12 Lead ECG Interpretation: Color Coding for MI's

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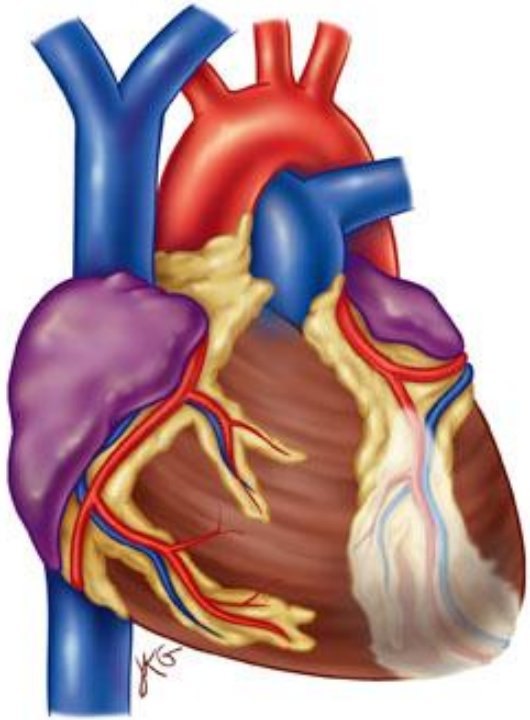


Objectives

- review the ECG waveform and intervals
- Define myocardial ischemia, injury and infarction
- Identify the 5 major infarct areas on the 12 lead
- Name occluded arteries common to the area
- Differentiate ECG changes reflecting ischemia, injury and infarction
- Identify cardiac enzymes associated with ACS

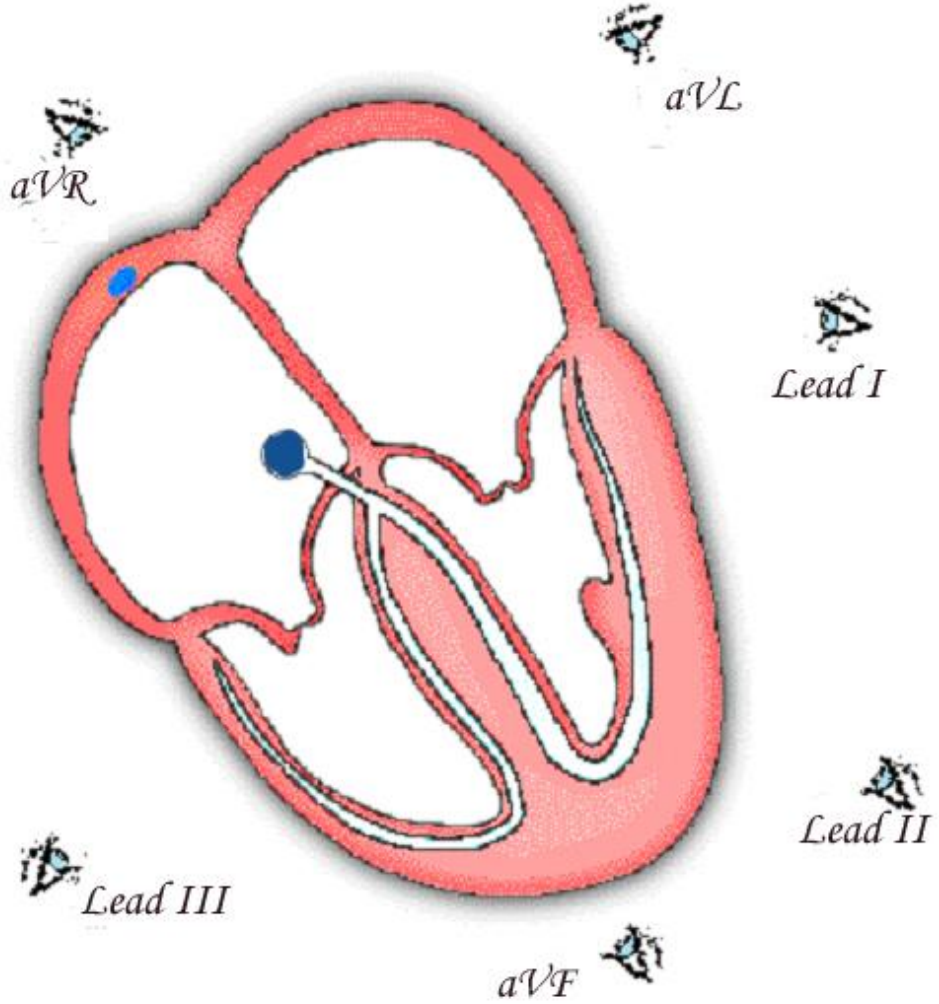
MI Definition

- A result of occlusion of arterial flow to the myocardium.
- Ischemia, injury and necrosis is result
- Occlusion occurs via spasm, blood clot or stenosis

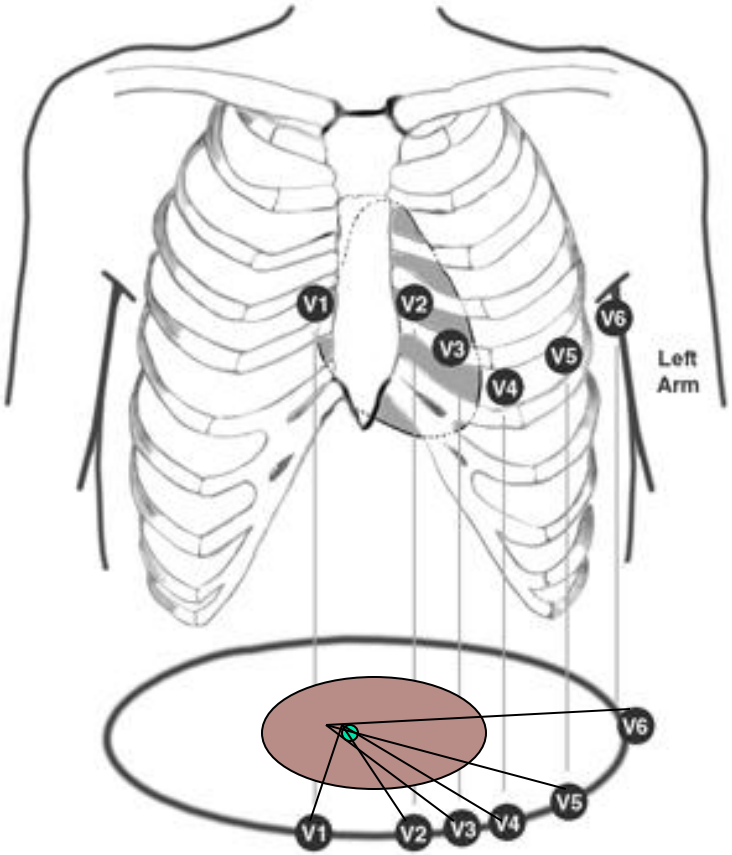
The 12-Lead view

- Each limb lead I, II, III, AVR, AVL, AVF records from a different angle
- All six limb leads intersect and visualize a frontal plane
- The six chest leads (precordial) V1, V2, V3, V4, V5, V6 view the body in the horizontal plane to the AV node
- The 12 lead ECG forms a camera view from 12 angles

Views from Augmented and Limb Leads- Frontal



Precordial lead snapshots



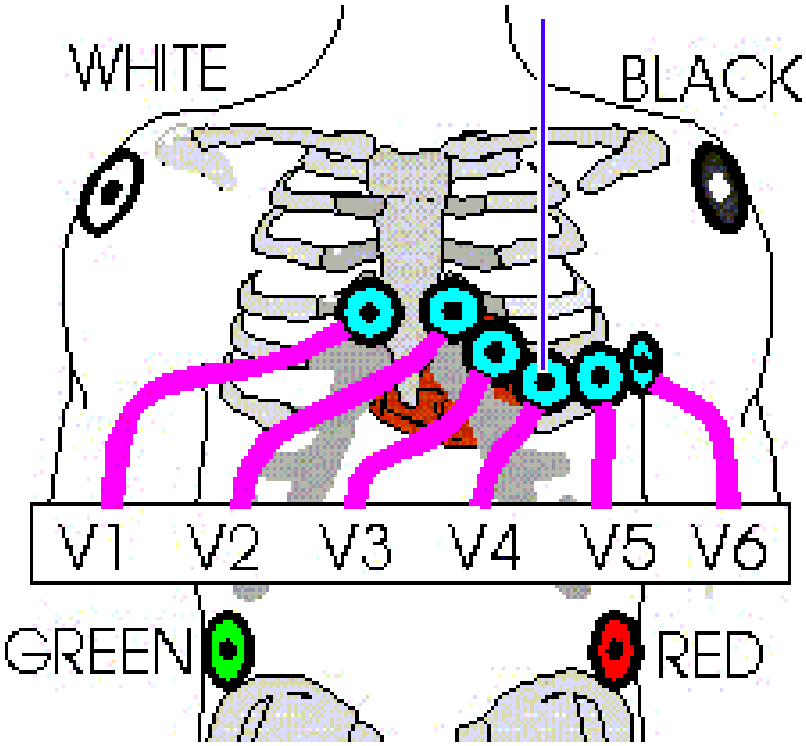
- Think of each precordial lead as a horizontal view of the heart at the AV node
- With the limb leads and the precordial leads you have a snapshot of heart portions

Unipolar and Bipolar

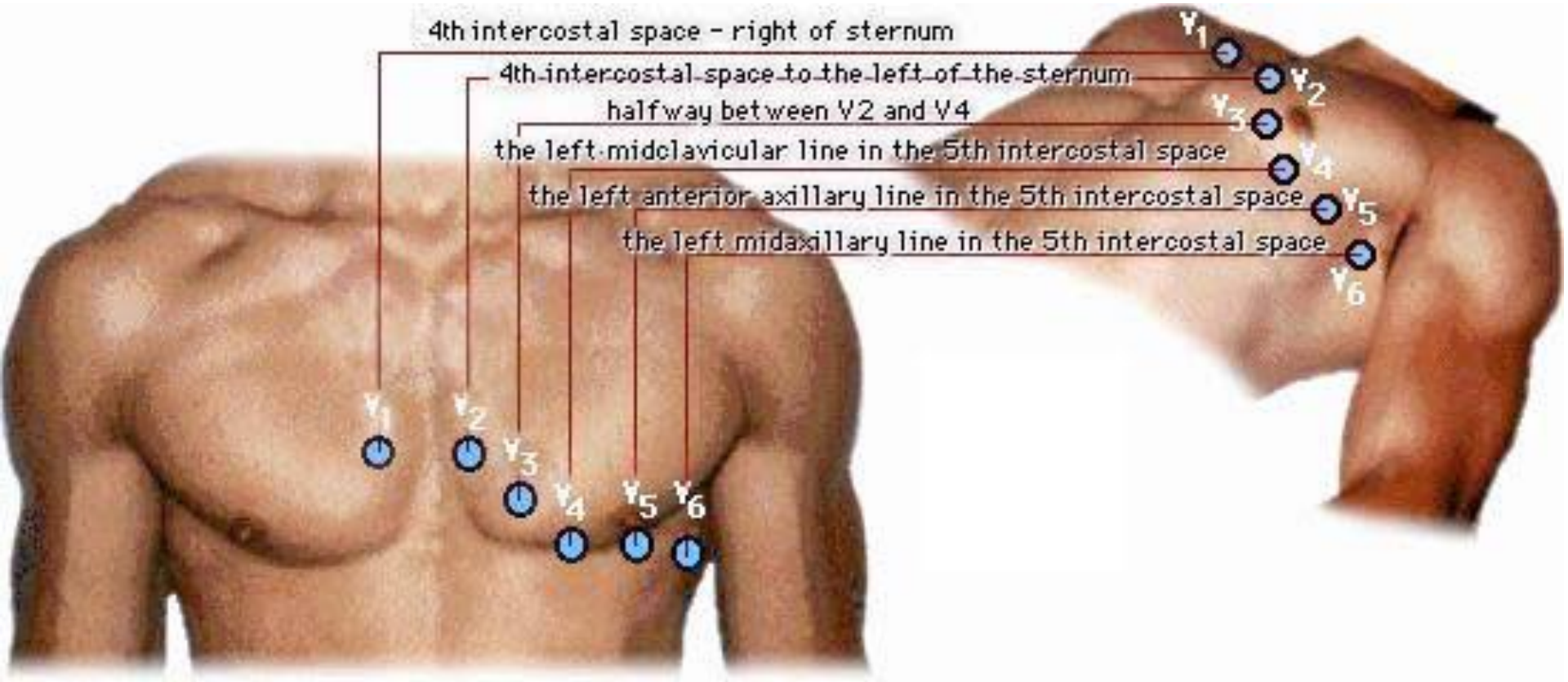
- Limb leads I, II, III are bipolar and have a negative and positive pole
  - Electrical potential differences are measured between the poles
- AVR, AVL and AVF are unipolar
  - No negative lead
  - The heart is the negative pole
  - Electrical potential difference is measured betweeen the lead and the heart
- Chest leads are unipolar
  - The heart also is the negative pole

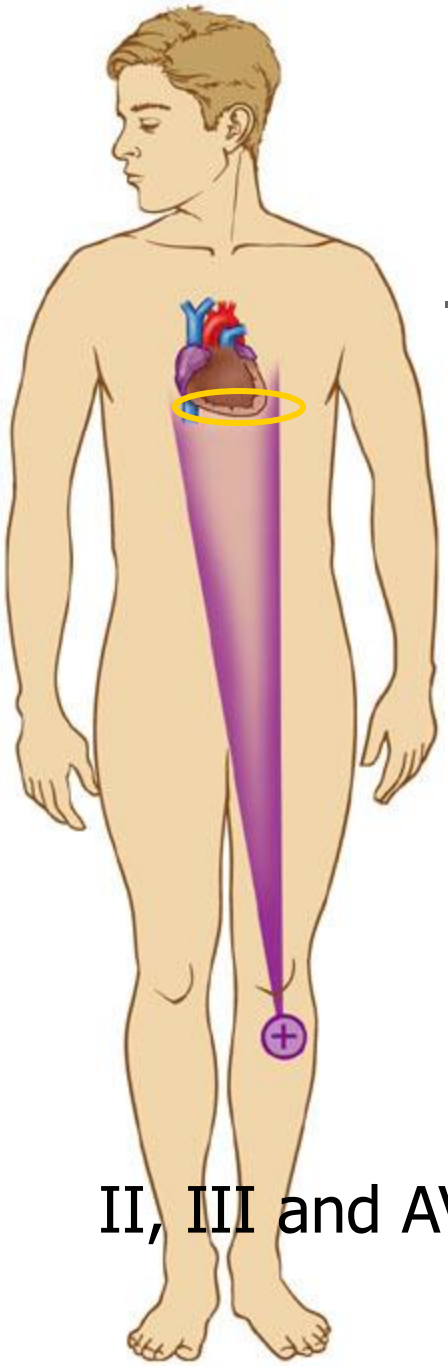
Lead Placement is Important

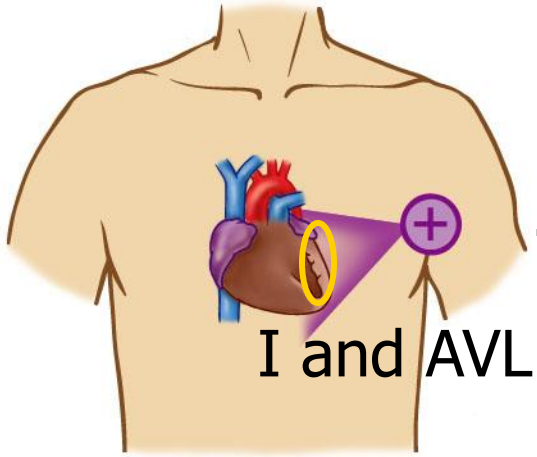
- Each positive electrode acts as a camera looking at the heart
- Ten leads attached for twelve lead diagnostics. The monitor combines 2 leads.
- Mnemonic for limb leads
  - White on right
  - Smoke(black) over fire(red)
  - Snow(white) on grass(green)



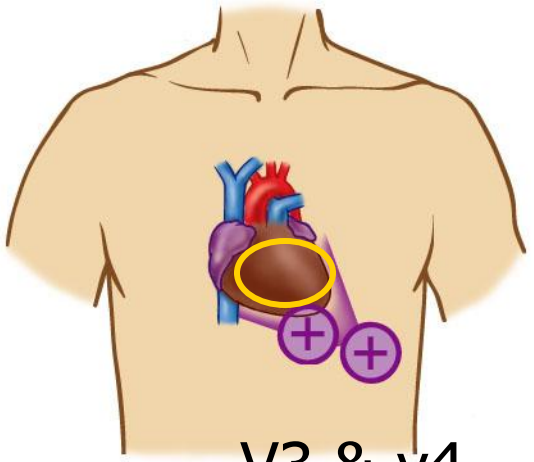
Precordial Leads



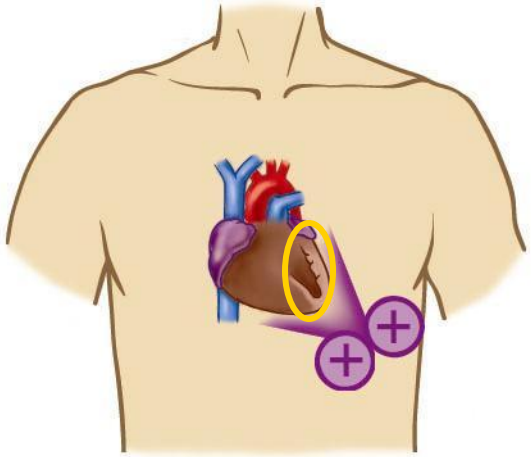




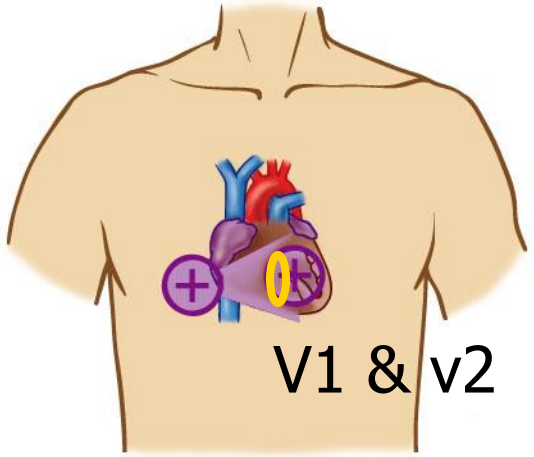
I and AVL



V3 & v4



V5 & v6



V1 & v2

II, III and AVF

Where the positive electrode is positioned, determines what part of the heart is seen!

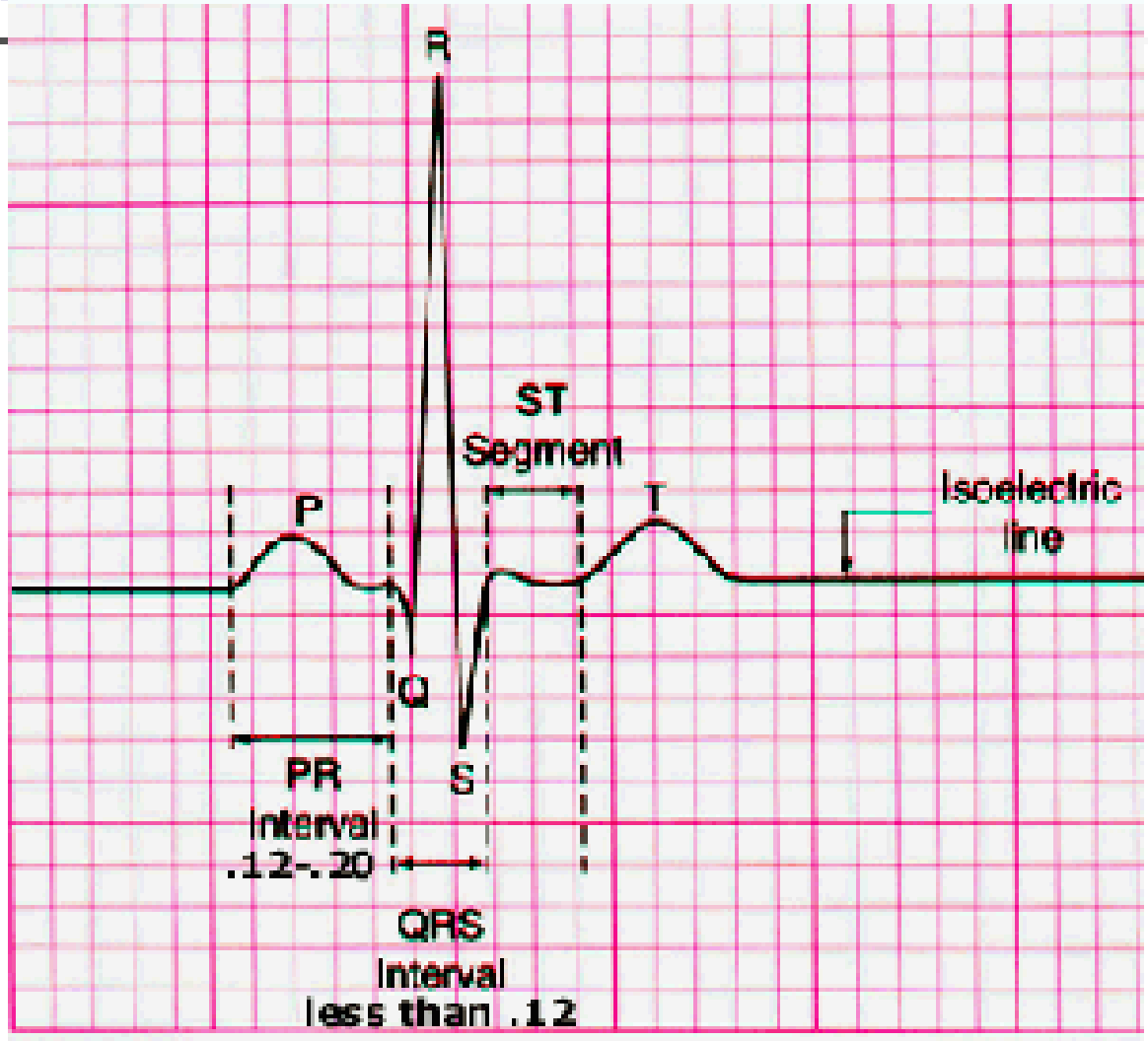
The ECG Tracing: Waves

- P- wave
  - Marks the beginning of the cardiac cycle and measures the electrical impulse that causes atrial depolarization and mechanical contraction
- QRS- Complex
  - Measures the impulse that causes ventricular depolarization
    - Q-wave- may or may not be evident on the ECG
    - R-wave- first upward deflection following P wave
    - S-wave- the first downward deflection following the R-wave
- T- wave
  - Marks ventricular repolarization that ends the cardiac cycle

Intervals and Segments

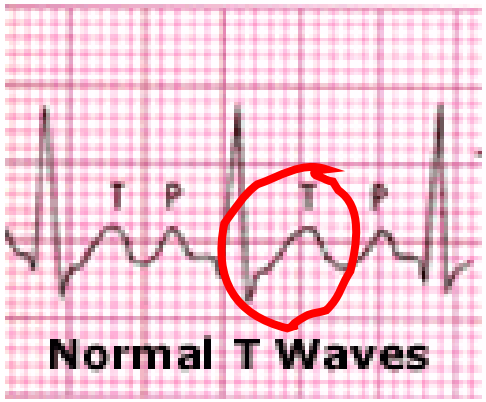
- P-R interval-
  - Time interval for impulse to go from the SA to the AV node
  - normal 0.12-0.20 secs
- QRS Interval
  - Time interval for impulse to go from AV node to stimulate Purkinjie fibers
  - Less than 0.12 secs
- QT Interval
  - Time interval from beginning of depolarization to the end of repolarization
  - Should not exceed ½ the length of the R-R
- ST segment
  - end of the S to the beginning of the T

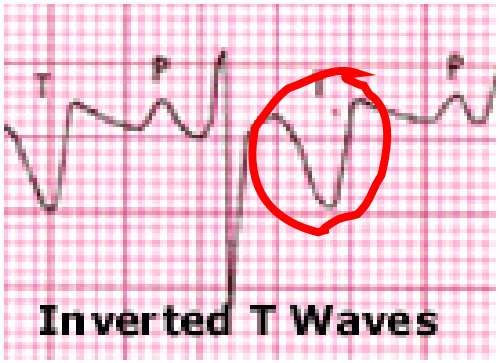
The ECG Tracing



ECG Changes : Ischemia

- T-wave inversion (flipped T)
- ST segment depression
- T wave flattening
- Biphasic T-waves

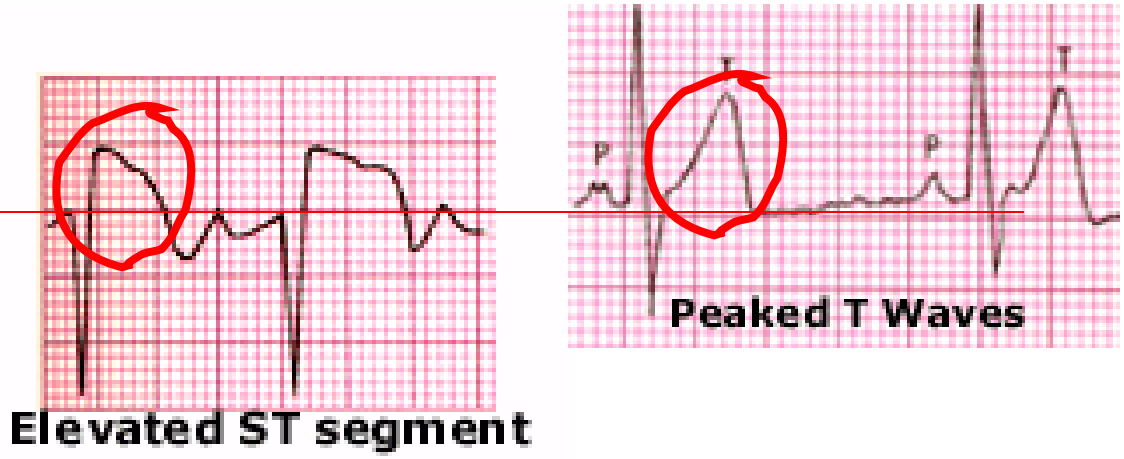




ECG Changes: Injury

- ST segment elevation of greater than 1mm in at least 2 contiguous leads
- Heightened or peaked T waves
- Directly related to portions of myocardium rendered electrically inactive

Baseline



ECG Changes: Infarct

- Significant Q-wave where none previously existed
  - Why?
    - Impulse traveling away from the positive lead
    - Necrotic tissue is electrically dead
- No Q-wave in Subendocardial infarcts
  - Why?
    - Not full thickness dead tissue
    - But will see a ST depression
    - Often a precursor to full thickness MI
- Criteria
  - Depth of Q wave should be 25% the height of the R wave
  - Width of Q wave is 0.04 secs
  - Diminished height of the R wave

Evolving MI and Hallmarks of AMI

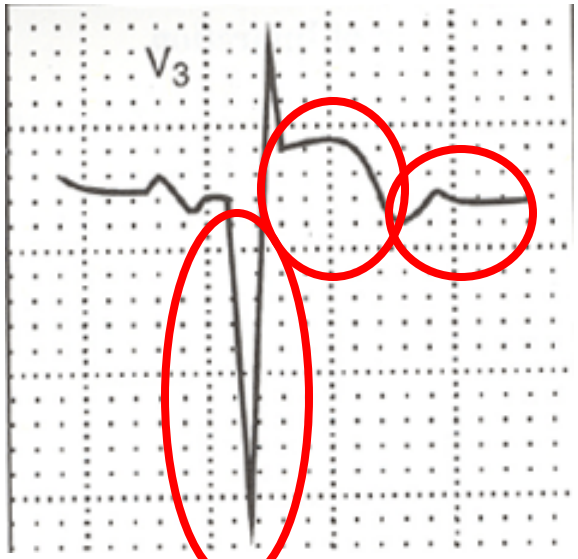
Preadmission

Admission

1 Hour

24 Hours

1 year



Q wave

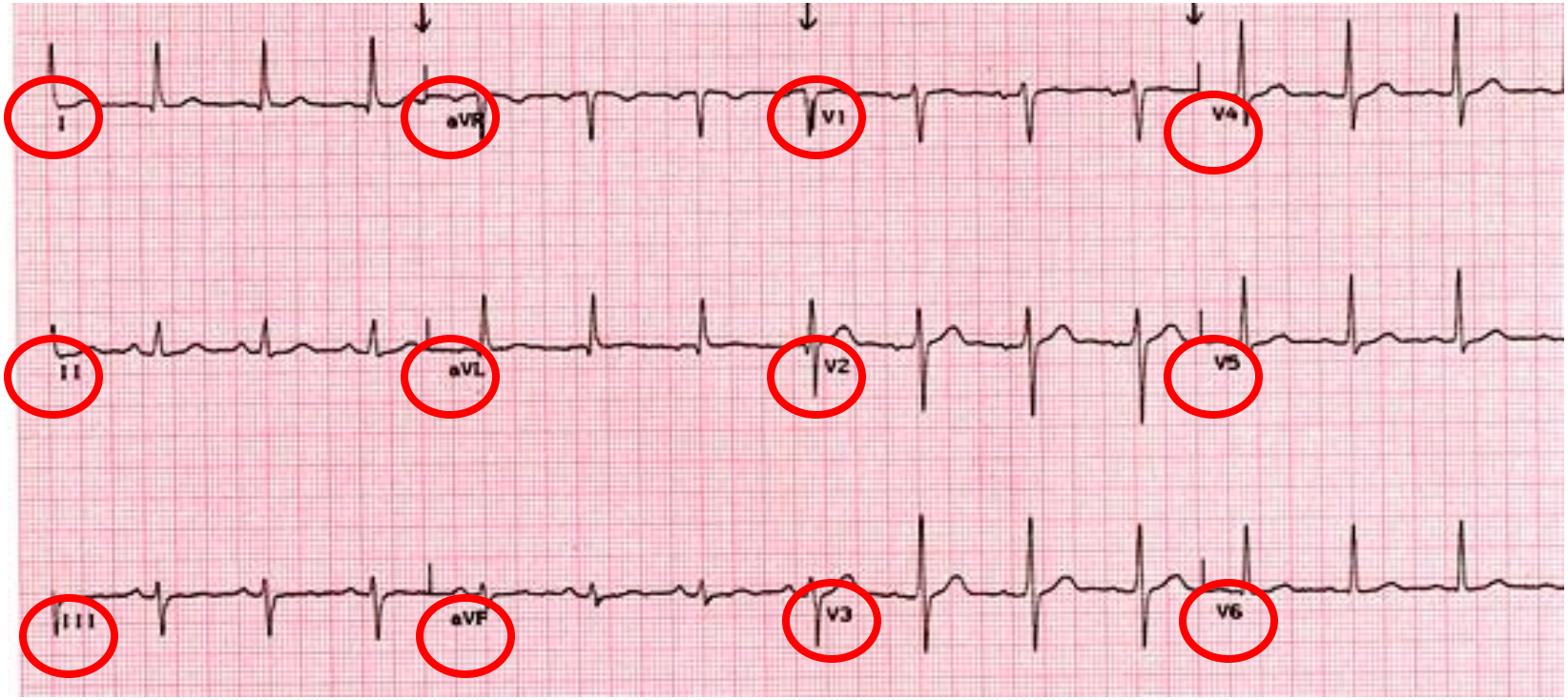
ST Elevation

T wave inversion

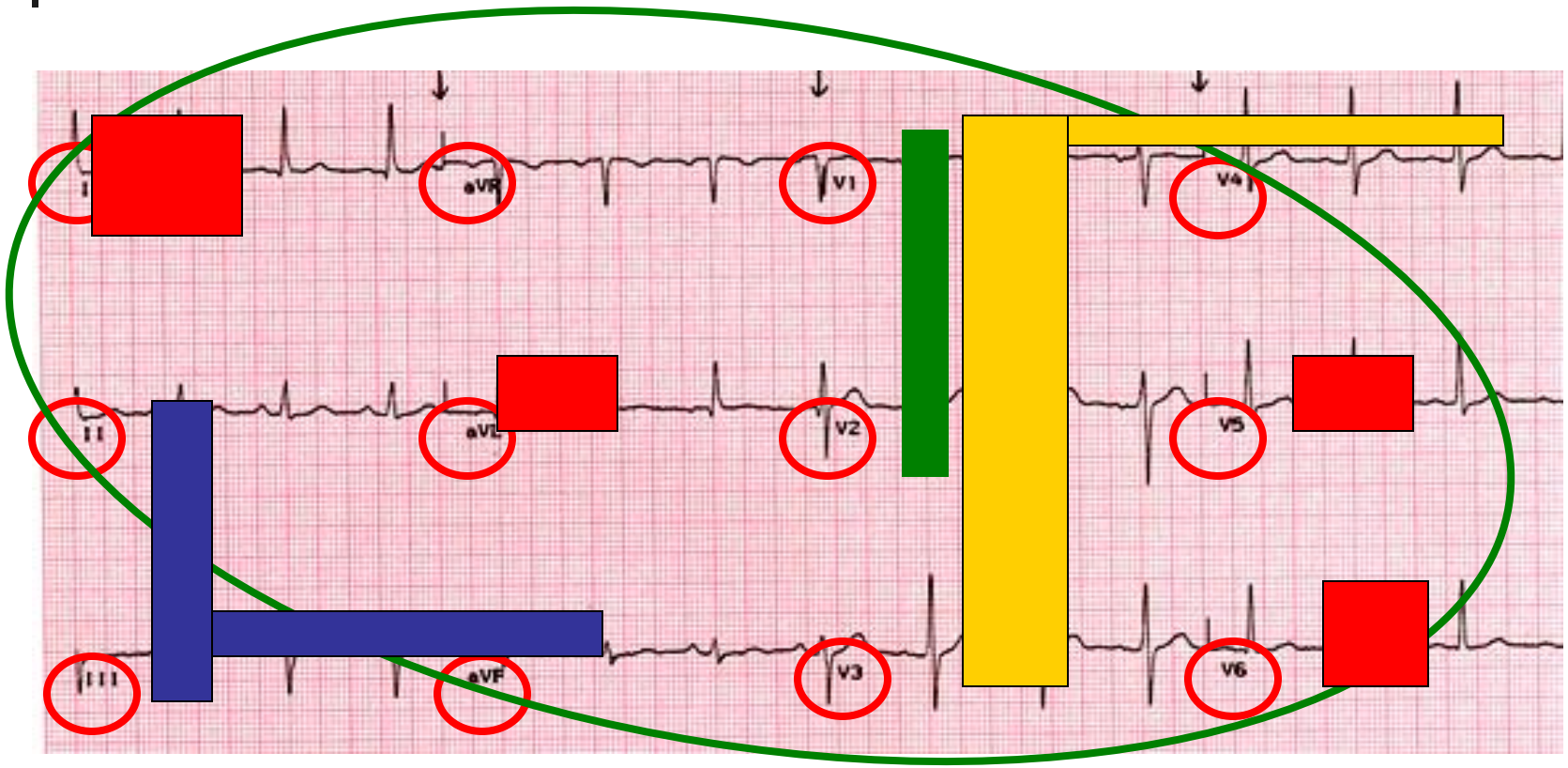
Dissecting the 12 Lead ECG

- Horizontal marks time
- Vertical marks amplitude
- 6 limb leads
- 6 precordial leads
- Positioning measures 12 perspectives or views of the heart
- The 12 perspectives are arranged in vertical columns
- Limb leads are I, II, III, AVR, AVL, AVF
- Precordial leads are V1, V2, V3, V4, V5, V6

A Normal 12 Lead ECG

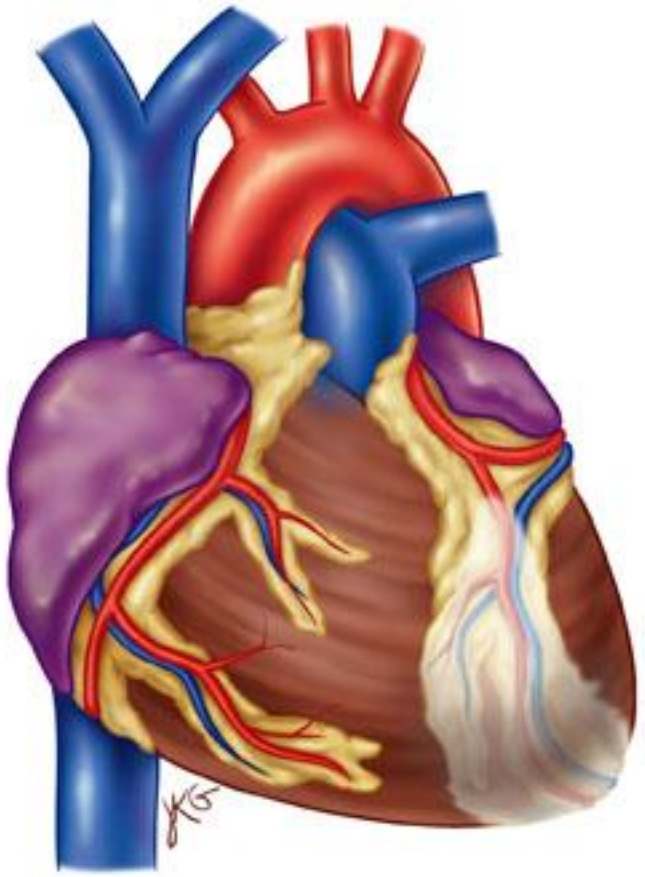


A Normal 12 Lead ECG

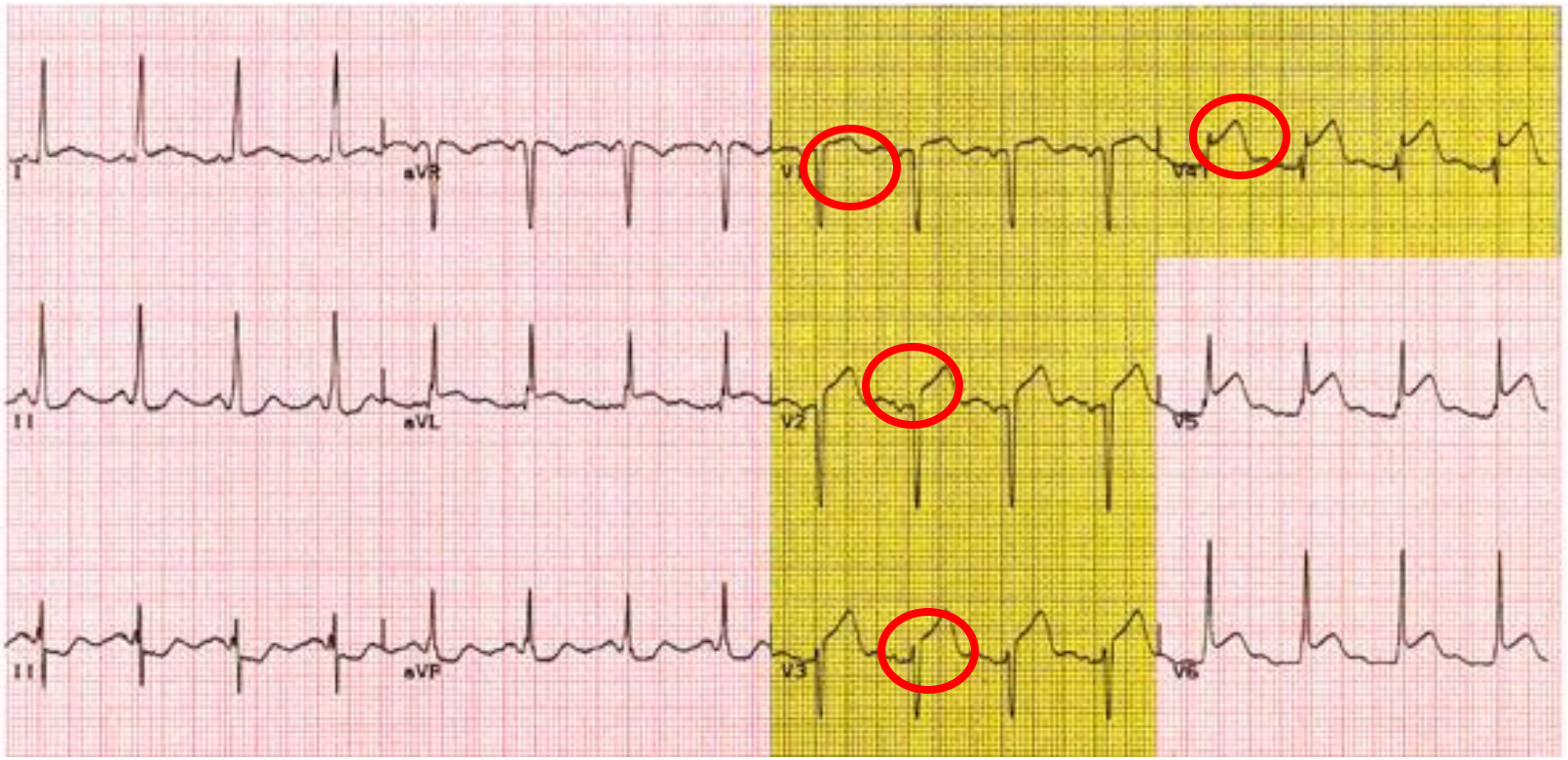


Color Coding ECG's **Anterior**

- Yellow indicates **V1, V2, V3, V4**
  - **Anterior infarct with ST elevation**
  - **Left Anterior Descending Artery (LAD)**
  - **V1 and V2 may also indicate septal involvement which extends from front to the back of the heart along the septum**
  - **Left bundle branch block**
  - **Right bundle branch block**
  - **2nd Degree Type2**
  - **Complete Heart Block**

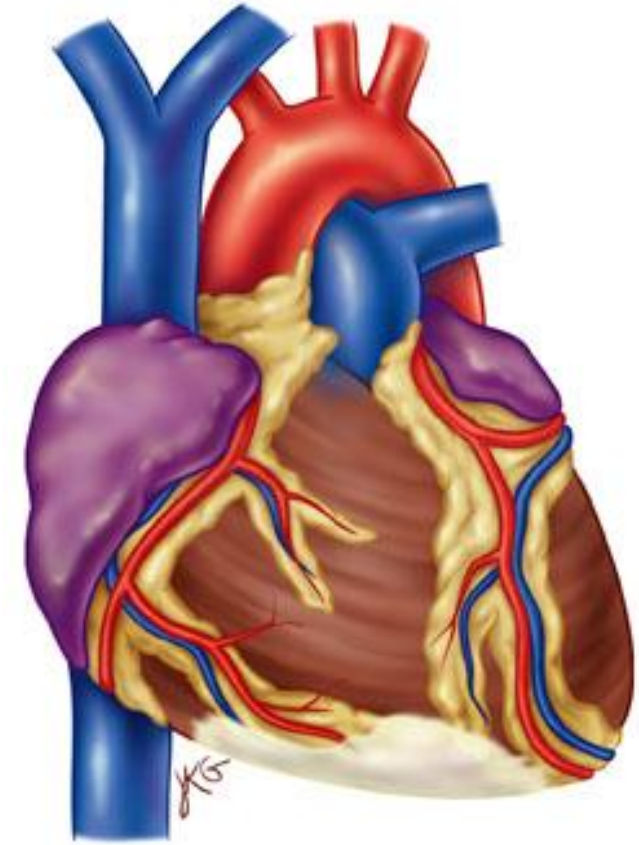


Anterior MI

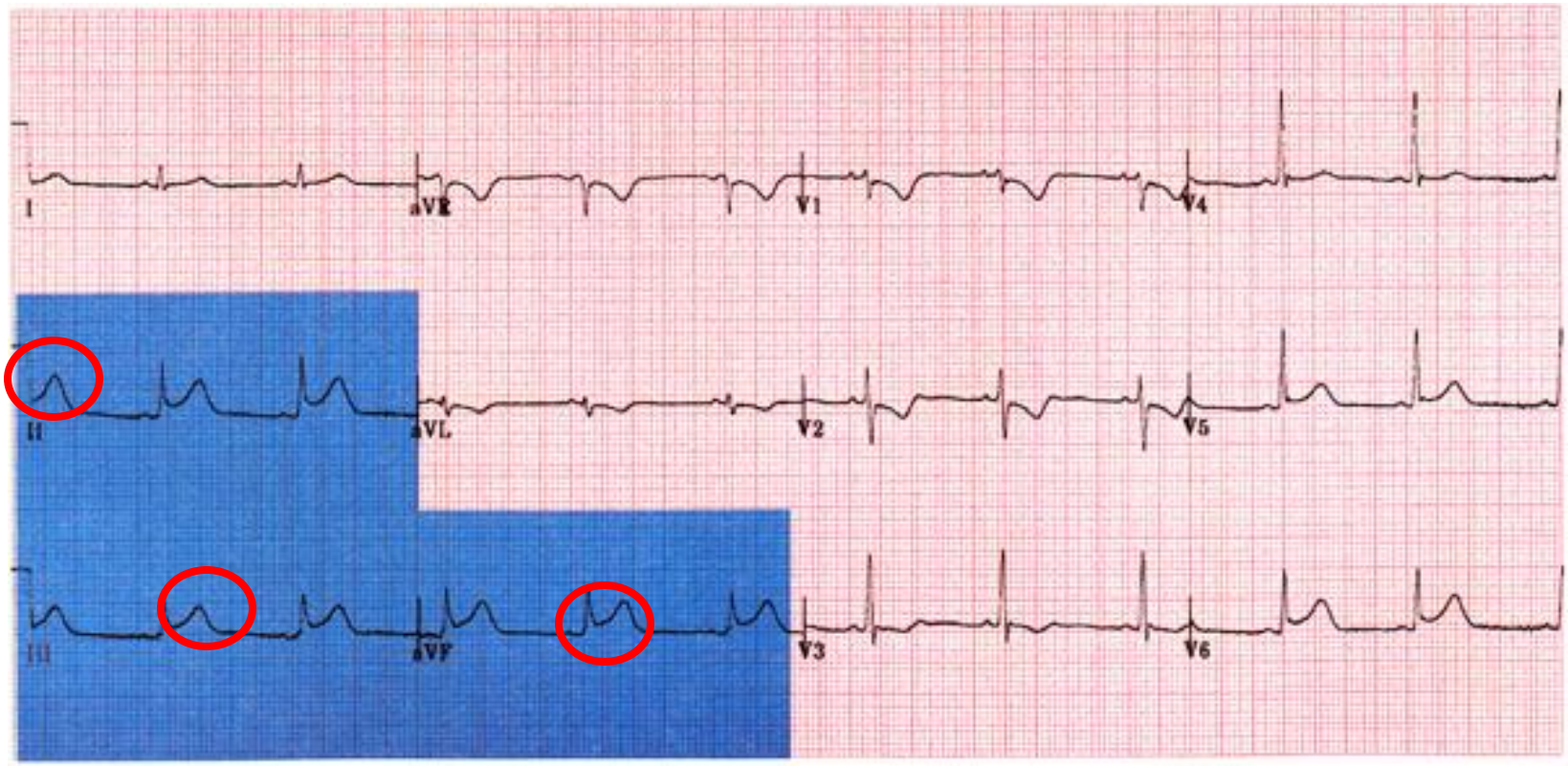


Color Coding ECG- **Inferior**

- Blue indicates leads **II, III, AVF**
  - **Inferior Infarct with ST elevations**
  - **Right Coronary Artery (RCA)**
  - **1st degree Heart Block**
  - **2nd degree Type 1, 2**
  - **3rd degree Block**
  - **N/V common, Brady**



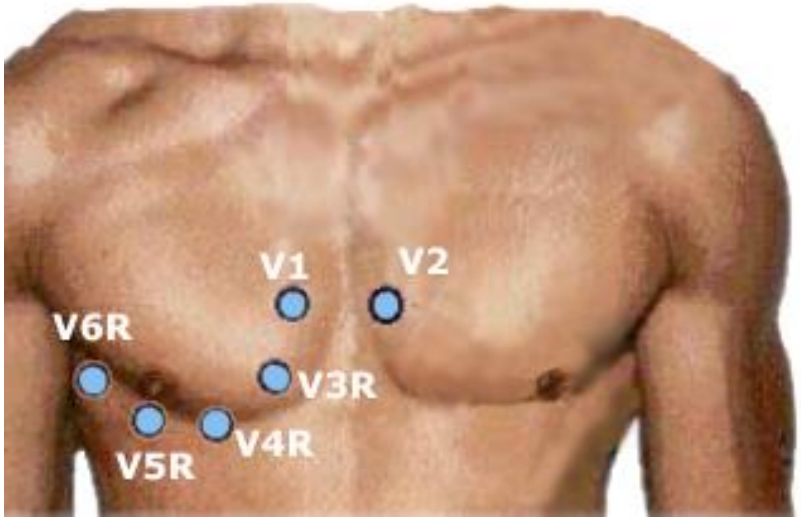
Inferior MI



As an aside….

- Right sided EKG
- Ever heard of it?
- Ever done one?
- Think about it…..
  - For your cases that are clearly inferior MI's
  - Obtain a dextrocardiogram whenever ST segment elevation is noted in Inferior leads

Right Sided EKG????

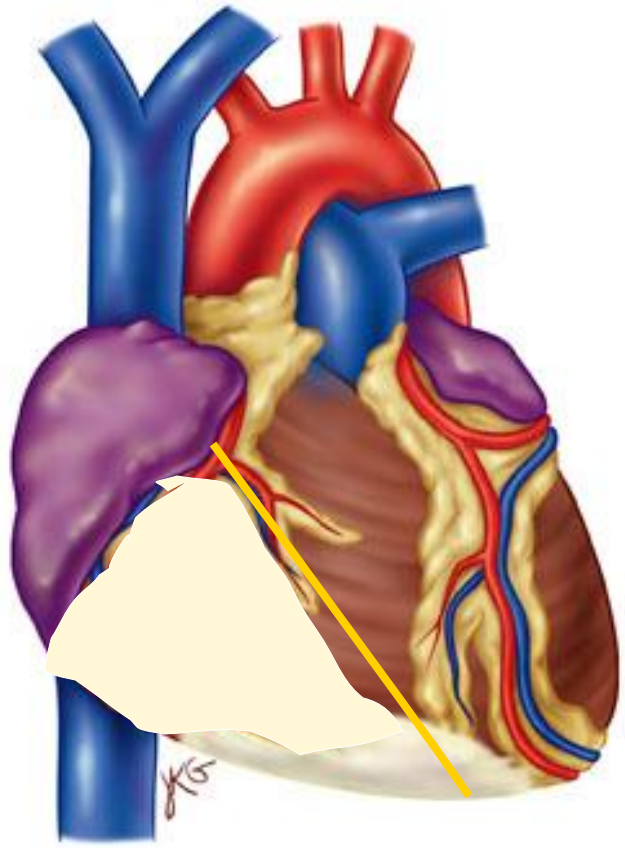


- RVI occurs around 40% in inferior MI's
- Significance
  - Larger area of infarct
  - Both ventricles
  - Different treatment
- Right leads "look" directly at Right Ventricle and can show ST elevations in leads II. III. AVF, V4R , V5R and V6R
- Occlusion in RCA and proximal enough to involve the RV

The single most accurate tool used in measuring RVI.

90% sensitive and specific

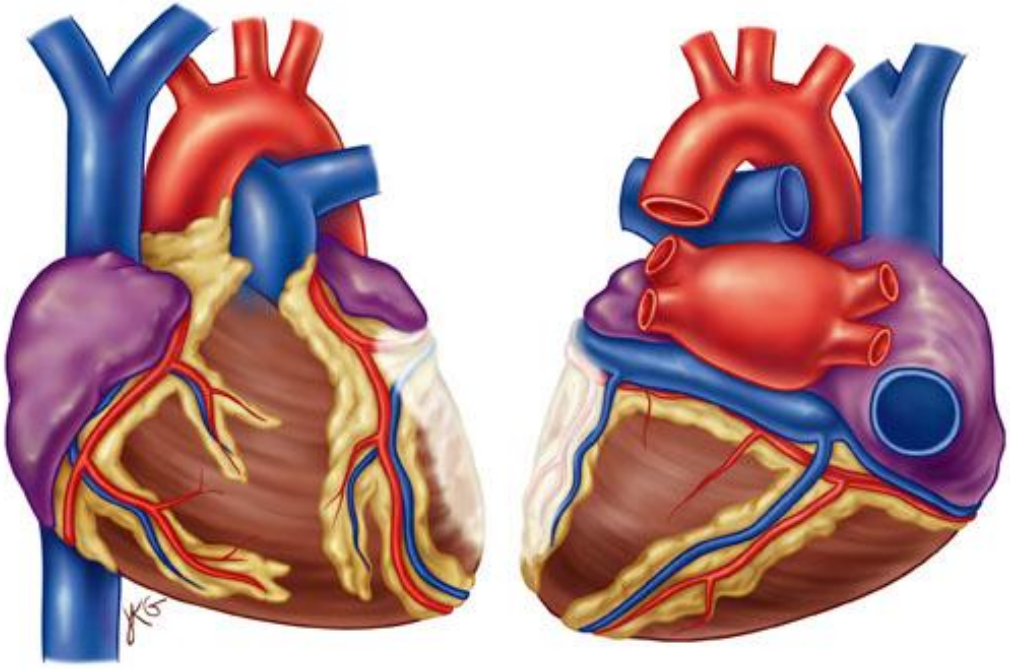
Clinical Triad of RVI



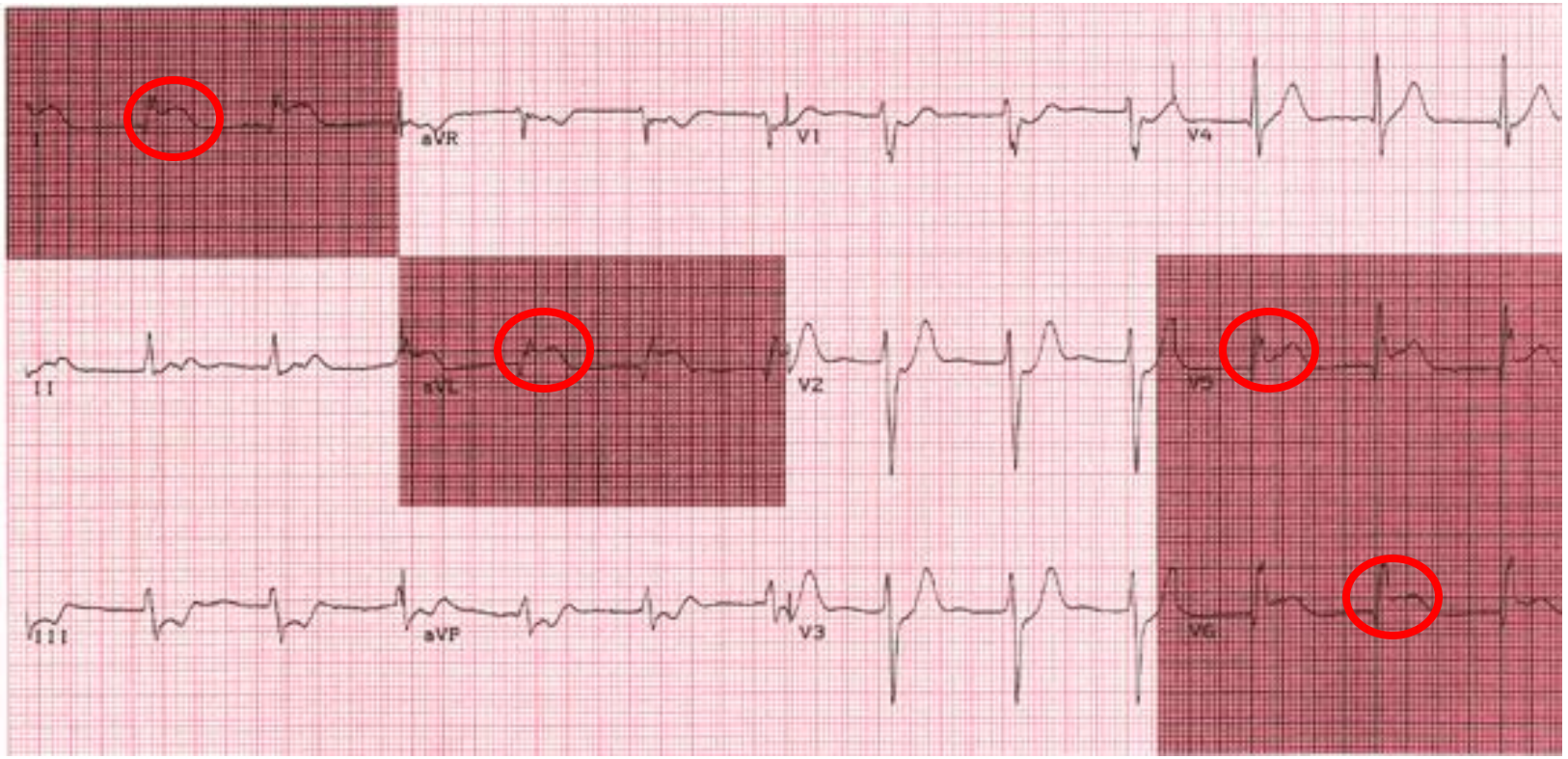
- Hypotension
- Jugular vein distention
- Dry lung sounds

Color Coding ECG- **Lateral**

- Red indicates leads
  I, AVL, V5, V6
  - **Lateral Infarct with ST elevations**
  - **Left Circumflex Artery**
  - **Rarely by itself**
  - **Usually in combo**

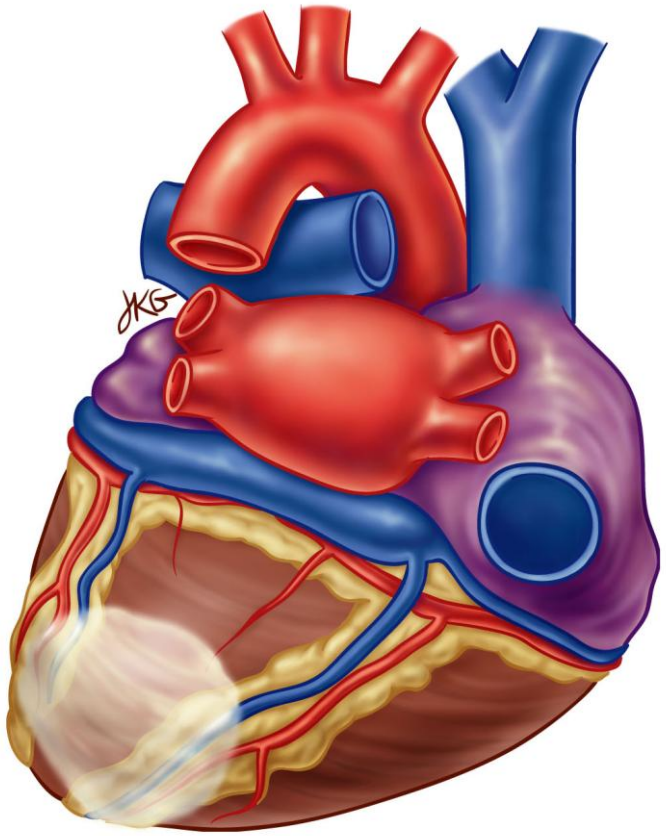


Lateral MI

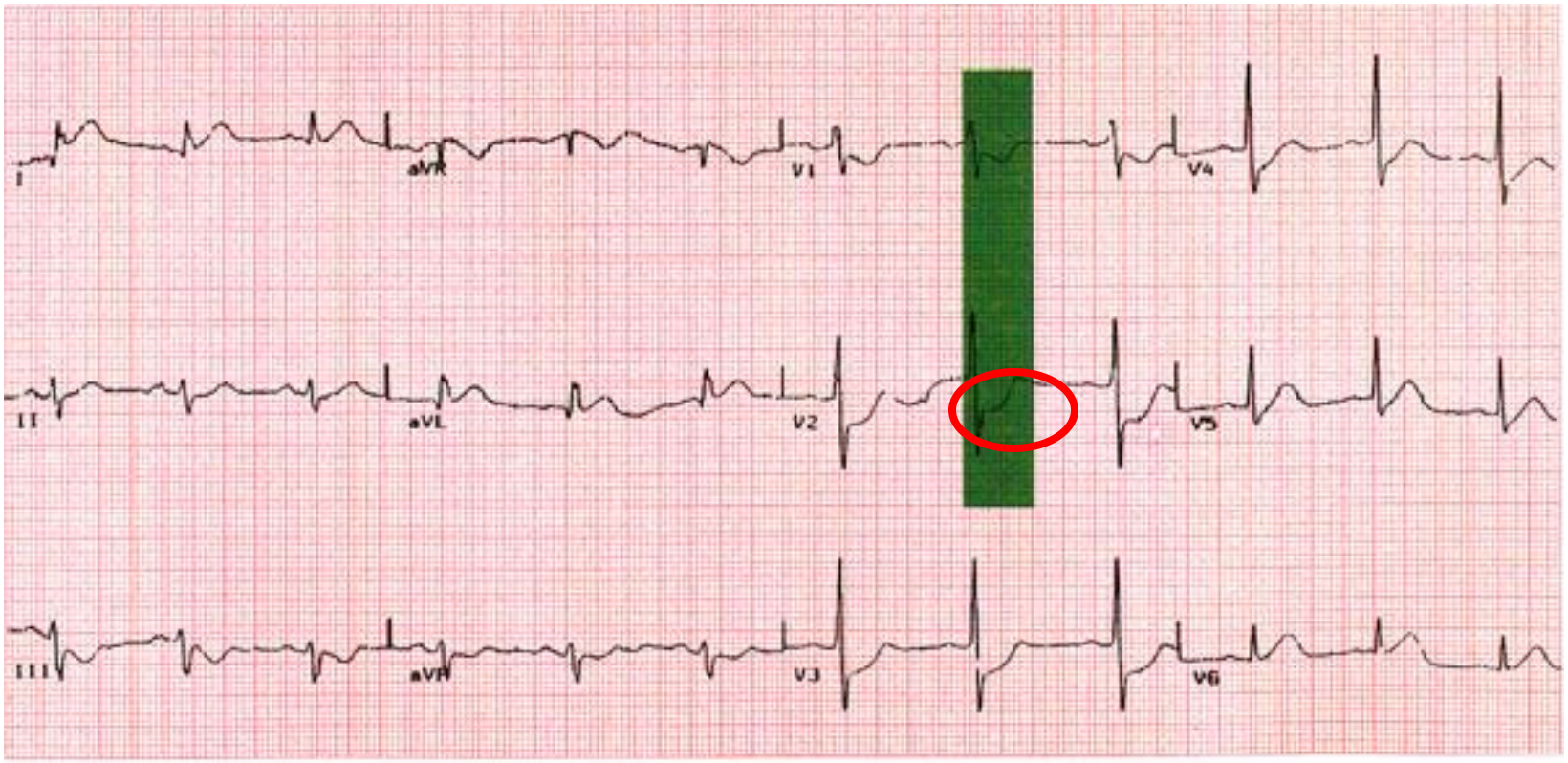


Color Coding ECG- **Posterior**

- Green indicates leads V1, V2
  - **Posterior Infarct with ST Depressions and/ tall R wave**
  - **RCA and/or LCX Artery**
- **Understand Reciprocal changes**
  - **The posterior aspect of the heart is viewed as a mirror image and therefore depressions versus elevations indicate MI**
  - **Rarely by itself usually in combo**

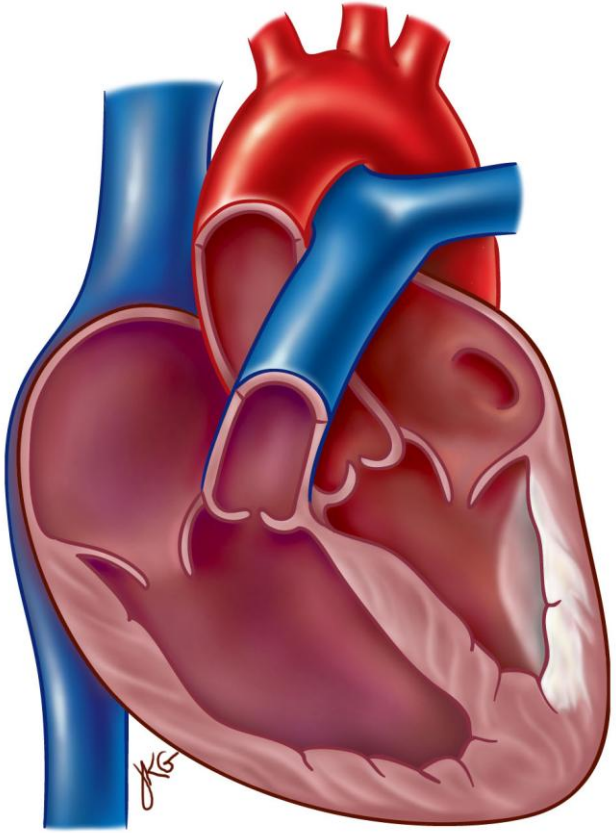


Posterior MI

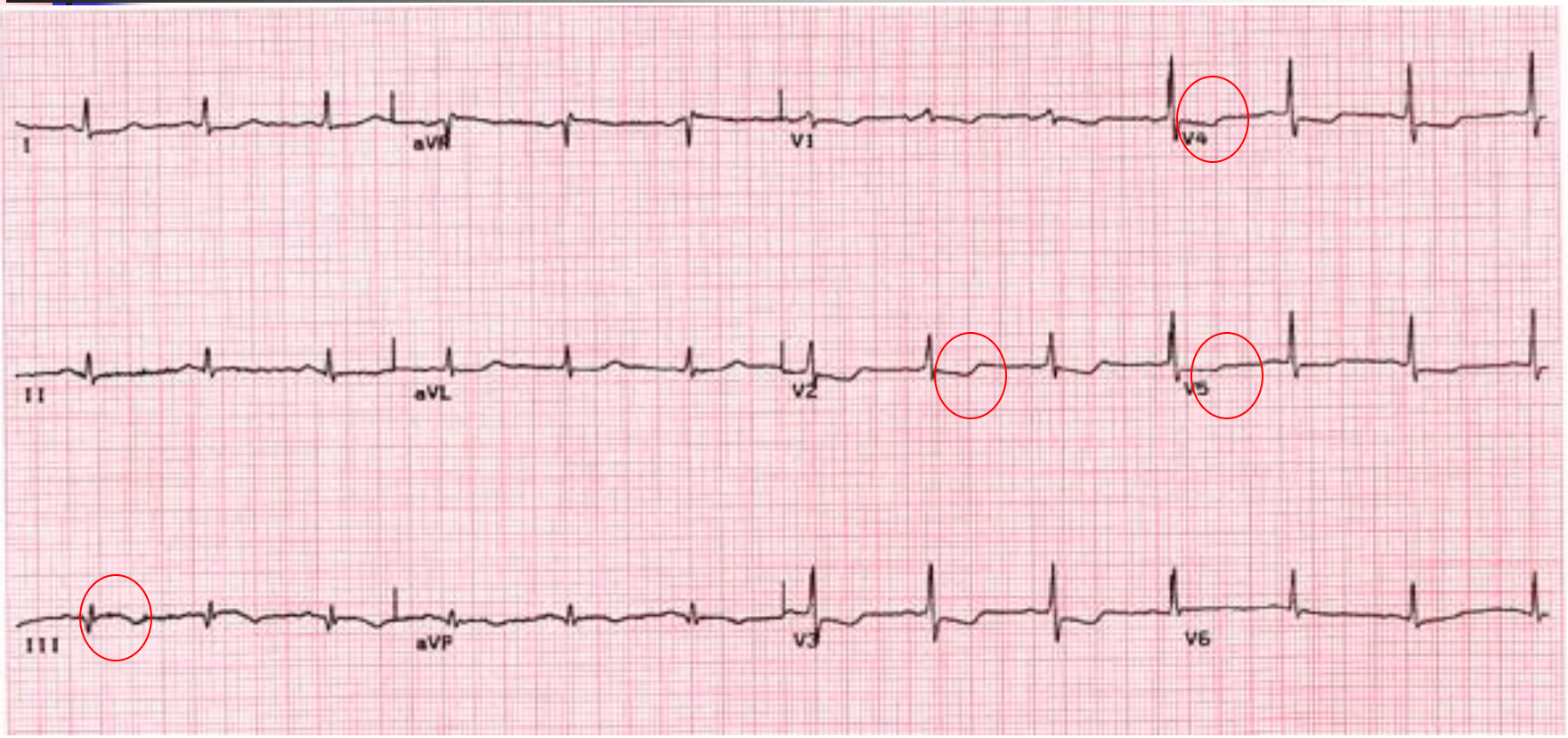


Color Coding ECG- **SubEndo**

- No color for SubEndocardial infarcts since they are not transmural
- Look for diffuse or localized changes and non – Q wave abnormalities
  - **T-wave inversions**
  - **ST segment depression**



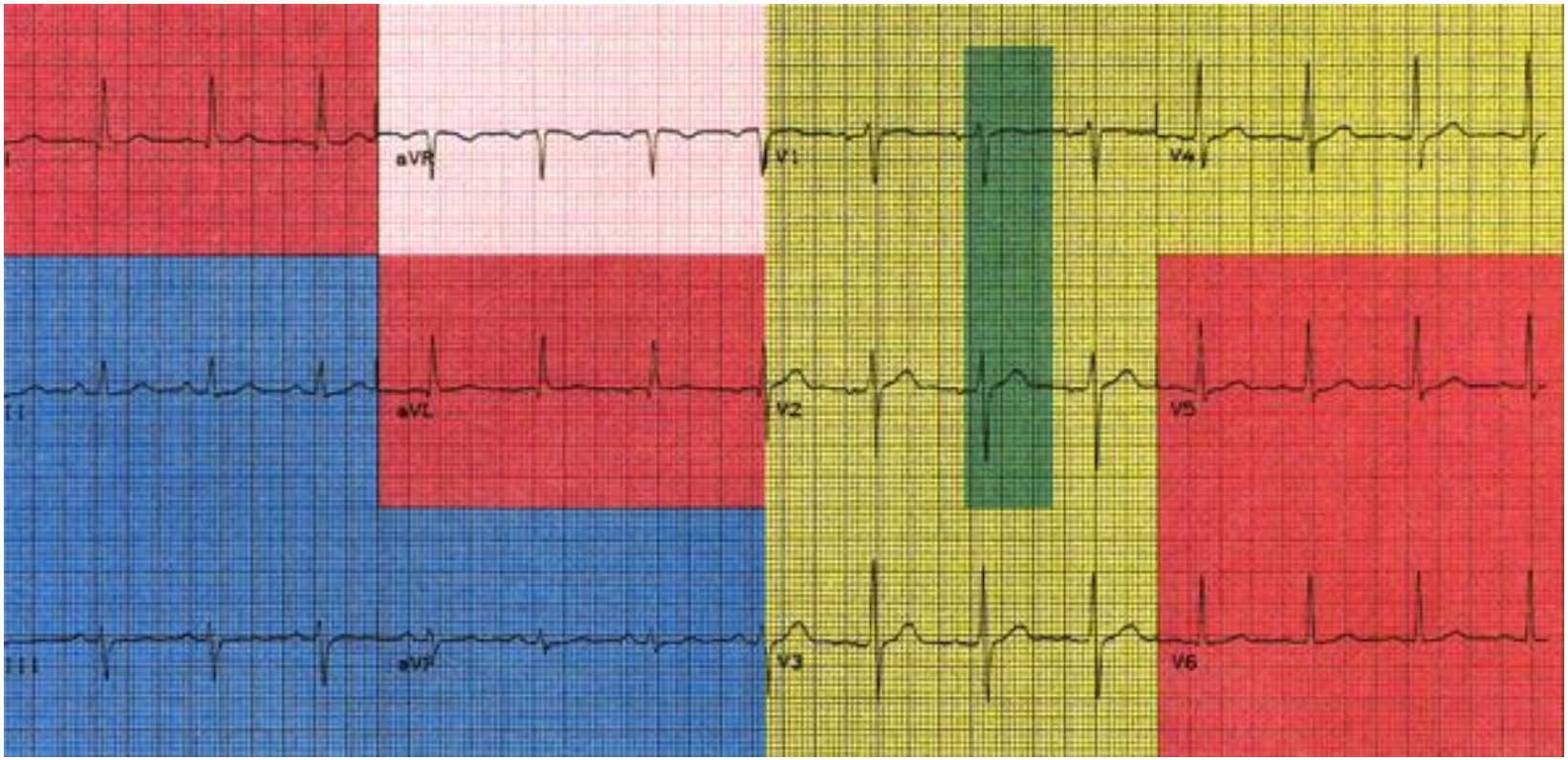
SubEndo MI

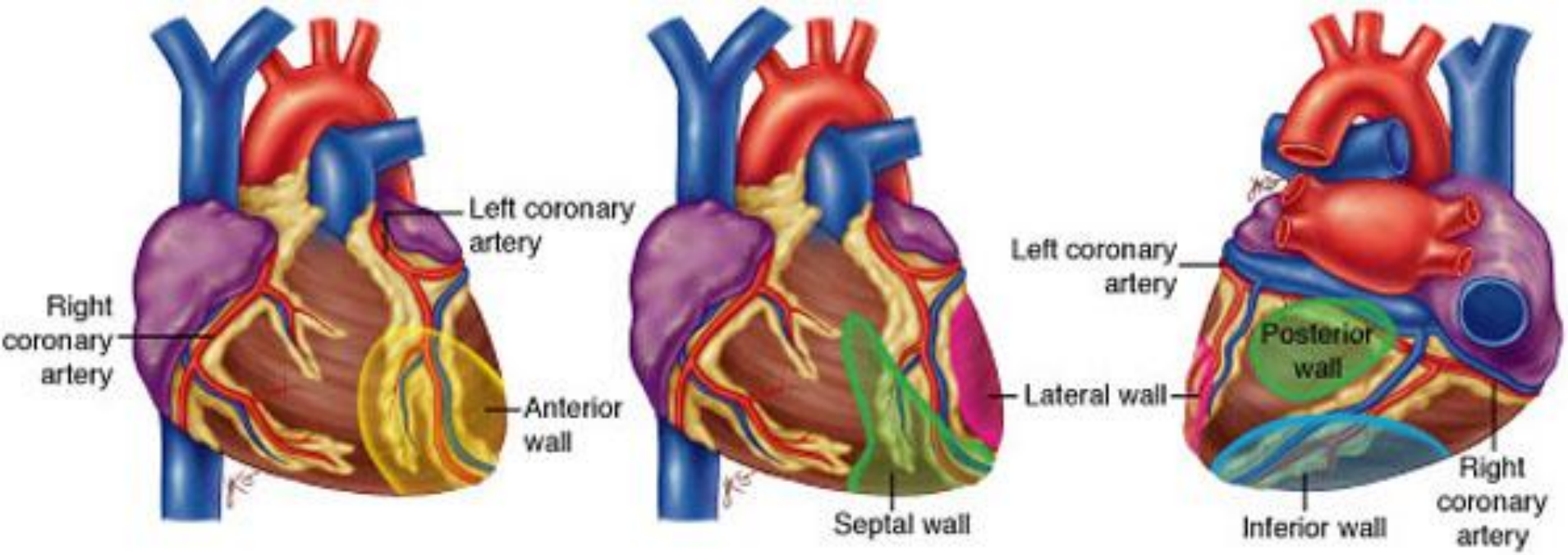


More than one color shows abnormality

- A combination of infarcts such as:
  - Anterolateral yellow and red
  - Inferoposterior blue and green
  - Anteroseptal yellow and green

Putting it ALL together

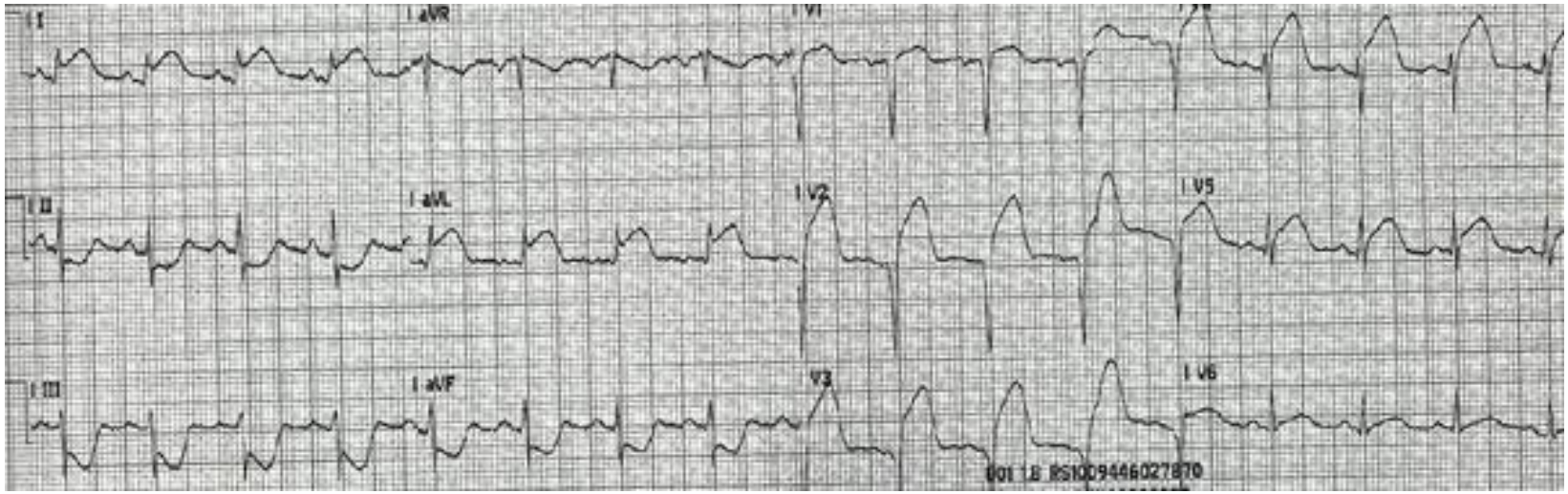




I	AVR	V1	V4
II	AVL	V2	V5
III	AVF	V3	V6

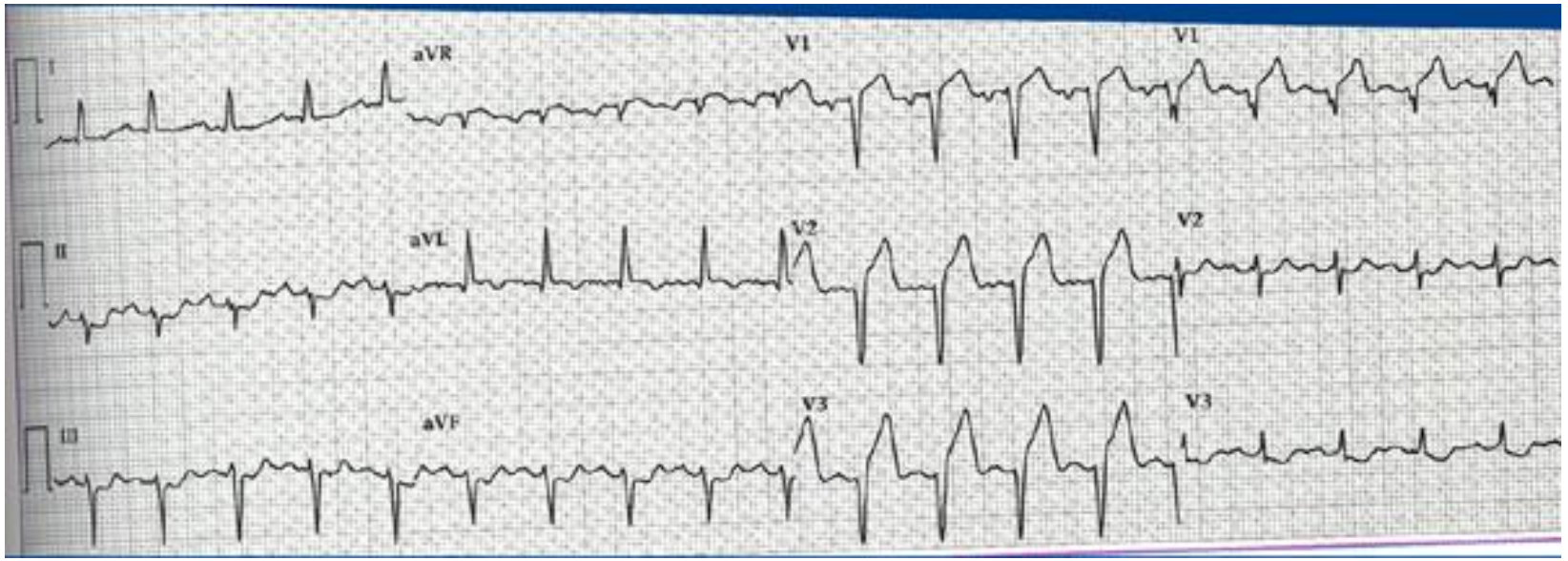
Anterior: V3, V4
Septal: V1, V2
Inferior: II, III, AVF
Lateral: I, AVL, V5, V6

Practice 1



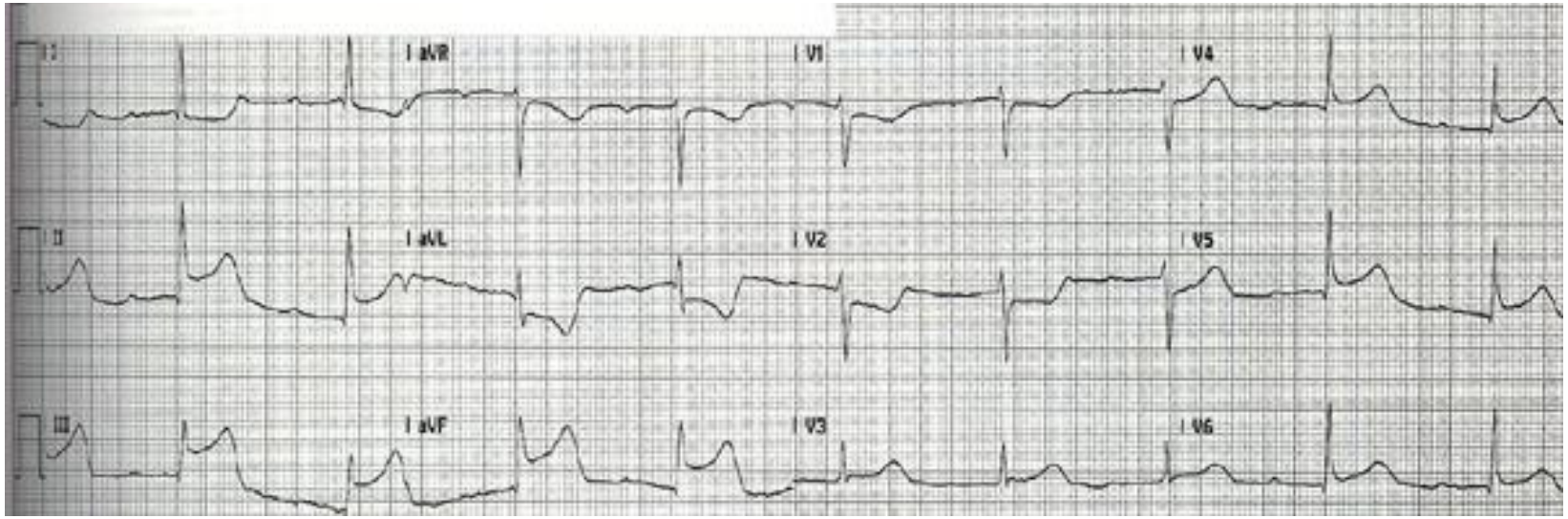
- Anterior MI with lateral involvement
- ST elevations V2, V3, V4
- ST elevations II, AVL, V5

Practice 2



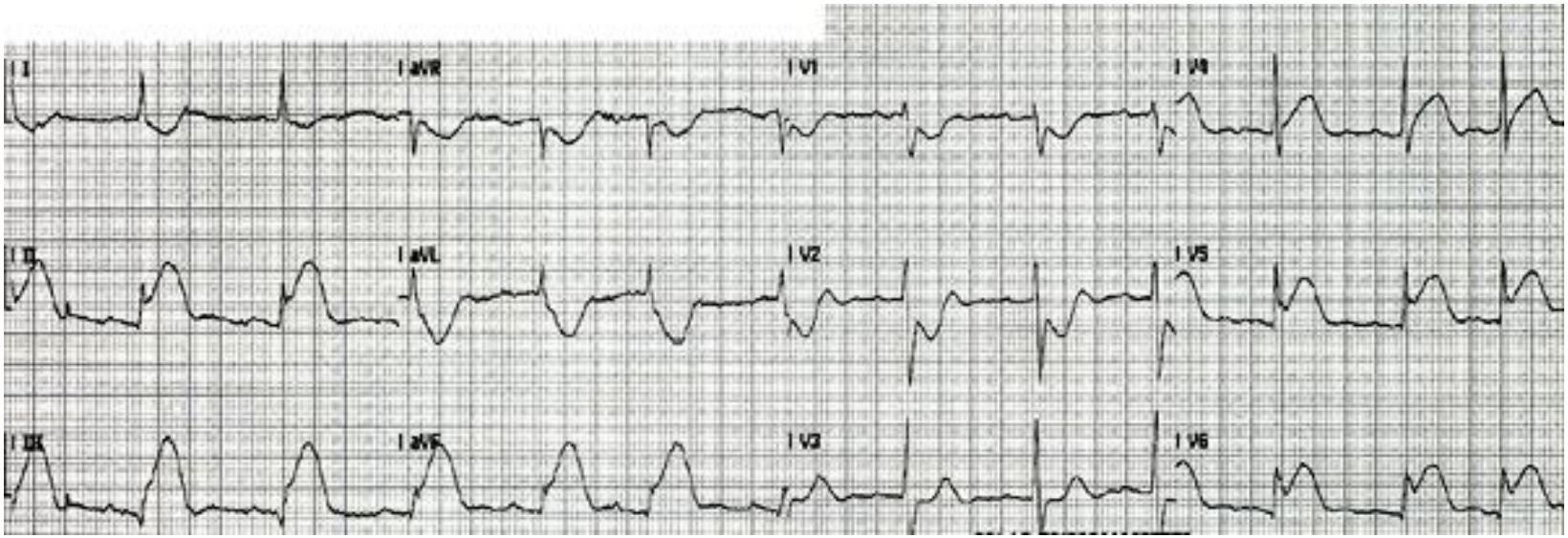
- Anteroseptal MI
- ST elevations V1, V2, V3, V4

Practice 3



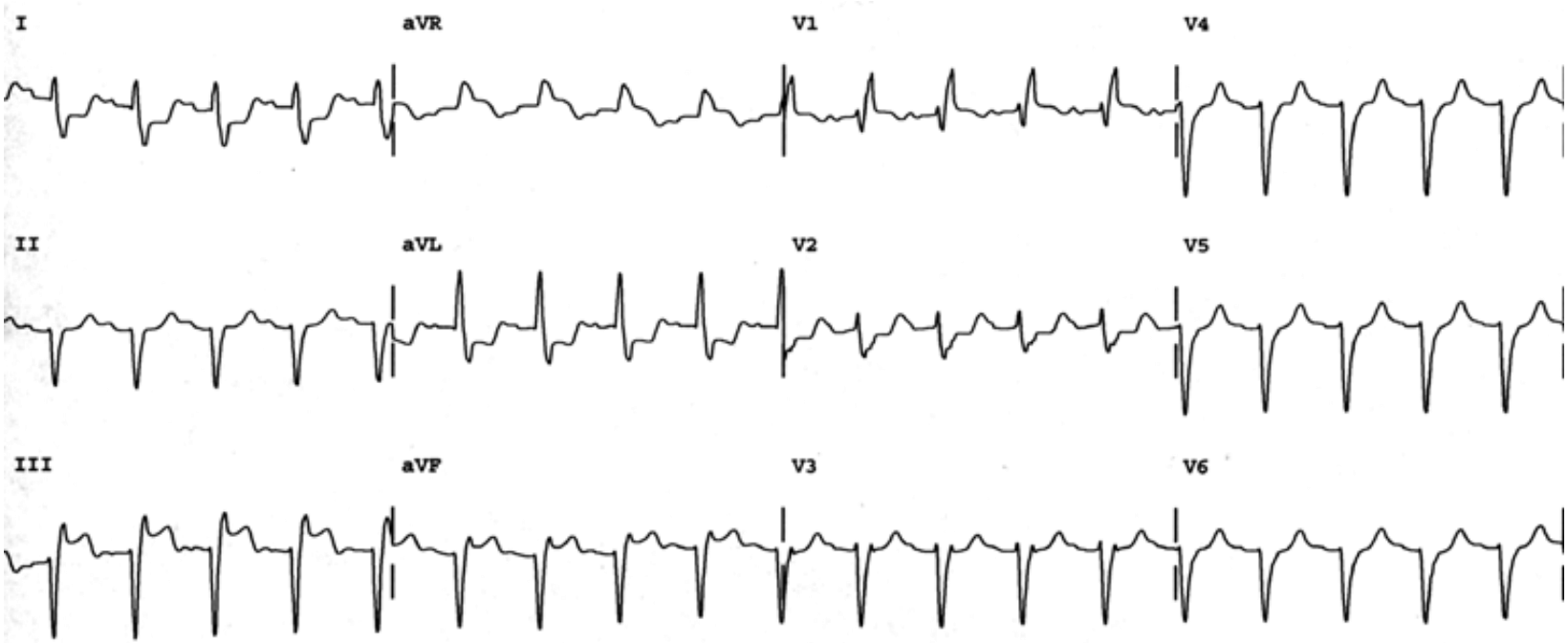
- Inferior MI
- ST elevation 2,3 AVF

Practice 4



- Inferior lateral MI
- ST elevations 2, 3, AVF
- ST elevations V5

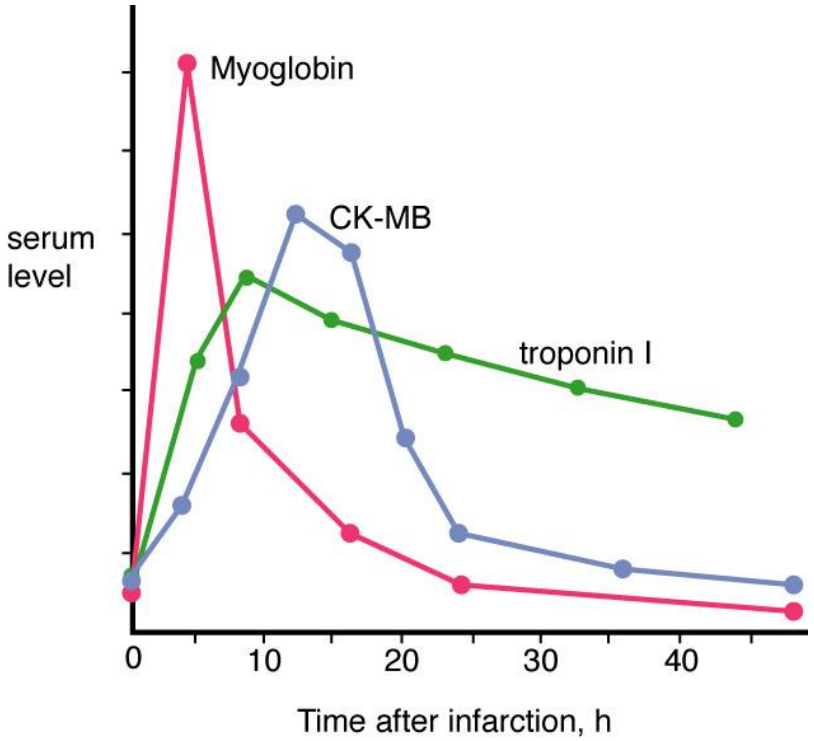
Practice 5



- Acute inferior MI
- Lateral ischemia

Cardiac Enzymes Indicating Infarct

- Troponins- Now the Gold Standard!
  - Rises after 3-6 hours
  - Negative Troponin within 6 hours of onset of S&S rules out the MI
  - Peaks at about 20 hours
  - May be raised for 14 days



Cardiac Enzymes Indicating Infarct

- Troponin T
  - 84% sensitivity for MI 8 hours after onset of symptoms
  - 22% for unstable angina
    - Advantages
      - Highly sensitive for detecting myocardial ischemia
      - Levels may help to stratify risks
    - Disadvantages
      - Less specific than Troponin I
      - Increased in angina
      - Increased in chronic renal failure

Cardiac Enzymes Indicating Infarct

- Troponin I
  - 90% sensitivity for MI 8 hours after onset of S&S and 95% specificity
  - Level greater than 1.2 suggest MI
  - Negative rules out MI
  - Obtain two negative troponin values 4 hours apart
  - Normally exceedingly low
  - Even a small elevation indicates myocardial damage

References

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