A Provincial Prehospital Reperfusion Strategy

Ryan Brown, MPH, PCP, FRSPH
Adjunct Professor, Dalhousie University EM
November 7th, 2019
"Try this—I just bought a hundred shares."
Objectives

- Discuss Demographics
- Discuss the Hx of Prehospital Fibrinolysis
- Examine Local Case Studies
- Review Quality Data
- Examine Outcome Data
- Discuss the Future of PHF in NS
Demographics

- 1.3 million (2018)
- 35,385 sq mi
- 61% pop. rural
- 3 cath labs

- 923,598 (2016)
- 21,345 sq mi
- 35% pop. rural
- 1 cath lab
Our System

- Provincial System
- Highly Integrated with Provincial Health Authority
- 1100 Paramedics
- 100+ Ambulances
- 500+ Calls/day
- 170,000/year
- Lyse once every 3 days
Provincial Prehospital STEMI Reperfusion Strategy RESTORE
EMS Systems in Developed Nations
A Natural Progression

- 2002 - Cape Breton’s 12 lead EKG study
- 2004 - WEST Study in HRM
- 2006 - 12 lead EKGs province wide
- 2008 - RESTORE project in CB
- 2010 – By December all former DHAs Provincially were capable of lysis in the field
LifePak 12s in CB

- May 1\textsuperscript{st}, 2002 – Oct. 1\textsuperscript{st}, 2002
- Prior to this 3-lead cables utilized as MCLs
- 6 trucks equipped w/ LP12s, 6 without
- Uni-leads were a failure, proper 12-lead cables were put into use
- 8 STEMIs identified in 6 months (Didn’t reflect incidences levels of the time)
Uni lead

WORK IT
Success?

48 Pts experienced ST depression which resolved prior to ED arrival w/ O2/ASA/NTG
**Protocol**

*Randomize n=300 open label*

**Group A**

- Usual Care

**Group B**

- CATH <24h

**Group C**

- PCI

<table>
<thead>
<tr>
<th>Admit primary hosp</th>
<th>Transfer to PCI hosp</th>
<th>Protocol PCI as</th>
<th>Angiography / PCI asap i.e. &lt; 3 hrs from rand’n</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Transfer / PCI as clinically req’d</td>
<td>IIb/IIIa inhib, restricted to cath lab as indicated Clopidogrel for stented patients</td>
<td>IIb/IIIa inhib: investigator discretion at PCI or referring hosp</td>
</tr>
</tbody>
</table>
## Efficacy and Safety Endpoints

<table>
<thead>
<tr>
<th></th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>n</strong></td>
<td>100</td>
<td>104</td>
<td>100</td>
</tr>
</tbody>
</table>

### Primary efficacy endpoint (30 d)

<table>
<thead>
<tr>
<th>Event</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Death</td>
<td>4%</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Re-MI</td>
<td>9%</td>
<td>5.8%</td>
<td>3%</td>
</tr>
<tr>
<td>Heart failure</td>
<td>15%</td>
<td>14.4%</td>
<td>18%</td>
</tr>
<tr>
<td>Cardiogenic shock</td>
<td>6%</td>
<td>3.8%</td>
<td>7%</td>
</tr>
<tr>
<td>Refractory ischemia</td>
<td>0</td>
<td>2.9%</td>
<td>0</td>
</tr>
<tr>
<td>Major ventricular arrhythmias</td>
<td>1%</td>
<td>1%</td>
<td>1%</td>
</tr>
</tbody>
</table>

### Safety endpoint (hosp)

<table>
<thead>
<tr>
<th>Event</th>
<th>Group A</th>
<th>Group B</th>
<th>Group C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intracranial hemorrhage</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Non-hemorrhagic stroke</td>
<td>0</td>
<td>1%</td>
<td>1%</td>
</tr>
<tr>
<td>Major systemic bleeding</td>
<td>1%</td>
<td>1.9%</td>
<td>1%</td>
</tr>
</tbody>
</table>
A comparison of pharmacologic therapy with/without timely coronary intervention vs. primary percutaneous intervention early after ST-elevation myocardial infarction: the WEST (Which Early ST-elevation myocardial infarction Therapy) study

Paul W. Armstrong*, WEST Steering Committee

Objective Uncertainty exists as to which reperfusion strategy for ST-elevation myocardial infarction (MI) is optimal. We evaluated whether optimal pharmacologic therapy at the earliest point of care, emphasizing pre-hospital randomization and treatment was non-inferior to expeditious primary percutaneous coronary intervention (PCI).

Methods and results Which Early ST-elevation myocardial infarction Therapy (WEST) was a four-city Canadian, open-label, randomized, feasibility study of 304 STEMI patients (>4 mm ST-elevation deviation) within 6 h of symptom onset, emphasizing pre-hospital ambulance treatment and participation of community and tertiary care centres. All received aspirin, subcutaneous enoxaparin (1 mg/kg), and were randomized to one of three groups: (A) tenecteplase (TNK) and usual care, (B) TNK and mandatory invasive study ≤24 h, including rescue PCI for reperfusion failure, and (C) primary PCI with 300 mg loading dose of clopidogrel. Time from symptom onset to treatment was rapid (to TNK for A = 113 and B = 130 min and for PCI in C = 176 min). The primary outcome, a composite of 30-day death, re-infarction, refractory ischaemia, congestive heart failure, cardiogenic shock, and major ventricular arrhythmia, was 25% (Group A), 24% (Group B), and 23% (Group C), respectively. However, there was a higher frequency of the combination of death and recurrent MI in Group A vs. Group C (13.0 vs. 4.0%, respectively, P log rank = 0.024), yet no difference between Group B (6.7%, P log rank = 0.378) and C.

Conclusion These data suggest that a contemporary pharmacologic regimen rapidly delivered, coupled with a strategy of regimented rescue and routine coronary intervention within 24 h of initial treatment, may not be different from timely expert PCI.
Pre-hospital transport associated with ambulance-transported acute coronary syndrome is critically important in current opinion.

Erik Björkqvist and Bertil Emblem

STATE-OF-THE-ART
Reperfusion ST-Segment Elevation Myocardial Infarction: Focused Update on Regionalization and Reperfusion

Erik Björkqvist and Bertil Emblem

Revised and Accepted November 20, 2020. Members of the Secondary Panel are listed at the end of this article in Appendix 1.

William E. Boden


Society Guidelines 2019 Canadian Cardiovascular Society/Canadian Association of Interventional Cardiology Guidelines on the Acute Management of ST-Elevation Myocardial Infarction: Focused Update on Regionalization and Reperfusion

Primary Panel: Graham C. Wong, MD, MPH, (Co-chair), Michelle Welsford, MD, Craig Arseneau, MD, Ward Abuzaid, MD, MSc, Christopher B. Foulds, MD, MHC, MHS, MSc, Jennifer Greene, BSc, ACP, Thad Huyhn, MD, MSc, Ph.D, Laurie Lambert, MPH, PhD, Michel Le May, MD, Mohab Lunchmedel, MDCM, Shamir R. Mehta, MD, MSc, Madhu Narayanan, MDCM, Colleen M. Norris, RN, MN, PhD, Christopher B. Overgaard, MD, MSc, Michele Perry Arnesen, MHA, BSN, RN, Ata Quraishi, MBBS, Jean François Tanguay, MD, Mouhieddin Traboulsi, MD, Sean van Dijk, MD, MSc, Robert Welsh, MD, David A. Wood, MD, and Warren J. Camor, (Co-chair), and members of the Secondary Panel

Vancouver General Hospital, University of British Columbia, Vancouver, British Columbia, Canada; Hamilton Health Sciences, McMaster University, Hamilton, Ontario, Canada; Kingston Health Science Centre, Queen's University, Kingston, Ontario, Canada; Queen Elizabeth II Health Science Centre, Dalhousie University, Halifax, Nova Scotia, Canada; McMaster Health Research Institute, McMaster University, Hamilton, Ontario, Canada; Canadian Interagency for Emergency Health Care, Ottawa, Ontario, Canada; Mississauga Hospital, University Health Network, University of Toronto, Mississauga, Ontario, Canada; The University of Ottawa Heart Institute, Ottawa, Ontario, Canada; Ottawa General Hospital, University of Ottawa, Ottawa, Ontario, Canada; Quebec Heart Institute, University of Montreal, Montreal, Quebec, Canada; Video Cardiovascular Institute, University of Calgary, Calgary, Alberta, Canada; Université Laval, Quebec, Canada, Canada/United Kingdom Regional Health Centre University of Toronto, Toronto, Ontario, Canada.

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RESTORE Pilot in CB

• Launched July 21st, 2008
• First Pt received TNK July 25th, 2008
Case Study #1

- 64yo M building a deck and developed chest discomfort
- Retrosternal CP 5/10 radiating into the Lt arm
- Pale/Weak/Diaphoretic
- 130/70 76BPM 18BrPM 97%RA A&Ox4
- Cardiac Hx, MI x5 years, did not require stents
First 12 Lead
• 50mg TNK, IV @ 10:54
• 30mg Lovenox, IV @ 10:56
• 100mg Lovenox, SQ @ 10:57
• 300mg Plavix, PO @ 10:59
• EMS to 1st ECG  10 Mins
• EMS to Needle  30 Mins
• EMS to Transport  40 Mins
• EMS to ED   60 Mins
• Just another day at the office, right......
Case Study #2

- 78yo M awoken from his sleep
- Retrosternal CP 10/10 non-radiating
- 112/60 (bilat) 76BPM 20BrPM 98%RA A&Ox4
- Obvious Inferior MI (II, III, aVL)
- 02/ASA/NTG, IV access X2 (18ga) Rt arm
- 3 transmission attempts, successful on the 3rd attempt
- TNK/Plavix/Lovenox
• “The success of RESTORE will not be measured or celebrated by ACP performance, it will be celebrated by a global reduction in time to treat all STEMI patients regardless of where they call from and who responds to their care”.

Dr. Andrew Travers
STEMI Reperfusion Worksheet: PCI vs TNK

1. STEMI Patient: Is there criteria for reperfusion therapy?
   - A. Symptoms lasting longer than 20 minutes and less than 12 hours? Yes No
   - i) 2mm of ST elevation in two or more contiguous precordial (chest) leads; or
   - ii) 1mm of ST elevation in two or more limb leads; or
   - iii) A presumably new LBBB?

   If both 'YES' refer to Reperfusion Options below

   If ST elevation present in any one inferior lead (II, III, aVF) or
   ST depression present in V1 & V2, consider obtaining a 15 lead ECG.

2. STEMI Management
   General care of STEMI patient
   - Oxygen (to target SpO2 between 94-99%), ASA, Nitroglycerin, Morphine as per ischemic chest pain guidelines
   - Obtain 2 IVs (if possible); preferably 18 gauge in LEFT arm (1 line and 1 lock)

3. Reperfusion Options
   A. Direct-to-PCI:
      STEMI patient and time from diagnostic ECG to QEI 60 minutes or less? Yes No

      If yes, transmit 12 lead to QEI, contact charge MD and discuss the following with the emergency physician
      - Identify yourself, registration level, call location, and reason for call (possible PCI candidate)
      - Confirm receipt of ECG and ensure ECG matches the patient
      - Agree on interpretation
      - Discuss patient signs and symptoms and vitals
      - Discuss if the patient has:
        i) Serious systemic disease / terminal co-morbidity that will limit lifespan less than one year? Yes No
        ii) Severe dementia? Yes No
        iii) Prior CABG? Yes No
      - Confirm appropriate destination choice
      - Discuss back up plan in the event of complications
      - Provide ETA to ED
      - If going direct-to-PCI - Administer 300mg PO Plavix (Clopidogrel)
      - If time allows, complete 'Exclusion criteria for fibrinolysis' section (below)

      Not Direct-to-PCI candidate? Consider fibrinolysis (go to Reperfusion Option B)
B. Early Fibrinolysis:

STEmI patient and time to PCI lab more than 60 minutes or patient not candidate for PCI

Exclusion criteria for fibrinolysis:

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>i) Active bleeding or known bleeding/clotting disorder or on blood thinners</td>
<td></td>
<td></td>
</tr>
<tr>
<td>[e.g. warfarin (Coumadin), dabigatran (Pradax), rivaroxaban (Xarelto)]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ii) Recent (within 6 wks) major trauma, surgery (including eye surgery), GI / GU bleed?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>iii) History of stroke, TIA, severe dementia or structural CNS damage</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>(tumor, AV malformation, aneurysm)?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>iv) Significant closed head / facial trauma within last three (3) months?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>v) Significant hypertension (SBP &gt; 180 or DsBP &gt; 110) at any time from presentation?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>vi) Right arm versus left arm SBP difference of 15 mmHg?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>vii) Prolonged [greater than 10 minutes] CPR?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>viii) Cardiogenic shock (relative contraindication — would do best with PCI; consult with MD)</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>

If fibrinolysis candidate:

- Transmit 12 lead to regional hospital
- Consult MD with information as outlined here
- Obtain consent from patient
- Proceed with management

Discussion with Emergency Physician for fibrinolysis

- Identify yourself, registration level, call location, and reason for call (possible fibrinolysis candidate)
- Confirm receipt of ECG and ensure ECG matches the patient
- Agree on interpretation
- Discuss patient signs and symptoms and vitals
- Confirm no exclusion criteria
- Confirm appropriate destination choice
- Discuss back up plan in the event of complications
- Provide ETA to ED

Reperfusion Checklist v2.3 May 10, 2013
After discussion with MD and consent is obtained, reconstitute TNK with 10mL sterile water.

### Fibrinolysis Medication Dosages

**Administer TNK**

<table>
<thead>
<tr>
<th>Patient's weight:</th>
<th>TNK (mg)</th>
<th>TNK (mL) administered</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 60 kg, less than 130 lbs</td>
<td>30</td>
<td>5</td>
</tr>
<tr>
<td>60 to 69 kg, 130 to 154 lbs</td>
<td>35</td>
<td>7</td>
</tr>
<tr>
<td>70 to 79 kg, 155 to 174 lbs</td>
<td>40</td>
<td>8</td>
</tr>
<tr>
<td>80 to 89 kg, 175 to 199 lbs</td>
<td>45</td>
<td>9</td>
</tr>
<tr>
<td>90 kg or greater, 200 kg or greater</td>
<td>50</td>
<td>10</td>
</tr>
</tbody>
</table>

**After TNK**

- **Patient Age**
  - Less than 75 years old
  - 75 years of age and above

- **Subcutaneous Lovenox**
<table>
<thead>
<tr>
<th>Weight kg (lbs)</th>
<th>Less than 75 years old</th>
<th>75 years and older</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 (110)</td>
<td>50 mg</td>
<td>38 mg</td>
</tr>
<tr>
<td>60 (130)</td>
<td>60 mg</td>
<td>45 mg</td>
</tr>
<tr>
<td>70 (154)</td>
<td>70 mg</td>
<td>53 mg</td>
</tr>
<tr>
<td>80 (175)</td>
<td>80 mg</td>
<td>60 mg</td>
</tr>
<tr>
<td>90 (200)</td>
<td>90 mg</td>
<td>68 mg</td>
</tr>
<tr>
<td>≥ 100 (220)</td>
<td>100 mg</td>
<td>75 mg</td>
</tr>
</tbody>
</table>

**Subcutaneous (lateral abdomen) Lovenox dose - Black labeled syringe**
- 1mg/kg – maximum 100mg
- 0.75mg/kg – maximum 75mg

**IV Lovenox dose - Blue labeled syringe**
- 30mg IV
- No IV dose

**Plavix (Clopidogrel) dose**
- 300mg PO
- 75mg PO

**Transfer of care to receiving staff**
- Time of onset
- Medication list (most specifically if patient on any blood thinners)
- Medical history
- Vitals
- Did the patient go into cardiac arrest at any time during care?
- Does the patient currently have an arrhythmia or unstable rhythm?
- Interventions done

Reperfusion Checklist v2.3 May 15, 2013
TNK Timeline Summary:
Symptom Onset to TNK (minutes)
Based on median intervals

<table>
<thead>
<tr>
<th>Period</th>
<th>Symptom Onset to 1st Medical Contact</th>
<th>1st Medical Contact to 1st ECG</th>
<th>1st ECG to Medical Consult</th>
<th>Medical Consult to TNK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jul-Sep 2018</td>
<td>59</td>
<td>6</td>
<td>16</td>
<td>8</td>
</tr>
<tr>
<td>Oct-Dec 2018</td>
<td>58</td>
<td>7</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Jan-Mar 2019</td>
<td>56</td>
<td>7</td>
<td>14</td>
<td>10</td>
</tr>
<tr>
<td>Apr-Jun 2019</td>
<td>62</td>
<td>5</td>
<td>27</td>
<td>8</td>
</tr>
</tbody>
</table>

Legend:
- Blue: Symptom onset to first medical contact
- Red: First medical contact to 1st ECG
- Green: 1st ECG to medical consult
- Purple: Medical consult to TNK
### LO026: Outcomes of a provincial cardiac reperfusion strategy: a population-based, retrospective cohort study

<table>
<thead>
<tr>
<th></th>
<th>PHF</th>
<th>EDF</th>
<th>EHS to PPCI</th>
<th>ED to PPCI</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>30 day Mortality</strong></td>
<td>5 (3)</td>
<td>36 (6)</td>
<td>2 (2)</td>
<td>10 (4)</td>
</tr>
<tr>
<td><strong>Cardiac Re-admission within 30 days?</strong></td>
<td>8 (6)</td>
<td>26 (4)</td>
<td>5 (4)</td>
<td>4 (2)</td>
</tr>
<tr>
<td><strong>Rescue PCI</strong></td>
<td>29(20)</td>
<td>103(17)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Conclusions:

• Our mortality results support prehospital fibrinolysis as an effective means of reperfusion.

• Mortality was slightly less for prehospital lytic patients as compared with ED lytic patients.

• Our mortality results are consistent are the same or better than those published in the literature.
Conclusions:

• Our mortality results support prehospital fibrinolysis as an effective means of reperfusion.
• Mortality was slightly less for prehospital lytic patients as compared with ED lytic patients.
• Our mortality results are consistent are the same or better than those published in the literature.
### < 75 Min Catchment Area

<table>
<thead>
<tr>
<th>Risk Matrix</th>
<th>ED Patient Clinical Assessment (e.g. ECG criteria etc)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High Risk</td>
</tr>
<tr>
<td>EHS System Risk Assessment</td>
<td>High Risk</td>
</tr>
<tr>
<td>Low Risk</td>
<td>Critical Care Transport</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Critical Care Transport = Lifeflight or ‘Hybrid NSHA/EHS Team’
Outside scope and role

> 75 min inter-facility transport interval

STEMI → Regional ED Admission

Cardiogenic Shock → NHSA RN EHS ACP

High Risk for Deterioration in Transport → NHSA RN EHS PCP

Low Risk for Deterioration in Transport → PCI

Lifeflight Team

ED Roles*
- Patient/Transport Risk Assessment
- Admits Patient to the Regional
- MD Activation of PCI
- Adjunctive Meds as required
- ?Other

SMRH to NHI: 2h13m, 220 km
AH to NHI: 1h38m, 157 km
CRH to NHI: 1h58m, 195 km
YRH to NHI: 3h28m, 327 km

Draft: 20160531 Andrew Travers
6. We suggest that PCPs may transport clinically stable STEMI patients from the field to a PCI centre when an ACP crew is not readily available. If patients under the care of a PCP crew clinically deteriorate en route to a PCI centre, the ambulance should redirect to the closest ED and/or rendezvous with an ACP crew depending on resource availability in the particular region (Weak Recommendation, Low-Quality Evidence).

7. We suggest that PCPs may transport clinically stable STEMI patients from a non-PCI centre to a PCI centre when an ACP crew is not readily available. For patients who have hemodynamic instability, early CS, respiratory failure, life-threatening arrhythmias, or are comatose post arrest, transport should be facilitated by a critical care crew and/or medical personnel from the sending facility (Weak Recommendation, Low-Quality Evidence).

**Values and Preferences.** Most paramedics in ground ambulances in Canada are PCPs. Because of the low rates of clinically important events that require ACP training, our recommendation enables regions that have few or no ACPs to transport stable STEMI patients with no anticipated complications for PPCI without compromising patient safety. Additional medical personnel or ACPs might be required for transfer if the patient requires intravenous (I.V.) medications that are beyond the scope of PCP care.
References:

Thank You