Tips and Tricks to Demystify 12 Lead ECG Interpretation

Mission: Lifeline North Dakota
Regional EMS and Hospital Conference
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Disclosures

- None
Agenda

• Role of EMS in pre-hospital STEMI Identification

• “Where is my MI?!?!?!?!”

• ST-Elevations and the Differential Diagnosis
EMS Role in Activation

• Education and Recognition
  – Your eyes won’t “see” if you don’t know what you are looking for.

• Action
  – Knowledge leads to empowerment

• The above leads to improved outcomes
  – Significantly improved DTB
    • Mortality, Morbidity
    • Standard of Care
    • How we are “judged”
ECG 101

- Representation of bio-electrical currents
  - using leads positioned at set reference points on the body
Patient Preparation:
1. Ensure the patient is warm and relaxed.
2. Shave electrode site before cleaning if excessive hair is present.
3. Normal skin – wipe with soap and water, then dry.
4. Oily skin – wipe with alcohol, then dry.

Chest Placement
- Lead Electrode Placement:
  - V1: Fourth intercostal space at right margin of sternum.
  - V2: Fourth intercostal space at left margin of sternum.
  - V3: Midway between position V2 and position V4.
  - V4: Fifth intercostal space at junction of the left midclavicular line.
  - V5: At horizontal level of position V4 at left anterior axillary line.
  - V6: At horizontal level of position V4 at left midaxillary line.

For technical support or supplies, please call 1-800-426-8837. Or contact your Cardiac Science distributor.
“What is the ST segment?”

- Represents the phase in cardiac cycle between ventricular depolarization and repolarization
- Iso-electric relative to TP segment
- Measured starting at J-point
TP Segment

P

PR

R

Q

S

J point

ST

T

U

QT
What exactly is a STEMI?

- ST-Elevation Myocardial Infarction
  - WHO criteria
    - Ischemic chest pain for $\geq 20$ minutes
    - ECG changes
    - Rise and fall of serum biomarkers (CK-MB, troponin)
“Typical” Chest Pain

- Substernal chest discomfort
  - Radiation to shoulder, neck, jaw, back, arms
    - May be epigastric, “burning,” associated with vomiting
- Onset with exertion or emotional stress
  - Often lasting 20 minutes or more
- Relief with rest or nitroglycerin
Defining ST Elevation

• ST segments measured
  – At J point if relative to PR segment
  – At 0.06-0.08s from J point if relative to TP segment
Defining ST Elevation

• Minnesota Code
  – ≥1 mm ST elevation in one or more of leads I, II, III, aVL, aVF, V5, V6, or ≥ 2 mm ST elevation in one or more of leads V1-V4

• AHA/ACC
  – ST elevation at the J point in at least 2 contiguous leads of ≥ 2 mm in men or ≥ 1.5 mm in women in leads V2–V3 and/or of ≥1 mm in other contiguous chest leads or the limb leads
Localizing an MI
Location of Myocardial Infarction

- Anteroseptal: V1-V3
- Anterior: rS V1, V2-V4
- Anterolateral: V4-V6, I, aVL
- Extensive Anterior: V1-V6 +/- I, aVL
Localization of Myocardial Infarction

- Lateral (high) I, aVL
- Inferior II, III, aVF
- Inferolateral II, III, aVF, V5, V6
- Posterior R/S V1>1
Suspected Posterior MI

- Suspected MI with a non-diagnostic ECG
- Record leads V7-V9
- Correlates with posterior wall MI
- Left circumflex infarct related artery in all

V7: posterior axillary line
V8: posterior scapula line
V9: Left border of spine
V5-V9: same horizontal plane as V4

J Am Coll Cardiol 1999;34:748.
RV Infarct

• IWMI + ST elevation in V1 $\rightarrow$ RV infarct

• Or use of Right-sided chest leads
RV Infarction

- Higher in-hospital mortality: 31% vs 6%
- Higher in-hospital complication: 64% vs 28%
- No difference in post-hospital course
- In-hospital complications: VT, heart block, myocardial rupture, cardiogenic shock or reinfarction

“But there is a left bundle branch block…….”

- Try to obtain and compare to prior ECGs/establish if different from baseline

- Keep in mind presentation of patient!!
### Sgarbossa Criteria

**Table 4. Odds Ratios and Scores for Independent Electrocardiographic Criteria.**

<table>
<thead>
<tr>
<th>Criterion</th>
<th>Odds Ratio (95% CI)</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>ST-segment elevation $\geq 1$ mm and concordant with QRS complex</td>
<td>25.2 (11.6–54.7)</td>
<td>5</td>
</tr>
<tr>
<td>ST-segment depression $\geq 1$ mm in lead $V_1$, $V_2$, or $V_3$</td>
<td>6.0 (1.9–19.3)</td>
<td>3</td>
</tr>
<tr>
<td>ST-segment elevation $\geq 5$ mm and discordant with QRS complex</td>
<td>4.3 (1.8–10.6)</td>
<td>2</td>
</tr>
</tbody>
</table>

- **Sum score of 3:** 90% specificity for MI
“But don’t all ST elevations mean an MI?”

• No!

• Beware of mimics

• Always keep in mind clinical presentation
“But how often does this really happen…?”

- Of 123 adult chest pain patients with ST segment elevation $\geq 1\text{mm}$, 63 patients (51%) did not have myocardial infarctions.
- These non-MI were mainly
  - LBBB (21%) and
  - LVH (33%).
ACS

• Clinical Presentation
  – Chest Pain*
  – Diaphoresis
  – Dyspnea
  – Fatigue
  – Nausea
  – Syncope
  – Sudden Cardiac Death
Some reasons why there are STEMI masqueraders....
### Differential Diagnosis of ST Elevation

<table>
<thead>
<tr>
<th>MI</th>
<th>Tumor invading LV</th>
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</thead>
<tbody>
<tr>
<td>Prinzmetal’s angina</td>
<td>Trauma to the ventricles</td>
</tr>
<tr>
<td>Takotsubo syndrome</td>
<td>Hypothermia</td>
</tr>
<tr>
<td>Ventricular aneurysm or dyskinesis or akinesis</td>
<td>Post DC cardioversion</td>
</tr>
<tr>
<td>Acute pericarditis</td>
<td>Intracranial hemorrhage</td>
</tr>
<tr>
<td>Early repolarization</td>
<td>Hyperkalemia</td>
</tr>
<tr>
<td>LVH or LBBB</td>
<td>Brugada syndrome</td>
</tr>
<tr>
<td>Myocarditis</td>
<td>Type 1C antiarrhythmic drugs</td>
</tr>
<tr>
<td>Hypercalcemia</td>
<td></td>
</tr>
</tbody>
</table>
"Atypical" Chest Pain

- Sharp in nature (Pleurisy, pericarditis)
- Positional (Pericarditis, musculoskeletal)
- Tearing quality (Aortic dissection)
- Pain worsened with respiration (Pleurisy, pericarditis)
The More I Think
The More Confused I Get
Morphology of STE

- Concave shape STE – non AMI causes
- **AMI** causes – usually demonstrate convex/straight STE

Apex of T wave

J point

Convex STE

Concave STE
Benign Early Repolarization

- Concave STE
- Large amplitude T wave
- Notching or slurring of J point
Pericarditis

Pericarditis
Hyperkalemia

Hyperacute T waves
ST Elevation morphologies in Brugada Syndrome

RBBB with RSR pattern rather than rSR pattern and there is associated STE

FIGURE 9. (A) The “coved”-type ST-segment elevation; note the convex morphology. (B) The “saddle”-type ST-segment elevation; note the concave morphology.
Key Points

• What you know and do matters!!!!

• Learn from Experience (yours, others, feedback)

• Clinical presentation is as important (if not more) than what is on the ECG.