Trouble With Troponins

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MERCYHEALTH

Our Mission

We extend the compassionate ministry of Jesus by improving the health and well-being of our communities, and bring good help to those in need, especially people who are poor, dying and underserved.

Our Values

Human Dignity | Integrity | Compassion | Stewardship | Service

Disclosures:

None

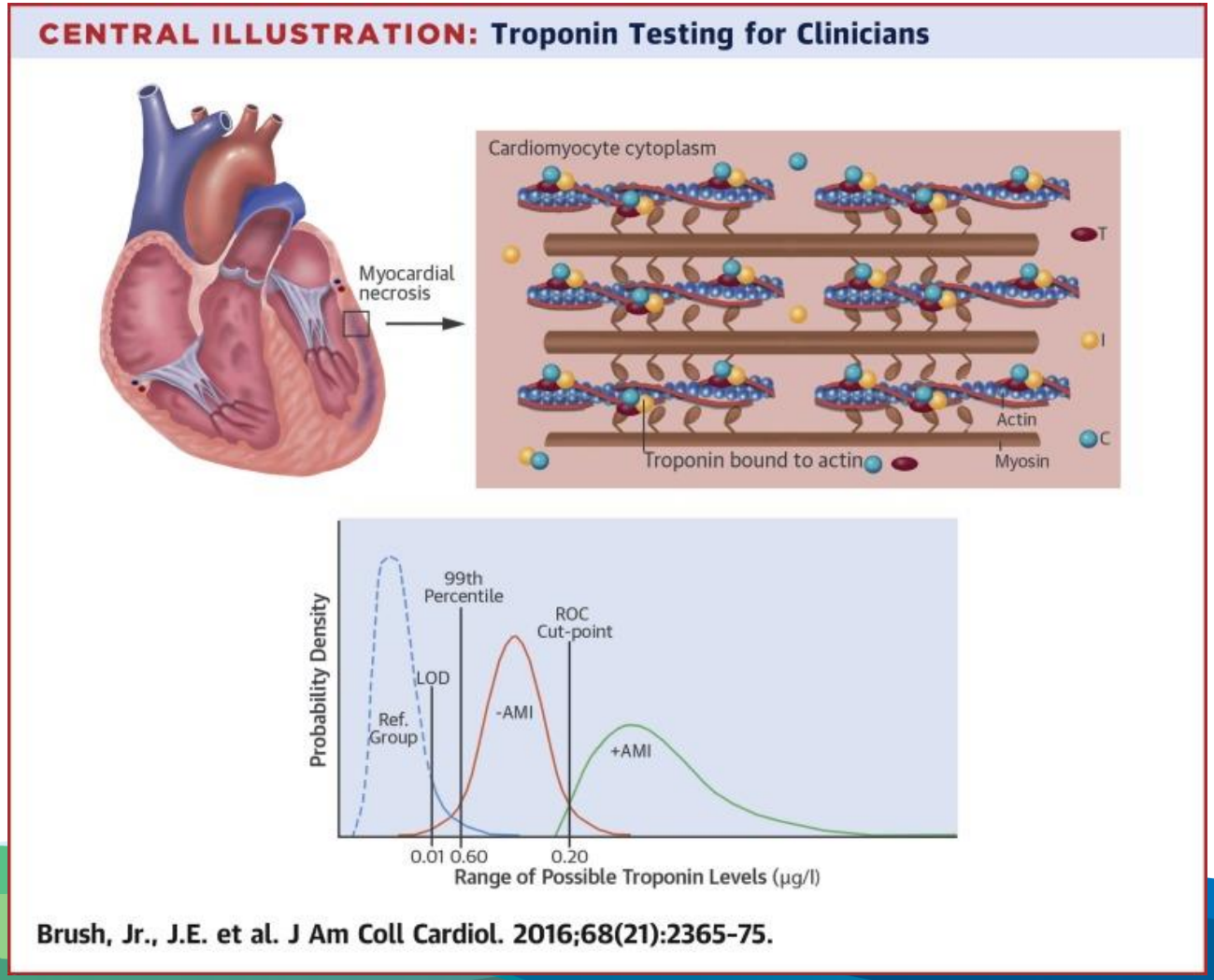
Why talk about troponin?

- The Fourth Universal Definition of MI (2018) proposes specific criteria to defining MI
- Universally used in workup for acute MI (AMI)
- Sensitivity is excellent, specificity not so much. Complicated!

Fourth Universal Definition of MI

- Group of physicians, clinical documentation specialists, coding experts and health policy experts from the ACC and AHA has focused on educating clinicians about the importance of accurately documenting MI and non-MI causes of troponin elevation in the medical record.

What is troponin?

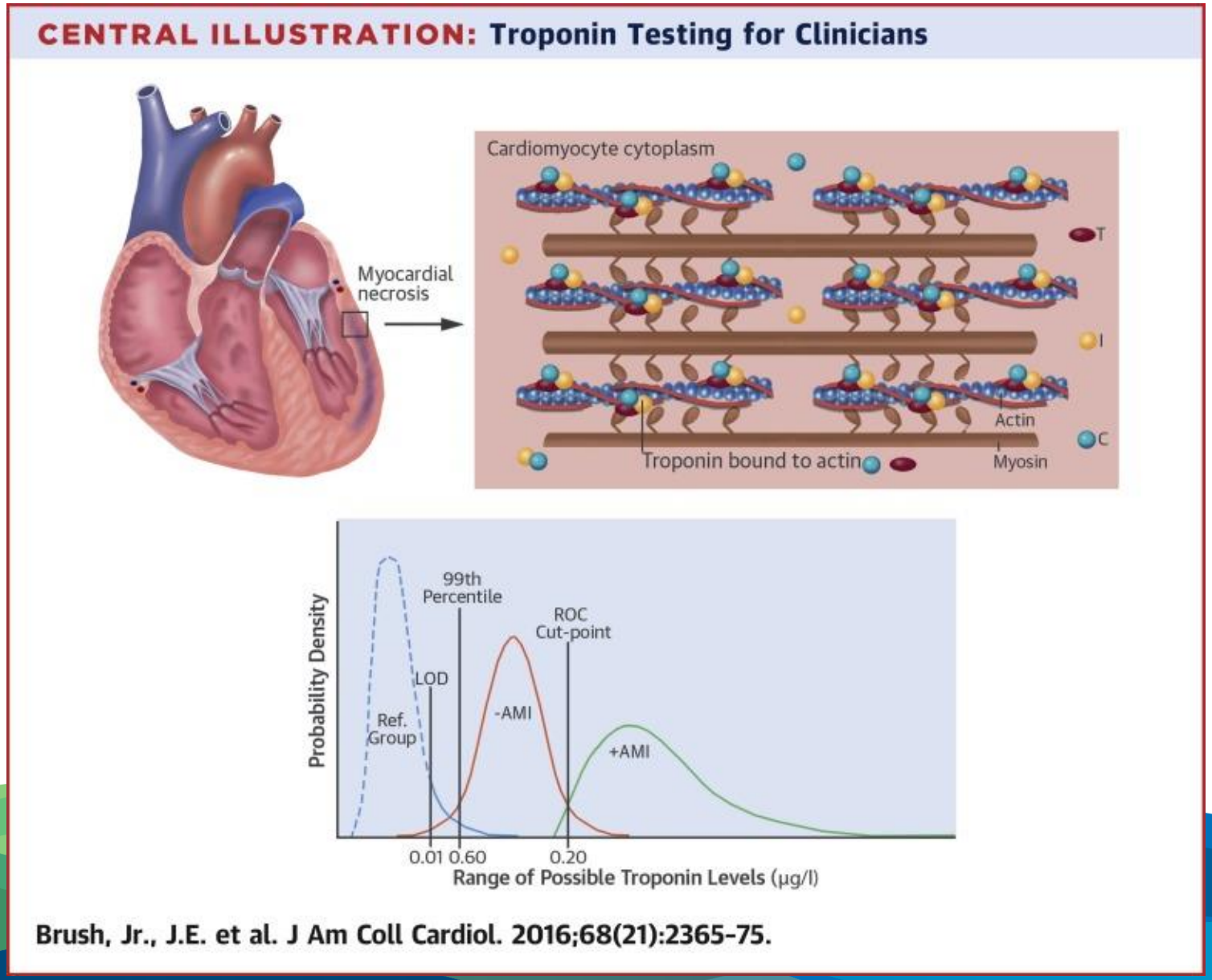


Brush, Jr., J.E. et al. J Am Coll Cardiol. 2016;68(21):2365-75.

What is Troponin?

- Troponin is a protein complex bound to actin and found freely in cardiomyocytes.
- When a cardiomyocyte is injured, Troponin leaks into the blood stream
- There are 3 types of Troponin in cardiomyocytes: Troponin C,I, and T
- Troponin I&T are specific to only cardiomyocytes

Troponin as an assay for MI:



Brush, Jr., J.E. et al. J Am Coll Cardiol. 2016;68(21):2365-75.

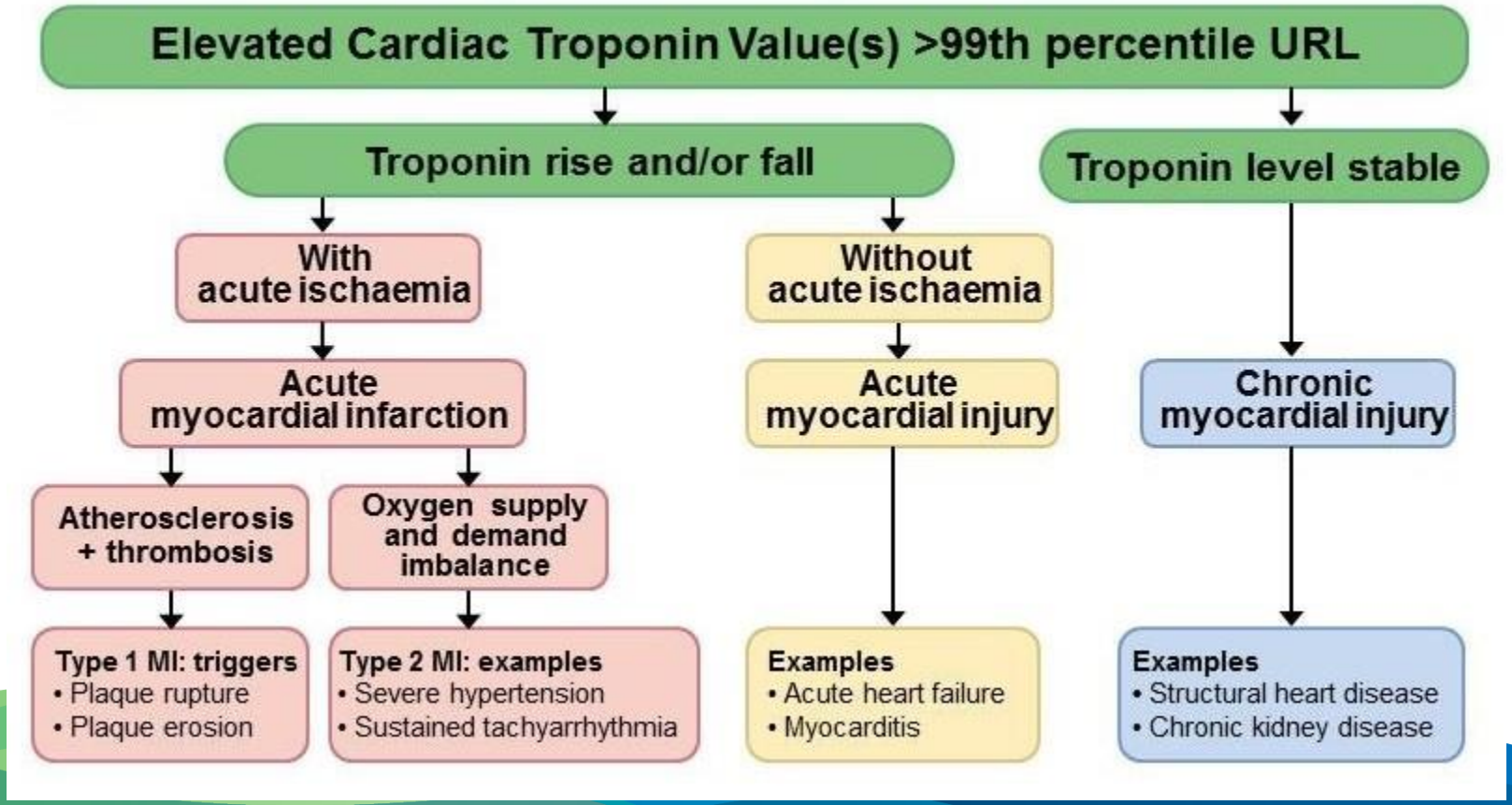
Improved Sensitivity and Precision

- Since the 1990's troponin has become the preferred test for diagnosing MI over CK-MB
- With each generation of the test, sensitivity is improving, unfortunately specificity has declined

- So, the troponin is positive… What do you do???

Causes of Troponin Elevation due to Ischemia

Myocardial injury related to acute myocardial ischemia
Atherosclerotic plaque disruption with thrombosis.
Myocardial injury related to acute myocardial ischemia because of oxygen supply/demand imbalance
Reduced myocardial perfusion, e.g.,•Coronary artery spasm, microvascular dysfunction •Coronary embolism •Coronary artery dissection •Sustained bradyarrhythmia •Hypotension or shock •Respiratory failure •Severe anemia
Increased myocardial oxygen demand, e.g.,•Sustained tachyarrhythmia •Severe hypertension with or without left ventricular hypertrophy
Other causes of myocardial injury
Cardiac conditions, e.g.,•Heart failure •Myocarditis •Cardiomyopathy (any type) •Takotsubo syndrome •Coronary revascularization procedure •Cardiac procedure other than revascularization •Catheter ablation •Defibrillator shocks •Cardiac contusion
Systemic conditions, e.g.,•Sepsis, infectious disease •Chronic kidney disease •Stroke, subarachnoid hemorrhage •Pulmonary embolism, pulmonary hypertension •Infiltrative diseases, e.g., amyloidosis, sarcoidosis •Chemotherapeutic agents •Critically ill patients •Strenuous exercise


Elevated Cardiac Troponin Value(s) >99th percentile URL
Troponin rise and/or fall
Troponin level stable
With acute ischaemia
Without acute ischaemia
Acute myocardial infarction
Acute myocardial injury
Chronic myocardial injury
Atherosclerosis + thrombosis
Oxygen supply and demand imbalance
Type 1 MI: triggers
• Plaque rupture
• Plaque erosion
Type 2 MI: examples
• Severe hypertension
• Sustained tachyarrhythmia
Examples
• Acute heart failure
• Myocarditis
Examples
• Structural heart disease
• Chronic kidney disease

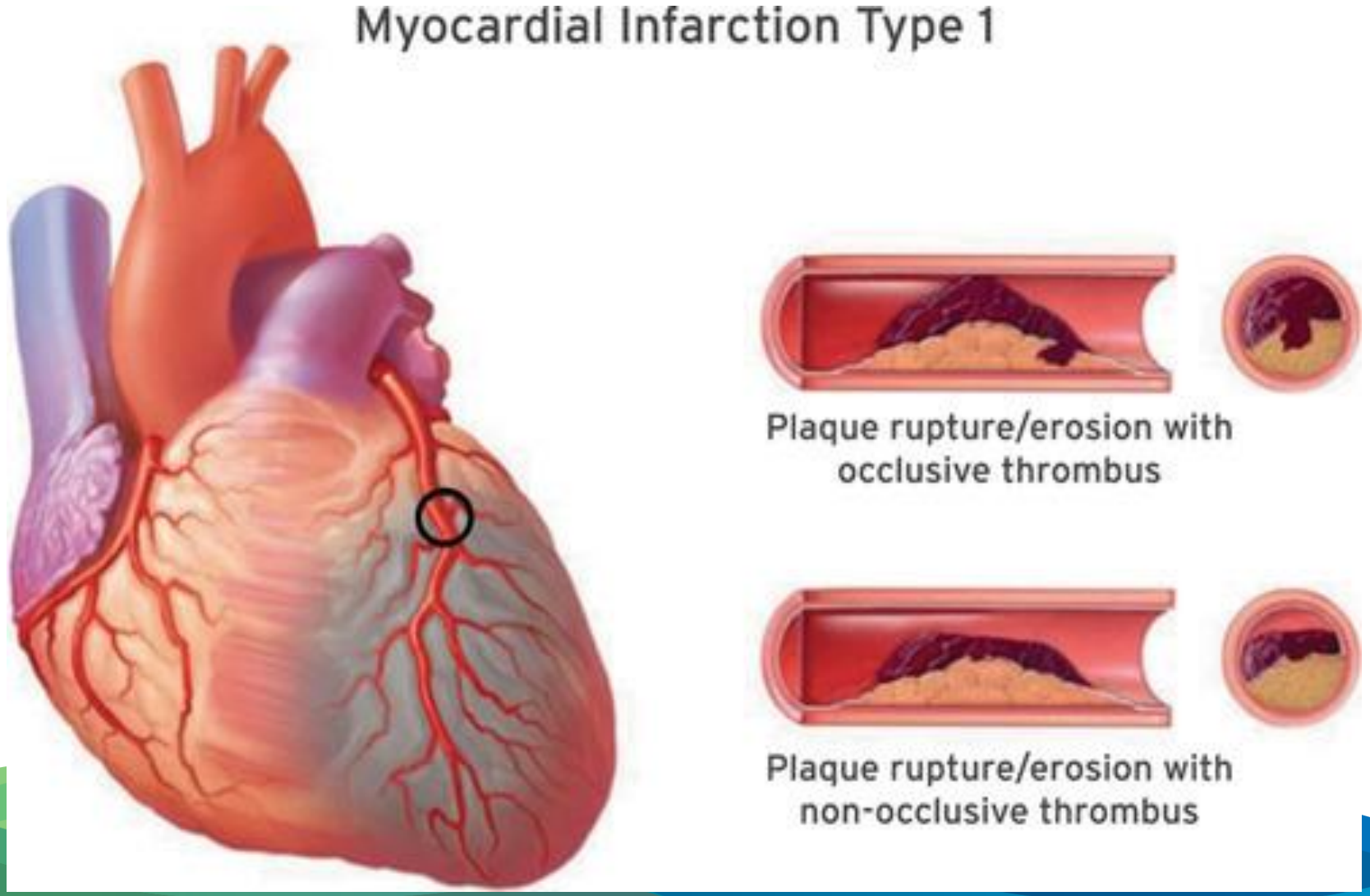
Classification of troponin elevation

- Previously NSTEMI was the catchall term.
- Now:
  - Type I MI:
    - Spontaneous MI, Plaque Rupture/coronary thrombosis
  - Type 2 MI:
    - Supply/Demand mismatch
  - Type 3 MI:
    - Cardiac death in setting of ischemic process without biomarker evidence
  - Type 4 MI:
    - 4a: PCI related MI
    - 4b: Stent thrombosis
  - Type 5 MI:
    - CABG related MI

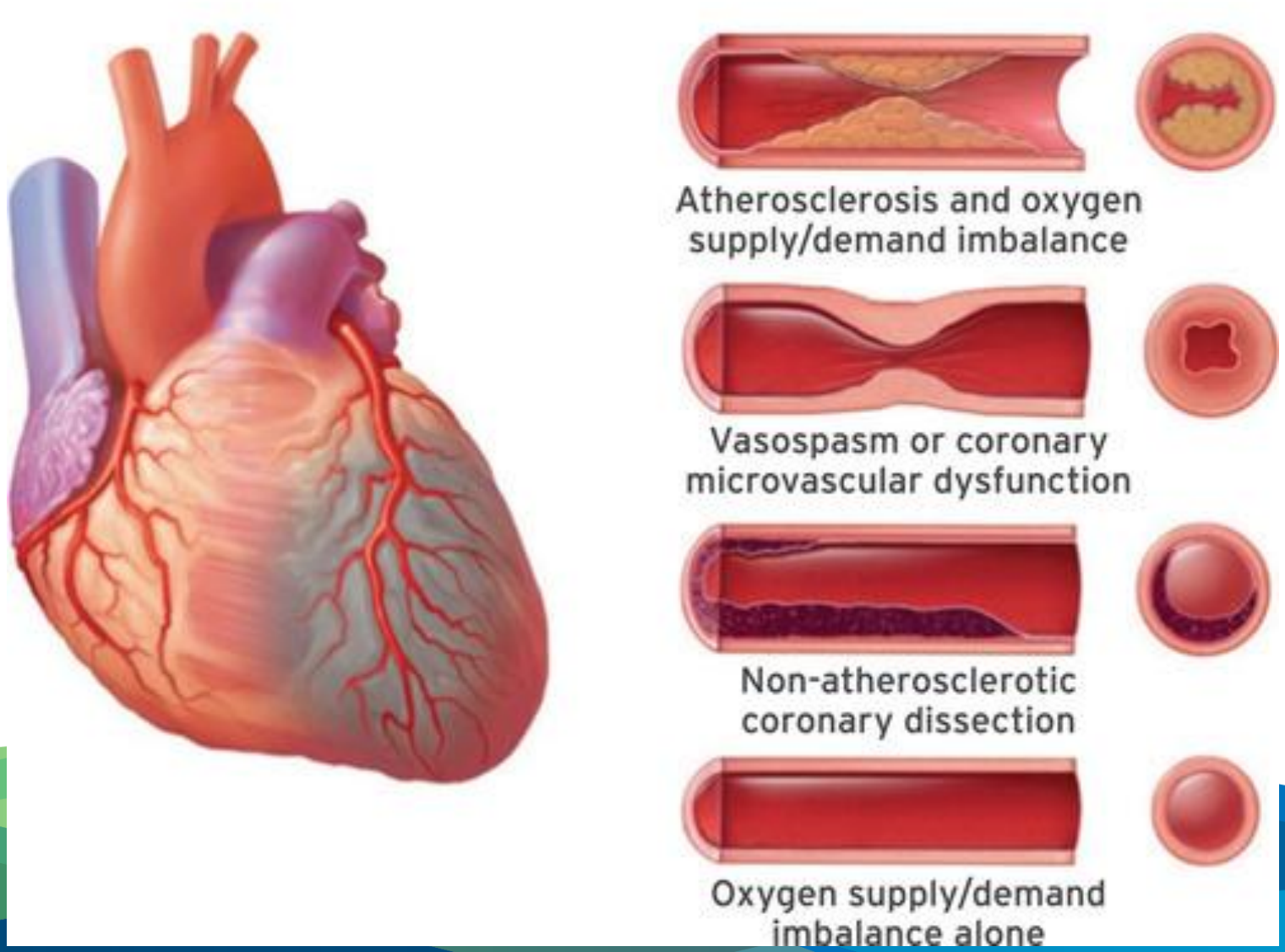
Type 1 and Type 2 MI

- Type 1 MI: + Troponin with:
  - Symptoms
  - New ischemic ECG changes;
  - Development of pathological Q waves;
  - Imaging evidence of Myocardial Ischemia
  - Identification of a coronary thrombus by angiography including intracoronary imaging or by autopsy.
- Type 2 MI: + Troponin
  - evidence of an imbalance between myocardial oxygen supply and demand unrelated to coronary thrombosis, requiring at least one of the following:
  - Symptoms of acute myocardial ischemia;
  - New ischemic ECG changes;
  - Development of pathological Q waves;
  - Imaging evidence of new loss of viable myocardium, or new regional wall motion abnormality in a pattern consistent with an ischemic etiology.

Type I MI


Myocardial Infarction Type 1
Plaque rupture/erosion with occlusive thrombus
Plaque rupture/erosion with non-occlusive thrombus

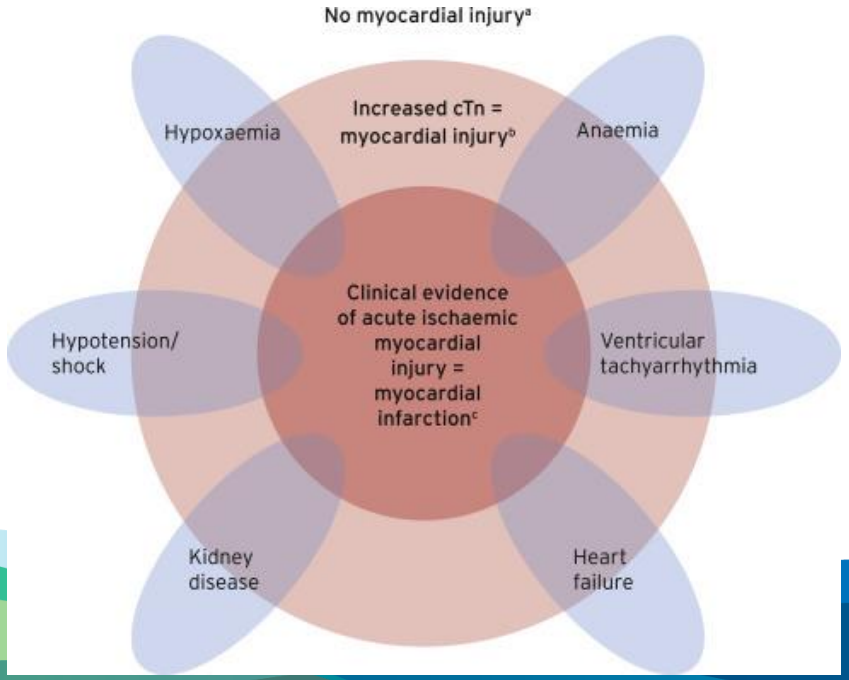
Type II MI


Myocardial Infarction Type 2
Atherosclerosis and oxygen supply/demand imbalance
Vasospasm or coronary microvascular dysfunction
Non-atherosclerotic coronary dissection
Oxygen supply/demand imbalance alone

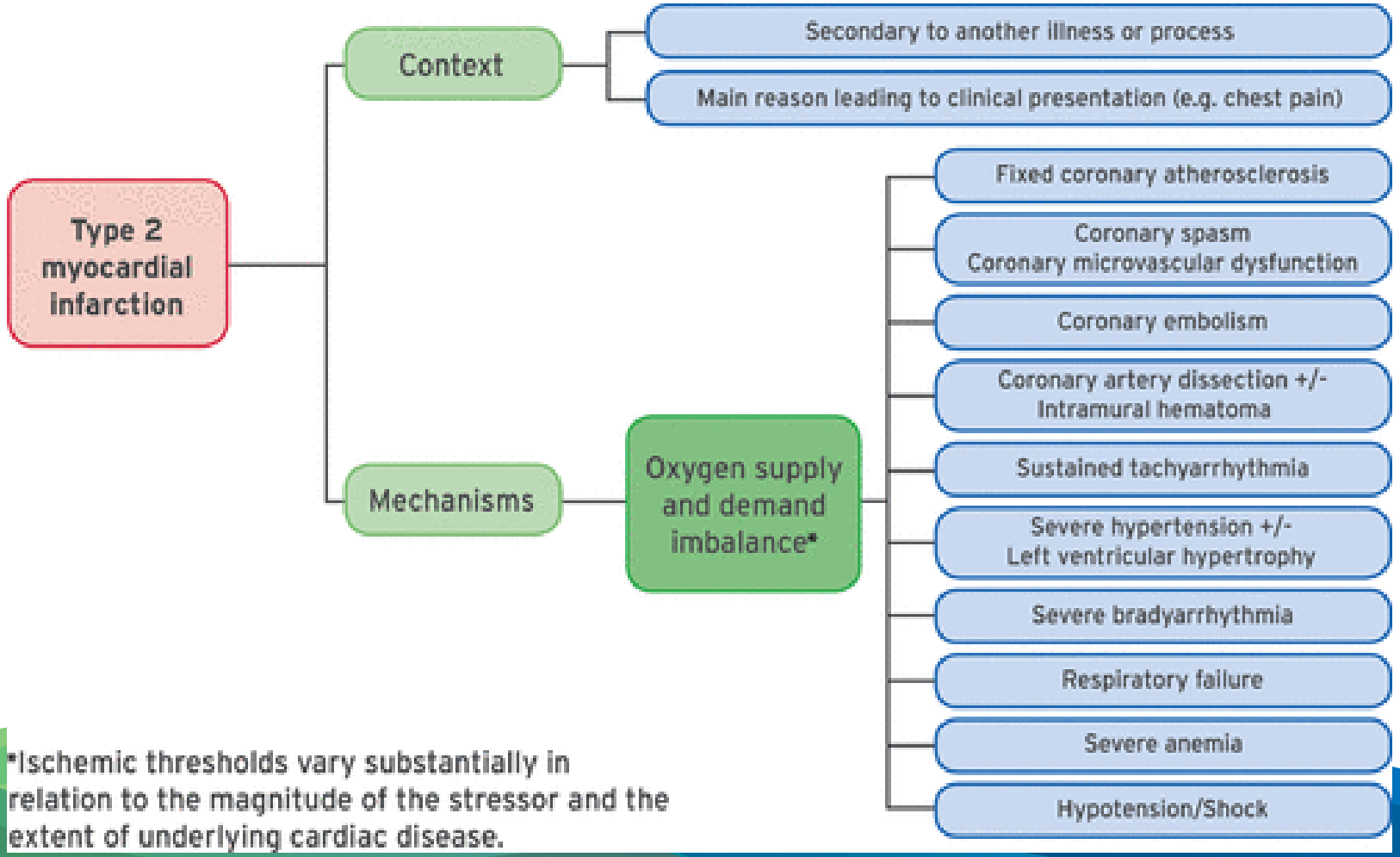
	Type 1 Myocardial Infarction	Type 2 Myocardial Infarction
Mechanism	Atherosclerotic processes such as plaque rupture, ulceration, fissuring, or erosion resulting in coronary thrombosis	Inadequate myocardial blood supply, increased demand or both; occurring in the absence of atherothrombosis; includes coronary artery embolism, vasospasm, and spontaneous coronary artery dissection
Patient characteristics	Generally younger with fewer comorbidities	Older, greater medical complexity with multiorgan involvement including precipitating cause for supply/demand imbalance
Prognosis	•30-day all-cause mortality 5%–9% •5-yr all-cause mortality rate of 37% •Generally lower rates of subsequent MACE (21 events/100 patient-years)	•30-day all-cause mortality 14%–24% •5-yr all-cause mortality rate of 63% •Generally higher rates of subsequent MACE (54 events/100 patient-years)
30-day readmission rate	Between 15% and 20%	Uncertain, may be as high as ~20%
Strategies to reduce mortality	Defined	Undefined
Strategies to reduce 30-day readmission	Defined	Undefined
ICD-10 code	Yes, I21.9	Yes, I21.A1
Included in HRRP	Yes	Yes

Causes of Type II MI

- Type 2 MI results from imbalance between myocardial oxygen supply and demand that is unrelated to acute coronary thrombosis or plaque rupture.



Causes of Type II MI



*Ischemic thresholds vary substantially in relation to the magnitude of the stressor and the extent of underlying cardiac disease.

Documentation Implications

- Role of documentation: tell the story, what do you think is going on and what are you doing about it, and bill.

- Improper documentation or coding can lead to penalties (Hospital Readmission Reduction Program under CMS)

Avoiding inaccurate documentation

Avoid NSTEMI as default for elevated trop

Avoid using NSTEMI when uncertain and diagnostic testing incomplete.

When documenting that an MI is present, must state etiology (Demand?, Plaque Rupture?, etc.)

Consult cardiology when warranted

10 Key Points when documenting MI or Non-MI troponin elevation[2]

1. Avoid reflexively documenting an MI whenever troponin levels are elevated.
2. Documentation of MI type requires identification of etiology.
3. Terminology updates of MI types.
4. Documentation of the term "non-MI troponin elevation".
5. Degree and pattern of troponin elevation.
6. Troponin elevation in patients with heart failure exacerbation.
7. Troponin elevation in hypertensive emergency.
8. Troponin elevation in patients with tachyarrhythmias.
9. Critically ill patients and perioperative patients.
10. Documenting uncertainty during the diagnostic workup.

Avoid reflexively documenting an MI whenever troponin levels are elevated.

- To document MI: Troponin elevation accompanied by clear clinical evidence of active myocardial ischemia
  - Overt clinical symptoms
  - New ECG changes
  - New perfusion abnormalities or wall motion abnormalities on noninvasive imaging.

Documentation of MI type requires identification of etiology.

Terminology updates of MI types.

- Specific ICD-10 codes for Type 1, Type 2, and "other types"

Documentation of the term "non-MI troponin elevation"

- Positive troponin
- No clear symptoms
- No EKG changes
- No findings of ischemia on imaging/angiography

Degree and pattern of troponin elevation.

- Does NOT determine if Type 1 MI

Troponin elevation in patients with heart failure exacerbation.

- May be due to ischemic or non-ischemic mechanisms.

Troponin elevation in hypertensive emergency.

Troponin elevation in patients with tachyarrhythmias.

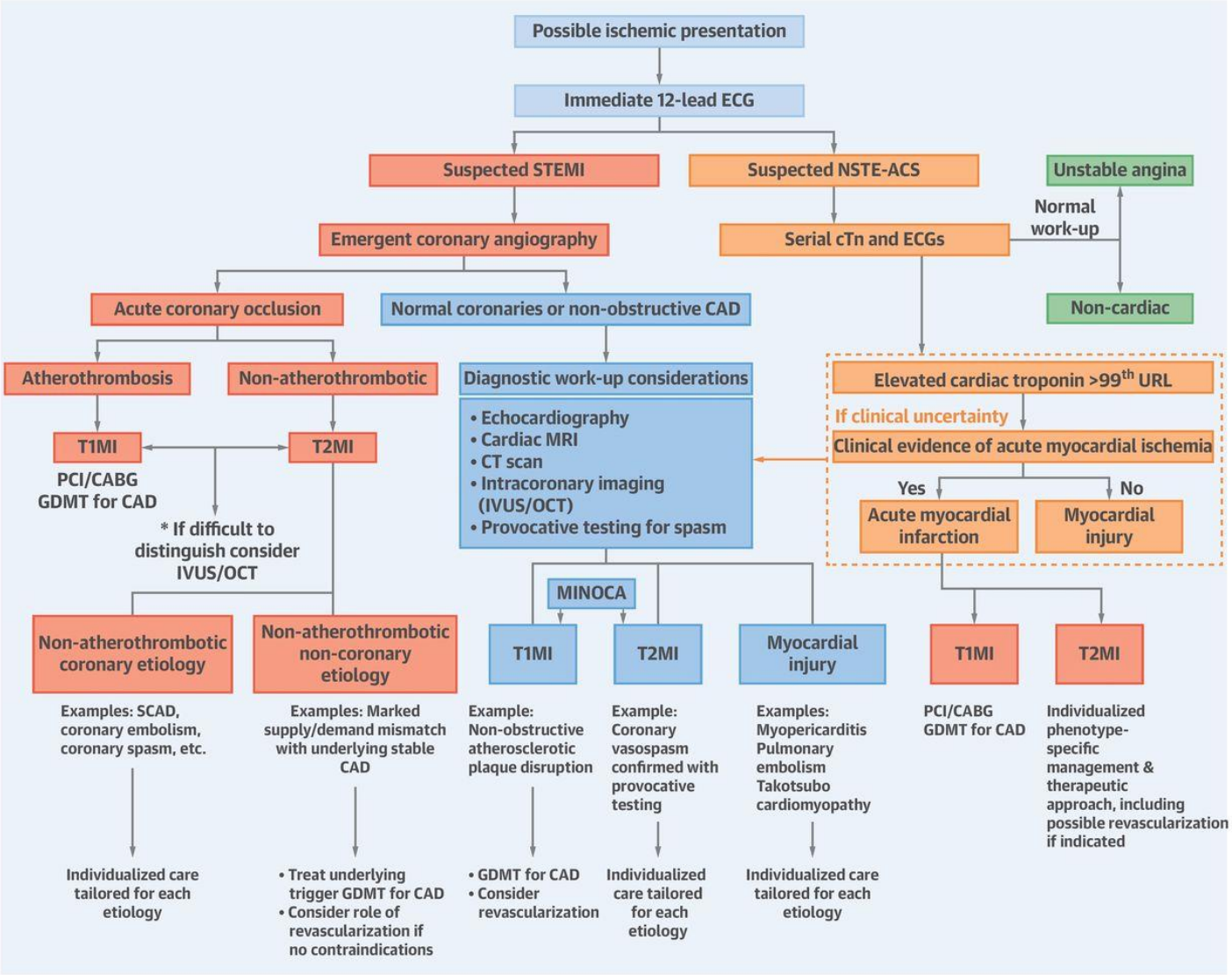
- Can cause Type 2 MI or non-MI troponin elevation.
- ECG may falsely suggest ischemia

Critically ill patients and perioperative patients.

Documenting uncertainty during the diagnostic workup.

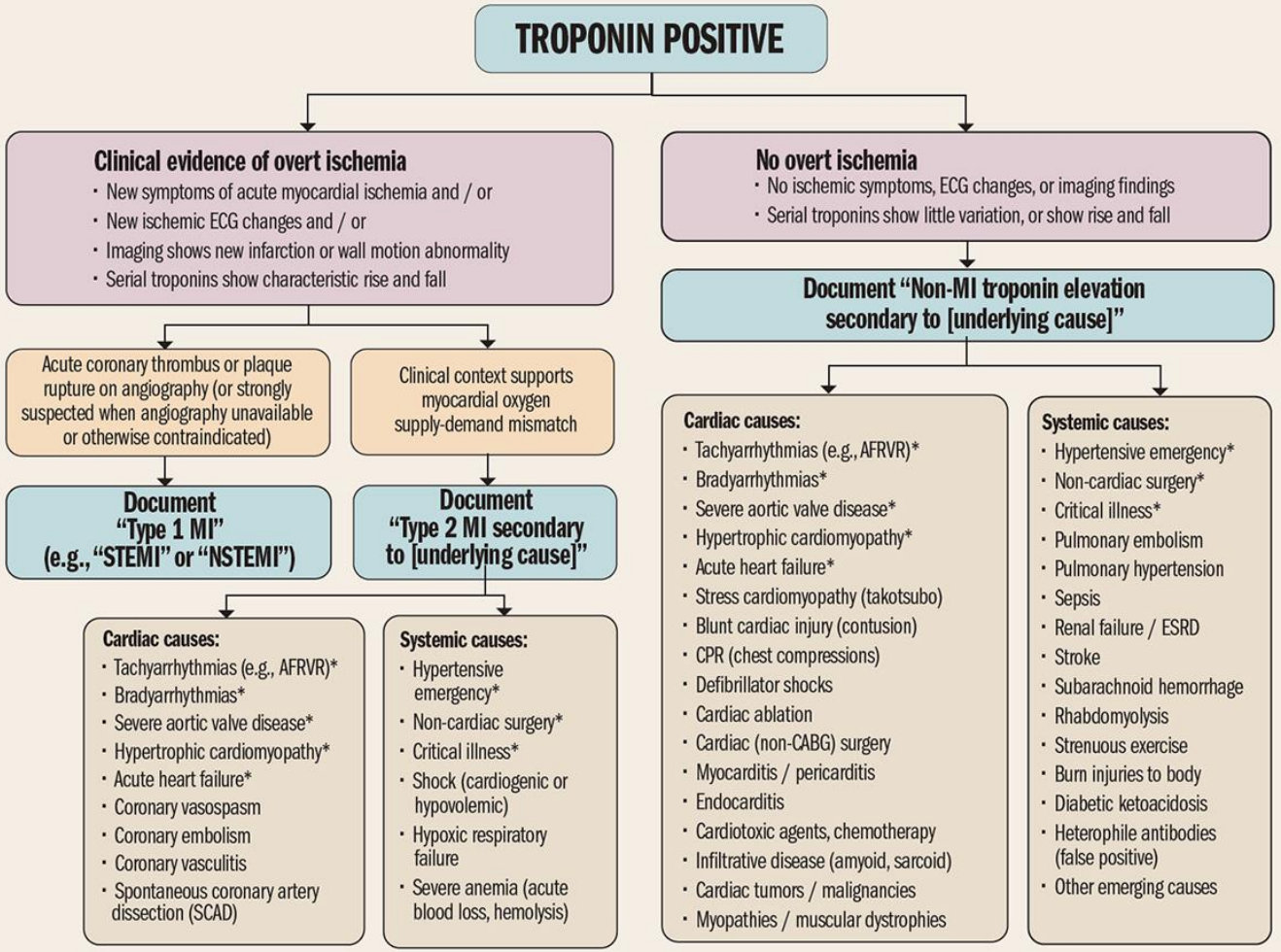
- It's ok to not know. Just clarify when you do.

CENTRAL ILLUSTRATION: Diagnostic Approach for Patients With Suspected Acute Myocardial Ischemia



Sandoval, Y. et al. J Am Coll Cardiol. 2019;73(14):1846-60.

Schema for documenting a type 1 MI, type 2 MI, or non-MI troponin elevation based on clinical presentation and underlying causes.



AFRVR: atrial fibrillation with rapid ventricular response; **CABG**: coronary artery bypass graft surgery; **ECG**: electrocardiogram; **ESRD**: end-stage renal disease; **MI**: myocardial infarction; **SCAD**: spontaneous coronary artery dissection.

* These conditions may cause either a type 2 MI or a non-MI troponin elevation. The presence or absence of overt symptoms of acute myocardial ischemia, new ischemic ECG changes, imaging showing new MI or wall motion abnormality, and/or findings on coronary angiography may help distinguish the two.

References:

1. Thygesen K, Alpert JS, Jaffe AS, et al. Fourth universal definition of myocardial infarction (2018). *J Am Coll Cardiol* 2018;Aug 25.
2. Goyal A, Gluckman T, Levy A, et al. Translating the Fourth Universal Definition of Myocardial Infarction into Clinical Documentation: Ten Pearls For Frontline Clinicians. *J Am Coll Cardiol* 2018;Nov 6.
3. McCarthy C, et al.Type 2 Myocardial Infarction and the Hospital Readmission Reduction Program. *J Am Coll Cardiol* 2018;Sept 4.

Questions?

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Thank you.