

Revisiting the Definition of Type 2 Myocardial Infarction: When is an abnormal troponin value not an MI?

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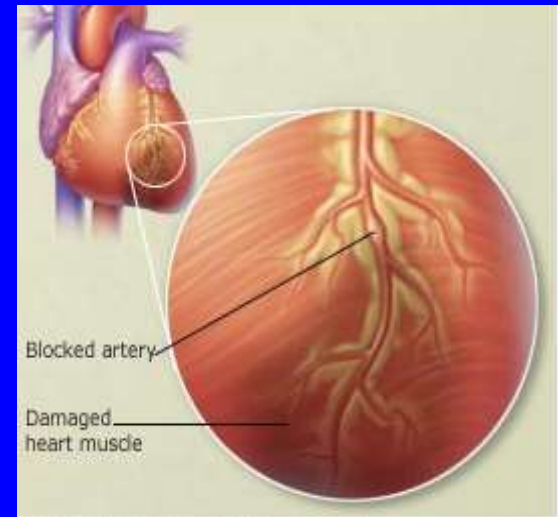
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Classification of Myocardial Infarction

- Type 1** Spontaneous myocardial infarction related to ischemia due to a primary coronary event such as plaque erosion or rupture, fissuring or dissection
- Type 2** Myocardial infarction secondary to ischemia due to imbalance between oxygen demand and supply e.g. coronary spasm, anemia, or hypotension
- Type 3** Sudden cardiac death with symptoms of ischemia, accompanied by new ST elevation or LBBB, or verified coronary thrombus by angiography or autopsy, but death occurring before blood samples could be obtained
- Type 4a** Myocardial infarction associated with PCI
- Type 4b** Myocardial infarction associated with verified stent thrombosis
- Type 5** Myocardial infarction associated with CABG

Myocardial Infarction Type 2

Myocardial infarction secondary to ischemia due to either increased oxygen demand or decreased supply e.g. spasm, anemia, arrhythmia, or hypotension



Criteria for Acute Myocardial Infarction Type 1 and Type 2

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

- Symptoms of ischemia
- ECG changes of new ischemia (new ST-T changes or new LBBB)
- Development of pathological Q waves in the ECG
- Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality

1. The Joint European Society of Cardiology/American College of Cardiology Committee: Myocardial infarction redefined — A consensus document of The Joint European Society of Cardiology/American College of Cardiology Committee for the Redefinition of Myocardial Infarction. Eur Heart J 2000; 21:1502-1513; J Am Coll Cardiol 2000;36:959-969.
2. Thygesen K, Alpert JS, White HD: joint ESC/ACCF/AHA/WHF Task Force for the Redefinition of Myocardial Infarction. Universal definition of myocardial infarction. Eur Heart J 2007;28:2525-2538; Circulation 2007; 116: 2634-2653; J Am Coll Cardiol 2007.50:2173-2195.

Have either of these two patients had a type 2 MI?

1. A 14 year old female with WPW with 5 hours of SVT at a heart rate of 240 bpm.
2. A 70 year old male in the medical ICU with respiratory failure, hemoglobin of 4.5 mmol/L (7.3 g/dL), arterial pO_2 of 45 mm Hg, systolic blood pressure of 65 mm Hg, and a history of an inferior wall MI two years ago.

Examining Type 2 MI (1)

- Of the 5 subtypes of MI in the revised 2007 universal definition of MI, the type 2 MI has proven to be the most difficult to interpret and therefore to implement.
- The problem arises from the fact that multiple clinical conditions can injure the myocardium and lead to abnormal elevations in blood troponin levels.

Elevations of Troponin in the Absence of Overt Ischemic Heart Disease

- Cardiac contusion, or other trauma including surgery, ablation, pacing etc
- Congestive heart failure – acute and chronic
- Aortic dissection, aortic valve disease
- Hypertrophic cardiomyopathy
- Tachy- or bradyarrhythmias, or heart block
- Apical ballooning syndrome
- Rhabdomyolysis with cardiac injury
- Pulmonary embolism, severe pulmonary hypertension
- Renal failure
- Acute neurological disease, including stroke, or subarachnoid hemorrhage
- Infiltrative diseases, e.g., amyloidosis, hemochromatosis, sarcoidosis or scleroderma
- Inflammatory diseases, e.g., myo/pericarditis or myocardial extension of endocarditis
- Drug toxicity or toxins
- Critically ill patients, especially with respiratory failure, or sepsis
- Burns, especially if affecting > 30% of body surface area
- Extreme exertion

Examining Type 2 MI (2)

What did the task force really envision when they discussed the type 2 MI in 2005-2007?



Examining Type 2 MI (3)

- The task force envisioned two situations that might lead to myocardial ischemia severe enough to result in myocardial necrosis:
 1. Conditions that would **decrease** myocardial oxygen supply;
 2. Conditions that would **increase** myocardial oxygen demand.

Conditions leading to decreased myocardial oxygen supply

- Severe anemia
- Respiratory failure with severe hypoxemia
- Bradycardia leading to hypotension
- Hypotension or frank shock
- Transient coronary vasospasm or marked endothelial dysfunction
- Embolism to the coronary artery

Conditions leading to **increased** myocardial oxygen demand

- Tacharrhythmias, supraventricular or ventricular in origin;
- Severe hypertension in a patient with left ventricular hypertrophy with a resultant marked increase in myocardial oxygen demand.



Examining Type 2 MI (4)

It was never openly discussed by the task force that wrote the 2007 revision of the universal definition of MI, but it was widely understood by the members that **decreased myocardial oxygen supply** or **increased myocardial oxygen demand** would have to result in myocardial ischemia in order for a type 2 MI to be diagnosed.

Examining Type 2 MI (5)


Unfortunately, it is often unclear whether patients with conditions that decrease myocardial oxygen supply or increase myocardial oxygen demand have underlying coronary artery disease.



Examining Type 2 MI (6)

Consider these two patients with elevated blood troponin levels:

1. A 14 year old female with WPW with 5 hours of SVT at a heart rate of 240 bpm.
2. A 70 year old male in the medical ICU with respiratory failure, hemoglobin of 4.5 mmol/L (7.3 g/dL), arterial pO_2 of 45 mm Hg, systolic blood pressure of 65 mm Hg, and a history of an inferior wall MI two years ago.

Which of these two patients has had a type 2 MI 

- The opinion of many of the members of the current task force is that the 2nd patient has had a type 2 MI. This patient has known CAD as well as both demand and supply imbalance.
- The first patient has had **myocardial ischemia/necrosis secondary to tachycardia**.
- However, this interpretation was not universally accepted by all task force members.

Examining Type 2 MI (7)

One suggested revision to the type 2 MI definition (personal and not yet approved by the task force):

“Patients with myocardial ischemia secondary to increased demand or decreased supply of myocardial blood flow with known or probable coronary artery disease with resultant myocardial necrosis as diagnosed by abnormal blood troponin levels are said to have had a type 2 myocardial infarction. Careful clinical judgment must be exercised in diagnosing a type 2 MI.”

Examining Type 2 MI (8)

- The definition for type 2 MI involves clinical judgment, i.e., if the patient likely has atherosclerotic coronary artery disease (previous history of MI, PCI, CABG or multiple risk factors such as diabetes mellitus, hyperlipidemia, etc) and has an increase in demand or a decrease in supply, this constitutes the only situation where type 2 MI is diagnosed.

Examining Type 2 MI (9)

- Using this second interpretation of what constitutes a type 2 MI, the first patient has not had a type 2 MI but rather a myocardial injury secondary to a prolonged episode of tachycardia. The second patient has had type 2 MI.

Careful thought and expert **clinical judgment** is needed to make the diagnosis of type 2 myocardial infarction.



Examining Type 2 MI

Conclusion: Further clinical research must be done on patients with potential type 2 MI's in order to clarify the definition of this subtype.

There are already protocols underway to examine this important question.

The End