Hamilton is one of the few centers in Canada recognized as a leader in Primary PCI.

Primary PCI at Hamilton Health Sciences

By Leslie Gauthier and Dr. Madhu Natarajan

The treatment of ST Elevation Myocardial Infarction (STEMI) has undergone significant changes over the past several decades. Since the 1980’s, the gold standard has been to administer thrombolytic therapy to eligible patients, with a “door to needle time” goal of thirty minutes. Current evidence now supports percutaneous coronary interventions (PCI) as clinically superior to thrombolysis for STEMI patients in reducing mortality, reinfarction and stroke, recognizing that the sooner the “door to balloon time”, the better the outcomes. The “Door to Balloon Time” goal is recognized to be ninety minutes.

Hamilton is one of the few centers in Canada recognized as a leader in Primary PCI. In January 2003, we implemented a staged approach to offering Primary PCI for STEMI patients in our LHIN. The project began with offering Primary PCI initially to patients presenting at the General Site during the Heart Investigation Unit’s (HIUs) operational hours. In collaboration with Emergency Medical Services (EMS), the initiative was expanded to include the other HHS sites and then later St. Joseph's Healthcare. Within the city of Hamilton, the EMS model is to bring the patient to the nearest hospital. Once the STEMI is diagnosed by the Emergency Physician, the Interventionalist on-call is notified and the patient accepted for transfer to the HIU. A specific script is used to call EMS and another ambulance is dispatched code 4 to bring the patient to the General.

HHS’s Primary PCI model was then expanded to include Joseph Brant Hospital, where the EMS model is slightly different. EMS in Halton has 12 Lead ECG capabilities in the field. When the Advanced Care Paramedic identifies the STEMI, the patient is initially brought to Joseph Brant. The Emergency Physician confirms the diagnosis and then the same ambulance crew transfers the patient to the HIU. This variation in the Burlington model has allowed us to achieve excellent door to balloon times. There is also a plan underway to implement 12 lead ECG acquisition in the Hamilton ambulances which will facilitate implementation of the Burlington model and potentially direct field to cath lab transfer over the next year.

continued on page 2
Primary PCI is routinely offered 24-7 for patients presenting to a Hamilton and/or Burlington hospital. Based on our experience we are confident that we can usually achieve acceptable “door to balloon times”. From the Primary PCI database, we know that on average it takes approximately 30 minutes from the patient’s arrival in the HIU to balloon inflation time. Therefore, our goal is to have the time from the patient’s first medical contact to arrival at the HIU, within 60 minutes.

The HIU continues to accept emergency cases from all LHIN hospitals for complicated STEMI patients whom are contraindicated to fibrinolytic therapy, who present after 4 hours of chest pain and/or those patients who are hemodynamically unstable.

For all patients across our LHIN, there will always be situations whereby we are unable to offer Primary PCI as a first line strategy for STEMI. Such situations include:

- We are unable to transport the patient to the General hospital within sixty minutes of the onset of their symptoms and/or from their first medical contact.
- Inclement weather
- There is already an emergency patient being cared for in the HIU, which would delay our ability to care for a second primary PCI patient in a timely fashion. This is more applicable on the off-hours and weekends.

In these situations, we will recommend that the patient receive fibrinolytic therapy unless contraindicated and that the 12 Lead ECG be repeated within 60–90 minutes post-thrombolysis or if the patients’ chest pain reoccurs. In the event that the patient does not reperfuse with thrombolysis or if there is evidence of re-infarction/recurrent ischemia within the first 24 hours of receiving fibrinolytic therapy, they should be referred to the Interventional Cardiologist on-call for a rescue procedure.

The graph to the right, identifies the median times for Primary and rescue angioplasty from the time of presentation in the Emergency Department to the time of first balloon inflation in the HIU.

The Primary PCI Operations Committee continues to work on the expanding Primary PCI service across the LHIN. This takes teamwork between our referring centers, the Emergency Departments, the EMS, the Interventional Cardiologists, communication departments and the HIU staff. This work involves significant collaboration with the EMS services and repatriation agreements with our referring centers. There are also exciting changes happening within the EMS, with 12 Lead ECG ability in the field that may facilitate additional changes to our Primary PCI Program in the future.

For patients presenting with non-STEMI, please refer the patient to General Internal Medicine and/or Cardiologist at your hospital.
Urgent Inpatient Wait Times for Cardiac Catheterization by Referring Hospital
October 1, 2007 – December 31, 2007

<table>
<thead>
<tr>
<th>REFERRING HOSPITAL</th>
<th>Number of Cases</th>
<th>Median</th>
<th>Average</th>
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<tbody>
<tr>
<td>Brantford General</td>
<td>22</td>
<td>0.00</td>
<td>0.36</td>
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<tr>
<td>Haldimand War Memorial</td>
<td>4</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
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<tr>
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<td>Hotel Dieu (St. Catharines)</td>
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<td>0.00</td>
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<tr>
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<tr>
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<tr>
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<tr>
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<tr>
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<tr>
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<td>0.00</td>
</tr>
<tr>
<td>West Haldimand General</td>
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<td>0.09</td>
</tr>
<tr>
<td>West Lincoln Memorial</td>
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<td>0.00</td>
<td>0.04</td>
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Note: A “wait time” of Zero = Procedure Completed on the Day of Referral

Median Times: Primary and Rescue Cases
August - October 2007

D A Y S W A I T E D

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<tr>
<th>SITE</th>
<th>MINUTES</th>
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<tbody>
<tr>
<td>Hamilton/Burlington Primary n=56</td>
<td>330</td>
</tr>
<tr>
<td>Other Sites Primary n=19</td>
<td>300</td>
</tr>
<tr>
<td>Hamilton/Burlington Rescue n=8</td>
<td>270</td>
</tr>
<tr>
<td>Other Sites Rescue n=19</td>
<td>240</td>
</tr>
</tbody>
</table>

ED-ECG
ECG-HIU
HIU-Balloon

Note: A “wait time” of Zero = Procedure Completed on the Day of Referral
STEMI Algorithm Hamilton/Burlington Hospitals

Criteria for STEMI
- > 1mm ST Elevation in 2 continuous limb leads
  or
- > 2 mm ST Elevation in 2 continuous precordial leads
  &/or
- new LBBB
  with
- persistent ischemic symptoms
- < 12 hrs since onset of symptoms

** Hamilton EMS Communication Strategy
1. Physician or designate to place call to Ambulance Dispatch.
2. Communicate the following sequence:
   (a) This is Dr. ___ from ___ (hospital), I have a transfer for EMERGENCY ANGIOPLASTY.
   (b) Patient is critically ill, requesting Code 4 transfer to Hamilton General Hospital, patient has been accepted by the Heart Investigation Unit.
   (c) Patient's Diagnosis: Acute Myocardial Infarction
   (d) State what equipment and/or escorts will be accompanying patients on transfer
   (e) Is patient a DNR, or do they have a communicable disease?
   (f) Patient is prepared and READY TO GO
3. Obtain and provide a Medical Transfer Number to CACC. However, do not delay transfer while waiting for number.

Note: The ambulance service will not provide return transport for any escorts. The sending facility will need to make arrangements for escorts to return to their facility.

**Immediate transport to HIU as per EMS script**
Prior to Transport give:
- ASA 160 mg PO x 1
- clopidogrel 300 mg PO x 1
- heparin IV bolus 60 units/kg to a max of 4,000 units
  unless:
  - on warfarin
  - treated with fondaparinux or LMWH within 12 hours
  - other management as per MD

In addition please call:
GIM (Henderson, MUMC, SJHC & Joseph Brant) CCU/Cardiology (General) to inform service of STEMI & plan for repatriation

**Consider Rescue PCI for failed lysis &/or hemodynamic instability**

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[Flowchart diagram of STEMI algorithm with decision points for Primary PCI, rescue PCI, and transport protocols.]
STEMI Algorithm for Hospitals Outside Hamilton/Burlington

Niagara Health • Haldimand War Memorial Hospitals • West Lincoln Memorial • Brantford General • Norfolk General

1. **STEMI (Hx & ECG)**
   - AMI Complicated by any of the following:
     - Patient contraindicated to lytics?
     - Patient presents late to ED >4 hrs after chest pain?
     - Patient Unstable:
       - requires balloon support
       - Systolic BP < 90 mm HG
       - Inotrope support

   - M-F (0700-2000 hrs)
     Call HIU HOTLINE 905-577-8007 or ext.48007
     or (after hrs, week-ends & holidays)
     Call Interventionalist on-call 905-577-8688

2. **Primary PCI?**
   - **YES**
   - Immediate transport to HIU as per EMS script **

     - **Rx:**
       - ASA 160 mg PO x 1
       - clopidogrel 300 mg PO x 1
       - Heparin IV bolus 60 units/kg to max of 4,000 units

     - unless:
       - on warfarin
       - treated with fondaparinux or LMWH within 12 hours
       - other management as per MD

     - In addition please call:
       - GIM &/or Cardiology at your hospital to inform service of STEMI & plan for repatriation

   - **NO**
   - Patient Uncomplicated AMI

   - **YES**
   - Consider Thrombolysis protocol if eligible

     - **Rx:**
       - ASA 160 mg PO x 1
       - clopidogrel 300 mg PO x 1
       - heparin ACS protocol OR fondaparinux 2.5 mg IV

     - unless:
       - on warfarin
       - treated with fondaparinux or LMWH within 12 hours
       - other management as per MD

     - repeat ECG at 60-90 minutes &/or with reoccurring chest pain

3. **Need for Rescue PCI for failed lysis &/or hemodynamic instability?**
   - **YES**
     - M-F (0700-2000 hrs)
       Call HIU HOTLINE 905-577-8007 or ext.48007
       or (after hrs, week-ends & holidays)
       Call Interventionalist on-call 905-577-8688

   - **NO**
     - Patient Uncomplicated AMI
Diagnosing MI without ST Elevation

By Dr. Tej Sheth and Dr. James Velianou

A 72 year old woman was admitted to St. Joseph's Hospital for a non-cardiac reason. There was no prior history of coronary artery disease and no identified cardiac risk factors. While in hospital, she developed acute onset of chest pain and shortness of breath. An EKG was promptly obtained that demonstrated marked ST depression from leads V1 to V5 with tall R waves in leads V1 and V2. These findings are indicative of acute posterior wall myocardial infarction. The patient rapidly deteriorated requiring intubation, ventilation and inotropic therapy. She was then transferred to the HIU for further treatment. Aspirin, clopidogrel, and intravenous heparin were given prior to transfer.

In the HIU, the angiographic findings were as follows:

The RCA was non-dominant and diseased.

Flow was re-established with balloon dilation of the occlusion and a stent was implanted at the lesion site.

The origin of the circumflex was anomalous, arising from the right coronary sinus. Selective injection of this vessel demonstrated that it was the culprit.

The left main had an ostial 50 to 60% stenosis. The left circumflex was not seen on these initial angiograms.

The occlusion of this large, dominant circumflex likely accounts for development of pulmonary edema and hypotension. A left ventricular angiogram was performed that demonstrated grade 2 left ventricular function and no evidence of mechanical complications such as mitral regurgitation. An intra-aortic balloon pump was placed for hemodynamic support. Thirty minutes post PCI the patient experienced a run of sustained VT and was cardioverted, but remained free of arrhythmias subsequently. The patient was weaned off inotropes and extubated several days later.

Key Points:

Although the main diagnostic criteria for STEMI are symptom onset within the prior 12 hours and ST elevation greater than 0.1 mV in at least 2 contiguous precordial leads or at least 2 adjacent limb leads or a new left bundle branch block, posterior MI may be manifested by tall R waves in the right precordial leads and ST-segment depression in leads V1 through V4, especially when the T waves are upright. This patient's infarct evolved rapidly and there was an indication for HIU referral based on the development of cardiogenic shock. However, in other situations, the diagnosis of posterior infarction may be more challenging. Repeat ECGs and incorporation of additional leads such as V7 through V9 may aid in the diagnosis.
Anti-Thrombin Management for ST-Elevation Myocardial Infarction (STEMI)

By Dr. Michael Rokoss and Dr. Shamir Mehta

For patients treated with thrombolytics, there are currently three anti-thrombotic therapies with established efficacy: unfractionated heparin (UFH), enoxaparin, and fondaparinux. Unfortunately, not all of these agents have been compared in a head-to-head fashion in randomized controlled trials. Based on older data, UFH has been indicated for fibrin-specific thrombolytics (TPA, TNK etc), but not for non-fibrin specific thrombolytics such as streptokinase. The OASIS-6 study examined fondaparinux versus usual therapy across a range of treatments for STEMI, including primary PCI, thrombolysis, and usual medical therapy for those not treated with either of these two therapies. The overall OASIS-6 study results showed a mortality benefit of 12% (p=0.029) in favour of fondaparinux at 6 months. In OASIS-6, approximately 45% of patients had thrombolysis; fondaparinux was compared to UFH for fibrin-specific thrombolytics and versus placebo for non-fibrin-specific thrombolytics. Amongst those receiving thrombolysis, the combined end-point of death and MI at 6 months was reduced by 11% (p<0.04), and severe bleeding was reduced by 34% (p=0.04) in favour of fondaparinux. The point estimates for both the ischemic end-points and major bleeding, for both classes of thrombolytic, favored fondaparinux; OASIS-6 was not powered statistically to examine the effects on each group of thrombolytic separately. In patients not eligible for reperfusion therapy (advanced age, late presentation, co-morbidities etc.), fondaparinux reduced death and MI by 19% (p=0.04) compared with UFH at 1 month.

Another recent large RCT, the EXTRACT trial, demonstrated enoxaparin to be superior to UFH for ischemic outcomes in patients treated with thrombolysis: the combined efficacy outcome of death and non-fatal MI at one month was reduced by 17% (p<0.0001) in favour of enoxaparin. Most of this observed reduction was due to a significant decrease in non-fatal MI, as mortality rates were similar between groups. From a safety viewpoint, major bleeding was significantly increased by 53% (p<0.001) with enoxaparin, and fatal bleeding was doubled (p<0.001). Enoxaparin should be dosed cautiously in renal failure. Finally, although there have been no direct head-to-head comparisons of fondaparinux versus enoxaparin in a STEMI population, there is compelling data for this comparison in an ACS/NSTEMI population from OASIS-5. In this trial, fondaparinux was similar to enoxaparin for death and MI at day 9, but major bleeding was reduced by 50% (p=0.00001). By day 30, there was a 17% decrease in mortality (p=0.02) for fondaparinux compared with enoxaparin. Given the lack of head-to-head comparisons amongst these agents, The American College of Cardiology/American Heart Association 2007 Guidelines for thrombolytic use in STEMI recommend any of the three available anti-thrombotic agents.

Adjunctive anti-thrombotic therapy with primary PCI is perhaps clearer. Despite a lack of RCT data, UFH remains the gold standard. The ideal dose of UFH at the time of primary PCI remains unclear; higher doses are associated with slightly higher bleeding rates. The dose of UFH is also usually decreased if concomitant Gp2b3a receptor blockers are co-administered, in order to decrease major bleeding rates. Enoxaparin has not been rigorously studied in this population, and the primary PCI subset from OASIS-6 showed no benefit with fondaparinux compared with UFH. Bivalirudin, an intravenous direct thrombin inhibitor, has been studied in the HORIZONS-AMI study, but this study has not yet been published, and bivalirudin is not yet indicated for primary PCI.

Select References:

OASIS 6. JAMA 2006;295: 1519-30
### Emergency Contact Information

| **HIU “Hotline” for Emergency Referrals** | Monday to Friday 0700-2000 hours  
905-577-8007 or 905-527-4322 ext 48007 |
| **Interventionalist on Call** | After hours, weekends and holidays  
905-577-8688 & ask for the Interventionalist on Call |

### Heart Investigation Unit

**Heart Investigation Unit**  
905-527-4322 ext 46210 or 41725 (overnight end)

**Pre-HIU Clinic Booking Office**  
905-527-4322 ext 44831

**Triage Office**  
905-527-4322 ext 46674

**Clinical Manager: Leslie Gauthier**  
905-527-4322 ext 46899

**Clinical Educator: Marion Quirk**  
905-527-4322 ext 46316

**Advanced Practice Nurse: Tammy Cosman**  
905-527-4322 ext 46315

### Interventional Cardiologists

| Dr. Douglas Holder | 905-532-1241 | Fax: 905-523-8352 |
| Dr. Shamir Mehta | 905-521-2631 | Fax: 905-527-4463 |
| Dr. Sanjit Jolly | 905-527-4322 ext 44831 | Fax: 905-523-8352 |
| Dr. Madhu Natarajan | 905-527-6241 | Fax: 905-527-2337 |
| Dr. Michael Rokoss | 905-574-0953 | Fax: 905-574-8417 |
| Dr. Tej Sheth | 905-526-7616 | Fax: 905-527-4463 |
| Dr. Nicholas Valettas | 905-574-0953 | Fax: 905-574-8417 |
| Dr. James Velianou | 905-526-7616 | Fax: 905-527-4463 |
| Dr. Shy Amlani | 905-527-6241 | Fax: 905-523-8352 |
| Dr. Eric Stanton (angiographer) | 905-521-6058 | Fax: 905-521-6068 |

### Cardiac Surgeons

| Dr. Victor Chu | 905-523-0448 | Fax: 905-523-0279 |
| Dr. Irene Cybulsky | 905-777-8248 | Fax: 905-527-6225 |
| Dr. Andre Lamy | 905-522-0175 | Fax: 905-522-2029 |
| Dr. Lloyd Semelhago | 905-527-7168 | Fax: 905-527-0538 |
| Dr. Kevin Teoh | 905-523-7746 | Fax: 905-523-4885 |
| Dr. Joseph Noora | 905-527-4322 ext 46391 | Fax: 905-521-4825 |

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### LHIN IV

![Map of LHIN IV](image-url)