

MI and Myocardial injury

Myocardial injury: elevated troponin *without* manifestations of myocardial ischemia.

- Acute: rise and/or fall of troponin values. Multiple causes (see table 1 and figure 6)
- Chronic: mild and flat elevation of troponin. Usually in setting of chronic kidney disease or structural heart disease

Acute myocardial ischemia: at least one of the following:

- Symptoms of acute myocardial ischemia
- New ECG changes: ST-T ischemic abnormalities, development of pathological Q waves
- New echocardiographic regional wall motion abnormalities in a pattern consistent with an ischemic etiology
- Identification of a coronary thrombus by angiography

Acute myocardial infarction: elevated troponin *with* manifestations of myocardial ischemia.

MI type 1: Acute myocardial infarct (STEMI or NSTEMI) caused by coronary thrombosis identified by angiography.

MI type 2: Acute myocardial infarct due to an imbalance between myocardial oxygen supply and demand *unrelated* to coronary thrombosis. Multiple causes (see table 1 and figure 6).

MI type 3: Patients who suffer cardiac death, with symptoms suggestive of myocardial ischemia accompanied by presumed new ischemic ECG changes or ventricular fibrillation but die before blood samples for biomarkers can be obtained.

MI type 4: Acute myocardial infarct that occurs \leq 48 hours after interventional procedure.

- MI type 4a: elevation of troponin after PCI with values $>$ 5 times in patients with normal baseline values or 20% variation in patients with elevated pre-procedure.
- MI type 4b: Stent thrombosis MI as documented by angiography using the same criteria utilized for type 1 MI.

MI type 5: CABG-related MI defined as elevation of troponin \leq 48 h after the procedure with values $>$ 10 times in patients with normal baseline or 20% variation in patients with elevated pre-procedure values.

It is important that the post-procedural elevation of cTn values is accompanied by ECG, angiographic, or imaging evidence of new myocardial ischemia/new loss of myocardial viability.

TABLE 1 Reasons for the elevation of cardiac troponin values because of myocardial injury

Myocardial injury related to acute myocardial ischaemia

Atherosclerotic plaque disruption with thrombosis.

Myocardial injury related to acute myocardial ischaemia 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 anaemia

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 haemorrhage
- Pulmonary embolism, pulmonary hypertension
- Infiltrative diseases, e.g. amyloidosis, sarcoidosis
- Chemotherapeutic agents
- Critically ill patients
- Strenuous exercise

FIGURE 6 A model for interpreting myocardial injury. Ischaemic thresholds vary substantially in relation to the magnitude of the stressor and the extent of underlying cardiac disease. MI = myocardial infarction; URL = upper reference limit. ^aStable denotes $\leq 20\%$ variation of troponin values in the appropriate clinical context. ^bIschaemia denotes signs and/or symptoms of clinical myocardial ischaemia.

