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

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

Electrodes and Waves

Leads are like Pictures

Limb Leads

They view the heart from a specific perspective

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

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

- Anterior Wall is viewed by I and aVF

The precordial leads view the heart in a 2-dimensional plane perpendicular to that of the limb leads.
By combining the limb leads and the precordial leads, we can obtain a 3 dimensional view of the heart.
Each of these views represents a different portion of the LEFT ventricle.

**Summation Vectors of Cardiac Depolarization**

1. Atrial Depolarization
2. Septal Depolarization
3. Ventricular Depolarization
4. Ventricular Repolarization
A Normal 12-Lead ECG

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

- 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

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**Reciprocal Changes**

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

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**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.

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**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 EPI cardium) 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.

Zones of Involvement

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

Inferolateral Wall

The Q wave on the left is physiologic
The Q wave on the right is pathologic
Anteroseptal

Anteroseptal with lateral extension

Anteroseptal with lateral extension

Inferolateral
Practice

Inferolateral

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 aneurysm Dx based on ST elevation persisting indefinitely 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

Ventricular Aneurysm

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

- 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

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

Left BBB

Bundle Branch Blocks

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