

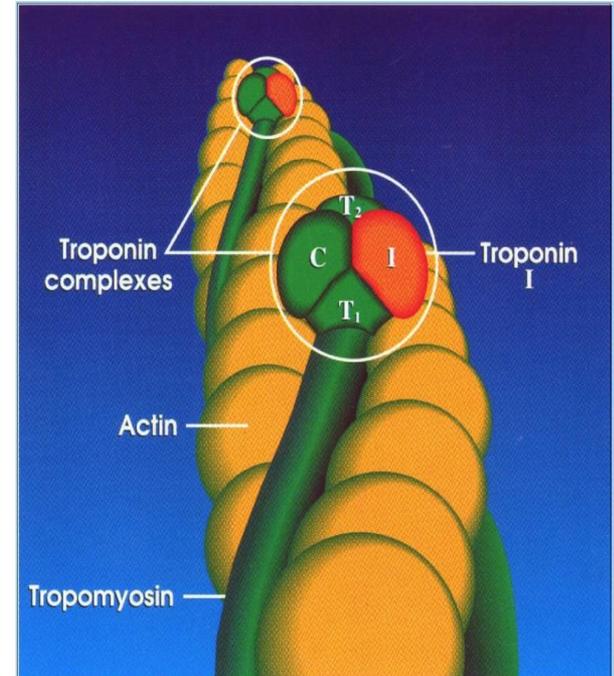
High-sensitivity Troponin T: What you need to know

Last Edits: 4/18/19



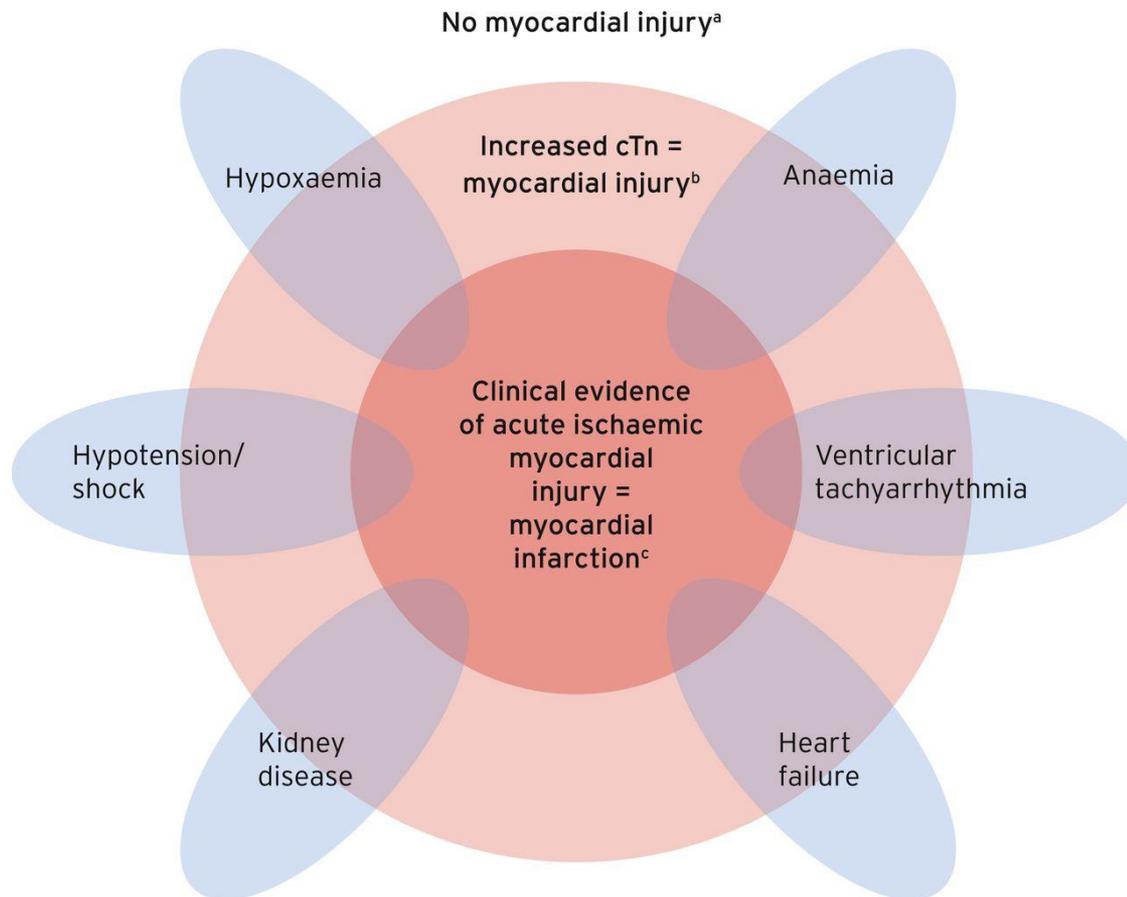
hs-Troponin: What does it do?

- High-sensitivity Troponin (hs-Trop) assays have been introduced in an effort to improve detection of myocardial infarction.
- These assays are able to detect much lower concentrations of the troponin protein, thereby shortening the time interval required to identify myocardial injury.
- Although kinetics are different for Trop T and Trop I, an hs-Trop T measurement of 30 pg/ml roughly correlates with the initial detectable level of our current Trop I assay (just above 0.1 ng/ml). An hs-Trop T of 140 pg/ml roughly correlates with a current Trop I value of 1.0 ng/ml.
- Because of their increased sensitivity, up to 50% of patients without Acute Coronary Syndrome (ACS) will have a detectable (but not abnormal) hs-Trop.
- Since hs-Trop T will result in more detectable Troponins, it is critical that we understand how to interpret these values.



Elevated troponins constitute myocardial injury

Myocardial infarction (MI) is one cause of myocardial injury

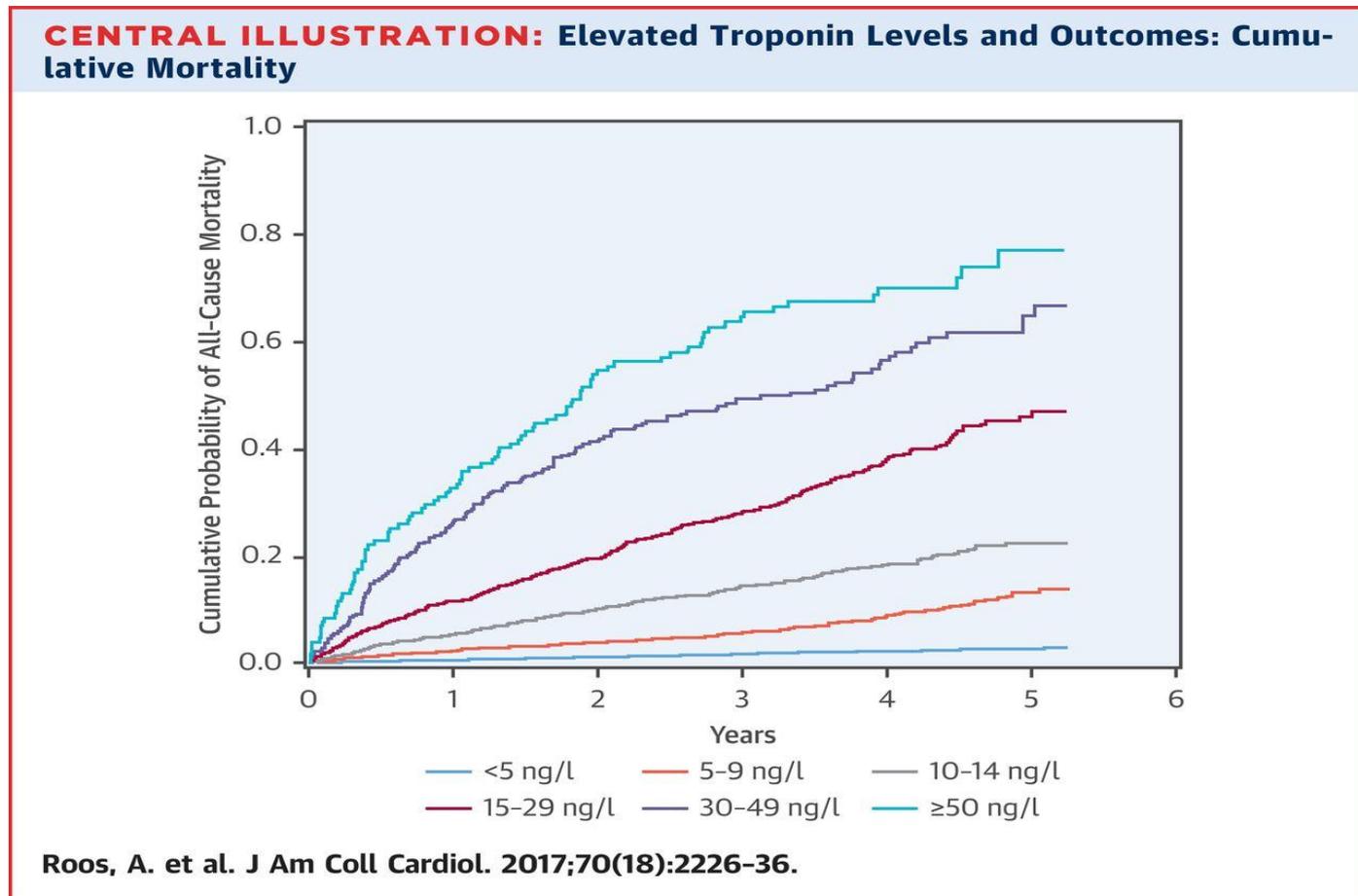


Spectrum of myocardial injury, ranging from no injury to myocardial infarction. Various clinical entities may involve these myocardial categories, e.g. ventricular tachyarrhythmia, heart failure, kidney disease, hypotension/shock, hypoxaemia, and anaemia. cTn = cardiac troponin; URL = upper reference limit. ^aNo myocardial injury = cTn values \leq 99th percentile URL or not detectable. ^bMyocardial injury = cTn values $>$ 99th percentile URL. ^cMyocardial infarction = clinical evidence of myocardial ischaemia and a rise and/or fall of cTn values $>$ 99th percentile URL.

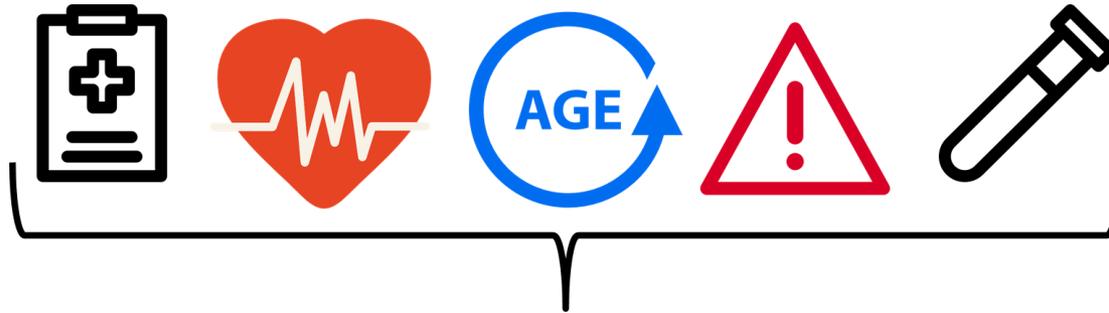
Elevated Troponin Levels & Outcomes

Any level of Troponin whether due to myocardial injury or infarction is worse than no Troponin. Higher Troponin is worse than lower Troponin.

This figure illustrates the cumulative probability of death over 5 years based on the initial high sensitivity troponin level at presentation.



Clinical context critical to interpretation



The enhanced sensitivity of hs-Trop T means the assay may come back with more “positive results”. It is important to put clinical context into decision making. Do not rely on the interpretation of the test alone.

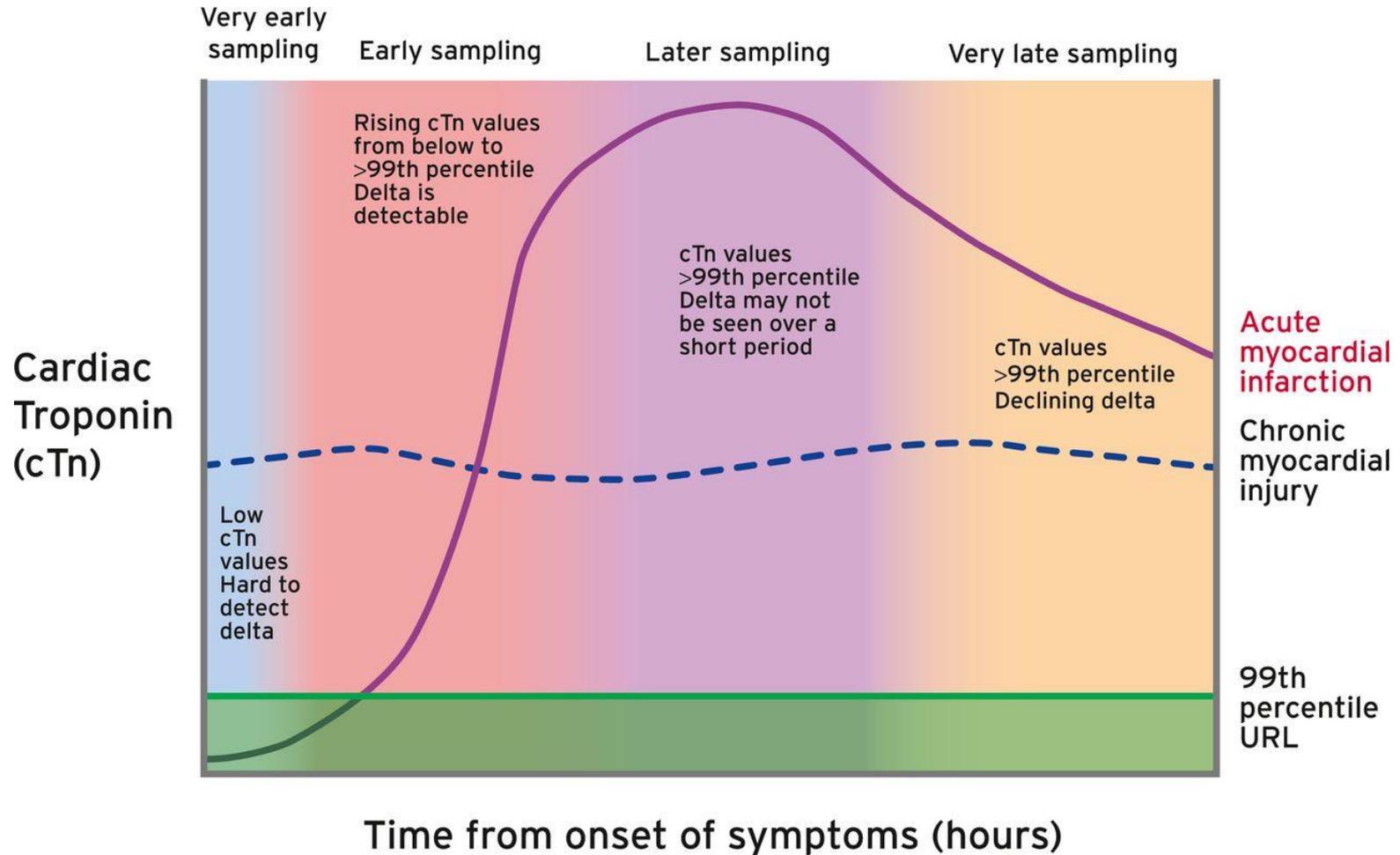
- Are the troponins chronically elevated?
- Is there any acute rise and fall?
- Does the patient have a suspicious history for ACS?
- Is there evidence of ischemia?

Troponin: acute from chronic injury?

Troponin is a marker of myocardial injury, **it does not differentiate acute from chronic injury.**

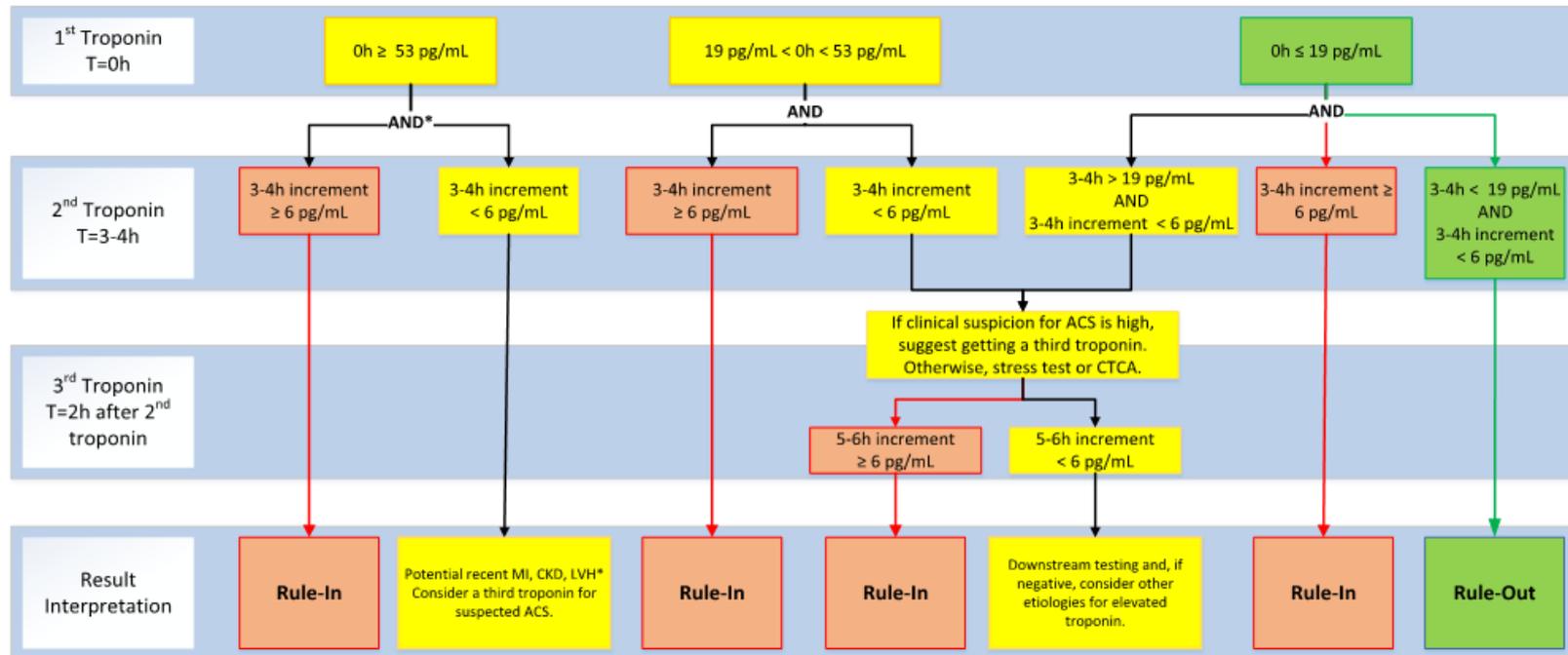
- Acute injury such as that seen in Acute Coronary Syndrome (ACS) should display a rise in Troponin over time. For rule in and rule out on the floor, samples drawn 3-4 hours apart are used and a difference or delta value of 6 pg/mL is considered consistent with acute injury.
- A decrease in hs-Trop T over time can indicate an acute injury that occurred days ago, but is less specific for ACS and **more often associated with non-ACS conditions.**
- Chronic conditions that can produce an elevation of hs-Trop T rarely show an increase over time intervals of 2 to 6 hours.

Timing Matters and Serial Sampling is Important



Troponin Interpretation for workup of suspected ACS

High Sensitivity Troponin T Interpretation For Inpatients



Rule-In means ruled-in for myocardial injury. Clinical content must be taken into consideration to determine if this constitutes myocardial infarction. If you have a strong suspicion for ACS, then do not delay proper treatment until the hs-trop results come back from the lab.

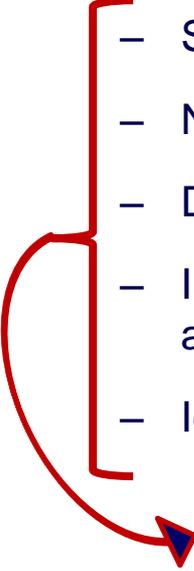
*Patients should be considered for the possibility of known CKD (GFR < 30), CHF w/ LVH or known CAD w/ LVH. A repeat troponin for with these conditions should be demonstrated by a stable follow up troponin level with a delta of less than 6; however, in some instances this could still be suggestive of a recent MI depending on level of suspicion. If suspicion is high, consider downstream stress or CTCA testing to further assess patient condition, else consider other etiology.

Biotin Notice: If a patient has taken greater or equal to 10 mg of Biotin in the last 6-hours at time of blood draw, the troponin values may present falsely lower.

Fourth Universal Definition of Myocardial Infarction:

- Detection of a rise and/or fall of a biomarker (preferably cardiac troponin) in serial samples, with at least one value above the 99%ile reference limit (19ng/ml) **and at least one of the following;**

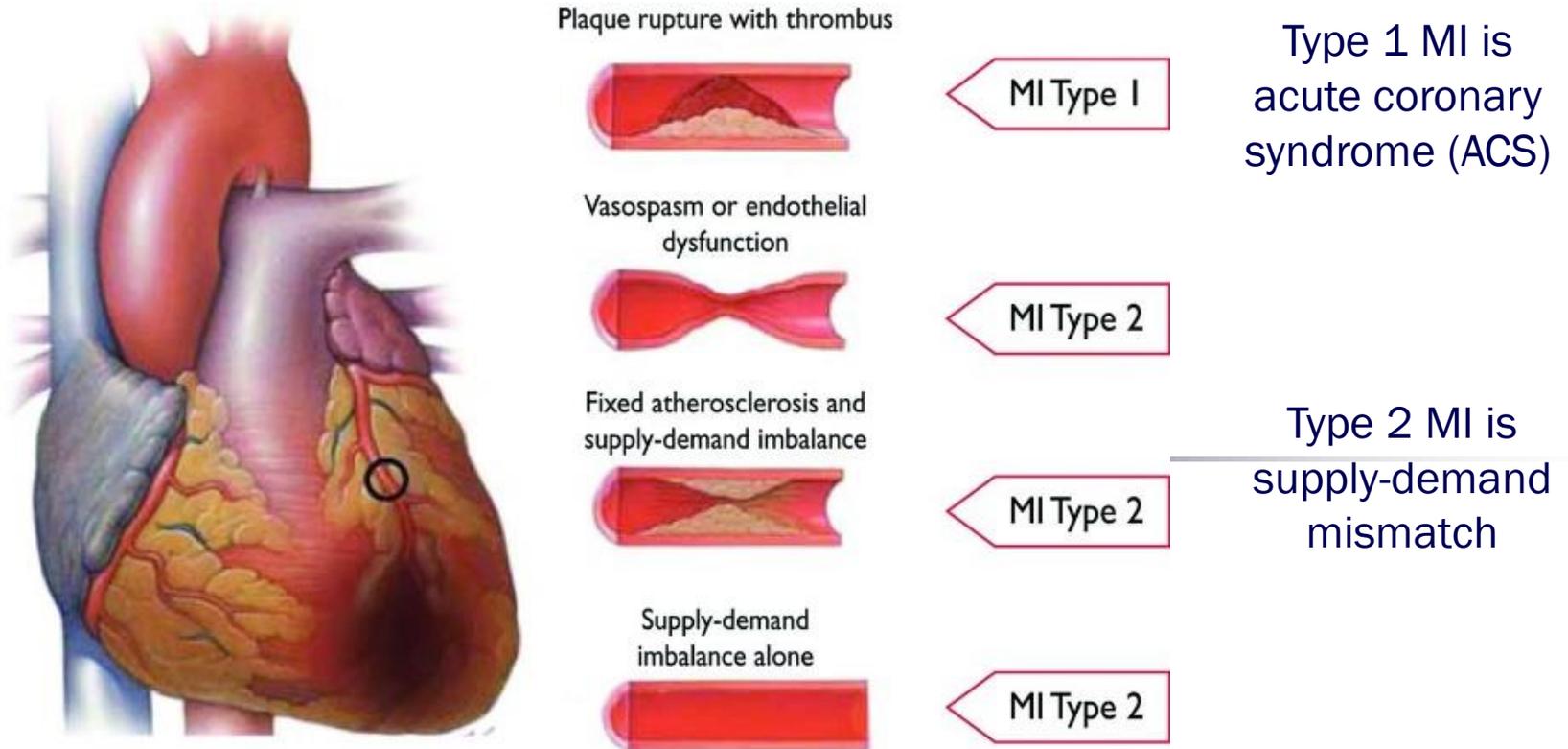
- Symptoms of acute myocardial ischemia
- New ischemic ECG changes
- Development of pathologic Q waves
- Imaging evidence of new myocardial viability loss or new regional wall motion abnormality
- Identify coronary thrombus by angiography



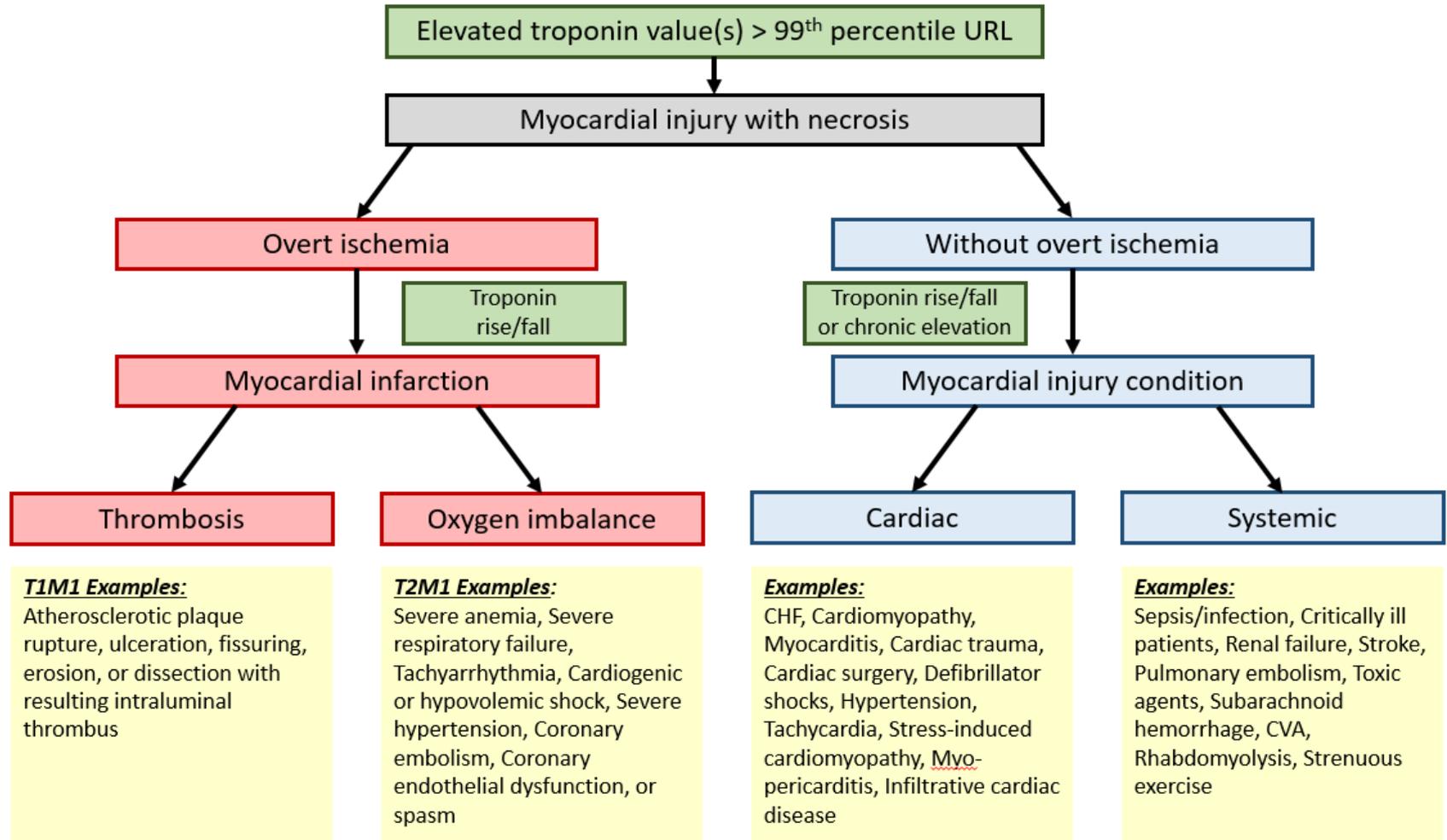
This is particularly important for patients with declining delta between 1st and 2nd hs Trop T!

- **You need to have one of these findings to make a diagnosis of acute coronary syndrome/AMI.**

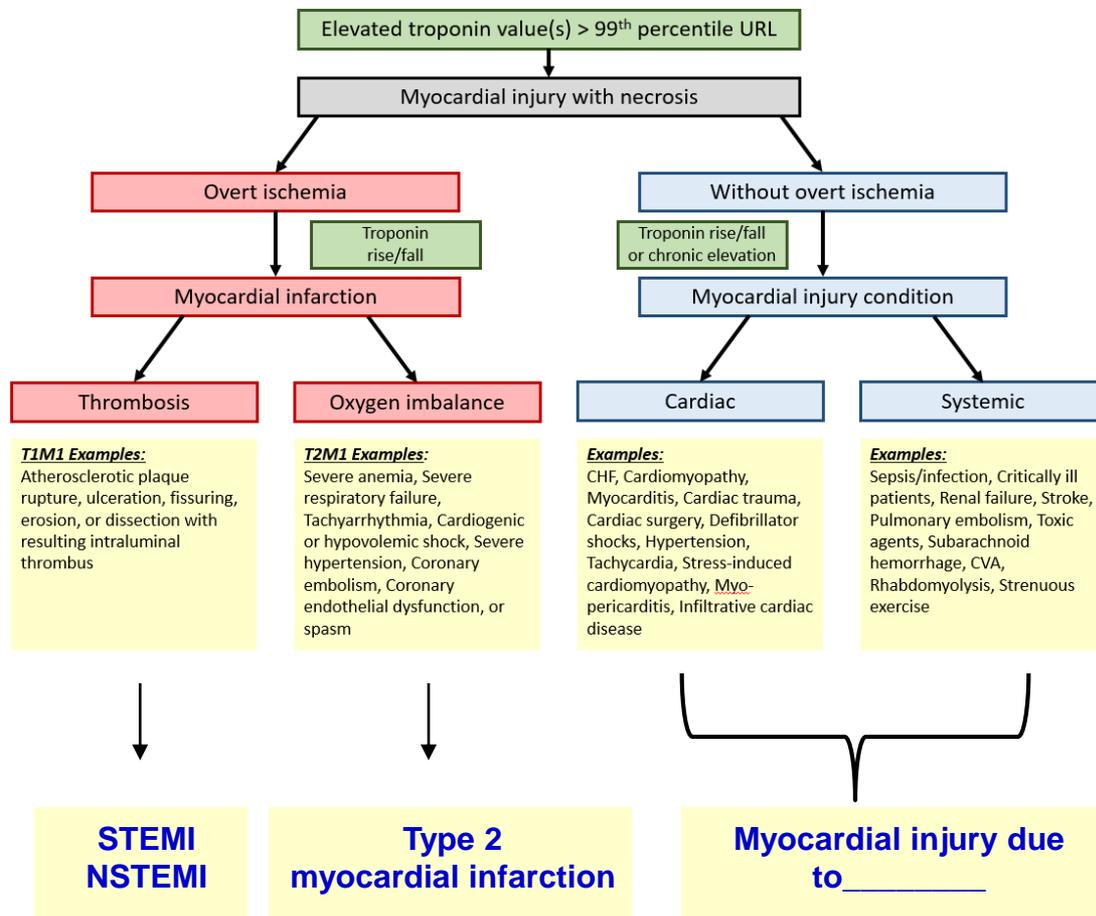
Once a diagnosis of myocardial infarction (MI) is made, it is further classified into type based on the etiology:



Troponin elevations and myocardial infarction/injury

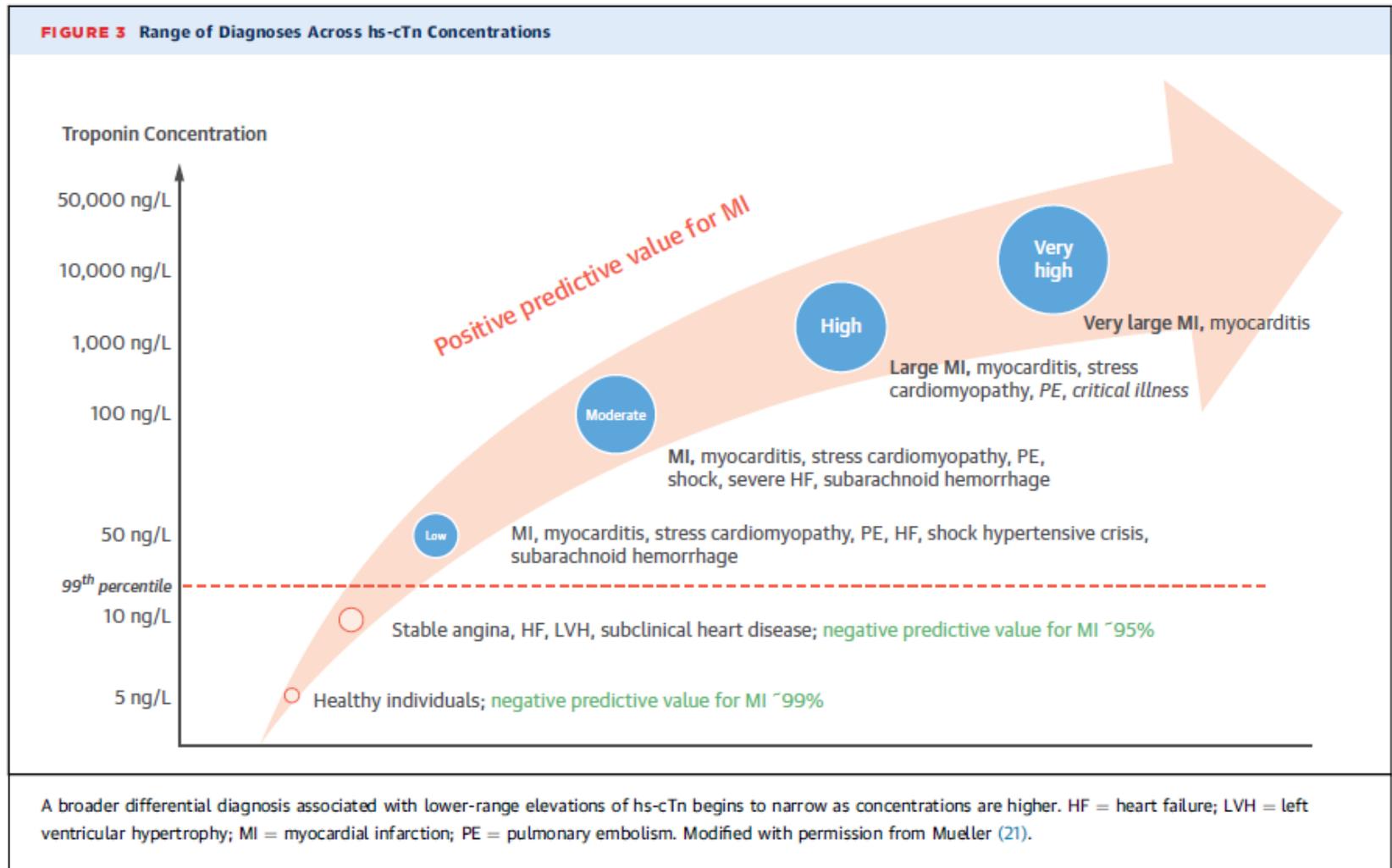


What do we call these different causes of tropon elevation in MiChart?



If NSTEMI is not the final diagnosis associated with elevated hs-trop T value, but you initially stated that you were “evaluating for NSTEMI”, then you should clarify in your later notes that you have “ruled-out for NSTEMI” and specify the final diagnosis as “type 2 myocardial infarction” or “myocardial injury due to _____”.

Rapid and substantial increases in hs-trop T enhance the likelihood of acute MI



When is it safe to do a stress test?

It would usually be safe to perform a stress test in the following situations:

Active Chest Pain	No Active Chest Pain* or Resolved Chest Pain* <i>*if clinically indicated</i>
<ul style="list-style-type: none">Ruled-out troponins and clinically stable (<i>no aortic dissection, no acute PE, no severe aortic stenosis, etc.</i>)	<ul style="list-style-type: none">Indeterminate troponins
	<ul style="list-style-type: none">Ruled-out troponins

Cardiology Consultation can be considered for:

- Any patient with a down trending troponin above the normal range of 19 pg/ml, prior to stress
- Unsure what type of stress test is most appropriate
- Active chest pain with unclear cardiovascular stability



Do not perform a stress test on a patient with active chest pain and a rising troponin.

Stress Test Decision Algorithm:

- **Consider ETT/Echo for:** can exercise/walk on treadmill, BMI < 40
- **Consider Nuc Med Perfusion for:** Prior MI, Obesity, Hx of AF or Arrhythmia
- **Consider Dobutamine Stress for:** Lung Disease, no Arrhythmia, inability to exercise

CTCA Algorithm:

- Renal function (GFR \geq 30)
- Able to get HR \leq 65 (w/ or w/o beta-blocker)
- Normal sinus rhythm
- No known CAD
- No IV contrast allergy

Take Home Points:

- More sensitive Troponin assay with a lower level of detection leads to;



– Higher confidence and quicker rule-outs



– More “false positives” for ACS evaluation that make clinical assessment critically important

- Acute MI is defined by labs and clinical changes, **not just labs alone**. Serial measurement of hs-trop T is important.
- Do not order hs-tropT routinely unless you have a compelling clinical reason (concern for ACS/NSTEMI) to do so
- Utilize stress testing or imaging in patients with **no active chest pain** and/or **non-rising troponins**
- Proper MiChart documentation of the cause of an elevated hs-trop T (myocardial injury due to _____, NSTEMI, or type 2 myocardial infarction) is critical.

***Please contact the following individuals
with any questions or concerns:***

Core Team Members

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For patient concerns, consult Cardiology.

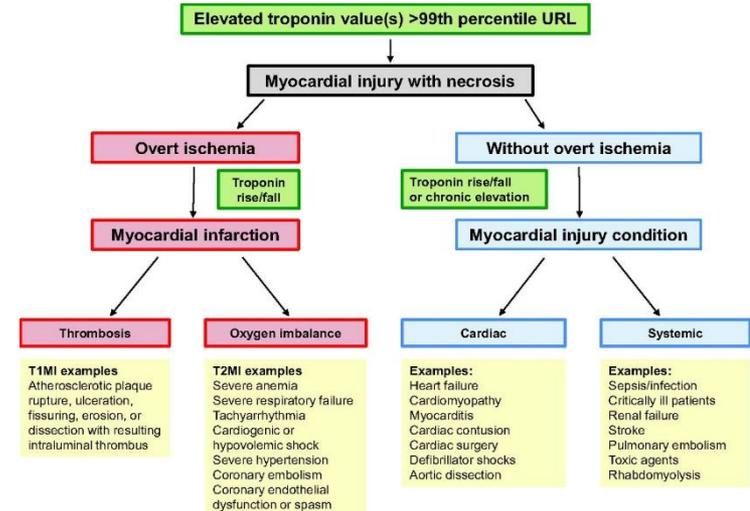
Troponin elevations and myocardial infarction/injury

Fourth Universal Definition of Myocardial Infarction 2018

The term acute myocardial infarction (MI) should be used when there is evidence of myocardial necrosis in a clinical setting consistent with acute myocardial ischemia. Under these conditions any one of the following criteria meets the diagnosis for MI:

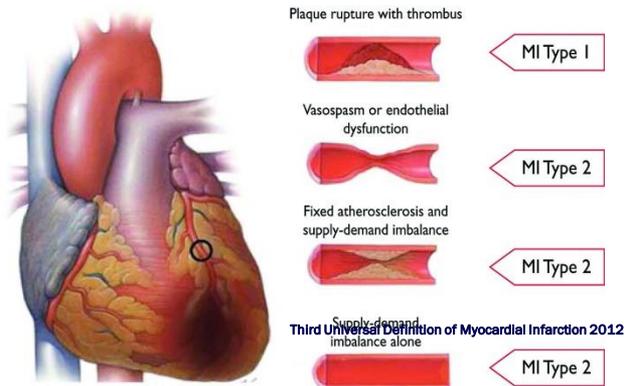
Detection of a rise and/or fall in cardiac biomarkers (preferably cardiac troponin) with at least one value above the 99th percentile upper reference limit and at least one of the following:

- Symptoms of ischemia
- New or presumed new ST-T wave changes or new LBBB
- Development of pathologic Q waves
- Imaging evidence of new loss of viable tissue or new regional wall motion abnormality
- Identification of an intracoronary thrombus by angiography or autopsy



DOI: 10.1373/clinchem.2016.255521 Published December 2016

Once a diagnosis of MI is made, it is further classified into type based on the etiology:



How this relates to MiChart Problems:

STEMI codes are obvious. Please fill them out properly.

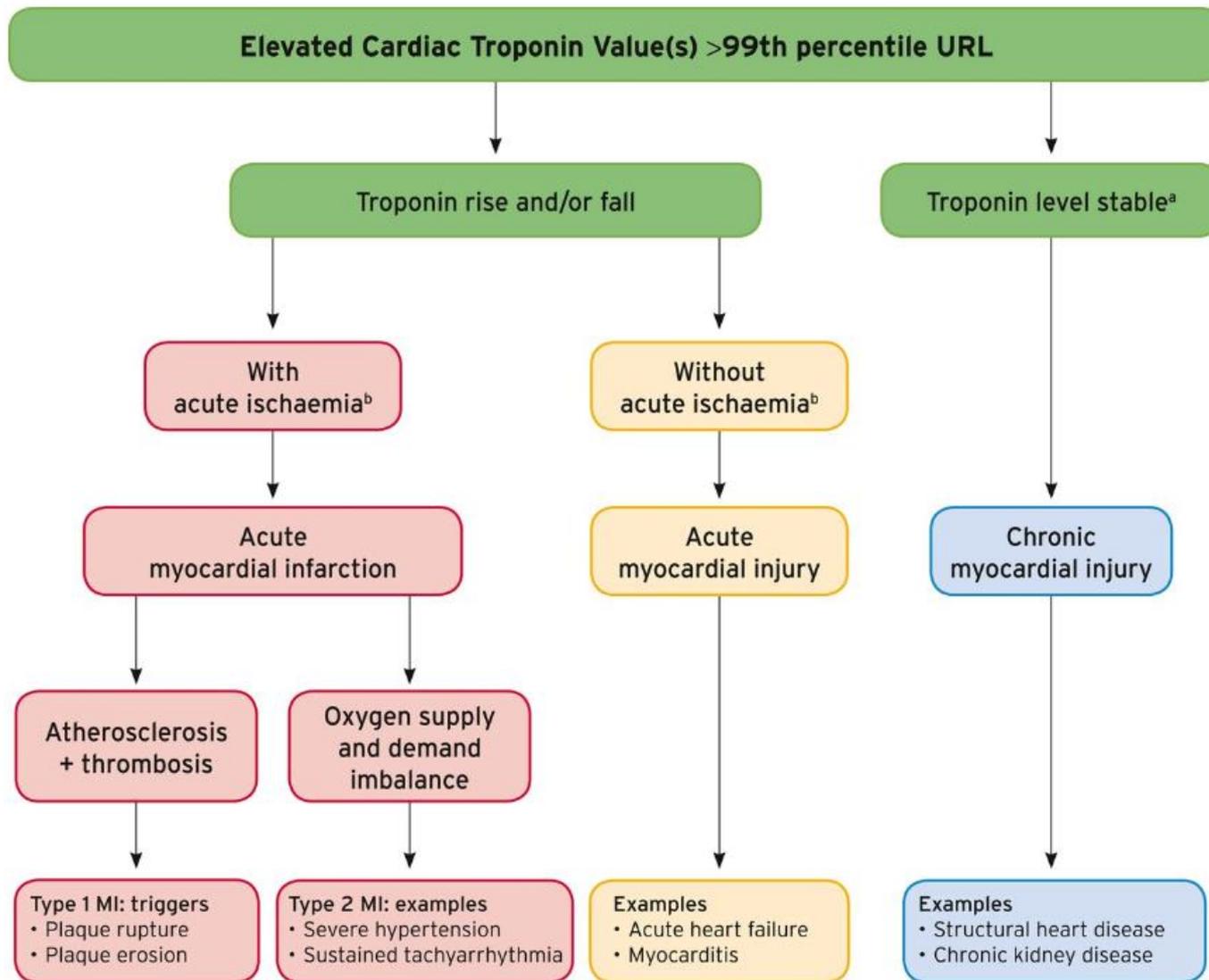
Type 1 NSTEMI with a plaque rupture event should be called “NSTEMI”

Type 2 MI due to ischemia (supply-demand mismatch) without plaque rupture should be called “Type 2 myocardial infarction” or “demand ischemia”

Myocardial injury is defined by elevated troponins in the absence of overt ischemia. In MiChart this should be coded “myocardial injury due to _____”.

If a patient rules out for an NSTEMI, then you should include the phrase “ruled out for NSTEMI”

Additional Supplemental Figure



Thygesen, K. et al. (2018). Fourth Universal Definition of Myocardial Infarction. JACC. (In press)

Indeterminate hs-Troponin: What do you do?

- A patient with hs Trop T levels that are above the 99 %ile (19 pg/mL) but not changing over time needs to be assessed for **the known chronic condition causes** of hs-Trop T elevation and treated accordingly.
- ACS diagnosis is not just a biochemical marker elevation, but a clinical evaluation of **history, ECG findings, age, risk factors and serial Troponin levels.**
- If low or moderate suspicion for ACS, consider stress testing or CTCA.

What are the advantages and disadvantages?

High Sensitivity Troponin

- Faster Rule-Out
- High degree of confidence
- Patients may have above normal, elevated troponin in non-ACS conditions

- **Heart failure** (chronic or acute)
- **Renal Disease** (Chronic Kidney Disease)
- Critical illness (shock, sepsis, burns)
- Tachyarrhythmias
- Left Ventricular Hypertrophy
- Hypertensive emergencies
- Myocarditis
- Pulmonary embolism or pulmonary hypertension
- Aortic dissection
- Infiltrative disease (amyloidosis, hemochromatosis, sarcoidosis)
- Cardiac contusion or cardiac procedures
- Takotsubo cardiomyopathy
- Rhabdomyolysis
- Drug toxicity (doxorubicin, 5-fluorouracil, herceptin)

Methods to increase specificity of troponin results:

- **Serial samples**
- **Rate of change over time**
- **Clinical history and ECG**