12 Lead ECG and STEMI Triage

Protocols 5.1 & 4.27

Revised 3/3/2008
References provided on last slide
Objectives

- Purpose of Pre-Hospital 12-Lead ECGs
- Pre-Hospital 12-Lead ECG Background
- 12-Lead ECG (ACS 12-Lead ECG Protocol)
  - Indications of 12-Lead ECG
  - Skin preparation
  - Practical understanding of lead placement
  - 12-Lead ECG acquisition process
- Understanding the 12-Lead ECG printout
- What to do with the printout
- Skills evaluation: Lead placement & acquisition
Pre-Hospital 12-Lead ECG Purpose

- **What is this all for?**
  - Earlier selection and transport to definitive care facility\(^{(5)}\)
    - STEMI Triage Protocol will determine the receiving facility
  - Speed diagnosis & treatment to reduce the amount of tissue death by reperfusing the heart sooner\(^{(5)}\)
    - Fibrinolysis (meds) or Percutaneous Coronary Intervention (PCI)
  - Overall decrease in mortality\(^{(5)}\)
    - Less deaths from AMI overall
    - VF & VT most likely to occur in first 4 hours after onset of s/s
  - Preserve Left Ventricular function\(^{(5)}\)
    - Thus preserving lifestyle for patient (with less CHF)
  - Decrease long term overall incidence of CHF and its financial impact on society
Pre-Hospital 12-Lead ECG Purpose

• What is this **not** for?
  – Ruling out an AMI (heart attack)
    • Only about 50% of AMIs have ST Segment Elevation\(^1\)
  – Deciding how to treat your patient
    • Do not let the 12 lead decide how you are going to proceed with treatment
    • Follow the Adult –Cardiac: Chest Pain (Suspected Myocardial Event) Protocol
      – Providing Oxygen, Aspirin, assisting with prescribed Nitroglycerin and calling for ALS are all **required** (within indications and contraindications) by the Chest Pain (Non-Traumatic) protocol regardless of 12 lead ECG interpretation
      – ALS: INT or IV, Nitroglycerin, Morphine and Metoprolol as necessary
EMT – Basic

1. Administer oxygen, obtain vital signs, and initiate pulse oximetry monitoring.

2. EMT-B (OPTIONAL) Aspirin 325 mg (4 baby aspirin) chewed.

3. Assist patient with prescribed Nitroglycerin (NTG), 1 tablet SL every 5 minutes as long as SBP >90 mmHg, to a maximum of 3 doses.

4. EMT – Basic (OPTIONAL) should apply 1 inch of 2% Nitropaste (15 mg) topically. If patient has taken NTG in past, may administer 1 Nitroglycerin tablet SL every 5 minutes as long as SBP >90 mmHg.

* NOTE ASK PATIENT REGARDING PERFORMANCE ENHANCING DRUGS
1. Establish IV access.
2. Nitroglycerin 0.4 mg SL every 5 minutes with a SBP >90 mmHg.
3. Apply 1 inch of 2% Nitropaste (15 mg) topically keeping SBP >90 mmHg.

* NOTE ASK PATIENT REGARDING PERFORMANCE ENHANCING DRUGS
Adult-Cardiac: Chest Pain (Suspected Myocardial Event) Protocol Review

EMT – Intermediate / Paramedic

1. Initiate cardiac monitoring.
2. If pain persists, consider Morphine Sulfate 2 mg slow IV, maintaining a SBP >90 mmHg. May be repeated every 5-10 minutes to a total of 6 mg.
3. Obtain 12-lead ECG if available.
4. For patients with persistent chest pain after above measures, and/or a 12 lead ECG indicating an Acute Myocardial Infarction, pulse rate greater than 80 and systolic blood pressure greater than 120 mmHg, Metoprolol (Lopressor) 5 mg IV, may be repeated every 10 minutes up to a total of 15 mg.
5. For patients with repeated vomiting, consider Ondansetron (Zofran) 4 mg IV/IM.
Acute Coronary Syndrome (ACS) 12-Lead ECG Guideline
To be used in conjunction with the Adult – Cardiac: Chest Pain Guideline

- Since ALS providers are not always available or first on the scene, it may be appropriate for providers of all levels to be trained to perform 12-lead ECG. Continuing cardiac (rhythm) monitoring remains an EMT – Intermediate / Paramedic skill.
- 12-lead ECG may be indicated for chest pain or severe dyspnea (difficulty breathing).
- Obtaining a 12-lead ECG should not delay patient transport more than 2-3 minutes. Initiating care of the unstable patient takes precedence over 12-lead ECG; whenever possible patient care and 12-lead ECG to take place simultaneously.
- Once a 12-lead ECG has been obtained, the patient must be transported, and every effort will be made by a BLS provider to obtain ALS-level care for the patient.
- If an acute ischemic event is suspected on the 12-lead ECG, it should be transmitted electronically to Medical Control with verbal report of ECG analysis.
- If unable to transmit electronically, call with verbal report.
- If an acute ischemic event is suspected, Medical Control should be contacted promptly, the care of the patient discussed, and additional resources may be mobilized as necessary to expedite patient care (i.e., potentially including re-toning ALS, ALS rendezvous, critical care transport, Medevac).
- Obtaining the field 12-lead ECG is still valuable for comparison to later 12-lead ECG’s even if transmission is not possible.
1. If 12-lead ECG trained, obtain 12-lead ECG and transmit if possible. Leave 12-lead electrodes in place in case a repeat ECG is desired, and disconnect the leads and turn off the monitor until ALS assistance is secured.

2. If no ALS is immediately available, and the software interpretation indicates an acute ischemic event, contact Medical Control and advise you are an EMT requesting physician consultation for a chest pain patient.
Considerations and Precautions

- Treatment of lethal dysrhythmias and life threatening problems associated with airway, breathing, and circulation should be initiated prior to obtaining a 12-lead ECG.
- Perform 12 lead ECGs as soon as possible
  - Treatments such as oxygen, aspirin, and nitroglycerin, or requesting ALS should never be delayed to acquire a 12-lead ECG. Ideally, 12-lead acquisition and treatment of the patient should occur concurrently.
  - Keep time on the scene to a minimum by moving the patient to the ambulance prior to ECG if possible
- Acquire another 12-Lead EGC for comparison every 15 minutes or if the patient’s clinical condition changes.
- Being in a moving vehicle and engine vibration can interfere with obtaining a quality tracing.
Lead Placement Generalities

- Prepare all equipment in advance (i.e. check your equipment routinely)

- Skin preparation issues
  - Dirt, dead skin, oil, sweat, hair on the skin can interfere with obtaining a quality tracing

- Prep the skin
  - Dry sweat and water
  - Buff the placement area
    - Foam dots... abrasive pad on the removable cover of some electrodes
    - Alcohol preps
  - Buff or rub briskly... removes dirt and oil, stimulates capillary blood to decrease diaphoresis. A clean 4x4 gauze works great!
  - Diaphoresis... use “all hands” if necessary
  - Shave... battery clippers do work best
    - Disposable razors clog up with one stroke
Lead Types – Limb Leads

- Limb lead vs. chest leads
  - One on each limb... GO ON THE LIMBS!

Figure 8. Patient sitting in the University Hospital while his telecardiogram is being taken in the physiological laboratory. The hands are immersed in strong salt (NaCl) solution. (Courtesy The Einthoven Foundation Cardiology Information Portal)
Lead Types – Chest Leads

- Limb lead vs. chest leads
  - Six (6) on the anterior and left lateral chest
  - Also known as Precordial or V leads
Limb Lead Placement

- RA – Right arm – **White**
- LA – Left arm – **Black**
- LL – Left leg – **Red**
- RL – Right Leg – **Green**

- Mnemonics
  - White to right, and red to bed
  - Salt, pepper, and catsup
  - Smoke over fire
Limb Lead Placement

- Place the four limb leads according to the manufacturer’s recommendations.
- Limb leads typically placed:
  - On the wrists
  - On the ankles
- Due to artifact (interference) the protocol allows for placement as shown:
  - The thigh may be used as needed
  - Avoid placing limb leads over bony prominences

Figure 5.1-A  Limb Lead Electrode Placement for 12-lead ECG
# Chest Lead Placement

<table>
<thead>
<tr>
<th>Lead</th>
<th>Lead Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_1$</td>
<td>Fourth intercostal space to the right of the sternum</td>
</tr>
<tr>
<td>$V_2$</td>
<td>Fourth intercostal space to the left of the sternum</td>
</tr>
<tr>
<td>$V_3$</td>
<td>Directly between leads V2 and V4</td>
</tr>
<tr>
<td>$V_4$</td>
<td>Fifth intercostal space at midclavicular line</td>
</tr>
<tr>
<td>$V_5$</td>
<td>Level with V4 at left anterior auxiliary line</td>
</tr>
<tr>
<td>$V_6$</td>
<td>Level with V5 at left midaxillary line</td>
</tr>
</tbody>
</table>

![Image of chest lead placement](image-url)
Chest Lead Placement

- Protocol/Medtronic/Philips/Zoll all agree on locations of chest leads and how to find them

- Locating V1
  - i. Place your finger at the notch in the top of the sternum
  - ii. Move your finger slowly downward about 1.5 inches until you feel a slight horizontal ridge or elevation. This is the Angle of Louis.
  - iii. Locate the second intercostal space on the patient’s right side, just below the Angle of Louis
  - iv. Move your finger down two more spaces to the fourth intercostal space
  - v. Place V1 in the identified location (just to the right of the sternum)
Chest Lead Placement

- Place V2 to the left of the sternum at the same level (fourth intercostal space) as V1
- Skip V3
- Place V4 at the intersection of the fifth intercostal space and the midclavicular line
- Place V3 midway between V2 and V4
- Place V5 in the fifth intercostal space at the anterior axillary line
- Place V6 in the fifth intercostal space at the midaxillary line
Notes on Chest Lead Placement

- V4, V5 & V6 should be in a straight line
- Placing leads on female patients, (and some male patients) – always place leads V3 – V6 **under (or below as the case maybe)** the breast. Never place leads on the breast.
- Never use the nipples or nipple line to locate lead placement
Acquisition of 12 Leads

- After all leads placed and wires plugged...
- Stop ambulance, if during transport
  - turn off engine if necessary (noisy data error)
- Enter 12 Lead mode or select the 12 Lead soft key
  - Enter patient age and sex if prompted
- Place patient in supine position if they can tolerate being flat; most SOB or CP patients will not
- Ask the patient to remain still with legs uncrossed and arms by their side
  - Push the AQUIRE button
  - Patient should remain still for 10 seconds or until the 12 Lead ECG starts to print or states 12 obtained
Moving vs. Stopped Ambulance

- **ACUTE MI SUSPECTED**
- Abnormal ECG **Unconfirmed**
- Atrial fibrillation
- ST elevation considers lateral injury or acute infarct

- Abnormal ECG **Unconfirmed**
- Normal sinus rhythm with occasional premature supraventricular complexes
- Minimal voltage criteria for LVH, may be normal variant
Philips HEARTSTART MRx #1

Event ID: 080409234254b1f6 ID: 09-Apr-2008 23:43:29

61 years MALE

- SINUS RHYTHM
- CONSIDER LEFT ATRIAL ABNORMALITY
- ST ELEVATION, PROBABLE ANTERIOR INJURY
- INFEROPosterIOR INFARCT, ACUTE
- LATERAL LEADS ARE ALSO INVOLVED

Unconfirmed diagnosis
Event ID: 080409234254b1f6 ID: 10-Apr-2008 00:03:29

80409234254b1f6 ID: 10-Apr-2008 00:03:29

61 years MALE

- SINUS RHYTHM
- CONSIDER LEFT ATRIAL ABNORMALITY
- ANTEROLATERAL INFARCT, ACUTE
- INFEROPosterior INFARCT, ACUTE

ST > 1
Philips HEARTSTART MRx #3

Event ID: 02163011b1f6 ID: 02-Mar-2008 16:32:30

42 years MALE

SINUS RHYTHM

CONSIDER LEFT ATRIAL ABNORMALITY

INFERIOR INFARCT, ACUTE

CONSIDER POSTERIOR WALL INVOLVEMENT

ABNORMAL ECG
Medtronic Lifepak 12 ECG #1

- **ACUTE MI SUSPECTED**
- Abnormal ECG - Unconfirmed
- Normal sinus rhythm with 1st degree AV block
- ST elevation consider inferolateral LV1
ACUTE MI SUSPECTED

- Abnormal ECG Unconfirmed
- Normal sinus rhythm
- Incomplete right bundle branch block
- Lateral infarct, possibly acute

Inferior injury pattern
Anterior injury pattern
**Medtronic Lifepak 12 ECG #3**

- **ACUTE MI SUSPECTED**
- Abnormal ECG **Unconfirmed**
- Normal sinus rhythm
- Inferior infarct, possibly acute
- Anterolateral injury pattern

- **HR:** 69 bpm
- **RR:** 120 seconds
- **TS:** 118 seconds
Zoll M Series ECG #1

Normal sinus rhythm
Left ventricular hypertrophy with QRS widening
ST elevation consider anterolateral injury or acute infarct
ST elevation consider inferior injury or acute infarct

** ** ** ** Acute MI ** ** ** **

Abnormal ECG
*** Unconfirmed ***

Device: Zoll M Series ECG #1
Patient: Male
Age: 60
Date: 15:36:48 16 MAY 08
HR: 69
Device ID: 200805161523
Patient ID: 200805161523
Patient Name: 
Patient Age: 60
Patient Sex: Male
Vent. rate: 70
PR interval: 134 ms
QRS Duration: 118 ms
QT/QTc: 360/388 ms
P-R-T axes 6 3 2

All levels
Zoll M Series ECG #2

Normal sinus rhythm

ST elevation consider anterolateral injury or acute infarct

** ** ** ** * Acute MI ** ** ** **

Abnormal ECG

*** Unconfirmed ***
Unusual P axis and short PR, probable junctional rhythm
Left anterior fascicular block
Lateral infarct, possibly acute
Increased R/S ratio in V1, consider early transition or posterior infarct
Anterior injury pattern
** ** ** ** Acute MI ** ** **
Abnormal ECG
*** Unconfirmed ***
What do I do with the 12-Lead ECG?

- All levels of providers
  - Transmit the ECG to the hospital as soon as possible
  - If the ECG indicates a STEMI is present, tell the medic you are rendezvousing with
  - If not rendezvousing with a medic and transmitting the ECG is not possible, tell the hospital the ECG interpretation in your patient report

- Medic level providers
  - Follow the ST Elevation Myocardial Infarction Triage Protocol
  - A process to determine the transport destination and notify the facility of the STEMI patient’s arrival
Transmitting the 12-Lead ECG

- The process for each type of monitor is a little different
- Some monitors can be programmed to transmit automatically (sometimes to more than one location)
- Therefore transmitting is device specific
- You must practice with and be familiar with your agency's configuration
Questions?
References:
5. *Part 8: Stabilization of the Patient With Acute Coronary Syndromes* *Circulation* 2005 © 2005 by American Heart Association

Questions?