AMI LOOK-A-LIKES
Conflict of Interest

- None
Objectives

- List the criteria used for diagnosing acute myocardial infarction.
- Distinguish between acute coronary events requiring immediate intervention and those that do not.
- Recognize the more common conditions that may cause a pseudo-infarction pattern on ECG.
- Expand EKG reading skills
Acute Myocardial Infarction
AMI – World Health Organization Definition

- A combination of two of three characteristics:
  - Typical symptoms (i.e., ischemic-type chest discomfort)
  - A rise and fall in serum cardiac markers
  - Typical ECG pattern
    - ST-segment elevation in 2 or more contiguous leads
    - Typical evolution pattern
EKG evolution in ST segment elevation MIs

- Tall peaked T-waves
- ST-segment elevation
- Appearance of abnormal Q wave
- Decrease of ST-segment elevation with the beginning of T-wave inversion
- Isoelectric ST-segment with symmetrical T-wave inversion
EKG #1 – 68 y.o. BF with chest pain for 2-3 days...
Tall peaked T-waves

- The earliest sign of AMI
- Due to subendocardial ischemia
- Within minutes or hours after the onset of chest pain
- Transient

- Most ECGs fail to show this pattern
ST segment elevation (STE)

- The most common early ECG sign
- STE - specificity 91%, sensitivity 46%
- Mortality increases with the number of ECG leads showing ST elevation
- STE decreases in the first 7-12 hours
- STE resolves within 2 weeks in 90% of IWMI, but only in 40% of anterior MI
Reciprocal ST-segment depression

- Seen in up to 82%
- Marked early, 50% resolve within 24 hours
- Due to reciprocal electrical alteration
- Increases specificity of AMI to 99%
- Seen in 72% of IWMI
- Indicative of:
  - Larger AMI
  - Lower ventricular ejection fraction
  - Higher mortality
Abnormal Q-waves

- Most commonly presents while ST-segment still elevated
- 12-20% of Q-waves do not persist
- CHF is more common with persistent Q-waves
Errors in AMI over diagnosis


- 93 patients with chest pain receiving thrombolytic therapy, AMI did not occur in 10 (11%)
  - Left Ventricular Hypertrophy (LVH)- 30%
  - Benign Early Repolarization (BER)- 30%
  - Intraventricular Conduction Delay (IVCD)- 30%
Causes of ST segment elevation

- Acute myocardial infarction
- Variant (Prinzmetal's) angina
- Acute pericarditis
- Left ventricular aneurysm
- Left ventricular hypertrophy
- Bundle branch blocks
- Benign early repolarization
Causes of ST segment elevation

Metabolic

- Hyperkalemia
- Hypothermia (Osborne or "J" waves)
- Hyperventilation
Causes of ST segment elevation

Miscellaneous

- Acute abdominal disorders (pancreatitis, cholecystitis, peritonitis)
- Central nervous system hemorrhage
- Medications (type I anti-arrhythmic agents, isoproterenol)
- Body habitus
- Idiopathic
EKG #2 – 66 y.o. WM with 1 hr hx of chest pressure
LBBB- ECG criteria

- Prolonged QRS duration (≥ 0.12 sec)
- Delayed onset of intrinsicoid deflection in leads I, V5, V6
- Broad monophasic R waves in leads I, V5, V6
- Secondary ST & T wave changes opposite in the direction to the major QRS deflection
- rS or QS complex in right precordial leads
- Left axis deviation may be present
LBBB with MI

- Fulfills criteria for LBBB
- Three criteria (Sgarbossa criteria) with independent value for diagnosing AMI:
  - ST elevation \( \geq 1 \) mm concordant to the major deflection of the QRS
  - ST depression \( \geq 1 \) mm in V1, V2, or V3
  - ST elevation \( \geq 5 \) mm discordant with the major deflection of the QRS
LBBB with inferolateral MI...
LBBB and AWMI...
EKG # 3 – 68 y.o. HM with sharp, stabbing chest pain
RBBB- ECG criteria

- QRS duration $\geq 0.12$ sec
- Delayed onset of intrinsicoid deflection
- Increased amplitude of the R’ in V1-V2
- Wide, slurred S wave in leads I,V5,V6
- Secondary ST-T abnormality
Right bundle branch block...
Right bundle branch block...
Most patients with RBBB have CAD
Many have no evidence of underlying heart disease
In patients with AMI, RBBB is present in 3-7% of cases
In uncomplicated RBBB, there usually is little ST-segment displacement
AMI in the presence of RBBB

- RBBB does not interfere with the recognition of infarcts.
- Even in presence of RBBB and either LAHB or LPHB, infarcts can be evaluated normally - EXCEPT
  - True posterior MI
RBBB w/ inferoposterior MI...
RBBB+LAHB w/ anterolateral MI...
RBBB+LPHB w/ anteroseptal MI...
EKG #4 – 39 y.o. BM with chest pain and PMHx of HTN
LVH with ST-T wave changes

- ECG diagnosis: based on the increase of the QRS voltage
- **Possible LVH** - only voltage evidence of LVH
- **“Definite LVH”** - voltage evidence of LVH associated with ST-T wave changes (strain)
- **Strain pattern** – characterized by downsloping ST depression with asymmetric, biphasic, or inverted T wave (occurs in 70% of cases)
LVH

- ECG is 93-96% specific and 12-29% sensitive in diagnosing LVH
- Echocardiography - 86% specificity and 100% sensitivity for diagnosis of LVH
LVH by voltage only

- Commonly used voltage-based criteria
  - Precordial leads (one or more)
    - RV5 or V6 + SV1
      - >35 mm if age >30 years
      - >40 mm if age 20-30 years
      - >60 mm if age 16-19 years
    - Maximum R wave + S wave in precordial leads >45 mm
    - RV5 >26 mm
    - RV6 >20 mm
LVH by voltage only

- Cornell Criteria- RaVL+SV3
  - >24 mm in males
  - >20 mm in female
LVH by voltage only

Other commonly used voltage criteria
- Limb leads (one or more)
  - RaVL > 12 mm
  - RI + SII > 26 mm
  - RI > 14 mm
  - SaVR > 15 mm
  - RaVF > 21 mm
LVH by both voltage and ST-T segment abnormalities

- Voltage criteria for LVH
- ST-T segment abnormalities
  - ST segment and T wave deviation opposite in direction to the major deflection of QRS
  - ST segment depression in leads I, aVL, III, aVF +/- V4-V6
  - Subtle ST elevation (1-2 mm) in leads V1-V3
  - Inverted T waves in leads I, aVL, V4-V6
  - Prominent or inverted U waves
EKG #5 – 62 y.o. WM with profuse diaphoresis and vomiting
EKG #6 – 72 y.o. WM with generalized weakness and PMHx of CKD and PAF
Hyperkalemia – peaked T-waves...
Hyperkalemia – broad, low-amplitude P-waves...
Hyperkalemia – diffuse widening of QRS complex w/ merging of QRS and T-waves
EKG #7 – 45 y.o. female with onset of chest pain 2 hrs ago
Acute pericarditis

- Stage 1 - Concave up ST segment elevation
- Stage 2 - ST segment normal, flattening of the T waves
- Stage 3 - T wave inversion without Q wave formation
- Stage 4 - Normalization of ECG
Acute pericarditis – other ECG clues

- Sinus tachycardia
- PR depression early
- Low voltage QRS
- Electrical alternans if pericardial effusion
EKG #8 – 34 y.o. BM with chest pain and no PMHx
Benign Early Repolarization (BER)

- First described in 1936 by Shipley
- A normal variant - 1% general population
- Common in athletes
- BER - in adult ED chest pain patients ~13%
- BER is seen on ECGs of 23-48% of adult ED chest pain patients who have used cocaine
Benign Early Repolarization (BER)

- Mean age - 39 (16-80)
- Most commonly less than 50 years of age - older than 70 years (3.5%)
- Seen in men much more often than women
ECG criteria for BER

- Elevated take-off of ST segment at the J point
- Upward concavity of the initial portion of the ST segment
- Symmetric, concordant T waves of large amplitude
- Widespread or diffuse distribution of ST segment elevation on the ECG - most commonly in leads V2-V5, sometimes in inferior leads
- No reciprocal ST segment change
- Relative temporal stability
ECG criteria for BER

- J point elevation - less than 3.5 mm
- ST segment appears as if it has been lifted evenly upward
- STE is less than 2 mm in 80-90%
- Only 2% of cases STE is greater than 5 mm
BER or pericarditis?

- ST segment elevation in the two syndromes is similar
- PR segment in pericarditis is often depressed
- ST segment elevation in acute pericarditis tends to be widespread across the ECG
- The ratio of the ST segment elevation to the height of the T wave (ST/T) is also a helpful guide; a ratio greater than 0.25 in lead $V_6$ strongly suggests pericarditis
BER or pericarditis?
BER or AMI

- ST-T wave complex waveform
- Reciprocal changes
- Evolutionary changes
EKG #9 – 50 y.o. WM with crushing substernal chest pain for 30 min.
EKG #10 – 72 y.o. WF found unconscious and PMHx of HTN
CNS hemorrhage
EKG #11 – 67 y.o. BM in respiratory failure due to CHF and PMHx of MI
EKG # 12 – 74 y.o. WF with chest pain...
EKG # 13 – 78 y.o. WM with chest pain and known CAD...
EKG # 13 – 78 y.o. WM with chest pain and known CAD...
EKG # 14 – 24 y.o. WF with chest pain...
EKG # 15 – 71 y.o. WM with palpitations...
Questions ????