The 12-Lead ECG

In Diagnosis of Acute Myocardial Infarction

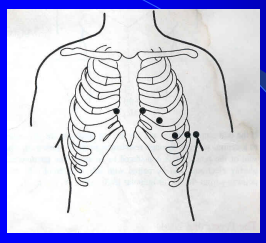
Placement of Electrodes

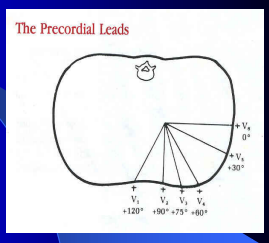
Limb Leads

- White – Right Arm
- Black – Left Arm
- Red – Left Leg
- Green – Right Leg

Placement of Electrodes

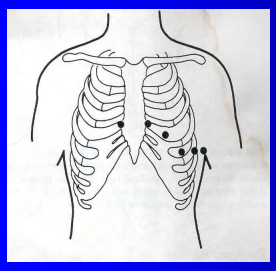
Precordial Leads





Placement of Electrodes

Precordial Leads



- V1 & V2
  - 4th interspace, either side of sternum
- V3
  - between V2 & V4
- V4
  - 5th interspace, midclavicular
- V5
  - 5th interspace, anterior axillary line
- V6
  - 5th interspace, midaxillary line

Placement of Electrodes

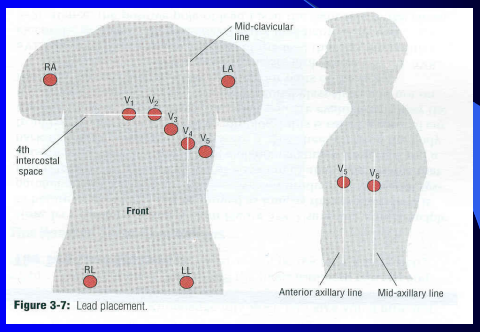


Figure 3-7: Lead placement.

Electrodes and Waves

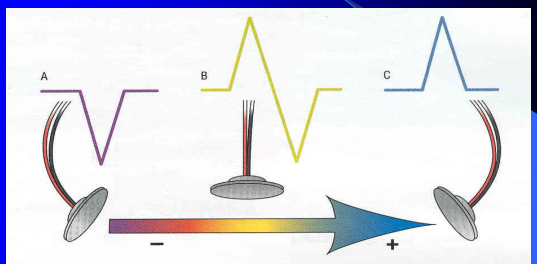


Figure 3-5: Three different ECGs resulting from the same vector, due to different lead placements.

Leads are like Pictures

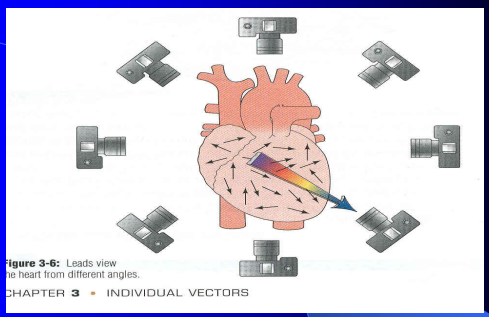


Figure 3-6: Leads view the heart from different angles.

CHAPTER 3 • INDIVIDUAL VECTORS

They view the heart from a specific perspective

Limb Leads

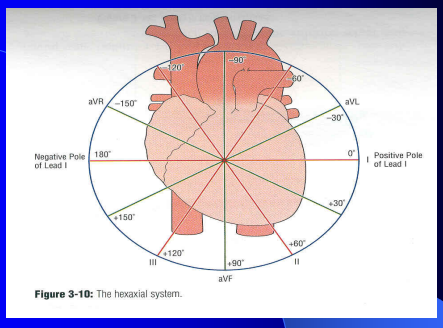


Figure 3-10: The hexaxial system.

The Hexaxial Reference System

Limb Leads

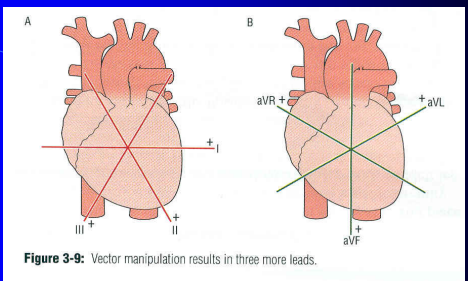
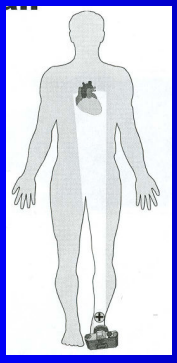


Figure 3-9: Vector manipulation results in three more leads.

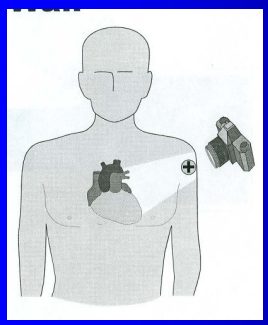
The limb leads give a 2 dimensional view of the heart. They assume that the body is flat and without depth

Limb Leads



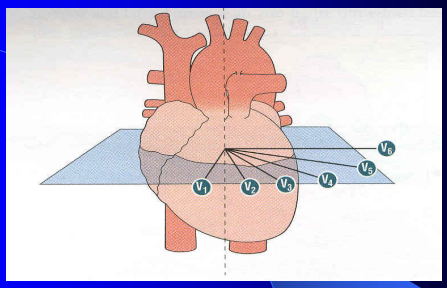
- Inferior Wall is viewed by….
- II, aVF, and III

Limb Leads



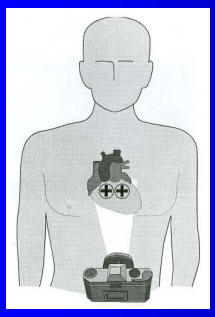
- Anterior Wall is viewed by…
- I and aVF

Precordial Leads



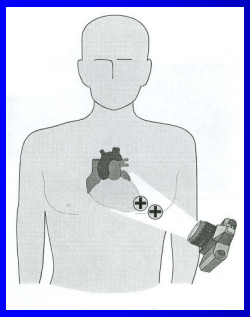
The precordial leads view the heart in a 2 dimensional plane perpendicular to that of the limb leads

Precordial Leads



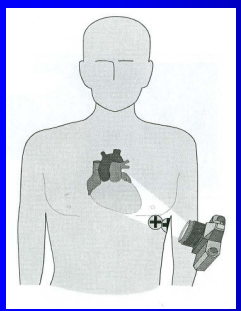
- Septal wall is viewed by…
- V1 and V2

Precordial Leads



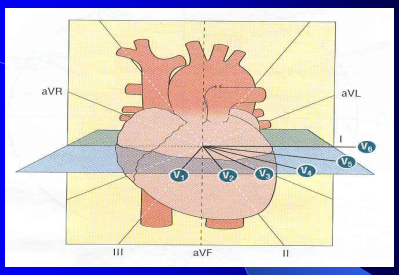
- Anterior wall is viewed by…
- V3 and V4

Precordial Leads



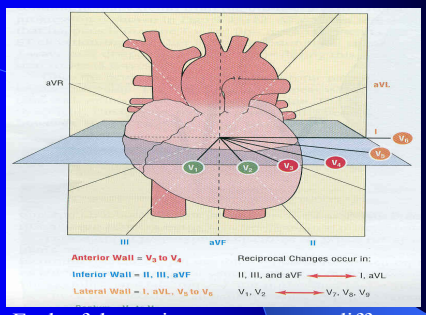
- Lateral wall is viewed by…
- V5 and V6

Leads in 3 Dimensions



By combining the limb leads and the precordial leads, we can obtain a 3 dimensional view of the heart

Views of the Heart



Each of these views represents a different portion of the LEFT ventricle

Typical Layout of the 12-lead ECG

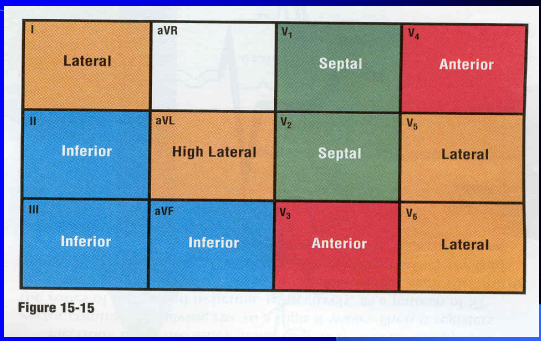
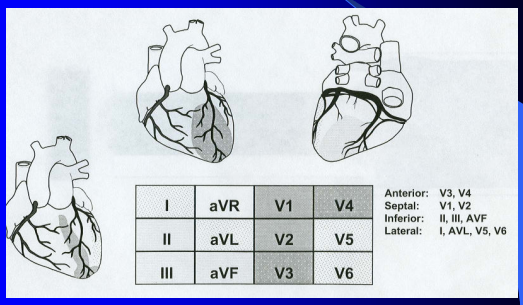


Figure 15-15

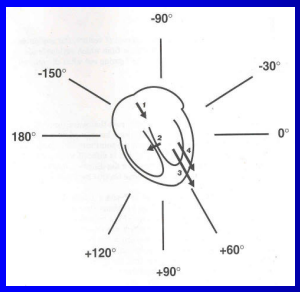
Typical Layout of the 12 lead ECG



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

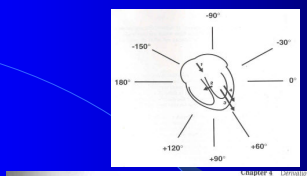
Anterior: V3, V4
Septal: V1, V2
Inferior: II, III, AVF
Lateral: I, AVL, V5, V6

Summation Vectors of Cardiac Depolarization



1 Atrial Depolarization
2 Septal Depolarization
3 Ventricular Depolarization
4 Ventricular Repolarization

A Normal 12-Lead ECG



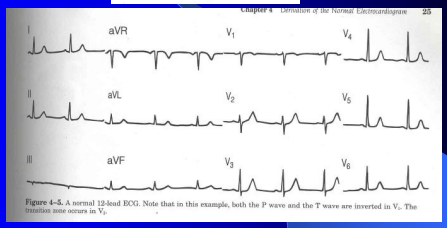
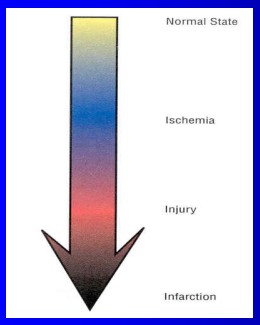


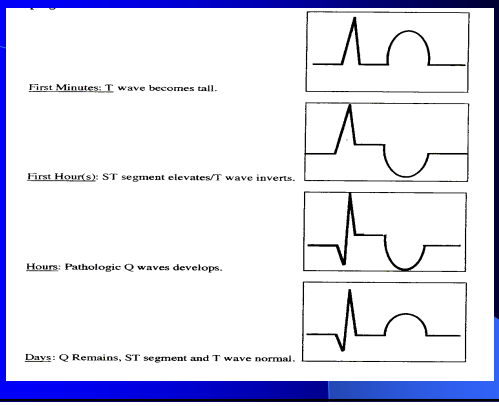
Figure 4–5. A normal 12-lead ECG. Note that in this example, both the P wave and the T wave are inverted in V_1. The transition zone occurs in V_2.

Progression of an AMI



- Ischemia and Injury are reversible
- An increase in demand, or a decrease in supply of oxygen can cause the ischemia/injury to worsen

Progression of an AMI



Progression of an AMI

T-Wave Inversion-

ischemia causes repolarization to occur along an abnormal pathway

ST Elevation-

the zone of injury does not repolarize completely, thus remaining more positive

Q-Wave Formation-

the infarcted (dead) tissue is electrically inert & acts like an electrical "window" allowing the electrode to "see" the opposite wall

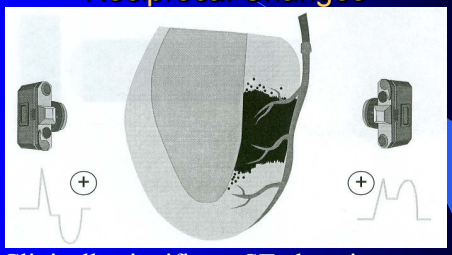
Progression of an AMI
ST Elevation

Must be > 1 mm in Inferior infarcts

" > 2 mm in Anterior "

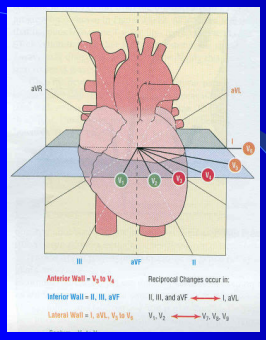
Must ALWAYS be present in 2 or more contiguous leads

Progression of an AMI
Reciprocal Changes



Clinically significant ST elevations may be confirmed by depressions in opposing leads

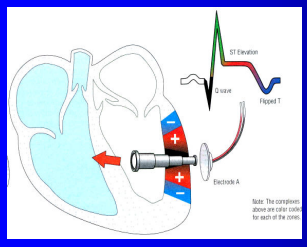
Progression of an AMI
R-Wave Progression



In an anterior infarct, for example, there normally is an R-wave in the anterior precordial leads (V3,V4).

As the tissue dies, the R becomes smaller and smaller due to a decrease in the forces of depolarization.

Progression of an AMI
Q-Waves



Eventually, the tissue becomes inert and a "window" allows the ECG to "see" the tissue on the opposite side of the ventricle.

This tissue (from ENDO cardium to EPIcardium) is depolarizing AWAY from these leads creating a NEGATIVE deflection (or Q-wave) where there would otherwise not be one.

Progression of AMI
Q-Wave

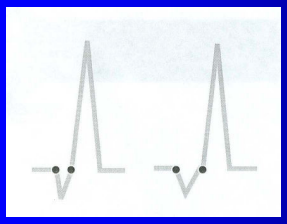
"Pathologic Q-Wave"-

.04 sec wide and 25% of height of R-wave

"Non-Q-Wave MI"

If the infarct is small, or does not involve the full thickness of the myocardium, it is referred to as a "non-q-wave" or "subendocardial" MI.

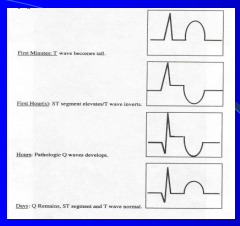
Progression of AMI
Q-Wave



The Q wave on the left is physiologic

The Q wave on the right is pathologic

Zones of Involvement



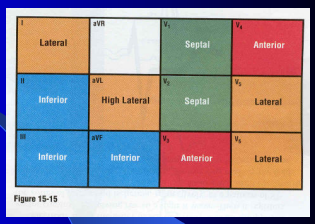
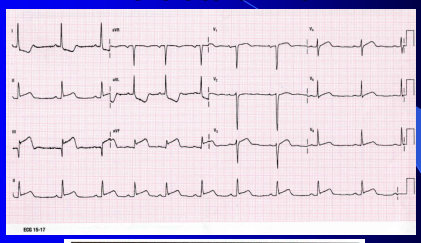


Figure 15-15

Look for these changes in 2 or more contiguous leads as well as reciprocal changes in opposing leads

Zones of Involvement
Inferolateral Wall



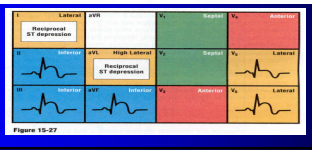
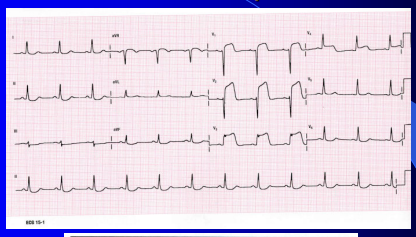


Figure 15-27

Zones of Involvement
Anteroseptal



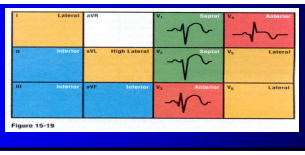
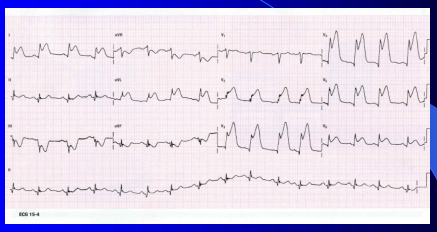


Figure 15-19

Zones of Involvement
Anteroseptal with Lateral Involvement



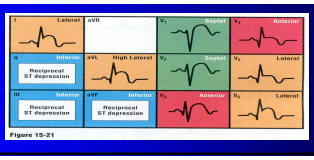
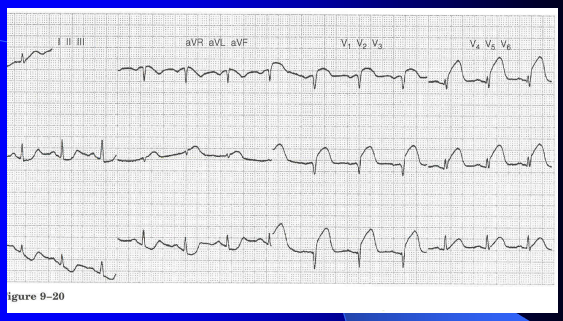


Figure 15-21

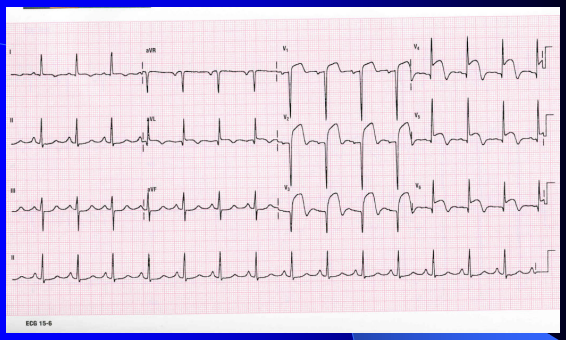
Practice



igure 9–20

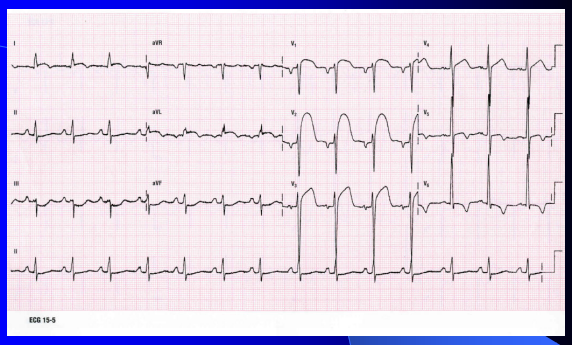
Anteroseptal

Practice



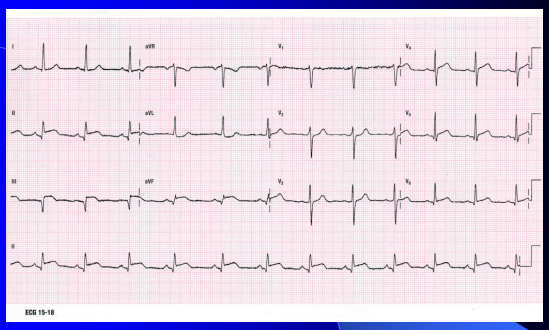
Anteroseptal with Lateral Extension

Practice



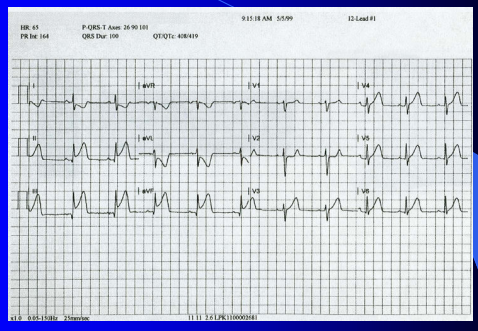
Anteroseptal with Lateral Extension

Practice



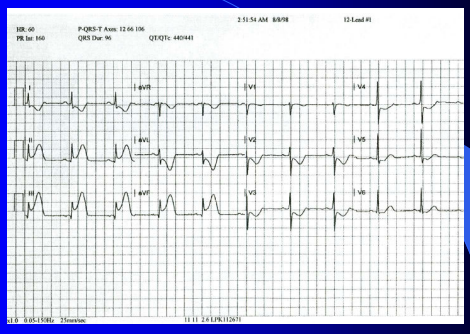
Inferolateral

Practice



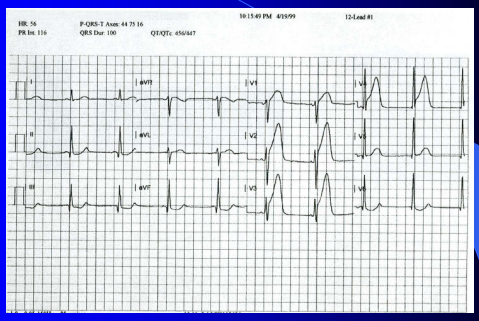
Inferolateral

Practice



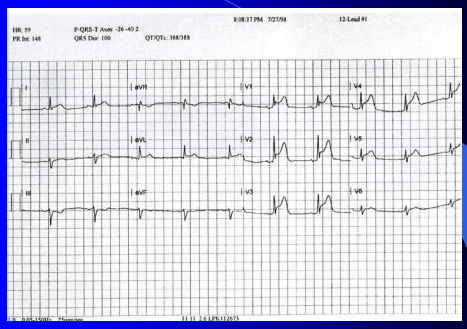
Inferolateral

Practice



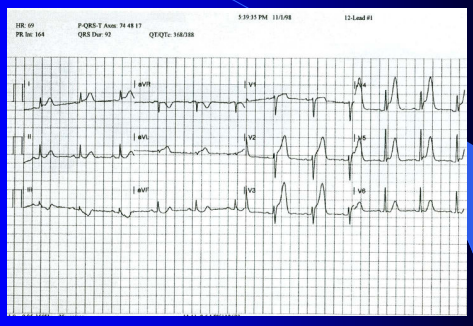
Anteroseptal

Practice



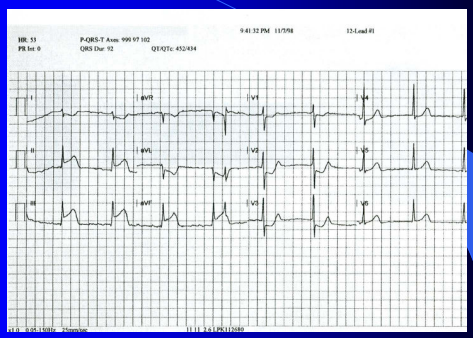
Anteroseptal with lateral extension

Practice



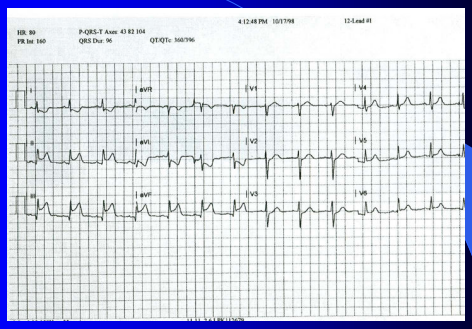
Anteroseptal with lateral extension

Practice



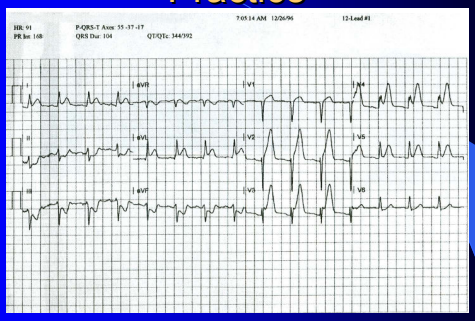
Inferolateral

Practice



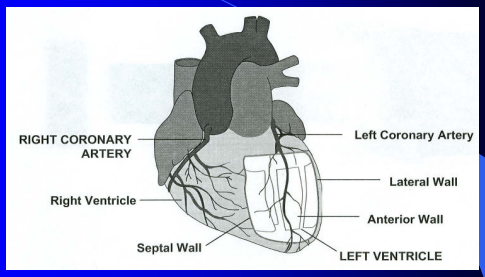
Inferolateral

Practice



Anteroseptal with lateral extension

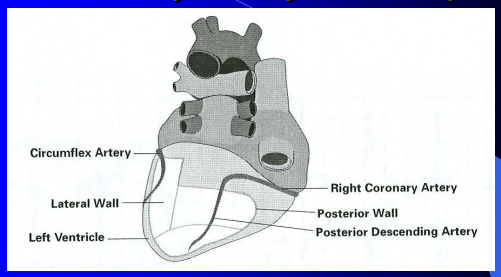
Coronary Artery Anatomy



Left Anterior Descending supplies septal and anterior walls

Left Circumflex supplies lateral wall

Coronary Artery Anatomy

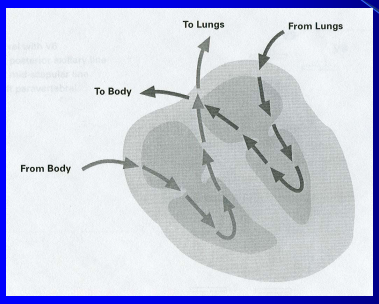


Right Coronary Artery supplies right ventricle, and inferior wall of left ventricle

Right Ventricular Infarct

- Should be suspected with Inferior Wall MI
- Confirm with Right sided ECG or V4R
- Respond poorly to vasodilators
- Respond well to fluids

Right Ventricular Infarct

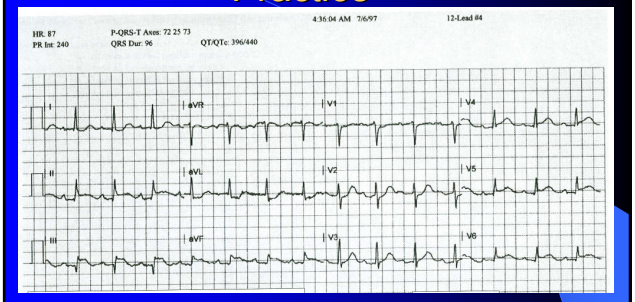


Dyspnea/Hypoxia with CLEAR lung sounds

Hypotension

JVD

Practice

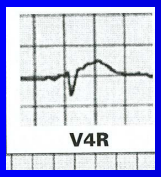


What walls are ischemic?

Where is the occlusion?

Do you need more information?

Practice cont'd.

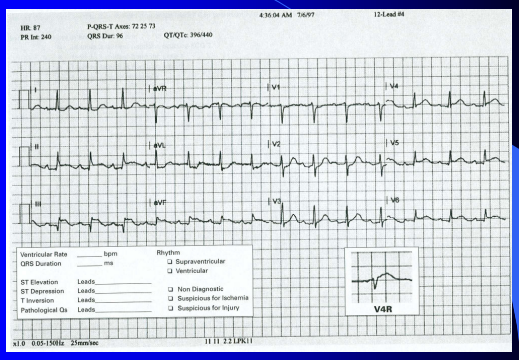


What information does this contribute?

Right ventricular ischemia

If the right ventricles and the inferior wall are all ischemic, the occlusion must be in the proximal portion of the RCA.

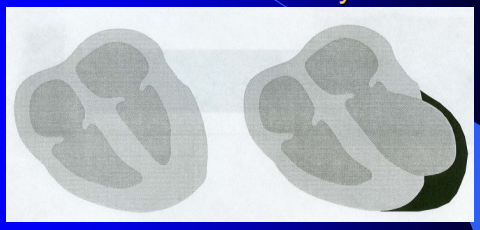
Right Ventricular Occlusion



Misc. ST Info

- May persist for months, especially with large infarctions
  - ventricular anneurysm Dx based on ST elevation persisting indefinately post MI.
- ST Elevations are also associated with pericarditis and "benign early repolarization changes"
  - both of these show elevation in all leads
  - " are usually deeply concave
  - ST elevation in MI is usually flat, sloping, or upwardly convex (tombstone)
  - Pericarditis often has P-R segment depression

Misc. ST Info
Ventricular Anneurysm

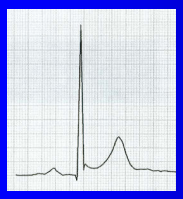


Infarcted tissue creates a bleb of diskinetic tissue that "pops out" when ventricle contracts.

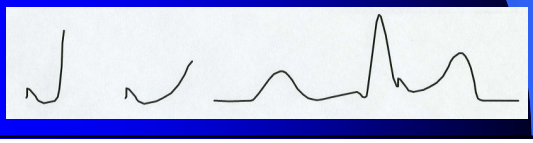
Misc. ST Info
Pericarditis

- Sharp chest pain that can be localized
- Radiates to base of neck between shoulder blades
- Pain worsens when supine, and improves when leans forward
- May produce ST elevation in ANY or all leads that may not be anatomically grouped
- Often, J-point notch or "fish hook" present

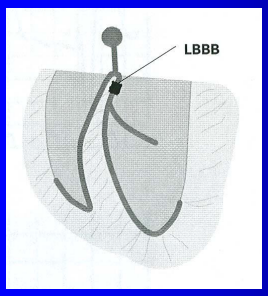
Misc ST Info
Benign Early Repolarization

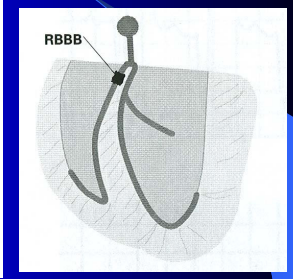


- Most often seen in 20-40 y/o African-American Males
- Usually seen in anterior and lateral leads
- Characteristic "Fish Hook" appearance to J point and ST



Bundle Branch Blocks

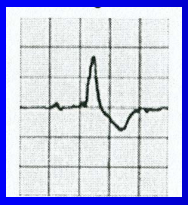




Bundle Branch Blocks

- Find the J-point in V1
- does preceding portion of QRS point up or down?
- Compare to turn signals

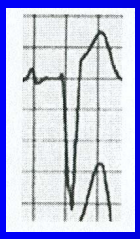
Bundle Branch Blocks



Assuming this is V1, is it a LBBB, or a RBBB?

Right BBB

Bundle Branch Blocks



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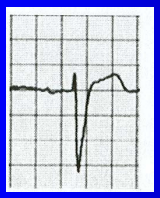
Left BBB

Bundle Branch Blocks



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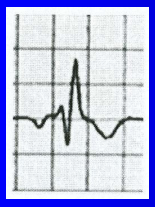
Left BBB

Bundle Branch Blocks



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