Chapter 3
for 12 Lead Training
-Precourse-

Ontario Base Hospital Group
Education Subcommittee
2008

TIME IS MUSCLE
Introduction and Purpose
Prehospital 12 Lead ECG (PHECG) is one of the fastest growing new additions to prehospital care in North America.

12 Lead ECG provides advantages over traditional 3 & 4 lead ECGs commonly used by prehospital providers for rhythm interpretation.

#1 most common reason for acquiring and interpreting 12 Lead ECG in the field is faster reperfusion for AMI patients.
Acute Myocardial Infarction (AMI) is the most frequent cause of death in the developed world.

Mortality is estimated at 50%.

AMI = coronary artery occlusion (thrombus).

Problem: death of myocardium beyond thrombus.

Modern treatment for AMI = reperfusion.
Reperfusion for AMI

Reperfusion involves opening up blocked coronary artery to restore blood flow to affected myocardium

Methods of reperfusion:

1. **Pharmacological** – administration of thrombolytics (fibrinolytics) that breakdown clot

2. **Mechanical** – balloon angioplasty referred to as Primary Percutaneous Coronary Intervention (PCI) that mechanically opens artery
Timing of Reperfusion
Survival from AMI is all about time!

Regardless of method (thrombolysis or PCI), early reperfusion therapy has been demonstrated to improve survival and quality of life for AMI patients.
Reperfusion Delays in AMI

1. Delays from onset of symptoms to patient recognition – 60 to 70%.
2. Delays in out-of-hospital transport – 5%
3. Delays in in-hospital evaluation and treatment – 25 to 30%
Prehospital Role in Reperfusion

Three current strategies:

- PHECG + ED notification for early in-hospital thrombolysis
- PHECG + prehospital thrombolysis
- PHECG + prehospital triage to Cath lab for Primary PCI
PHECG & Reperfusion

Prehospital 12 Lead ECG has been demonstrated to improve time to reperfusion for a select group of at risk patients – ST-elevation myocardial infarction (STEMI).

Multiple published trials: PHECG in conjunction with early ED notification has been associated with improved time to ED diagnosis and early thrombolysis for STEMI from 10 – 60 minutes. (Source: see references)
American Heart Association recommendations on out-of-hospital 12 Lead ECG:
- Implementation of prehospital 12 ECG
- PHECG & advance notification of ED for out-of-hospital patients w/ S&S of ACS
- STEMI patients: completion of a “fibrinolytic checklist”
- Door-to-needle time in ED of < 30 min
- Door-to-balloon time in cath lab < 90 min
Next Step: Prehospital Role in Reperfusion

Various EMS systems in North America and Europe have evolved prehospital strategies for managing reperfusion:

- Prehospital Thrombolysis: the delivery of fibrinolytic agents (associated with earlier symptom to treatment time)
- Prehospital triage for in-hospital Primary PCI
# D2B times for direct transfer to PCI center vs referral from ED

<table>
<thead>
<tr>
<th></th>
<th>Referred directly from field</th>
<th>Referred from emergency department</th>
<th>p value</th>
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</thead>
<tbody>
<tr>
<td>Median door-to-balloon time (min)</td>
<td>69</td>
<td>123</td>
<td>&lt;0.001</td>
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<tr>
<td>Door-to-balloon time less than 90 min (%)</td>
<td>79.7</td>
<td>11.9</td>
<td>&lt;0.001</td>
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2007 Recommendations to MOHLTC:

1. Prehospital 12 Lead ECG become a Provincial standard for all ambulances and paramedics.

2. MAC supports introduction of prehospital strategies demonstrated to improve early reperfusion in STEMI:
   a) Early ED notification (i.e.: STEMI Alert)
   b) Prehospital Thrombolysis
   c) Prehospital Triage for Primary PCI
Why 12 Lead???
Why 12 Lead

Other than for reperfusion…

The following case illustrates the importance of obtaining a 12 lead early in the patients care.

- Credit and thanks goes to Tim Phalen for the use of these slides
Case Presentation

- Chest Pain for 2 hours
- 4 on a 1-10 scale
- 12-lead obtained with the first vitals
- Oxygen and nitroglycerin given
- Next 12-lead eight minutes later
First 12 Lead
8 Minutes later
Value of an Early ECG

- ECG changes from ACS are dynamic
- MONA treatment may mask changes
- ST elevation = reperfusion indication
- EMS is in a privileged position
  - Early 12-lead
  - During symptoms
Making Sense of the 12 Lead
<table>
<thead>
<tr>
<th>Lead Groups</th>
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<tbody>
<tr>
<td>I</td>
</tr>
<tr>
<td>II</td>
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<td>III</td>
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</table>
### Inferior Wall

- II, III, aVF
- Left Leg

<table>
<thead>
<tr>
<th></th>
<th>aVR</th>
<th>V1</th>
<th>V4</th>
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<tbody>
<tr>
<td>I</td>
<td></td>
<td></td>
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<tr>
<td>II</td>
<td>aVL</td>
<td>V2</td>
<td>V5</td>
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<td>V6</td>
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</table>
Lateral Wall

- I and aVL
- Left Arm

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Lateral Wall

- V5 and V6
  - Left lateral chest

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Lateral

I, aVL, V5, V6
Anterior Wall

- V3, V4
- Left anterior chest

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Anterior Wall

- V3, V4

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Septal Wall

- V1, V2
- Along sternal borders

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Septal

- V1, V2

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AMI Localization

Anterior: V3, V4
Septal: V1, V2
Inferior: II, III, AVF
Lateral: I, AVL, V5, V6
## AMI Recognition

<table>
<thead>
<tr>
<th>I Lateral</th>
<th>aVR</th>
<th>V1 Septal</th>
<th>V4 Anterior</th>
</tr>
</thead>
<tbody>
<tr>
<td>II Inferior</td>
<td>aVL Lateral</td>
<td>V2 Septal</td>
<td>V5 Lateral</td>
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<tr>
<td>III Inferior</td>
<td>aVF Inferior</td>
<td>V3 Anterior</td>
<td>V6 Lateral</td>
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AMI Recognition

Know what to look for
- ST elevation
- \( \geq 1 \text{mm} \) in limb leads
- \( \geq 2 \text{mm} \) chest leads
- Two contiguous leads

Know where you are looking
- You will soon have this memorized
Mnemonic for Location

- Rhyme, phrase or device for remembering something
- “LII – LI – ASS (backwards) – ALL”

L = I (Lateral)
I = II (Inferior)
I = III (Inferior)
L = aVL (Lateral)
I = aVF (Inferior)

S = V1 (Septal)
S = V2 (Septal)
A = V3 (Anterior)
A = V4 (Anterior)
L = V5 (Lateral)
L = V6 (Lateral)
Using mnemonic on ECG

You may want to write the Letters in the corner of each Lead when interpreting
Lead Placement
Limb Lead Placement

- Place leads on limbs
- Away from major muscles or arteries
- Have patient remain still during 12 lead acquisition (to reduce artifact)
Place electrodes on the limbs if there is a 12 lead in the patient’s future – highly preferable to torso placement.
If Limb Leads are placed on the torso, make sure to document this directly on the 12 Lead ECG.

Reasons to place on the torso?
- Fracture
- Amputation
- Artifact

If Limb Leads are placed on the torso make sure to document this directly on the 12 Lead ECG.
Limb Leads

- aVR should be negative
- If aVR is upright, check for reversed limb leads
For every person, each precordial lead placed in the same relative position

- V1 - 4th intercostal space, R of sternum
- V2 - 4th intercostal space, L of sternum
- V4 - 5th intercostal space, midclavicular
- V3 - between V2 and V4, on 5th rib or in 5th intercostal space
- V5 - 5th intercostal space, anterior axillary line
- V6 - 5th intercostal space, mid-axillary
Chest Lead Placement
V1 is placed in the 4th intercostal space to the right of the sternal boarder
- To find the 4th intercostal space feel for the clavicle
- Just below the clavicle is the 2nd rib, then 3rd and 4th rib
- Between the 4th rib and the 5th rib is the 4th intercostal space

V2 is placed to the left of the sternal boarder in the 4th intercostal space
Chest Lead Placement

- V4 is placed next in the 5th intercostal space in the mid-clavicular line
  - Find the half way mark on the left clavicle and move down one rib so V4 is between the 5th and 6th ribs
- V3 is placed after V4 and is simply placed in between V2 and V4 either on the 5th rib or in the 5th intercostal space
V5 is placed in the 5th intercostal space and the anterior axillary line
  - To find the anterior axillary line lay the patient’s left arm at their side and follow the crease line in their armpit down the front of their chest
V6 is placed in the 5th intercostal space in the mid-axillary line
Chest Lead Placement

V1: 4th intercostal space to the right of the sternum
V2: 4th intercostal space to the left of the sternum
V3: directly between V2 and V4
V4: 5th intercostal space at the left mid-clavicular line
V5: level with V4 at the anterior axillary line
V6: level with V5 at the mid-axillary line
Well Done!

Education Subcommittee