STEMI
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**Levine Sign**

- The **Levine Sign** is a clenched fist held over the chest to describe the tightening or pressure felt during a heart attack.
A Critical Appraisal of the Evolution of ST Elevation Myocardial Infarction (STEMI) Therapy and the Evidence Behind the Current Treatment Guidelines
Leslie Mukau, MD, FAAEP, FACEP

- William Heberden coined the term angina pectoris in 1768
- Carl Weigert, a German Pathologist, described a myocardial infarction as a disease of the coronary arteries in 1880
- James Herrick in 1912:
  - Introduced the classic signs and symptoms of acute coronary artery occlusion to the Association of American Physicians
  - My paper “felt like a dud”
  - In 1918, he encouraged the use of ECG (Einthoven, 1902) in the diagnosis of AMI
  - Advocated bed rest for up to 6 weeks with no moving or feeding yourself for the first week….cornerstone for treatment for nearly 50 years
1929:
- Samuel Levine noted cardiac arrhythmias
  - Quinidine for VT
  - IM adrenaline for heart block and syncope
  - Trained nurses to use a stethoscope (30 years before CCUs)
- Werner Forsmann (surgical resident in Germany)
  - Performed the first heart catheterization by placing a catheter from his antecubital vein into the right atrium and capturing with radiography
  - Trying to find a way to inject drugs for cardiac resuscitation

1933:
- Tillet and Garner discovered streptokinase (accidently) and showed that it worked. In 1957 it was used for treatment of AMI and was found to decrease mortality (delayed by nearly 3 decades because of controversy, thrombus?)
- Heparin was developed (not used until the 50s?)

1950s:
- Lawrence Graven found that aspirin was preventative of coronary thrombosis
  - Was not used for decades
- Treatment for AMI was oxygen, IVF, atropine, papaverine and nitroglycerin
- Pathologists argued that AMI was NOT due to coronary obstruction but was a result of, rather than the cause, of myocardial necrosis
- William Roberts, Section Chief of Cardiac Pathology Heart Institutes at the National Institute of Health
  - “Although it may play a major role in causing atherosclerosis, coronary thrombosis may well play a minor role or none at all, in precipitating a coronary event….Evidence has been gathered suggesting that myocardial necrosis comes first and the coronary thrombosis is secondary”.

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1958:
- Mason Sones had performed selective coronary angiograms on over 1000 patients

1967:
- Melvin Judkins introduced specialized catheters and perfected the femoral artery approach to angiography

1974:
- Andreas Gruentzig
  - Developed the first balloon tipped catheter and did peripheral angioplasty
  - Shortly thereafter, PTCA was coined and performed on 50 patients

1980:
- Marcus DeWood published in the NEJM
  - Angiograms at the time of an AMI (within 24 hours)
  - Fear of fatal arrhythmias and hypotension
  - Showed that 87% of patients had total occlusion (110/126)
  - Thrombus was removed with a Fogerty catheter

  - The “Open Artery Hypothesis” began:
    - Lead to trials for lytics and PTCA
1986: GISSI-1 trial showed that streptokinase improved survival
   - GUSTO, GISSI-2 and ISIS-3 validated to “open artery hypothesis”
     ▪ Demonstrated that opening an occluded artery within 90 minutes resulted in a 15% reduction in mortality
   - Coronary atherectomy was developed

1987:
   - Palmaz/Schatz coronary stent mounted on a balloon

1993:
   - BENESTENT and STRESS trials
     ▪ Intracoronary stents drastically reduced restenosis and repeat angioplasty

1997:
   - Review of several small trials (2606 patients) revealed PCI to be superior to lytics (mortality, nonfatal reinfarction and hemorrhagic stroke)
   - DANAMI-2 (1572 patients)
     ▪ Proved that PCI was superior to lytics in the combined endpoint of death, MI and stroke at both primary PCI hospitals and with transfer.

1999:
   - 84% of all PCIs used stents

2003:
   - FDA approves DES
Mortality from ACS

- Year:
  - 1960s
  - 1975
  - 1984
  - 1994
  - 2009

- Mortality:
  - 30-40%
  - 27%
  - 19%
  - 10%
  - 6%

Case Presentation

- 56 yo male
- Hypertension (not treated), former tobacco use
- 2 days of intermittent chest tightness
- Persistent pain this am
- Wife drives him to the ER
12 Lead ECG
Definition of STEMI

- Acute and persistent closure of one or more of the coronary arteries
- Secondary to:
  - Plaque rupture
  - Erosion
  - Fissuring
  - Dissection
- Result is typically an obstructing thrombus

Major Risk Factors

- Dyslipidemia
- Diabetes
- Hypertension
- Smoking
- Positive family history
12 lead ECG

- New ST segment elevation at the J point in 2 contiguous leads of greater than 0.1 mV (0.15 to 0.25 mV in V2 and V3)
- New Left Bundle Branch Block

<table>
<thead>
<tr>
<th>V2 -or- V3</th>
<th>&lt;40 yr</th>
<th>&gt;40 yr</th>
<th>All Ages</th>
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<tbody>
<tr>
<td>&gt;2.5 mm</td>
<td>&gt;2 mm</td>
<td>&gt;1.5 mm</td>
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<tr>
<td>ALL other Leads</td>
<td>&gt;1 mm</td>
<td>&gt;1 mm</td>
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History and Physical Exam

- Focused physical exam and brief history
  - Onset and duration of symptoms
    - Other diagnosis: Pulmonary embolism, aortic dissection, pericarditis
  - Evidence for heart failure
  - Arrhythmias
  - Shock?

Treatment

- PCI within 90 minutes at a PCI capable hospital
- PCI within 120 minutes of first medical contact at a non-PCI hospital
- Aspirin
- Statin
- Beta blocker (vitals)
- P2Y inhibitor (clopidogrel, ticagrelor and prasugrel)
- Heparin IV Bolus
Prognosis

- Mortality rates at 30 days
  - 2.5 to 10%

TIMI STEMI RISK SCORE

1) Age 65–74/≥75  2/3 points  
2) Systolic Blood Pressure <100  3 points  
3) Heart Rate >100  2 points  
4) Killip class II-IV  2 points  
5) Anterior STE or LBBB  1 point  
6) Diabetes, h/o HTN, or h/o angina  1 point  
7) Weight <67 kg  1 point  
8) Time to treatment >4 hours  1 point

doi:10.1371/journal.pone.0007947.t002
65 yo male with DM and an Anterior MI
30 day mortality

- 7.3%
- Add HR > 100, then 12.4%
- Add SBP < 100, then 26.8%
- 14 points gives a 30 day mortality of 35.9%

Complications

- Arrythmias
- Congestive heart failure
- Mechanical
  - Ventricular free wall rupture (first 2 weeks) 80% mortality
  - Interventricular Septum Rupture (3-5 days) 70% mortality
  - Acute Mitral Regurgitation
    - Papillary muscle displacement
    - Left ventricular dilation
    - Rupture of the chordae apparatus
    - 30 day mortality is 75%
Incidence

- 250,000 Americans experience STEMI
  - 3,000 in Minnesota (7,000 NSTEMI)

- Fatal Myocardial infarction:
  - 57% male at 65 yo
  - 43% female at 72 yo

Key Facts – Minnesota Department of Health

- 30% of STEMI patients do not receive PCI or thrombolytic therapy
- Only 40% of STEMI patients undergoing PCI are within 90 minutes
- Less than ½ of the patients receiving thrombolytics are treated within 30 minutes (door to needle)
PCI Hospitals in Minnesota

- 18 hospital (2015)
- ACC/AHA guideline 2013 class 1 level of evidence B
  - “all communities should create and maintain a regional system of STEMI care that includes assessment and continuous quality improvement of EMS and hospital-based activities….”

Case Presentation

- 63 yo female
- Diabetes (oral medications) and hyperlipidemia
- Heartburn symptoms that woke her up
- Husband drives to the local ER
STEMI-SC Started in April, 2004

- Dr. Richard Aplin
  - Interventional Cardiologist
- Cheryl Lovitz, R.N.
- Mark Gartner
  - STEMI coordinator

STEMI-SC Inclusion Criteria

1. Symptoms: (c/w MI to include any of the following)
   - Chest discomfort
   - Arm/jaw/neck pain
   - Dyspnea
   - Nausea/vomiting
   - Sudden death with resuscitation within 5 minutes
2. Onset:
- >30 min and within 6 hours of unrelenting symptoms
- < 12 hours if clear evidence of ongoing ischemia and evidence that infarct is not completed or nearing completion

3. ECG:
- > 1mm of ST elevation in 2 contiguous leads or new LBBB
- V-paced rhythm with convincing evidence of MI presentation

4. Age range:
- > 21 yo and less than 90 yo

J Invasive Cardiol. 2009 Dec;21(12):639-44.
A regional system for delivery of primary percutaneous coronary intervention in ST-elevation myocardial infarction: STEMI-St. Cloud.


Overall mortality rates in-hospital, at 30 days, at 6 months, and 1 year were 2.1%, 2.9%, 3.8% and 4.5%, respectively, with follow up on 998 of 1,000 patients. In-hospital stroke, reinfarction and major bleeding were 0.7%, 2.0% and 2.7%, respectively.

CONCLUSIONS:

Despite increasing trends toward a pharmacoinvasive approach in transfer patients with STEMI, a protocol which stresses rapid transfer and PPCI results in excellent outcomes, with very low complication rates without fibrinolytic therapy.
STEMI – St. Cloud Hospital Emergency Trauma Center
A protocol for the care of patients who present with symptoms and findings of acute ST segment elevation myocardial infarction. (Revised June 10, 2019)

- ECG on arrival (usually only 1 is necessary).
  - Fax ECG as soon as possible to 320-255-5845. NO exceptions.
  - ECG will be reviewed ASAP by the on-call cardiologist.
- When STEMI is suspected: Provider CALL 55896.
- Provider WILL BE connected with the on-call cardiologist and Transfer Facilitator. Provide the following information:
  - Patient Medical Record Number (If known, TF will verify name/DOB.)
  - Patient Name: Last, First, Middle Initial
  - Patient DOB (Date of Birth)
  - Is the patient intubated? ___ Yes ___ No ___
  - Provider name and call-back number
- STEMI confirmed. Transfer Facilitator will complete STEMI process.
STEMI – St. Cloud Hospital Emergency Trauma Center (Cont.)
A protocol for the care of patients who present with symptoms and findings of acute ST segment elevation myocardial infarction. (Revised June 10, 2019)

MEDICATIONS: (Utilize appropriate administration route(s))
- **ASA**: 324 mg orally (Four chewable 81mg tablets)
- **Heparin**: 4000u IV bolus  NO heparin infusion. (The bolus will suffice.)
- **Ticagrelor (Brilinta)**: 180 mg orally
  - If unable to administer Ticagrelor, administer ONLY ONE (1) of the following two medications (Use in the order listed):
    - **Prasugrel (Effient)**: 60 mg orally
    - **Prasugrel Cautions/Contraindications**:
      - Age greater than 75 Y.O.
      - Prior TIA/Stroke
      - Less than 60 kg in weight
    - **Plavix (Clopidogrel)**: 600 mg orally

LABS: CBC, Chem 8, Trop I, INR if on warfarin.
- Serum HCG if female and childbearing age.
- DO NOT delay transfer for lab results.

- NO: Thrombolytics, GPIIb/IIIa inhibitor.
- Use Amiodarone 150mg IV for VT/VF.
- TRANSFER QUICKLY. Goal is 30 minutes IN and OUT of ETC.

See backside for STEMI Timeline guidelines.

STEMI – St. Cloud Hospital Emergency Trauma Center
Door to Cath Lab Timeline

**5 Minutes:**
- Recognition of chest pain and triage to treatment room.

**5 Minutes:**
- Obtain ECG and determine STEMI.
  - Fax ECG as soon as possible to 320-255-5845.

**5 Minutes:**
- Provider Call 55896.
  - Provide the following information:
    - Patient Medical Record Number (If known, TF will verify name/DOB)
    - Patient Name: Last, First, Middle Initial
    - Patient DOB (Date of Birth)
    - Is the patient intubated? ___ Yes    ___ No
    - Provider name and call-back number
  - Referring provider MUST speak to the on-call cardiologist.
  - As STEMI is confirmed, prepare patient for transport.

**5 Minutes:**
- ASA, Heparin and Ticagrelor or Prasugrel or Plavix

**10 Minutes:**
- Prep patient for transfer; portable monitor and O2 therapy. If time permits, draw labs and chest x-ray. Do NOT delay transfer. Cath Lab staff will transport patient to the Cath lab.

PLAN TO TRANSFER QUICKLY!
Goal is 30 minutes IN and OUT of ETC.
STEMI – St. Cloud Referral Hospitals/Facilities
A protocol for the care of patients who present with symptoms and findings of acute ST segment elevation myocardial infarction. (Revised April 1, 2019)

- ECG on arrival (usually only 1 is necessary).
  - Fax ECG as soon as possible to 320-255-5845. **NO exceptions.**
  - ECG will be reviewed ASAP by the on-call cardiologist.
- When STEMI is suspected:
  - CALL 1-877-STEMI-SC. (1-877-783-6472)
  - Referring Provider MUST speak to the on-call cardiologist.
- STEMI confirmed
  - Arrange transport (Prefer air transport):
    - Life Link 1-800-328-1377
    - North 1-800-247-0229

STEMI – St. Cloud Referral Hospitals/Facilities (Cont.)
A protocol for the care of patients who present with symptoms and findings of acute ST segment elevation myocardial infarction. (Revised April 1, 2019)

- MEDICATIONS: (Utilize appropriate administration route(s))
  - **ASA:** 324 mg orally (Four chewable 81mg tablets)
  - **Heparin:** 4000u IV bolus NO heparin infusion. (The bolus will suffice.)
  - **Ticagrelor (Brilinta):** 180 mg orally
    - If unable to administer Ticagrelor, administer **ONLY ONE** (1) of the following two medications (Use in the order listed):
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        - Age greater than 75 Y.O.
        - Prior TIA/Stroke
        - Less than 60 kg in weight
    - **Plavix (Clopidogrel):** 600 mg orally
- Labs: CBC, Chem 8, Trop I, INR if on warfarin.
  - Serum HCG if female and childbearing age.
  - DO NOT delay transfer for lab results or H&P transcription!
    - Fax results to MI Control Center @ 320-255-5845.
- Transfer quickly. **Goal is 30 minutes IN and OUT of ETC.**
- Faster Transfer will Save Lives!

See backside for STEMI Timeline guidelines.
The above is a guideline. Use your best judgment for the medical care of each patient individually. Call 1-877-STEMI-SC to discuss care with the on-call cardiologist.
STEMI – Referring Hospital Emergency Department (April 2019)
Door to Transfer Timeline

- 5 Minutes:
  - Recognition of chest pain and triage to treatment room.
- 5 Minutes:
  - Obtain ECG and determine STEMI.
  - Fax ECG as soon as possible to 320-255-5845. NO Exceptions!
- 5 Minutes:
  - Alert STEMI hotline. 1-877-STEMI-SC (1-877-783-6472)
  - Referring Provider MUST speak to the on-call cardiologist.
  - As STEMI is confirmed, arrange transport.
- 5 Minutes:
  - ASA, Heparin and Ticagrelor or Prasugrel or Plavix
- 10 Minutes:
  - Prep patient for transfer; portable monitor and O2 therapy. If time permits, draw labs and chest x-ray. Do NOT delay transfer for either.

PLAN TO TRANSFER QUICKLY!
Goal is 30 minutes IN and OUT of ETC
Faster transfer will save lives!

The above is a guideline.
Use your best judgment for the medical care of each patient individually.
Call 1-877-STEMI-SC to discuss care with the on-call cardiologist.

Questions?