

High Sensitivity Troponin

What you need to know

Dr. Nathan Lambert, Cardiology
Dr. Ben Hunter, Emergency Medicine



West Hospital

IUH adoption of high-sensitivity troponin

■ What?

- Systemwide conversion from current generation troponin I assay, to newer high-sensitivity troponin I assay (hs-TnI)

■ When?

- 7/12/2021

■ Why?

- Increased sensitivity allows for earlier and more accurate detection of Myocardial Infarction (MI)

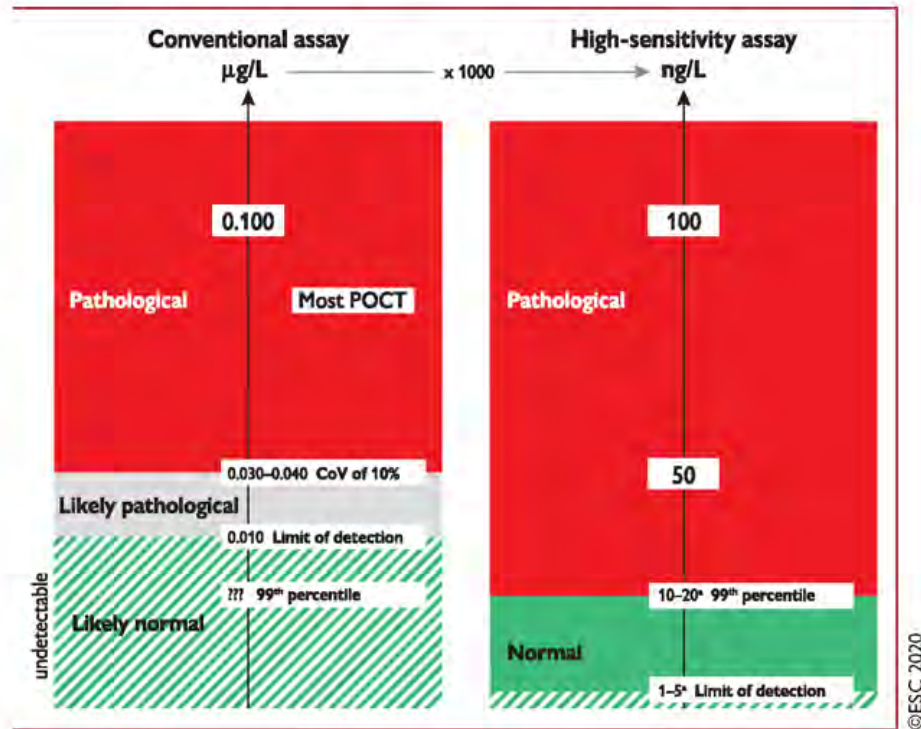
■ Who?

- All IU Health facilities statewide

hs-Troponin: background

- Troponin is a biomarker, most commonly used in the diagnosis of myocardial infarction
 - Enzyme found in myocardial tissue – release into the bloodstream indicates a degree myocardial injury
- Note the new assay does not detect a novel protein; it detects the same troponin enzyme, just at lower levels
- Note the change in scale: ng/ml → ng/L
 - 0.05 ng/ml = 50 ng/L
- Note there will now be sex specific cut-offs
 - 99th percentile, high sensitivity troponin: 12 ng/L (f), 20 ng/L (m)

Figure 2 Value of high-sensitivity cardiac troponin. hs-cTn assays (right) are reported in ng/L and provide identical ...

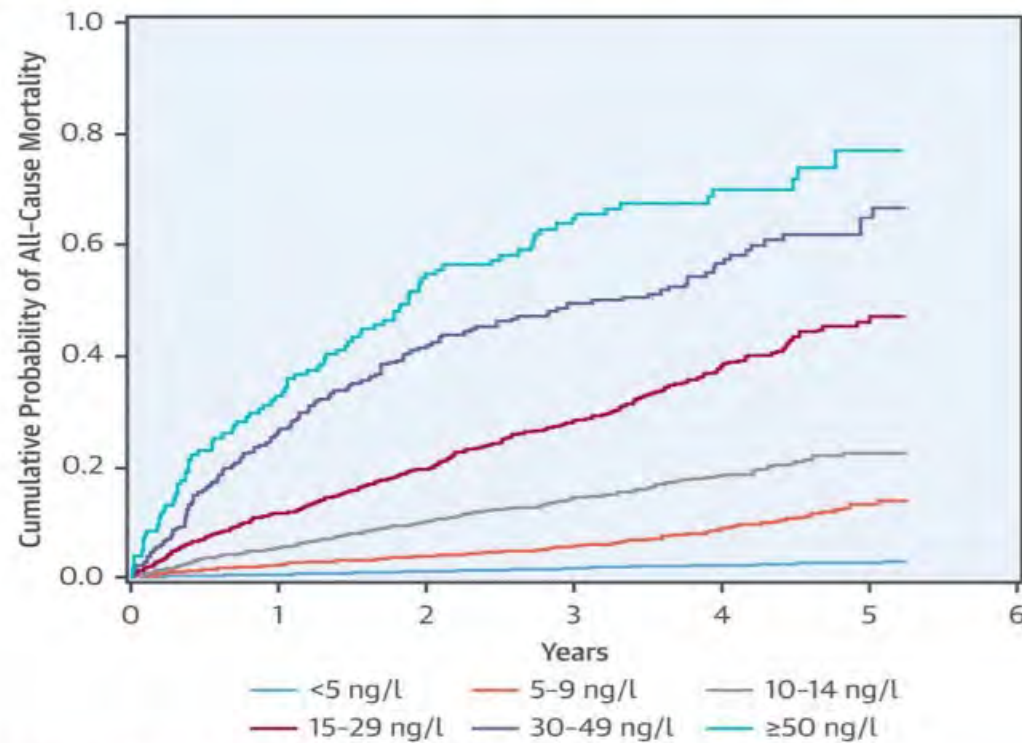


Eur Heart J, Volume 42, Issue 14, 7 April 2021, Pages 1289–1367. <https://doi.org/10.1093/eurheartj/ehaa575>

The content of this slide may be subject to copyright; please see the slide notes for details.

The prognostic power of troponin

CENTRAL ILLUSTRATION: Elevated Troponin Levels and Outcomes: Cumulative Mortality



Roos, A. et al. J Am Coll Cardiol. 2017;70(18):2226-36.

Rationale for adopting hs-Tn

- High sensitivity troponin is currently used in most of Europe/Asia and is recommended by the ACC/AHA
- High sensitivity troponin compared to current generation troponin assay
 - Higher precision at lower concentration
 - Allows for sex specific cut offs
 - More sensitive for detecting injury
 - Accurately recognizes smaller changes in a shorter time frame
 - Higher NPV, similar PPV for diagnosing MI

Clinical implications of adopting hs-Tn

- Clinical Implications

- Detect smaller MIs
 - Predictably reclassifies much unstable angina as MI
- Detect MIs more quickly
 - Allow for quicker triage, treatment → myocardial salvage
- Rule Out MIs more quickly
 - Allow for earlier ER discharge

Importantly, not all troponin elevation indicates myocardial infarction

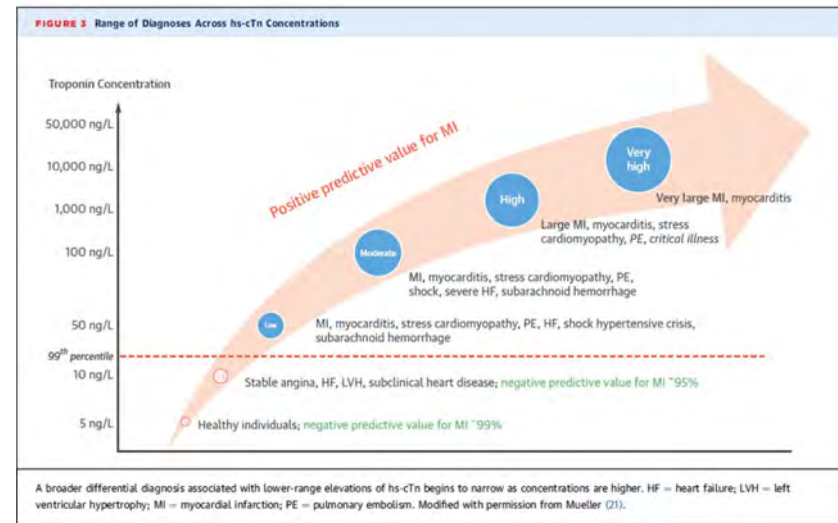
hs-Tn will create more abnormal troponin results → requires a shift in thinking from binary to linear test result, and understanding of infarct vs. injury

Diagnosing Myocardial Infarction

■ 4th Universal Definition of MI

Must have 3 criteria met

- Rising and falling pattern of biomarker, preferably hs-Tn
- At least one value > 99th percentile
- Symptom or sign of ischemia
 - Anginal chest pain
 - Ischemic ECG changes
 - New regional wall motion abnormality on imaging
 - Coronary thrombus on angiography



Infarct vs. Injury

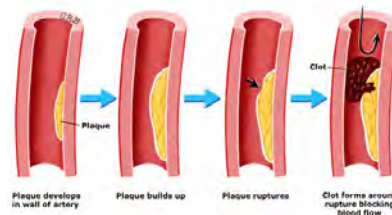
■ Patients with elevated troponin, meeting criteria for MI

■ Type I MI

- STEMI
- NSTEMI

■ Type II MI

- supply/demand



■ Patients with elevated troponin, not meeting criteria for MI

- Acute injury without infarction
- Chronic injury without infarction

→ *non-ACS troponin elevation*

TABLE 1 Differential Diagnosis for an Elevated hs-cTn Result

Injury related to primary myocardial ischemia

- Plaque rupture
- Intraluminal thrombus

Injury related to myocardial oxygen supply/demand imbalance

- Tachy/bradyarrhythmias
- Aortic dissection or severe aortic valve disease
- Hypertrophic cardiomyopathy
- Cardiogenic, hypovolemic, or septic shock
- Severe respiratory failure
- Severe anemia
- Hypertension with or without left ventricular hypertrophy
- Coronary endothelial dysfunction, spasm, or dissection

Injury not related to myocardial ischemia

- Cardiac contusion, surgery, ablation, pacing or defibrillation
- Rhabdomyolysis with cardiac involvement
- Myocarditis
- Cardiotoxic agents (e.g., anthracyclines, Herceptin)

Multifactorial or indeterminate myocardial injury

- Heart failure
- Stress cardiomyopathy
- Pulmonary embolism
- Pulmonary hypertension
- Sepsis
- Critical illness
- Renal failure
- Severe acute neurological disease (e.g., stroke, subarachnoid hemorrhage)
- Infiltrative cardiomyopathies (e.g., amyloidosis, sarcoidosis)
- Strenuous exercise

A key knowledge point is an elevated hs-cTn identifies the presence of myocardial injury but not the mechanism.

hs-cTn = high-sensitivity cardiac troponin.

Incorporating hs-Tn into an ED algorithm

- No POC
- Choosing 1 hr vs 2 hr time interval
- Incorporating HEART score improves PPV/specificity
- Ability to rule out with a single hs-Tn
 - 3 hrs of symptoms
- Appropriate triage for patient released from ED will be an important process for each site to work out individually

Does not apply to STEMI or dynamic ST depression w/ CP

High-Sensitivity Troponin I in evaluation for ACS Beckman Coulter Access hs-TnI

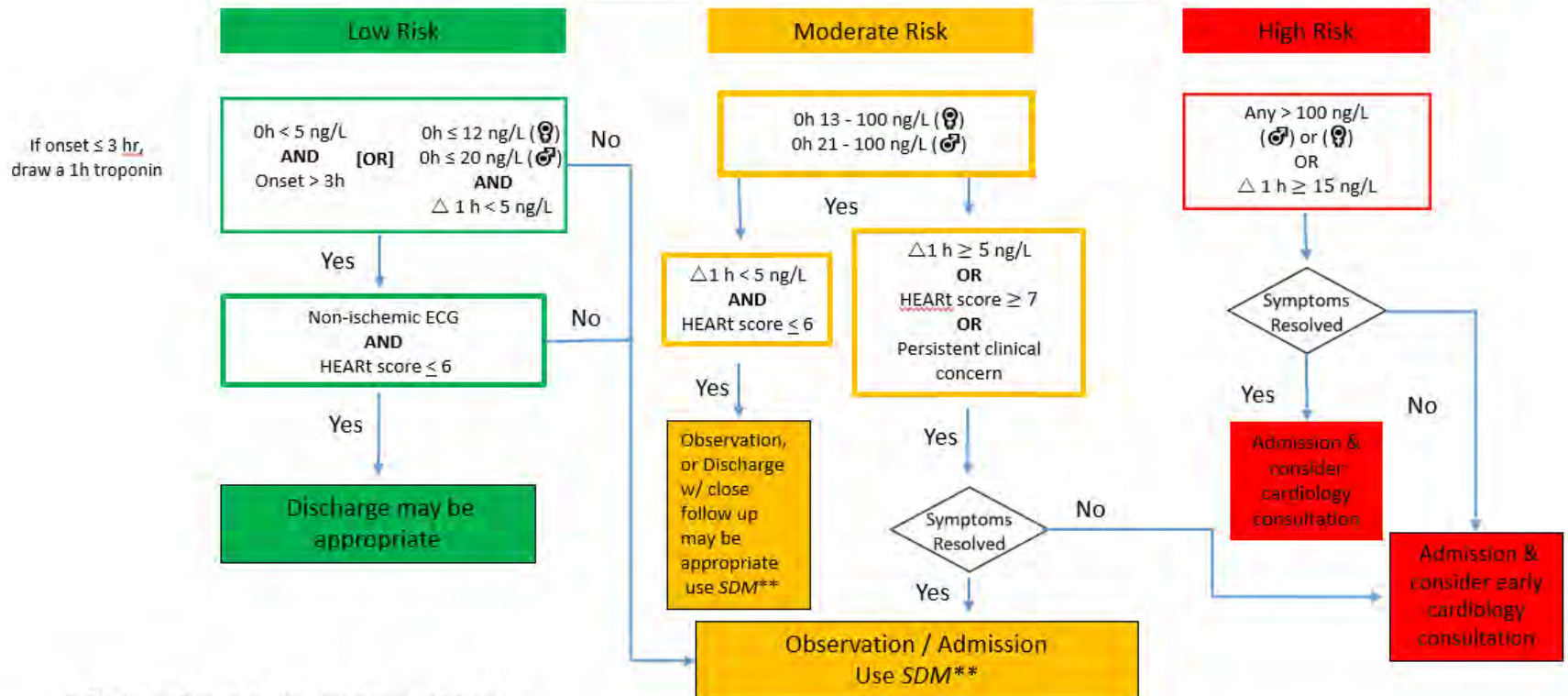
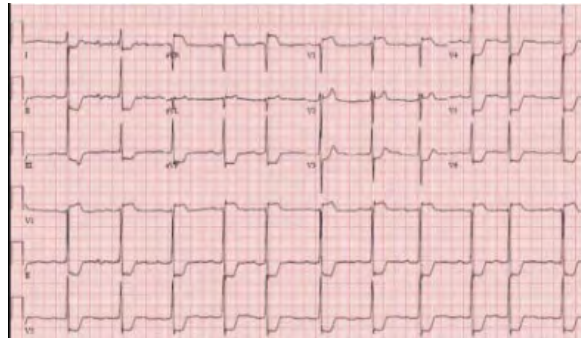


TABLE 3 The HEART Score for Evaluation of Patients With Suspected Acute Coronary Ischemia

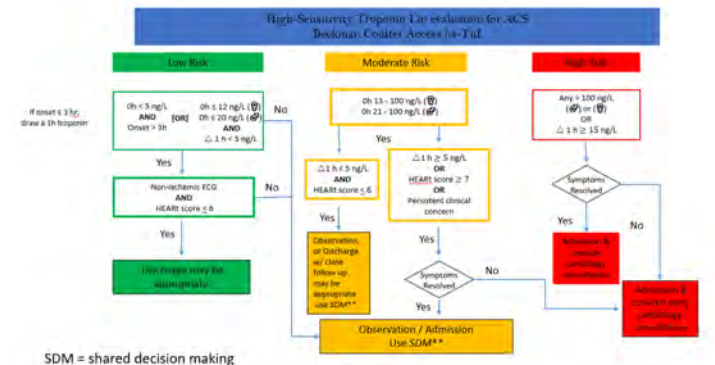
Variables	Points
History	
Highly suspicious	2
Moderately suspicious	1
Slightly suspicious	0
ECG	
Significant ST-segment depression	2
Nonspecific abnormalities	1
Normal	0
Age, yrs	
>65	2
45–65	1
<45	0
Risk factors	
3 or more risk factors	2
1 or 2 risk factors	1
No risk factors	0
Troponin	
>3 × normal limit	2
1–3 × normal limit	1
≥ Normal limit	0
Total	Range 0–10
<p>Low risk is 0 to 3 points, moderate risk 4 to 6 points, and high risk ≥7 points. ECG = electrocardiogram; HEART = history, ECG, age, risk factors, and troponin.</p>	

Case 1, Type 1 MI, NSTEMI

- 55 yo man presents with chest pressure at rest, duration 2 hrs, radiating to the jaw
- Risk factors: diabetes, tobacco use, HTN
- Relieved with SL Nitro by EMS
- Initial ECG:



- Initial hs-Tn: 500 ng/L
 - 1hr hs-Tn: 700 ng/L
- HEART score: 9
- Triage per ADP: early cardiology intervention
- Diagnosis: NSTEMI, Type 1 MI
- Expected coronary anatomy: ulcerated plaque with thrombus

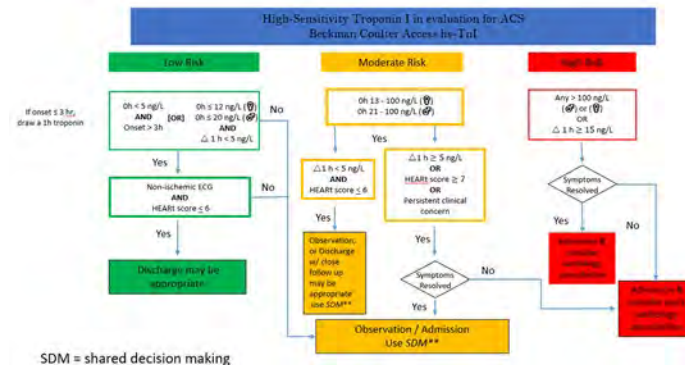


Case 2, Type II MI

- 80 yo woman presents with 3 days of chest heaviness, fatigue, and dark stools
- Hx: Afib on warfarin, HTN, CKD stage 3
- Initial ECG:

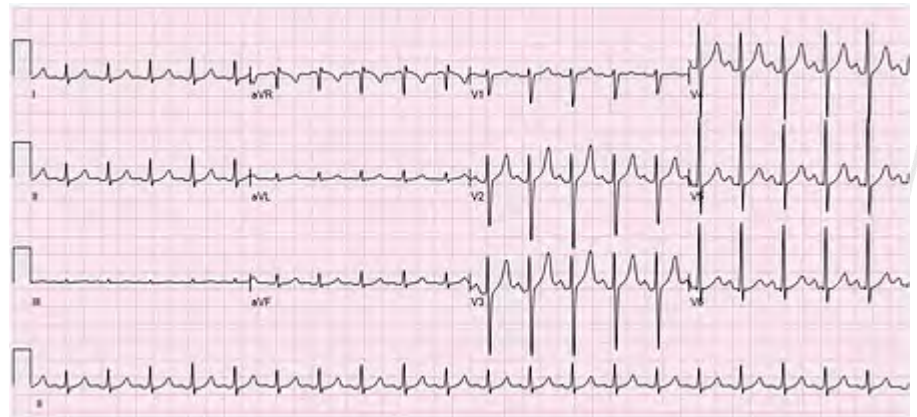


- Labs: BUN 40, Cr 1.6, Hgb 7, Hct 21, MCV 70, ferritin 6, INR 3
- Initial hs-Tn: 100 ng/L
 - 1hr hs-Tn: 150 ng/L
- Chest heaviness resolved completely with blood transfusion
- HEART score: 8
- Triage per ADP: early cardiology consultation
- Diagnosis: **Type II MI secondary to anemia**
- Expected coronary anatomy: fixed stenosis of 70%



Case 3, Non-ACS troponin elevation (acute injury) due to sepsis

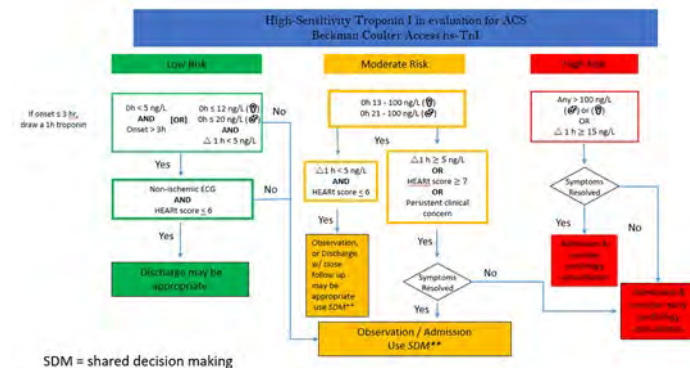
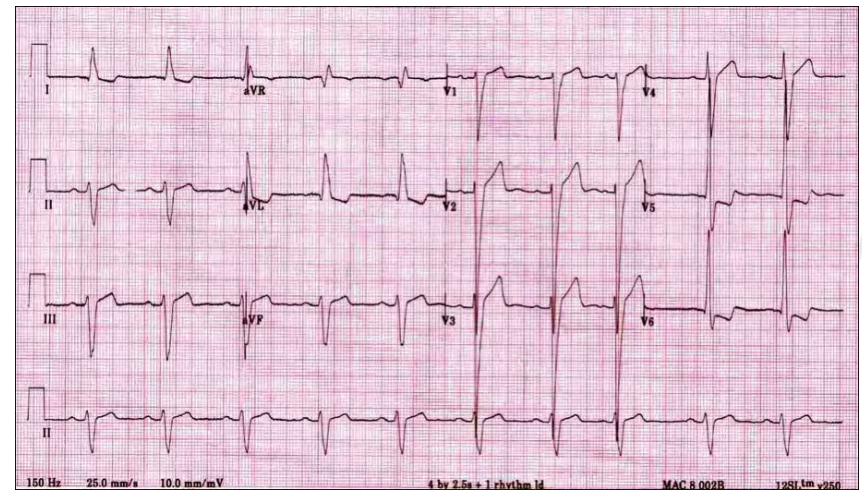
- 90 yo man presents from assisted living with confusion, lethargy, dyspnea
- PMHx: prostate CA, dementia
- Initial BP 70/30, HR 120, Temp 101
- Labs: WBC 14, Hgb 11, Cr 1.8, lactate 3
- ECG: sinus tachycardia
- Initial hs-Tn: 60 ng/L
 - 1hr hs-Tn: 58 ng/L



- Triage per ADP: does not apply
(alternate diagnosis of sepsis made)
- Diagnosis: **non-ACS troponin elevation secondary to sepsis**

Case 4, Non-ACS troponin elevation (chronic injury) due to CKD

- 35 yo man presents with dyspnea, and sharp chest pain, worse with coughing but also with exertion,
 - duration 3 days, course worsening
 - PMHx: ESRD, lupus, HTN, tobacco use
 - Pain unchanged with SL Nitro
 - Labs: BUN 75, Cr 6, WBC 11, Hgb 10
 - Initial ECG:
 - Initial hs-Tn: 42 ng/L
 - 1hr hs-Tn: 44 ng/L
 - HEART score: 5
 - Triage per ADP: observation, or discharge with close outpatient follow up
 - Diagnosis: non-ACS troponin elevation secondary to ESRD
- The ECG tracing displays 12 leads (I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6) on a standard grid. The rhythm is sinus. There is ST-segment depression (T-wave inversion) in leads I, II, III, aVR, aVL, and aVF, which is non-specific and can be seen in various conditions including non-ACS troponin elevation. The paper speed is 150 Hz and the sensitivity is 25.0 mm/s.
- The flowchart outlines the evaluation of ACS using High-Sensitivity Troponin I. It starts with a risk stratification: Low Risk, Moderate Risk, or High Risk. For Low Risk, if the patient is on a 3-hour troponin test, a 3-hour troponin is drawn. If the result is ≤ 5 ng/L AND/OR the onset is > 3h AND Δ 1h ≤ 5 ng/L, the patient is considered Low Risk. If the result is > 5 ng/L OR the onset is ≤ 3h OR Δ 1h > 5 ng/L, the patient is considered Moderate Risk. For Moderate Risk, if the result is ≤ 12 ng/L (or ≤ 20 ng/L if onset > 3h) AND Δ 1h ≤ 5 ng/L AND HEART score ≤ 6, the patient is considered Low Risk. If the result is > 12 ng/L (or > 20 ng/L if onset > 3h) OR Δ 1h > 5 ng/L OR HEART score ≥ 7 OR Persistent clinical concern, the patient is considered Moderate Risk. For High Risk, if the result is Any > 100 ng/L (or > 20 ng/L if onset > 3h) OR Δ 1h ≥ 15 ng/L, the patient is considered High Risk. If the patient is High Risk and symptoms are resolved, the patient is considered Low Risk. If the patient is High Risk and symptoms are not resolved, the patient is considered High Risk. The flowchart also includes a box for 'Discharge may be appropriate' for Low Risk patients.



Thank you!