



OYE VE hsTropinin

(What the heck
do I do with these
troponin levels)

Appropriate clinical context.

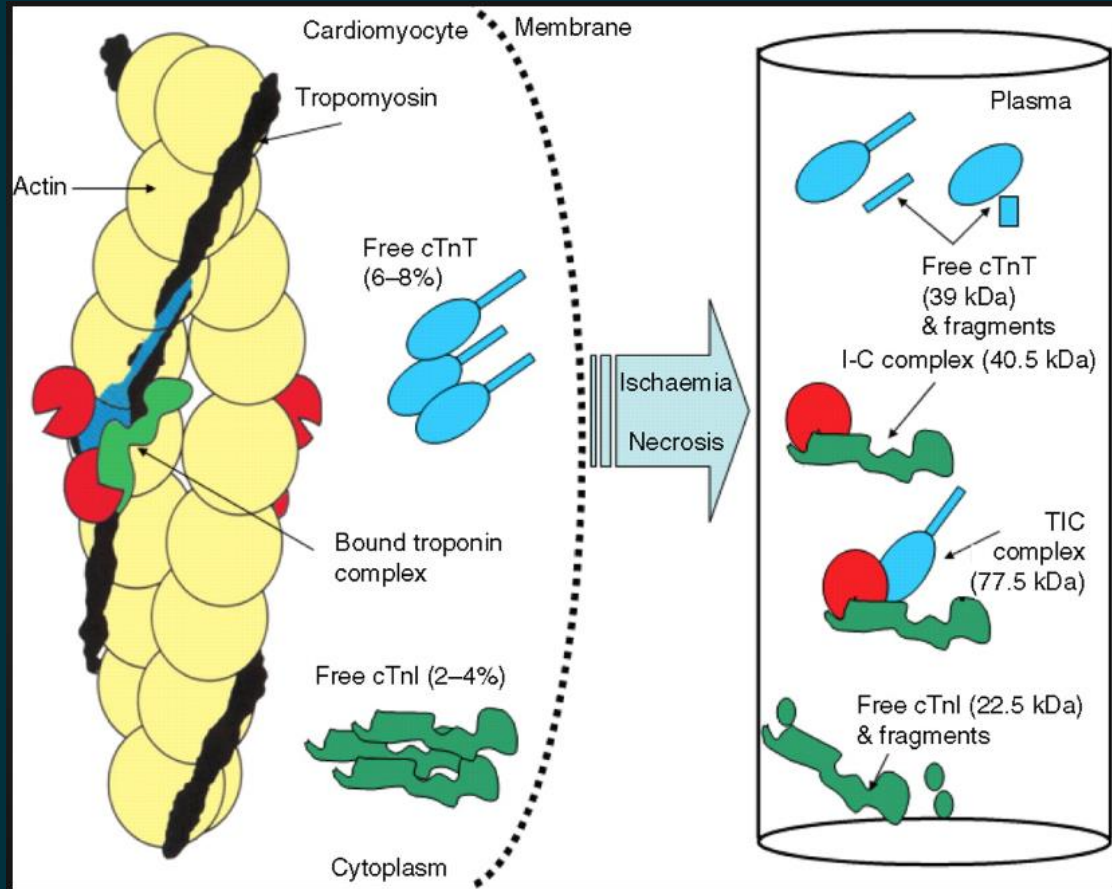
Draw high-sensitivity troponin if myocardial ischemia
is suspected otherwise do not order!

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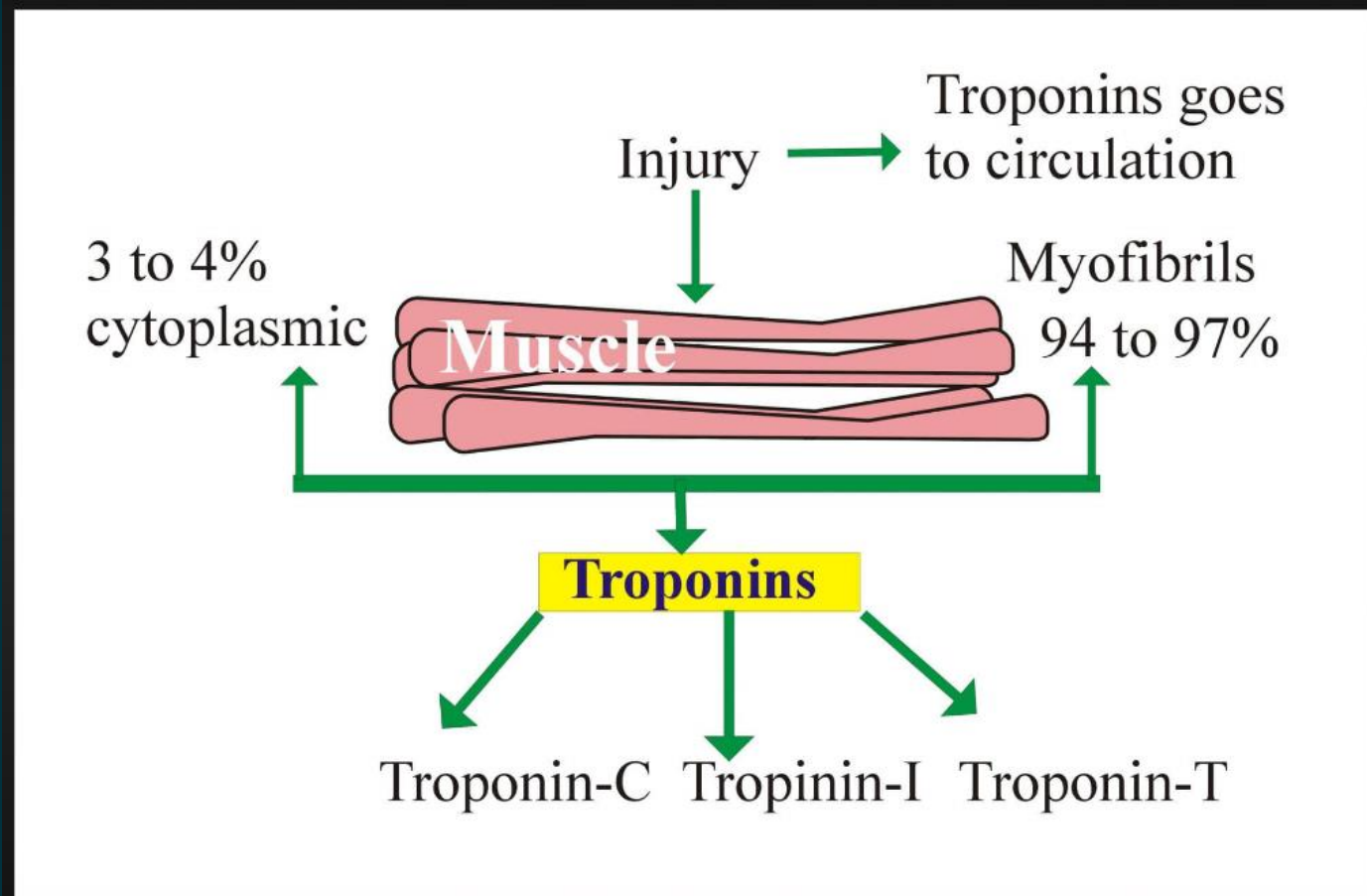
Cardiac Troponins

- Regulatory Proteins that form the cornerstone of muscle contraction
 1. *Troponin C: binds with calcium.*
 2. *Troponin T: binds with tropomyosin.*
 3. *Troponin I: inhibits contraction.*
- Troponin C is not cardiac specific, and thus is not used for the diagnosis of cardiac injury
- CTnT and I are specific markers of myocardial injury
ACS

Release of troponin

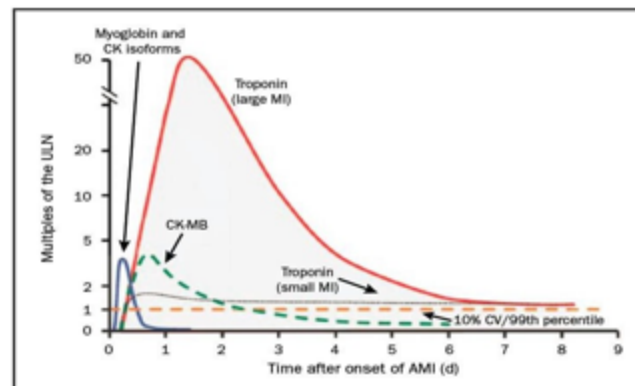


Troponin release



WHAT IS HIGH SENSITIVITY TROPONIN

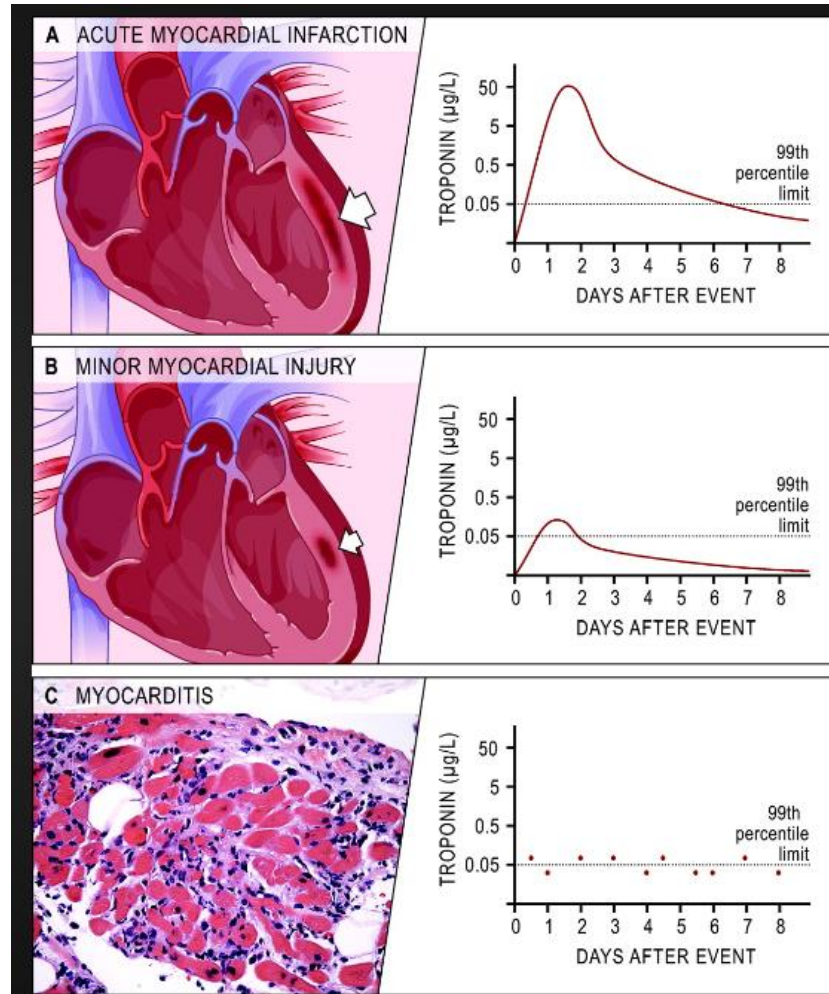
- › Same molecule that is specific to cardiac muscle cell
 - Acute coronary syndrome (ACS) is characterized by rising/falling pattern in cardiac biomarkers
 - Other myocardial injuries may have steady elevated levels
- › Improved analytical sensitivity
 - Better precision at clinical decision points
 - Lower limits of detection enabling quantification of troponin levels that were undetectable with current assay



Enhances ability to rapidly diagnose patients



Troponin release



Tnl vs. hsTnl Comparison cal Values

Tnl (Old)	hsTnl (New)
<0.030 ng/mL (Normal)	<30.0 pg/mL*
0.035 ng/mL (Abnormal)	35.0 pg/mL (Abnormal)
0.300 ng/mL (Abnormal)	300.0 pg/mL (Abnormal)

*We can now detect lower levels of Tnl.

HS Troponin

Normal Ranges

	Males	Females
Normal Range (URL)	≤19.8 pg/mL	≤14.9 pg/mL
Critical Values	≥99.0 pg/mL and/or Δ	≥74.5 pg/mL and/or Δ

Fourth universal definition of MI -2018

- Type I MI–Acute coronary thrombosis plaque rupture
- Type II MI–Consequent to mismatch between oxygen supply demand.
- Type III MI–Sudden cardiac death.
- Type IV MI–Associated with PCI.
- Type 5 MI–Associate with coronary bypass surgery.

Universal definition of MI- 5 types

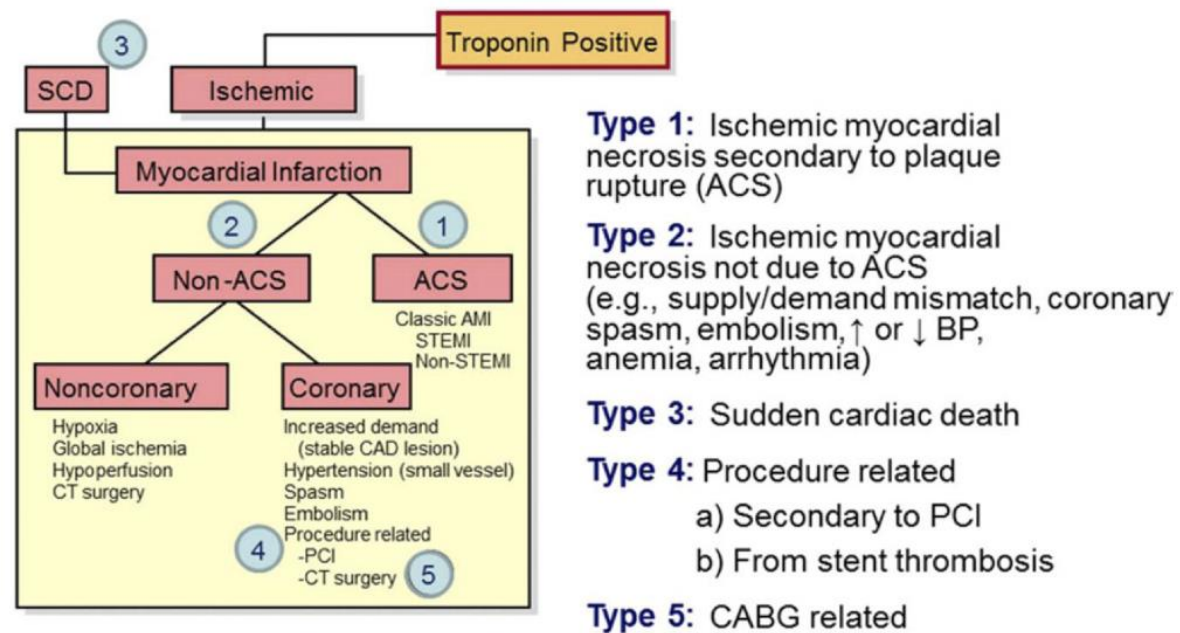


Figure 2. Troponin Positivity and the Universal Definition of MI (13) Classification of MI Type

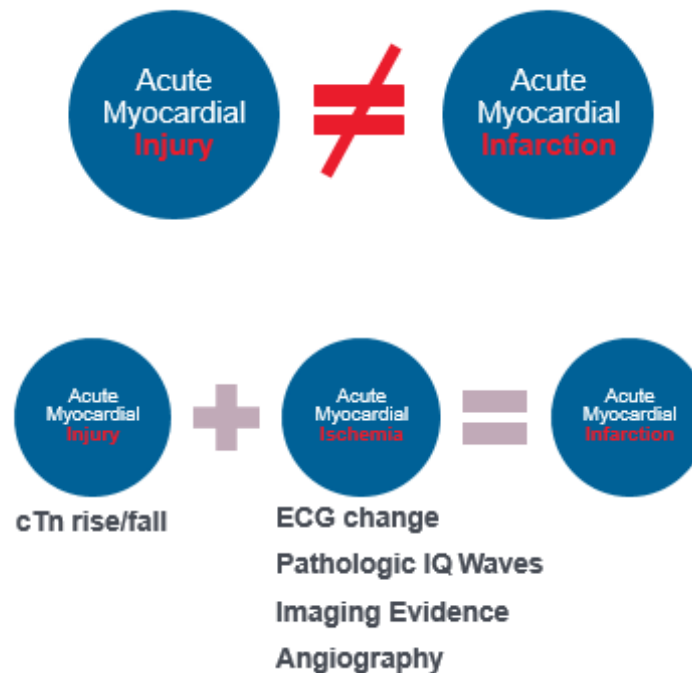
Myocardial Infarction

- Defined as the presence of acute myocardial injury detected by abnormal cardiac biomarkers in the setting of evidence of acute myocardial ischemia.
- Detection of rise and/or fall of cTn troponin with at least 1 value above the 99th percentile URL
- Symptoms of myocardial ischemia, new ST-T wave changes, Q waves, imaging evidence of loss of viable myocardium, New RWMA.

Clinical evidence of myocardial ischemia

1. Ischemic EKG changes.
2. Development of Q waves.
3. New regional wall motion abnormalities-
Echocardiography
4. Identification of coronary thrombus by coronary angiography

2018: 4TH UNIVERSAL DEFINITION OF MI



Thygesen. 2018. EHJ

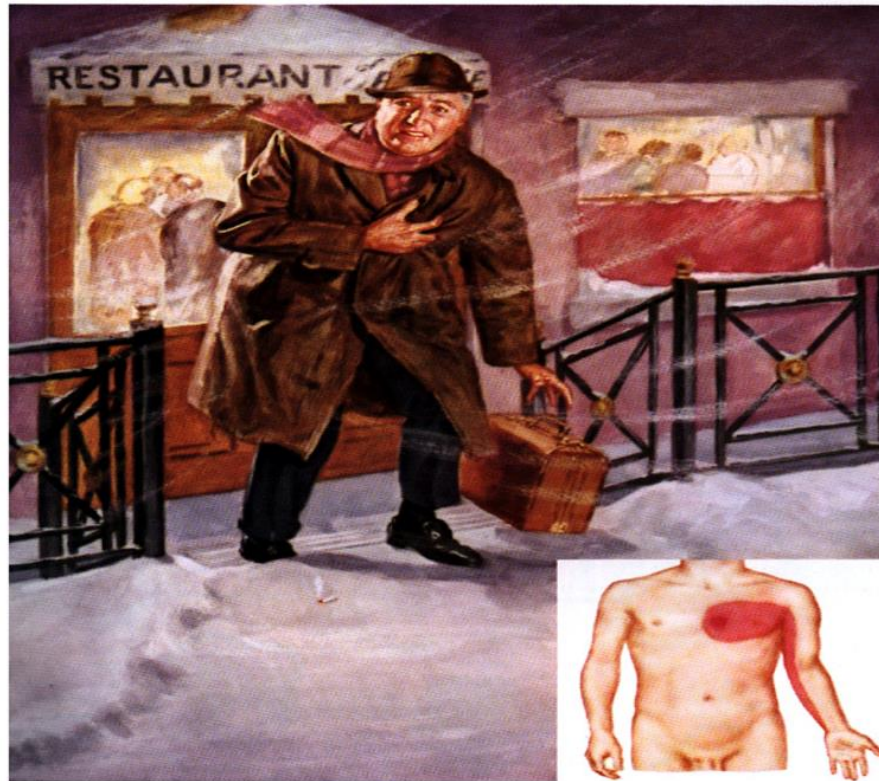
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Move healthcare forward.



Angina pectoris

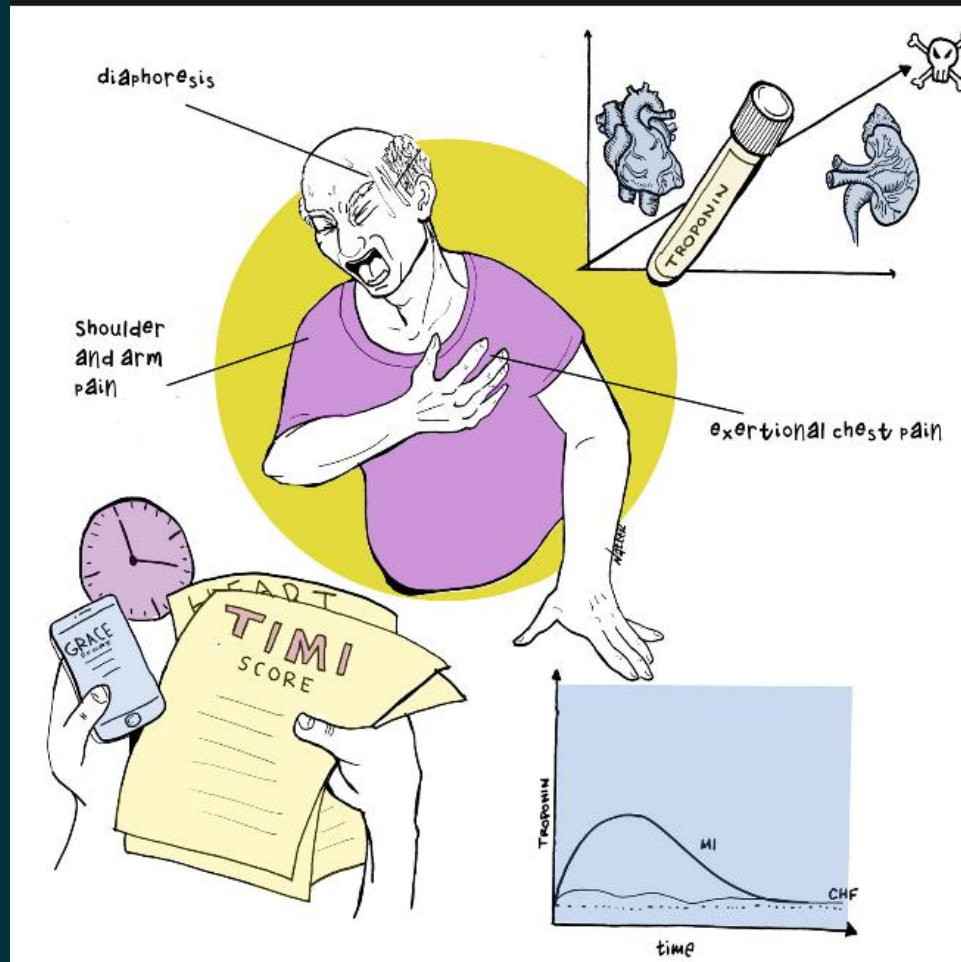
Angina Pectoris



Common precipitating factors in angina pectoris:
Heavy meal, exertion, cold, smoking

Characteristic distribution of
pain in angina pectoris

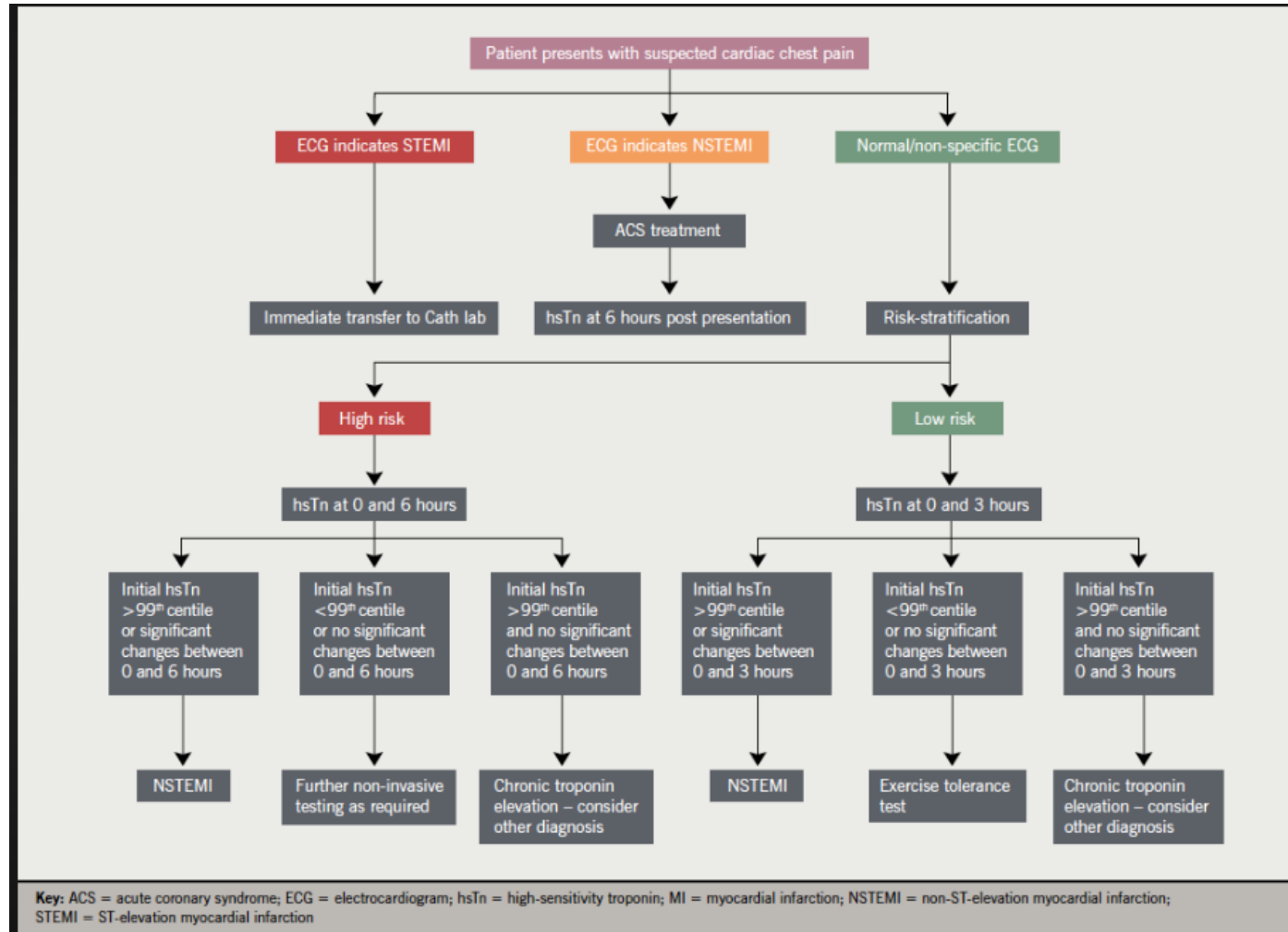
Assessment of chest pain



Chest pain

- 20 million ER visits in Europe and US each year
- 10 to 20% patient seen for chest pain are diagnosed with acute MI
- Only 2% Are inappropriately discharged from hospital
- 20% of patients that present with MI -normal EKG

ER evaluation of chest pain



Elevated troponin

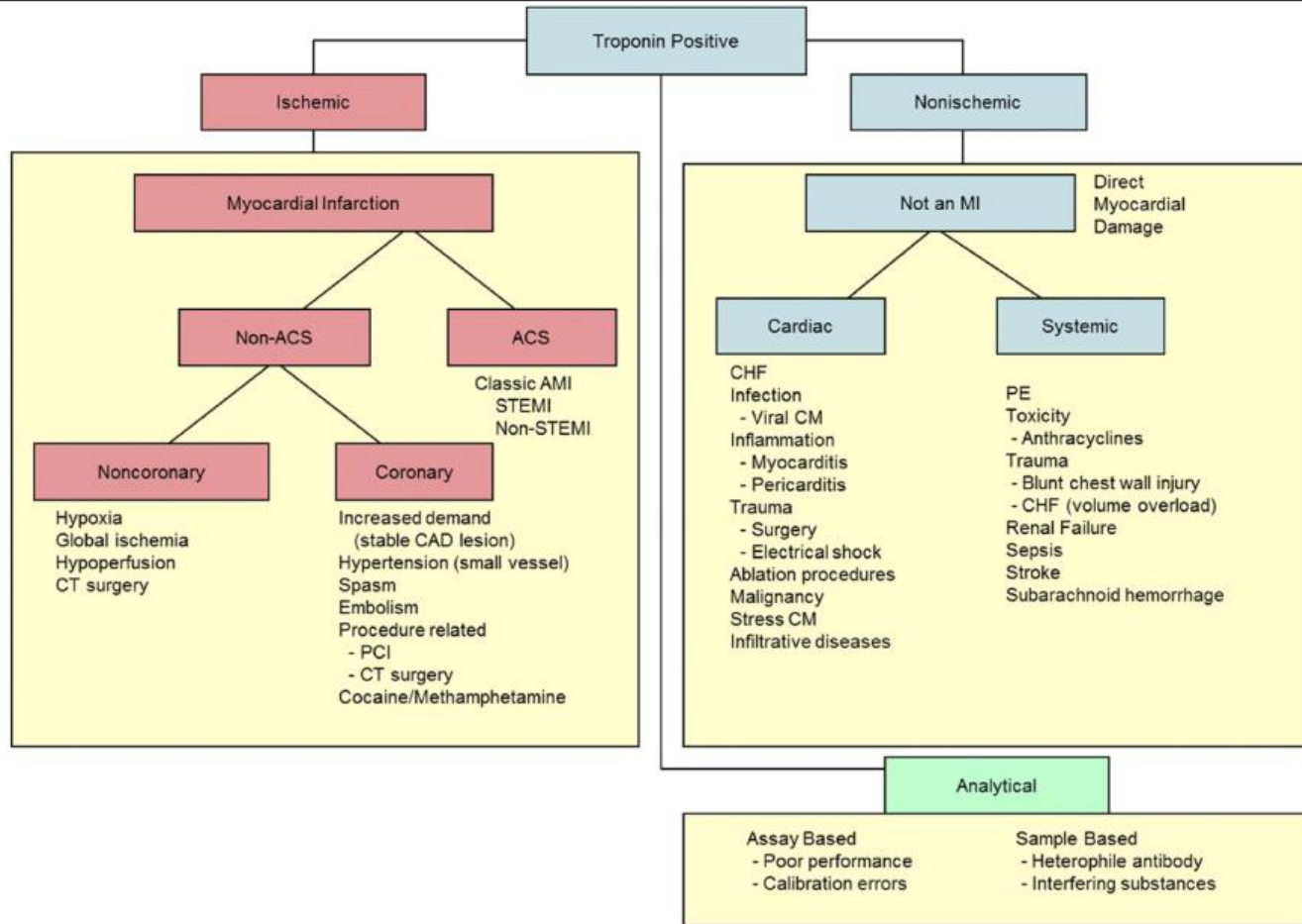


Figure 1. Conceptual Model for Clinical Distribution of Elevated Troponin

hs Troponin

- Most patients can be diagnosed within 2 to 3 hours of presentation
- Isolated hs Tn increases in the absence of myocardial ischemia should be considered myocardial injury
- Dynamic changes (delta) have acute injury and those without changes have chronic injury

hs TNI assay

- Male < 19.8 pg/mL
- Female < 14.9 pg/mL
- Critical values: male > 99 pg/ml
 - female > 74.5 pg/ml
 - 0-1hr delta > 12
 - 0-2hr delta > 15

Low to intermediate risk group

- Normal hsTn obtain another 1 to 3 hours after the first
- After return of troponin risk assess with heart score or TIMI score

Heart score

Composition of the HEART score for chest pain patients in the emergency room

HEART score for chest pain patients		Score
History	Highly suspicious	2
	Moderately suspicious	1
	Slightly suspicious	0
ECG	Significant ST depression	2
	Nonspecific repolarisation disturbance	1
	Normal	0
Age	≥65 years	2
	45-65 years	1
	<45 years	0
Risk factors	≥3 risk factors or history of atherosclerotic disease	2
	1 or 2 risk factors	1
	No risk factors known	0
Troponin	>2x normal limit	2
	1-2x normal limit	1
	≤normal limit	0
		Total ____

Heart score

- Low risk less than 3 -Discharge (30-day event rate of 0.4%)
- Intermediate risk (4-6) Outpatient ischemic evaluation
- High risk.(>7) Admit to the hospital

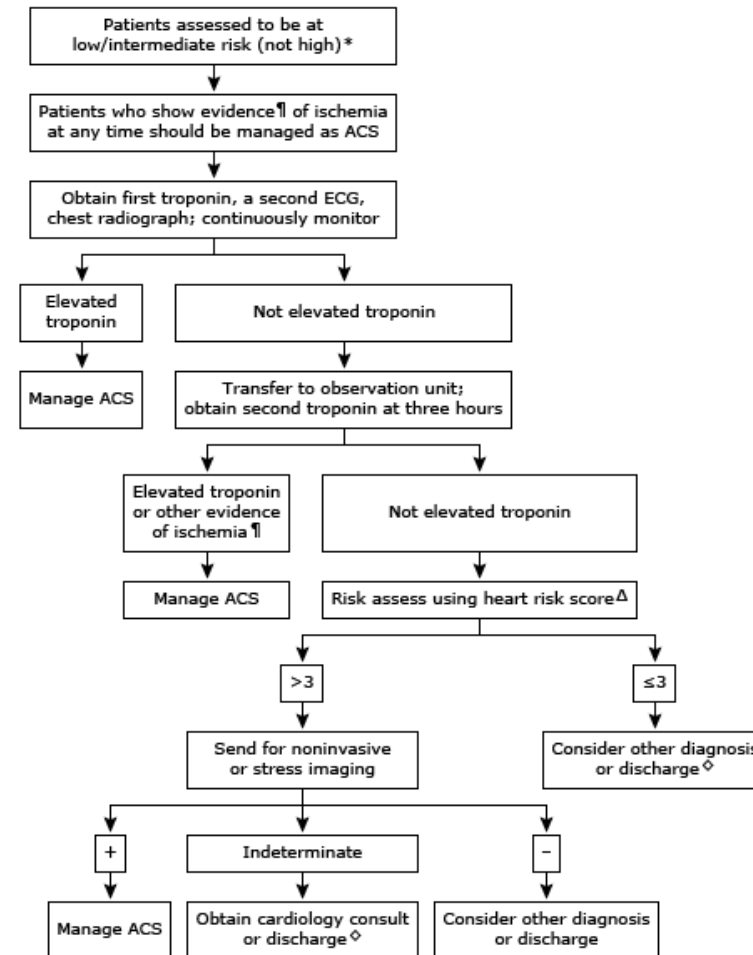
TIMI risk score

- Age ≥ 65 (1 point)
- Three or more CAD risk factors (1 point)
- Known CAD with more than 50% stenosis (1 point)
- Aspirin use in the past seven days (1 point)
- Severe angina in the preceeding 24 hours (1 point)
- Elevated cardiac markers* (1 point)
- ST deviation >0.5 mm (1 point)

TIMI risk score

Total point count	Two-week risk of death or MI	Two-week risk of death, MI, or urgent revascularization
0 to 1	3%	5%
2	3%	8%
3	5%	13%
4	7%	20%
5	12%	26%
6 to 7	19%	41%

Low to intermediate risk



Rapid Rule out

	Rule-out AMI	Rule-in AMI
0hr	<2.3 pg/mL	
0/1hr	≤6 pg/mL & HEART Score ≤3	Δ≥12
0/2hr	≤6 pg/mL and Δ≤2	Δ≥15

High-Sensitivity Troponin I Information Card*

0/1/2hr >URL without delta: Consider Dx other than AMI

*Use results in conjunction with all clinical information and further objective testing.

Troponin-itis epidemic.

If tests are not put in proper context do not order high-sensitivity troponin unless patients are having symptoms of myocardial ischemia Tools for fools!!!!

- hsTn is detected in 80% of all individuals tested
- Heart < 3 less hstnl negative no further testing—discharge

Missed ACS

- Woman less than 55 years old
- Nonwhite patient's
- Dyspnea is her primary complaint
- Patients with abnormal EKG(20% of acs) patients have a normal EKG
- Elderly with atypical symptoms

Myocardial injury

- Cardio myocyte turnover
- Nonischemic myocyte necrosis
- Apoptosis
- Myocardial strain
- Increased cell membrane permeability

Myocardial injury

- Myocardial injury with elevated troponin in the absence of clinical evidence of ischemia should prompt a search for other causes of myocardial necrosis
- Myocardial injury can be discriminated from chronically elevated values by a significant change over serial measurements.
- Nonischemic troponin elevation Acute or chronic

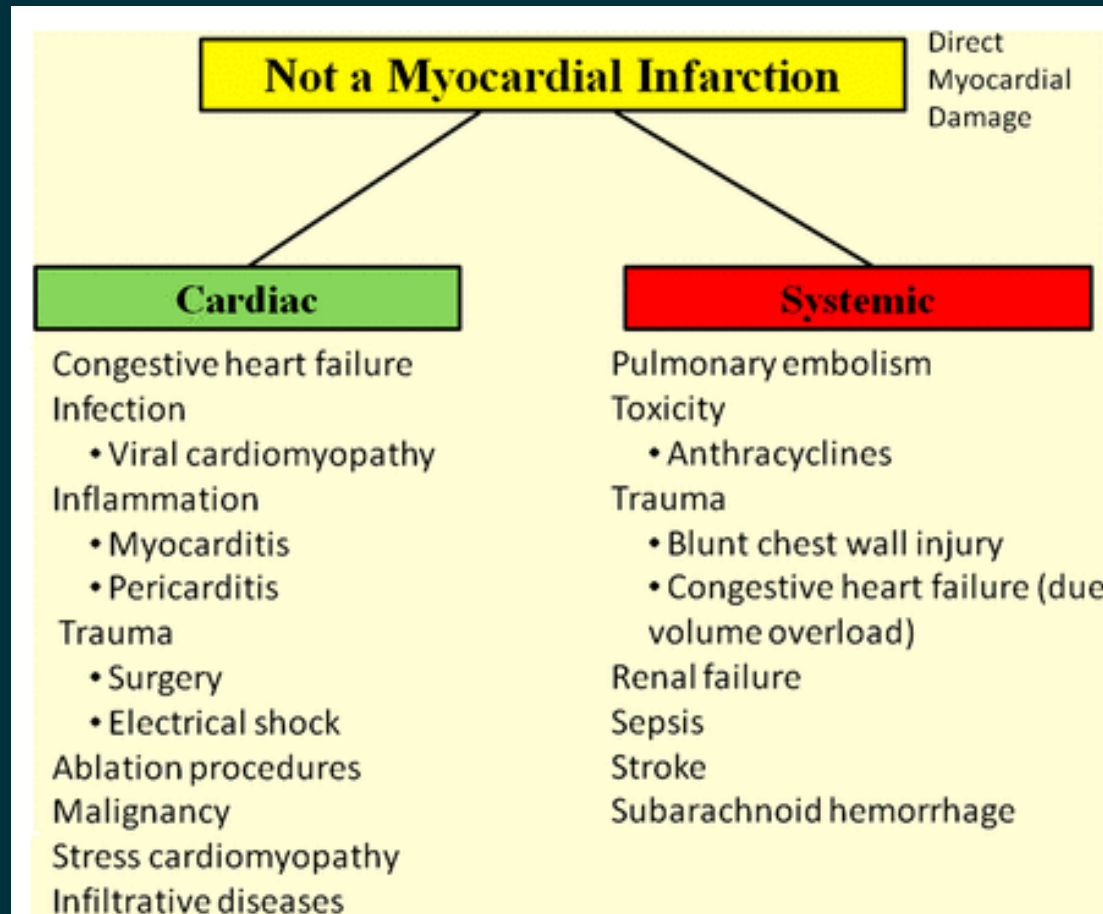
Acute myocardial injury

- Elevated high-sensitivity troponin level that increases further or there is a decrease in level.
- If unable to identify ischemia and this is referred to as myocardial injury

Chronic myocardial injury

Troponin levels remain elevated, consistent levels no, significant delta

Myocardial injury



Non-ACS cause of elevated troponin

*Doesn't really sound like ACS but
Troponin +ve.....*

- Myocarditis
- Pericarditis
- Severe CHF
- Hypertensive crisis
- Trauma
- Post arrhythmias
- Post CV surgery
- Post angioplasty
- Post cardioversion
- Post CPR
- Infiltrative cardiomyopathy
- Cardiotoxic drugs (chemotherapy)
- **RENAL FAILURE**
- **PULMONARY EMBOLISM**

Type II

Non-ACS Cardiac Causes of Elevated Troponin

Acute and chronic heart failure

Myocarditis

Cardiac contusion from trauma

Cardioversion

Endomyocardial biopsy

Aortic dissection

Hypertrophic cardiomyopathy

Aortic valve disease (aortic stenosis or regurgitation)

Cardiotoxic drugs

Tachyarrhythmia (SVT, VT, atrial fibrillation)

Bradyarrhythmia or heart block

Cardiac surgery

Cardioversion

Takotsubo cardiomyopathy

Rhabdomyolysis

Stenting or angioplasty (percutaneous coronary intervention)

Type II

Noncardiac Causes of Increased Troponin Levels

Renal failure

Pulmonary embolism

Severe pulmonary hypertension

Sepsis

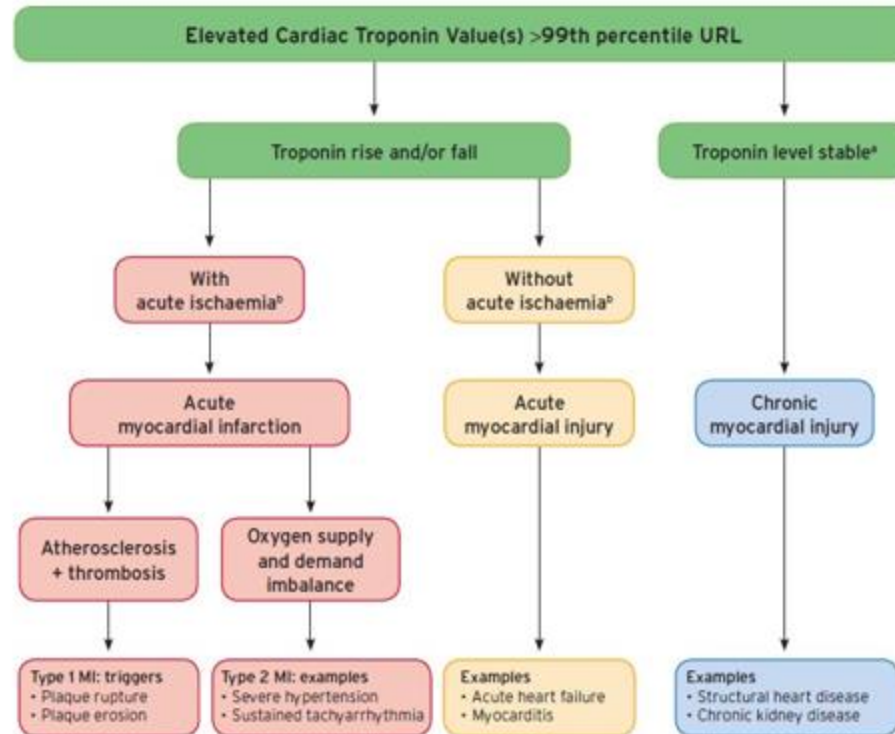
Severe critical illness

Burns

Extreme exertion

Acute stroke and subarachnoid hemorrhage

RECOMMENDED MODEL FOR INTERPRETING MYOCARDIAL INJURY — 4TH UNIVERSAL DEFINITION OF MI



Thygesen. 2018. EHJ

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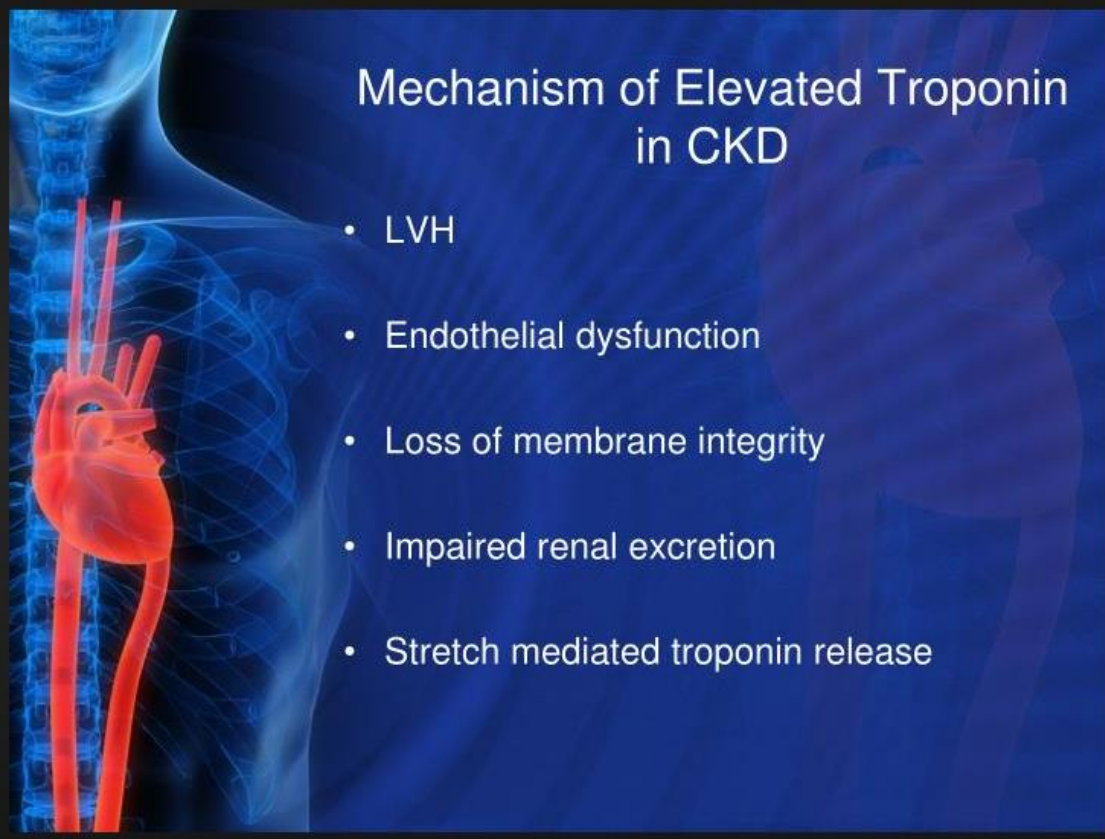
Move healthcare forward.



CKD

- Serial change in the rise or fall troponin concentrations over 3 to 6 hours after presentation
- If all troponins are at or above the 99th percentile a greater than 20% change in measure troponin is acceptable
- hsTNI more specific for myocardial injury in CKD patients
- Increase hsTN predicts worse long-term cardiovascular outcome

CKD



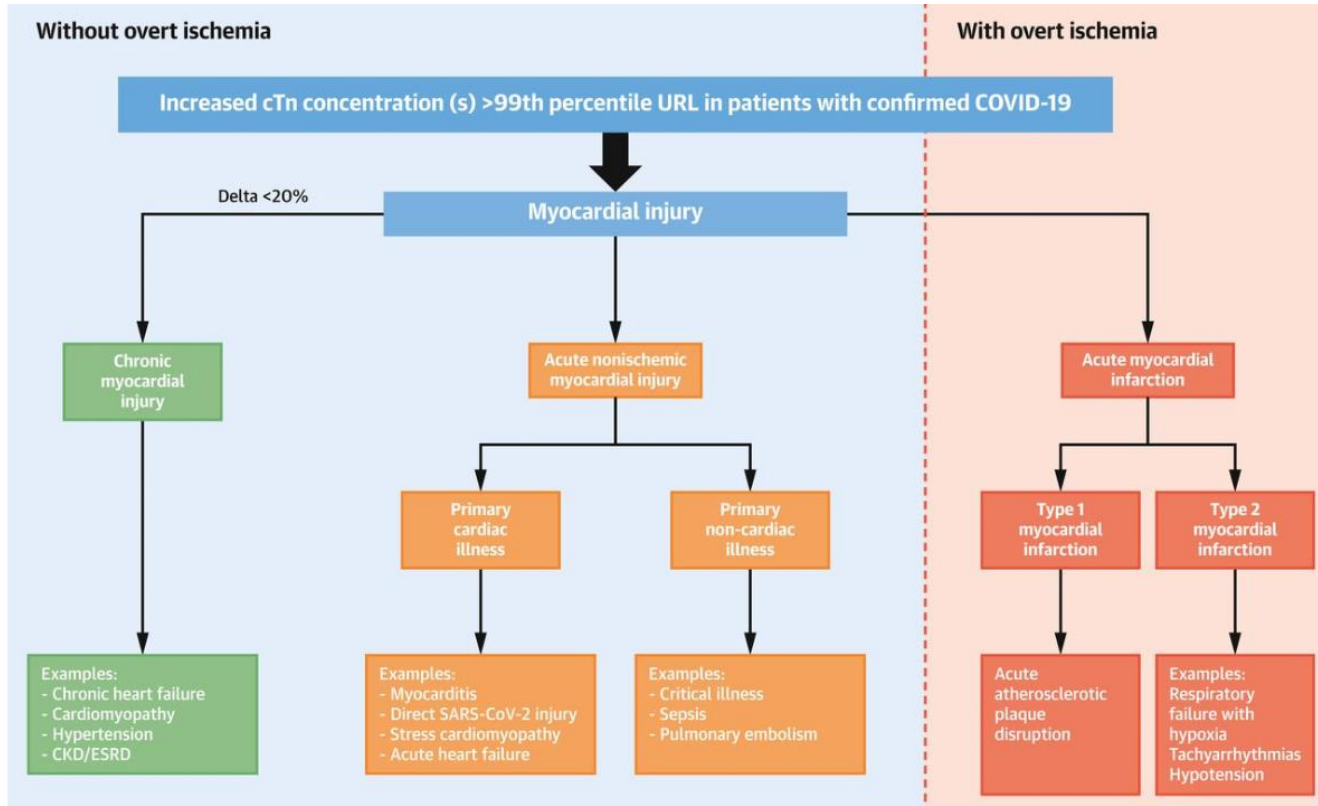
Mechanism of Elevated Troponin in CKD

- LVH
- Endothelial dysfunction
- Loss of membrane integrity
- Impaired renal excretion
- Stretch mediated troponin release

Noncardiac causes of Increased hsTn

- COVID-19 40% of patients with ARDS
- Acute respiratory illness > 40%
- SIRS/ sepsis 80% have positive hs troponin

Covid



Increased prevalence of chronic cardiovascular conditions in COVID-19 that can explain chronic myocardial injury

- Increased inflammatory responses (↑ CRP, ↑ interleukins, ↑ procalcitonin, ↑ ferritin) and prothrombotic state (↑ D-dimer) can contribute to acute nonischemic myocardial injury and acute myocardial infarction, with increases and/or dynamic changes in NT-proBNP and/or hs-cTn possible across all these conditions.
- For several conditions, such as critical illness, sepsis, or respiratory failure, there is a spectrum, with cTn increases categorized as acute non-ischemic myocardial injury in the absence of ischemia, and as acute myocardial infarction if

Classification of Myocardial Injury in COVID-19 Increases in cTn should be categorized as chronic myocardial injury, acute nonischemic myocardial injury, or acute myocardial infarction. For several conditions, there is a spectrum and the most common category is indicated, but can present in other ways. CKD = chronic kidney disease; COVID-19 = coronavirus disease-2019; CRP = C-reactive protein; cTn = cardiac troponin; ESRD = end-stage renal disease; NT-proBNP = N-terminal pro-B-type natriuretic peptide; URL = upper reference limit

False positive high-sensitivity troponin elevation

- Heterophile antibodies
- Infectious mononucleosis.
- Rheumatoid arthritis.
- Burkitt's lymphoma
- Vaccination

hsTroponin

- Prognostic information in congestive heart failure, valvular heart disease, stable ischemic heart disease, atrial fibrillation, Cardiomyopathy
- Augments chads vasc- score with regards to risk of embolic events
- Identifies many more patients with subtler forms of heart disease
- 80% of the general population has elevated hsTN

Myocardial injury

- Increased risk of all cause mortality cv mortality, MI, heart failure and stroke
- Myocardial injury patients should be referred for echocardiography and noninvasive ischemic assessment
- Cost implications and risk of over testing
- No evidence that revascularization benefits patients with myocardial injury in the absence of coronary ischemia

Myocardial injury

Optimal coronary risk factor modification.

Statins decrease troponin levels and improve mortality

Myocardial injury is not a benign condition and should not be called troponinemia or troponin-itis

Routine cardiology consultation for elevated at hs troponin in critically ill patients is associated with increased cardiac testing, LOS, without significant effect on mortality

Hs Troponin

	4/28/2020 1622	4/28/2020 1728	4/29/2020 0653	10/15/2020 1028	10/15/2020 1131
CARDIAC PROFILE					
hsTnl 0 Hour			96.9 ▲	42.2 ▲	41.2 ▲
hsTnl 1 hr	226.9 ▲				
hsTnl 2 hr		221.1 ▲			
Delta from 0 Hour	6.6	12.4			



CASE STUDY

50 year old Native American male, 6'5", 410lbs
18 hours post onset of symptoms

At presentation:

radiating right arm pain

indigestion

fatigue

tachycardia

Lab work: CBC, troponin

CASE STUDY

hsTnl

T = 0 25.6 ng/L

T = 1 hrs 46.3 ng/L $\Delta = 21.3\text{ng/L}$

T = 2 hrs 54.6 ng/L $\Delta = 29.0\text{ng/L}$



CASE STUDY

48 year old Asian female, 5'0", 110 lbs

3 hours post onset of symptoms

At presentation:

indigestion

lower back pain

tachycardia

Lab work: CBC, troponin



CASE STUDY

hsTnl

T = 0 11.0 ng/L

T = 2 hrs 21.0 ng/L $\Delta = 10\text{ng/L}$



CASE STUDY

40 year old male smoker, apparently healthy
6 hours post onset of symptoms

At presentation:

- chest pain
- sweating
- fatigue
- wheezing
- tachycardia

Lab work: CBC, UDS, troponin

CASE STUDY

	<u>Accu Tnl +3</u>	<u>hsTnl</u>	
T = 0	<0.02ng/L	0.005 ng/L	
T = 3 hrs	<0.02ng/L	0.020ngL	$\Delta = 15\text{ng/L}$

Hs troponin

Chart Normal Ranges and Criti-

	Males	Females
Normal Range (URL)	≤19.8 pg/mL	≤14.9 pg/mL
Critical Values	≥99.0 pg/mL and/or Δ	≥74.5 pg/mL and/or Δ