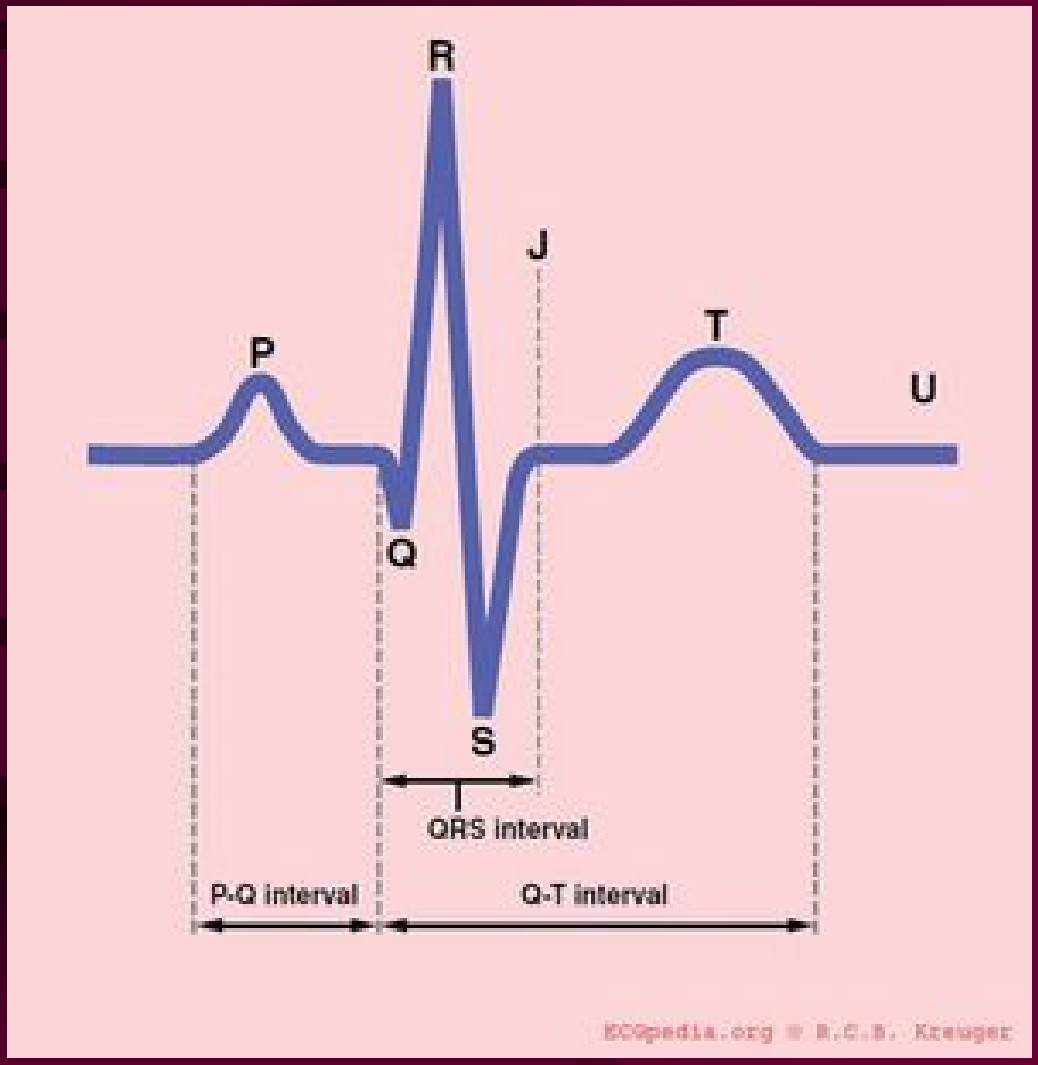
EKG Boot Camp: Ischemia and Infarction

Systematic Approach

- Heart Rate
- Rhythm
- Intervals
- Axis
- Voltage
- R Wave Progression
- Q Wave
- ST segments
- T waves
- Device Involvement

QRS complex

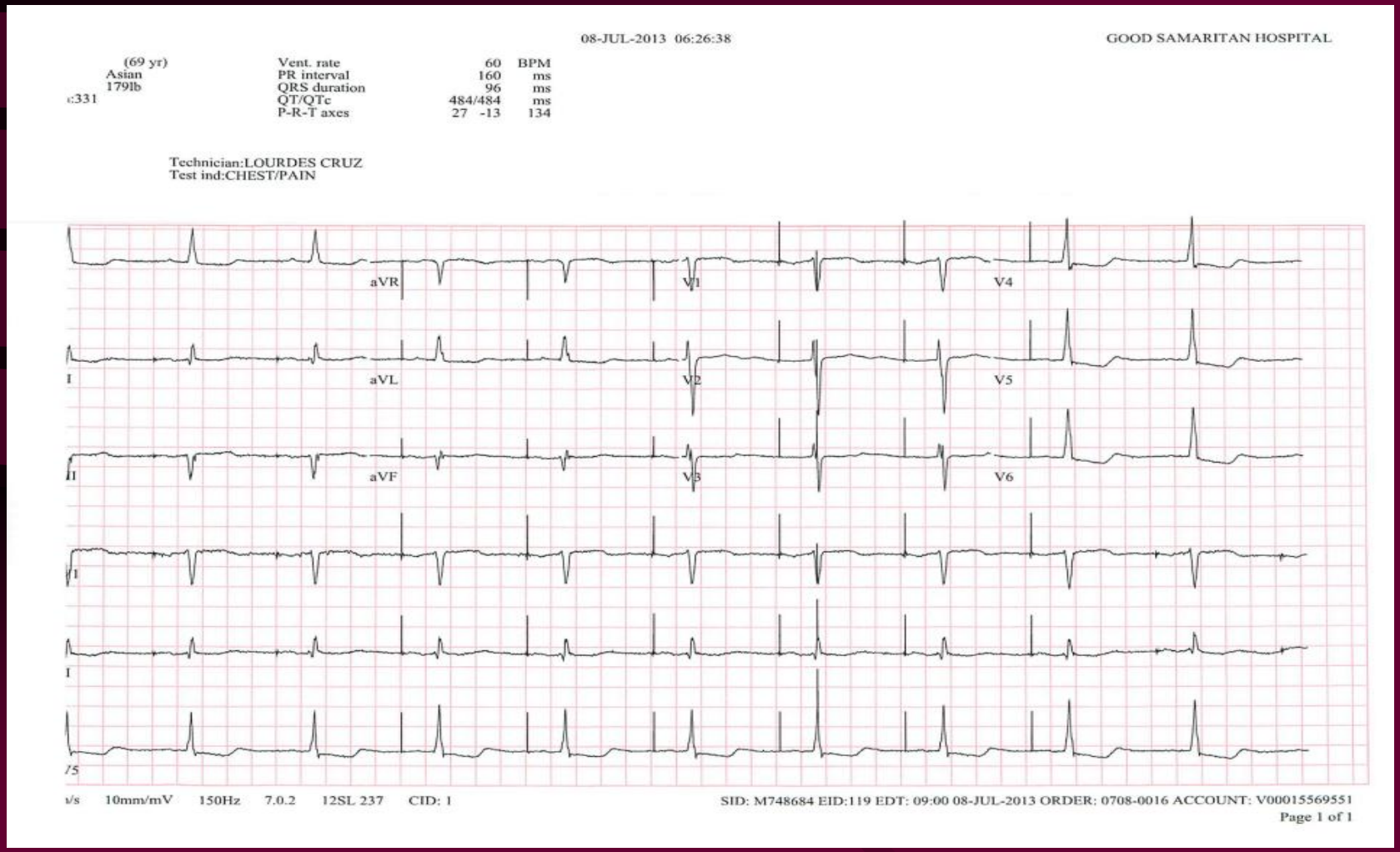
- Q wave – may or may not be present, always negative
- R – first positive deflection
- R’ second positive deflection
- S – negative deflection following R
- S’ – second negative deflection


R
J
T
P
U
Q
S
QRS interval
P-Q interval
Q-T interval
ECGpedia.org © R.C.B. Kreuger

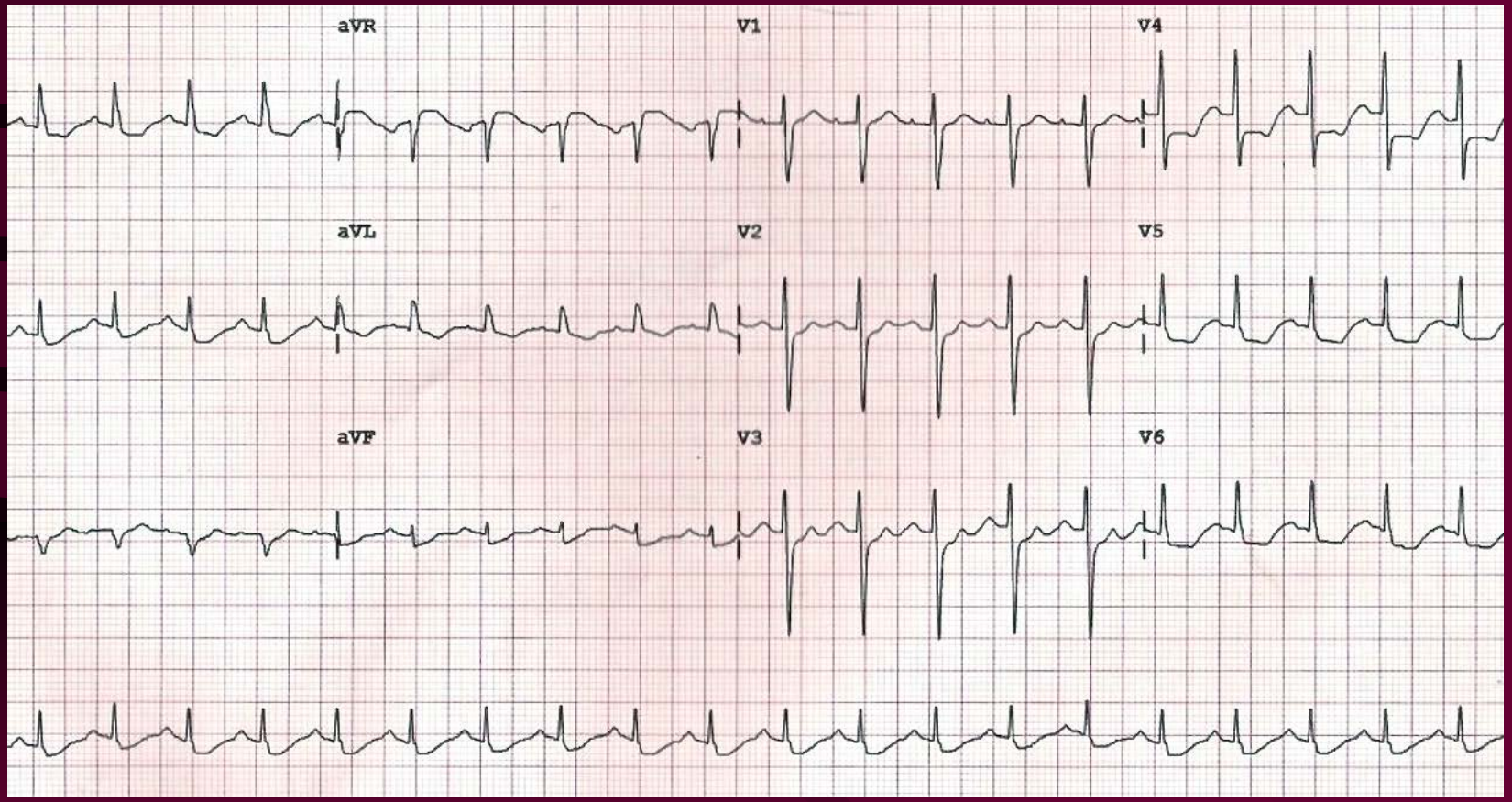
ST Segment

- In limb leads, the ST segment is isoelectric, may be slightly elevated or depressed by less than 1 mm
- In precordial leads, the ST segment may be elevated 1-2 mm
- The J point is where the QRS complex and the ST segment meet

ST Depression



ST Depression



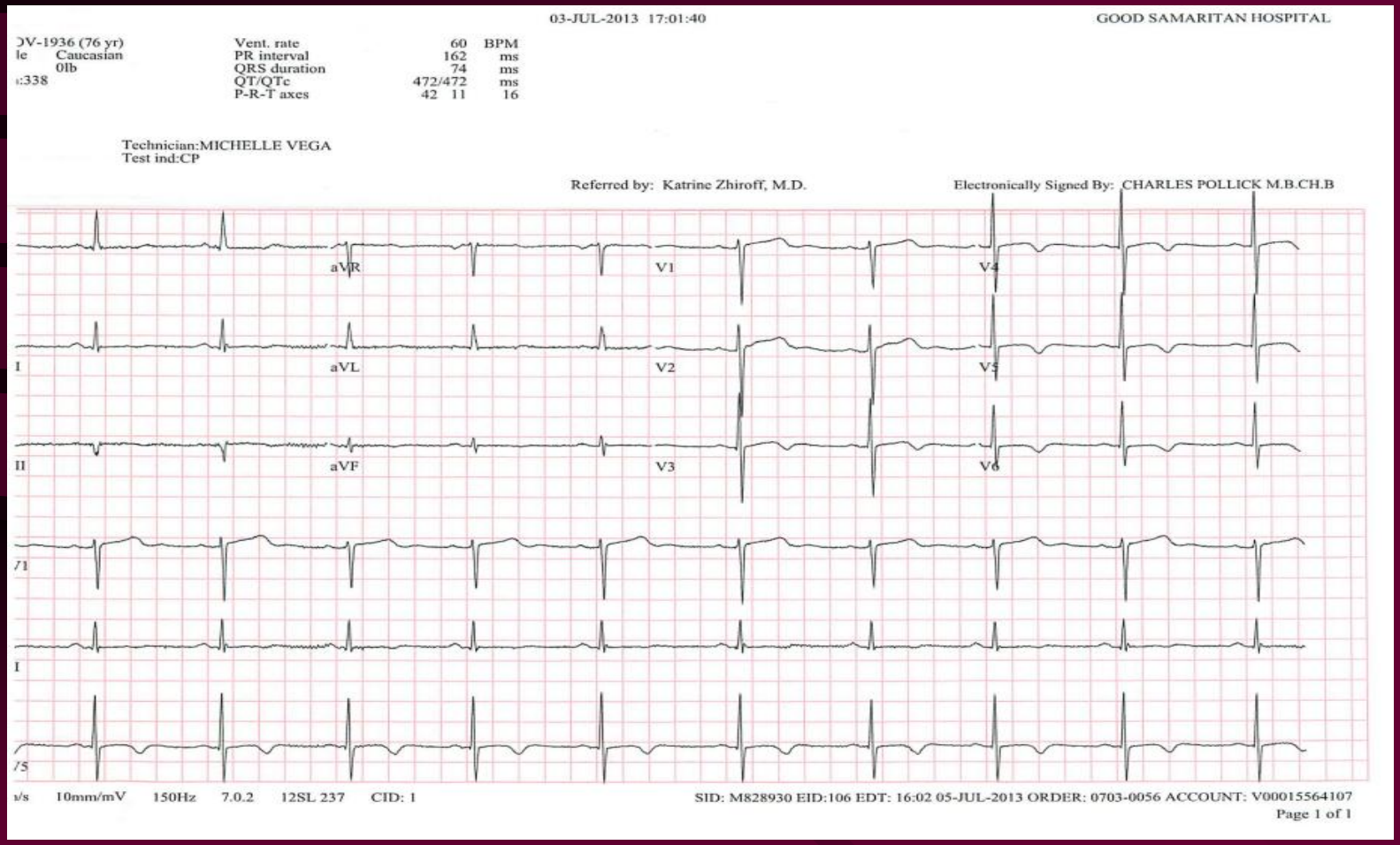
T waves

- Ventricular repolarization
- Usually oriented in the same direction as the QRS
- Slightly asymmetrical
- Height less than 5mm in the limb leads
- Height less than 10mm in precordial leads

T Wave Inversion

- T wave inversion suggestive of ischemia or injury
- T waves should be pos I, II
- Inversion is common in V1, may occur III, aVL aVF and be normal
- Inv in V2-V6 suggestive of ischemia/injury
- Symmetrical T wave inversion develops after terminal TWI, common in NSTEMI
- Post STEMI, TWI is a sign of reperfusion

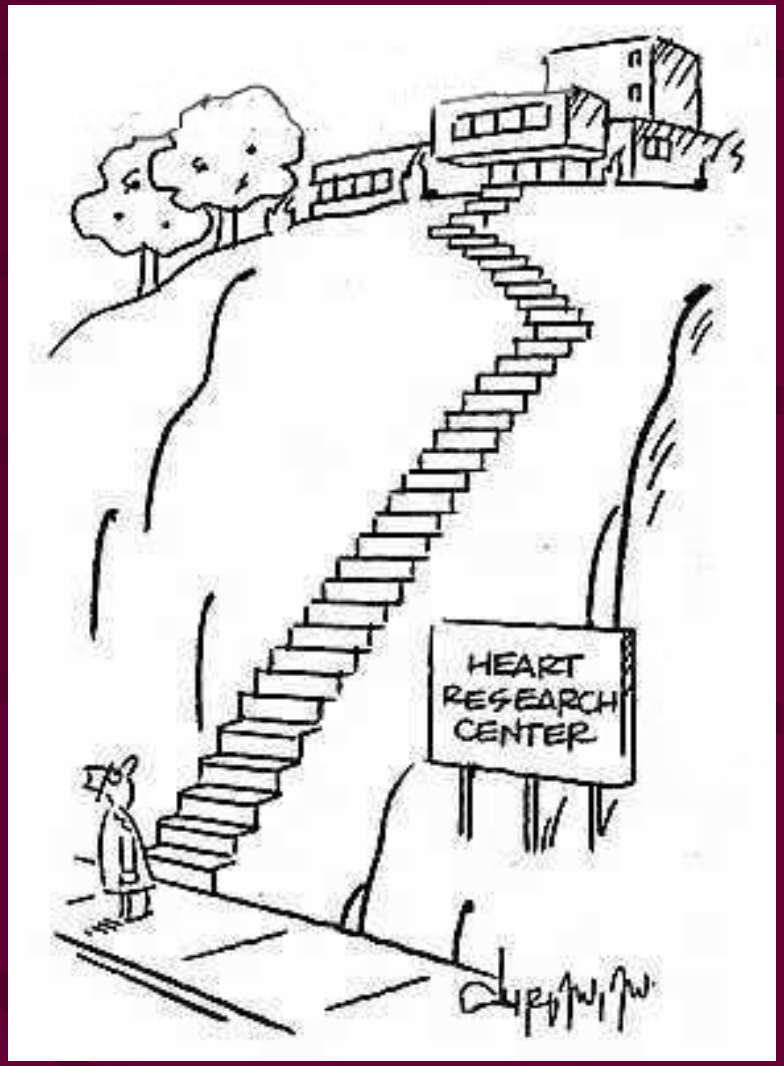
TWI


03-JUL-2013 17:01:40
GOOD SAMARITAN HOSPITAL
)V-1936 (76 yr)
le Caucasian
0lb
:338
Vent. rate 60 BPM
PR interval 162 ms
QRS duration 74 ms
QT/QTc 472/472 ms
P-R-T axes 42 11 16
Technician:MICHELLE VEGA
Test ind:CP
Referred by: Katrine Zhiroff, M.D.
Electronically Signed By: CHARLES POLLICK M.B.CH.B
aVR
V1
V4
I
aVL
V2
V5
II
aVF
V3
V6
/1
I
/5
s/s 10mm/mV 150Hz 7.0.2 12SL 237 CID: 1
SID: M828930 EID:106 EDT: 16:02 05-JUL-2013 ORDER: 0703-0056 ACCOUNT: V00015564107
Page 1 of 1

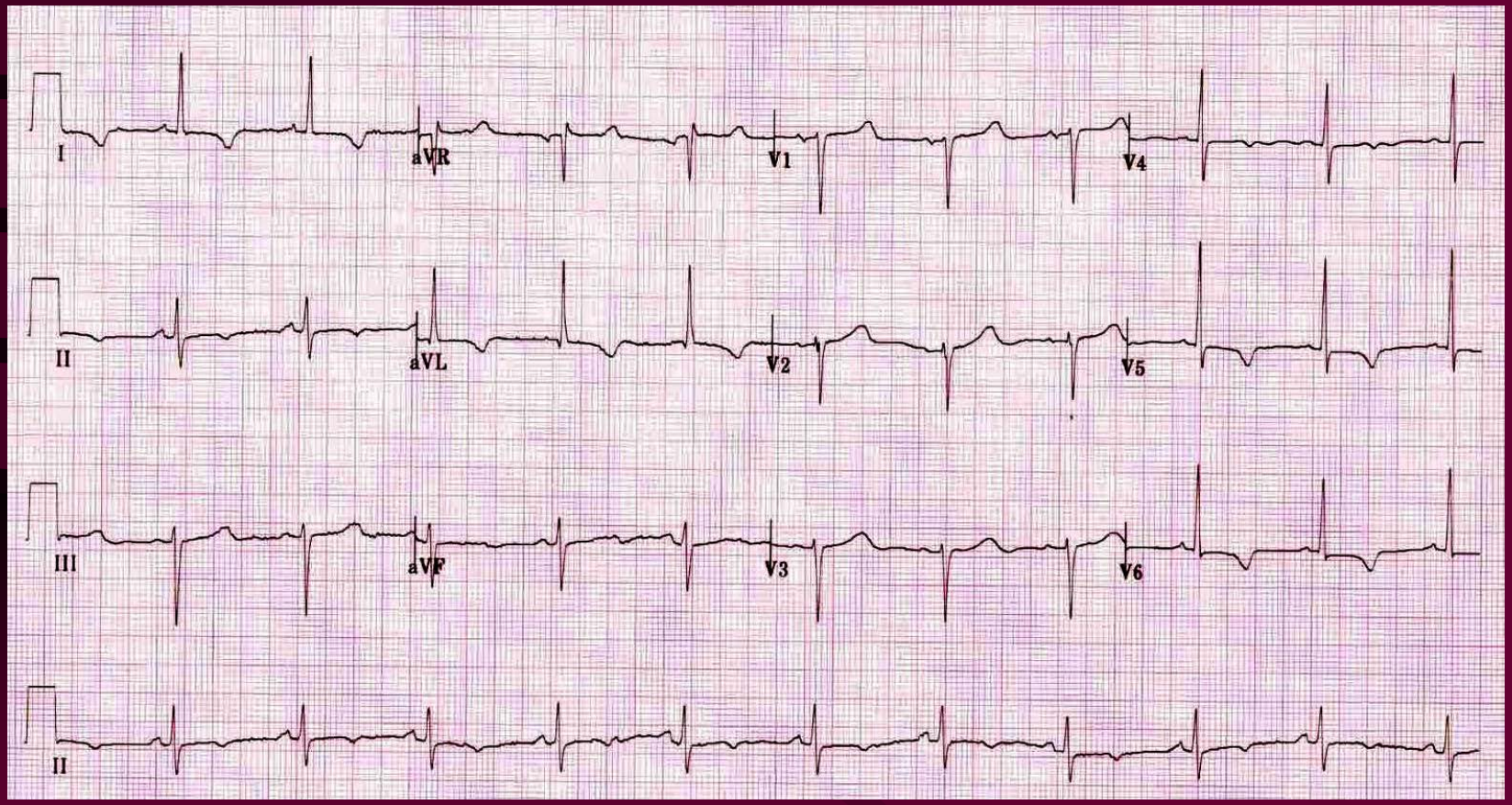
- *Always compare to the patient's prior EKG*

Ischemia

- Usually indicated by ST changes
  - Elevation = Acute infarction
  - Depression = Ischemia
- Can manifest as T wave changes
- Remote ischemia shown by q waves



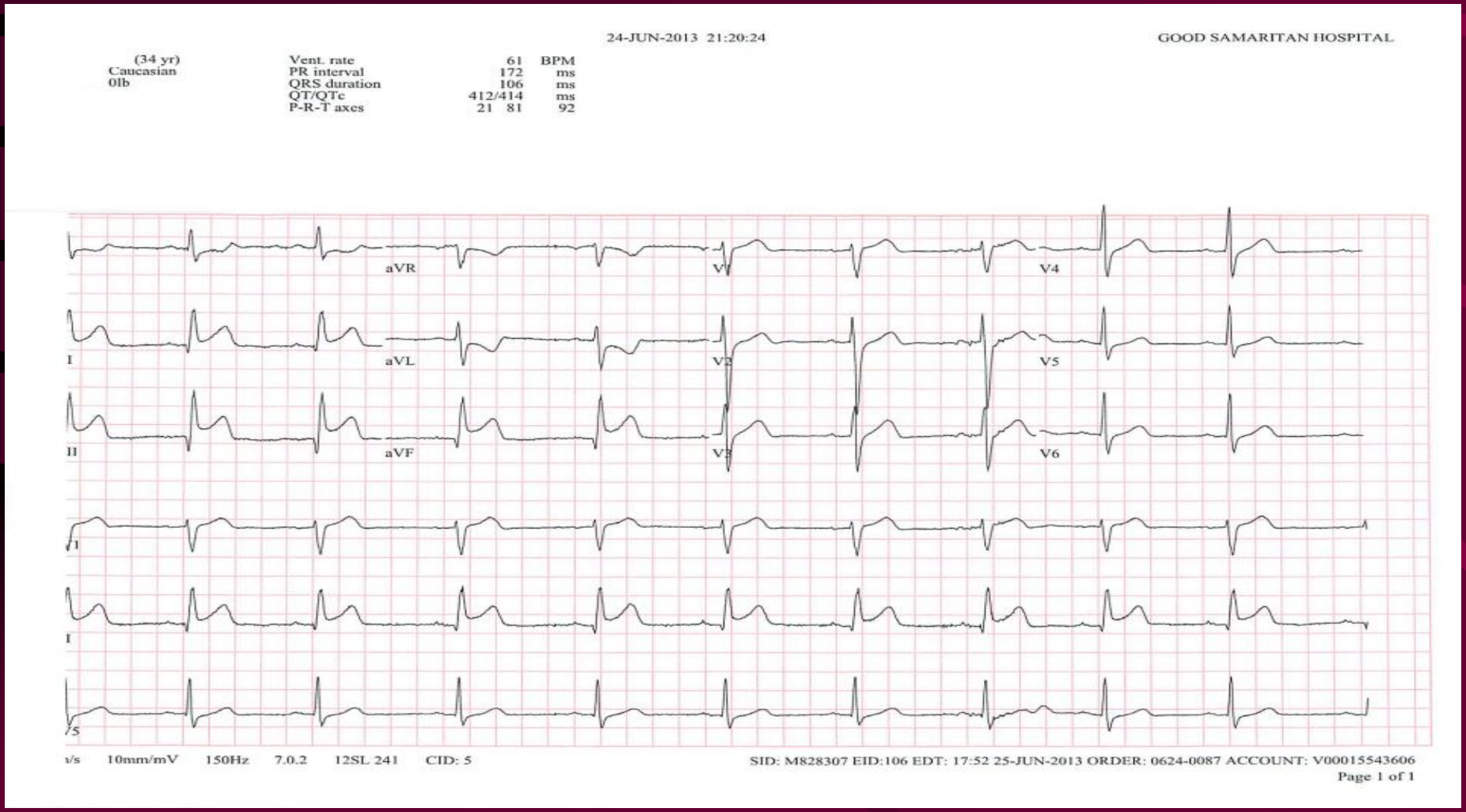
TWI



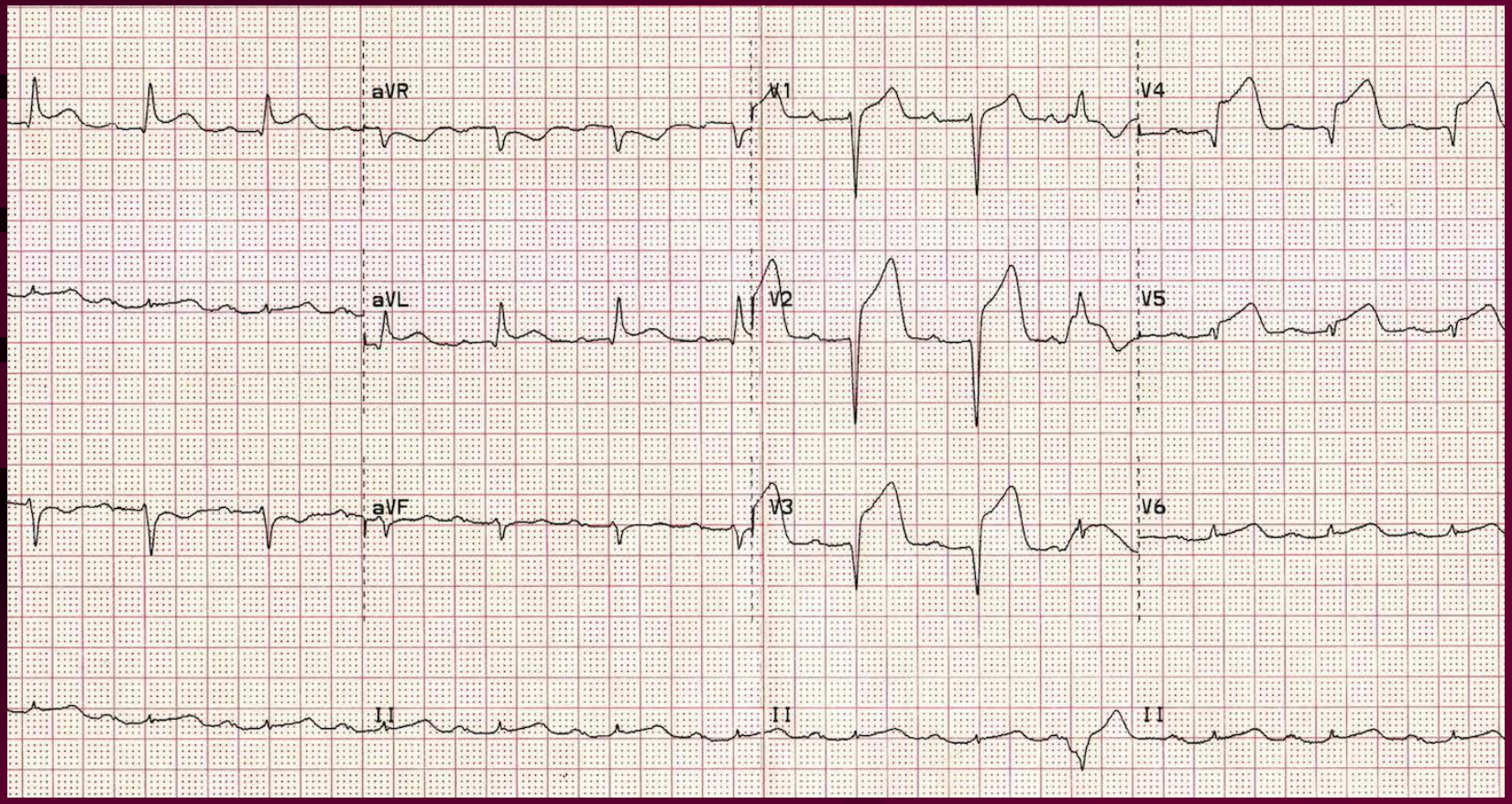
ST Segment Elevation Patterns

- Hyperacute T wave – may occur as early as 2 mins post myocardial occlusion
- J Point Elevation
- Subtle ST elevation forming broad T wave
- *If there is elevation in limb leads, I, II, III, then worry*
- *If there is depression in the V leads, then worry*

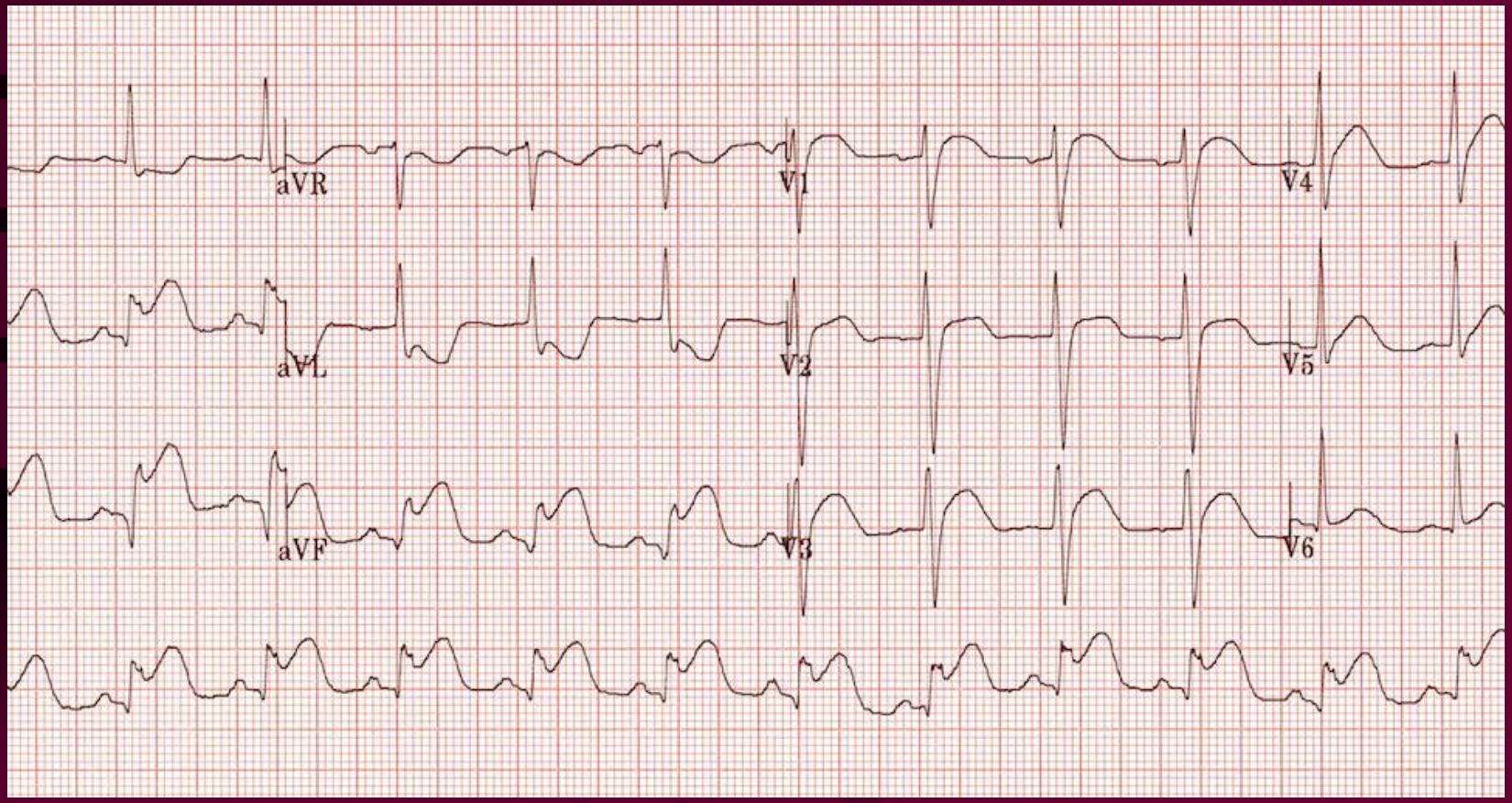
ST Elevation



ST Elevation



ST Elevation

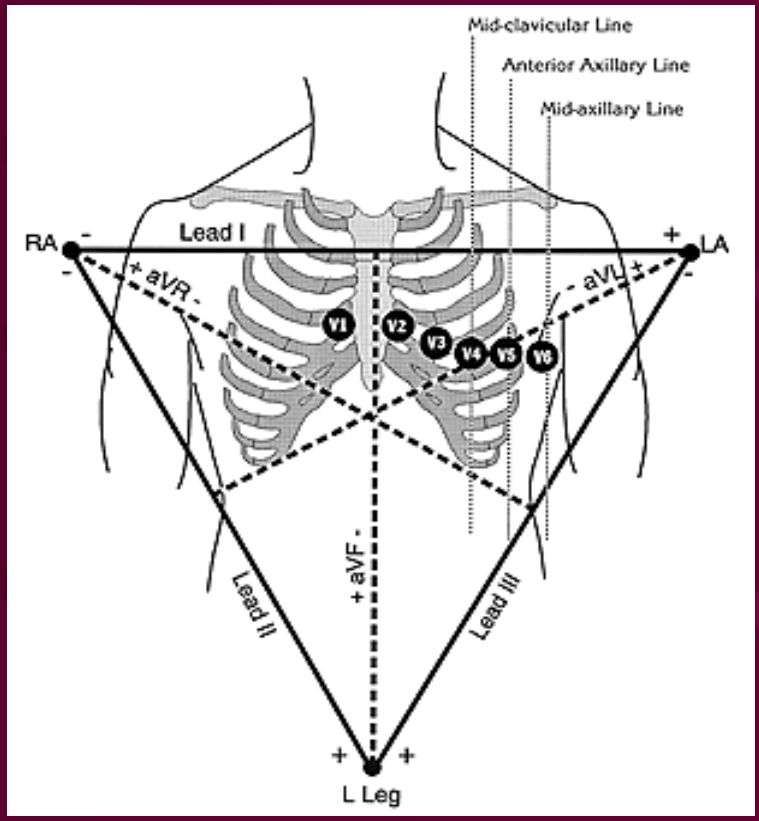


Ischemia and Infarction

- ST segment depression
  - Ischemia/Subendocardial
- T Wave Inversion
  - Ischemia/Injury
- ST segment elevation
  - Injury/Transmural
- Q Wave
  - Old MI

EKG Distributions

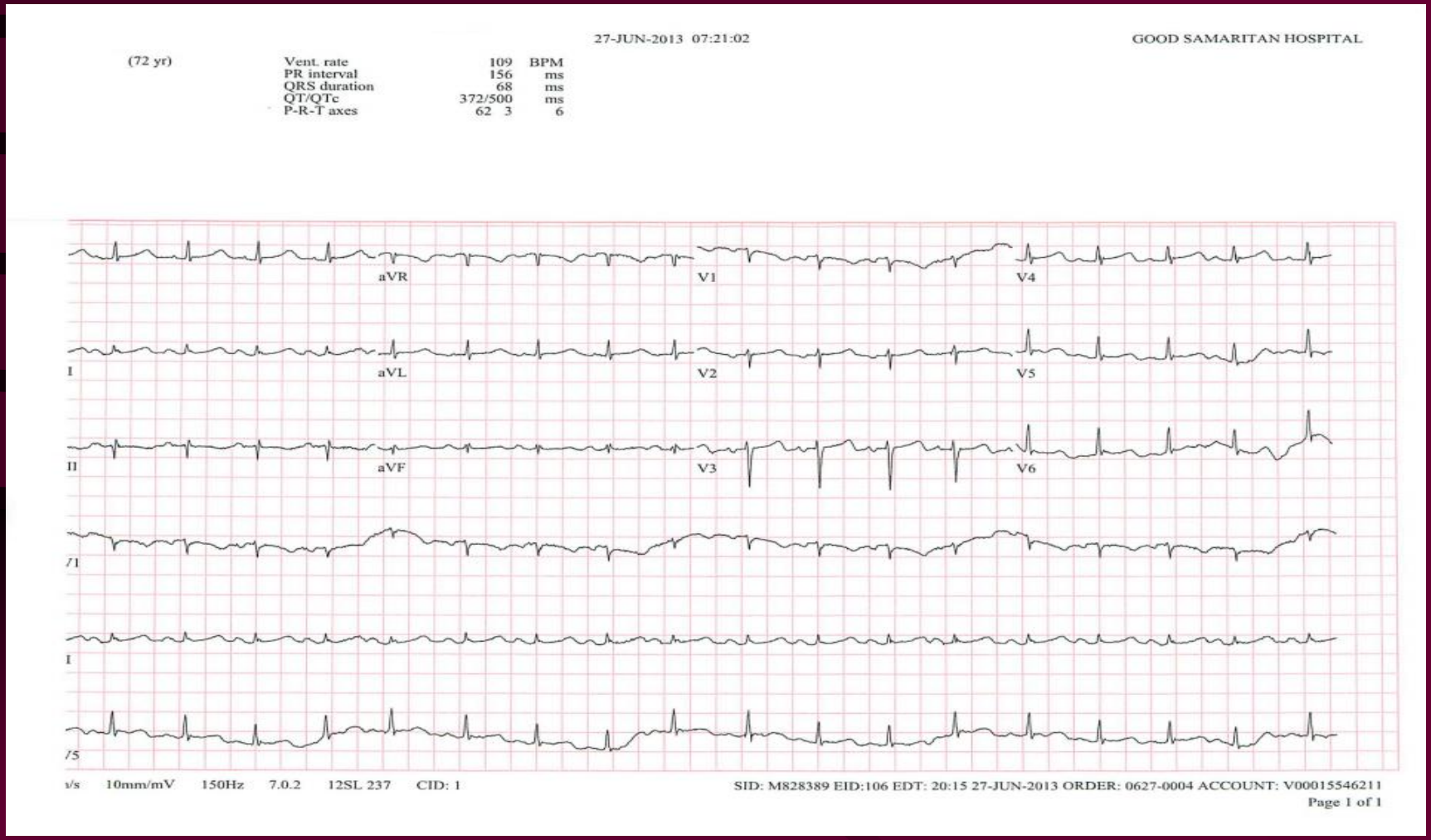
- Septal V1-V2
- Anterior: V3–V4
- Anteroseptal: V1-V4
- Lateral: V4–V6, I, aVL
- Inferior: II, III, and aVF
- Inferolateral: II, III, aVF, and V5 and V6



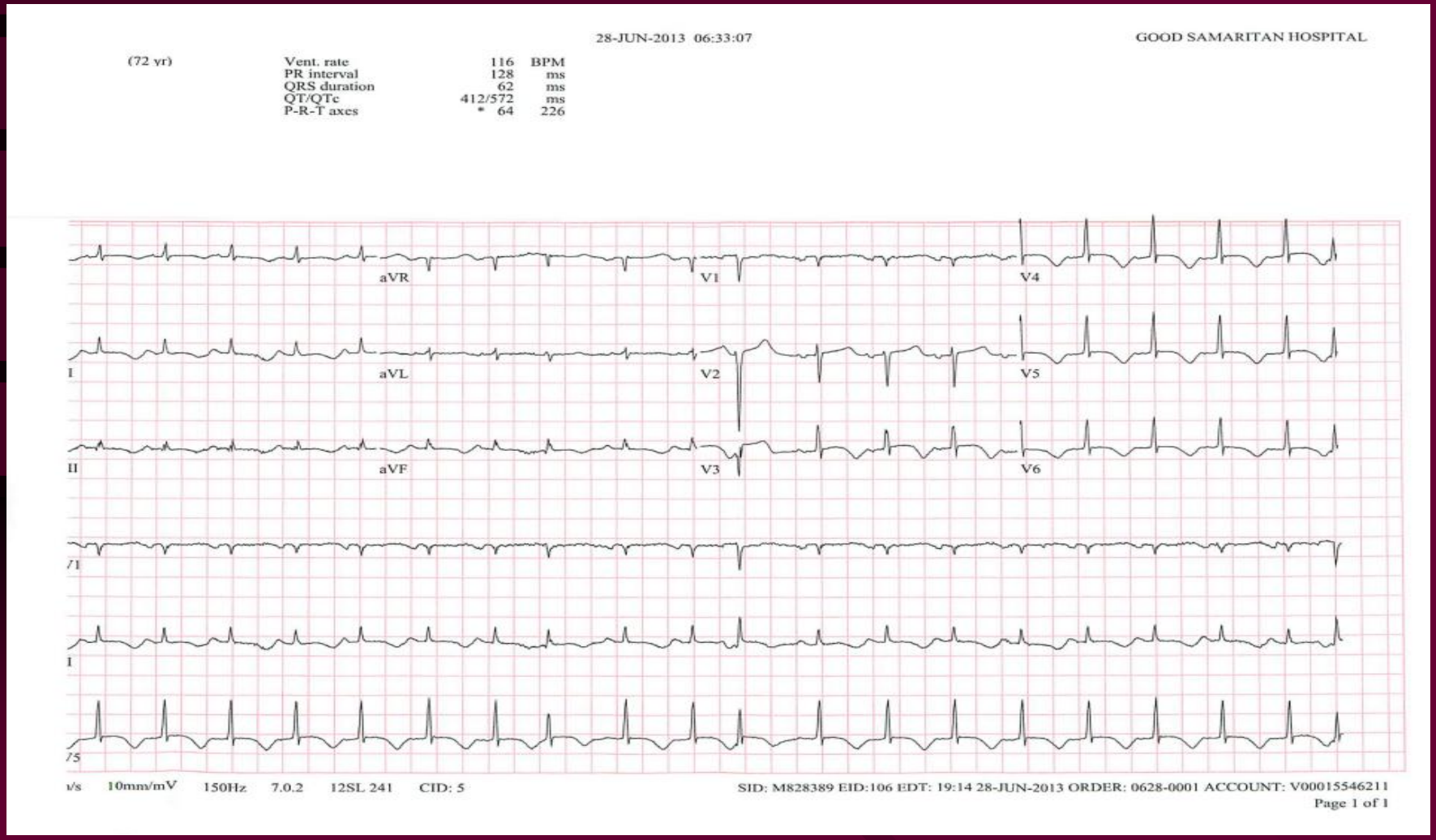
Lead Representation of the Heart

I Lateral	aVR	V1 Septal	V4 Anterior
II Inferior	aVL Lateral	V2 Septal	V5 Lateral
III Inferior	aVF Inferior	V3 Anterior	V6 Lateral

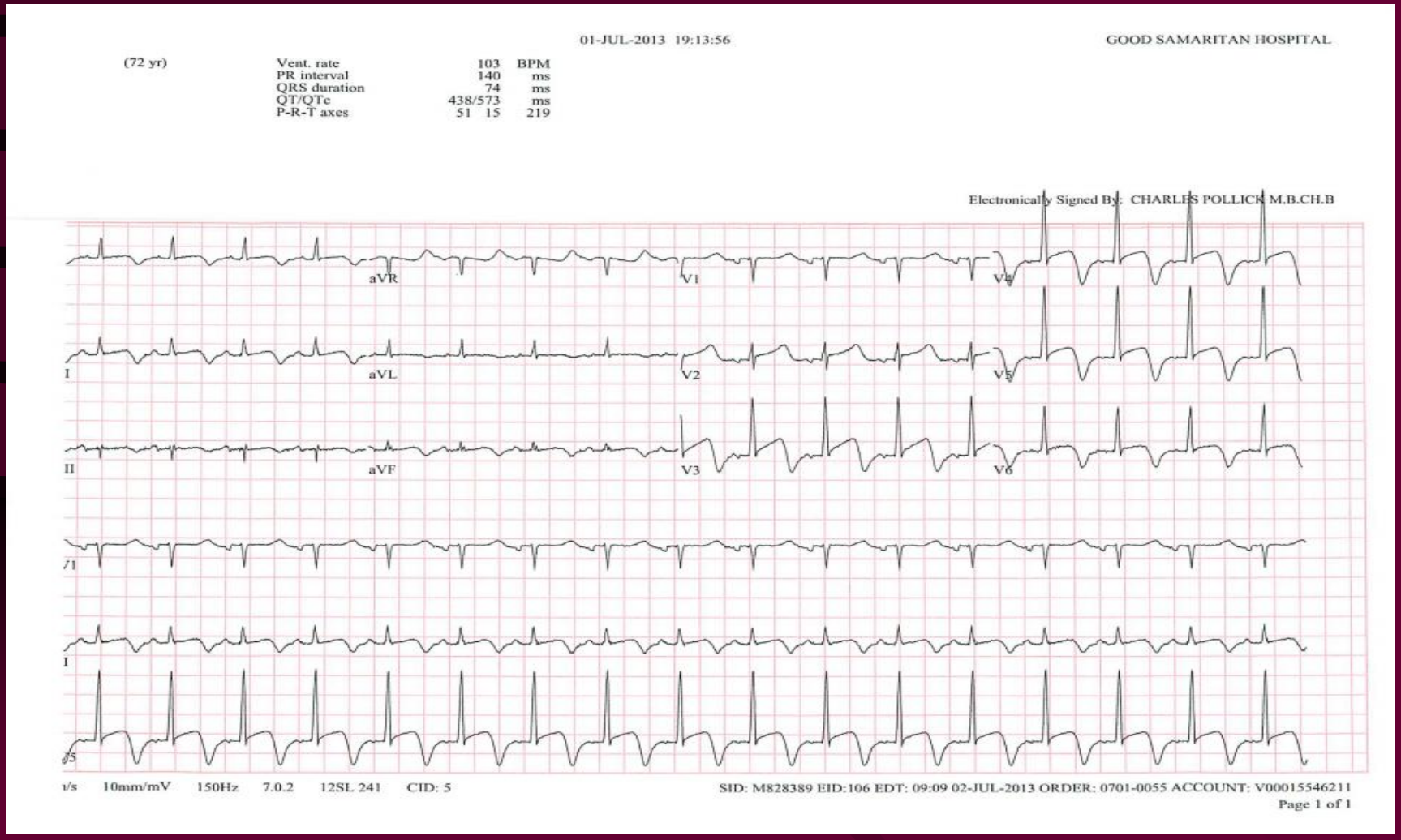
Evolution of MI



Evolution of MI

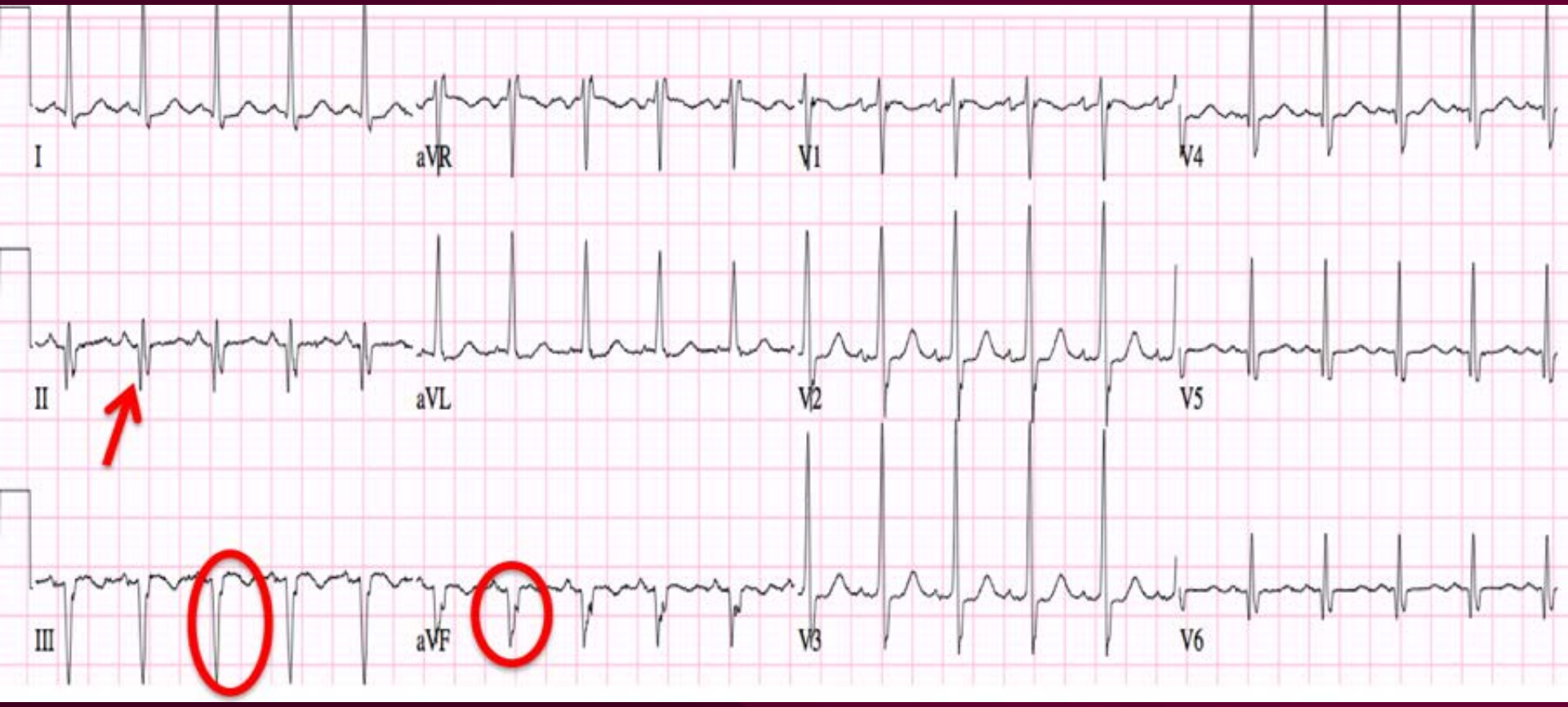


Evolution of MI

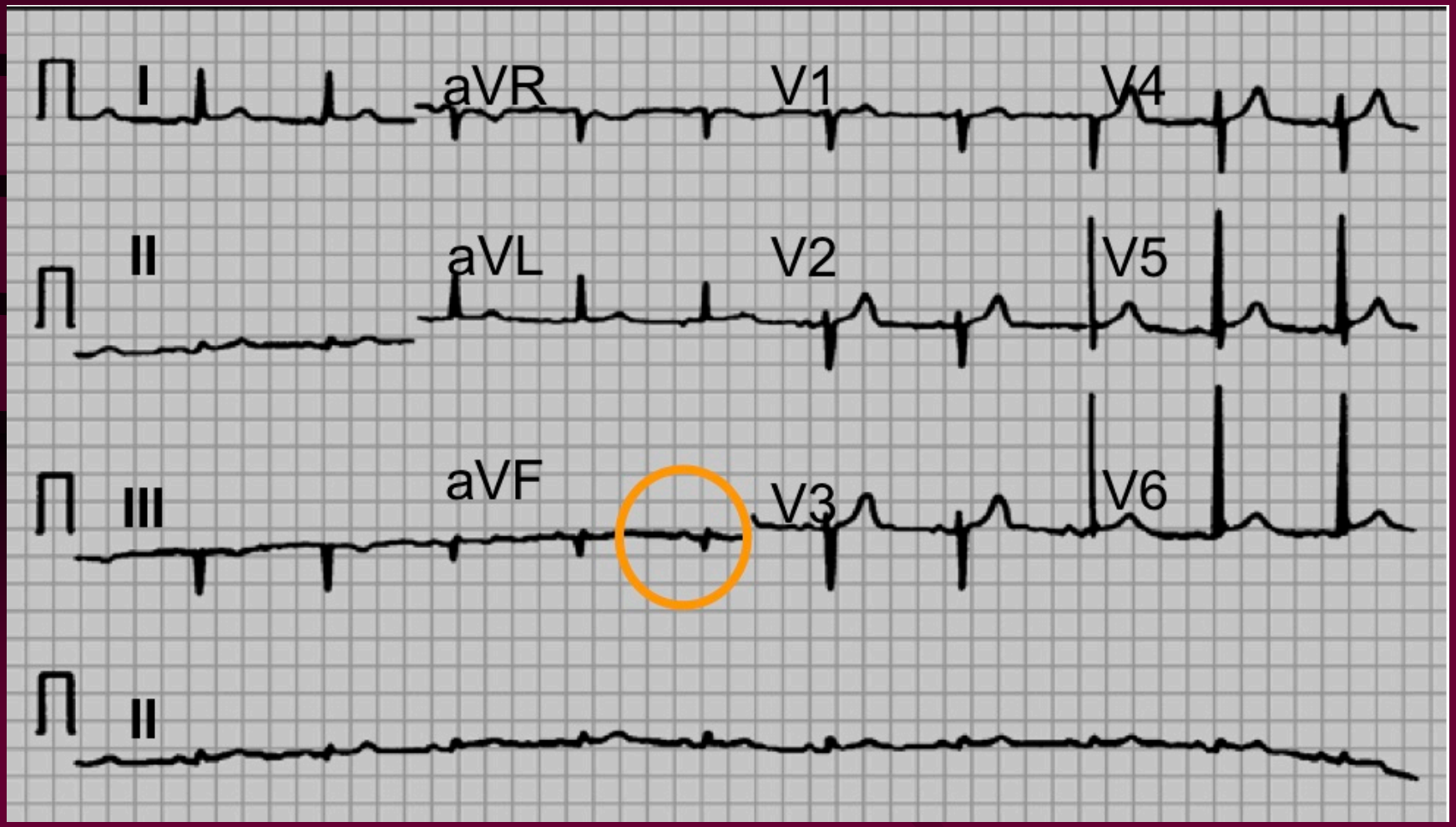


Pathologic Q Waves

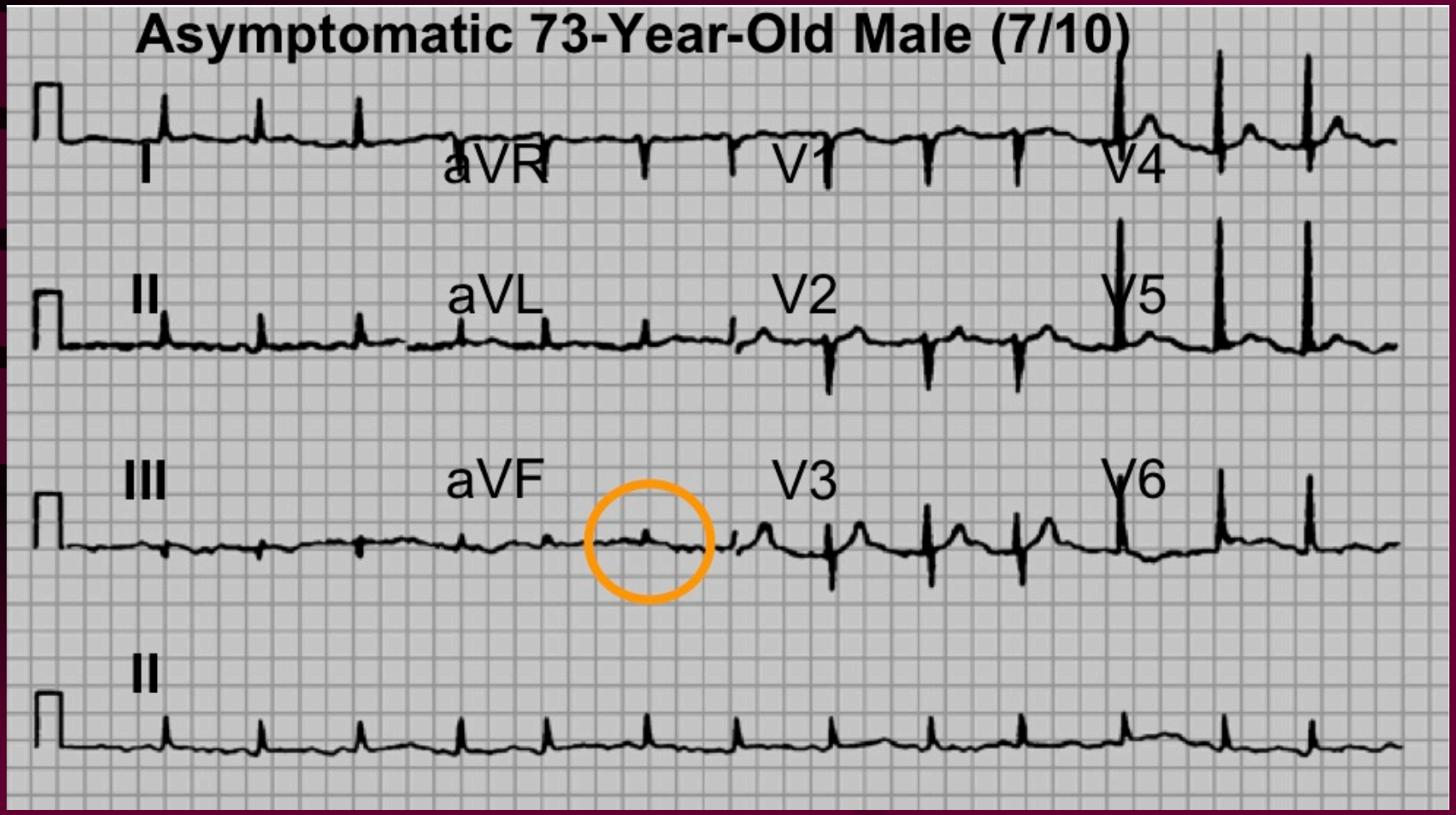
- A Q wave is the first negative deflection after the P wave.
- A pathologic Q wave is greater than .04 seconds wide (1 little box on the EKG paper) in 2 contiguous leads excluding V1, III.
- Depth is 1/3 the height of the R wave.
- 50% of adults have non-diagnostic Q wave


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

You are asked to review an ECG from an asymptomatic 73yo male scheduled for prostate surgery – is there an inferior MI?



Inferior Q wave inconsistency

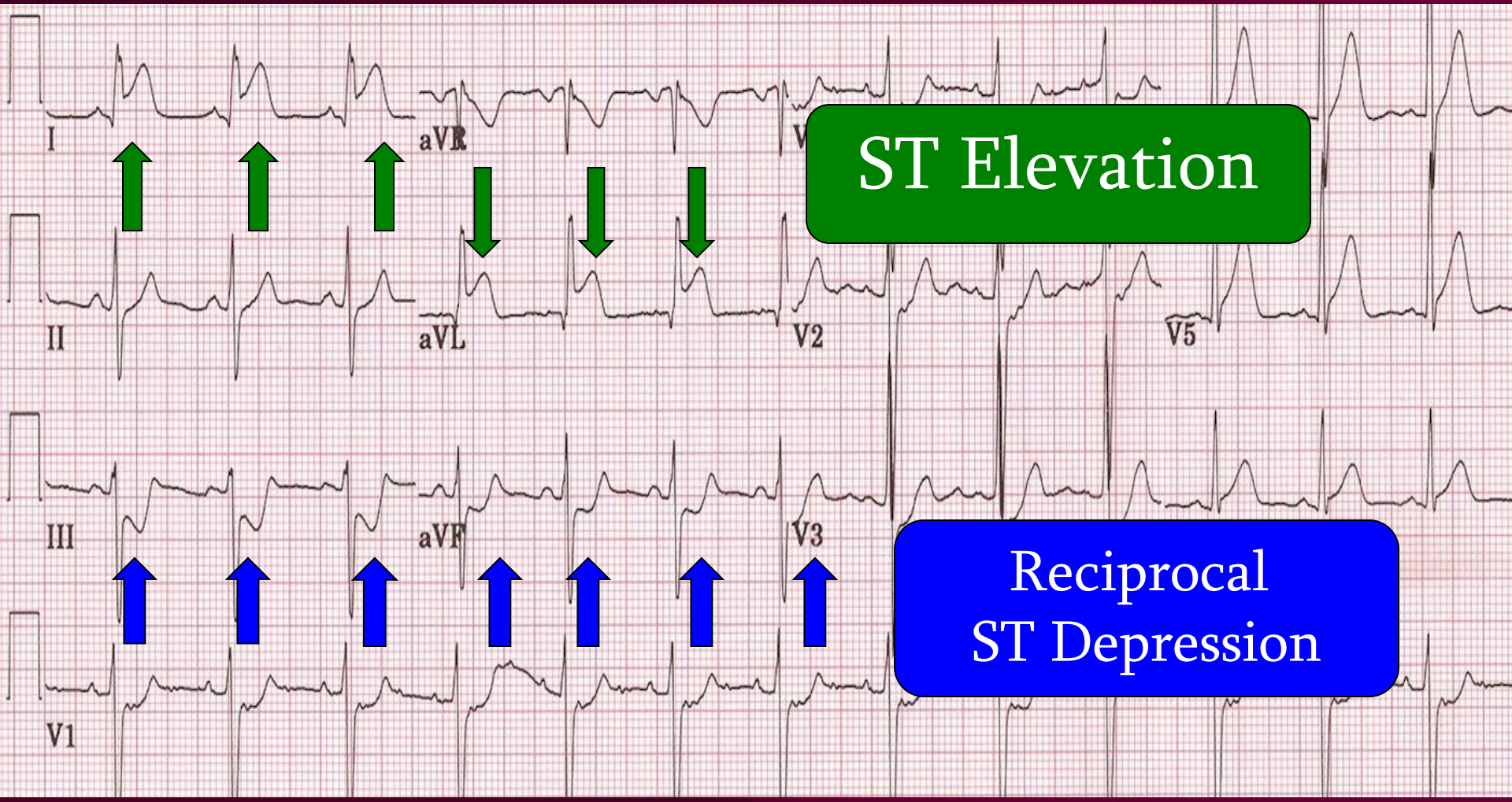


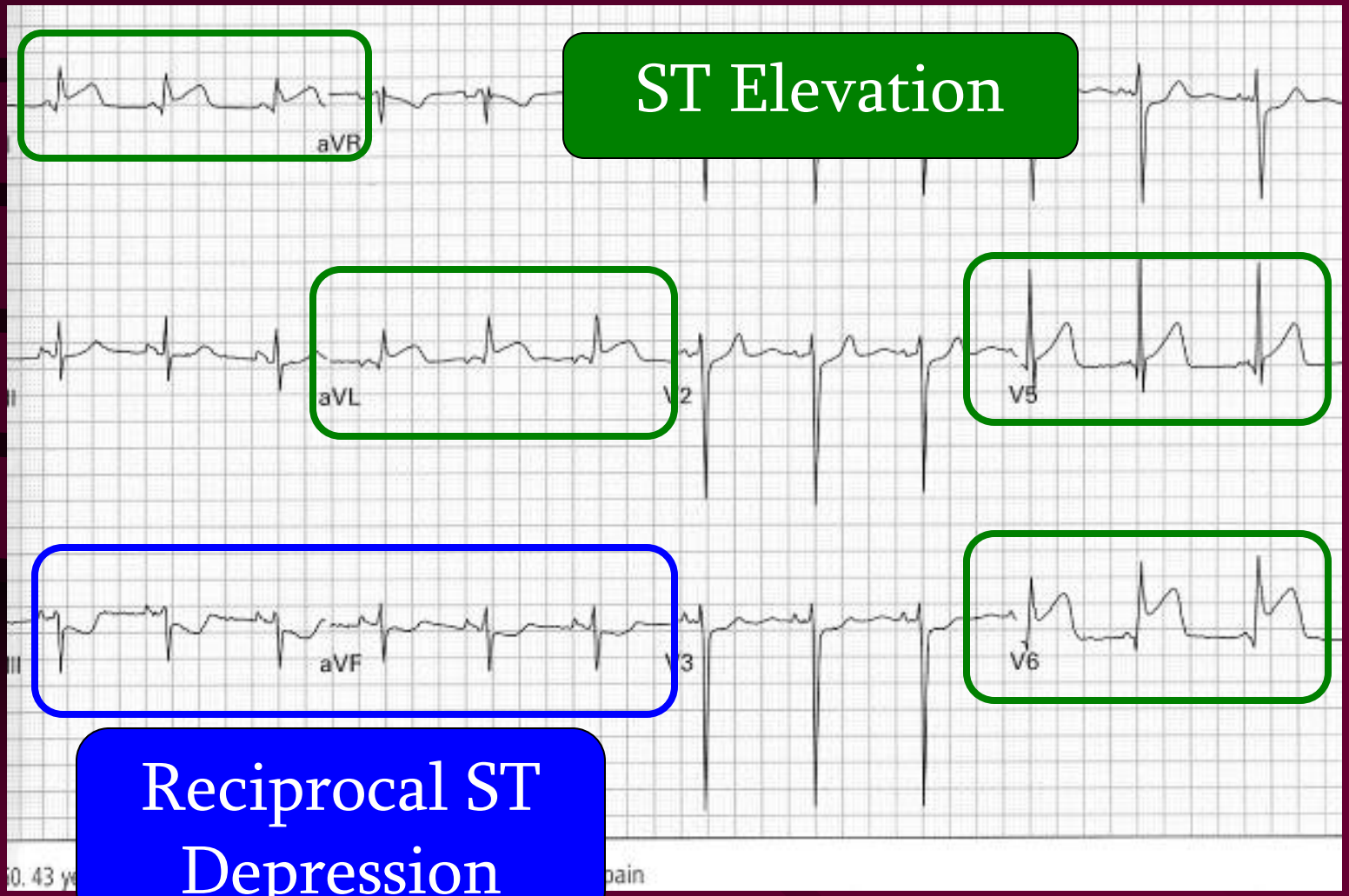
Coronary Arteries Supply to the Myocardium

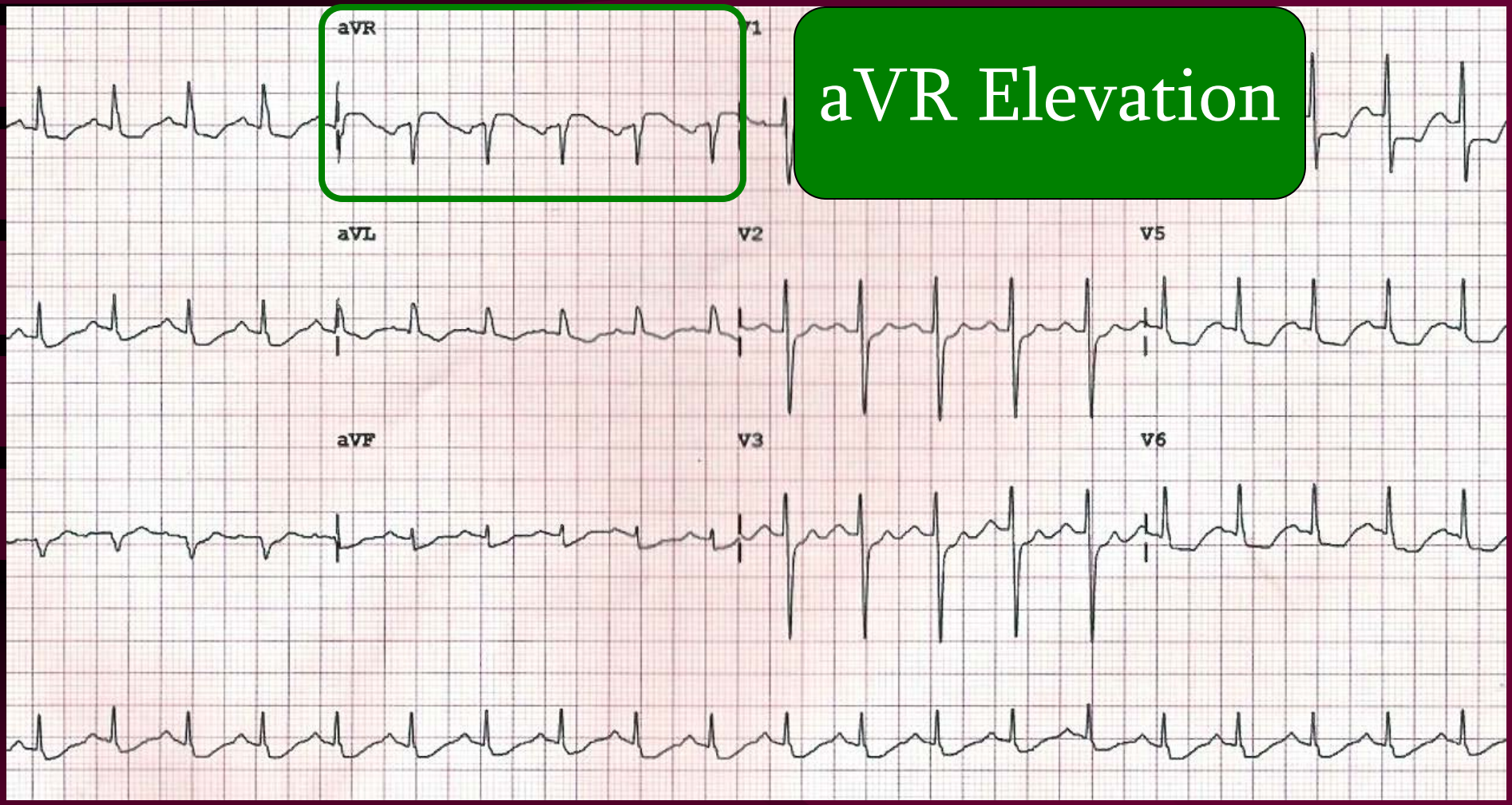
- Anterior LV – LAD
- Lateral LV – LCx (OM)
- Posterior LV – RCA (PDA), LCx (OM)
- Inferior LV – RCA (marginal)
- Septum – LAD, RCA (PDA)
- RV - RCA (marginal/PDA)

Reciprocal Leads

SITE	FACING	RECIPROCAL
SEPTAL	V1, V2	NONE
ANTERIOR	V3, V4	NONE
ANTEROSEPTAL	V1, V2, V3, V4	NONE
LATERAL	I, aVL, V5, V6	II, III, aVF
ANTEROLATERAL	I, aVL, V3, V4, V5, V6	II, III, aVF
INFERIOR	II, III, aVF	I, aVL
POSTERIOR	NONE	V1, V2, V3, V4


I
aVR
V
II
aVL
V2
V5
III
aVF
V3
V1
ST Elevation
Reciprocal
ST Depression

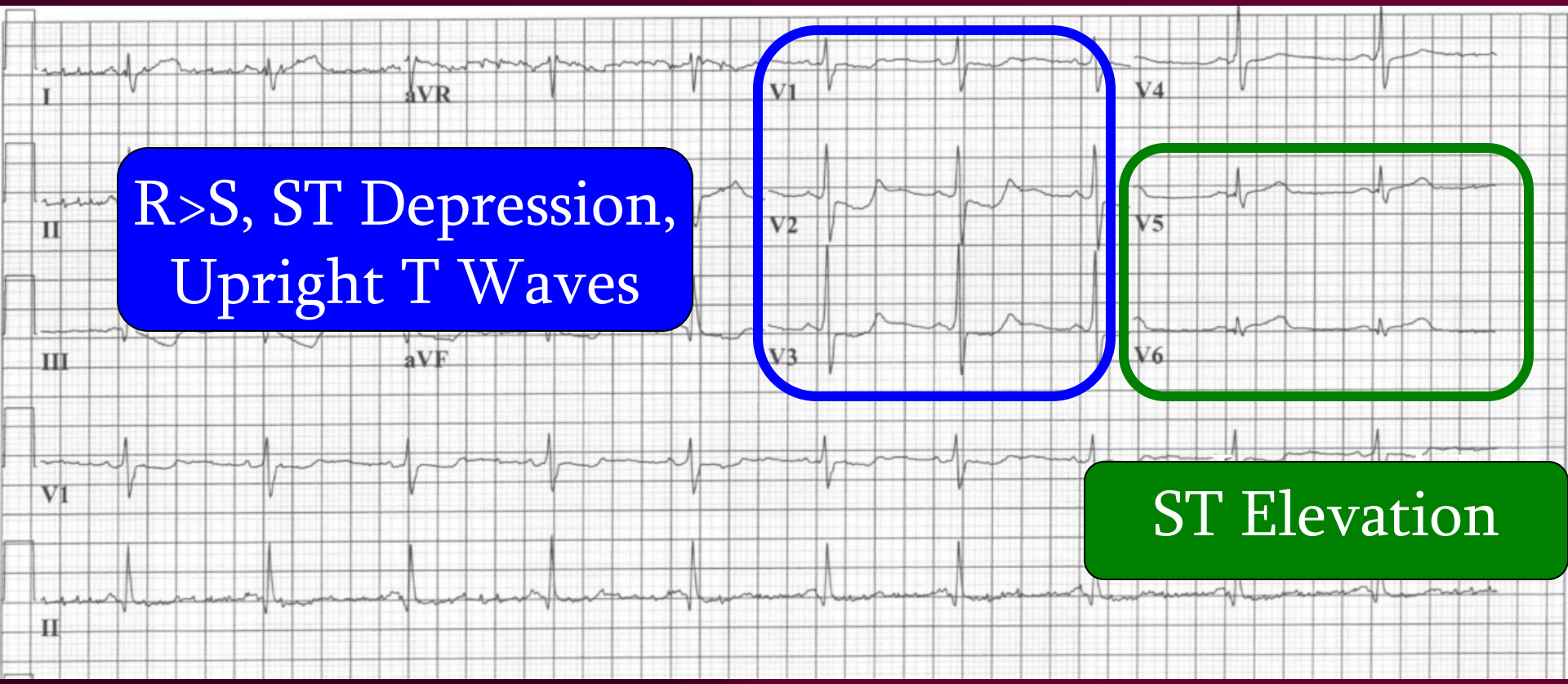

ST Elevation
aVR
aVL
V2
V5
aVF
V3
V6
Reciprocal ST Depression



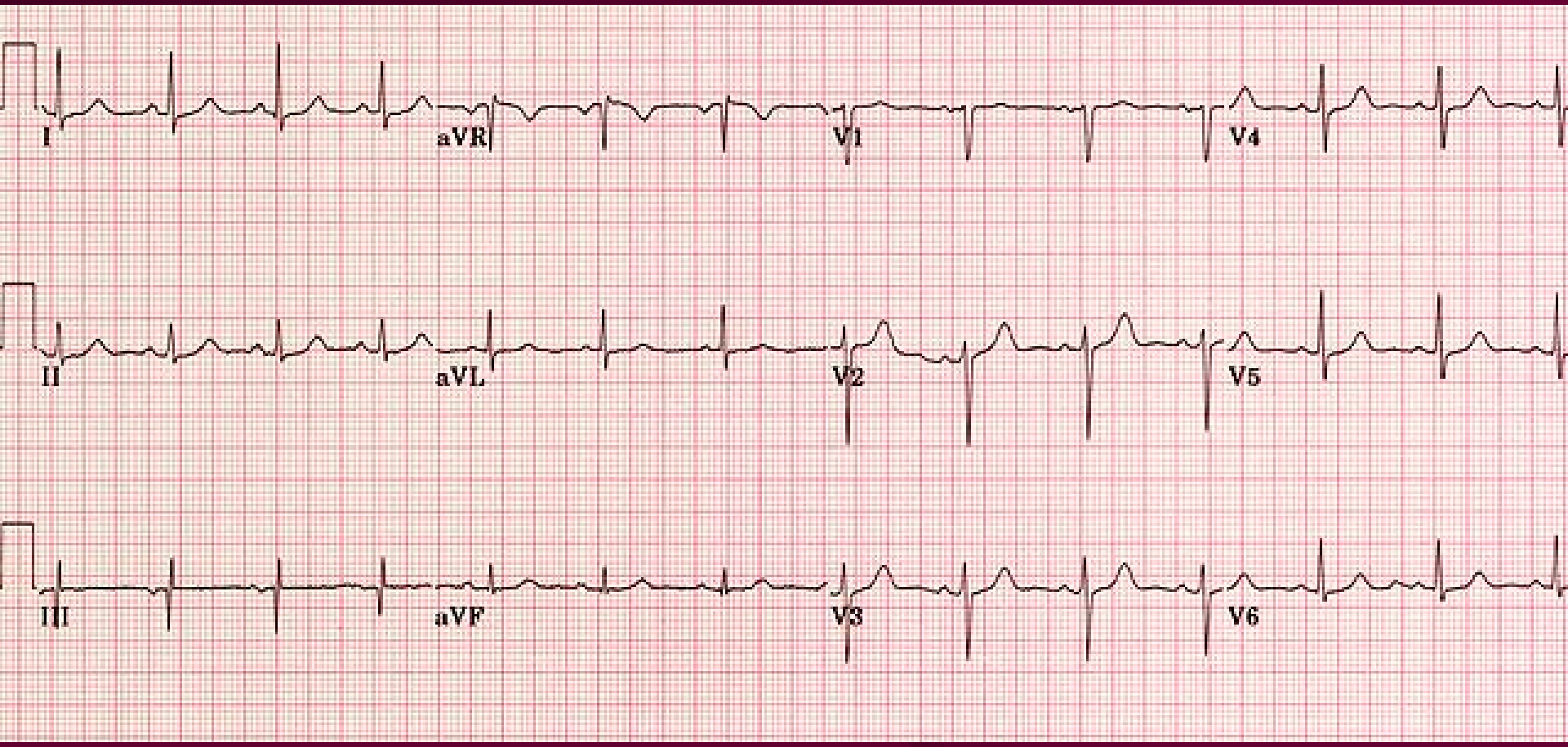
aVR Elevation

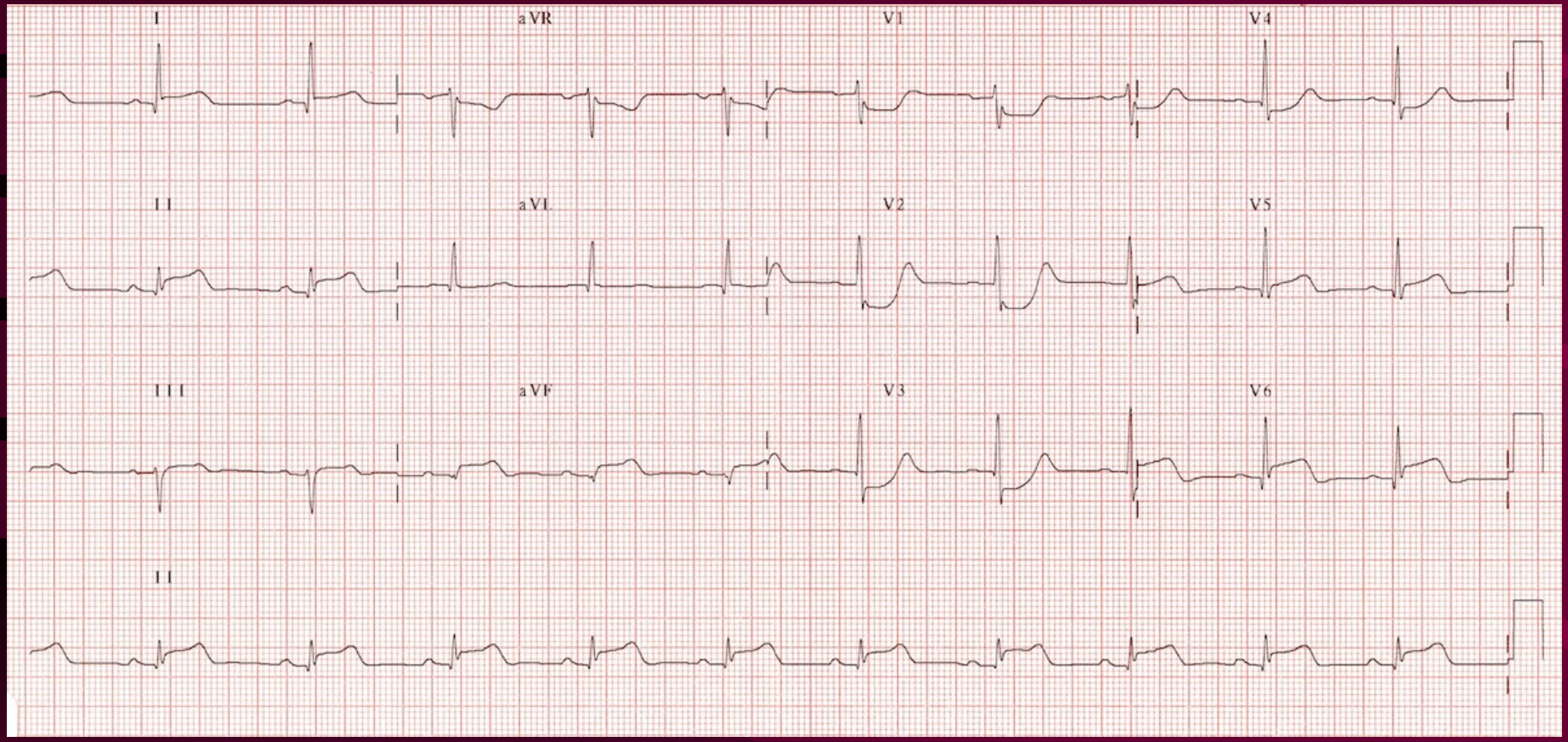
Posterior MI Criteria

- ST depression in V1-V3
- Prominent R>S in V1-V3
- Upright T waves in V1-V3
- Often coexisting with inferior-lateral MI
- True posterior MI involves the left Cx artery


I
aVR
V1
V4
II
V2
V5
III
aVF
V3
V6
V1
II
R>S, ST Depression, Upright T Waves
ST Elevation

Now compare with a normal ECG




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

Right Ventricular Infarct

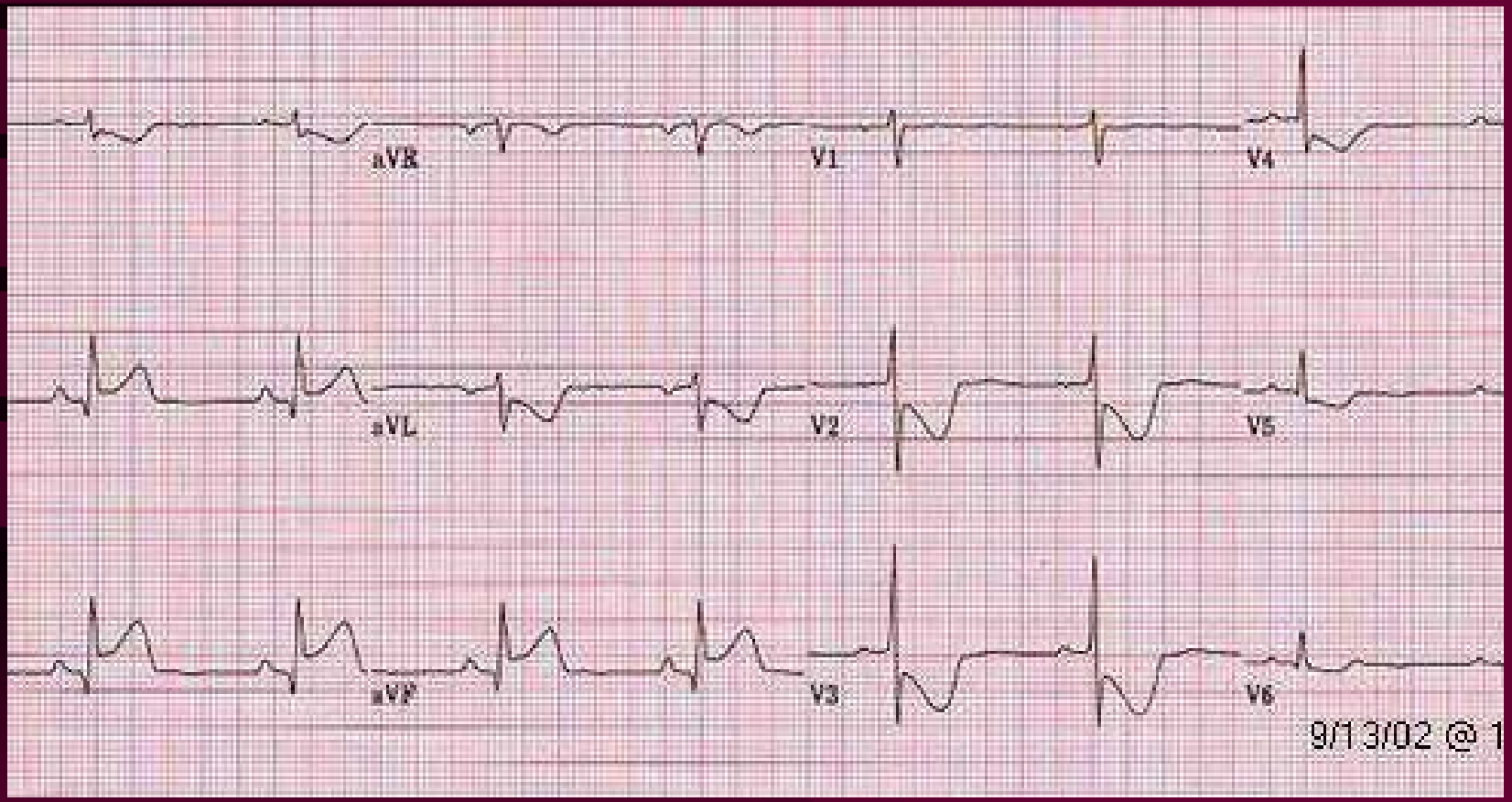
- RVI should be considered in all pts who have an inferior MI (found in 1/3 of pts)
- Right-sided ECG, echo, and invasive hemodynamic monitoring also be helpful in diagnosis
- Elevated JVD, Hypotension and clear lung fields suggests RVI
- Treatment: volume load with NS

Right Ventricular Infarct Criteria

- ST elevation > 1mm in V4R- V6R
- Concurrent Inferior and Infero-posterior MI
- V5 and V6 are reciprocal to RV MI

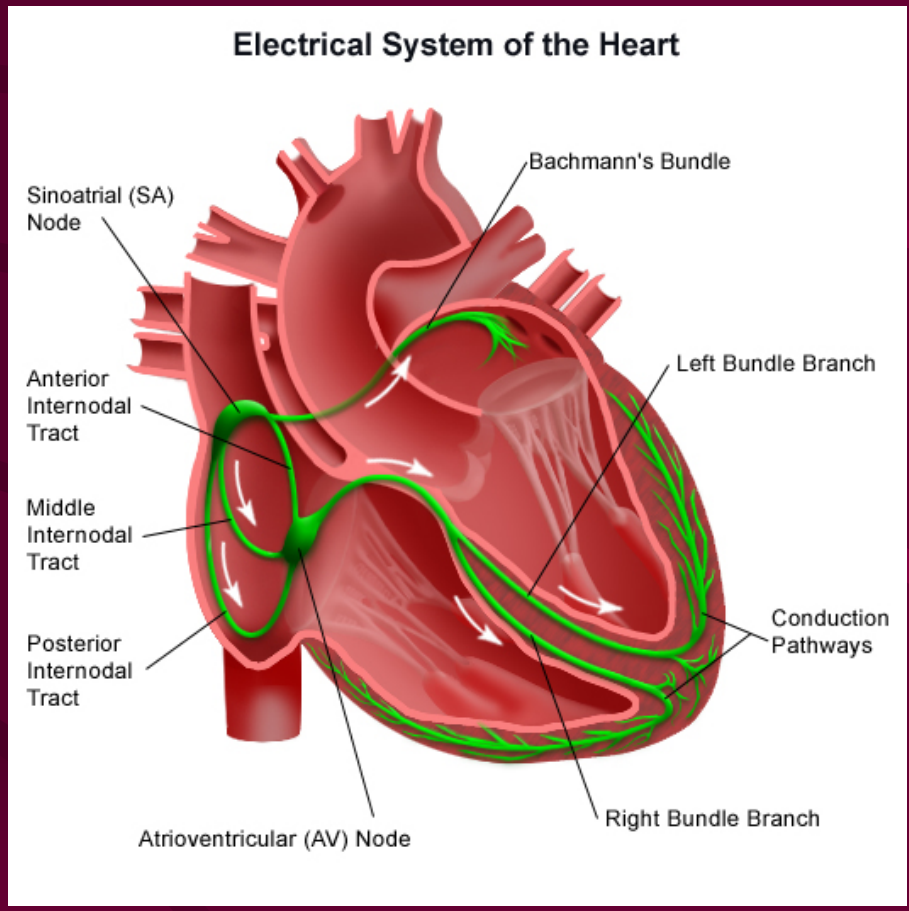
Treatment: fluid loading

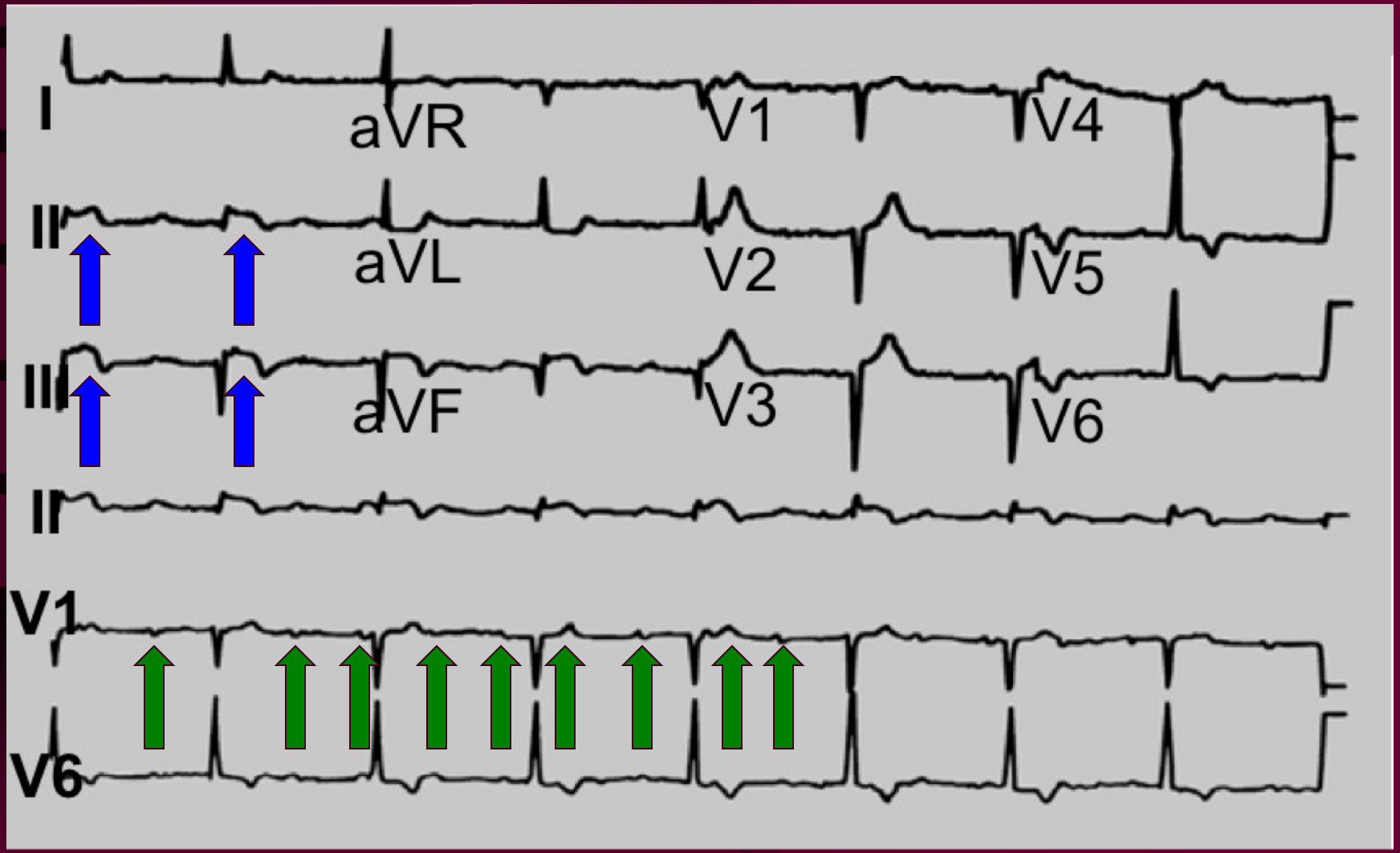
Right Ventricular Myocardial Infarction



Coronary Arteries Supply to the Conduction System

- SA node: RCA (LCx)
- AV node: RCA (LCx)
- His Bundle: RCA
- Bundle Branches: LAD
- ***Bradyarrhythmias/conduction disturbances are well recognized complications of acute MI***



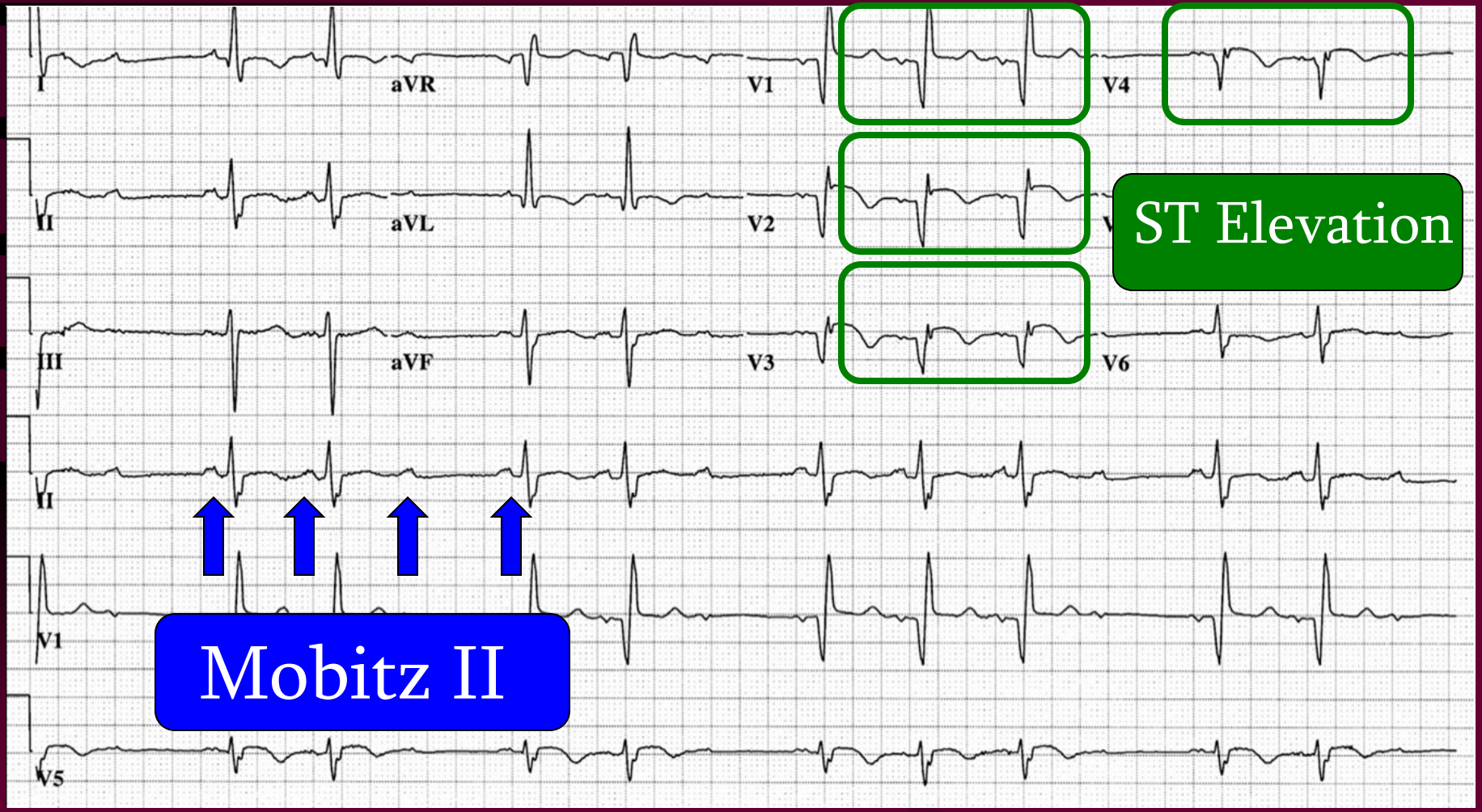


Bradyarrythmias that occur early in the setting of an inferior MI within the first 24 hours may respond to atropine

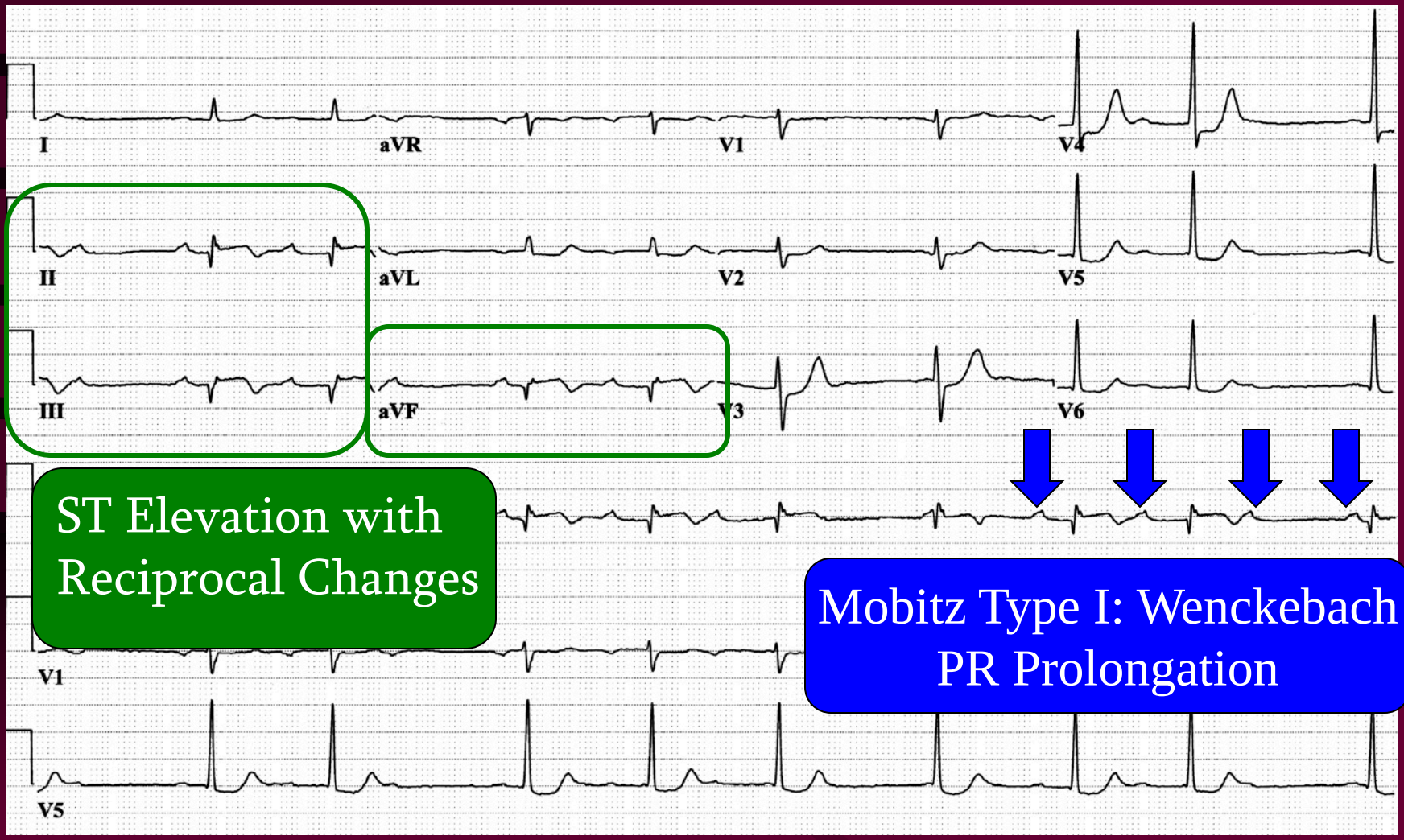
Conduction Disturbances and Infarct Location

- Inferior MI
  - Sinus brady most common arrhythmia, but Mobitz I and CHB also seen
  - High degree AV block located **above** the His
  - Usually resolves
- Anterior MI
  - Mobitz II, BBB, CHB
  - High degree AV block located **below** the AVN
  - Ppm for pts at high risk for CHB (2 or more: PR prolongation, 2nd degree AVB, left ant or post fascicular block, LBBB, RBBB

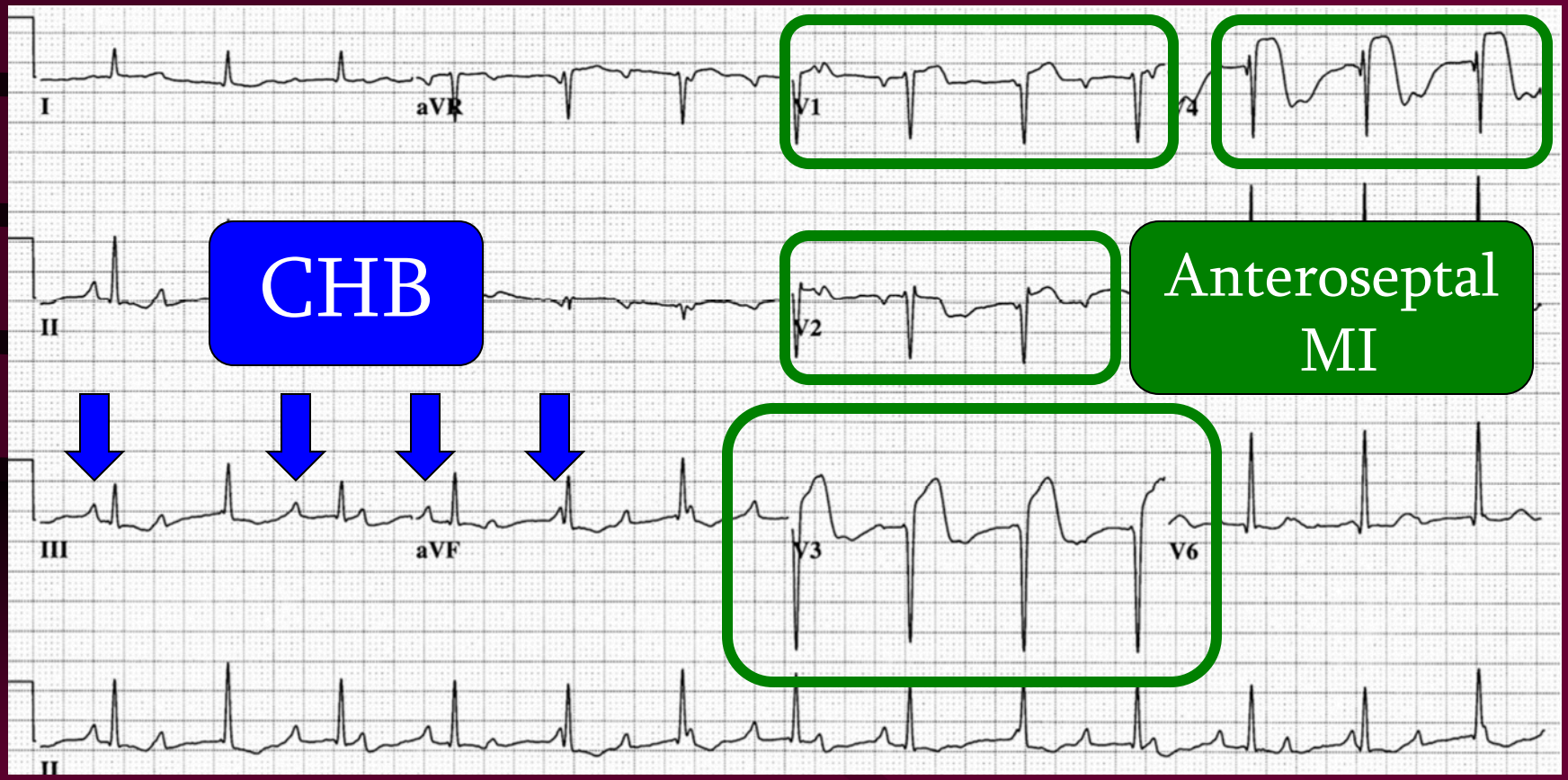
84 yo woman with syncope



72 year old man with nausea and dyspnea

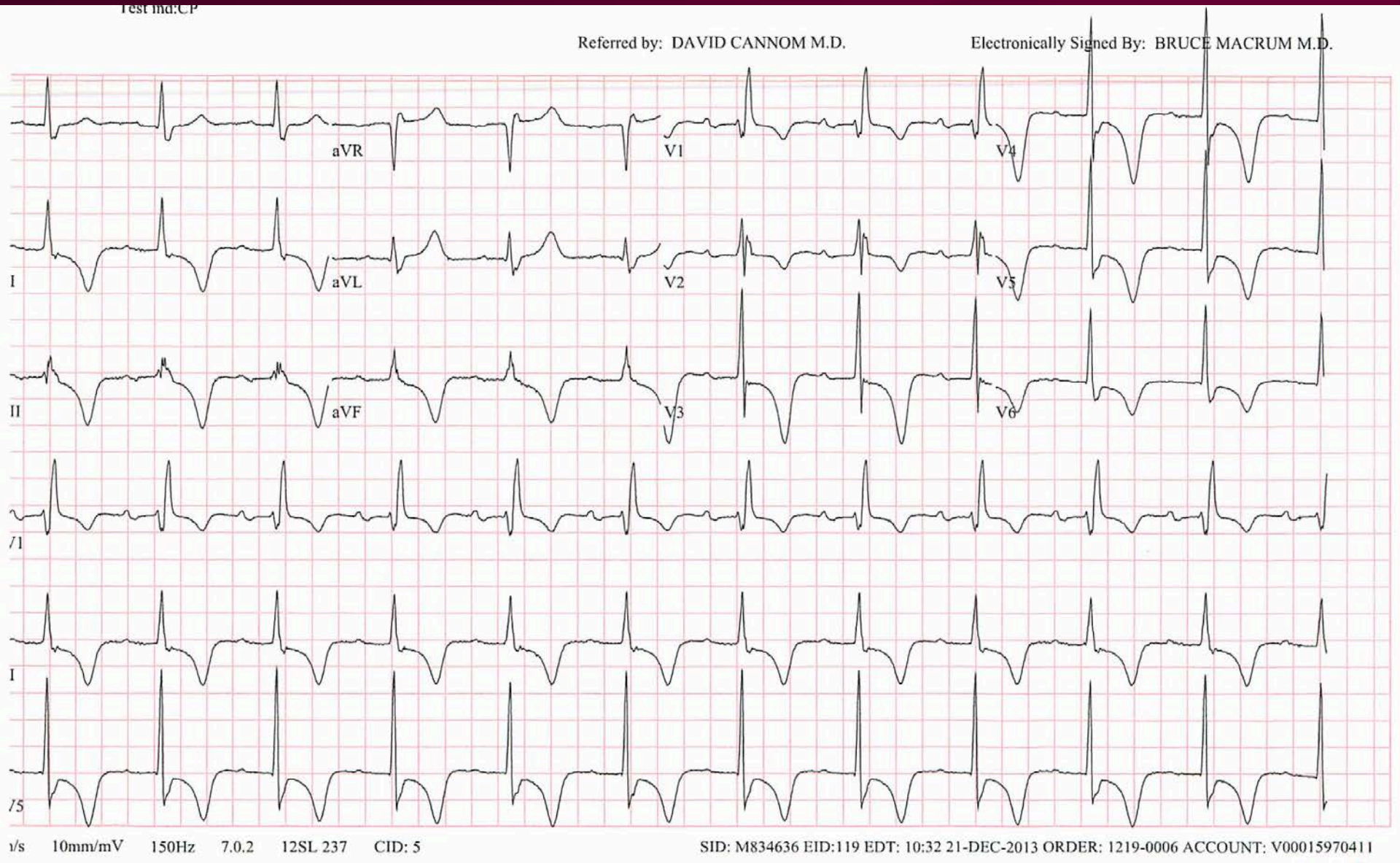


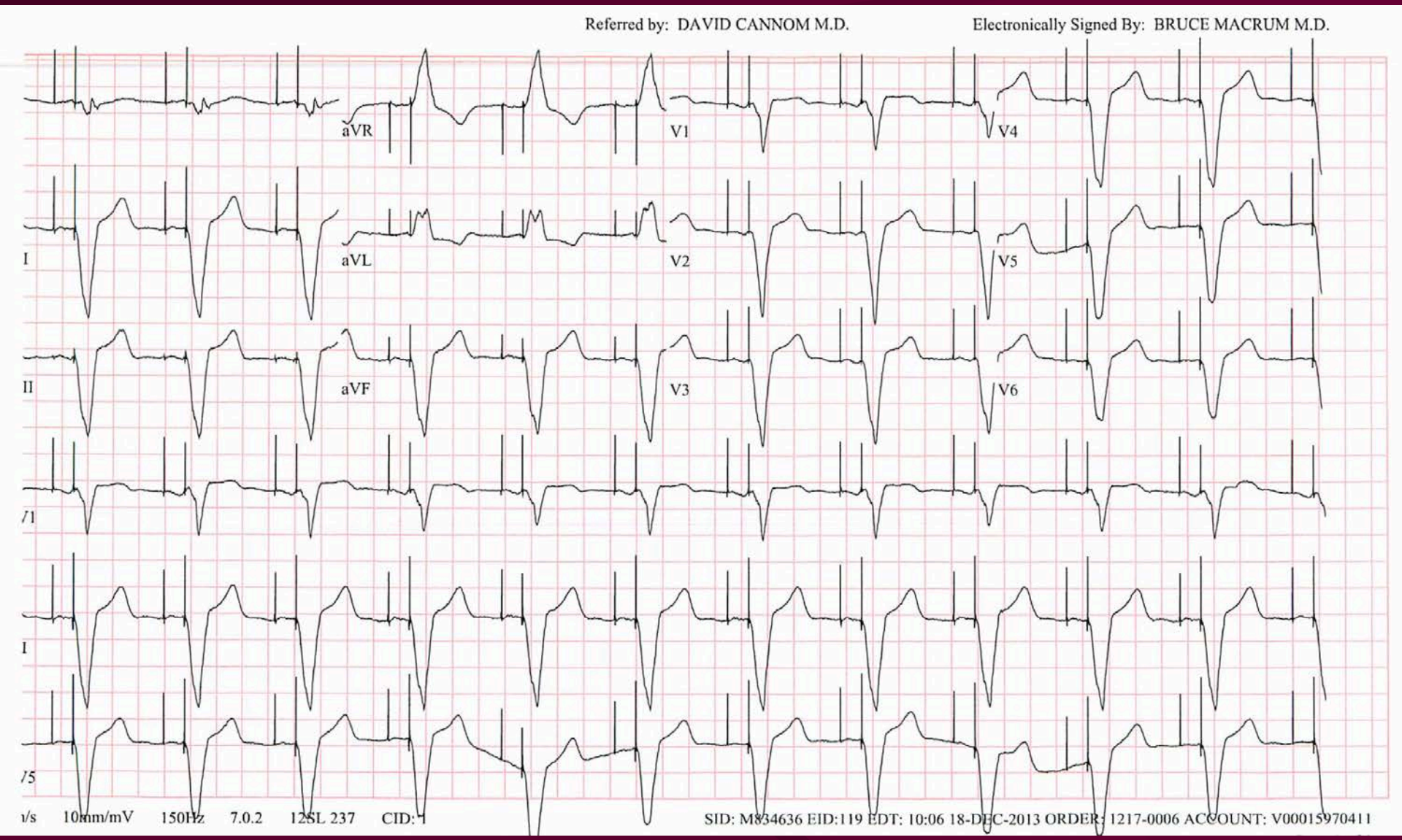
44 year old man with dyspnea



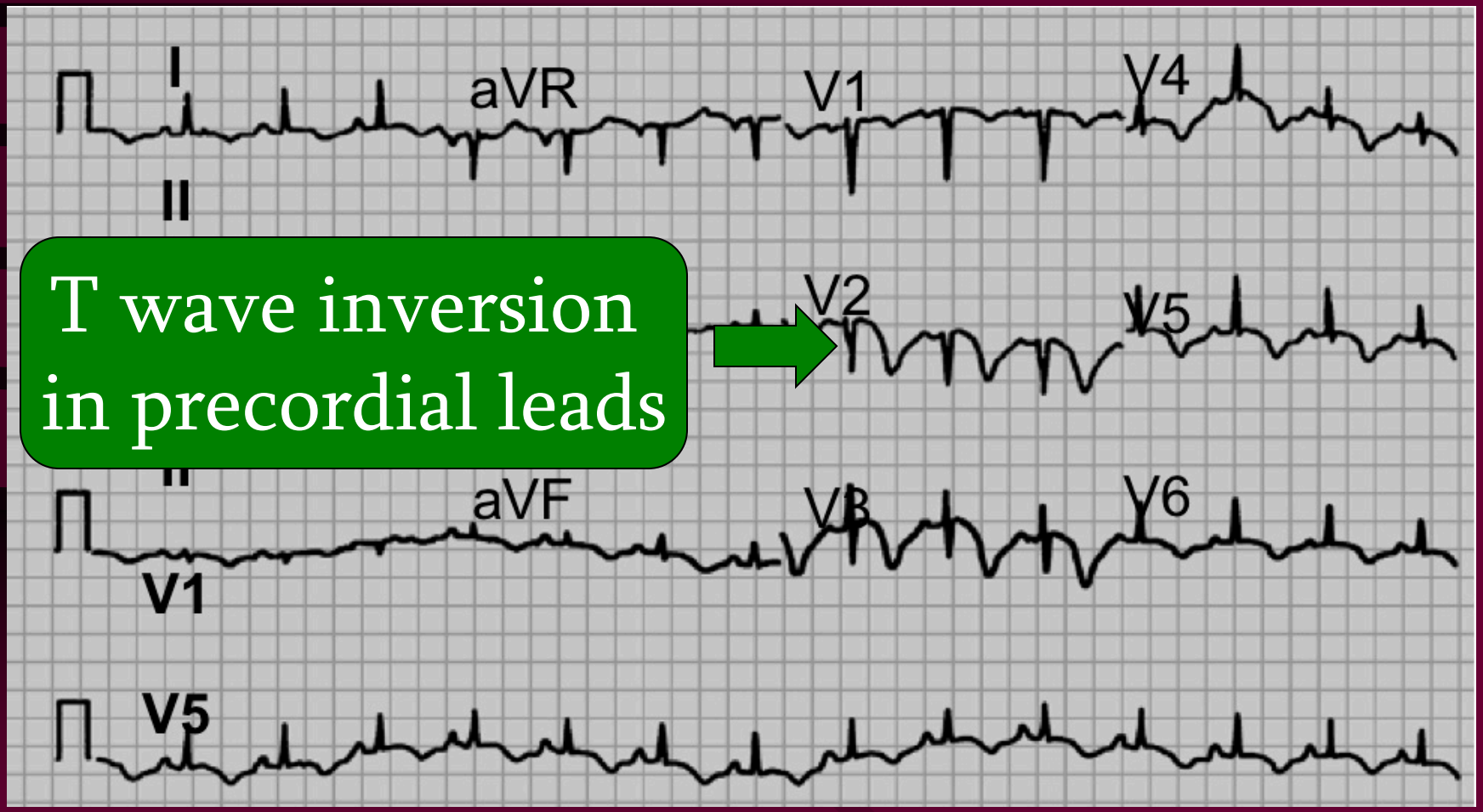
"It's not looking good. His pulse is up to 202 just from getting out of the chair and stepping on to the treadmill."

A few others

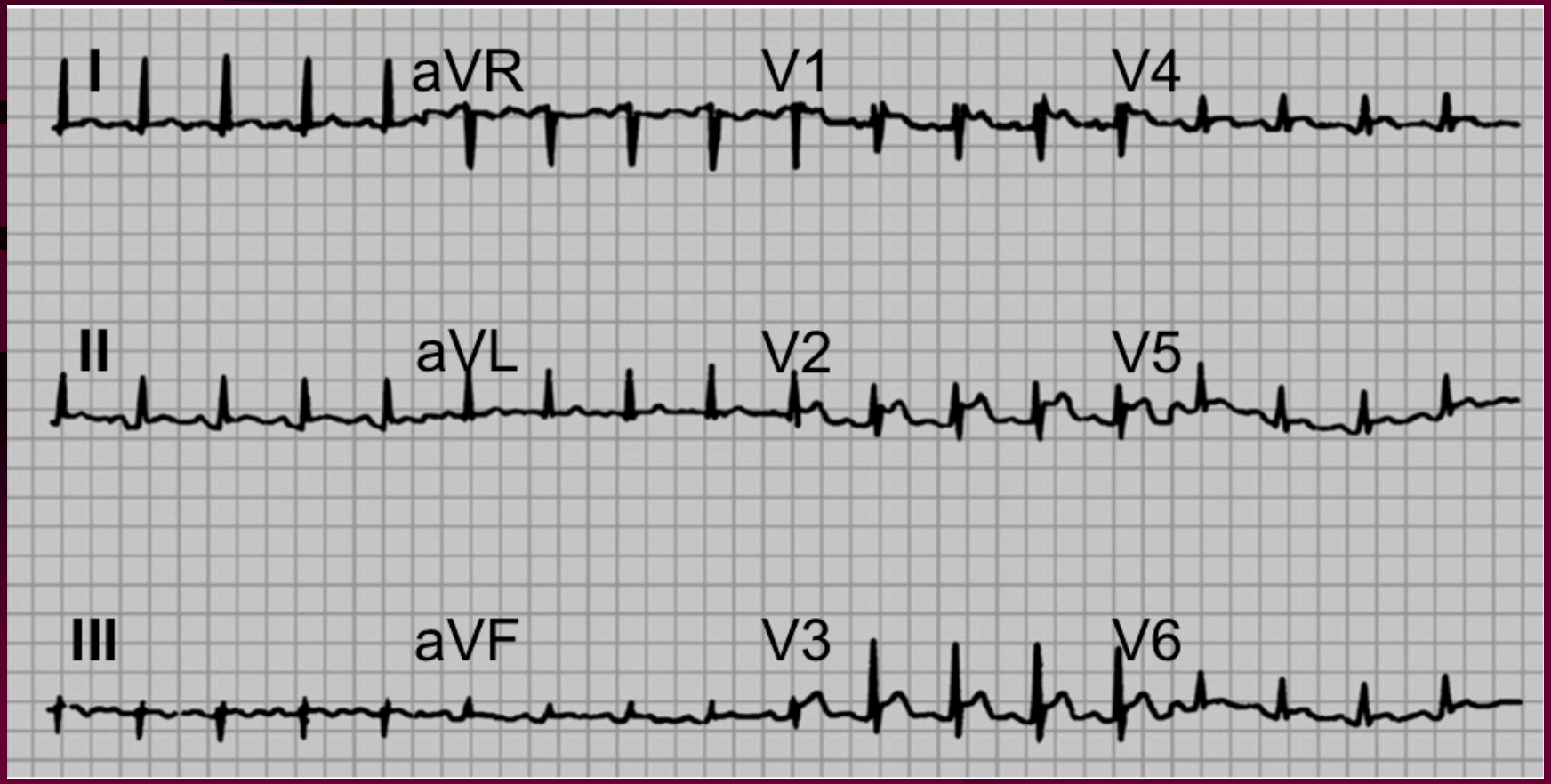

Test ind:CP
Referred by: DAVID CANNOM M.D.
Electronically Signed By: BRUCE MACRUM M.D.
aVR
V1
V4
I
aVL
V2
V5
II
aVF
V3
V6
/1
I
/5
/s 10mm/mV 150Hz 7.0.2 12SL 237 CID: 5
SID: M834636 EID:119 EDT: 10:32 21-DEC-2013 ORDER: 1219-0006 ACCOUNT: V00015970411


Referred by: DAVID CANNOM M.D.
Electronically Signed By: BRUCE MACRUM M.D.
aVR
V1
V4
I
aVL
V2
V5
II
aVF
V3
V6
/1
I
/5
ı/s 10mm/mV 150Hz 7.0.2 12SL 237 CID: 1
SID: M834636 EID:119 EDT: 10:06 18-DEC-2013 ORDER: 1217-0006 ACCOUNT: V00015970411

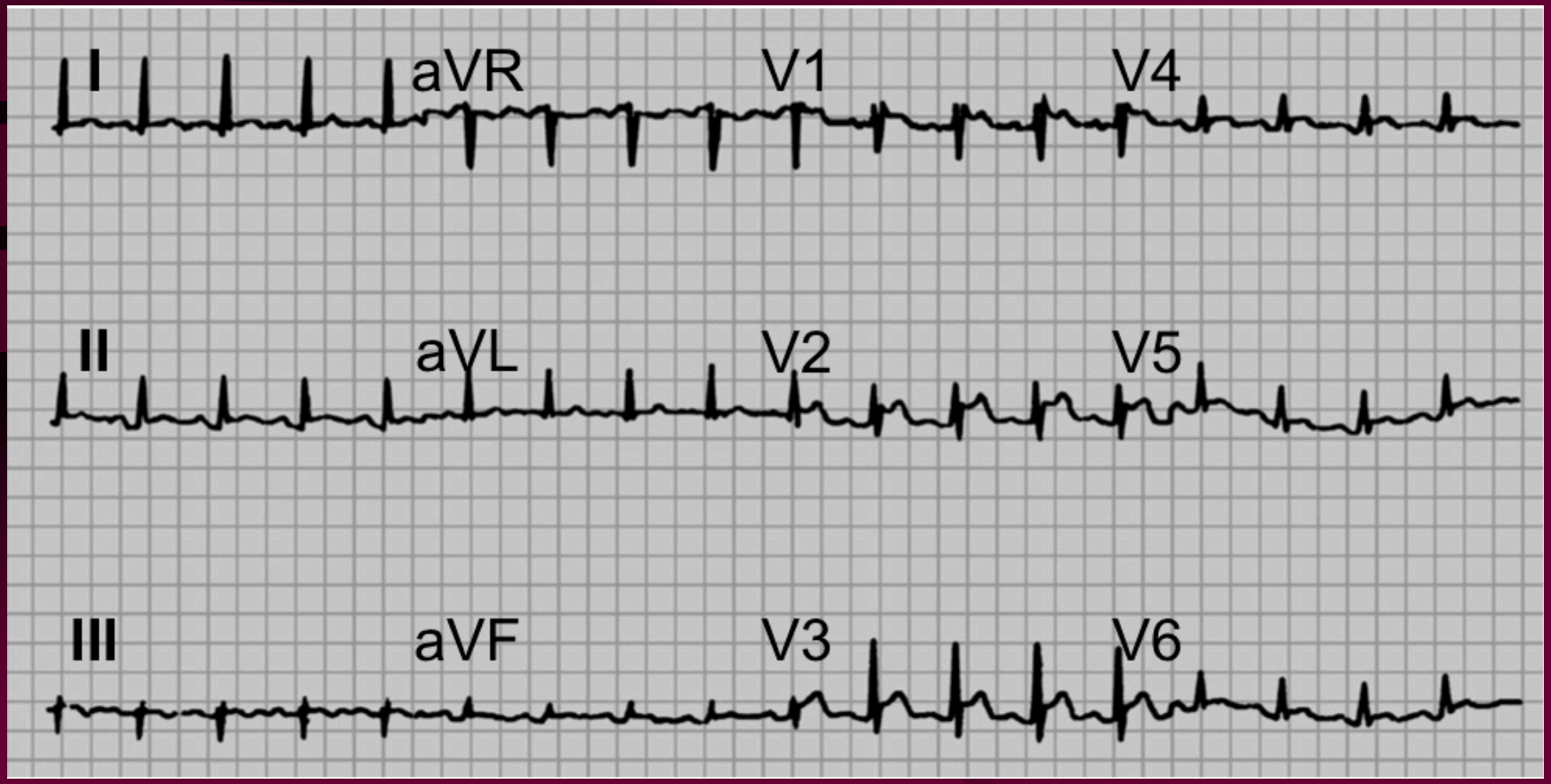
65 year old female with acute subarachnoid hemorrhage



A 36yo male presents with severe CP – EKG is consistent with: a) early repolarization b) ant MI **c) pericarditis** d) inf ischemia



A 36yo male presents with severe CP – EKG is consistent with: a) early repolarization b) ant MI **c) pericarditis** d) inf ischemia



2935093 09-Aug-2013 11:20:56
25 Years

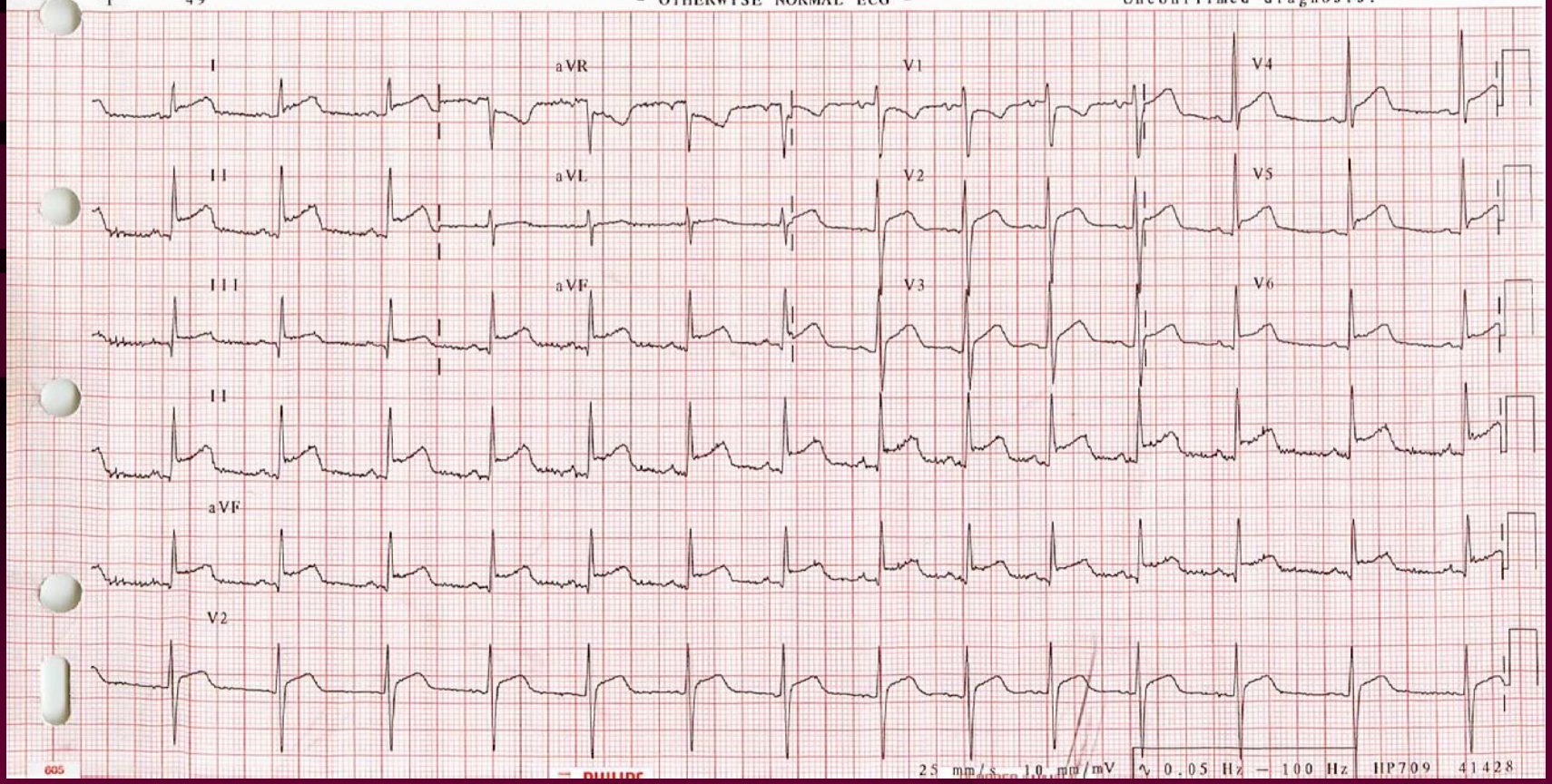
PageWriter 300pi
Department: uc
Room: 1150
Operator: dw

Chest Pain Status: Chief complaint

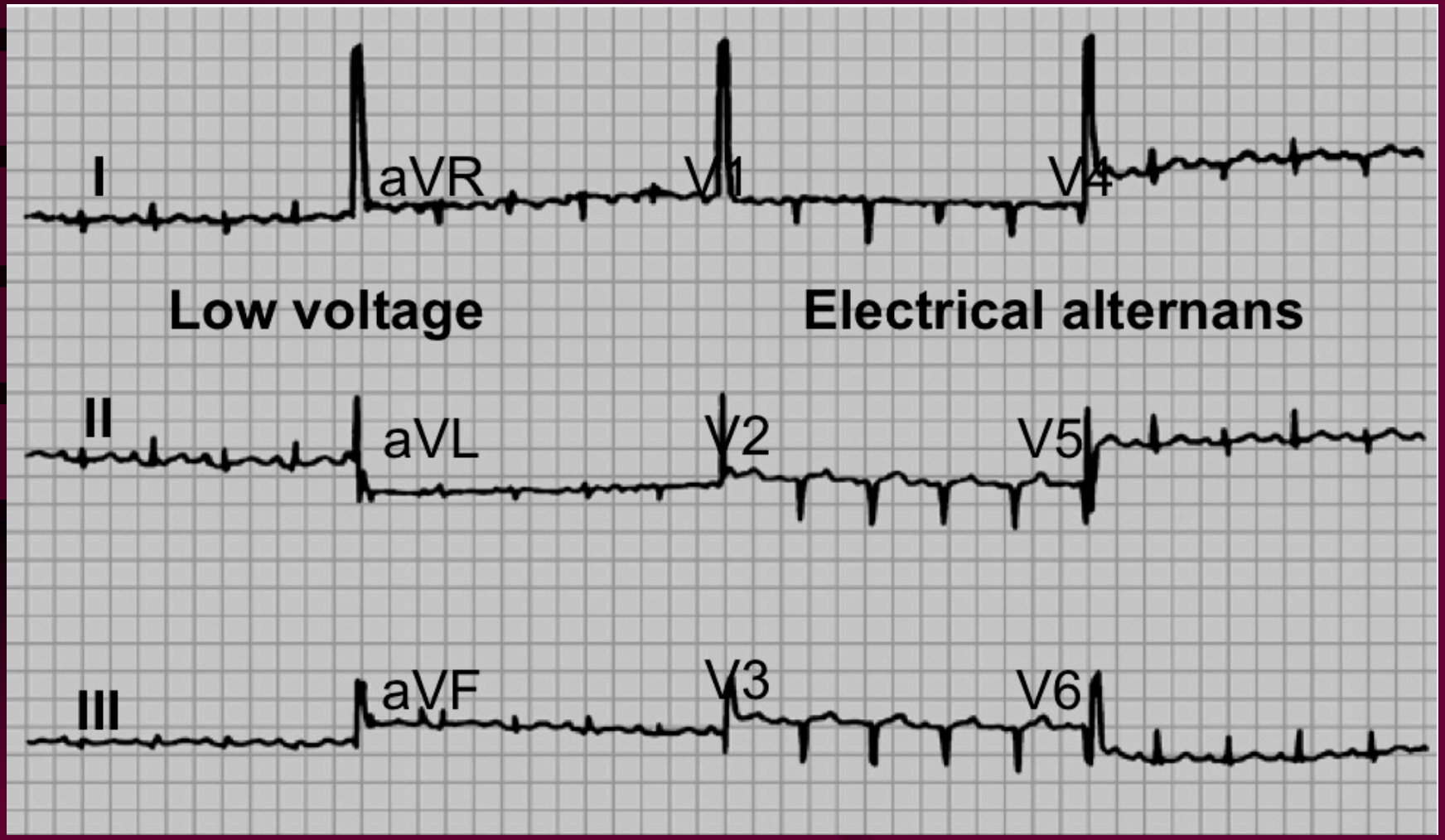
Rate	84	. NORMAL SINUS RHYTHM, RATE 84.....normal P axis, PR, rate & rhythm
PR	159	. ST ELEV, PROBABLE NORMAL EARLY REPOL PATTERN.....ST elevation, age 16-55
QRSD	73	
QT	342	
QTc	404	
--Axis--		
P	54	
QRS	60	
T	49	

- OTHERWISE NORMAL ECG -

Unconfirmed diagnosis.



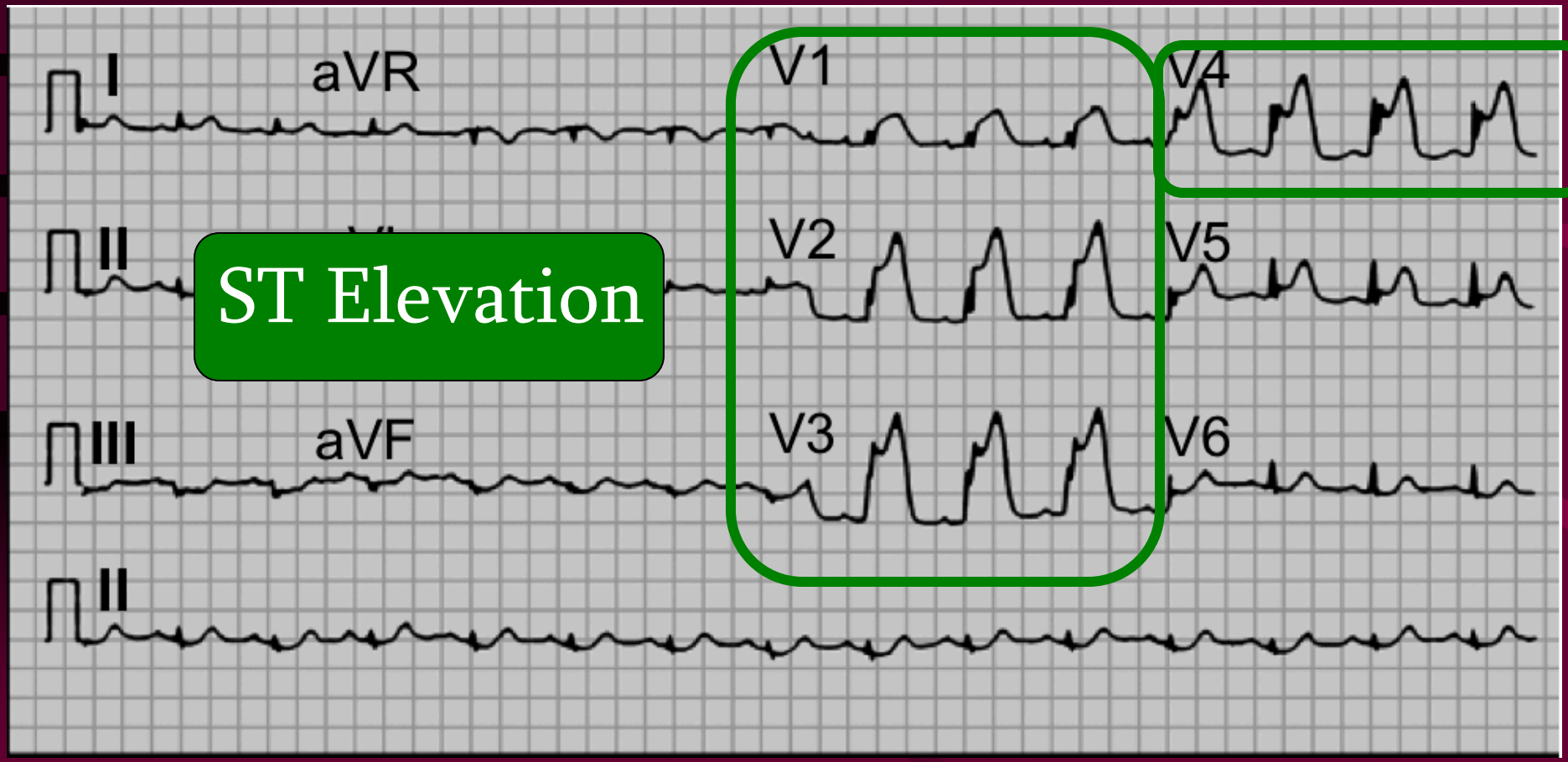
51 yo female with pericardial effusion



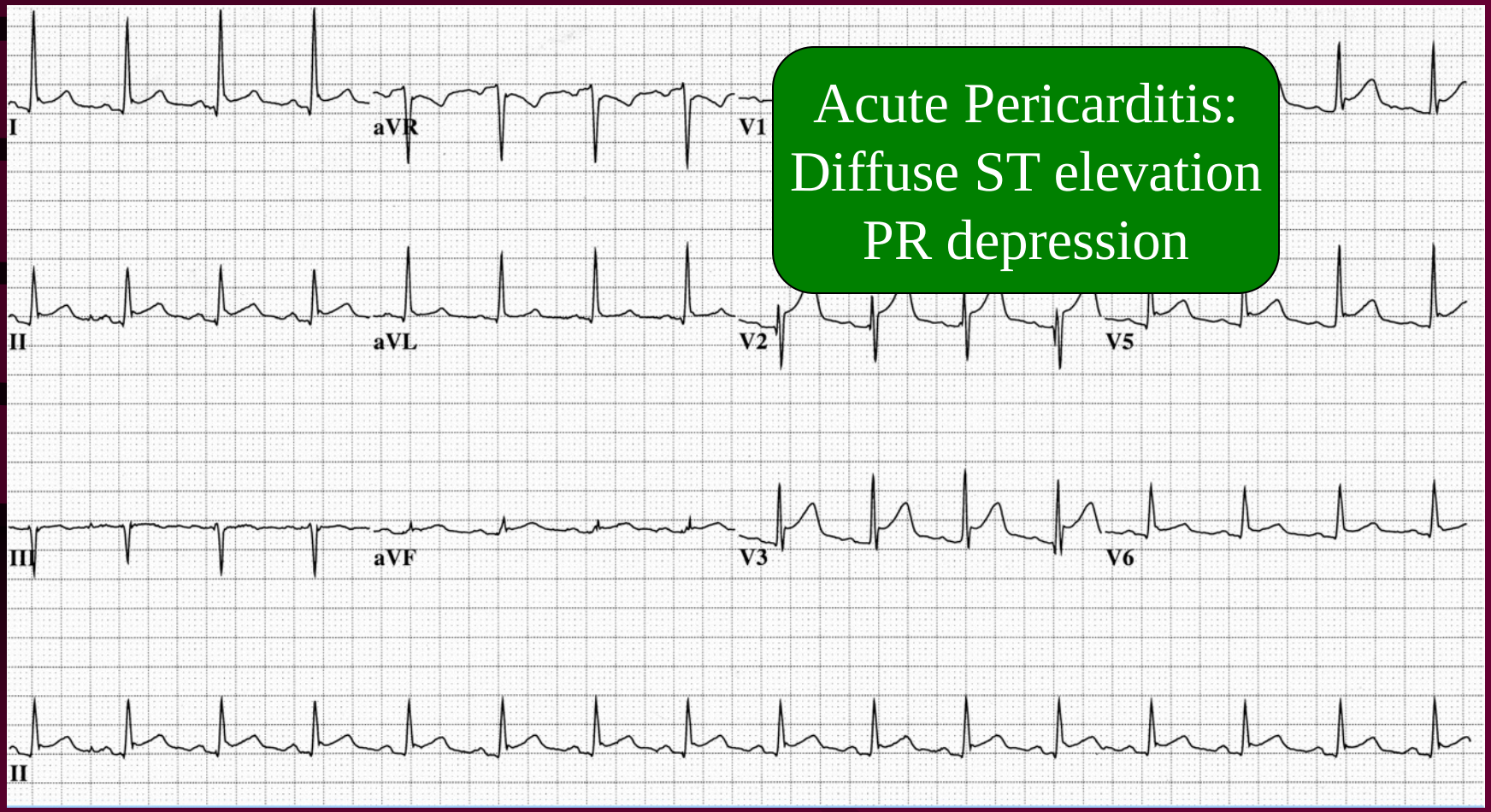
III

Case Studies

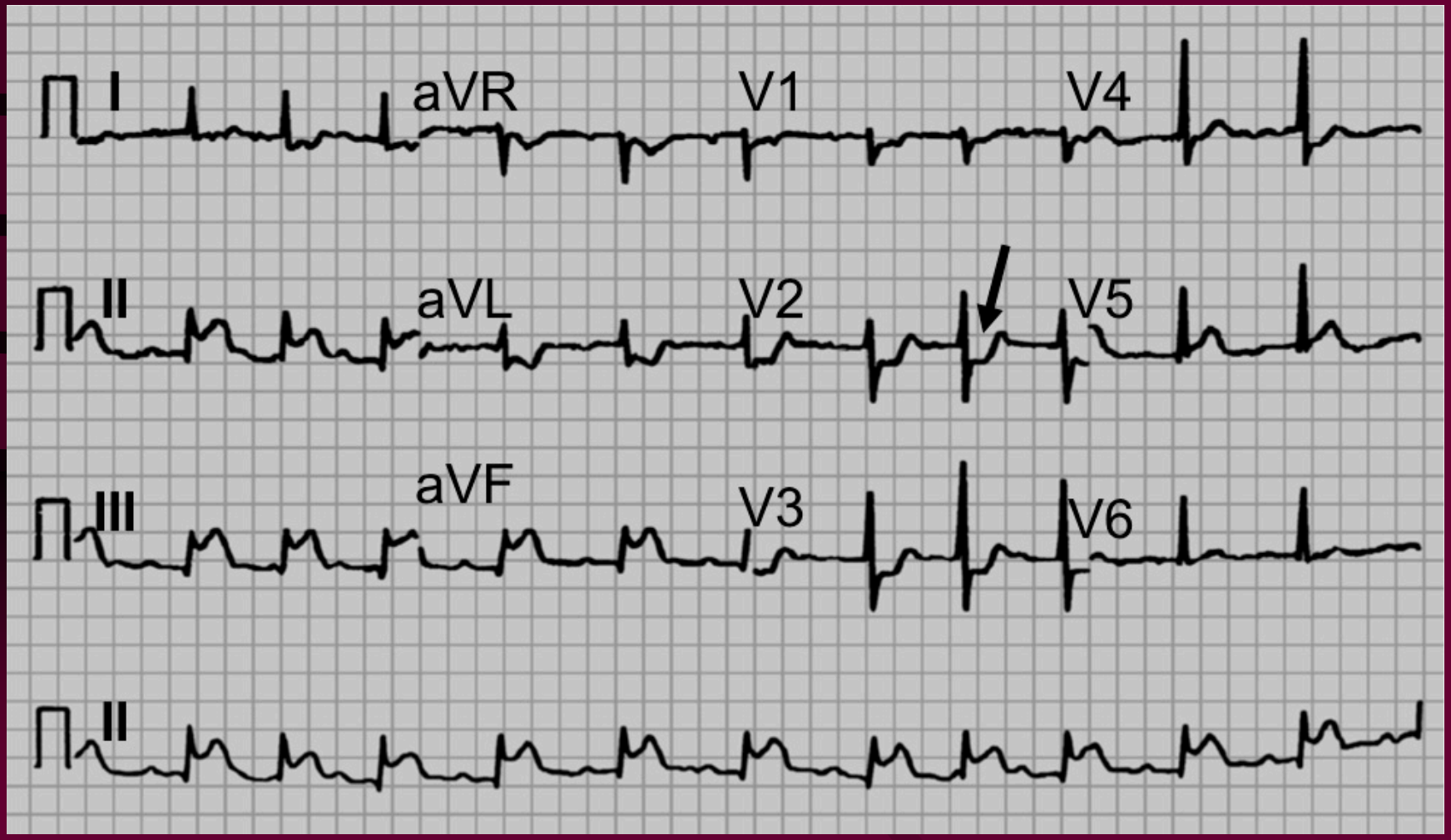
89yo female presents with dyspnea and back pain



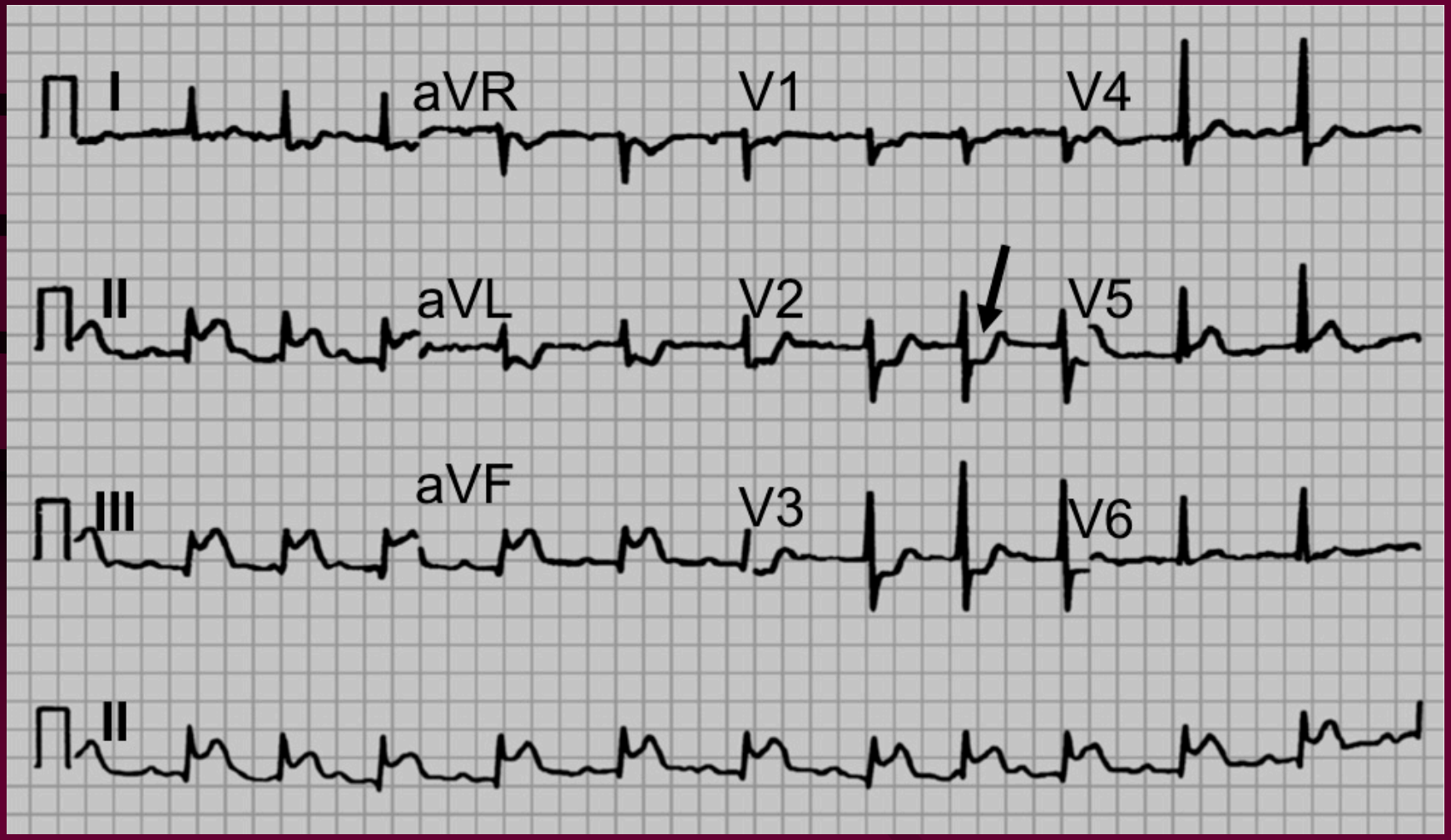
46 year old man with chest pain



71yo female with nausea, dyspnea and general malaise. ECG changes in V2 are due to: Ant ischemia or Post injury



71yo female with nausea, dyspnea and general malaise. ECG changes in V2 are due to: Ant ischemia or **Post injury**



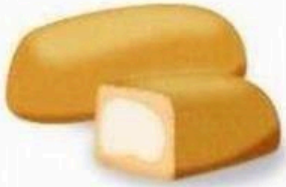
In 2011

The Eastern Cougar, a subspecies of the North American Cougar,

went extinct.

Remember hearing about it?
Me neither.

In 2012, Twinkies



were threatened with extinction and the entire country

lost its shit.