ECGs in Acute Myocardial Infarction

- Diagnosing an acute myocardial infarction by ECG is an important skill for healthcare professionals, mostly because of the stakes involved for the patient.

- One of the complications with using ECG for myocardial infarction diagnosis is that it is sometimes difficult to determine which changes are new and which are old.

- For the purposes of this learning module, we will assume that all changes are new for the patient and thus represent an acute myocardial infarction.

Acute Coronary Syndrome

- An acute coronary syndrome may include various clinical entities that involve some sort of ischemia or infarction. Specifically, an acute coronary syndrome includes unstable angina, non-ST segment elevation myocardial infarction, and ST segment elevation myocardial infarction (STEMI).

- One of the most significant findings of myocardial infarction is the presence of ST segment elevation. The ST segment is the part of the ECG tracing that starts at the end of the S wave and ends at the beginning of the T wave.

ECGs in Acute Myocardial Infarction

❖ Myocardial Infarction

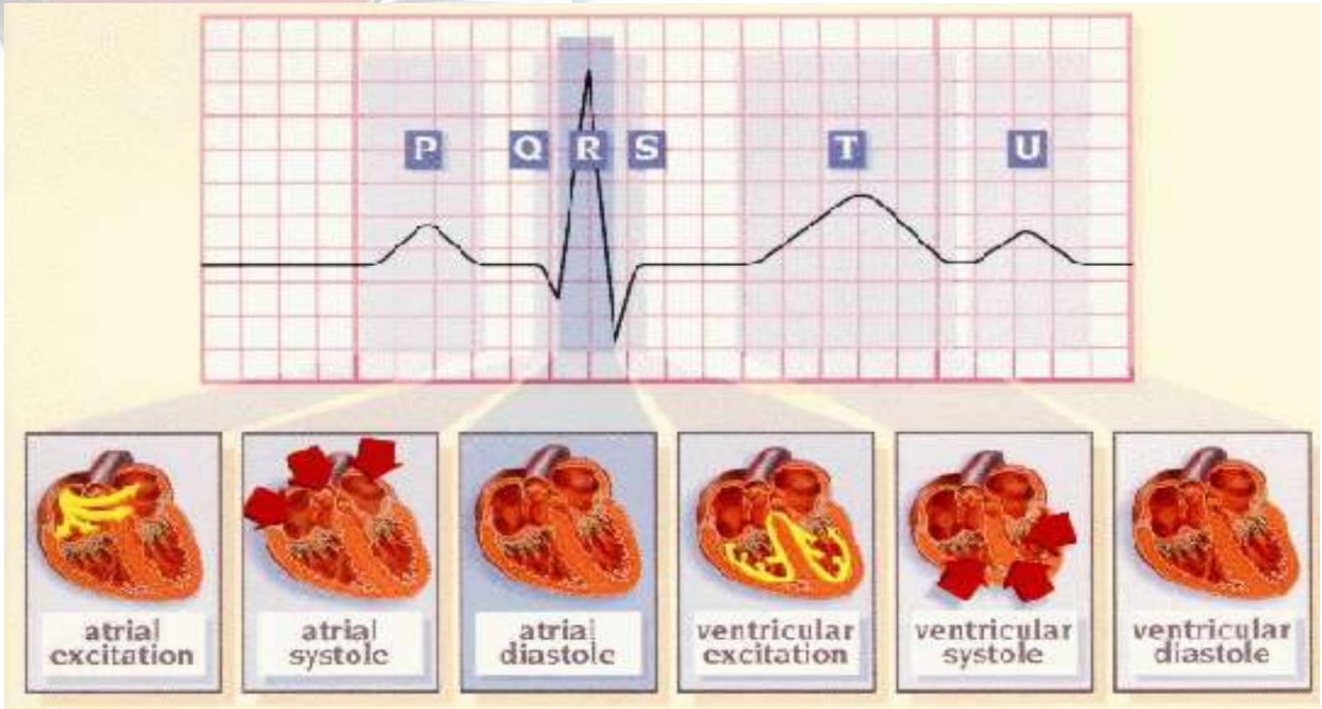
❖ In order for a patient to be diagnosed with a myocardial infarction, they must have at least two of the following three criteria, according to the World Health Organization:

Clinical history of chest discomfort consistent with ischemia, such as crushing chest pain
An elevation of cardiac markers in blood (Troponin-I, CK-MB, Myoglobin)
Characteristic changes on electrocardiographic tracings taken serially

❖ As to the last point, comparing the patient's current ECG within old ECG is an important part of diagnosis. On the other hand, particularly worrisome changes by ECG should still be treated presumptively if the prior ECG is not available.

❖ Because pathological Q waves may take hours to develop and can last for a long time, the presence of new pathological Q waves indicates acute myocardial infarction but the mere presence of Q waves does not necessarily mean that a new myocardial infarction is taking place.

Investigations-Normal ECG



Investigations - ECG

Earliest changes are seen in ST-segment

1. STEMI

- ST-segment elevation
- progressive loss of R wave .
- Development of Q wave .
- Resolution of ST-segment
- T-wave inversion

Investigations - ECG

2. NSTEMI

- St-segment depression
- T-wave changes
- Loss of R-wave
- Absence of Q-wave

Investigations - ECG

- Significance of chest leads

- Antero-septal infarct
  v1 ,v2,v3,v4

- Antero-lateral
  v4,v5,v6 and AVL and 1

Investigations - ECG

- Inferior infarction

  leads II , III and AvF

- Posterior wall infarction doesn't cause ST elevation or Q-waves in the standad leads but can be diagnosed by the reciprocal changes that is st depression and a tall R-wave and leads V1-V4.

Infarction:

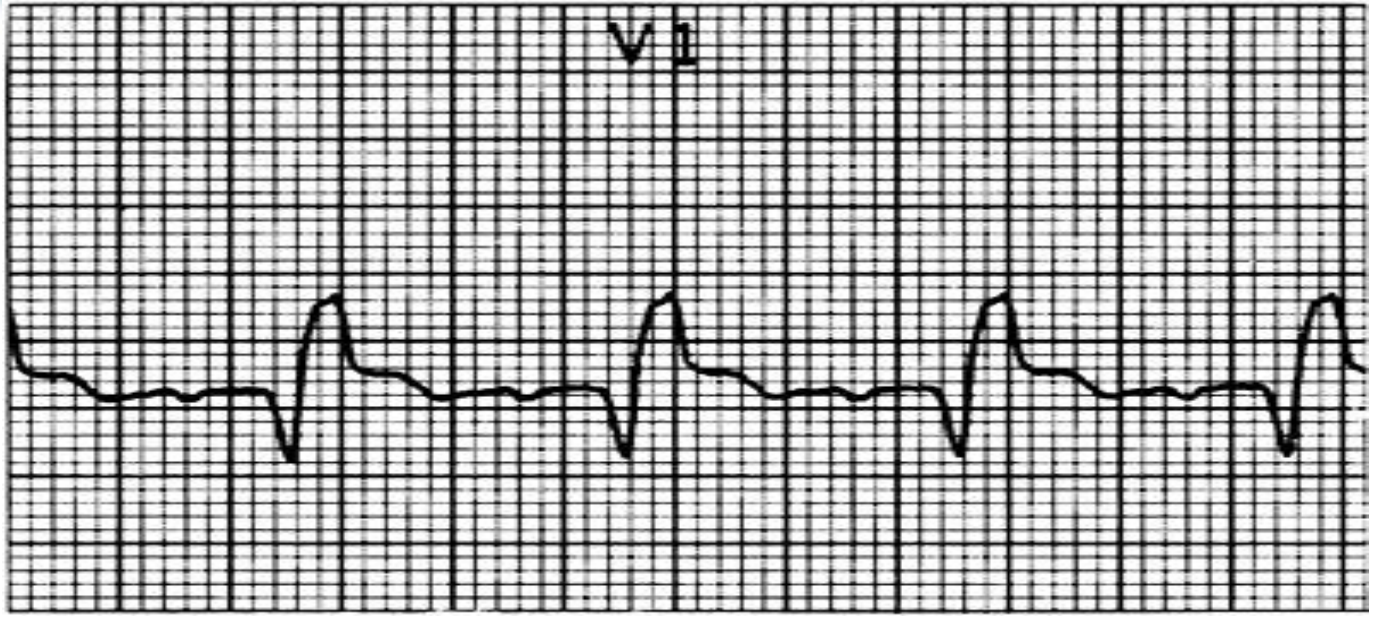
When myocardial injury persists, MI is the result.

- During the earliest stage of MI, known as the hyperacute phase, the T waves become tall and narrow. This configuration is referred to as hyperacute or peaked T waves.
- Within a few hours, these hyperacute T waves invert.
- Next, the ST segments elevate, a pattern that usually lasts from several hours to several days.
- In addition to the ST segment elevations in the leads of the ECG facing the injured heart, the leads facing away from the injured area may show ST segment depression.
- This finding is known as reciprocal ST segment changes.
- Reciprocal changes are most likely to be seen at the onset of infarction, but their presence on the ECG does not last long.
- Reciprocal ST segment depressions may simply be a mirror image of the ST segment elevations.

- However, others have suggested that reciprocal changes may reflect ischemia due to narrowing of another coronary artery in other areas of the heart.
- The last stage in the ECG evolution of an MI is the development of Q waves, the initial downward deflection of the QRS complex.
- Q waves represent the flow of electrical forces toward the septum. Small, narrow Q waves may be seen in the normal ECG in leads I, II, III, aVR, aVL, V5, and V6.
- Q waves compatible with an MI are usually 0.04 second (one small box) or more in width or one-fourth to one-third the height of the R wave.
- Q waves indicative of infarction usually develop within several hours of the onset of the infarction, but in some patients may not appear until 24 to 48 hours after the infarction.

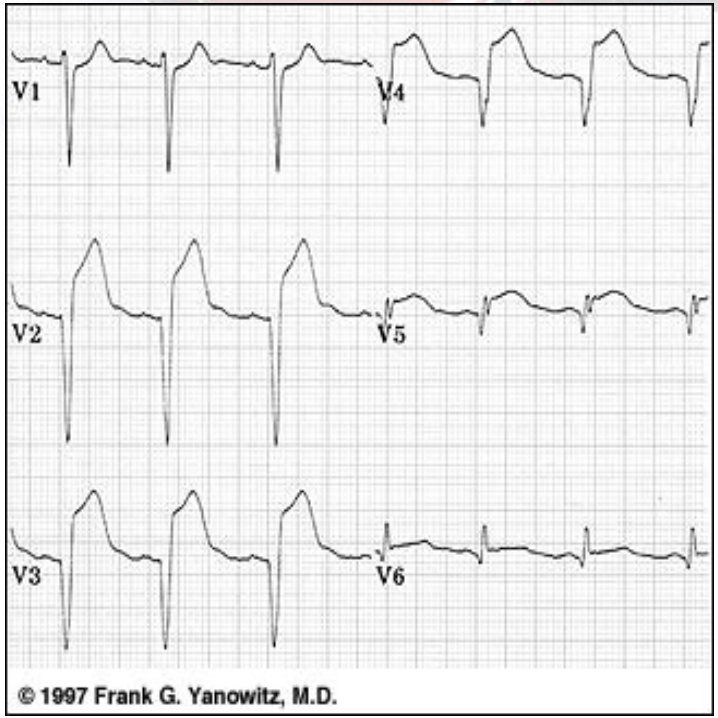
- Within a few days after the MI, the elevated ST segments return to baseline.
- Persistent elevation of the ST segment may indicate the presence of a ventricular aneurysm.
- The T waves may remain inverted for several weeks, indicating areas of ischemia near the infarct region.
- Eventually, the T waves should return to their upright configuration.
- The Q waves do not disappear and therefore always provide ECG evidence of a previous MI.

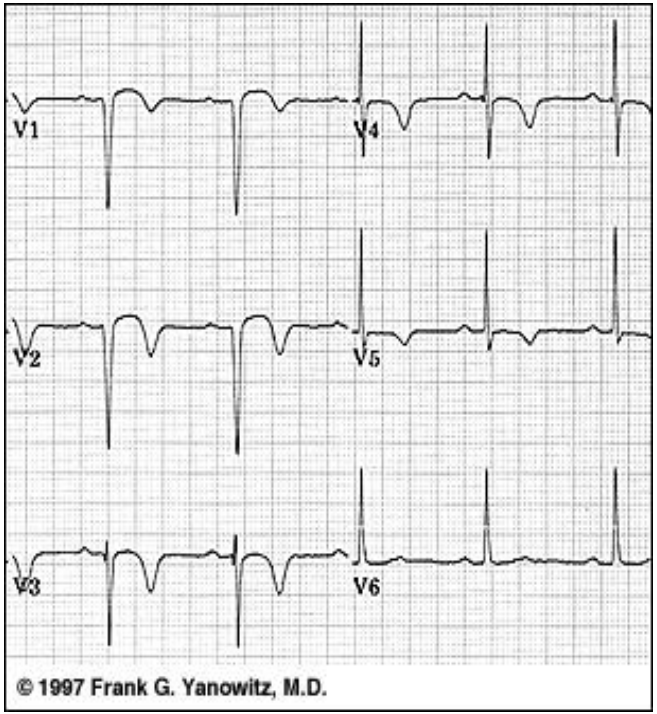
Q waves indicate tissue necrosis and are permanent. A pathologic Q wave is one that is greater than 3 mm in depth or greater than one-third the height of the R wave.



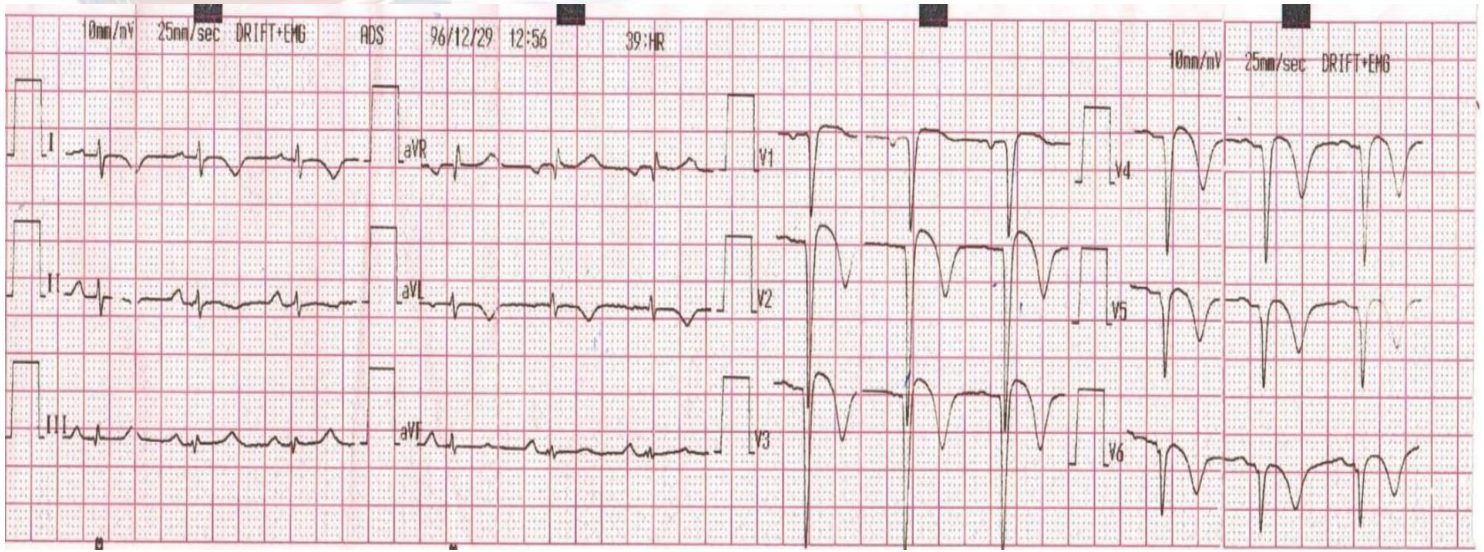
Anterior Myocardial Infarction

- If you see changes in leads V_1 - V_4 that are consistent with a myocardial infarction, you can conclude that it is an anterior wall myocardial infarction.



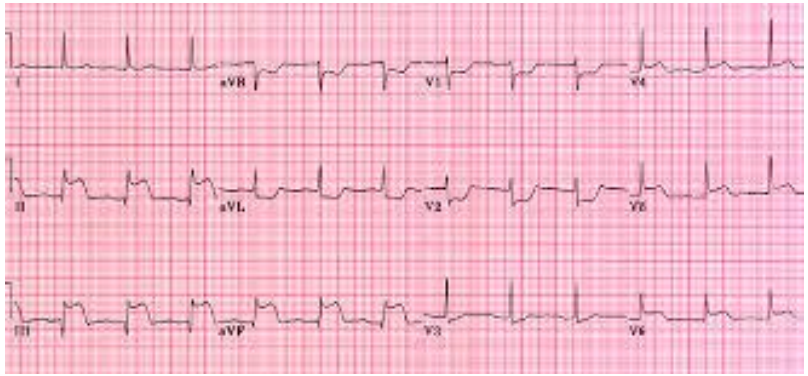


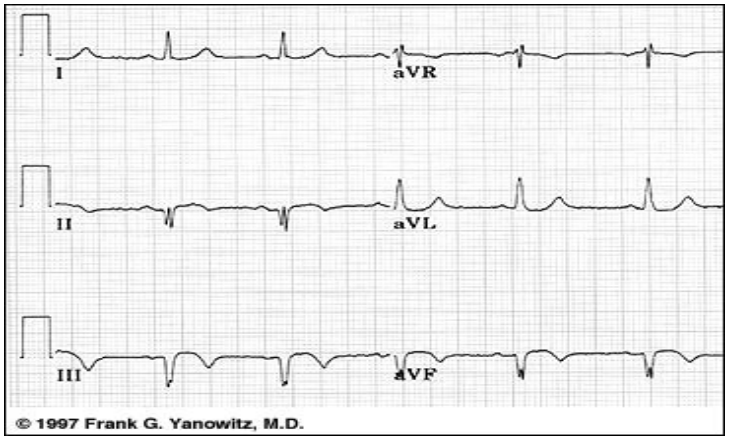
Old MI


10mm/mV 25mm/sec DRIFT+EMG ADS 96/12/29 12:56 39:HR
10mm/mV 25mm/sec DRIFT+EMG
I
aVR
V1
V4
II
aVL
V2
V5
III
aVF
V3
V6

Inferior MI

- Pathologic Q waves and evolving ST-T changes in leads II, III, aVF.
- Q waves usually largest in lead III, next largest in lead aVF, and smallest in lead II

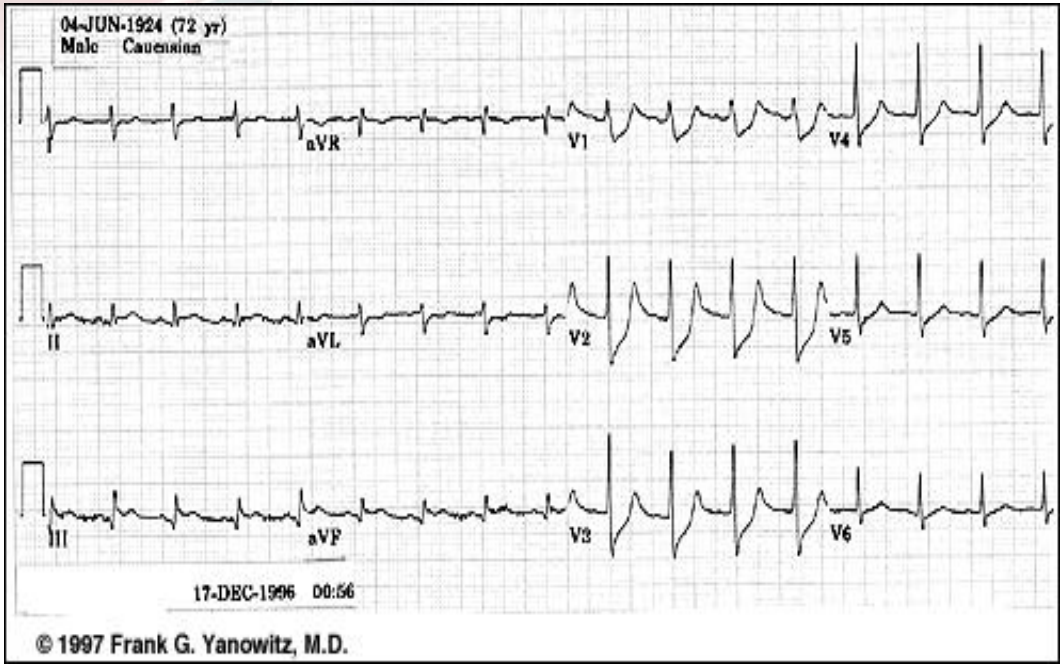




Inferoposterior MI

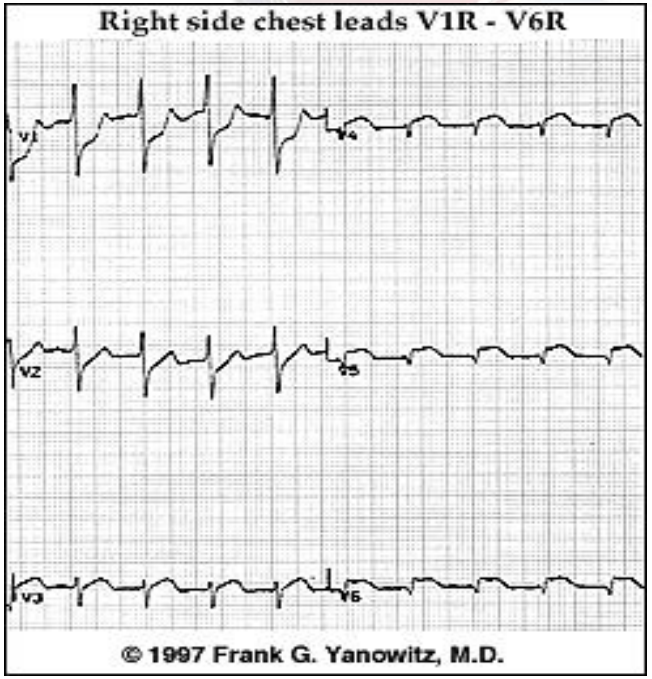
- ECG changes are seen in anterior precordial leads V1-3, but are the mirror image of an anteroseptal MI,
- Increased R wave amplitude and duration (i.e., a "pathologic R wave" is a mirror image of a pathologic Q).
- R/S ratio in V1 or V2 >1 (i.e., prominent anterior forces).
- Hyperacute ST-T wave changes: i.e., ST depression and large, inverted T waves in V1-3.
- Late normalization of ST-T with symmetrical upright T waves in V1-3.
- Often seen with inferior MI (i.e., "inferoposterior MI")

Inferoposterior MI



Right Ventricular MI

- Right Ventricular MI (only seen with proximal right coronary occlusion; i.e., with inferior family MI's)
- ECG findings usually require additional leads on right chest (V1R to V6R, analogous to the left chest leads)
- ST elevation, ≥1mm, in right chest leads, especially V4R.



High Lateral MI

Investigations

- ECG

It is central to confirming the diagnosis but may be difficult to interpret if there is bundle branch block or previous MI. so repeated ECGs are very important.

Apical HCM