All About STEMIls

Presented By:
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Disclosures

• None
Objectives

• Identify signs and symptoms of a heart attack
• Identify risk factors associated with having a heart attack
• Review and interpret ECGs and STEMI mimics
• Review and discuss elements of STEMI guidelines with rationales.
Photograph of a Complete Electrocardiograph, Showing the Manner in which the Electrodes are Attached to the Patient. In this Case the Hands and One Foot Being Immersed in Jars of Salt Solution
Einthoven’s Triangle
12-lead ECG Placement

1. Place limb leads on soft tissue surfaces & not the bone according to the diagram on above right:
   - White RA = Upper Right Arm
   - Black LA = Upper Left Arm
   - Red LL = Lower Left Leg
   - Green RL = Lower Right Leg

2. Apply the 12 Lead ECG per diagram on upper left:
   - V1 = Palpate the patient’s chest & locate the right 4th intercostal space below the 4th rib
   - V2 = Place directly across the sternum on the left 4th intercostal space below the 4th rib
   - V3 = Skip
   - V4 = Place on the left 5th intercostal space below the midclavicular line
   - V5 = Place right in the middle of the imaginary line between V2 & V4
   - V6 = Skip
   - V6 = Place on the mid-axillary line on the left 5th intercostal space keeping it in a horizontal line (do not curve upward)
   - V5 = Place directly in the middle of V4 & V6 keeping it in a horizontal line
   - Ignore V4R
12-Lead ECG Waveform Review

- Atrial Depolarization
- Ventricular Depolarization
- Ventricular Repolarization
- PR Interval
- QT Interval
- QRS Complex
- ST Segment

Essentia Health
Here with you
Isoelectric line

- Baseline tracing without electrical activity
- Resting phase of myocardium
- Waveforms and intervals are measured at the point of deviation from the isoelectric line
Normal ECG
Anatomical view of heart and corresponding leads

Inferior: II, III, AVF (RCA)

Septal: V1, V2 (LAD)

Anterior: V3, V4 (LAD)

Lateral: I, AVL, V5, V6 (Circ)
Assessing a 12-lead

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Inferior Leads  II, III, AVF
Septal Leads  V1, V2
Anterior Leads  V3, V4
Lateral Leads  V5, V6, I, AVL
J-Point
ST Segment
How to Measure ST Elevation

Baseline

ST-elevation

ST-segment

http://bit.ly/yXs4Cf
Measuring the ST Segment

Compare ST segment to the TP segment
T-wave abnormalities

- Normal ECG
- ST Depression
- ST Elevation
- T Inversion
STEMI Definition

• STEMI is characterized by the presence of both criteria:
  
  • **ECG evidence of STEMI:** ST-segment elevation at the J-point in two contiguous leads with the cut-off points: ≥2 mm in men or ≥1.5 mm in women in leads V2-V3 or ≥1 mm in other leads.
  
  • **Cardiac biomarkers (CKMB, Troponin)** exceed the upper limit of normal according to the individual hospital's laboratory parameters with a clinical presentation which is consistent or suggestive of ischemia.

J-point = Intersection of end of QRS complex with beginning of ST segment
Evolution of a STEMI

Figure 4.24. ECG evolution during acute ST elevation myocardial infarction (also termed “acute Q wave myocardial infarction”). However, as described in Chapter 7, if successful early reperfusion of the coronary occlusion is achieved, the elevated ST segments return to baseline without subsequent T wave inversion or Q wave development.
STEML

ST-Elevation Myocardial Infarction

–Complete occlusion of a coronary artery that eventually produces elevation of the ST segment in the ECG of most patients.
–Cardiac muscle death begins and proceeds rapidly through the various layers of the heart supplied by that artery unless flow is reestablished.

The “wave of necrosis”
Anterior STEMI

• **ECG Characteristics**
  » ST elevation in leads V1-V6. Maximum elevation in V3, maximum depression in III
  » Later: pathological Q-wave in the precordial leads V2 to V4-V5.

**Complications**

» Heart failure
» VT/VF
» Ventricular septal defect
» Complete heart block
» Myocardial rupture
Anterior STEMI

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Anterior: V3, V4 (LAD)
STEMI
Treatment in cath lab

Anterior: V3, V4 (LAD)

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### AnteroSeptal STEMI

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**Anterior:** V3, V4 *(LAD)*

**Septal:** V1, V2 *(LAD)*
Inferior STEMI

• **ST elevation in II, III and aVF**
  » This part of the heart muscle lies on the diaphragm and is supplied of blood by the right coronary artery (RCA) in 80% of patients. [In the remaining 20% the inferior wall is supplied by circumflex artery (LCx).]

• **Complications**
  » Sinus bradycardia, sinus arrest, heart block
  » Papillary muscle rupture
  » RV failure with RV involvement
Inferior STEMI

Inferior: II, III, AVF (RCA)
STEMI
Treatment in cath lab

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Inferior: II, III, AVF (RCA)
Lateral STEMI

- Lateral wall of the left ventricle
- ST elevation in leads I, aVL, V5 and V6
  » Supplied by the LCx, LAD, or a branch of the RCA
  » Usually accompanies an anterior or inferior MI
- Complications
  » VT
  » HF
  » HB

Lateral: I, AVL, V5, V6 (Circ)
Lateral STEMI

Lateral: I, AVL, V5, V6 (Circ)
STEMI
Treatment in cath lab

Lateral: I, AVL, V5, V6 (Circ)
Reciprocal Changes

» ST depression in leads opposite the infarction
» Strengthen suspicion for AMI, but are not necessary to identify STEMI
DIFFERENTIATE STEMI FROM STEMI IMPOSTERS

NOT SURE IF ITS A STEMI

OR JUST LVH
ST Segment Morphology

ST-segment morphology

STEMI
ST Segment Morphology

The various faces of STEMI
ST Segment Morphology

ST elevation in other conditions

- Pericarditis
- BER
- LBBB
- LV aneurysm
- Brugada
Left Ventricular Hypertrophy (LVH)

- Increases height of QRS
- Voltage criteria formula for determining if LVH:
  1. Compare V1 and V2 and decide which one has the deepest negative deflection
  2. Compare V5 and V6, deciding which one has the tallest positive deflection
  3. Add the numbers, and if the sum is 35 mm or more, suspect LVH.

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<th>Voltage</th>
<th>Measurement</th>
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<tr>
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<td>V5</td>
<td>23 mm</td>
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<td>43 mm</td>
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Left Ventricular Hypertrophy (LVH)
Left Bundle Branch Block

3 Criteria for AMI with LBBB

• ST Segment Elevation of ≥1mm concordant with QRS direction in any lead
  *(STRONGEST PREDICTOR – 5 points)*

• ST Segment Depression of ≥1mm in leads V₁, V₂ or V₃
  *(3 points)*

• ST Segment Elevation of ≥5mm discordant with QRS direction in any lead
  *(Weakest Predictor – 2 points)*
Left Bundle Branch Block

» It is difficult to distinguish an acute from a chronic left bundle branch block without access to a previous 12-lead EKG

» A left bundle branch block without other signs of symptoms of MI is not considered a STEMI
Left Bundle Branch Block
Paced Rhythm

Electrocardiographic Criteria

The three criteria used to diagnose infarction in patients with LBBB are:

- Concordant ST elevation > 1mm in leads with a positive QRS complex (score 5)
- Concordant ST depression > 1 mm in V1-V3 (score 3)
- Excessively discordant ST elevation > 5 mm in leads with a negative QRS complex (score 2). This criterion is sensitive, but not specific for ischemia in LBBB. It is however associated with a worse prognosis, when present in LBBB during ischemia.

A total score of ≥ 3 has a specificity of 90% for diagnosing myocardial infarction.

During right ventricular pacing the ECG also shows left bundle branch block and the above rules also apply for the diagnosis of myocardial infarction during pacing. However they are less specific.
Paced Rhythm
Paced Rhythm with a STEMI
Pericarditis

» **ST elevation is concave** – in STEMI it is typically convex or flat

» **ST elevation is diffuse** – in STEMI it is usually confined to one distribution

» **PR depression** – occurs in pericarditis
Pericarditis
Pericarditis
Benign Early Repolarization (BER)

**Early repolarization**
- The displacement is commonly 1-2 mm.
- Most prominent in early precordial leads V1-V3
- Causes elevation of the J point
- Causes a “downward sagging” of the ST-segment
- Has tall peaked T waves
- A notch on the R wave
- Sometimes sinus bradycardia

Early repolarization causes elevation of the J point and a “downward sagging” of the ST-segment.

Associated ECG findings are tall, peaked T waves, a slur or notch on the R wave and, in some cases, sinus bradycardia.

In contrast, the acute injury current causes horizontal or square root elevation of the ST-segment or “upward sloping” of the ST-segment.

An analogy to a smiley face has been used: smiley face, early repolarization; sad face, injury current. This differentiation can be difficult, and clinical correlation and repeat serial ECGs may be necessary.
Benign Early Repolarization (BER)
Brugada Syndrome

» RBBB pattern
» ST elevation only in the right precordial leads V1-V2
» Saddle-shaped or coved-shaped ST elevation
» Syndrome has been linked to mutations in the cardiac sodium channel gene
» Much more common in men

http://www.mayoclinic.org/diseases-conditions/brugada-syndrome/basics/definition/con-20034848
Brugada Syndrome

Brugada Syndrome

- AKA Sudden Unexpected Death Syndrome
- Death occurs from ventricular fibrillation
- Sodium-related conduction abnormality
- VERY UNCOMMON

The B column to the right shows the most common Presentation of Brugada Syndrome.
Brugada Syndrome
EKG Characteristics

Patients with Brugada have a pseudo-RBBB and persistent ST elevations in V1-V2.

**Type 1**
- ST elevations ≥ 2mm
- Downsloping ST segment
- Inverted T wave

**Type 2**
- ST elevations ≥ 2mm
- “Saddle back” ST-T wave configuration
- Upright or biphasic T wave
Brugada Syndrome

Tako-Tsubo Cardiomyopathy
a.k.a. “Broken Heart Syndrome”

» Almost always affects women
» Presentation: chest pain and shortness of breath after severe emotional or physical stress
» ECG can mimic STEMI
» Rise in biomarkers can occur
» Normal coronary arteries or nonobstructive CAD
» LV apical ballooning
» Temporary condition – usually resolves within one month

» https://youtu.be/60QDoupOsvQ

Tako-Tsubo Cardiomyopathy

a.k.a. “Broken Heart Syndrome”
IMPORTANT!

» The presence of an imposter does not rule out AMI

» If you suspect infarct BEFORE the 12-lead...you must still suspect infarct AFTER the 12-lead!
LETS PRACTICE!!!!

STEMI?

GET TO DA CATH LAB!!!

STEMI?

NO
Where’s the STEMI???
Where's the STEMI???
Where’s the STEMI???
Where’s the STEMI???
Where's the STEMI???
Where’s the STEMI???
Where’s the STEMI???
Thank you for your commitment to providing excellent cardiac care!