STEMI Systems of Care

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Mortality Reduction with Early Thrombolytic Therapy (≤ 6 hrs)

RR = 27%

1 SK vs. Placebo
2 APSAC vs. Placebo
3 rt-PA vs. placebo (<5 h)
Meta-Analysis of 23 Randomized Trials of PCI vs Lysis

**Event rate (%)**

- **Death**: PCI (5), Lysis (7) - *P* = 0.0003
- **Non-fatal MI**: PCI (2.5), Lysis (6.8) - *P* < 0.0001
- **Total stroke**: PCI (1), Lysis (2) - *P* = 0.0004
- **Hemorrhagic CVA**: PCI (0.05), Lysis (1.1) - *P* < 0.0001

Shock trial excluded

Time to PCI and Mortality in GUSTO IIb

Mortality %

<table>
<thead>
<tr>
<th>Time to Balloon Inflation</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;60 min</td>
<td>1.0%</td>
</tr>
<tr>
<td>61-75 min</td>
<td>3.7%</td>
</tr>
<tr>
<td>76-90 min</td>
<td>4.0%</td>
</tr>
<tr>
<td>&gt;91 min</td>
<td>6.4%</td>
</tr>
<tr>
<td>Assigned to PCI, No cath performed</td>
<td>14.1%</td>
</tr>
</tbody>
</table>

Advantage of PCI Compared With Fibrinolysis Decreases as PCI-Related Delay Increases

PCAT 2: PCI Delay and Adjusted 30-Day Mortality

* For each site, median randomized time to balloon, minus time to lytic

Boersma, E et al EHJ 2006;27: 779-88
Changes in STEMI Metrics

• Big changes in the goals of STEMI care by which hospitals are being evaluated
• Reimbursement is increasingly related to performance
• Door to balloon times are being de-emphasized in place of first medical contact to balloon times
• This places a new burden on the pre-hospital care we provide
AHA: System Goals (Revised)

- Door to needle for fibrinolytics: 30 min
- Door in to door out at a non-PCI hospital for transfer to a PCI center: 30 min
- Door to balloon at a PCI hospital: 90 min
- First medical contact to 1\(^{\circ}\) PCI: 90 min
- Door in at a non-PCI hospital to 1st inflation at a PCI hospital – 120 min
Changes in STEMI Care

- Our goal should not be to be within the guideline recommended times
- Our goal should be to be as fast and efficient and safe as we can possibly be
• What is the recommended time from first medical contact to a non-PCI hospital, transfer to a PCI hospital, and then first inflation?
• What is the recommended time from first medical contact to a non-PCI hospital, transfer to a PCI hospital, and then first inflation?

• This should never happen!

• Pre-hospital ECGs should (almost always) prevent this from occurring!
Patients Who Dialed 911 From a Zip Code Nearest to a Non-PCI Hospital
Geisinger Medical Center

Patients transferred with STEMI (n=280)

No-Pre Hospital ECG (n=205)

Pre-Hospital ECG (n=75)
## Baseline Characteristics

<table>
<thead>
<tr>
<th></th>
<th>Pre-Hospital ECG (n=75)</th>
<th>No Pre-Hospital ECG (n=205)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>54 (72%)</td>
<td>146 (71%)</td>
<td>0.89</td>
</tr>
<tr>
<td>Age</td>
<td>64 (13)</td>
<td>60 (14)</td>
<td>0.01</td>
</tr>
<tr>
<td>BMI</td>
<td>27.3</td>
<td>29.1</td>
<td>0.007</td>
</tr>
<tr>
<td>Smoker</td>
<td>33 (45%)</td>
<td>93 (46%)</td>
<td>0.86</td>
</tr>
<tr>
<td>Hypertension</td>
<td>52 (70%)</td>
<td>121 (59%)</td>
<td>0.10</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>49 (66%)</td>
<td>102 (50%)</td>
<td>0.02</td>
</tr>
<tr>
<td>Family Hx CAD</td>
<td>36 (49%)</td>
<td>78 (38%)</td>
<td>0.13</td>
</tr>
<tr>
<td>Prior MI</td>
<td>21 (28%)</td>
<td>30 (15%)</td>
<td>0.01</td>
</tr>
<tr>
<td>CHF</td>
<td>8 (10.8%)</td>
<td>8 (3.9%)</td>
<td>0.04</td>
</tr>
<tr>
<td>Prev. PCI</td>
<td>17 (23%)</td>
<td>26 (13%)</td>
<td>0.04</td>
</tr>
<tr>
<td>Prev. CABG</td>
<td>7 (9.3%)</td>
<td>8 (3.9%)</td>
<td>0.13</td>
</tr>
<tr>
<td>Cerebro Vasc Dis</td>
<td>11 (14.9%)</td>
<td>17 (8.4%)</td>
<td>0.11</td>
</tr>
<tr>
<td>Chronic Lung Dis</td>
<td>4 (5.4%)</td>
<td>16 (7.9%)</td>
<td>0.48</td>
</tr>
<tr>
<td>Diabetes</td>
<td>12 (16%)</td>
<td>53 (26%)</td>
<td>0.09</td>
</tr>
</tbody>
</table>
Mortality

P = 0.22

- Pre-hospital EKG
- No Pre-Hospital EKG
Conclusions

• Pre-hospital ECGs reduced the time from EMS contact to balloon time by 40%
• Pre-hospital ECGs associated with lower mortality by 50% (not statistically significant)
• Per the guidelines: Pre-hospital ECGs should be performed in all rural (and urban) STEMI networks
• Whether diversion and activation of a cath lab is based on the EMT read, computer interpretation, or by an MD via fax, PDF, smart phone, etc., pre-hospital ECGs should be obtained and acted upon
How STEMI Patients Present

EMS | Walk-in
---|---
Referral Hospital | Transfer to PCI Center

EMS | Walk-in
---|---
Referral Hospital | Thrombolytic Center

EMS | Walk-in | Air
---|---|---
Direct Presenters

PCI Heart Center
Important Time Intervals

- Time of symptom onset
- First medical contact (EMT arrival, hospital door)
- Time to ECG
- Time the ECG is shown to the decision maker
- Time STEMI alert is issued, “plan is made”
- Time pt arrives in cath lab (or receives lytic)
- Time pt is put on table; prepped; draped; arterial access achieved
- Time to first inflation (or aspiration)
Truism

• If you can’t measure it, you can’t improve it
Recommendations for ECG in ED Within 10 Minutes

- Age >30 with chest pain?
- Age >45 (50?) with any:
  - Dyspnea
  - Altered mental status
  - Upper extremity pain
    - Syncope
    - Weakness
  - Upper abd pain
  - Nausea/vomiting
- Other reason for suspicion of possible acute cardiac event?

Triage ECG Recommended

Ref: Development and validation of a prioritization rule for obtaining an immediate 12-lead electrocardiogram in the emergency department to identify ST-Elevation myocardial infarction. Glickman et al.
Triage of Patients for a Rapid (5-minutes) Electrocardiogram: A Rule Based on Presenting Chief Complaints. Graff et al
Establish a STEMI plan that includes:

- ECG for all possible STEMI patients
  - Same indications as for pts presenting to an ED
- Scene goal <15 minutes
- Pre-hospital cath lab activation
- Early notification to PCI Center (if close enough)
- Diversion plan to PCI hospital
  - Should not require a call to the PCI hospital to divert
Define Protocol for Cath Lab Activation by an EMT (or Other Appropriate Person)

- Symptoms compatible with ischemia >15 minutes and <12 hours.
- ST elevation on ECG (increasingly not LBBB)
- No contraindications to acute catheterization
  - Active severe bleeding?
  - Advanced cancer?
  - Patient or family refusal, DNR, severe dementia
- Trained EMT activates 1\textsuperscript{st} PCI hospital as soon as STEMI is identified, ie “STEMI alert”
• What about when a patient self transports to a hospital without a cath lab and is found to have a STEMI?
• How can they be rapidly transferred to a PCI facility?
• This has been the most difficult problem to solve in most regions
Prior to and during 2004:

- Pts with STEMI presenting to a non-PCI hospital were evaluated there by ED physicians, primary care physicians, or cardiologists.
- Most referring hospitals routinely transferred STEMI pts for PCI; a minority received thrombolytic therapy.
- Transfer was arranged by calling the ED physician or cardiologist on call at the PCI hospital.
- The PCI hospital ED physician screened the pt for appropriateness for PCI, checked CCU bed availability, then requested helicopter transfer.
Regional STEMI Network
Geisinger Clinic

Prior to and during 2004:

• On arrival at the PCI hospital, the pt was taken to the ED where the ED physician and general cardiologist on call assessed the pt, checked labs, then consulted the interventional cardiologist

• If appropriate, the interventional cardiologist directed the paging operator to page the catheterization team

• Each team member was paged individually

• All members of the team arrived in the laboratory within 30 min of being paged

Blankenship J et al JACC 2011;57:272-9
Patient presents to ED with chest pain

ED doctor sees patient

ED doctor orders EKG

ED doc looks at EKG, calls Cardiology fellow

Cardiology Fellow calls cardiology attending

Cardiology attending comes to hospital, sees patient, calls interventionalist

Interventionalist comes to hospital, calls cath lab team

Cath lab team comes to hospital

Cath team takes patient to cath lab, performs PCI
Regional STEMI Network
Geisinger Clinic

Beginning 1/05:

• On arrival at the non-PCI hospital, ED physicians were encouraged to call a dedicated number in the PCI hospital ED, fax the ECG

• The ED physician at the PCI hospital reviewed the faxed ECG, was empowered to activate “the STEMI team”

• Single group page went out
  • cath lab team, research coordinator, nursing

• On arrival, pt taken directly to the cath lab

Blankenship J et al JACC 2011;57:272-9
Regional STEMI Network
Geisinger Clinic

Starting 1/05 (continued):

• Best available evidence was reviewed with the referring hospitals; a single protocolized treatment strategy was not recommended, not mandated
• No contracts, formal transfer agreements, etc.
• Feedback on treatment intervals, outcomes was provided, usually within 24 hours
• “Awards” were given

Blankenship J et al JACC 2011;57:272-9
Patient presents to ED with chest pain. RN obtains ECG

ED doc sees ECG, evaluates patient; calls cath team

ED or Cath Lab team takes pt to cath lab for PCI

STEMI Care at Geisinger Since Jan. 1, 2005
Regional STEMI Network
Geisinger Clinic

- ~19 community hospitals send Geisinger 100 -150 STEMI pts/year for 1º PCI
- Range: up to ~100 miles
- Helicopter transport for 83% of patients
- Do not administer lytics, IIb/IIIa inhibitors

Blankenship J et al JACC 2011;57:272-9
Time from 1st Door at Non-PCI Hospital to Balloon in Rural PA STEMI Network

Minutes, 1st door to balloon

Year

2004 2005 2006 2007 2008 2009

189 113 105 95 88 83

N=109 N=136 N=144 N=118 N=180 N=119

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Mortality, 1 Year, %

0 2 4 6 8 10

10.1

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2009

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Blankenship J et al JACC 2011;57:272-9
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Mortality, 1 Year, %

Blankenship J et al JACC 2011;57:272-9
Decrease in time to treatment and mortality achieved despite:

- progressive increase in duration of symptoms to first hospital (75-96 minutes)
- increase in the frequency of shock, cardiac arrest, neurologic injury (~33%)
Regional STEMI Network
Geisinger Clinic

- Referred to as the Geisinger STEMI network
- Not appropriate, not fair
- We (interventionalists, rest of the team at Geisinger) receive >20 minutes notice, wait for the pt to arrive; pt goes straight to the lab
- From arrival to 1st inflation usually <20 min
- The difficult work is being performed by EMS, referring hospitals; team effort
Tips to Optimize Door-In/Door-Out Times for Pts Who Present to Non-PCI Hospitals

- Arrange for a dedicated number at PCI hospital
- Don’t wait to talk to cardiology, or to get a bed, before activating transport
- Minimize time at bedside
- Know the protocol, give the drugs
- Drip-less transport (no NTG or heparin drips)
- Do not delay transport waiting for labs or copying patient care records: fax or email them!
- Ready? Hotload and go!!
Tips to Optimize Door-In/Door-Out Times for Pts Who Present to Non-PCI Hospitals

- Some hospitals are too remote to transfer for PCI
- Protocolize the administration of lytics
- But have a transfer protocol for lytic ineligible pts, and for after the administration of lytics
Tips to Optimize Door-In/Door-Out Times for Pts Who Present to Non-PCI Hospitals

• The biggest impediment I encounter in most regions is rapidly accessing an ambulance (or helicopter)
• Most hospitals have contracts with ambulances; don’t insist upon rapid transport from them
• In some regions, *dialing 911 to transport a pt from an ED pt might be most appropriate*
• For helicopter transport, helicopter location may be key – centrally, or peripherally (closer to the transporting facilities)
• Not clear to me why helicopters are sometimes preferred over ambulances when transport time is similar
Ideal STEMI-Receiving PCI Hospital

- STEMI protocols include single call activation
  - Allow EMS, ED activation
- Single group page
- 30 min or less to cath lab coverage 24/7/365
- Volume and quality standards
  - For shock, cardiac arrest as well
- Universal acceptance—no diversion ever
- Support from hospital administration
Ideal STEMI-Receiving PCI Hospital, con’t

- Support for a STEMI Nurse/Regional Coordinator/STEMI team leader
  - consistent mechanism for monitoring performance, process measures, pt outcomes
  - Action REGISTRY/GWTG

- Multidisciplinary, multi-agency, multi-institutional team meetings to regularly identify processes done well and collaboratively address those that need improvement

- A continuing education program for all involved
Warning Signs of a Sub-Optimal System

• The need to determine who is on call, or the receiving doctor to determine what needs to be done

• The need to call ahead if the patient is a friend or family member or VIP
Shock and Cardiac Arrest

• Same fundamental issues exist for treatment of shock patients, cardiac arrest patients with neurological injury
• Not all STEMI centers are equipped to treat such patients
• Patients should be preferentially diverted to or taken to Centers of Excellence, designated centers with capability and demonstrated excellence
Stroke and STEMI

- Remarkable parallels between stroke (ischemic stroke) and STEMI
- Both usually result from an acute arterial occlusion
- The best possible treatment for both is immediate reperfusion of the occluded artery
STEMI

- Original treatment: bed rest for many weeks; then 2 weeks; then days
- Then, IV thrombolytic therapy was found to reduce mortality by 25-30%
- Then, intra-arterial lytic therapy was found to be efficacious as well
STEMI

• Then, lytics followed immediately by catheter based therapies
• Then, catheter based therapy (balloons, stents) found to be vastly superior to lytic therapy
• The best possible treatment is immediate reperfusion of the occluded artery
Stroke

- Original treatment: bed rest for many weeks; then 2 weeks; then days
- Then, IV lytic therapy (with time constraints)
- Catheter-based therapy initially found not to provide added benefit to IV lytics
- More recently, many studies showed improved outcome with catheter-based therapy after lytics in some pts
- Prediction – catheter based therapy with play in increasingly large role
Regional Stroke Systems of Care

- Will not have to reinvent the wheel
- Build upon the same lessons learned, infrastructure as with STEMI
- Different time intervals need emphasis, etc.
- I don’t care if the catheter based procedures are done by interventional neurosurgeons, interventional neurologists, radiologists, cardiologists, vascular surgeons… as long as they are done well
- Designated Mission Lifeline Stroke Centers
Fundamentals of Implementing a Regional System of Care in a Competitive Market

• Remember to always put patients’ needs first; focus on first medical contact to reperfusion
• Agree on definitions and transport protocols
• All hospital team stakeholders meet regularly
• Share best practices and uniform data repository
• Blinded regional hospital benchmarking of data
• Competition can drive the stakeholders to all be! their best
Working Together to Optimize STEMI Care Throughout the Region

- We can do this
- We cannot do it alone
- If we are successful, we will be reducing the morbidity and mortality of STEMI patients in this region for years to come
Thank you!