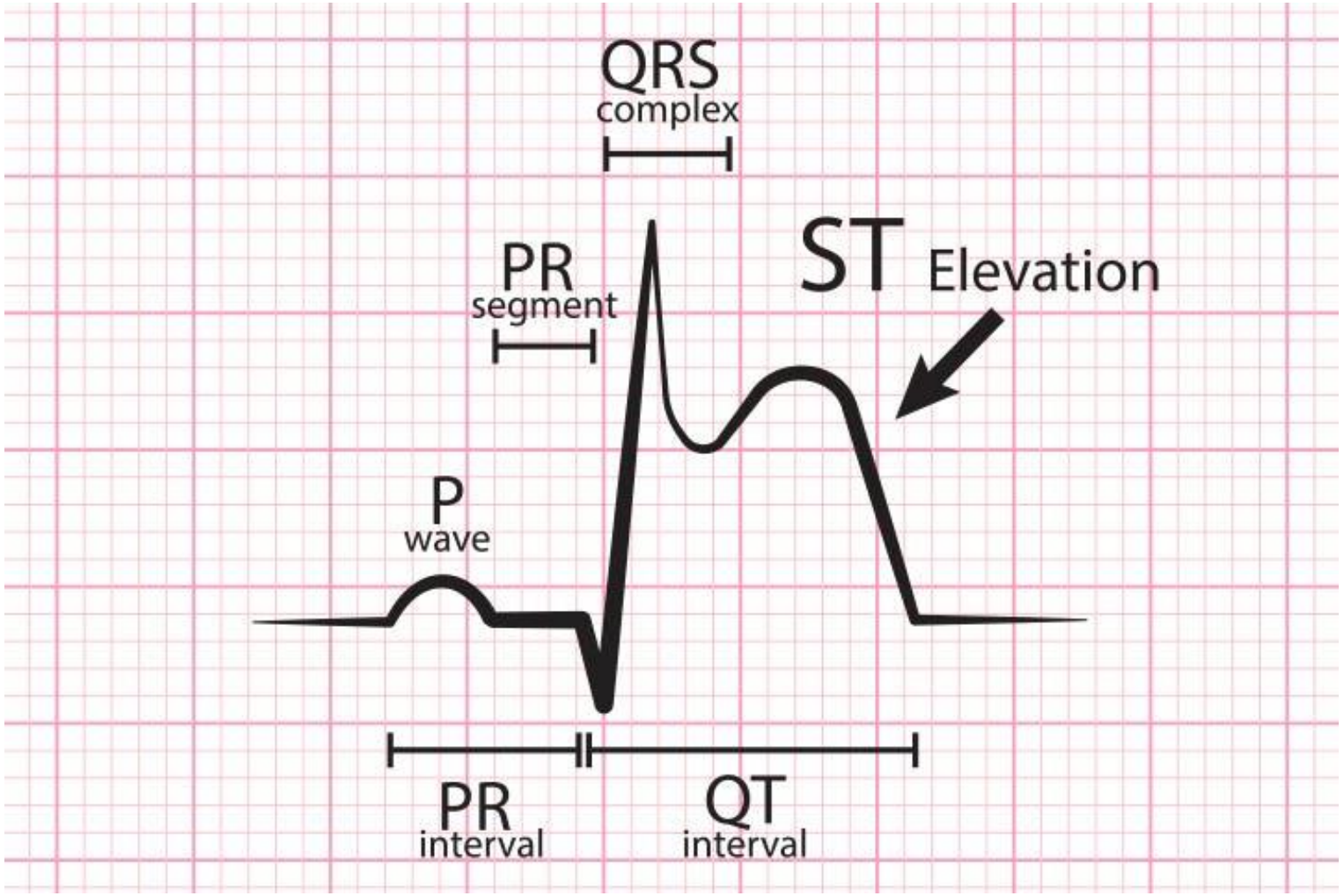
Chief Cardiology Fellow

8/24/21



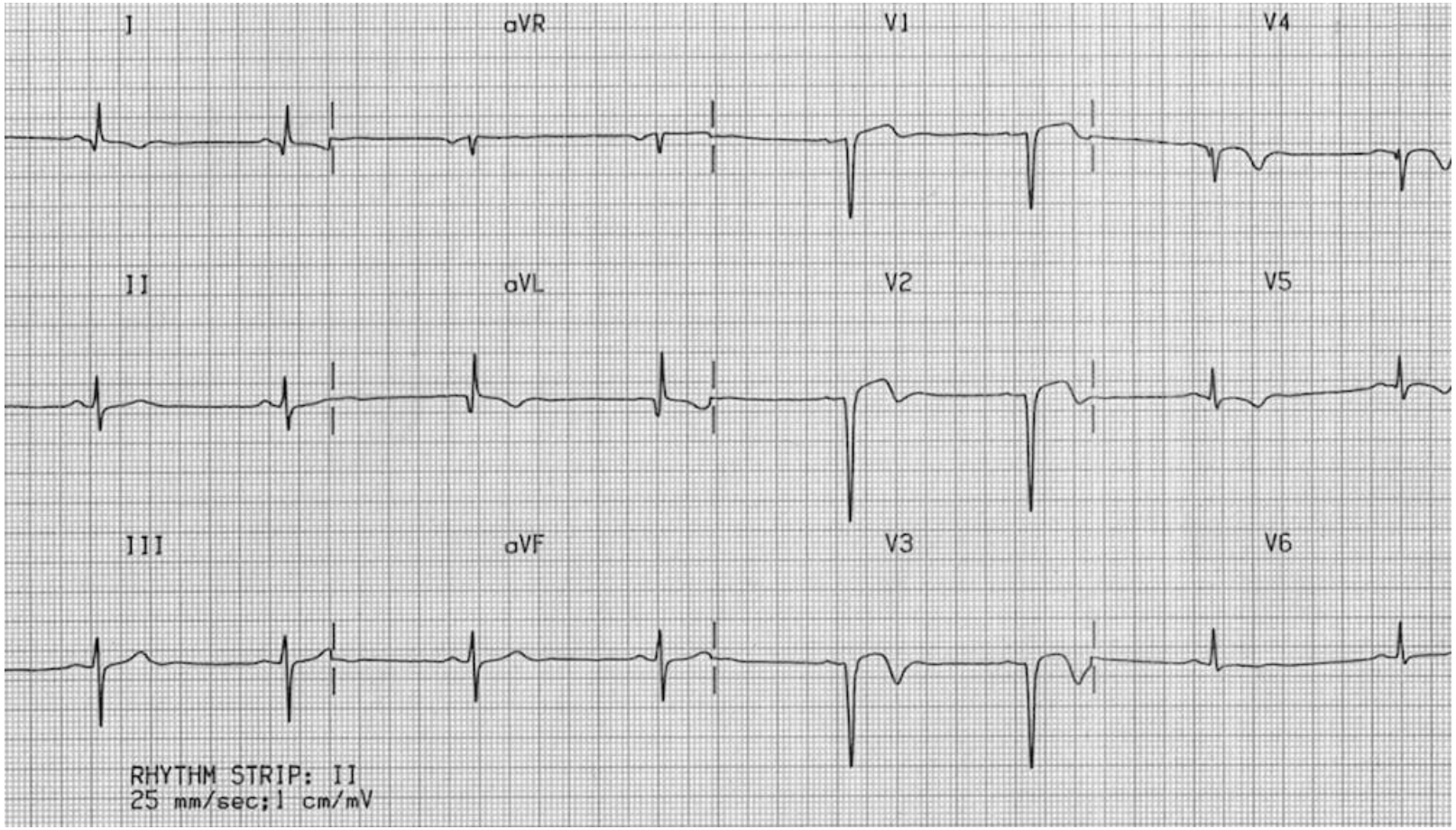
Objectives

- Definition
- EKG criteria
- Guidelines
- Reperfusion therapies
- Medical therapy post STEMI
- STEMI mimics
- STEMI equivalents
- Questions
- Examples

ACS

- **STEMI**
- NSTEMI
- Unstable angina

STEMI?


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

Definition

- STEMI is a clinical syndrome defined by characteristic symptoms of myocardial ischemia in association with persistent electrocardiographic (ECG) ST elevation and subsequent release of biomarkers of myocardial necrosis.

- EKG is the mainstay in the diagnosis of STEMI
- Within 10 minutes of presentation to the ER – Class I recommendation

Historical introduction

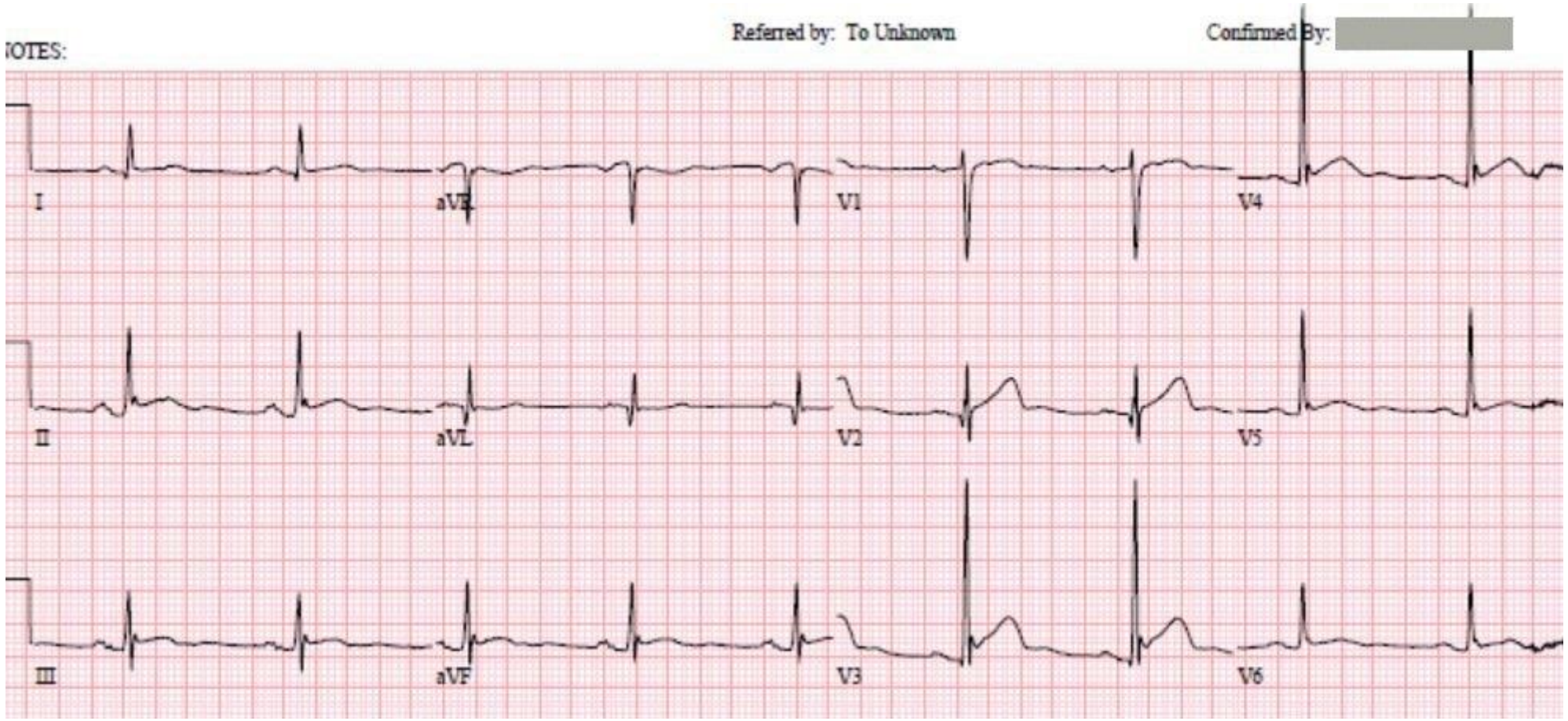
- 1895 – Einthoven, using an improved electrometer and a correction formula, distinguishes five deflections which he names P, Q, R, S and T
- 1912 – Einthoven's triangle is described
- 1918 – Bousfield describes the spontaneous changes in the ECG during angina

- 1920 – Harold Pardee, New York, publishes the first ECG of an AMI in a human and describes the T wave as being tall and "starts from a point well up on the descent of the R wave"

- Definition of STEMI – New ST elevation at the J point in two contiguous leads of >0.1 mV in all leads other than leads V2-V3

- For leads V2-V3 the following cut points apply: ≥0.2 mV in men ≥40 years, ≥0.25 mV in men <40 years

- The presence of reciprocal ST depression helps confirm the diagnosis.


NOTES:
Referred by: To Unknown
Confirmed By:
I
aVR
V1
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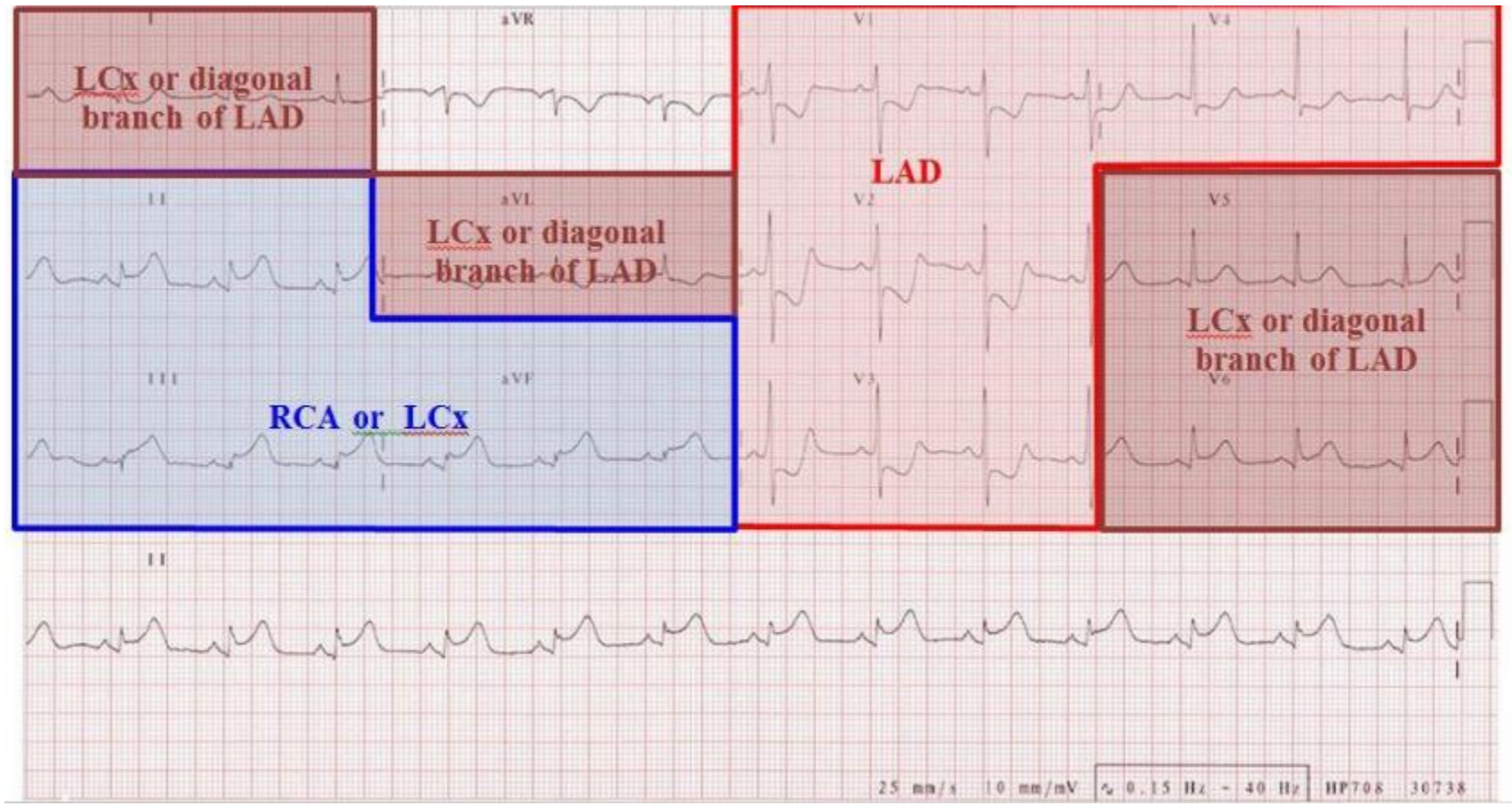
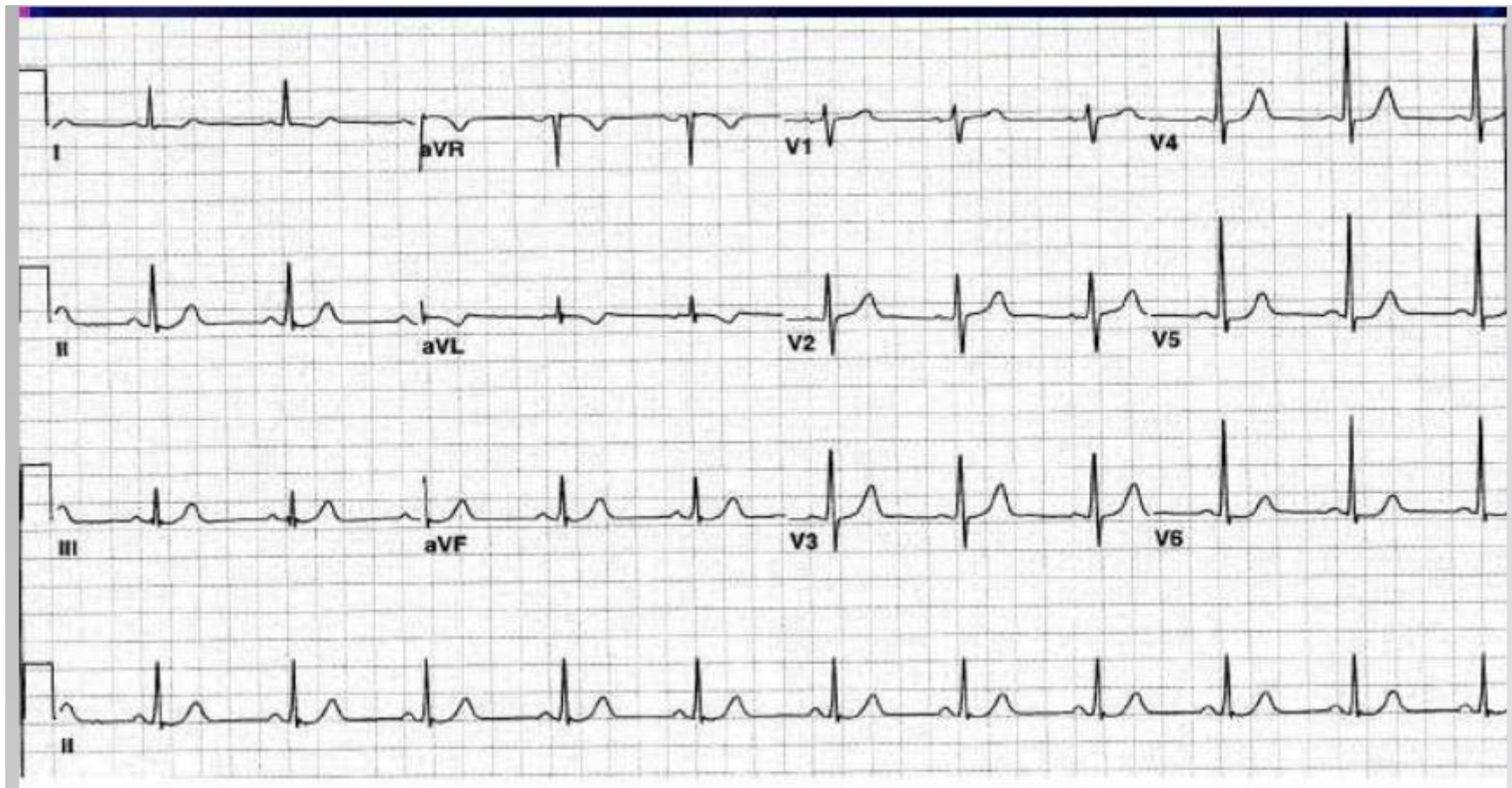
V3
V6

Localization of Infarction

- Septal: V1 and V2
- Anterior: V3 and V4
- Lateral: V5 and V6, I and aVL
- Anteroseptal: V1-V4
- Anterolateral: V3-V6
- Inferior: II, III, aVF
- Posterior: tall R wave and ST depression in V1-V2


LCx or diagonal branch of LAD
LAD
LCx or diagonal branch of LAD
LCx or diagonal branch of LAD
RCA or LCx
25 mm/s 10 mm/mV 0.15 Hz - 40 Hz HP708 30738

- If ever in doubt, REPEAT EKG!!!!
- There is no contraindication to obtain an EKG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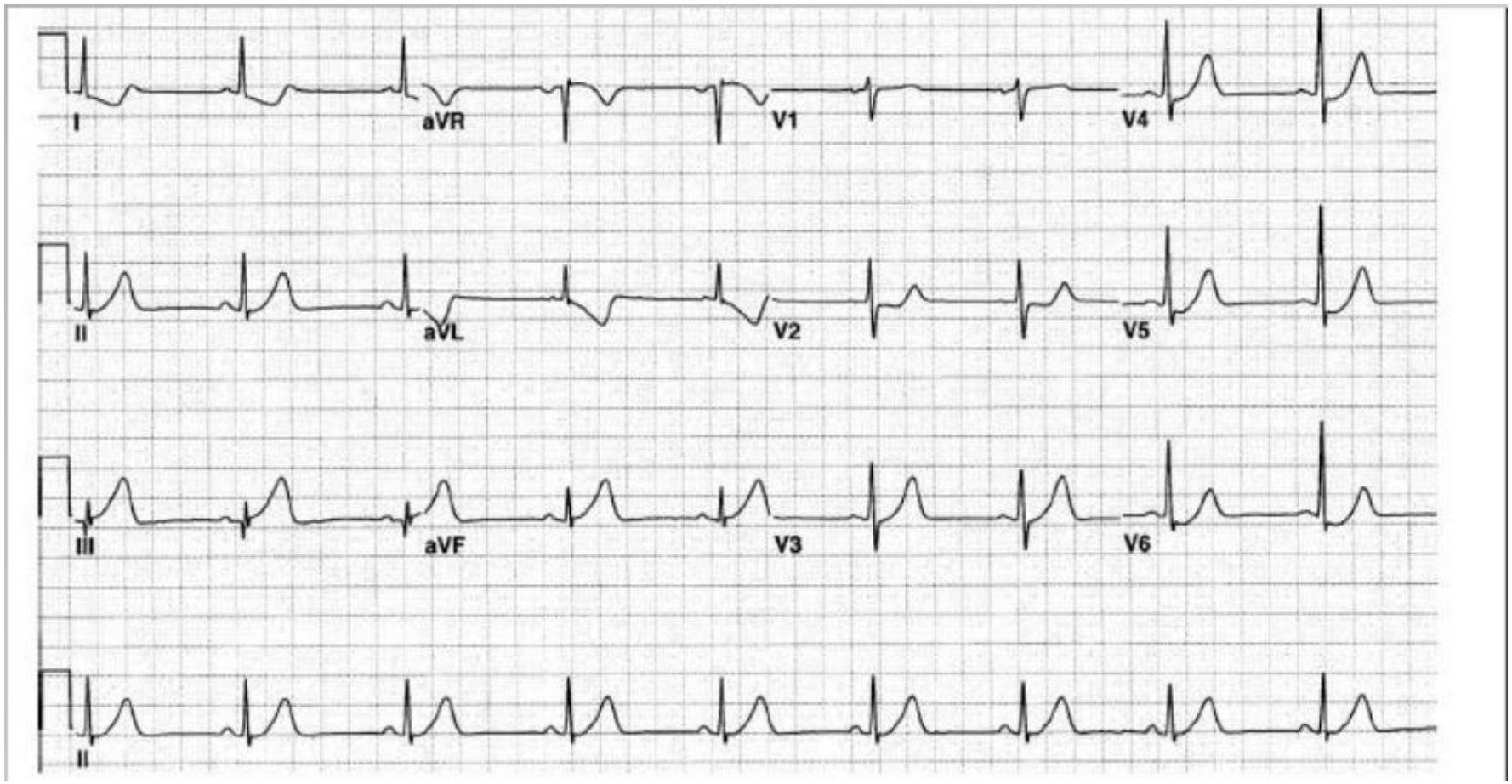
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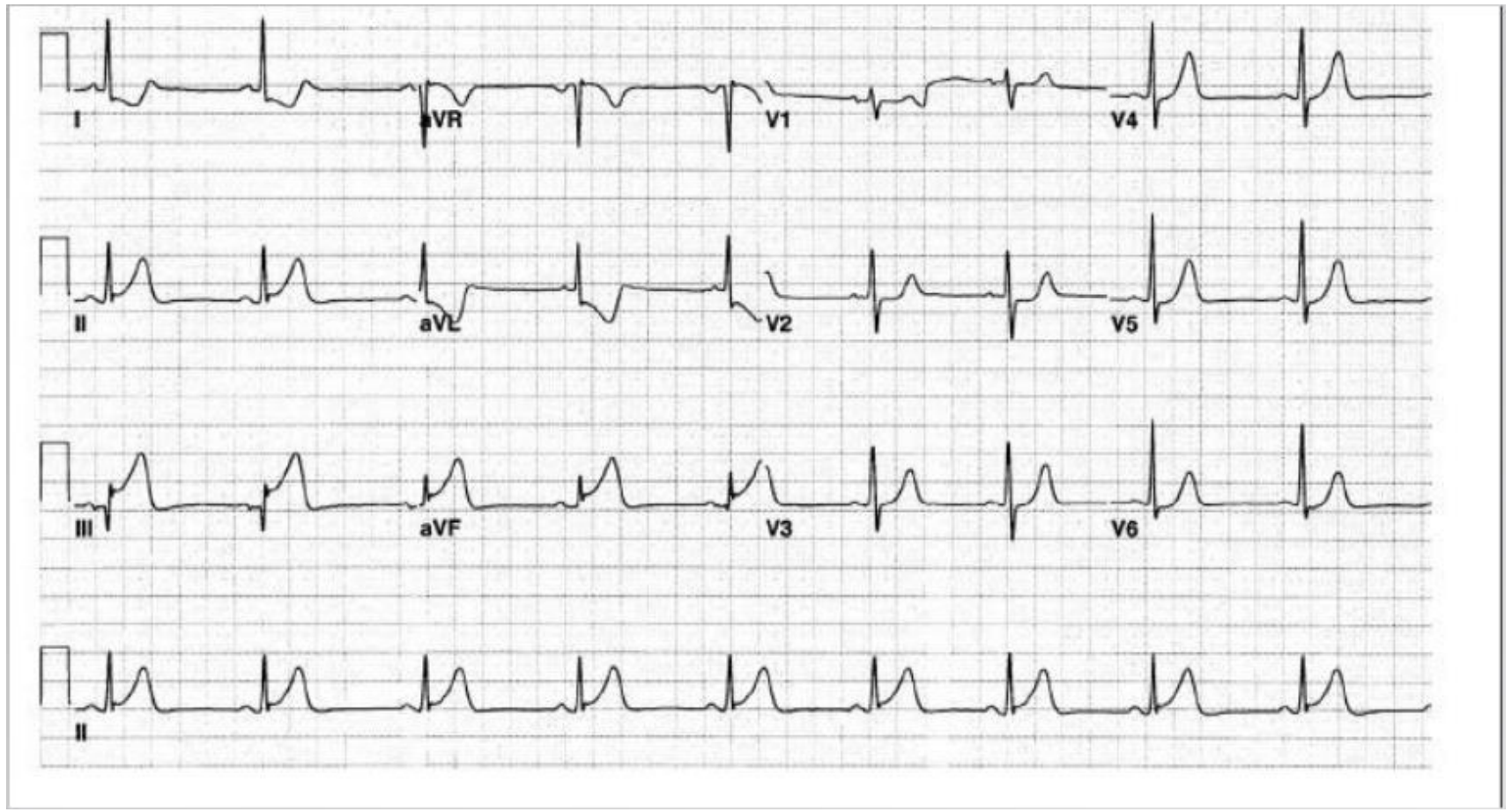
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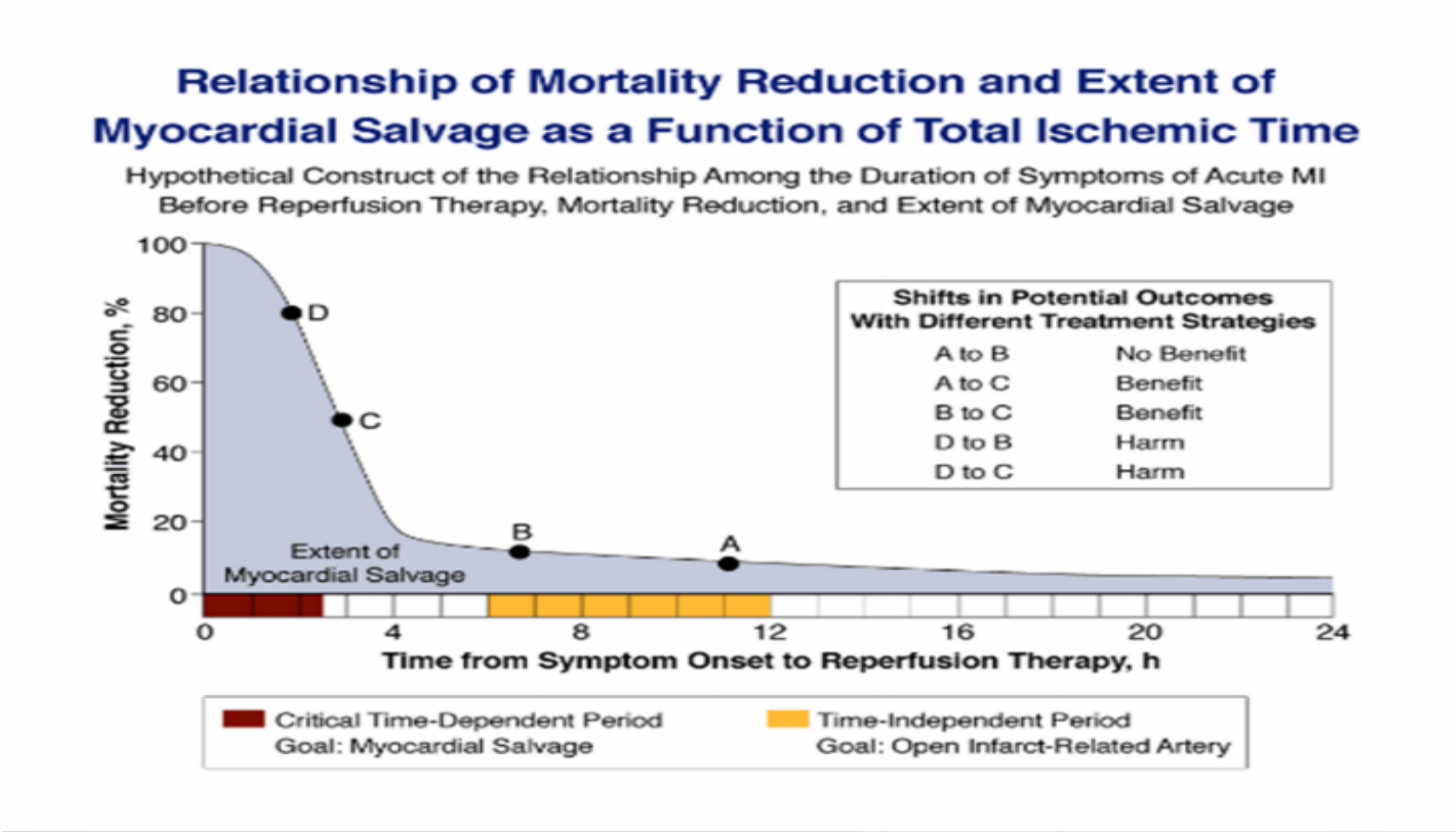
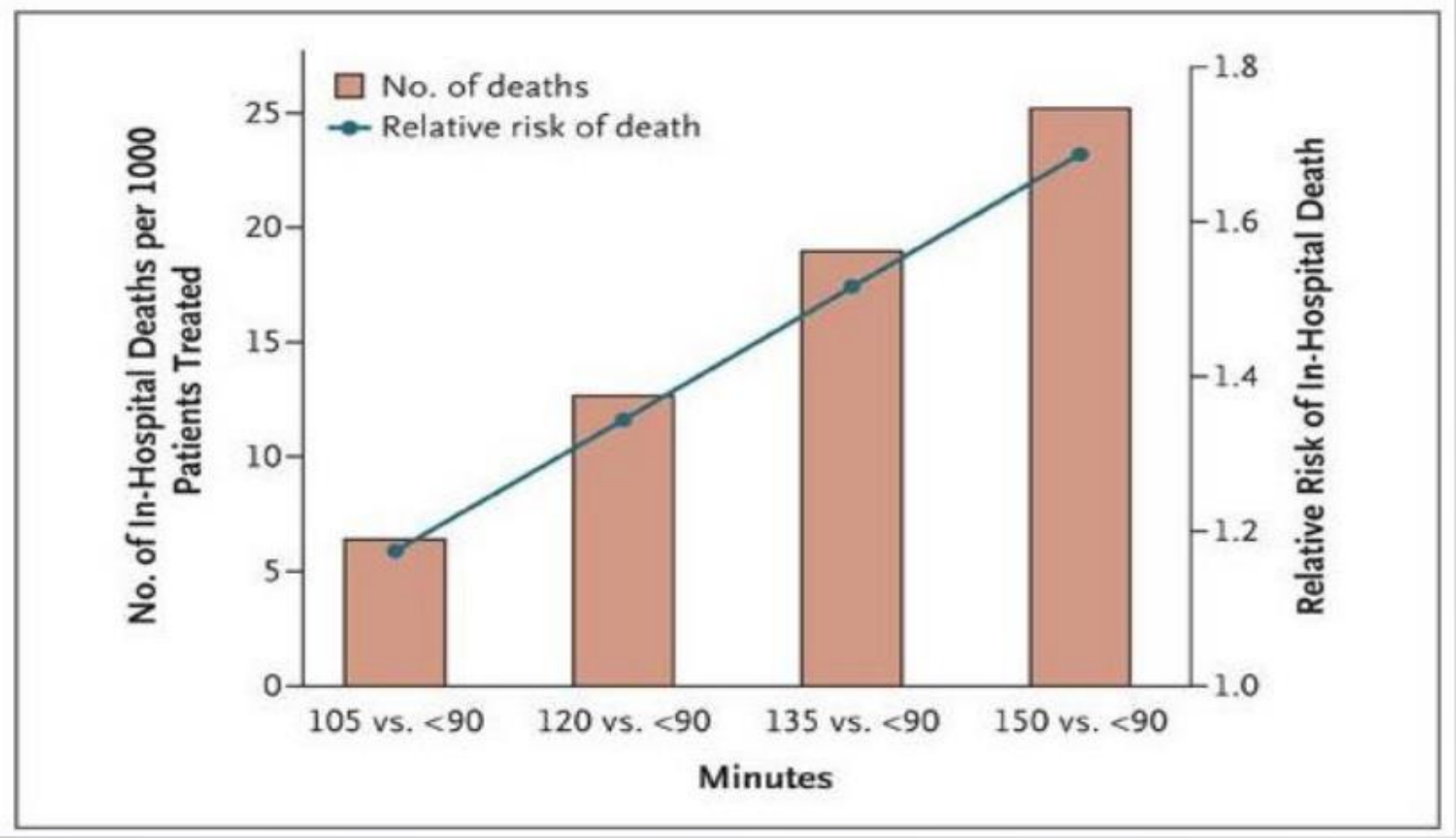
V6
II

Time is muscle



Outcomes based on time to reperfusion



Guideline based management

Regional Systems of STEMI Care, Reperfusion Therapy, and Time-to-Treatment Goals

Reperfusion therapy should be administered to all eligible patients with STEMI with symptom onset within the prior 12 hours.

Primary PCI is the recommended method of reperfusion when it can be performed in a timely fashion by experienced operators.

EMS transport directly to a PCI-capable hospital for primary PCI is the recommended triage strategy for patients with STEMI with an ideal FMC-to-device time system goal of 90 minutes or less.*

*The proposed time windows are system goals. For any individual patient, every effort should be made to provide reperfusion therapy as rapidly as possible.

Regional Systems of STEMI Care, Reperfusion Therapy, and Time-to-Treatment Goals

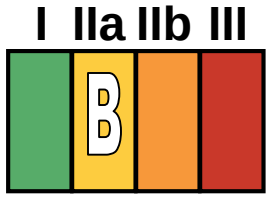
Immediate transfer to a PCI-capable hospital for primary PCI is the recommended triage strategy for patients with STEMI who initially arrive at or are transported to a non–PCI-capable hospital, with an FMC-to-device time system goal of 120 minutes or less.*

In the absence of contraindications, fibrinolytic therapy should be administered to patients with STEMI at non–PCI-capable hospitals when the anticipated FMC-to-device time at a PCI-capable hospital exceeds 120 minutes because of unavoidable delays.

*The proposed time windows are system goals. For any individual patient, every effort should be made to provide reperfusion therapy as rapidly as possible.

Regional Systems of STEMI Care, Reperfusion Therapy, and Time-to-Treatment Goals

When fibrinolytic therapy is indicated or chosen as the primary reperfusion strategy, it should be administered within 30 minutes of hospital arrival.*



Reperfusion therapy is reasonable for patients with STEMI and symptom onset within the prior 12 to 24 hours who have clinical and/or ECG evidence of ongoing ischemia. Primary PCI is the preferred strategy in this population.

*The proposed time windows are system goals. For any individual patient, every effort should be made to provide reperfusion therapy as rapidly as possible.

Primary PCI in STEMI

	COR	LOE
Ischemic symptoms <12 h	I	A
Ischemic symptoms <12 h and contraindications to fibrinolytic therapy irrespective of time delay from FMC	I	B
Cardiogenic shock or acute severe HF irrespective of time delay from MI onset	I	B
Evidence of ongoing ischemia 12 to 24 h after symptom onset	IIa	B
PCI of a noninfarct artery at the time of primary PCI in patients without hemodynamic compromise	III: Harm	B

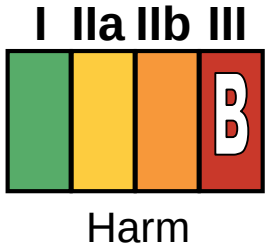
Antiplatelet Therapy to Support Primary PCI for STEMI

$P2Y_{12}$ inhibitor therapy should be given for 1 year to patients with STEMI who receive a stent (BMS or DES) during primary PCI using the following maintenance doses:

- Clopidogrel 75 mg daily; or
- Prasugrel 10 mg daily; or
- Ticagrelor 90 mg twice a day*

*The recommended maintenance dose of aspirin to be used with ticagrelor is 81 mg daily.

Antiplatelet Therapy to Support Primary PCI for STEMI



Prasugrel should not be administered to patients with a history of prior stroke or transient ischemic attack.

Adjunctive Antithrombotic Therapy to Support Reperfusion With Primary PCI

	COR	LOE
Antiplatelet therapy		
Aspirin		
• 162- to 325-mg load before procedure	I	B
• 81- to 325-mg daily maintenance dose (indefinite)*	I	A
• 81 mg daily is the preferred maintenance dose*	IIa	B
$P2Y_{12}$ inhibitors		
Loading doses		
• Clopidogrel: 600 mg as early as possible or at time of PCI	I	B
• Prasugrel: 60 mg as early as possible or at time of PCI	I	B
• Ticagrelor: 180 mg as early as possible or at time of PCI	I	B

*The recommended maintenance dose of aspirin to be used with ticagrelor is 81 mg daily.

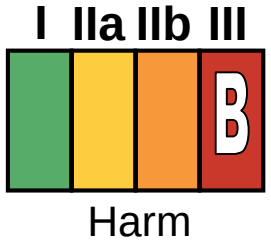
Reperfusion at non-PCI capable facility

- Fibrinolytic Therapy When There Is an Anticipated Delay to Performing Primary PCI Within **120 Minutes** of FMC

Fibrinolytic Therapy When There Is an Anticipated Delay to Performing Primary PCI Within 120 Minutes of FMC

In the absence of contraindications, fibrinolytic therapy should be given to patients with STEMI and onset of ischemic symptoms within the previous 12 hours when it is anticipated that primary PCI cannot be performed within 120 minutes of FMC.

In the absence of contraindications and when PCI is not available, fibrinolytic therapy is reasonable for patients with STEMI if there is clinical and/or ECG evidence of ongoing ischemia within 12 to 24 hours of symptom onset and a large area of myocardium at risk or hemodynamic instability.

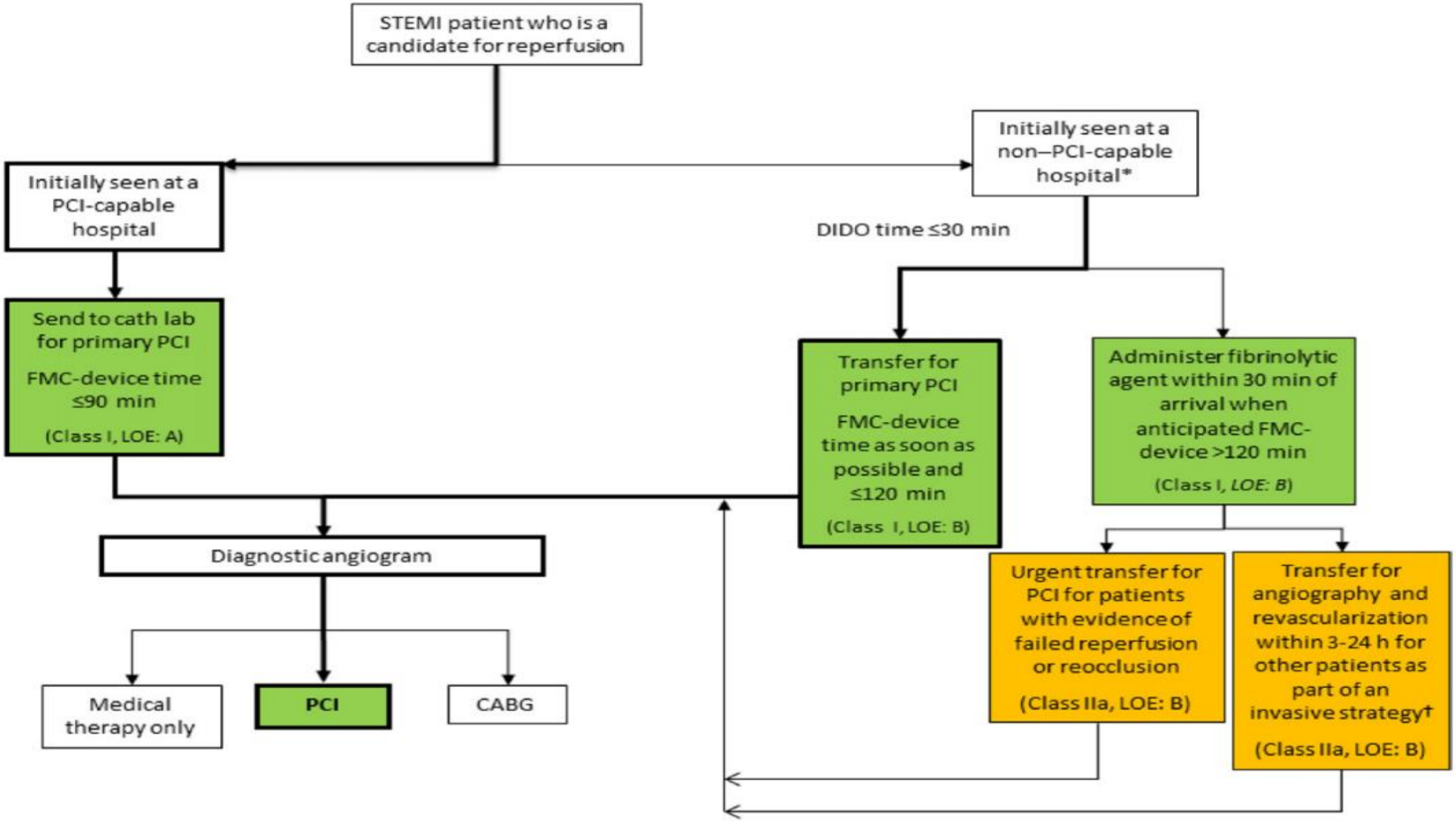


Fibrinolytic therapy should not be administered to patients with ST depression except when a true posterior (inferobasal) MI is suspected or when associated with ST elevation in lead aVR.

- DANAMI-2 showed that a reperfusion strategy involving the transfer of patients with STEMI from a non–PCI-capable hospital to a PCI-capable hospital for primary PCI was superior to the use of fibrinolysis at the referring hospital, driven primarily by a reduction in the rate of reinfarction in the primary PCI– treated group

- In an analysis of approximately 19,000 propensity score–matched patients with STEMI from NRMI-2, -3, -4, and -5, when delays related to transfer for primary PCI exceeded 120 minutes from FMC, the survival advantage of primary PCI over fibrinolysis was negated.

- Fibrinolytic therapy, in the absence of contraindications to its use, should be administered within 30 minutes of first door arrival when this 120-minute time goal cannot be met.


STEMI patient who is a candidate for reperfusion
Initially seen at a PCI-capable hospital
Initially seen at a non–PCI-capable hospital*
DIDO time ≤30 min
Send to cath lab for primary PCI
FMC-device time ≤90 min
(Class I, LOE: A)
Transfer for primary PCI
FMC-device time as soon as possible and ≤120 min
(Class I, LOE: B)
Administer fibrinolytic agent within 30 min of arrival when anticipated FMC-device >120 min
(Class I, LOE: B)
Diagnostic angiogram
Urgent transfer for PCI for patients with evidence of failed reperfusion or reocclusion
(Class IIa, LOE: B)
Transfer for angiography and revascularization within 3-24 h for other patients as part of an invasive strategy†
(Class IIa, LOE: B)
Medical therapy only
PCI
CABG

Fibrinolytic Agent	Dose
Fibrin-specific:	
Tenecteplase (TNK-tPA)	Single IV weight-based bolus†
Reteplase (rPA)	10 U+10-U IV boluses given 30 min apart
Alteplase (tPA)	90-min weight-based infusion‡
Non–fibrin-specific:	
Streptokinase§	1.5 million units IV given over 30–60 min

Absolute contraindications

- Any prior ICH
- Known structural cerebral vascular lesion (e.g., arteriovenous malformation)
- Known malignant intracranial neoplasm (primary or metastatic)
- Ischemic stroke within 3 mo
  - EXCEPT acute ischemic stroke within 4.5 h
- Suspected aortic dissection
- Active bleeding or bleeding diathesis (excluding menses)
- Significant closed-head or facial trauma within 3 mo
- Intracranial or intraspinal surgery within 2 mo
- Severe uncontrolled hypertension (unresponsive to emergency therapy)
- For streptokinase, prior treatment within the previous 6 mo

Signs of reperfusion with fibrinolysis

- The relatively sudden and complete relief of chest pain coupled with 70% ST resolution (in the index lead showing the greatest degree of elevation on presentation) is highly suggestive of restoration of normal myocardial blood flow.
- Complete (or near complete) ST-segment resolution at 60 or 90 minutes after fibrinolytic therapy is a useful marker of a patent infarct artery.
- Conversely, partial or absent improvement in the extent of ST elevation is not as accurate in predicting a “closed artery” .
- Lack of improvement in ST resolution is associated with worse prognosis.

- Lack of resolution of ST elevation by at least 50% in the worst lead at 60 to 90 minutes should prompt strong consideration of a decision to proceed with immediate coronary angiography and “rescue” PCI.

What after fibrinolysis

- Transfer to a PCI capable center
- TRANSFER-AMI trial - largest (n1059) of the RCTs evaluating transfer for coronary angiography and revascularization among high-risk patients
- Significant reduction in the combined primary endpoint of death, recurrent MI, recurrent ischemia, new or worsening HF, or shock at 30 days
- RR: 0.64; 95% CI: 0.47 to 0.87; p0.004

- In a meta-analysis that included 7 RCTs of early transfer for catheterization, a strategy of routine early catheterization after fibrinolysis was associated with a statistically significant reduction in the incidence of death or MI at 30 days and at 1 year, without an increase in the risk of major bleeding.

Coronary Angiography in Patients Who Initially Were Managed With Fibrinolytic Therapy or Who Did Not Receive Reperfusion

Cardiac catheterization and coronary angiography with intent to perform revascularization should be performed after STEMI in patients with any of the following:

a. Cardiogenic shock or acute severe HF that develops after initial presentation;

b. Intermediate- or high-risk findings on predischarge noninvasive ischemia testing; or

c. Myocardial ischemia that is spontaneous or provoked by minimal exertion during hospitalization.

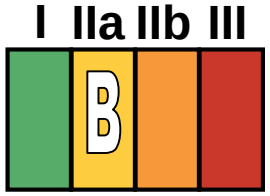
- Because of the associated increased bleeding risk, very early (2 to 3 hours) catheterization after administration of fibrinolytic therapy with intent to perform revascularization should be reserved for patients with evidence of failed fibrinolysis

Medical Therapy

- BB
- ACE-i/ARBs
- MRAs

Beta Blockers

Patients with initial contraindications to the use of beta blockers in the first 24 hours after STEMI should be reevaluated to determine their subsequent eligibility.



It is reasonable to administer intravenous beta blockers at the time of presentation to patients with STEMI and no contraindications to their use who are hypertensive or have ongoing ischemia.

Renin-Angiotensin-Aldosterone System Inhibitors

An ACE inhibitor should be administered within the first 24 hours to all patients with STEMI with anterior location, HF, or EF less than or equal to 0.40, unless contraindicated.

An ARB should be given to patients with STEMI who have indications for but are intolerant of ACE inhibitors.

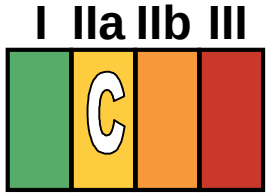
Renin-Angiotensin-Aldosterone System Inhibitors

An aldosterone antagonist should be given to patients with STEMI and no contraindications who are already receiving an ACE inhibitor and beta blocker and who have an EF less than or equal to 0.40 and either symptomatic HF or diabetes mellitus.

ACE inhibitors are reasonable for all patients with STEMI and no contraindications to their use.

Lipid Management

High-intensity statin therapy should be initiated or continued in all patients with STEMI and no contraindications to its use.



It is reasonable to obtain a fasting lipid profile in patients with STEMI, preferably within 24 hours of presentation.

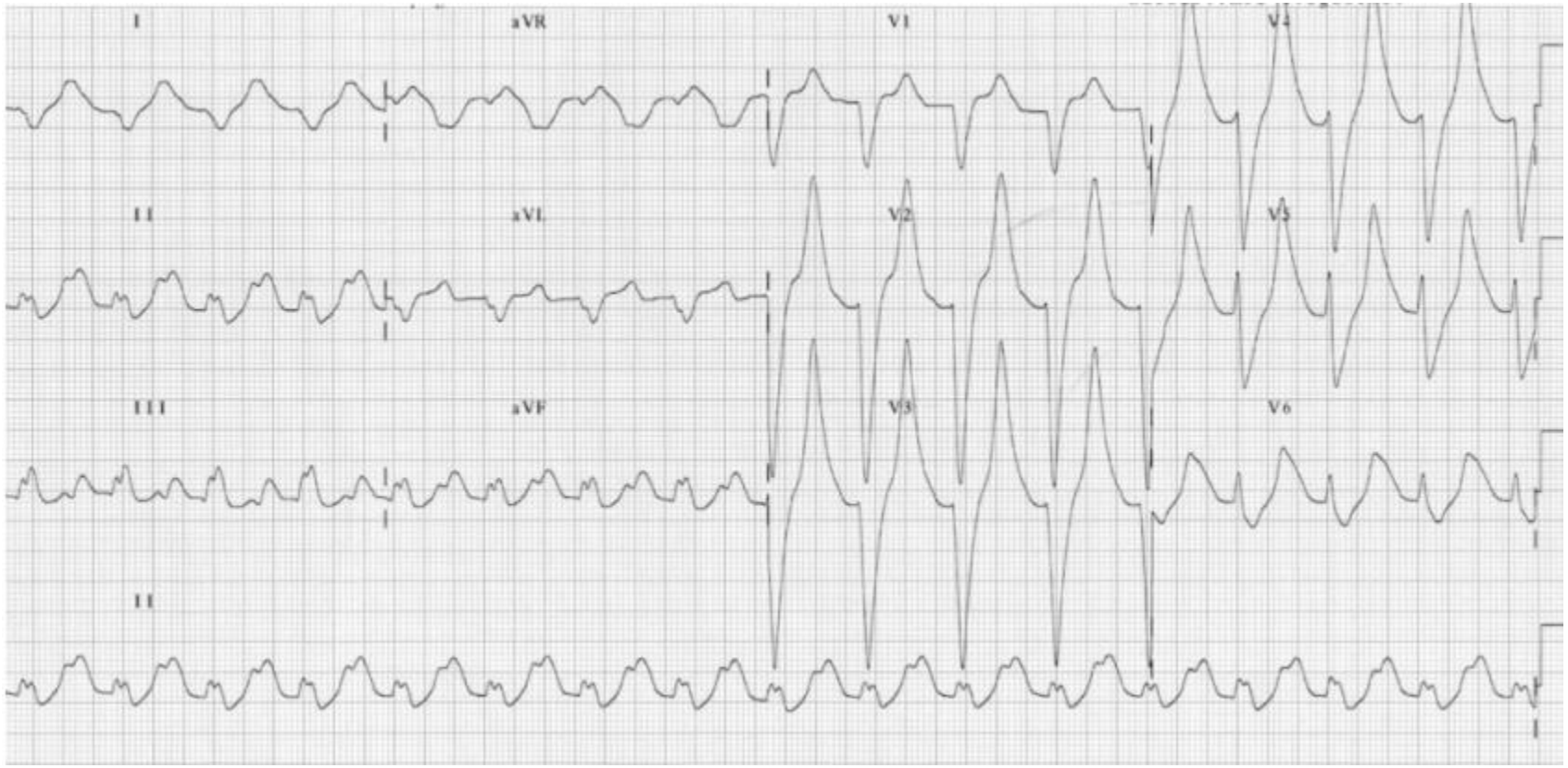
Complications after STEMI

- Pump failure
- Arrhythmias – Indications for ICD
- High degree AV blocks
- Pericarditis
- Mechanical complications e.g. VSD, free wall rupture

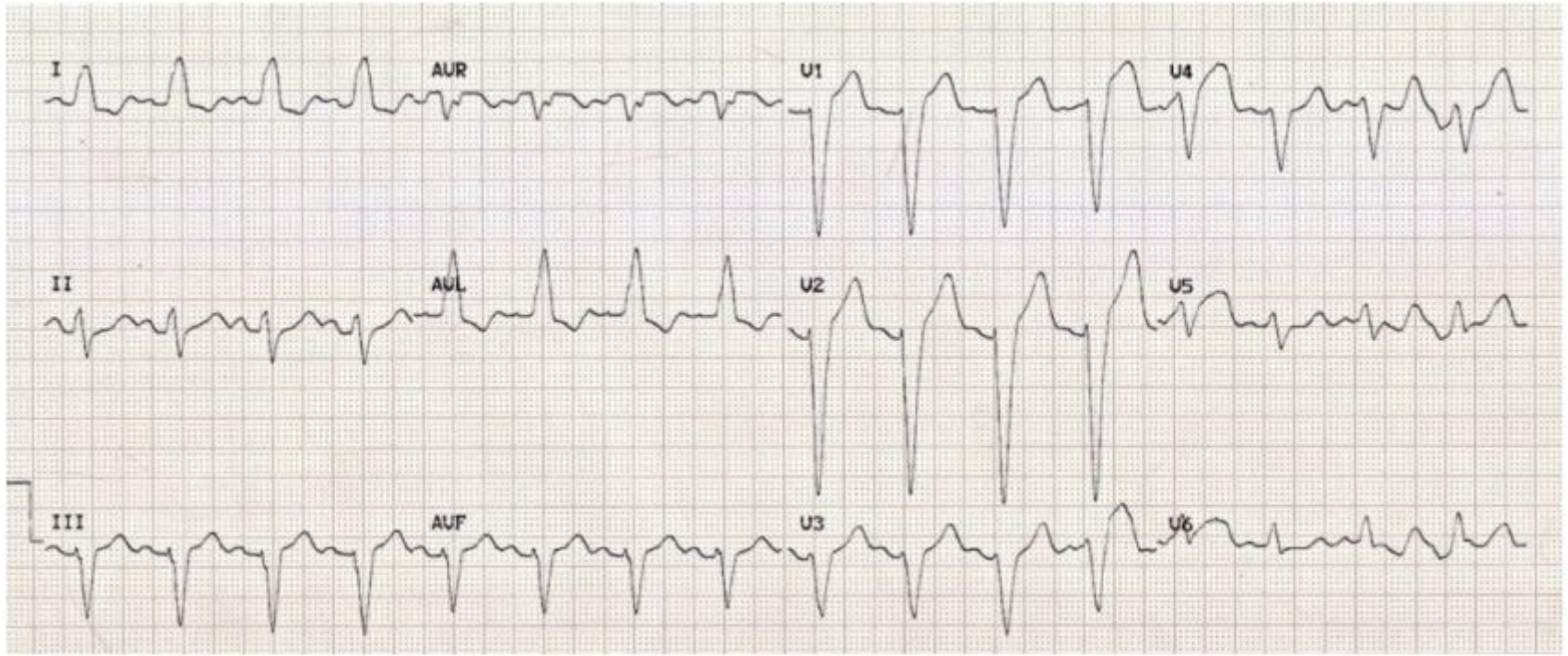
STEMI MIMICS

- Electrolytes - HyperK
- LBBB
- Early Repolarization
- Ventricular Hypertrophy (Left)
- Aneurysm (Ventricular)
- Brugada Syndrome
- Pericarditis
- Non-Ischemic Vasospasm
- Takotsubo’s cardiomyopathy

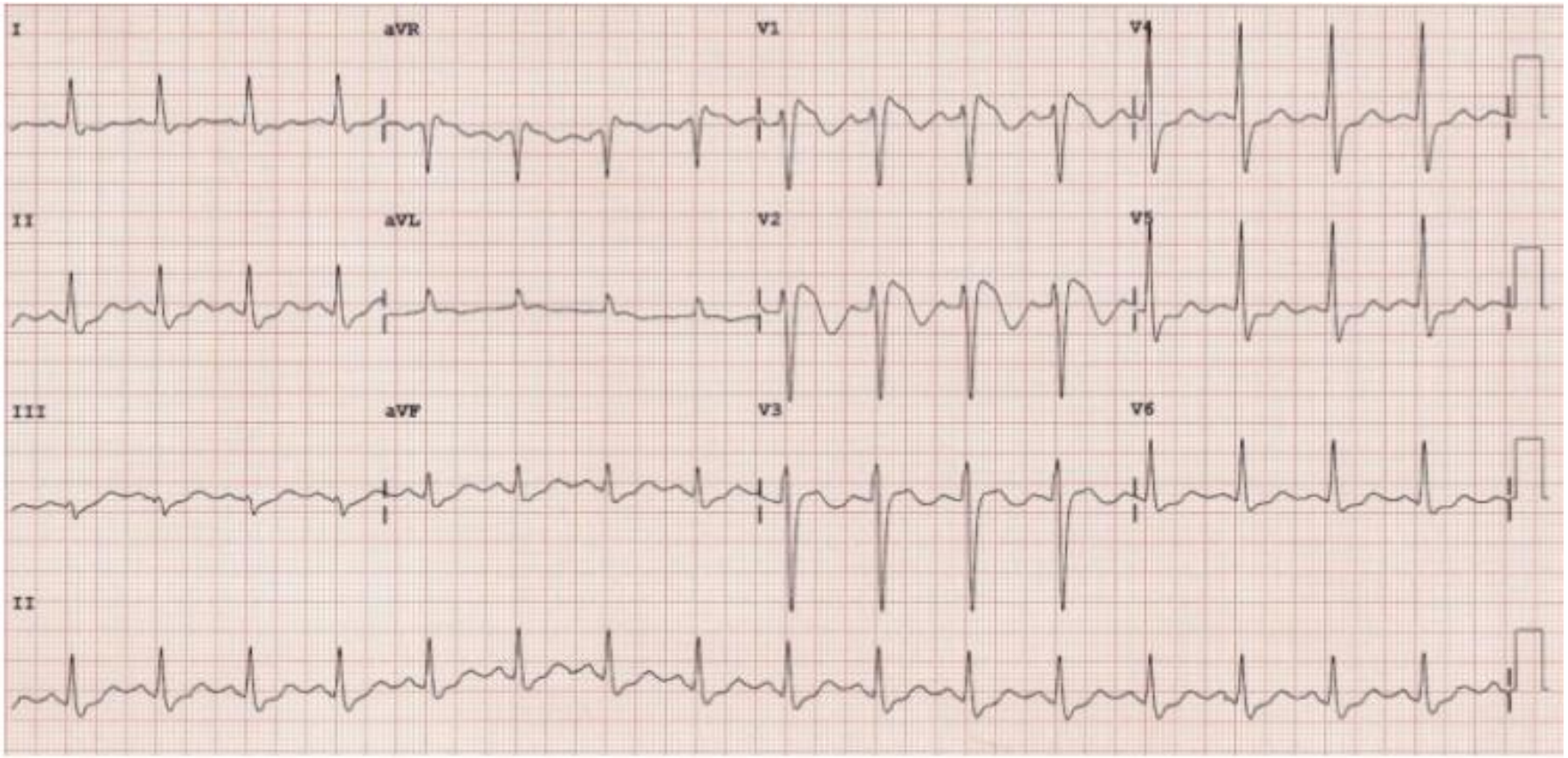
HyperK



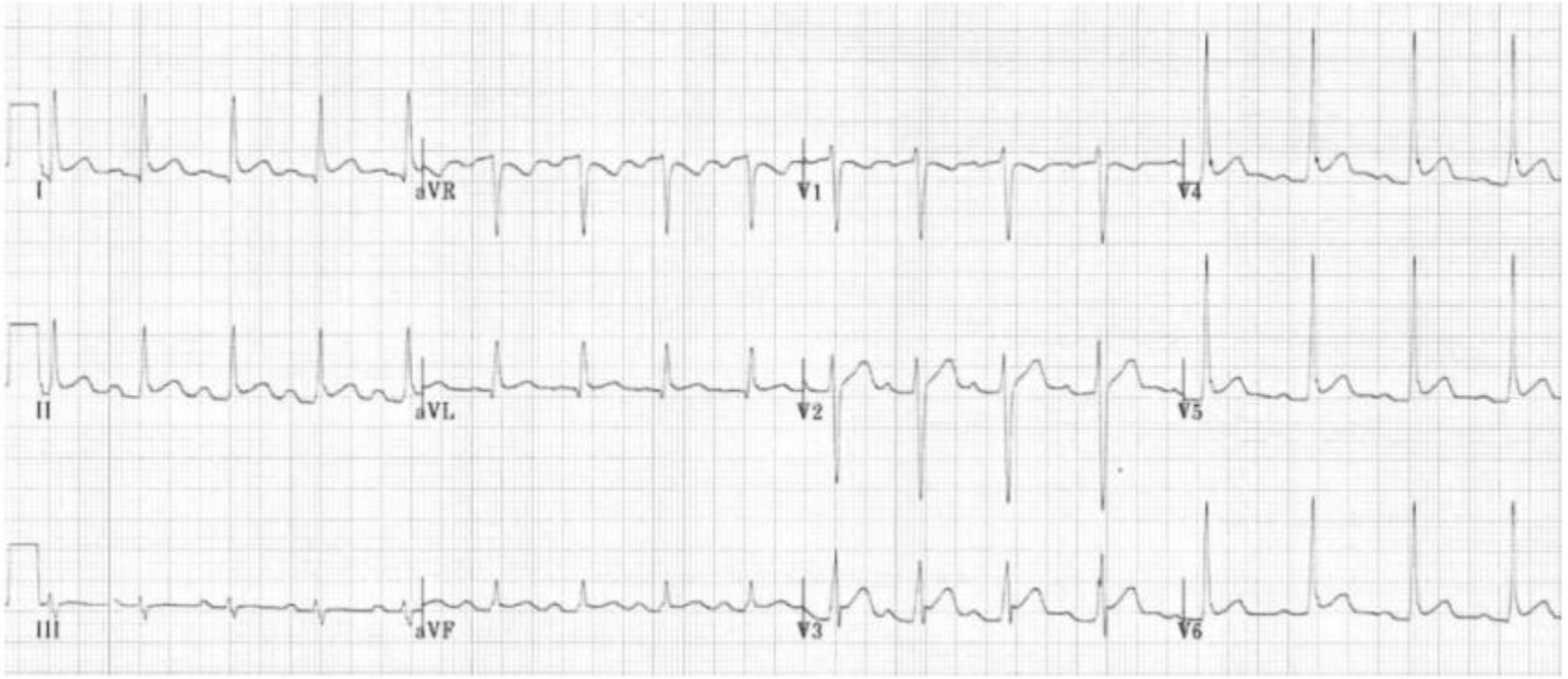
LBBB



Brugada



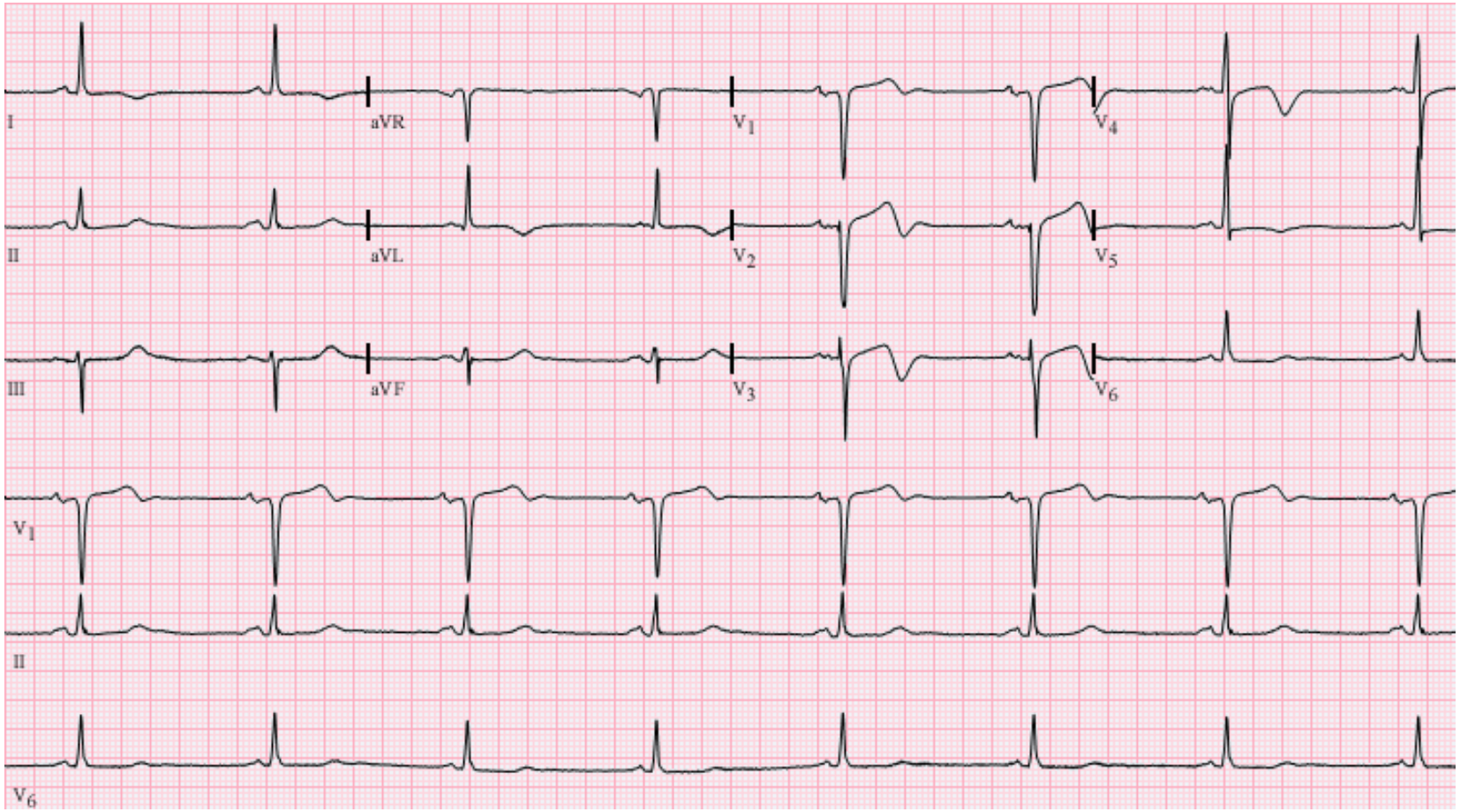
Pericarditis



STEMI Equivalents

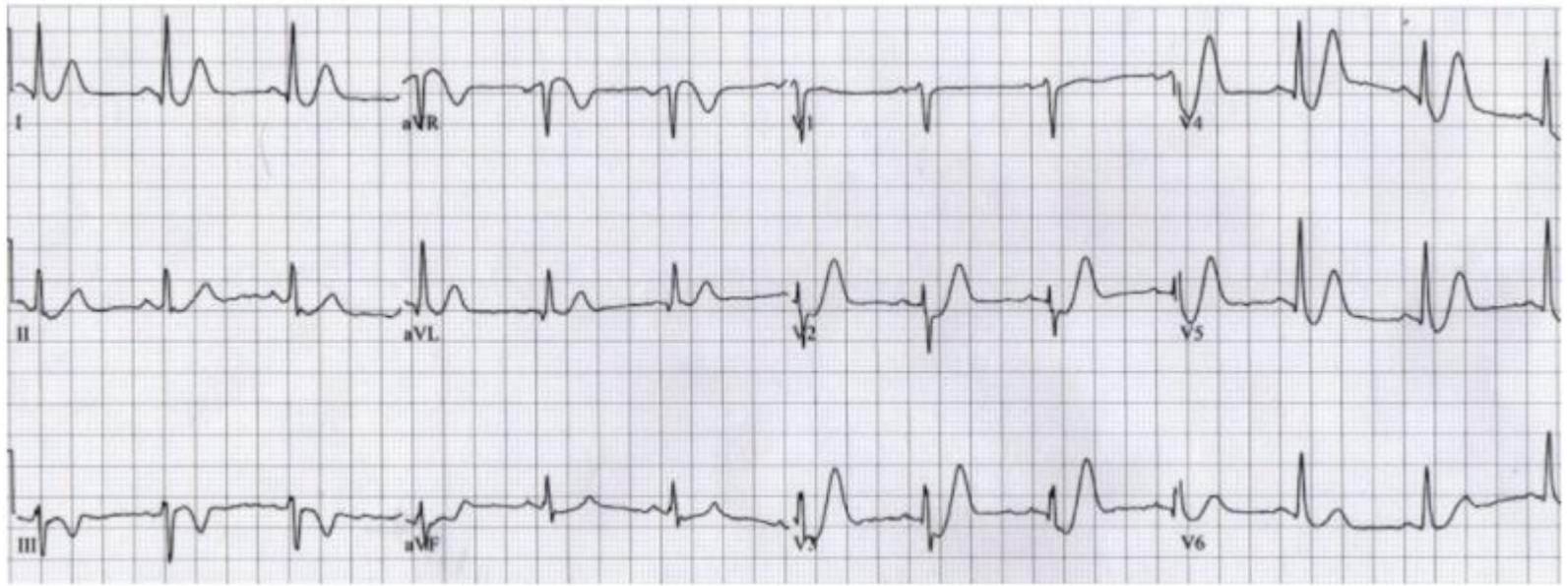
- Wellens' syndrome
- DeWinters T-waves
- STE in aVR - left main or pLAD

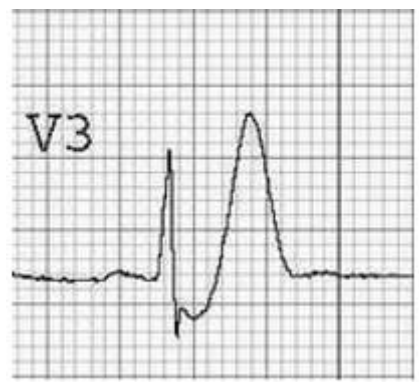
Wellens’

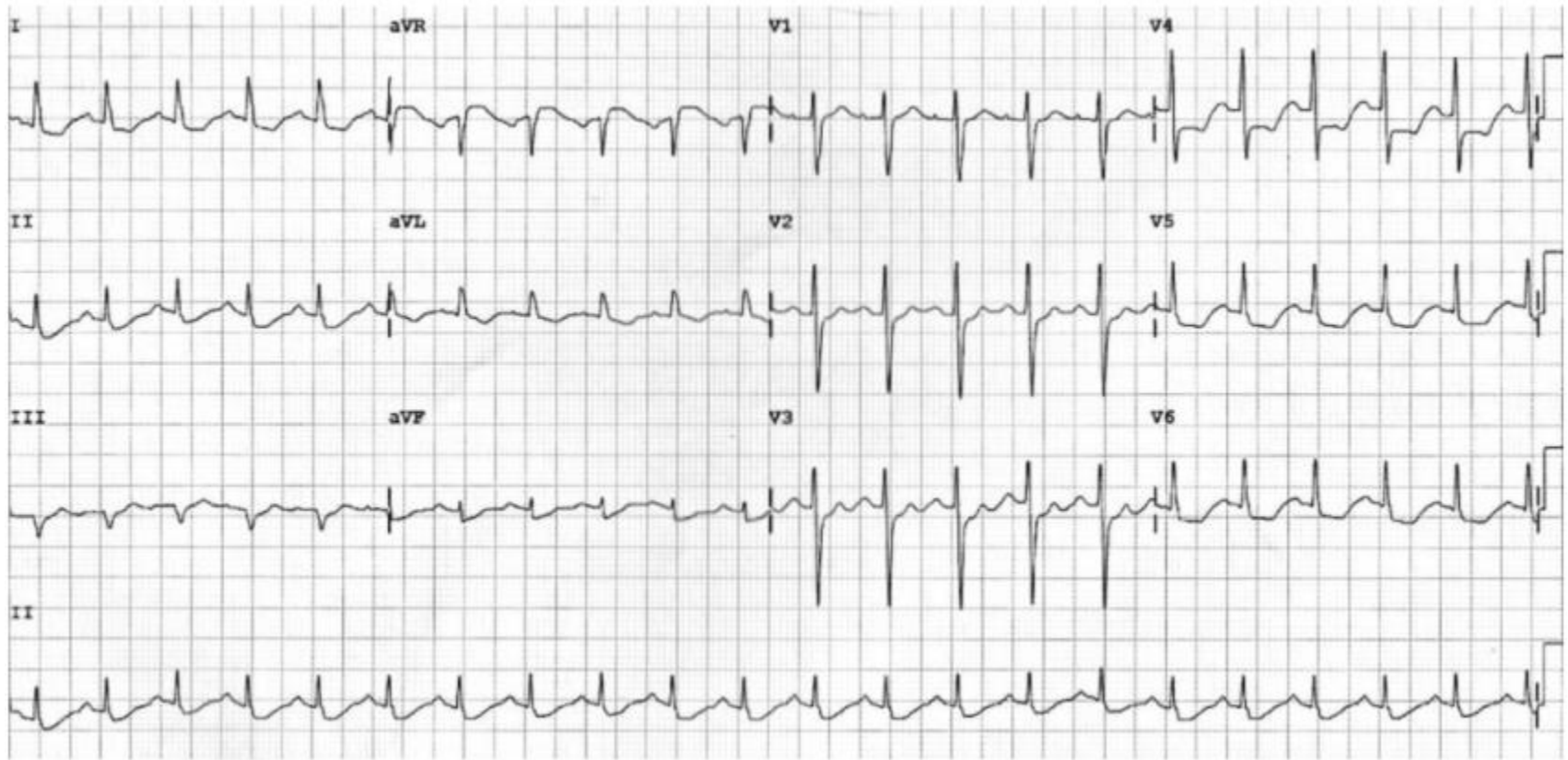


DeWinters

- First described in 2008
- 2% of LAD occlusions




V3


I
aVR
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III
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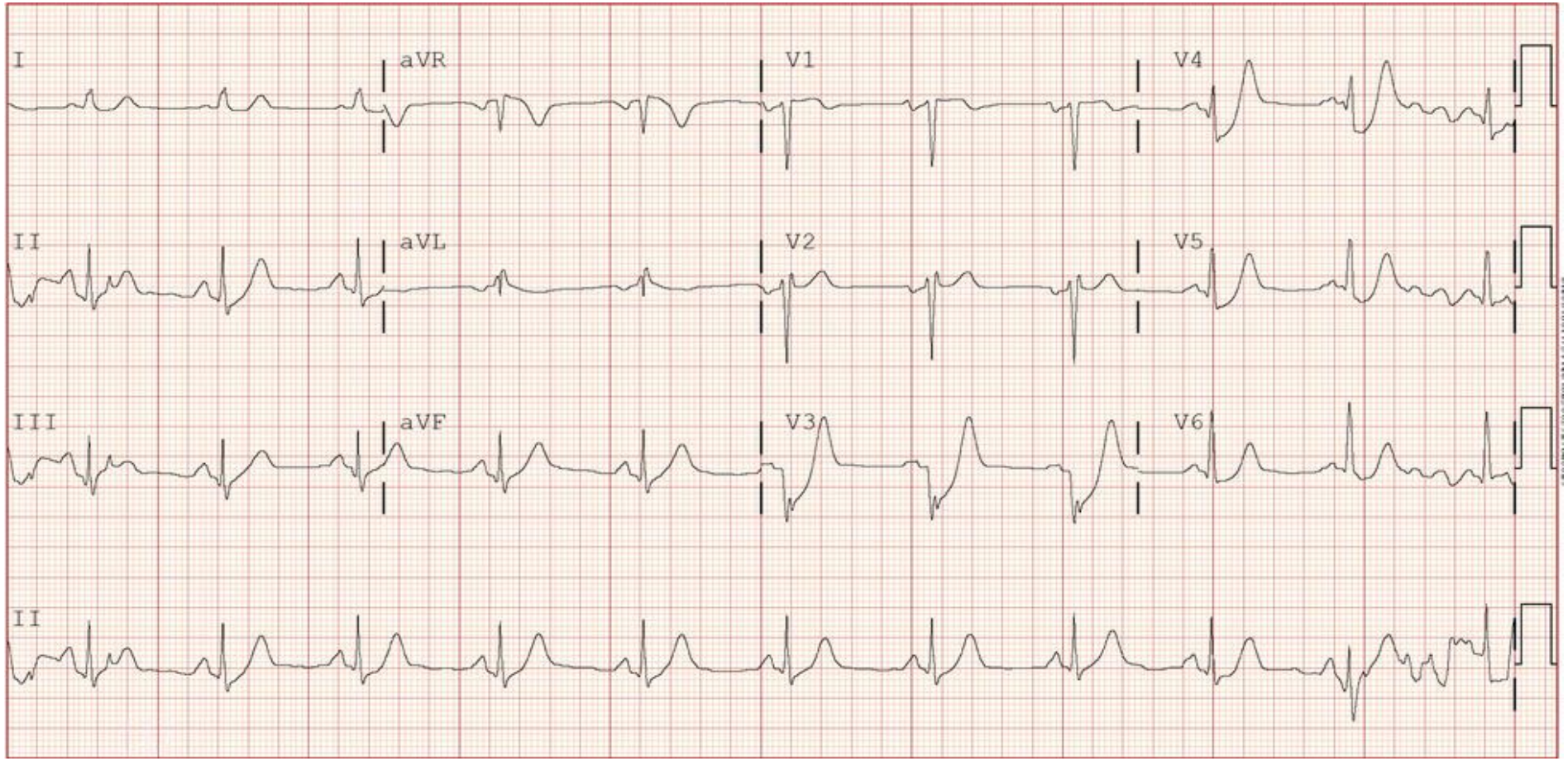
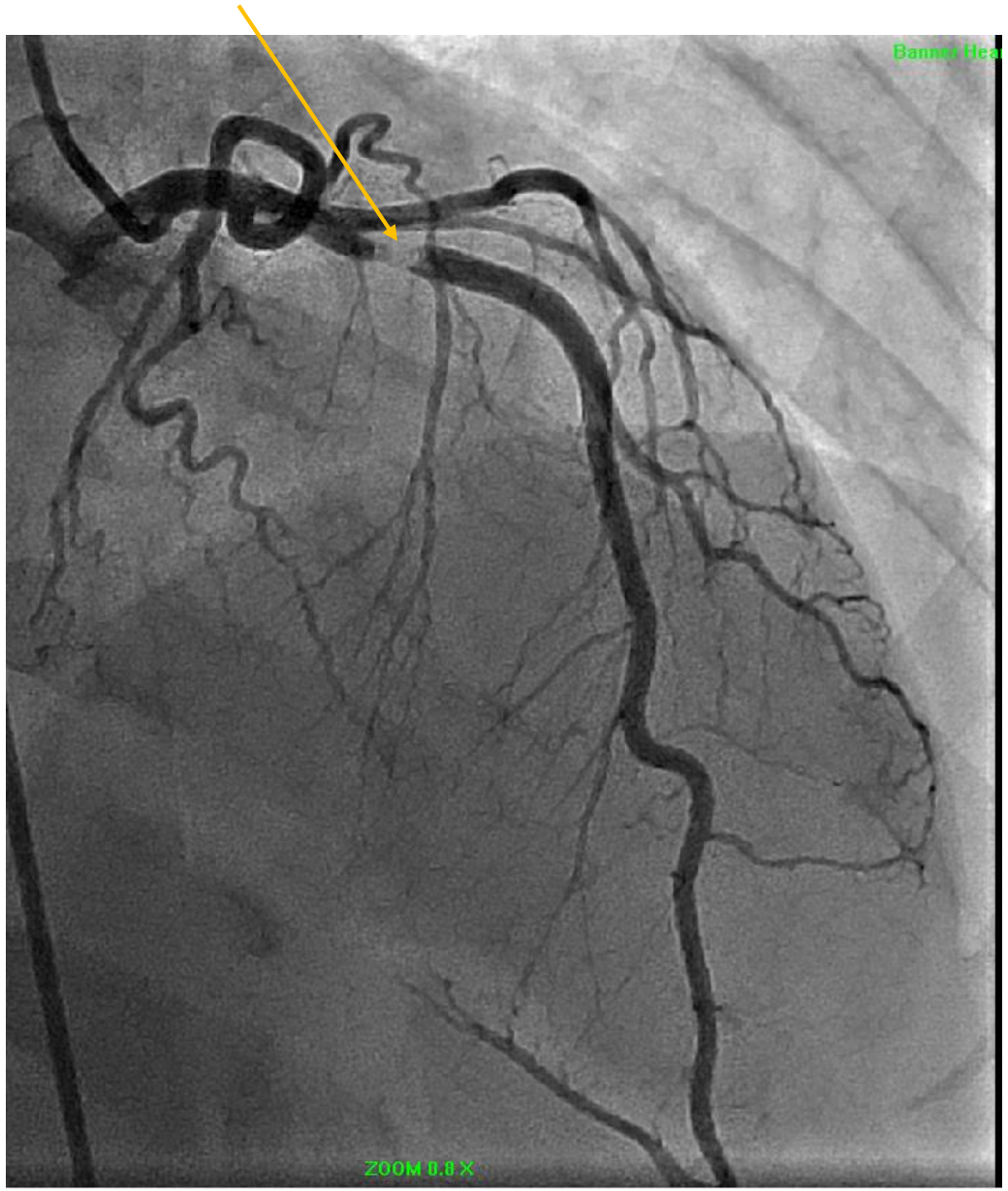
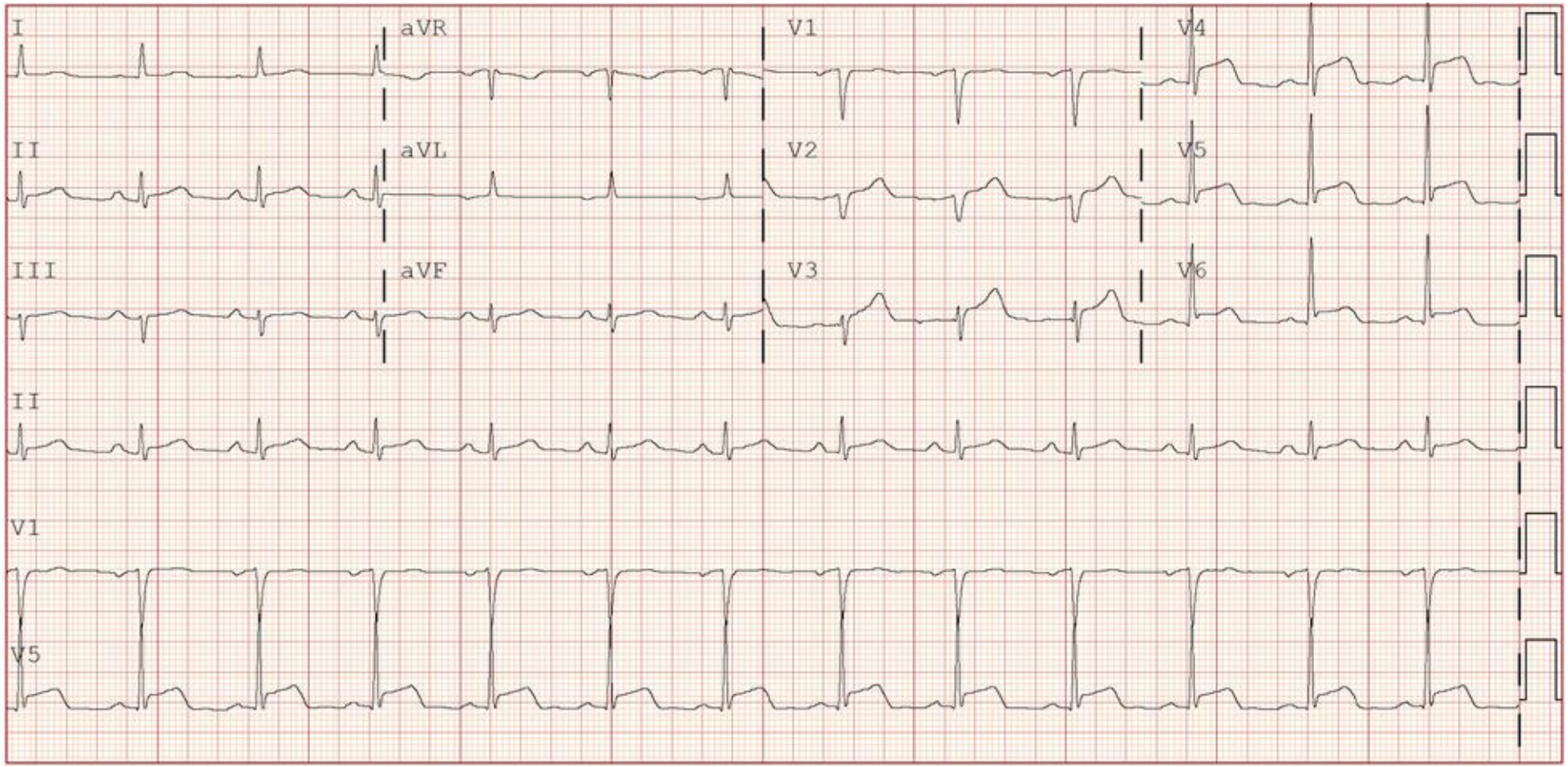
V6
II

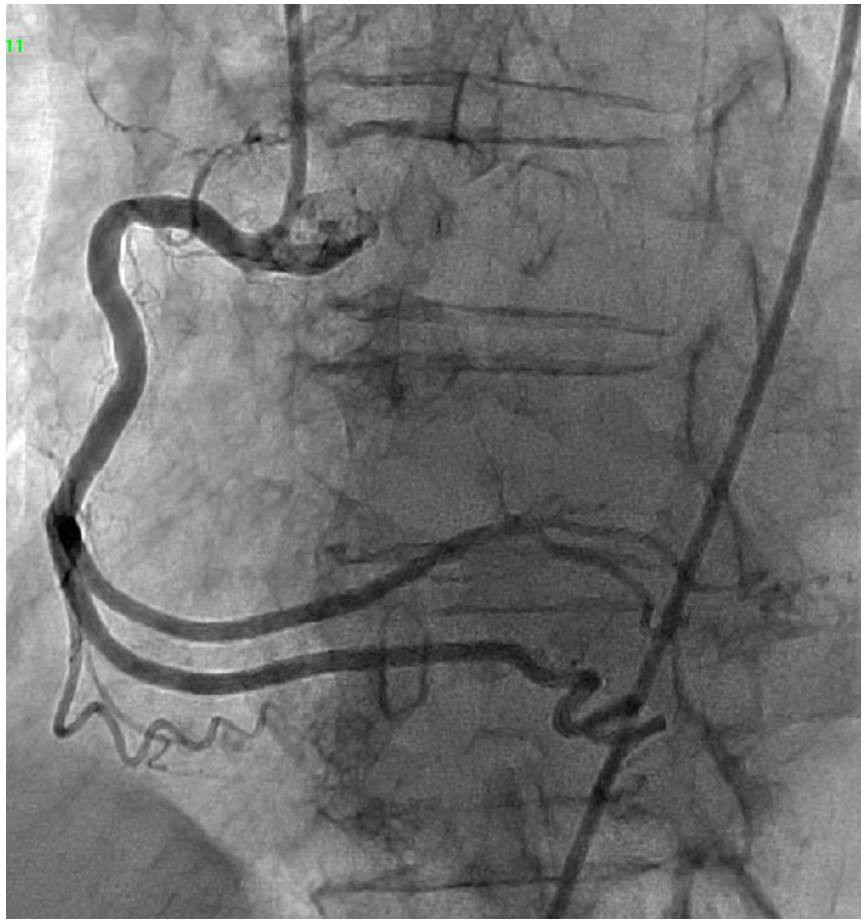
42 F with sudden onset chest pain

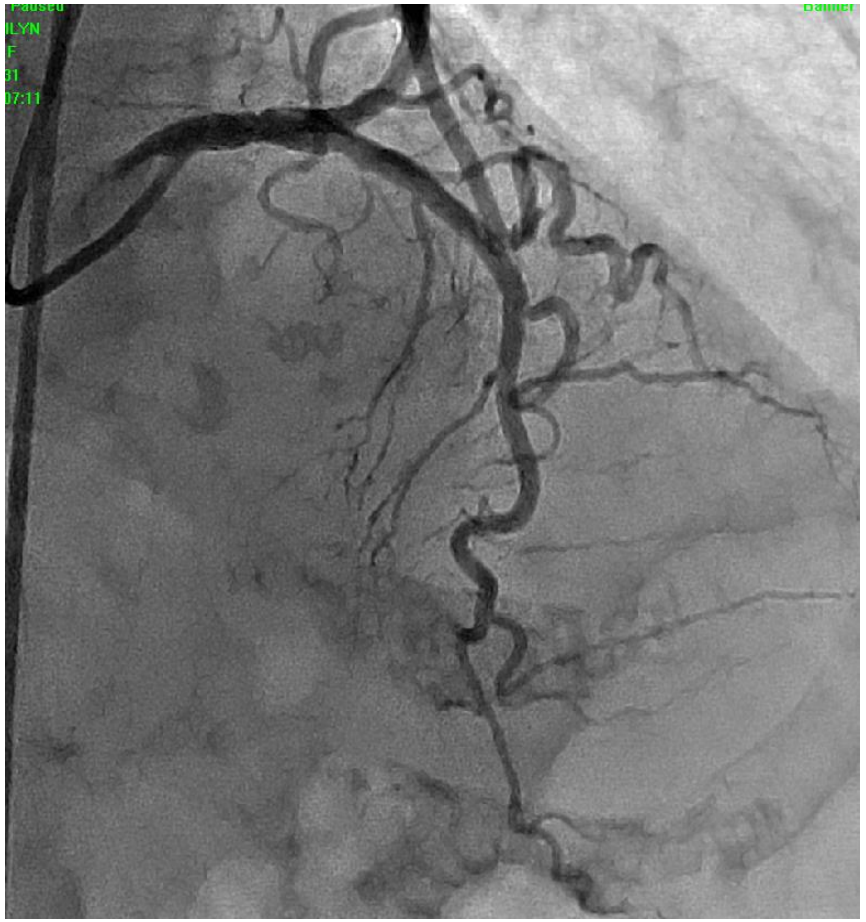


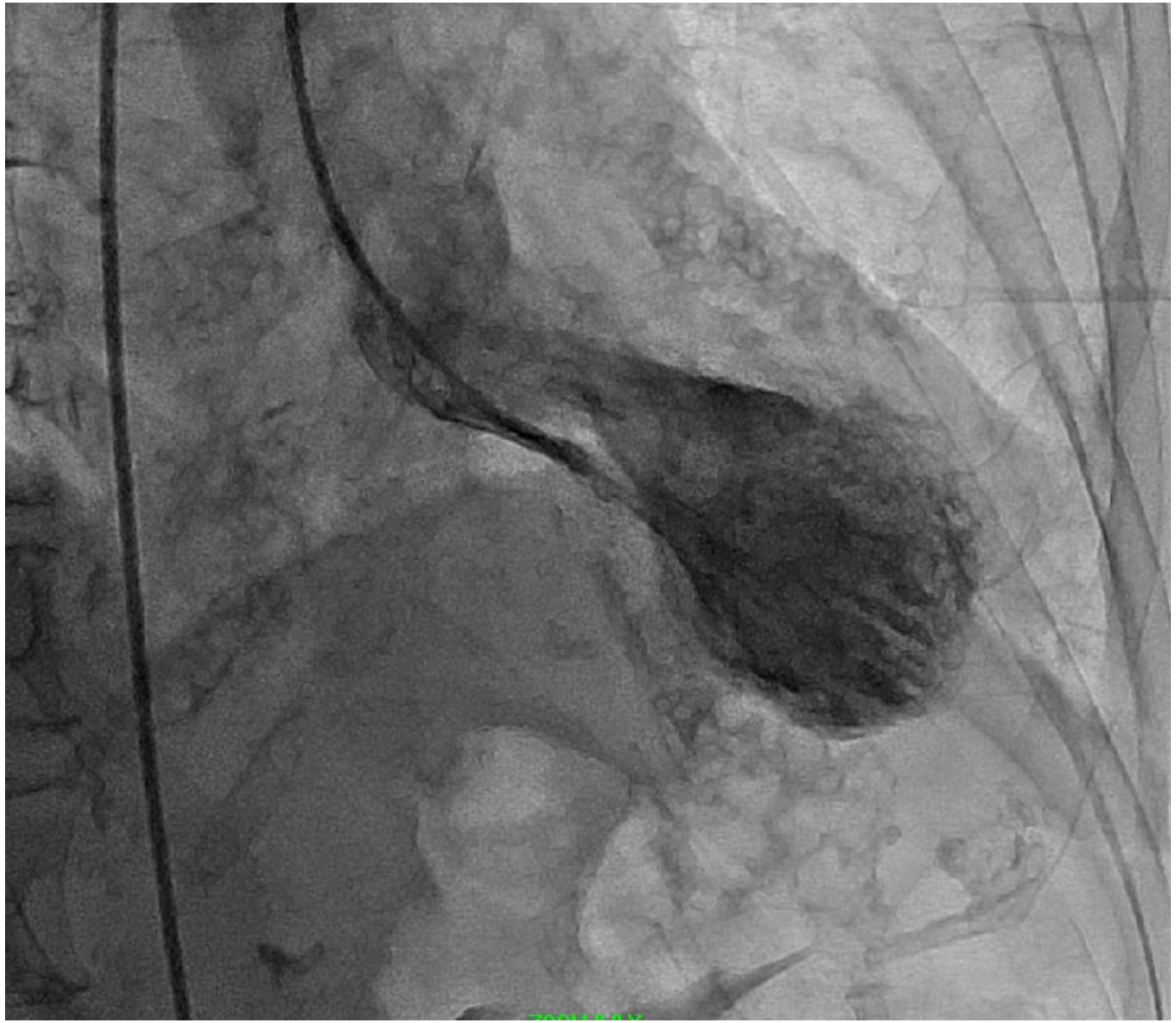

ZOOM 0.8 X

89 y/o F with chest pain









Questions

A 48-year-old man is evaluated in the Emergency department for epigastric discomfort and nausea that began 45 minutes ago. Medical history is significant for hypertension, tobacco use, and hyperlipidemia. His only medication is atorvastatin.

On physical examination, temperature is normal, blood pressure is 110/60 mm Hg, pulse rate is 90/min, and respiration rate is 18/min. Oxygen saturation is 98% breathing ambient air. The remainder of the physical exam is unremarkable.

Laboratory studies are notable for an elevated initial serum troponin I level. An electrocardiogram shows 3-mm ST-segment elevation in leads II, III, and aVF. A chest radiograph is normal. The patient is administered aspirin, clopidogrel, and a bolus of heparin.

Transport to the nearest hospital capable of percutaneous coronary intervention would take 4 hours.

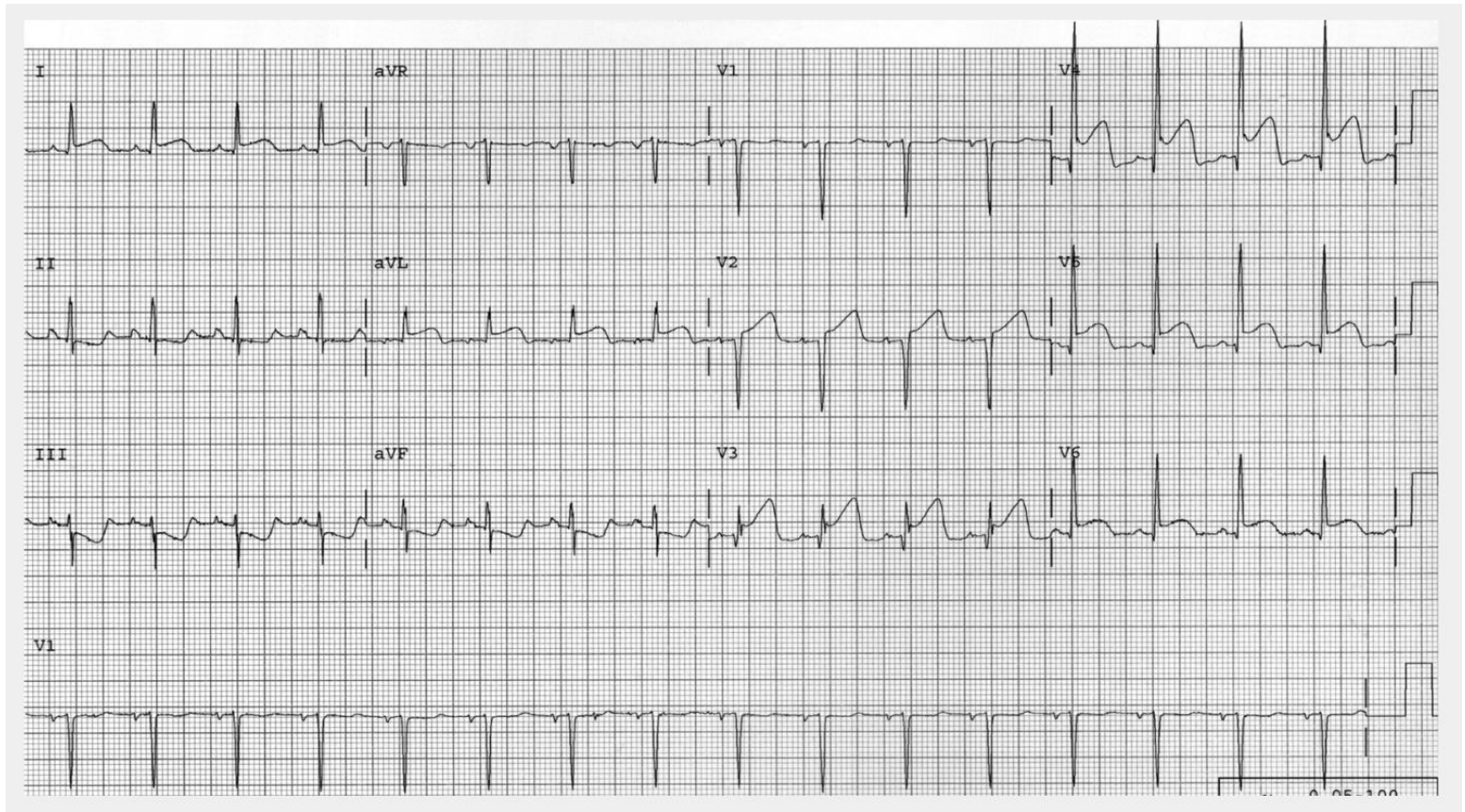
Which of the following is the most appropriate management?

A. Fondaparinux and ticagrelor
B. Full-dose reteplase
C. Half-dose reteplace with abciximab
D. Immediate transfer for primary percutaneous coronary intervention
E. Nitroprusside

A 56-year-old man is evaluated in the ED for progressive chest pain and dyspnea that began 3 hours ago. Medical history is significant for hypertension treated with lisinopril.

On physical examination, he is confused. Temperature is normal, blood pressure is 86/50 mm Hg, pulse rate is 118/min, and respiration rate is 24/min. Oxygen saturation breathing ambient air is 90%. Cardiac examination reveals an S3 gallop. Crackles are noted on pulmonary examination. The extremities are cool to the touch.

An ECG is shown. A chest radiograph reveals pulmonary edema.


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

Aspirin is initiated in the emergency department.

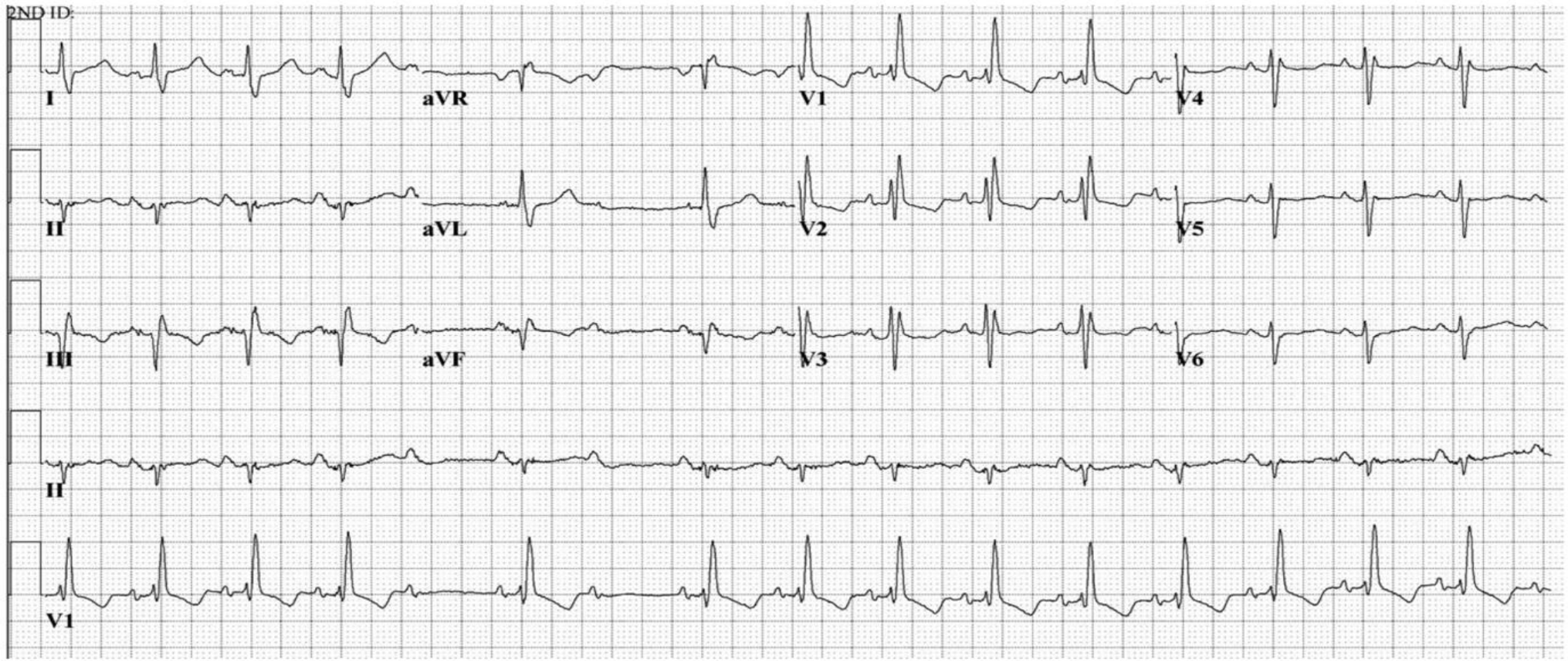
Which of the following is the most appropriate immediate management?

A. Admission to the ICU for medical stabilization
B. Intravenous metoprolol
C. Percutaneous coronary intervention
D. Sublingual nitroglycerin
E. Thrombolytic therapy

A 65-year-old man was hospitalized 24 hours ago with findings of a large anterior myocardial infarction. He underwent primary percutaneous coronary intervention with stent placement in the proximal left anterior descending artery. He is currently asymptomatic. Medical history is significant for hyperlipidemia and hypertension. Medications are atorvastatin, aspirin, prasugrel, captopril, and metoprolol.

On physical examination, temperature is normal, blood pressure is 110/65 mm Hg, pulse rate is 65/min, and respiration rate is 18/min. Oxygen saturation is 98% breathing ambient air. The remainder of the examination is unremarkable.

An ECG obtained in the coronary care unit is shown.


2ND ID:
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6
II
V1

Which of the following is the most appropriate treatment?

A. Atropine
B. Discontinue metoprolol and observe
C. Emergent coronary angiography
D. Emergent pacing