High Sensitivity Troponin

CLINICAL DECISION SUPPORT TOOL AND PRE-PRINTED ORDER SET FOR ACUTE CHEST PAIN IN THE EMERGENCY DEPARTMENT
High Sensitivity Troponin - Summary

Scheduled to replace current troponin in April 2019

Allows for more rapid rule in and out

More sensitive

Lower coefficient of variability

Risk stratifying patients requires monitoring the change in troponin value (delta troponin)

Pre-printed order set and clinical decision support tool has been developed by the Emergency Network in consultation with lab, and cardiology
Current Fraser Health Troponin Assay

Troponin I

Elevated >0.04 µg/L (40 ng/L)
- Acceptable Coefficient of Variation at this level: ± 0.02 µg/L (50%)

2017 Stats:
- Total Troponins: 206,835
  - # Results > 0.06 µg/L: 49,857 (24%)
- Total unique admissions: 133,117
  - # Results > 0.06 µg/L on admission: 13,564 (10%)
New High Sensitivity Troponin

Beckman high sensitivity (HS) Troponin I assay

Coefficient of Variation (CV) observed CV is 3.8% at 9 ng/L (0.3 ng/L)

Detectable Troponin in 50% of the healthy population

Lower Limit of Detection is 2.3 ng/L

No sex specific cut-off

“Abnormal”
  ◦ Greater than 18ng/L
  ◦ Delta troponin of greater than 11

Less possibility of false positive due to antibody interference with current assay
Cardiac Non-cardiac

Acute and chronic heart failure
Myocarditis
Cardiac contusion from trauma
Aortic dissection
Hypertrophic cardiomyopathy
Valvular disease
Tachyarrhythmia
Bradyarrhythmia or heart block
Cardioversion
Takotsubo cardiomyopathy
Rhabdomyolysis

Renal failure
Pulmonary embolism
Severe pulmonary hypertension
Sepsis
Severe critical illness
Burns
Extreme exertion
Amyloidosis or other infiltrative diseases
Stroke/ICH
Subarachnoid hemorrhage
Troponin is cleared by the kidneys, we can anticipate elevated levels in CKD or acute renal failure.
Cardiomyocyte

Troponin I

Actin

Troponin C

Troponin T

Myosin

Plasma troponin concentration

Complete article found here
https://www.nature.com/articles/nrcardio.2017.48
Terminology - Upper reference limit (URL)
A broader differential diagnosis associated with lower-range elevations of hs-cTn begins to narrow as concentrations are higher. HF = heart failure; LVH = left ventricular hypertrophy; MI = myocardial infarction; PE = pulmonary embolism. Modified with permission from Mueller (21).
HsTroponin Paradigm Shift

Conventional Assay
- Binary
- AMI = Trop +
- 6 hr rule out

High Sensitivity Assay
- Continuum
- Myocardial injury
- AMI = >URL, Lg delta
- 3hr rule out
- Delta troponin
Components of PPO and CDST

Applies to patients with acute chest pain presenting to the ED

Monitoring criteria

Incorporation of high sensitivity troponin

Repeat troponin at 3h

Able to rule out with single troponin if < 2ng/L at 3 hours post onset

Risk stratification tool – HEART score

Recommendations for admission and consultation criteria
Inclusion and monitoring criteria

Indication:
- Acute chest pain with potential acute coronary syndrome and no other obvious cause AND
- Greater than 30 years old OR less than 30 years old with a high clinical suspicion of acute coronary syndrome

Investigations:
- ER Nurse Initiated Chest Pain Panel (/ER CP) if not already done at triage
- Ensure ECG completed within 10 minutes of arrival
- Chest X-Ray
- Repeat Troponin at three hours after first Troponin

VITAL SIGNS:
- On arrival then as per Emergency VS Guidelines

Cardiac Monitoring:
- Triage to Zone 1 and place patient on cardiac monitor if ECG changes or active chest pain.
- Triage to Zone 2 if no active chest pain and normal ECG or nonspecific changes (no signs of acute ischemia; infarction; bundle branch block, prolonged QRS, QT or PR interval; left ventricular hypertrophy with strain; arrhythmia; or paced rhythm)

HEART Risk Score ____________ (calculation tool on back of page 1)
Evidence...

Journal of Emergency Medicine and Critical Care 2018

29 trials (>20 clinical scores)

#1 = HEART score

- Ability to accurately and consistently stratify patients into low and high risk groups
- Designed for the ED setting
### HEART Score

<table>
<thead>
<tr>
<th>History (Anamnesis)</th>
<th>Score</th>
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<tbody>
<tr>
<td>Highly suspicious</td>
<td>2</td>
</tr>
<tr>
<td>Moderately suspicious</td>
<td>1</td>
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<tr>
<td>Slightly suspicious</td>
<td>0</td>
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<table>
<thead>
<tr>
<th>ECG</th>
<th>Score</th>
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<tbody>
<tr>
<td>Significant ST-deviation</td>
<td>2</td>
</tr>
<tr>
<td>Non-specific repolarisation disturbance / LBBB / PM</td>
<td>1</td>
</tr>
<tr>
<td>Normal</td>
<td>0</td>
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<table>
<thead>
<tr>
<th>Age</th>
<th>Score</th>
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<tr>
<td>≥ 65 years</td>
<td>2</td>
</tr>
<tr>
<td>45 – 65 years</td>
<td>1</td>
</tr>
<tr>
<td>≤ 45 years</td>
<td>0</td>
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<table>
<thead>
<tr>
<th>Risk factors</th>
<th>Score</th>
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<tr>
<td>≥ 3 risk factors or history of atherosclerotic disease</td>
<td>2</td>
</tr>
<tr>
<td>1 or 2 risk factors</td>
<td>1</td>
</tr>
<tr>
<td>No risk factors known</td>
<td>0</td>
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</table>

<table>
<thead>
<tr>
<th>Troponin</th>
<th>Score</th>
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<tbody>
<tr>
<td>≥ 3x normal limit</td>
<td>2</td>
</tr>
<tr>
<td>1-3x normal limit</td>
<td>1</td>
</tr>
<tr>
<td>≤ normal limit</td>
<td>0</td>
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</table>

<table>
<thead>
<tr>
<th>HEART score</th>
<th>~ % pts</th>
<th>MACE/n</th>
<th>MACE</th>
<th>Death</th>
<th>Proposed Policy</th>
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<tbody>
<tr>
<td>0-3</td>
<td>32%</td>
<td>38/1993</td>
<td>1.9%</td>
<td>0.05%</td>
<td>Discharge</td>
</tr>
<tr>
<td>4-6</td>
<td>51%</td>
<td>413/3136</td>
<td>13%</td>
<td>1.3%</td>
<td>Observation, risk management</td>
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<tr>
<td>7-10</td>
<td>17%</td>
<td>518/1045</td>
<td>50%</td>
<td>2.8%</td>
<td>Observation, treatment, CAG</td>
</tr>
</tbody>
</table>
Risk Stratification Algorithm

- Order Chest Pain Panel on arrival. Order 2nd Troponin 3 hours post 1st Troponin
- If chest pain greater than 3 hours on arrival, cancel 2nd Troponin if 1st Troponin is < 2 ng/L

**Troponin**

- < 2 ng/L OR < 18 ng/L and Δ < 11 ng/L
  - HEART score 0 to 3
    - Follow-up with GP for risk factor reduction
  - Urgent outpatient cardiology follow-up (i.e., chest pain clinic) within 72 hours

- 18 ng/L to 88 ng/L OR Δ is 11 ng/L to 21 ng/L
  - HEART score 0 to 3
  - Consider alternate causes of elevated Troponin (CKD, Sepsis, other cardiovascular disease), another 3 hour Troponin or Cardiology Consult

- > 88 ng/L OR Δ ≥ 22 ng/L
  - Consider cardiology consult

**Legend**

Δ = Delta Value
<= = less than
> = greater than
≥ = greater than or equal to
Serial troponin

1\textsuperscript{st} troponin ordered on arrival
2\textsuperscript{nd} troponin ordered 3 hours after the 1\textsuperscript{st} troponin
2\textsuperscript{nd} troponin not required if
- Chest pain greater than 3 hours at time of 1\textsuperscript{st} troponin
- 1\textsuperscript{st} troponin is < 2ng/L
Only one troponin required at 3 hours of onset to “rule out” if <2ng/L
Proportion of Patients

- ~60%
  - <2ng/L or <18ng/L and Δ<11ng/L
    - HEART score 0 - 3
      - Follow up with GP
    - HEART score 4 - 7
      - Urgent outpatient cardiology follow-up (i.e. chest pain clinic) within 72 hours

- ~15-20%
  - 18-88ng/L or Δ11-22ng/L
    - HEART score 0 - 3
      - Consider alternate causes of elevated Troponin (CKD, Sepsis, other cardiovascular disease), another 3 hr Troponin or Cardiology Consult
    - HEART score 4 - 7
      - Consider Cardiology Consult

- ~20-25%
  - >88ng/L or Δ>22ng/L
    - Consider admit Cardiology ACS
Most likely discharge

- <2ng/L or <18ng/L and Δ<11ng/L
  - HEART score 0 - 3
    - Follow up with GP
  - HEART score 4 - 7
    - Urgent outpatient cardiology follow-up (i.e. chest pain clinic) within 72 hours

- 18-88ng/L or Δ11-22ng/L
  - HEART score 0 - 3
    - Consider alternate causes of elevated troponin (CKD, Sepsis, other cardiovascular disease), another 3 hr Troponin or Cardiology Consult
  - HEART score 4 - 7
    - Consider Cardiology Consult

- >88ng/L or Δ>22ng/L
  - Consider admit Cardiology ACS
Most likely admit

- <2ng/L or <18ng/L and Δ<11ng/L
  - HEART score 0 - 3: Follow up with GP
  - HEART score 4 - 7: Urgent outpatient cardiology follow-up (i.e. chest pain clinic) within 72 hours
- 18-88ng/L or Δ 11-22ng/L
  - HEART score 0 - 3: Consider alternate causes of elevated Troponin (CKD, Sepsis, other cardiovascular disease), another 3 hr Troponin or
  - HEART score 4 - 7: Consider Cardiology Consult
- >88ng/L or Δ>22ng/L
  - Consider admit Cardiology ACS
"Observation Zone"

- <2ng/L or <18ng/L and Δ<11ng/L
- 18-88ng/L or Δ 11-22ng/L
- >88ng/L or Δ>22ng/L

1. HEART score 4 - 7
   - Urgent outpatient cardiology follow-up (i.e. chest pain clinic) within 72 hours
   - Consider alternate causes of elevated Troponin (CKD, Sepsis, other cardiovascular disease), another 3 hr Troponin or Cardiology Consult

2. HEART score 0 - 3
   - Follow up with GP

3. HEART score 4 - 7
   - Consider Cardiology Consult

4. Consider admit Cardiology ACS
Observation Zone - Clinical Gestalt

1. Consider other causes of myocardial injury

2. Stratify based on likelihood of ACS
   - Unlikely ACS
     - No ECG changes
     - Atypical CP or symptoms resolved
     - Heart score of 0-3
   - Possible ACS / Likely ACS
     - Serial trop/ecg = dynamic changes
     - Typical cardiac CP or ongoing symptoms
     - Additional testing - Cardiology
       - Functional - MIBI, Treadmill
       - Anatomical - CCTA, Angiogram

Urgent outpatient cardiology follow-up (i.e. chest pain clinic) within 72 hours

Consider Cardiology Consult
# Other Causes of Myocardial Injury

## Cardiac causes:
- Tachyarrhythmias (e.g., AFRVR)*
- Bradyarrhythmias*
- Severe aortic valve disease*
- Hypertrophic cardiomyopathy*
- Acute heart failure*
- Stress cardiomyopathy (takotsubo)
- Blunt cardiac injury (contusion)
- CPR (chest compressions)
- Defibrillator shocks
- Cardiac ablation
- Cardiac (non-CABG) surgery
- Myocarditis / pericarditis
- Endocarditis
- Cardiotoxic agents, chemotherapy
- Infiltrative disease (amyloid, sarcoïd)
- Cardiac tumors / malignancies
- Myopathies / muscular dystrophies

## Systemic causes:
- Hypertensive emergency*
- Non-cardiac surgery*
- Critical illness*
- Pulmonary embolism
- Pulmonary hypertension
- Sepsis
- Renal failure / ESRD
- Stroke
- Subarachnoid hemorrhage
- Rhabdomyolysis
- Strenuous exercise
- Burn injuries to body
- Diabetic ketoacidosis
- Heterophile antibodies (false positive)
- Other emerging causes
Case 1

ID: 44 F  CC: Chest pain

HPI: Onset 6 hrs ago while watching TV, CP intermittent, resolved for the last 3 hours currently CP free

PMHx: Healthy

CV Rfs: none

Px: Unremarkable, VSS

ECG: NSR

Initial hsTroponin = <2 ng/L

2nd hsTroponin = not required

HEART score = 0

Follow-up with GP for risk factor reduction
Case 2

ID: 70 F        CC: “Chest Pressure”

HPI: Recurrent chest pain, last episode started 11 hours ago. In ED she is pain free.

PMHx: DM, HTN

CV Rfs: HTN and DM

Px: unremarkable

ECG: LVH

Initial hsTroponin = 12 ng/L
2nd hsTroponin = 16 ng/L
3hr delta = 4 ng/L

<2ng/L or <18ng/L and Δ<11ng/L

HEART score = 4

Urgent outpatient cardiology follow-up (i.e. chest pain clinic) within 72 hours
Case 3

ID: 70 F CC: “Chest Pressure”

HPI: Recurrent chest pain, last episode started 11 hours ago. In ED she is pain free.

PMHx: CAD (pci-des x2), DM, HTN

CV Rfs: HTN, DM, + FM hx

Px: unremarkable

ECG: LVH

Initial hsTroponin = 12 ng/L
2nd hsTroponin = 32 ng/L
3hr delta = 20 ng/L

18-88ng/L or Δ 11-22ng/L

HEART score = 5

Consider Cardiology Consult
Case 4

ID: 64 M  CC: Chest pain

HPI: Onset 3 hrs ago while walking up stairs, CP intermittent, no SOB, no diaphoresis.

PMHx: Alport syndrome - CKD (eGFR 30)

CV Rfs: none

Px: Unremarkable, VSS

ECG: NSR

Baseline hsTroponin = 32 ng/L
Initial hsTroponin = 45 ng/L
2nd hsTroponin = 48 ng/L
3hr delta = 3 ng/L

Consider alternate causes of elevated Troponin (CKD, Sepsis, other cardiovascular disease), another 3 hr Troponin or Cardiology Consult
Case 5
ID: 56 M CC: Chest pain
HPI: Onset 2 hours ago, initially intermittent and now constant x 1.5hrs. Rad neck and back. No dyspnea
PMHx: HTN
Px: mod discomfort, normal VS
ECG: non diagnostic ST changes

Initial hsTroponin = 17 ng/L
2nd hsTroponin = 152ng/L
3hr delta = 135ng/L

>88ng/L or Δ>22ng/L

Consider admit Cardiology ACS
ACS
Acknowledgements

- Dr. Shayla Behrens
- Dr. Richard Cleve
- Dr. Dennis Orton

Questions?
  - Neil.Barclay@fraserhealth.ca