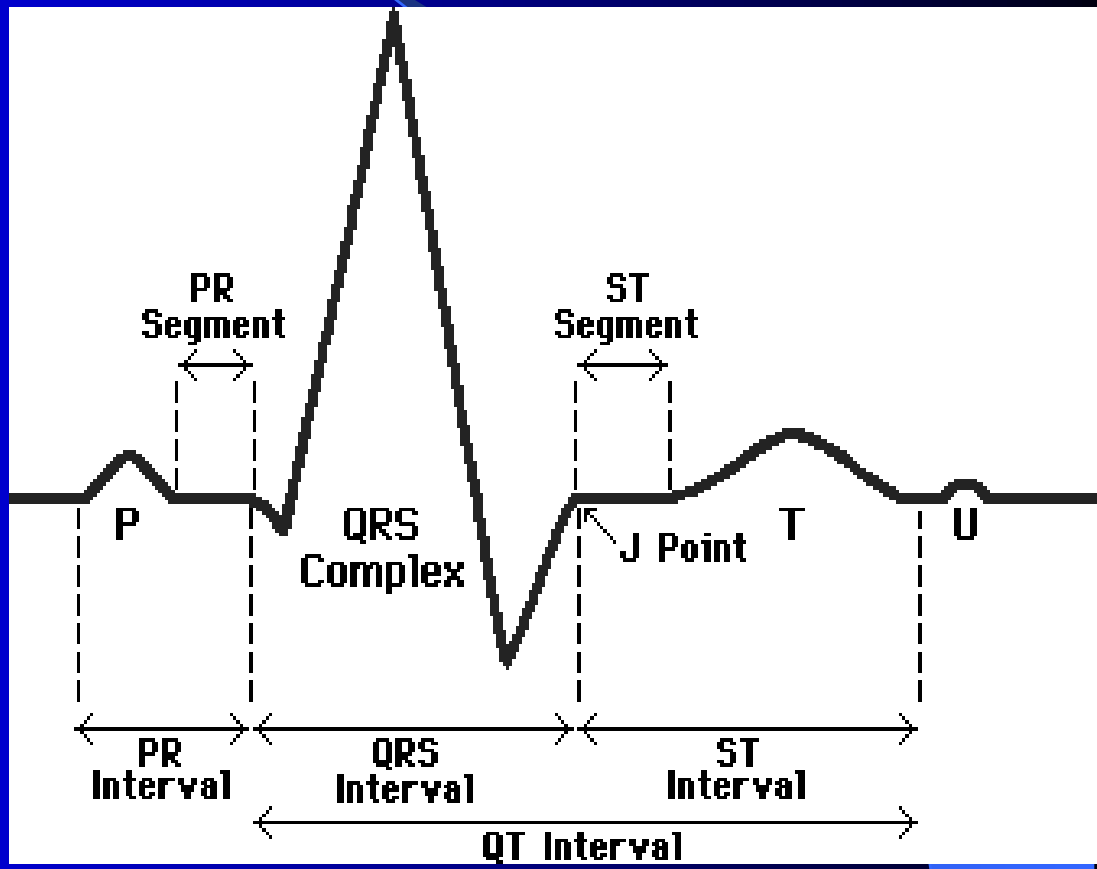
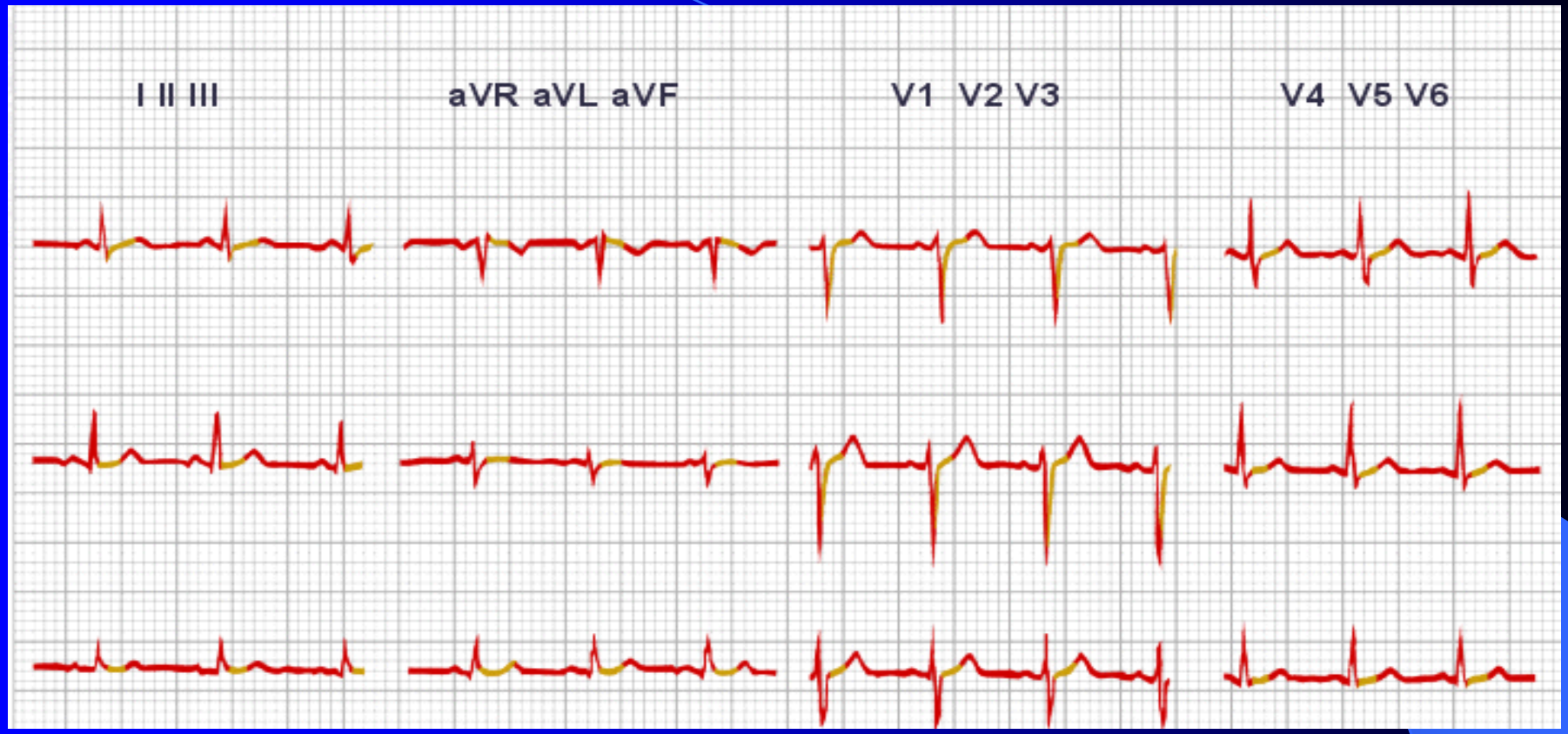
ECG Findings of Myocardial Ischemia/Injury

Components of a Normal EKG Complex

- P wave is present, precedes and correlates to the QRS
- PR interval: .12-.20 ms
- QRS complex is present
- QRS Interval: .06 - .10

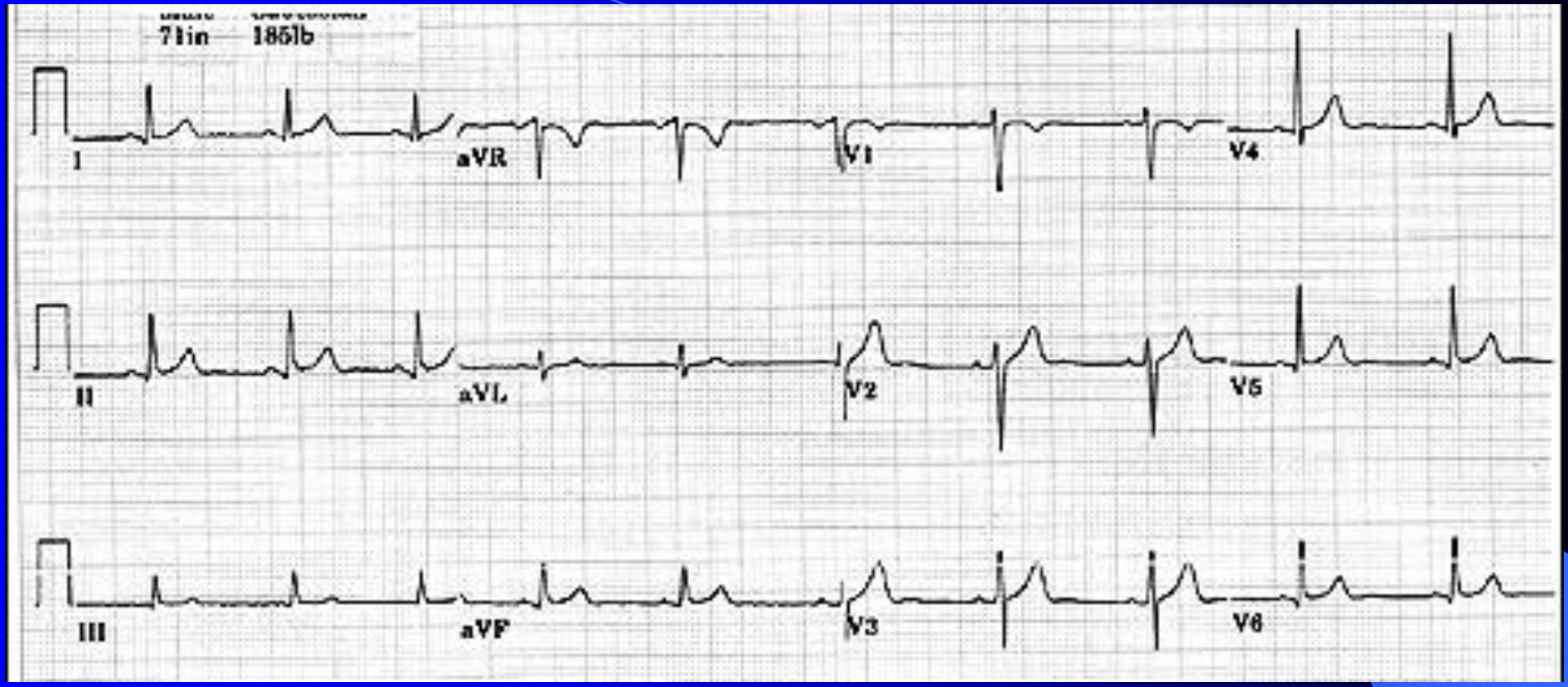


ST segments

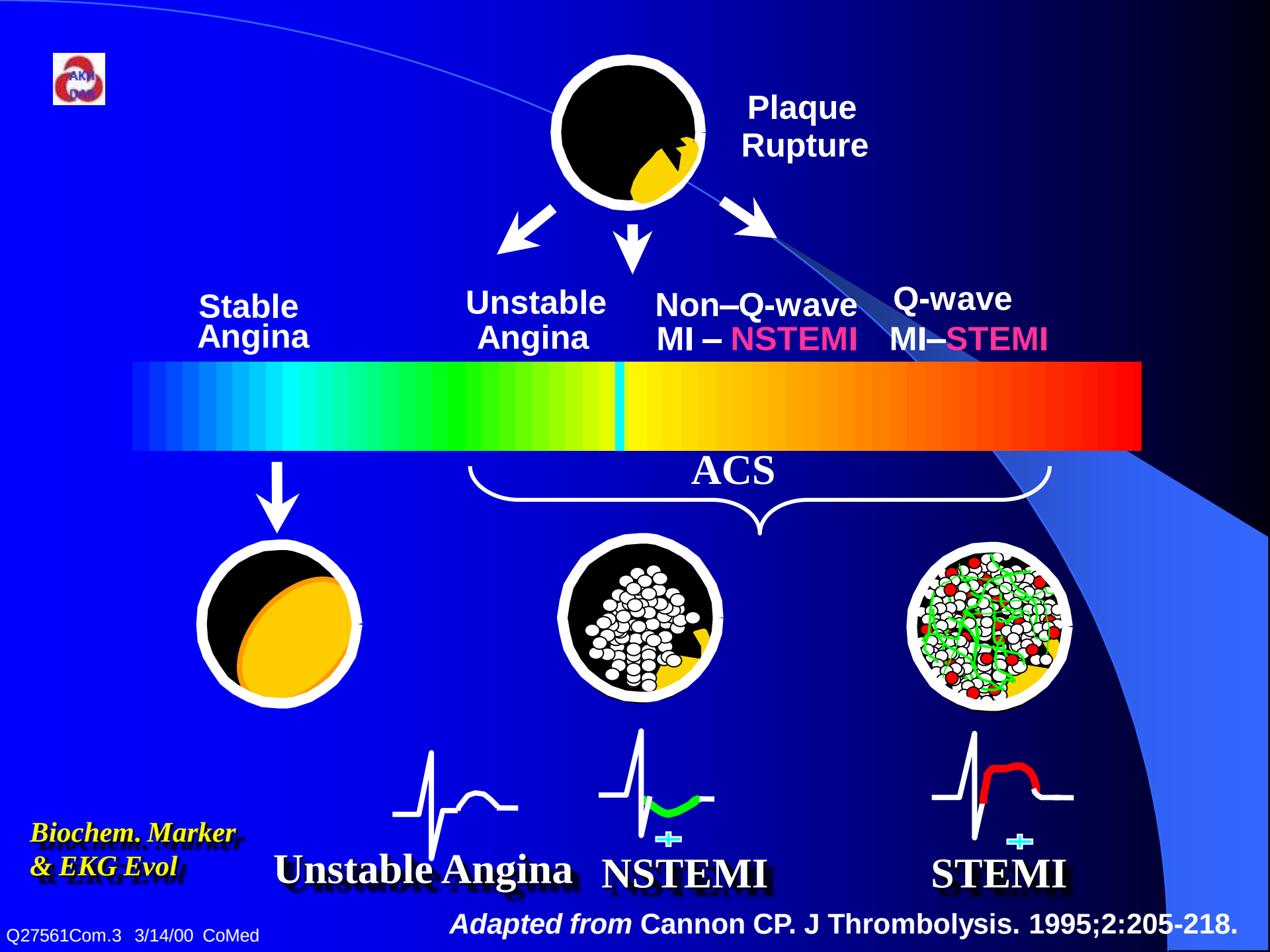


The ST segment should start isoelectric except in V1 and V2 where it may be elevated

T wave



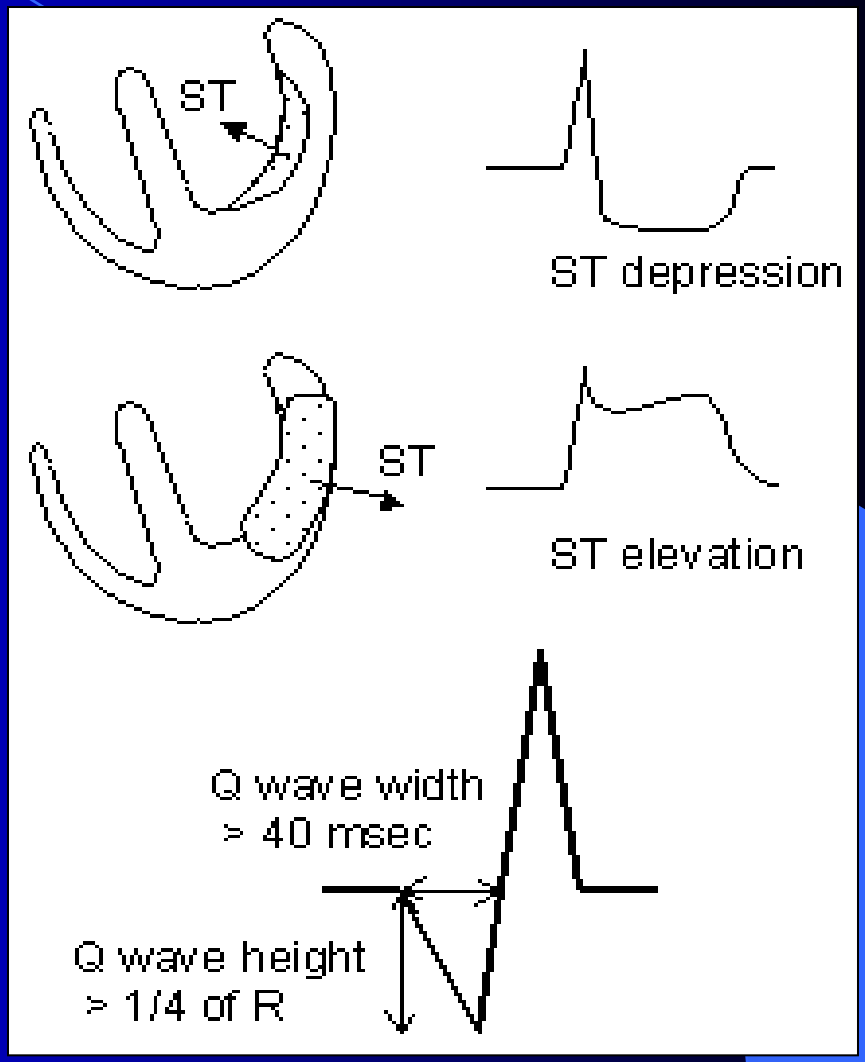
- Normal T wave is asymmetrical, first half having a gradual slope than the second
- T wave follows the direction of the QRS deflection.
- Should be at least 1/8 but less than 2/3 of the amplitude of the R
- T wave amplitude rarely exceeds 10 mm
- Abnormal T waves are symmetrical, tall, peaked, biphasic or inverted.



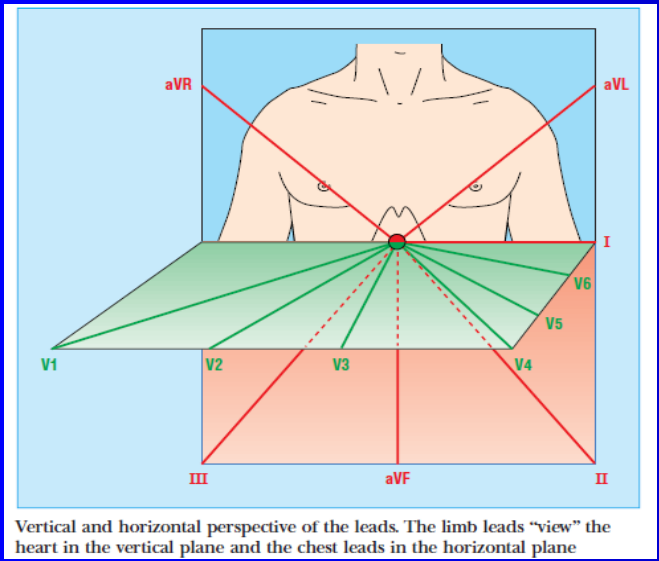
Adapted from Cannon CP. J Thrombolysis. 1995;2:205-218.

Ischemia, Injury and Infarction

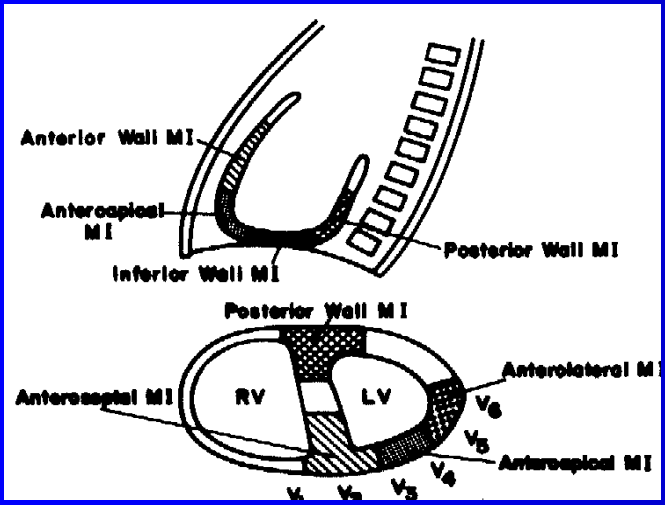
- Ischemia
  - T wave changes
- Injury
  - ST segment changes
    - Depression – subendocardial injury
    - Elevation- transmural injury
- Infarction
  - Q waves



Vertical and horizontal perspective of the ECG Leads

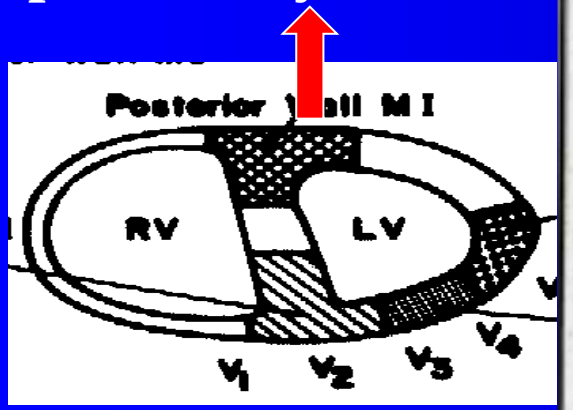


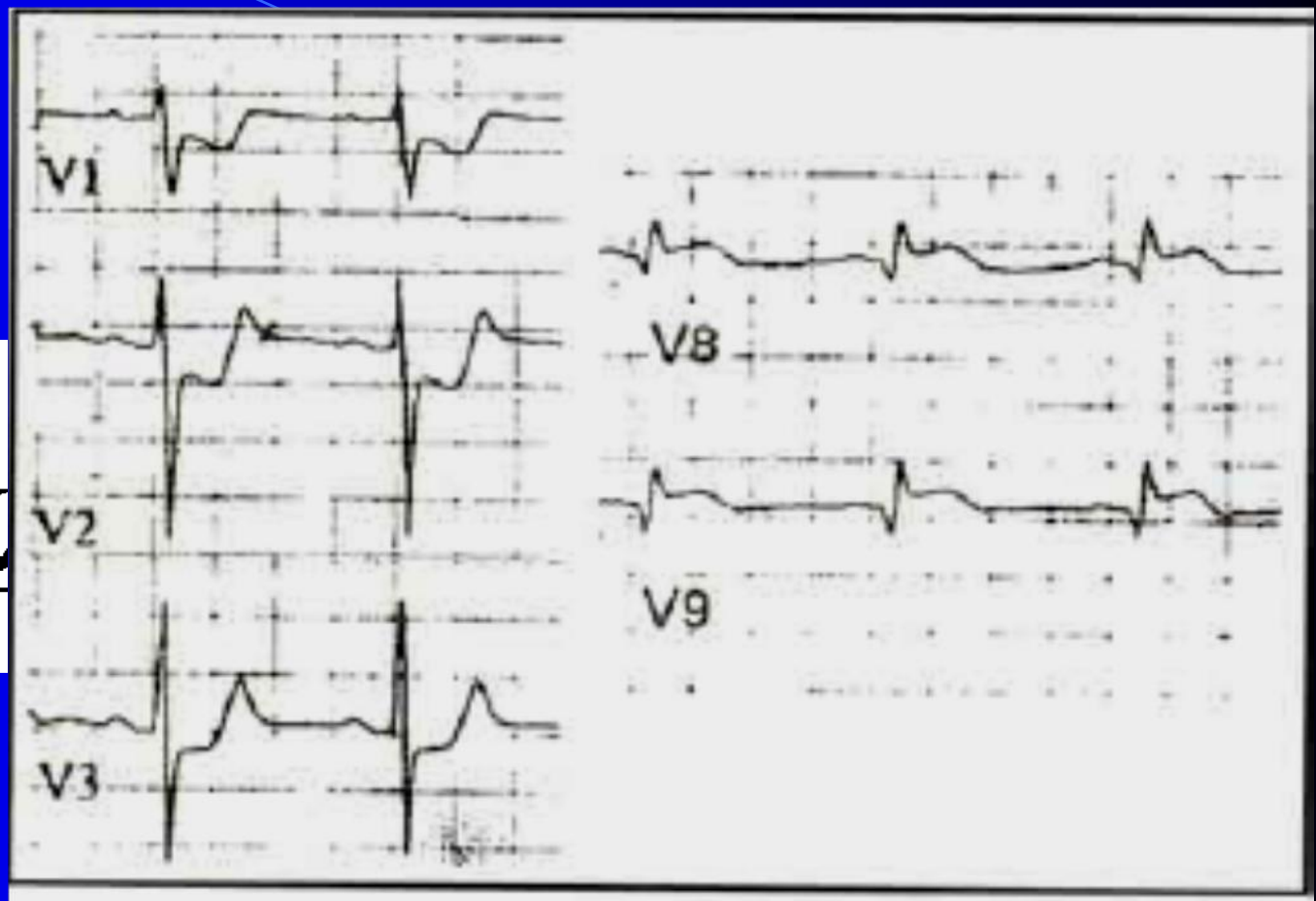
Vertical and horizontal perspective of the leads. The limb leads "view" the heart in the vertical plane and the chest leads in the horizontal plane



Leads	Anatomical
II, III, aVF	Inferior surface of heart
V1 to V4	Anterior surface of heart
I, aVL, V5, V6	Lateral surface of heart
V1 and aVR	Right atrium

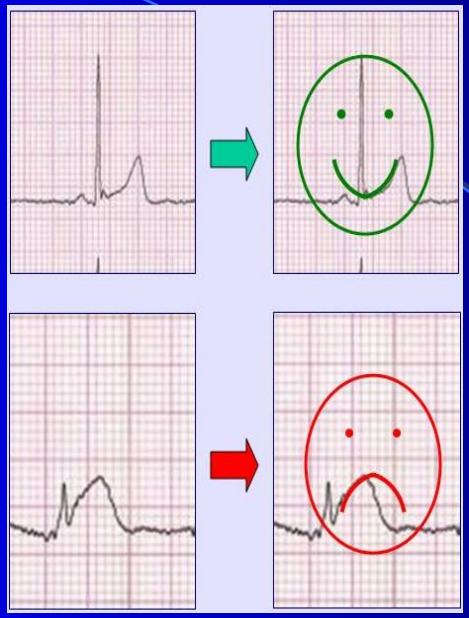
ST vector pointing posteriorly

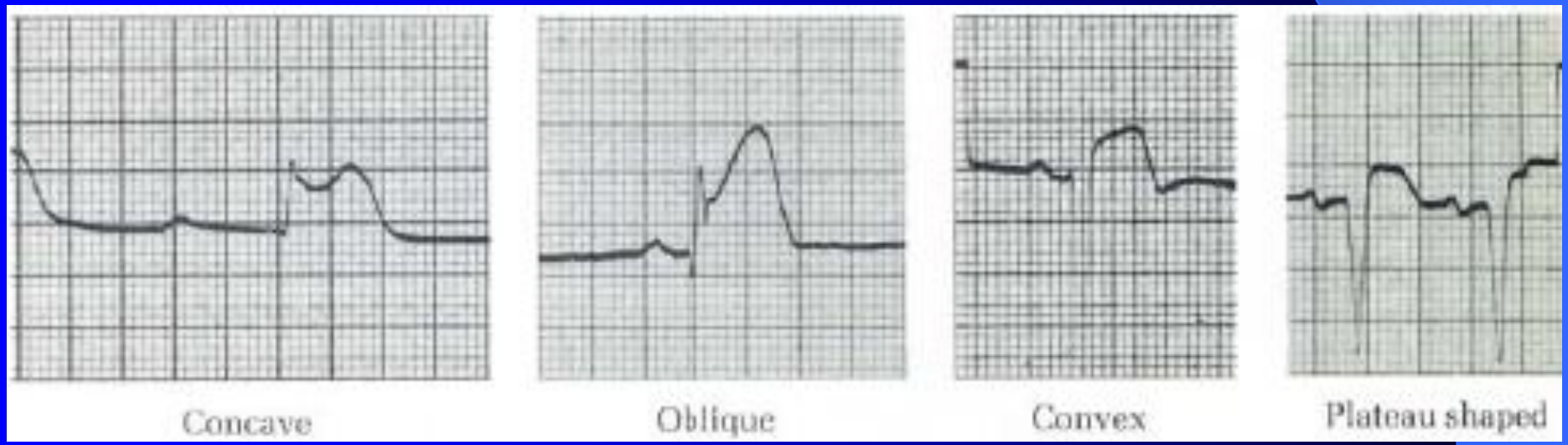




Posterior wall AMI: Right precordial (leads V_1 to V_3) ST segment depression and posterior thoracic leads with STE consistent with posterior wall AMI.

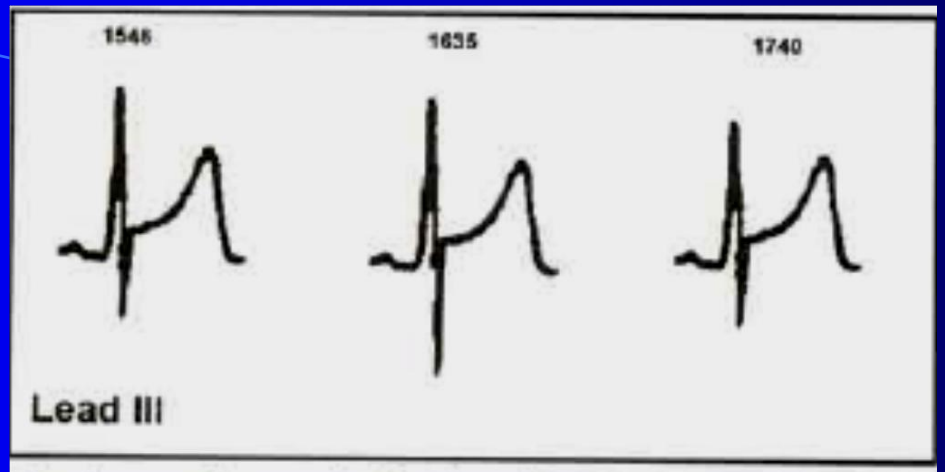
Shapes Of ST Segment Elevations in AMI



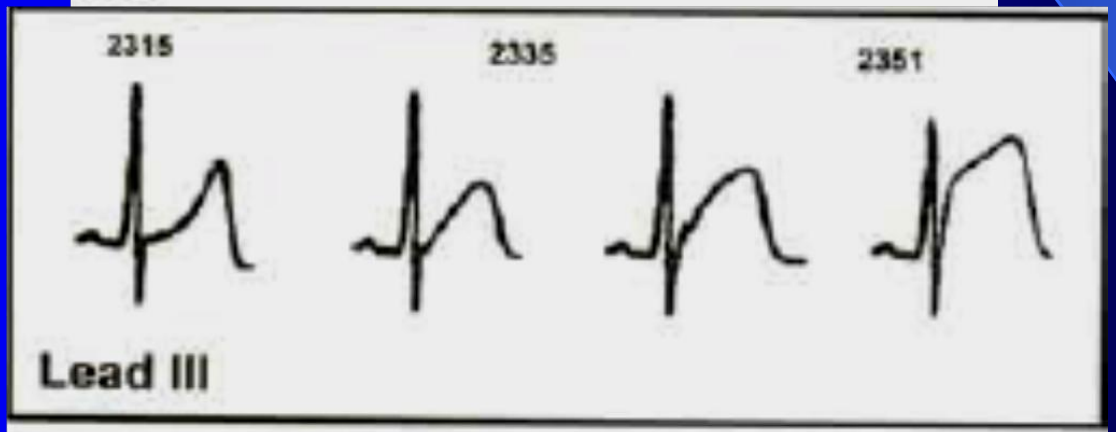


Goldberger AL. Goldberger: Clinical Electrocardiography: A Simplified Approach. 7th ed: Mosby Elsevier; 2006.

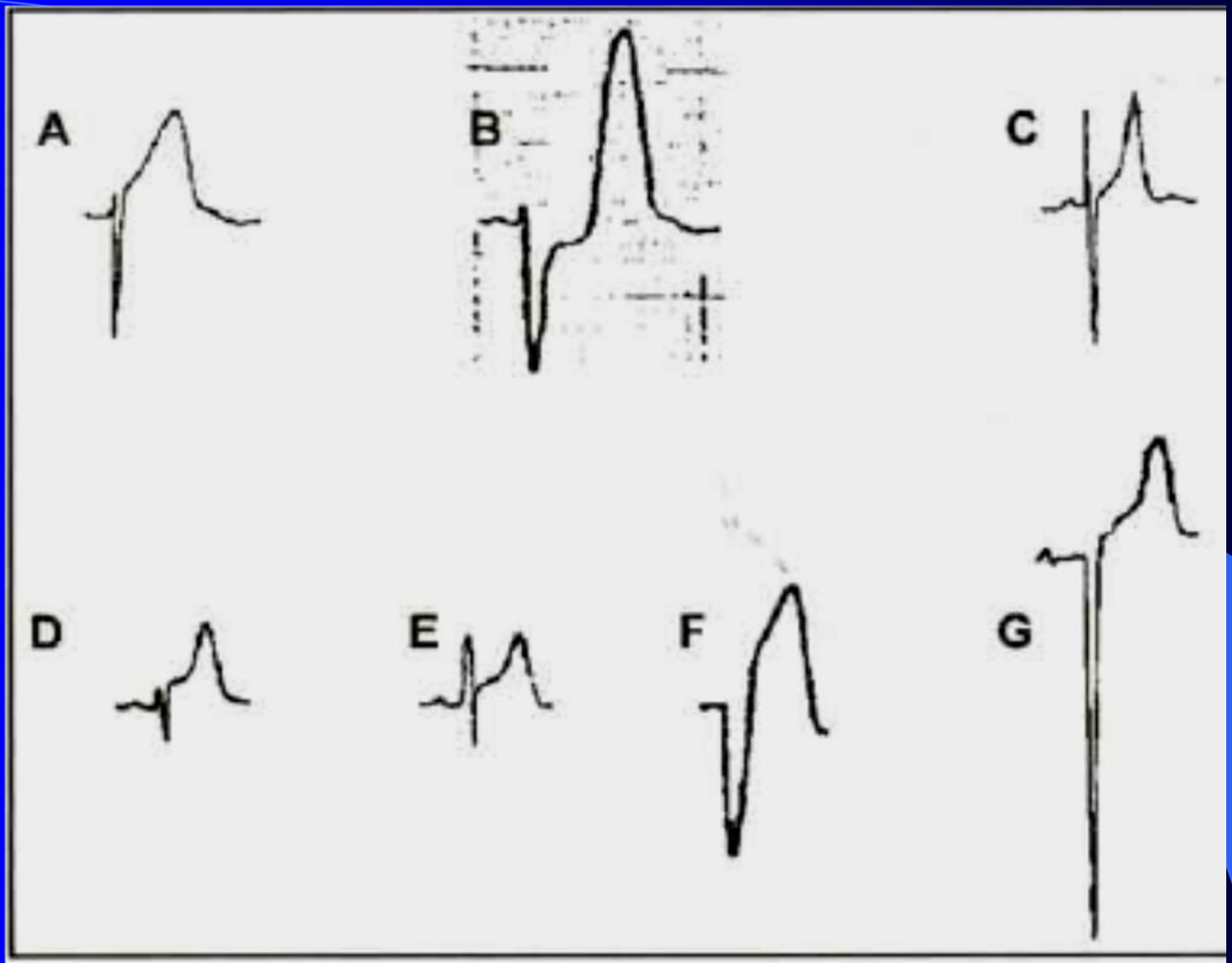
Serial ECGs



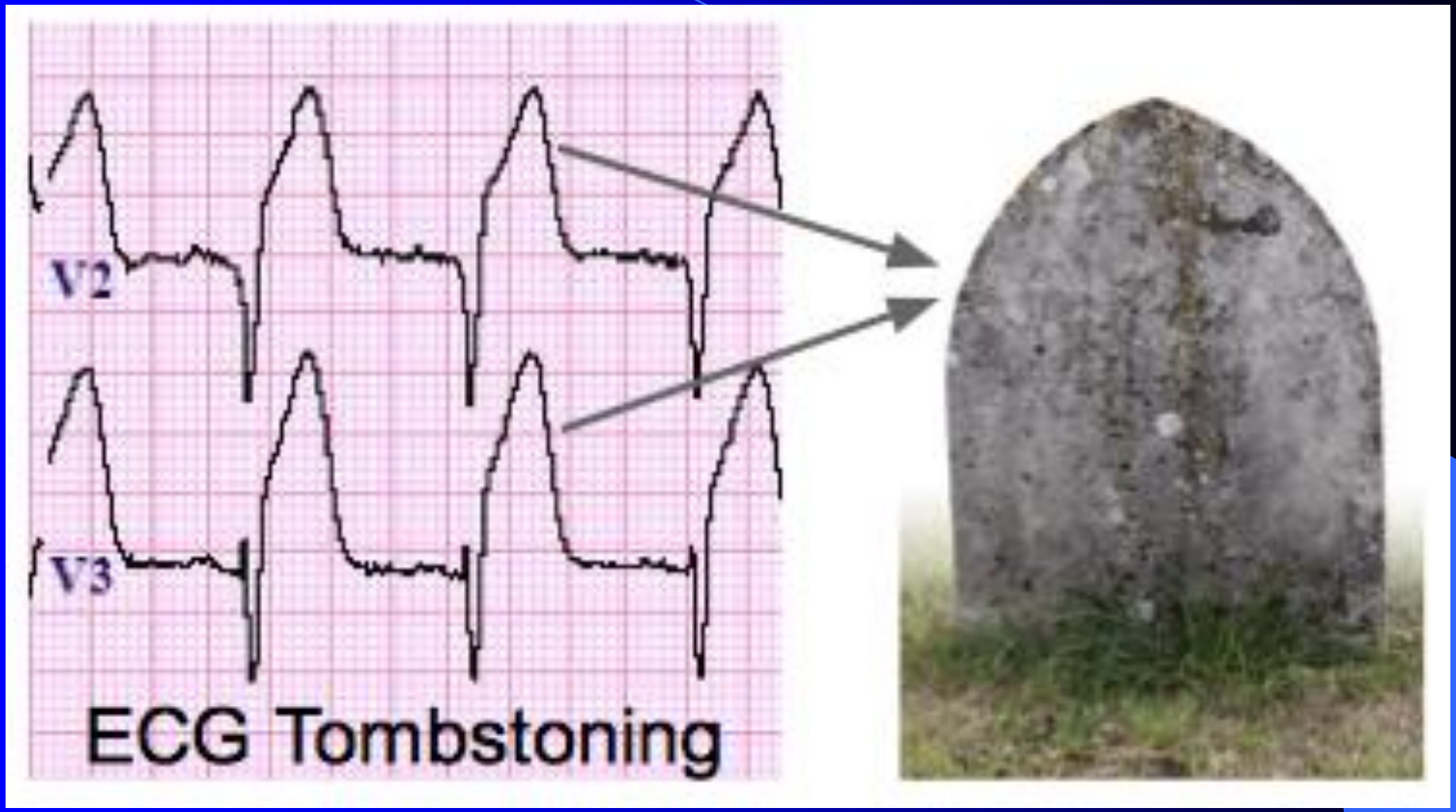
Benign early repolarization (BER): Serial ECG demonstrating lack of interval change in the BER pattern—confirming a non-infarction cause of the STE.



AMI noted with serial ECGs: Adult patient presents with chest pain and an initially normal ECG. With continued pain, serial ECGs are performed that quickly detect change, ultimately diagnostic of AMI.

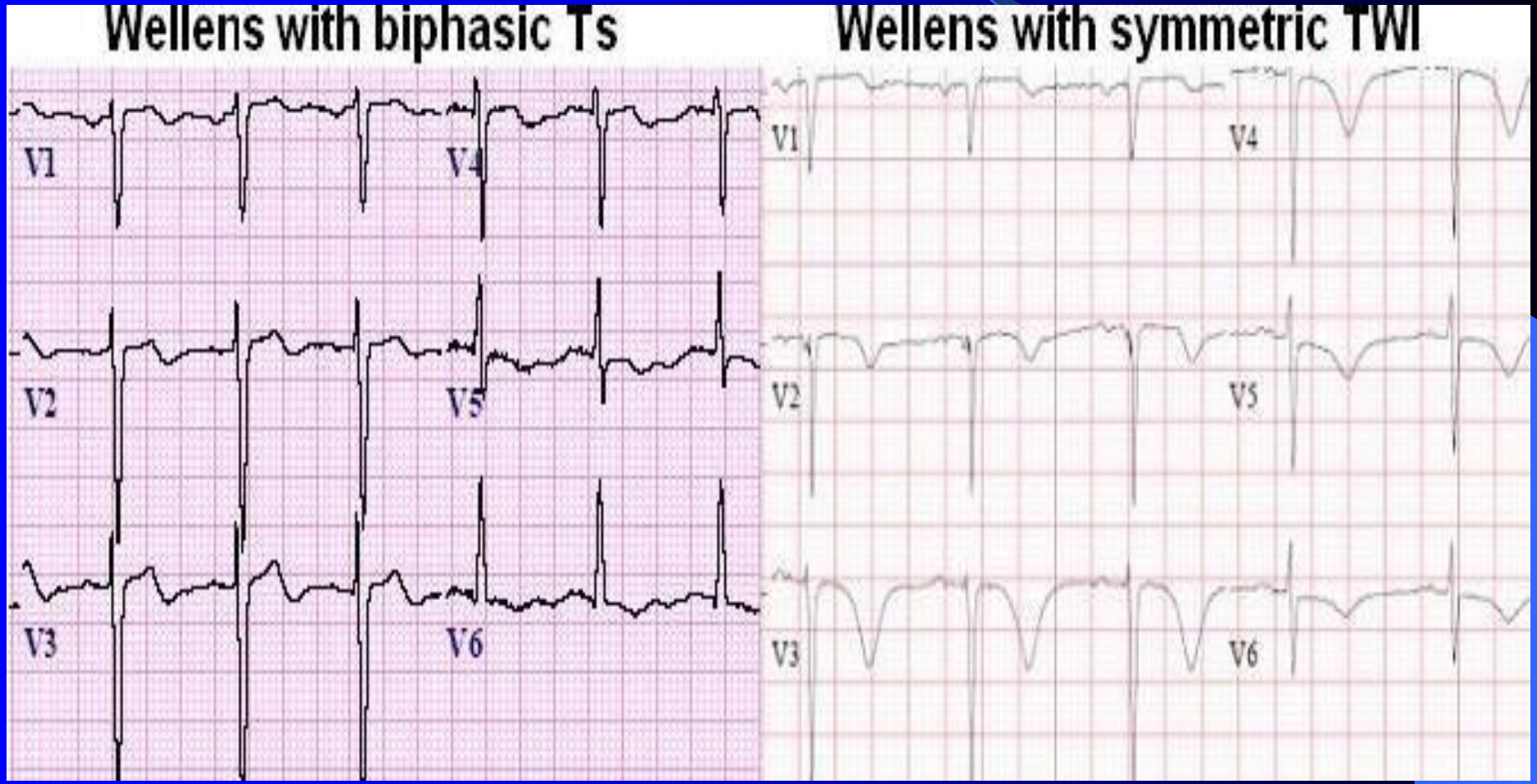


Electrocardiographic differential diagnosis of the hyperacute T wave: A, AMI. B, AMI. C, Hyperkalemia. D, Benign early repolarization (BER). E, Acute pericarditis. F, Left bundle-branch block (LBBB). G, Left ventricular hypertrophy (LVH).


V2
V3
ECG Tombstoning

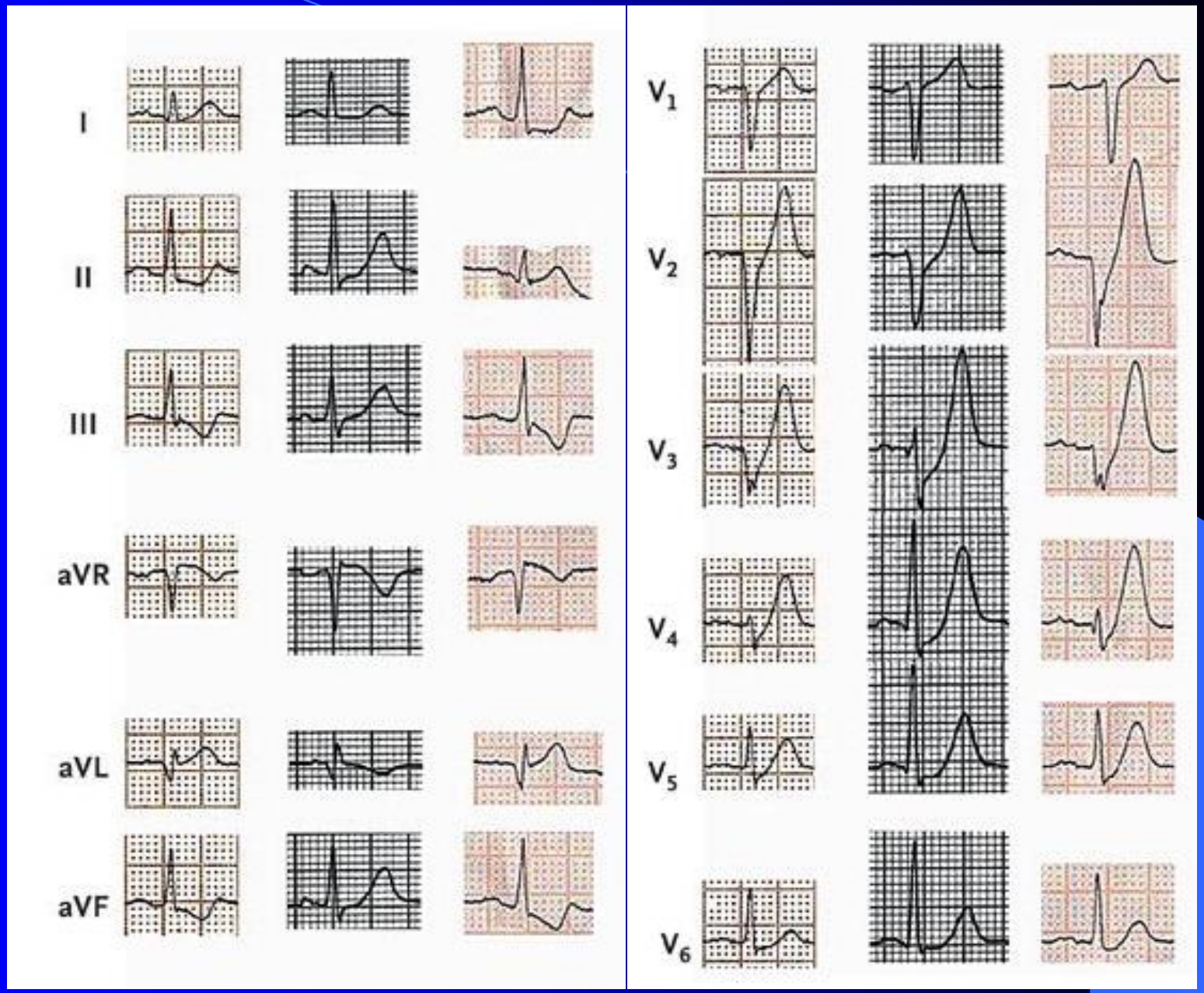
Wellen's Syndrome ECG

Wellen's phenomenon occurs when biphasic T waves are seen in leads V1-V3 OR deep symmetric inverted T waves are seen in the precordial leads. Both of these ECG findings are indicative of a severe proximal left anterior descending stenosis (acute or chronic).



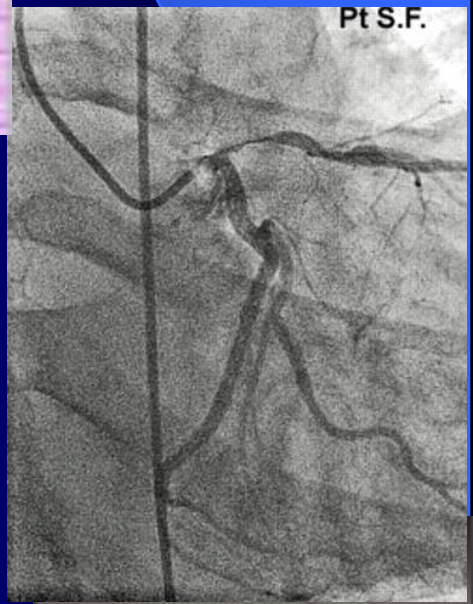
de Winter

- Precordial ST depression at J point followed by peak positive T waves
- aVR shows slight STelevation
- Occlusion of proximal LAD



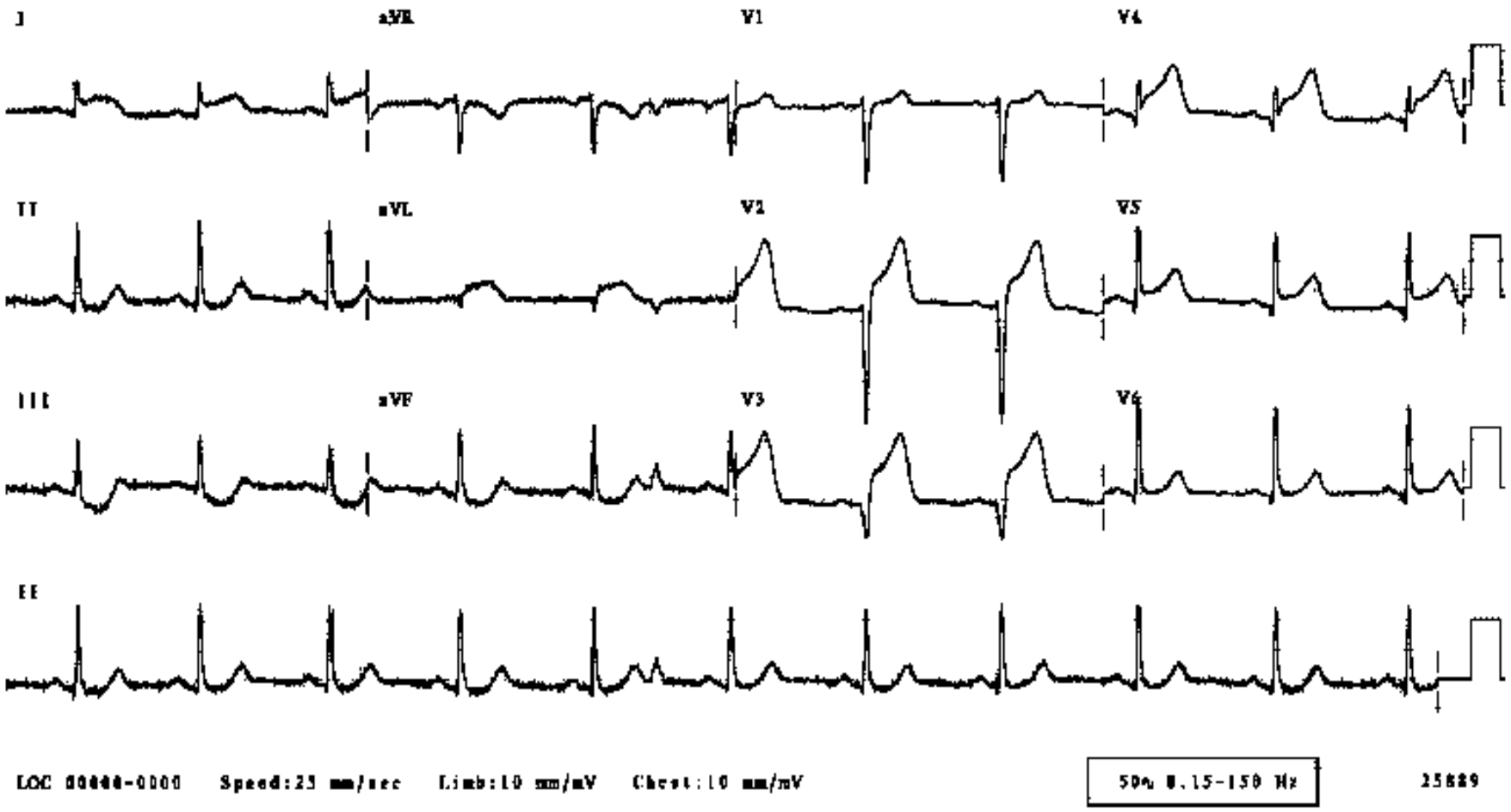
N EJ M 2008; 359:2071-2073.

During Ischemia in a Patient With LMCA, Ostial LAD Stenosis



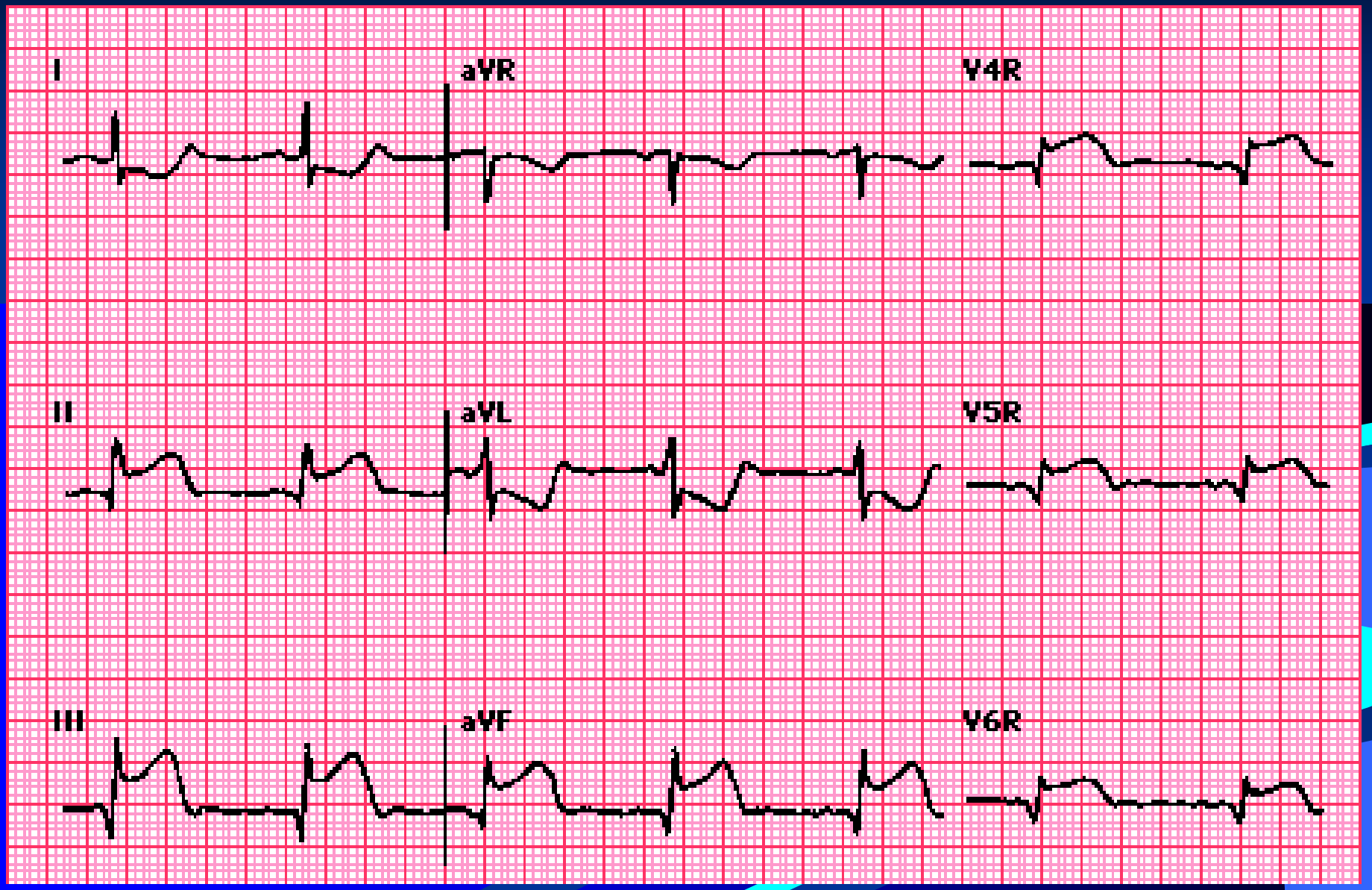
Uthamalingam, S. et al. J Am Coll Cardiol Img 2011;4:176-186

Antero-lateral MI

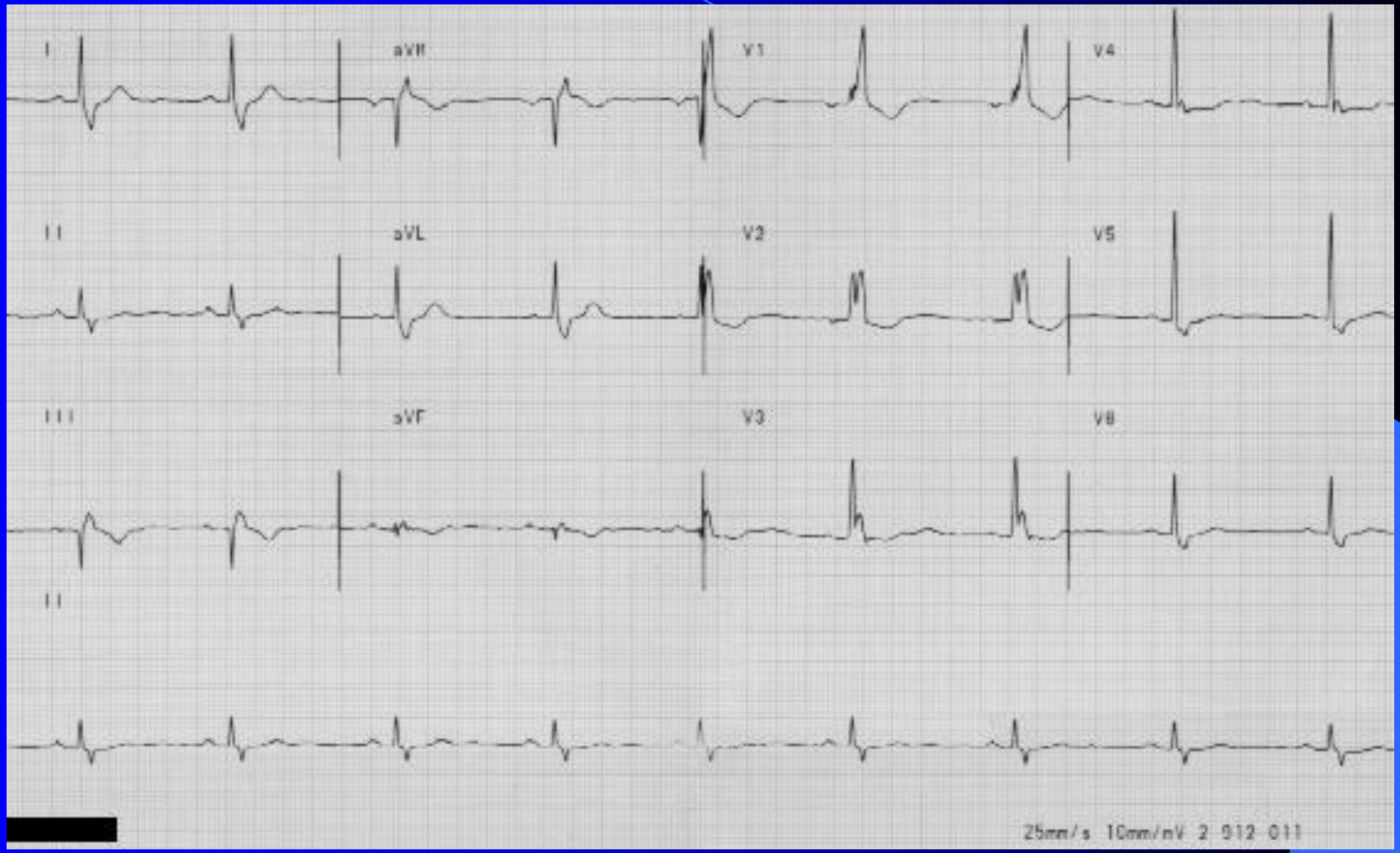


Lateral AMI: Isolated lateral wall AMI is seen with STE in leads I and aVL. Note the STD seen in the inferior and right precordial leads, consistent with reciprocal change. The STD in leads V_1 to V_3 also may represent posterior wall AMI.

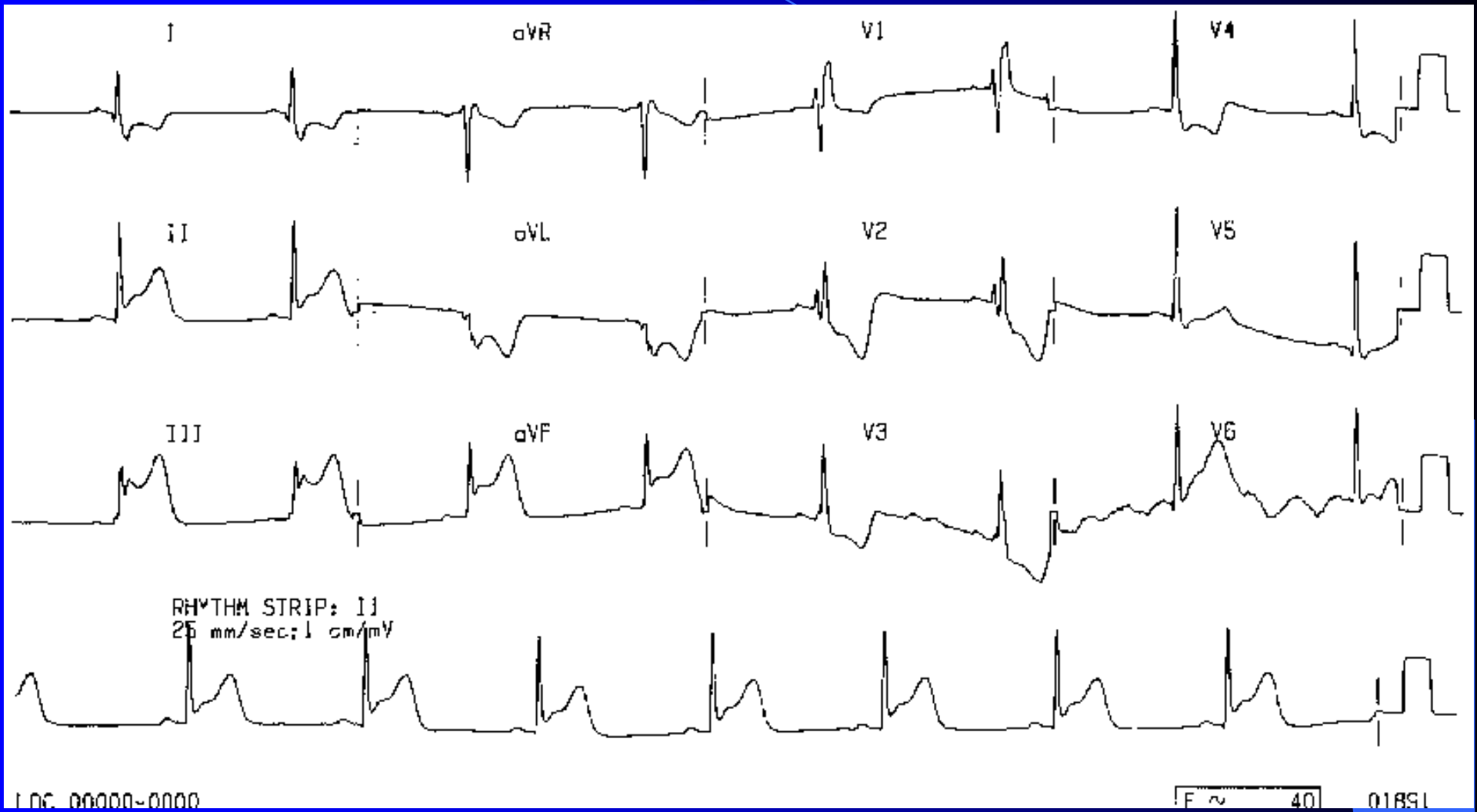
IWMI with RV Infarction



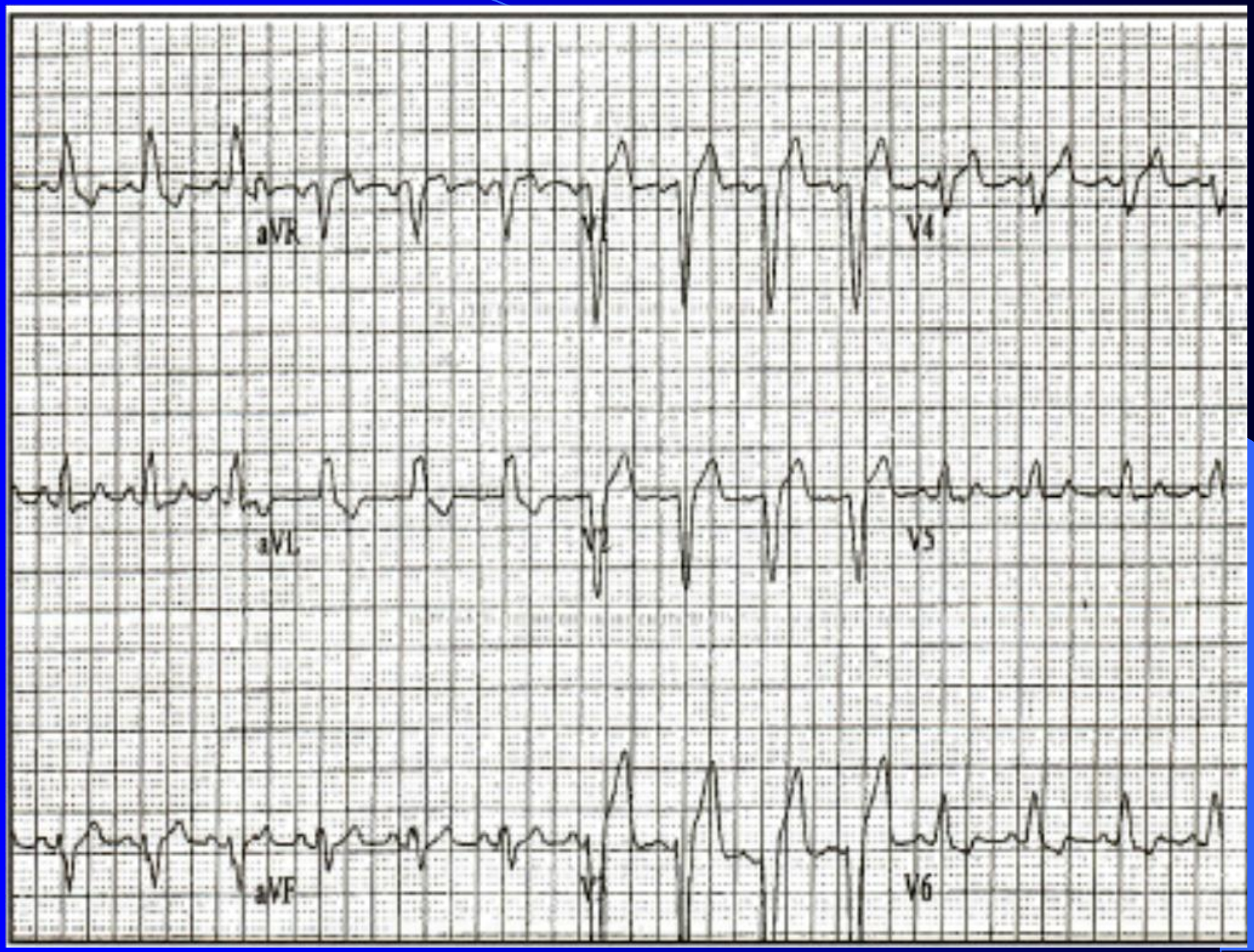
RBBB



RBBB does not interfere with MI diagnosis

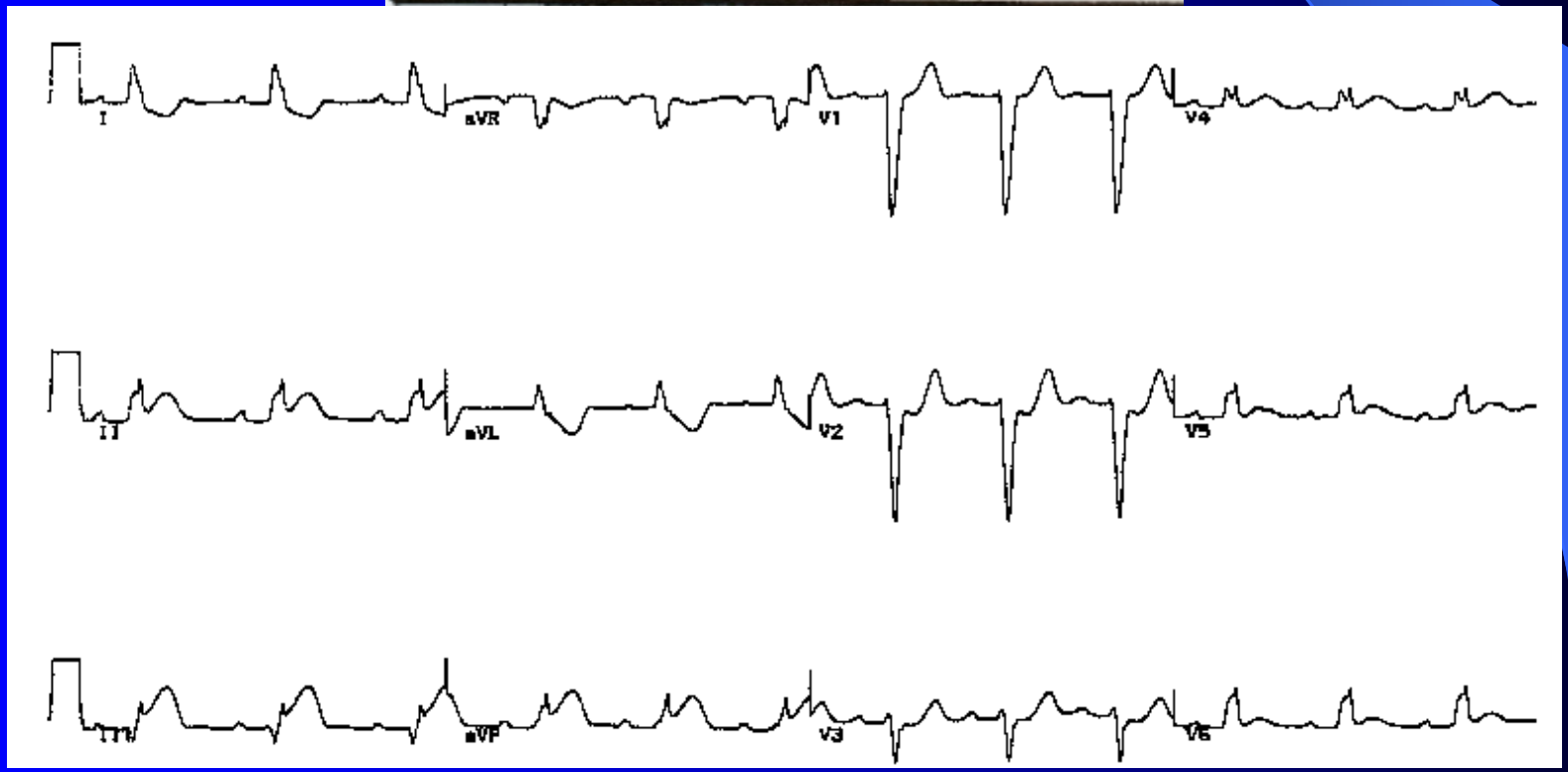


Normal ST segments in LBBB



Sgarbossa Criteria for diagnosing MI in LBBB

Concordant ST segment elevation > / = 1 mV – highly suggestive of AMI	
ST segment depression > / = 1 mV in leads V1, V2, or V3 – highly suggestive of AMI	V2
Discordant ST segment elevation > / = 5 mV – suggestive of AMI	



Common ECG Pitfalls in Diagnosing MI

False positives

- Early repolarization
- LBBB
- Pre-excitation
- Brugada syndrome
- Peri-/myocarditis
- Pulmonary embolism
- Subarachnoid haemorrhage
- Hyperkalaemia

False negatives

- Prior myocardial infarction with Q-waves and/or persistent ST elevation
- Paced rhythm
- LBBB

Acute Pericarditis

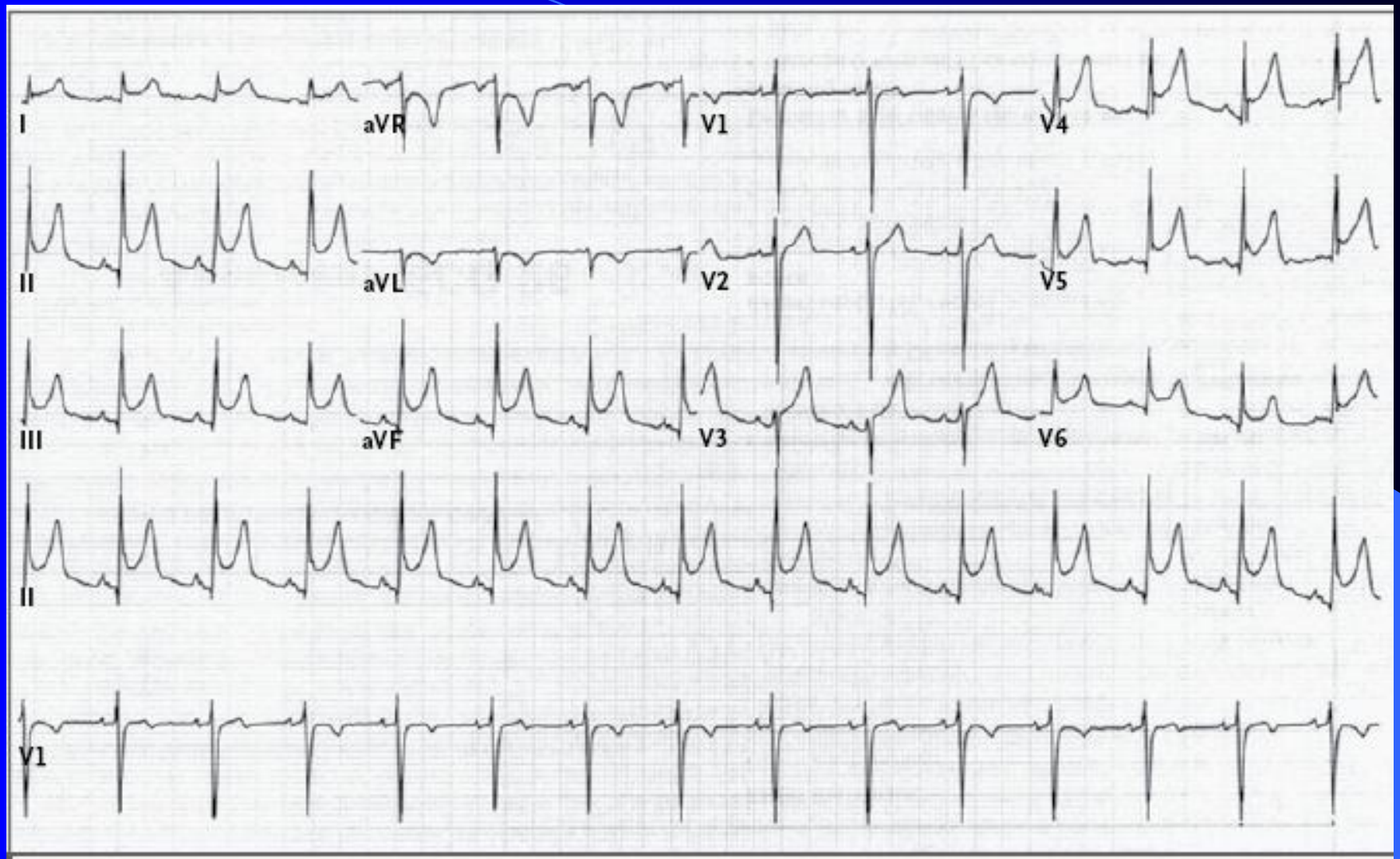
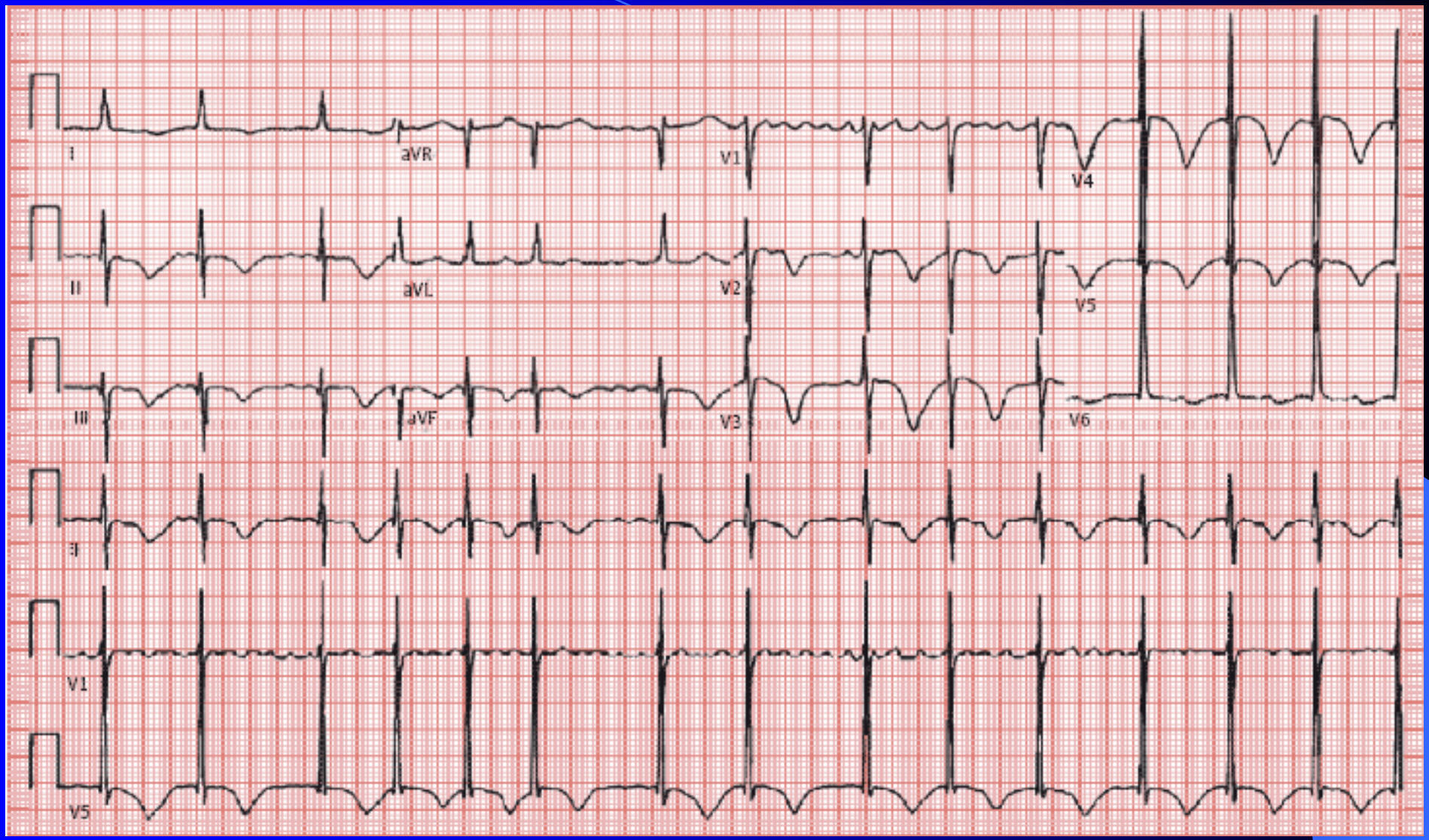


Figure 1. Typical Electrocardiogram in a Patient with Acute Pericarditis.

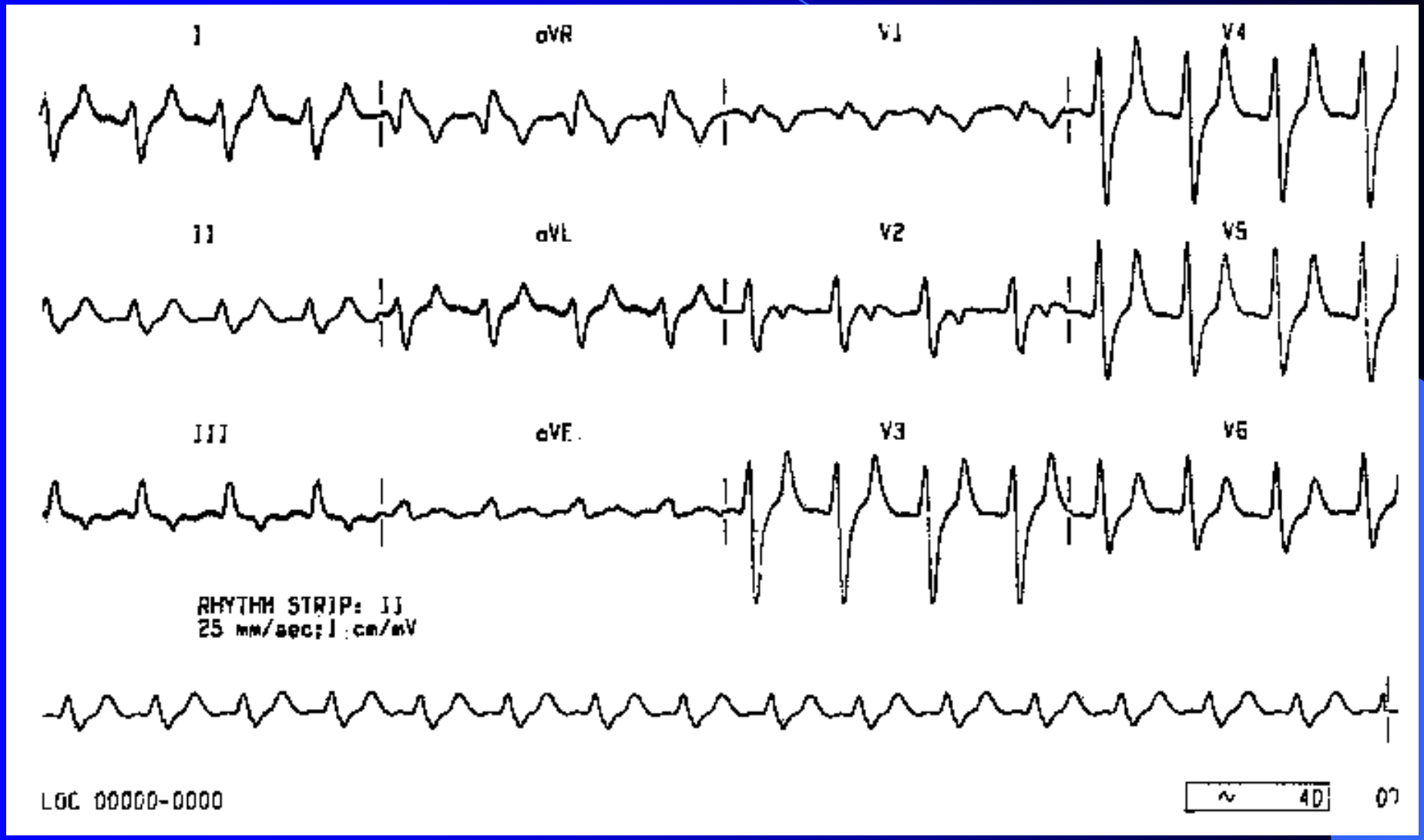
In the electrocardiogram depicted, there is an ST-segment vector directed anteriorly, inferiorly, and to the left, which results in ST-segment elevation in all leads except AVR and V1. There is also PR-segment depression, which is most evident in lead II.

Intra-cranial hemorrhage deep T wave inversions

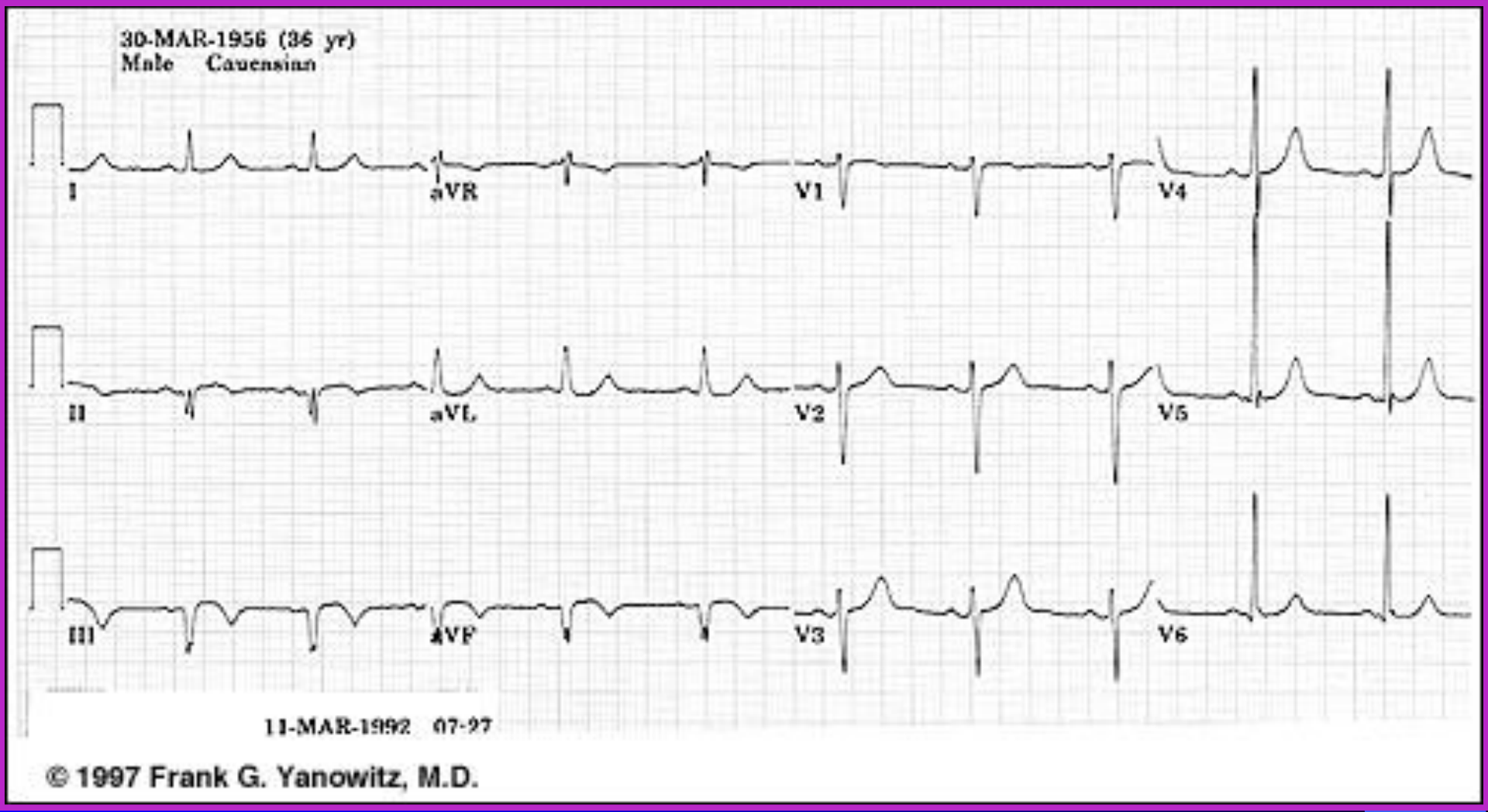


JAMA Internal Medicine July 2015 Volume 175, Number 7

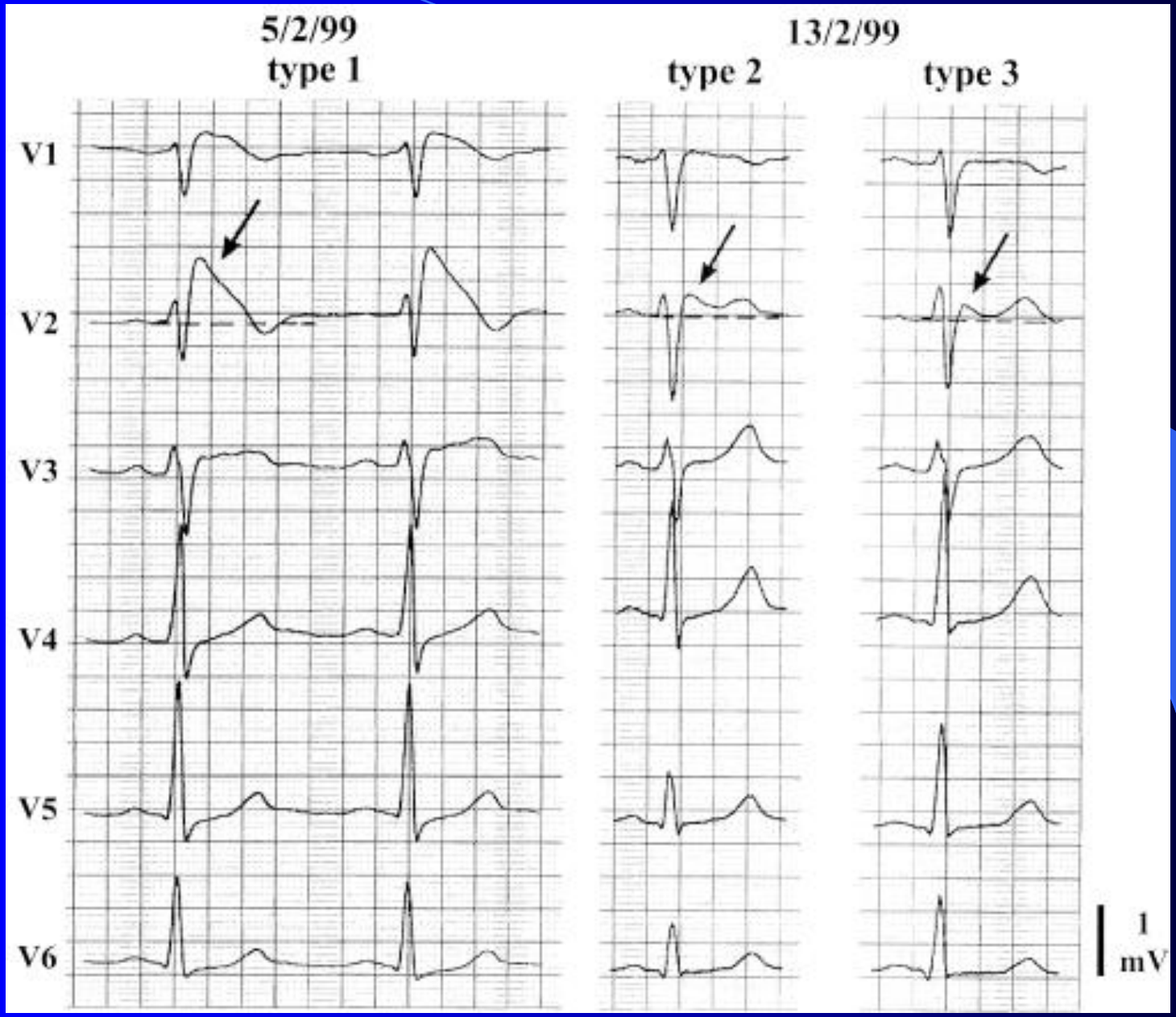
Hyperkalemia



Q waves with persistent ST elevation



Brugada Syndrome



Asante Sana