# 130322 – PBL 1: Chest Pain – Learning Issues
## MI: EKG findings and localization

| EKG Finding | Mechanism and Details |
|---|---|

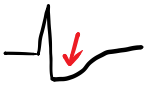
**Pathologic Q wave**

- *Transmural infarction*
- Because necrotic muscle does not generate electrical force, the EKG lead records current from healthy tissue on the opposite region of the ventricle, directed away from the lead and negative.
- Does not distinguish prior versus acute MI.
- On EKG: duration ≥ 1 small box, depth > 25% of QRS height.

**ST elevation**

- *Transmural ischemia*
- Ischemic myocardium leaks ions resulting in partial depolarization in diastole, producing electrical forces towards the patient's right shoulder, shifting the EKG baseline in lead II *downward.*
- When fully depolarized, the voltage is true zero, but the ST segment appears elevated versus the *abnormally depressed* baseline.

**ST depression**



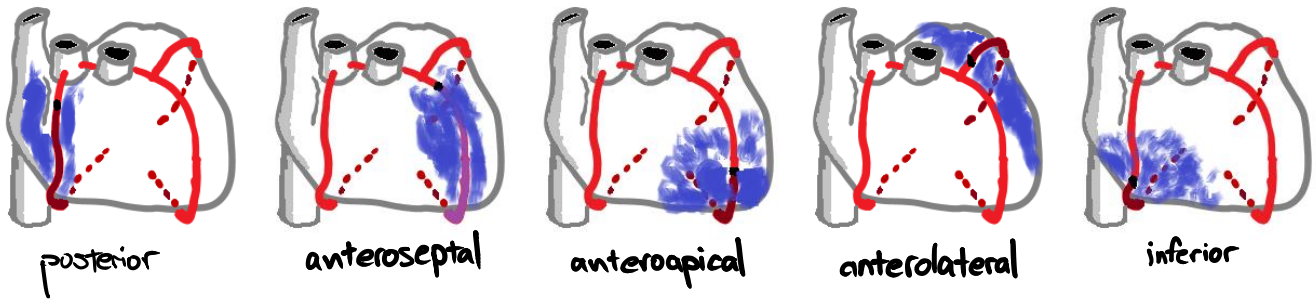
- *Subendocardial injury, angina*
- Partial depolarization before stimulation results in electrical forces towards the recording electrode, shifting the baseline EKG *upward.*
- When fully depolarized, the voltage is true zero, but the ST segment appears depressed versus the *abnormally elevated* baseline.

**T wave inversion**

- *Transmural ischemia*
- Ischemia increases current flow through $K^+$ channels which shortens depolarization.
- The base of the ventricle is more likely to suffer ischemia than the apex due to coronary artery anatomy and overall muscle mass.
- If the base of the ventricles is ischemic, it will exhibit a shortened depolarization and thus repolarize before the apex of the ventricle.
- The repolarization vector would thus point from the apex towards the base, opposite of the standard repolarization vector (see *systolic current theory*).

## Localization of MI

| Anatomic site | Leads with abnormalities | Coronary artery most responsible |
|---|---|---|
| Inferior | II, III, $aV_F$ | RCA |
| Anteroseptal | $V_1$-$V_2$ | LAD |
| Anteroapical | $V_3$-$V_4$ | LAD (distal) |
| Anterolateral | $V_5$-$V_6$, I, $aV_L$ | CFX |
| Posterior | $V_1$-$V_2$ (tall R wave, but no Q wave) | RCA |




● = thrombus
● = non-perfused coronary artery
● = ischemic tissue

## FAQ

**Q:** In MI, why is ST segment elevation and T wave inversion temporary, while Q wave pathology persist?

**A:** ST segment elevation and T wave inversion are due to ionic leak from injured myocardium; see diastolic and systolic leak current theories from Lilly. Pathologic Q waves are due to ischemic or dead myocardium not contributing to the depolarization vector. If the patient survives the MI, the prior two EKG pathologies correct themselves while the Q wave persists. If the ST segment remains elevated several weeks later, a fibrotic scar or ventricular aneurism has developed.

## References

Pathophysiology of Heart Disease 5E by Lilly, p.100
Medical Physiology 12E by Guyton and Hall, p.142
All images were made by the author with breathtaking skill in MS Paint and fancy tablet hardware