STEMI Management In 2012: Facilitating Timely Reperfusion Therapy For Urban And Rural Patients

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Disclosures

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- Abiomed, Astra Zeneca, Bayer, Boeringher Ingelheim, Bristol Myers-Squibb, Eli Lilly, Johnson and Johnson, Pfizer, Portola, Regado, Roche, sanofi aventis

Consultant/honorarium:
- Astra Zeneca, Bayer, Bristol Myers-Squibb, Eli Lilly, Medtronic, Roche, sanofi-aventis
Opportunities to improve time to Treatment: Enhanced Regional STEMI systems

Myocardial necrosis occurs minutes after coronary occlusion
Not on arrival to hospital
Opportunities to improve time to Treatment: Enhanced Regional STEMI systems

Vienna, Lille, Paris, South East Scotland, Edmonton Canada, North Carolina, Minneapolis, Mayo Network
Overview

Regional STEMI networks

What is the ‘Ideal’ regional STEMI network?
Is a dual reperfusion strategy justified?
Potential and Pitfalls of regional STEMI networks

Review lessons learned from a regional reperfusion protocol - Vital Heart Response

1. Knowledge is key – Understand regional environment
2. Importance of ‘on line’ medical oversight
   1. Individual patient risk assessment and treatment
   2. Enhanced time to treatment
   3. Expansion of protocols to rural patients
3. Importance of comprehensive quality improvement
Regional STEMI Networks - Potential

• A spirit of collaboration focused on optimizing STEMI patient care

• Incorporates regional referral hospitals without primary PCI capacity with experienced primary PCI centers – Hub and Spoke centers

• Multidisciplinary team: pre-hospital care providers, inter-hospital transportation teams, emergency departments, general cardiology and interventional cardiology teams

• Acknowledges and incorporates geographic reality
Regional STEMI Networks - Potential

Common approaches include:

Pre-hospital diagnosis of STEMI

• Public access to a single call number for emergencies
• Education of emergency dispatch personnel
• EMS dispatch of MICU to patients with STEMI correct in 70%
• Of the 30% with an incorrect dispatch - time to PPCI increased from 107 to 170 minutes (p<0.001)

Regional STEMI Networks - Potential

Common approaches include:

Pre-hospital diagnosis of STEMI

- Public access to a single call number for emergencies
- Education of emergency dispatch personnel
- Pre-hospital 12 lead (transmission if necessary)
- Pre-hospital screening checklists
- Pre-hospital treatment algorithms

In-hospital diagnosis of STEMI

- Education of triage personal – symptom recognition, early 12 lead ECG in all potential ACS patients, and communication of finding immediately
Regional STEMI Networks - Potential

Common approaches include:

– Rapid confirmation of diagnosis, assessment of patient risk with immediate reperfusion decision

– Major focus on increasing proportion of STEMI patients treated with timely Primary PCI

– Activation of the catheterization lab team
  • Done at time of first medical contact
  • Facilitated by a well develop and consistent system

– Rapid transport via ambulance
  • Implementation of bypass protocols of hospitals without specialized cath lab capability
Regional STEMI Networks - Potential

Common approaches include:

– Rapid confirmation of diagnosis, assessment of patient risk with immediate reperfusion decision

– Major focus on increasing proportion of STEMI patients treated with timely Primary PCI

– Activation of the catheterization lab team

• **Minneapolis** (Larson et al, JAMA, 2007)
  • 14% - no culprit; 9.5% no significant CAD, 11.2 % no increase in cardiac biomarkers

• **Newark** (Kaluski et al, CV Revasc Med, 2010)
  • Appropriate activation 81.8%, borderline 5.7%, inappropriate 12%
Barriers to implementing and maintaining a STEMI system of care

- Patient delay in seeking medical assistance
- Communication issues between multi-disciplinary teams
- Financial barriers to support required staff, training, equipment, technology and medications
- Lack of agreement of ‘optimal’ approach among regional opinion leaders
- Transportation barriers/regional legislation
- Lack of experienced 24/7 primary PCI capacity
Regional STEMI Networks - Pitfalls

• Not all networks are created equally: competition for patients within regionalized care can impede their effectiveness

• Competition is a double-edge sword
  – It can motivate collaborators to participate but it may also presents obstacles as hospitals/physicians don’t necessarily want to ‘help’ their competition
  – Competitive Networks in same geographic region
    • Competitive networks aligned around political, academic or financial relationships
Primary PCI is the dominant reperfusion strategy but...

1. Regional STEMI programs have diminished reperfusion treatment delay but timely primary PCI remains improbable for many
   - Primary PCI is a complex, multi-disciplinary and time-sensitive intervention only available in a minority of hospitals (one out of five U.S. hospitals have primary PCI capacity)

2. The acceptable delay for withholding pharmacological reperfusion in anticipation of PCI is not static and is dependent upon individual patient and temporal characteristics
   - In patients with high-risk clinical presentation and/or characteristics that predict complications of pharmacological reperfusion; a longer delay to mechanical reperfusion is justified
   - In early presenting patients (<3 hours) the acceptable delay is abbreviated

3. Focus on Primary PCI with STEMI networks has led to a positive and negative consequences
Primary Percutaneous Coronary Intervention Door-to-Balloon Time and Mortality in Patients Hospitalized with ST-Elevation Myocardial Infarction: Is 90 Minutes Fast Enough?

<table>
<thead>
<tr>
<th>Time (min)</th>
<th>30-d Mortality</th>
<th>1-Year Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adjusted</td>
<td>Adjusted</td>
</tr>
<tr>
<td>30</td>
<td>7.3 (6.1–8.6)</td>
<td>8.8 (7.0–10.7)</td>
</tr>
<tr>
<td>60</td>
<td>8.8 (7.8–9.9)</td>
<td>12.9 (11.6–14.2)</td>
</tr>
<tr>
<td>90</td>
<td>10.7 (9.8–11.6)</td>
<td>16.6 (15.6–17.6)</td>
</tr>
<tr>
<td>120</td>
<td>12.8 (12.0–13.5)</td>
<td>19.9 (19.1–20.8)</td>
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<tr>
<td>150</td>
<td>15.0 (14.3–15.7)</td>
<td>22.9 (22.0–23.7)</td>
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<tr>
<td>180</td>
<td>17.2 (16.4–18.0)</td>
<td>25.5 (24.5–26.5)</td>
</tr>
<tr>
<td>210</td>
<td>19.4 (18.3–20.4)</td>
<td>27.7 (26.5–28.9)</td>
</tr>
<tr>
<td>240</td>
<td>21.4 (20.1–22.6)</td>
<td>29.5 (28.1–30.9)</td>
</tr>
<tr>
<td>270</td>
<td>23.2 (21.7–24.6)</td>
<td>30.9 (29.4–32.5)</td>
</tr>
</tbody>
</table>

Rathore SS, et al, Am J Cardiol. 2009 Nov 1;104(9):1198-203
Benefit of Transferring ST-Segment-Elevation Myocardial Infarction Patients for Percutaneous Coronary Intervention Compared With Administration of Onsite Fibrinolytic Declines as Delays Increase

Median door to balloon time within this analysis was 160 minutes and 48% of patients failed to receive primary PCI within 120 minutes of PCI related delay

Baseline patient risk modulates optimal mode of reperfusion

**DANAMI – 2: 3 Year Mortality**

26% of patients high-risk (TIMI ≥5)

- FL = Fibrinolysis
- PPCI = Primary PCI

Number at risk
- TIMI 0-4: Fx 556, n = 1134
- TIMI ≥ 5: Fx 207, n = 393

Mortality (%)

<table>
<thead>
<tr>
<th>Years</th>
<th>TIMI &lt;5 = 74%</th>
<th>TIMI ≥5 = 26%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

FL = Fibrinolysis
PPCI = Primary PCI

Thune et al. Circulation 2005
A pooled analysis of an early fibrinolytic strategy versus expediated primary PCI from CAPTIM and WEST

Westerhout et al, Am Heart J. 2011 Feb;161(2):283-90
A pooled analysis of an early fibrinolytic strategy versus primary PCI from CAPTIM and WEST

One year survival by time to treatment

$p=0.021 \text{ FL}<2h \text{ versus PCI}<2h$

Westerhout et al, Am Heart J. 2011 Feb;161(2):283-90
Edmonton Vital Heart Response - Impact of time from symptom onset to presentation Clinical events – in-hospital events (<3hrs)

<table>
<thead>
<tr>
<th>Clinical events</th>
<th>Pharmacoinvasive (n=308)</th>
<th>Primary PCI (n=425)</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHF</td>
<td>4 (1.30%)</td>
<td>21 (5.0%)</td>
<td>0.007</td>
</tr>
<tr>
<td>IABP</td>
<td>6 (2.0%)</td>
<td>18 (4.2%)</td>
<td>0.09</td>
</tr>
<tr>
<td>Inotropes</td>
<td>11 (3.6%)</td>
<td>45 (10.6%)</td>
<td>0.0004</td>
</tr>
<tr>
<td>Cardiac Arrest</td>
<td>20 (6.5%)</td>
<td>62 (14.6%)</td>
<td>0.0006</td>
</tr>
<tr>
<td>Renal Failure dialysis</td>
<td>1 (0.3%)</td>
<td>1 (0.2%)</td>
<td>1.00</td>
</tr>
<tr>
<td>Intracranial hemor.</td>
<td>3 (1.0%)</td>
<td>1 (0.2%)</td>
<td>0.32</td>
</tr>
<tr>
<td>Refractory Ischemia</td>
<td>2 (0.7%)</td>
<td>2 (0.5%)</td>
<td>1.00</td>
</tr>
<tr>
<td>Re-MI</td>
<td>2 (0.7%)</td>
<td>1 (0.2%)</td>
<td>0.58</td>
</tr>
<tr>
<td>Ischemic Stroke</td>
<td>1 (0.3%)</td>
<td>2 (0.5%)</td>
<td>1.00</td>
</tr>
<tr>
<td>Major bleeding (without transfusion)</td>
<td>1 (0.3%)</td>
<td>5 (1.2%)</td>
<td>0.41</td>
</tr>
<tr>
<td>Major bleeding (with transfusion)</td>
<td>11 (3.6%)</td>
<td>16 (3.8%)</td>
<td>0.89</td>
</tr>
<tr>
<td>Non-Major bleeding</td>
<td>8 (2.6%)</td>
<td>7 (1.7%)</td>
<td>0.37</td>
</tr>
<tr>
<td>Death</td>
<td>3 (1.0%)</td>
<td>33 (7.8%)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>

Presented at CCC, 2010. CJC
Edmonton Vital Heart Response - Impact of time from symptom onset to presentation Clinical events – in-hospital events (<3hrs)

**STrategic Reperfusion Early After MI**

Patients presenting with STEMI < 3 hrs from onset of symptoms that cannot reliably undergo primary PCI < 60 min

**Group A**

- <75 yrs: TNK Routine ASA
  - Clopidogrel: LD 300 mg + 75 mg QD
  - Enoxaparin: 30 mg IV + 1 mg/kg SC Q12h

- ≥ 75 yrs: ½ TNK Routine ASA
  - Clopidogrel: 75 mg QD
  - Enoxaparin: 0.75 mg/kg SC Q12h

ECG at 90 min: ST resolution ≥ 50%

- YES
  - Diagnostic angiography + PCI / stent, if indicated > 6 hrs / < 24 hrs
  - Standard angiography + PCI / stent immediately

- NO
  - Rescue angiography + PCI / stent immediately

**Group B**

- ASA, No lytic
  - Antiplatelet and anticoagulation treatment according to local standards

Presented at CCC, 2010. CJC
Reperfusion Paradox – Focus on Primary PCI with STEMI networks

Value-Added Contributions

• Enhanced coordination and collaborative support of hub-and-spoke model
• Greater focus on performance metrics with increased transparency across providers
• Increased emphasis on overcoming undertreatment
• Shorter times to PPCI in PCI-capable centers

Unintended Negative Consequences

- Persistent delays in accessing timely PCI in most patients presenting to non-PCI hospitals
- Decline in ability to provide “state-of-the-art” fibrinolytic management
- Proliferation of low-volume, stand-alone PPCI centers
- Diversion of patients from local community hospitals, with resultant potential for discontinuity of care and negative effect on long-term, comprehensive secondary prevention

Contemporary Management of Acute MI

Pre-hospital ambulance

Pre-hospital fibrinolysis

Pre-hospital triage for PCI or in-hospital fibrinolysis

Tertiary hospital

Community hospital

Rescue PCI

Transfer for Primary PCI

Patient Risk

higher

lower

Adapted from Welsh et al AHJ, Jan 2003
Contemporary Management of Acute MI

Pre-hospital ambulance

Pre-hospital fibrinolysis

Pre-hospital triage for PCI or in-hospital fibrinolysis

Tertiary hospital

Community hospital

Rescue PCI

Transfer for Primary PCI

Empower decision makers
“Avoid reperfusion paralysis”

Pre-hospital fibrinolysis

Pre-hospital triage for in-hospital fibrinolysis

Adapted from Welsh et al AHJ, Jan 2003
Time from 1st medical contact to reperfusion by point of randomization

- 1st balloon: P<0.001
  - in-hospital ambulance: 160 minutes
  - in-hospital self presented: 108 minutes
  - pre-hospital: 105 minutes

- 1st medication: P<0.001
  - in-hospital ambulance: 76 minutes
  - in-hospital self presented: 47 minutes
  - pre-hospital: 43 minutes

Bata I et al, CJC, 25(8), 2009
Time from 1\textsuperscript{st} medical contact to reperfusion by point of randomization

In STEMI patients that active EMS but do not receive pre-hospital reperfusion decision:

Time from first medical contact to fibrinolysis increased 33 minutes
to primary PCI increased 55 minutes

LOST OPPORTUNITY TO IMPROVE PATIENT CARE
Hospital Via Ambulance -> Emergency Department

- 90 - 100 minutes
  - Direct (pre-hospital) PCI

Self Transport to Community Hospital

- 30 - 40 minutes

Self Transport to Tertiary Hospital

- 60 - 80 minutes
  - Fibrinolysis
- 110 - 150 minutes
  - Transport to Tertiary Hospital
- 120 - 160 minutes
  - PCI

- 90 - 100 minutes
  - Fibrinolysis
- 110 - 150 minutes
  - PCI
- 160 - 200 minutes
  - PCI

Time reality

#Times estimated

Vital Heart Response
Goals and Objectives

• To develop and implement a referral region-wide protocol to standardize the management of STEMI patients that incorporates best evidence-based medicine
  – Focused on initiating care at first point of patient contact
  – Including emergency medical services and hospitals outside the metropolitan Edmonton area to enhance treatment of urban and rural patients
Alberta, Canada
- 661,848 km² (255,500 mi²)
- 3.7 million people

Edmonton, Alberta
- 782,439 city
- 1,155,383 metro
- 1.8 – 2.0 million referral population

Texas: 268,820 square miles (696,200 km²), and a pop of 25.1 million residents
Diagnosis, Triage and treatment

• Regional approach
  – Single phone number for paramedic teams and referral physicians
  – Dedicated on ‘call’ team of physicians capable of immediate response (direct to cell phone)
  – Reliable means of receiving and interpreting ECG’s
    • LIFENET receiving station and fax to email server
      • Secured access limited to VHR team
  – Review patient characteristics, inclusion/exclusion criterion and risk profile
  – Assign the patient to reperfusion strategy
Lessons Learned from a regional reperfusion program

1. Knowledge is key – requirement for quality assurance
2. Importance of on-line medical oversight
   1. Individual patient risk assessment and treatment
   2. Expansion of protocols to rural patients
   3. Enhanced time to treatment
3. Importance of quality improvement measures
   1. Individual case based feedback
Importance of real time on line medical oversight

• Avoidance of therapeutic misadventures
• Factor in PCI availability and delay
• Avoid inappropriate cardiac catheterization team activation
• Provide real time medical consultation in a critically ill patient population
• Allow administration of timely fibrinolysis including in the pre-hospital environment
Managing patient ‘risk’ during a STEMI

Risk of Disease

- Large AMI, cardiogenic shock
  - Preferred therapy: ASA, clopidogrel, heparin, fibrinolysis, Transfer for urgent cardiac Catheterization
  - Risk of Therapy: Death 50-80%

- Majority of ST elevation AMI
  - Preferred therapy: ASA, heparin, reperfusion, Ongoing risk stratification
  - Risk of Therapy: Death 1.5-2.5%

- Isolated inferior AMI
  - Preferred therapy: ASA, heparin, +/- reperfusion
  - Risk of Therapy: ICH 0.3%
  - Young patient, no comorbid disease

- Elderly, frail HTN, Relative contraindications
  - Preferred therapy: ICH 3.5%

Welsh RC & Armstrong PW, New Horizons in AMI
Importance of real time on line medical oversight

Vital Heart Response Data 2010

All STEMI patients
Median time from first medical contact to PPCI **128 minutes**
Median time from first medical contact to fibrinolysis **47 minutes**

STEMI patients reperfused via online medical support

<table>
<thead>
<tr>
<th>Primary PCI median time (minutes) (n=150)</th>
<th>99.5</th>
<th>39.8</th>
<th>34-271</th>
</tr>
</thead>
<tbody>
<tr>
<td>Within Metro Edmonton (n=143)</td>
<td>98</td>
<td>38.7</td>
<td>34-271</td>
</tr>
<tr>
<td>Non-metro Edmonton (n=7)</td>
<td>141</td>
<td>38.5</td>
<td>96-198</td>
</tr>
<tr>
<td>Fibrinolysis median time (minutes) (n=80)</td>
<td><strong>37.0</strong></td>
<td>18.5</td>
<td>10-100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>All Reperfused patients (n=230)</th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Median time from first medical contact to ECG (goal 10 min)</td>
<td>9.0</td>
<td>12.6</td>
<td>0-118</td>
</tr>
<tr>
<td>Median time from ECG to reperfusion decision (goal 10 min)</td>
<td>15.0</td>
<td>10.4</td>
<td>0-74</td>
</tr>
<tr>
<td>Median time from decision to fibrinolysis (goal 10 min)</td>
<td>9.0</td>
<td>11.9</td>
<td>0-66</td>
</tr>
<tr>
<td>Median time from decision to 1st device for PCI (goal 70 min)</td>
<td>72.5</td>
<td>28.3</td>
<td>25-163</td>
</tr>
</tbody>
</table>
Importance of real time on line medical oversight

**Vital Heart Response Data 2010**

All STEMI patients
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<td>Non-metro Edmonton</td>
<td><strong>141</strong></td>
<td></td>
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<tr>
<td>Fibrinolysis</td>
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</tbody>
</table>

**VHR - Data 2011**

Median time to fibrinolysis – **33 minutes** (n=97)
Median time to primary PCI – **94 minutes** (n-140)
Rural EMS

VHR physician team
5 clinicians provide 24/7 coverage one week at a time for Central and Northern Alberta

ECG Transmission

Rural Hospitals
Lesson: Importance of real time on line medical oversight

Rural Patients

45% of all STEMI
72% pharmacoinvasive strategy
Death & reMI urban 6.8% vs. rural 4.3%, p0.001
## Importance of Quality Improvement

<table>
<thead>
<tr>
<th></th>
<th>2009</th>
<th>2010</th>
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<tbody>
<tr>
<td>Number of PCI Cases</td>
<td>148</td>
<td>150</td>
</tr>
<tr>
<td>Median time to treatment for PCI (minutes)</td>
<td>138.0</td>
<td>99.5</td>
</tr>
<tr>
<td>Number of Fibrinolysis Cases</td>
<td>111</td>
<td>80</td>
</tr>
<tr>
<td>Median time to treatment for fibrinolysis (minutes)</td>
<td>54.0</td>
<td>37.0</td>
</tr>
</tbody>
</table>

CCC Vancouver, 2011, CJC abstract
Reflections on regional STEMI care

Success Through Co-operation

- Administration
- Paramedic
- System wide integration
- Emergency Physicians
- Cardiologists
- Government
- Acute Care Nurses
- Internal Med FP’s

Adapted from Welsh & Armstrong, Evidence Based Cardiology, 2009