Clinical protocols for high-sensitivity troponin testing at Grady Memorial Hospital and Emory Healthcare *
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* Disclaimer: The high-sensitivity troponin I protocols in these slides have been developed only for hospitals that use the Beckman Coulter UniCel Dxl Access analyzer, including Grady Memorial Hospital, Emory University Hospital, Emory University Hospital Midtown, Emory Saint Josephs Hospital, and Emory Johns Creek Hospital. The troponin cut points in these slides do not pertain to Emory University Orthopedics and Spine Hospital, Emory Decatur Hospital, Emory Hillandale Hospital, and Emory Long-Term Acute Care hospital, which use different lab analyzers (refer to separate protocols).

References:

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For all Emory HS troponin clinical protocols and videos, visit: https://med.emory.edu/departments/medicine/divisions/cardiology/hs-troponin-protocols/index.html
For Emory HS troponin educational video, visit: https://youtu.be/v0muP7bveYM

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Background

• Europe has been using high-sensitivity troponin testing (hs-Tn) for >5 years; U.S. hospitals in various stages of adopting hs-Tn testing

• High sensitivity troponin test is more sensitive, & more precise at low concentrations, than standard troponin

• High-sensitivity troponin testing allows for faster MI “rule outs” in chest pain patients presenting to the ED
  – This leads to more efficient ED throughput

• Tradeoff: hs-Tn less specific for treatable heart attacks (e.g. Type 1 NSTEMI), and instead detects all types of heart injury (including nonischemic myocardial injuries and Type 2 MI), that don’t necessarily warrant treatment or change management
**Equivalency of values: TnI vs. hs-TnI (EUH, EUHM, ESJH, EJCH, Grady) * **

Note the following differences between standard troponin I and high-sensitivity troponin I (hs-TnI):

1. Units of measurement are different. hs-TnI is reported as **integers in ng/L** (whereas TnI was in ng/mL)
2. To convert from hs-TnI to standard TnI (for clinical context), **divide by 1000**. Example: hs-TnI value of 100 ng/L corresponds to a standard TnI value of 0.1 ng/mL. See table below.
3. hs-TnI has different “abnormal” cut point, (or 99th percentile value) in women and men.

<table>
<thead>
<tr>
<th>standard TnI (ng/mL)</th>
<th>hs-TnI (ng/L)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.0023</td>
<td>&lt; 2.3</td>
<td>LOQ** for hs-TnI</td>
</tr>
<tr>
<td>0.015</td>
<td>15</td>
<td>99 percentile (abnormal) hs-TnI value for women</td>
</tr>
<tr>
<td>0.02</td>
<td>20</td>
<td>99 percentile (abnormal) hs-TnI value for men</td>
</tr>
<tr>
<td>0.03</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>0.04</td>
<td>40</td>
<td>99 percentile (abnormal) standard TnI value</td>
</tr>
<tr>
<td>0.05</td>
<td>50</td>
<td></td>
</tr>
<tr>
<td>0.1</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>0.5</td>
<td>500</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>1000</td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>10000</td>
<td></td>
</tr>
<tr>
<td>25</td>
<td>&gt; 25000</td>
<td>Highest reportable value of analytic range for hs-TnI</td>
</tr>
<tr>
<td>&gt;70</td>
<td></td>
<td>Highest reportable value of analytic range for TnI</td>
</tr>
</tbody>
</table>

* Grady, EUH, EUHM, ESJH, and EJCH use a Beckman Coulter UniCel DxI analyzer with the following “abnormal” (>99th percentile) cut points: >14.9 ng/L in women; >19.8 ng/L in men. These cut points do NOT apply for EUOSH, EDH, EHH, or ELTAC (see separate protocols for these operating units).

** LOQ: Lowest hs-TnI concentration that is reportable as a number with specified certainty

hs-TnI: high-sensitivity troponin I
FOOTNOTES:

1. Beckman UniCel DxI Access analyzer “abnormal” (>99th percentile) cut points: >15 ng/L (women); >20 ng/L (men)

2. Refers to acute findings not seen on prior ECGs, and not associated with LVH, LBBB, RBBB, or early repolarization

3. “No delta”, “All deltas”, or “Any delta” includes 0→1h, 1→3h, and 0→3h changes in hsTnI

CP chest pain; OP outpatient; SXS symptoms

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### HEART Score (used only in ED)

<table>
<thead>
<tr>
<th>Component</th>
<th>Description</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>History</strong></td>
<td>Slightly suspicious</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Moderately suspicious</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Highly suspicious</td>
<td>2</td>
</tr>
<tr>
<td><strong>EKG</strong></td>
<td>Normal</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Non-specific repolarization disturbance</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Significant ST deviation</td>
<td>2</td>
</tr>
<tr>
<td><strong>Age</strong></td>
<td>&lt; 45</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>45-64</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>&gt; 65</td>
<td>2</td>
</tr>
<tr>
<td><strong>Risk Factors</strong></td>
<td>No known risk factors</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>1-2 risk factors</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>≥ 3 risk factors OR atherosclerotic disease</td>
<td>2</td>
</tr>
<tr>
<td><strong>Initial troponin</strong></td>
<td>Less than upper limit of normal</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>1 to 3x normal limit</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>&gt; 3x normal limit</td>
<td>2</td>
</tr>
</tbody>
</table>

**TOTAL:**
Acute chest pain

Chest pain sounds ischemic?

Yes / maybe → Obtain ECG → ECG meets STEMI criteria?

No → Obtain ECG → ECG with acute ischemia?

No → Do NOT order hs-Tnl

Yes / maybe → Order hs-Tnl and ECGs at 0h & 3h → Any Trop ≥ 15(F)/20(M)

→ MYOCARDIAL INJURY

→ Order repeat hs-Tnl & ECG at 6h

→ Clinical evidence of myocardial ischemia without injury

→ “NONISCHEMIC MYOCARDIAL INJURY”

→ “TYPE 2 MI”

→ “NSTE MI” (“TYPE 1 NSTE MI”)

→ Consider clinical context (see following slide)

No myocardial ischemia

• Work up symptoms for other causes

“NONISCHEMIC MYOCARDIAL INJURY”

• Document and treat underlying cause

“TYPE 2 MI”

• Document and treat underlying precipitant

“NSTE MI” (“TYPE 1 NSTE MI”)

• Cardiology consult

• Treat per NSTE MI guidelines

Footnotes:
1. Beckman UniCel DxI Access analyzer “abnormal” (>99th percentile) cut points: ≥ 15 ng/L (women); ≥ 20 ng/L (men)
2. Refers to acute findings not seen on prior ECGs, and not associated with LVH, LBBB, RBBB, or early repolarization
3. “No delta”, “All deltas”, or “Any delta” includes 0→1h, 1→3h, and 0→3h changes in hsTnI

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Acute nonischemic injury is associated with a rise/fall in troponin. Chronic injury associated with “flat” troponins.

Some conditions may cause either a Type 2 MI or a nonischemic myocardial injury. The presence / absence of ischemic symptoms, or findings on ECG / cardiac imaging / coronary angiography may help distinguish the two.

The term “NSTEMI” should only be documented when referring to Type 1 NSTEMI, and not for Type 2 MI.

Acute nonischemic myocardial injury:
- Critical illness
- Hypertensive emergency
- Acute heart failure
- Takotsubo cardiomyopathy
- Acute pulmonary embolism (PE)
- Sepsis without shock
- Myocarditis / Pericarditis
- Acute endocarditis
- Non-cardiac surgery
- Tachycardia (AFRVR, SVT, VT)
- Blunt chest injury (CPR, contusion)
- Defibrillator shocks
- Cardiac ablation
- Cardiac (non-CABG) surgery
- Acute neuro event (stroke, seizure)
- Diabetic ketoacidosis
- Rhabdomyolysis
- Strenuous exercise
- Burn injuries to body

Chronic nonischemic myocardial injury:
- Structural heart disease
- Severe aortic valve disease
- Hypertrophic cardiomyopathy
- Chronic pulmonary hypertension / chronic PE
- Infiltrative disease (amyloid, sarcoid, tumors, etc.)
- ESRD / advanced CKD
- Cardiotoxic agents, chemotherapy

Underlying causes of nonischemic myocardial injury:

Document “TYPE 2 MI secondary to [underlying precipitant]”
• Treat underlying precipitant of Type 2 MI

Underlying precipitants of Type 2 MI:

Cardiac causes:
- Tachycardia (AFRVR, SVT)
- Bradycarrhythmias
- Aortic dissection
- Coronary vasospasm
- Coronary vasculitis / endothelial dysfunction / microvascular disease
- Embolism to coronary artery
- Spontaneous coronary artery dissection (SCAD)

Systemic causes:
- Hypertensive emergency
- Critical illness
- Non-cardiac surgery
- Septic shock
- Acute hypoxic resp. failure
- Severe anemia (acute blood loss, hemolysis)

References:
- Goyal A et al. What’s in a name? The new ICD-10 codes and Type 2 MI. Circulation 2017;136:1180-2

1 Acute nonischemic injury is associated with a rise/fall in troponin. Chronic injury associated with “flat” troponins.
2 Some conditions may cause either a Type 2 MI or a nonischemic myocardial injury. The presence / absence of ischemic symptoms, or findings on ECG / cardiac imaging / coronary angiography may help distinguish the two.
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