Lab 6: (***Biochemical tests in myocardial Infarction and ischemia***)

Myocardial infarction (MI) can be defined pathologically as myocardial necrosis due to prolonged myocardial ischemia. The diagnosis of MI depends on triangle of a typical history of chest pain suggestive of ischemia, the presence of diagnostic ECG abnormalities and arise in biochemical markers. The presence of two or more of these three defined the diagnosis. After MI, a number of intracellular proteins are released from the damaged cells. The proteins of major diagnostic interest include:

- Troponin I and troponin T;
- Enzymes, such as creatine kinase (CK), CK-MB, aspartate aminotransferase (AST) and lactate dehydrogenase (LDH);
- Myoglobin.

The troponins and CK are the most widely established biochemical indices of myocardial damage, with the troponins largely taking the place of the enzymes in recent years.

Optimal times for blood sampling:

A sample taken on admission with an appropriate clinical history, if sufficiently elevated, will make the required diagnosis, but if not elevated will not rule out the diagnosis if insufficient time has elapsed for a significant CK or troponin rise to have occurred. Detection of arise and/or fall in measurements is ideally required for the diagnosis of an acute MI, so testing should be repeated after 3-6 hours.

Note: Except for the occasional patient seen for the first time 2 days or more after the episode, in whom troponin measurements might still be useful, it is very rarely of any value to take samples for plasma markers after 48 h from the onset of symptoms that suggest a diagnosis of MI.

Troponins:

The preferred biomarkers for assessment of myocardial necrosis are the cardiac troponins. Troponin is a complex of three proteins that bind to the thin filament (actin) of cardiac and skeletal muscle. The three proteins of the troponin complex are troponin T (TnT), troponin I (TnI), and troponin C (TnC). The major function of troponins is to bind calcium and regulate muscle contraction. Following injury to skeletal or heart muscle cells, the troponin complex and free troponin subunits are released into the bloodstream. The troponins have been shown to have high sensitivity and specificity for myocardial damage. Under normal circumstances there is no cardiac troponin T or I detectable in the circulation by currently available assays, so any detectable rise is of significance, contributing to the high sensitivity of these tests.

Notes:

1. Blood samples for troponins should be drawn at presentation, at 6–9 hours, and again at 12–24 hours if the earlier measurements were not elevated and the clinical suspicion of MI is high
2. Troponin T and I are cardiospecific, whereas C is also present in skeletal muscle.
3. Troponin may also sometimes be elevated in congestive cardiac failure, and pulmonary embolism.

Cardiac marker	Starts to rise (hours)	Time after infarction for peak rise (h)	Duration of rise (days)
Troponin	4–6	12–24	7–10

Normal values: (method dependent)

Troponin I — 0-0.04 ng/mL (0-0.04 µg/L)
Troponin T — 0-0.01 ng/mL (0-0.01 µg/L)

Creatine kinase CK:

CK is a cytosolic enzyme involved with the transfer of energy in muscle metabolism. CK is a dimer composed of two subunits, B and M, resulting in three cytosolic isoenzymes, CK-MM (CK-3), CK-MB (CK-2), and CK-BB (CK-1). CK-BB is of brain origin, CK-MM is found primarily from skeletal muscle and heart, while CK-MB has been shown to be most specific for the myocardium. As a result, CK-MB is a valuable tool for the diagnosis of MI because of its relative high specificity for myocardial damage.

Note: When a cardiac troponin is available, the determination of CK-MB remains useful in a few specific clinical situations as the diagnosis of early infarct extension (re-infarction), because the short half-life of CK-MB compared with troponin permits the detection of a diagnostic new increase after initial peak.

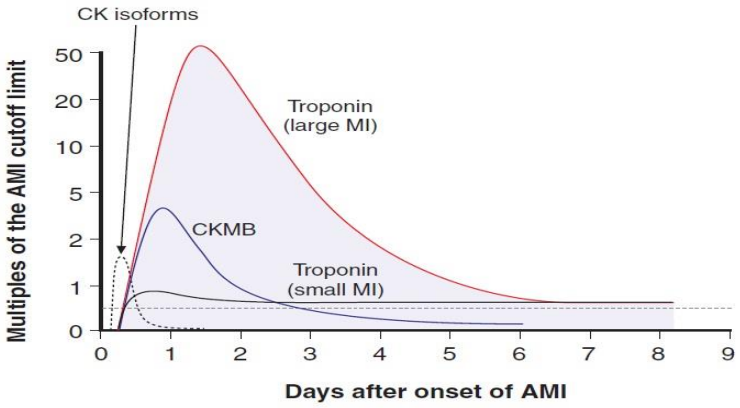
Note: CK increases sometimes large, may occur after trauma or surgical operations, IM injections, in comatose patients, in diabetic ketoacidosis, acute renal failure, hypothyroidism, and after prolonged muscular exercise.

Cardiac marker	Abnormal activity detectable (h)	Peak value of abnormality (h)	Duration of abnormality (days)
CK-MB isoenzyme	3-10	12-24	1.5-3

Normal value:

Creatine kinase (CK; total)

Male 55–170 U/L. Female 30–135 U/L.



Time schedule of the change in the plasma level of cardiac markers after myocardial infarction, CKMB: Creatine kinase MB, MI: myocardial infarction

Myoglobin:

Is a low molecular- weight haem-containing protein found in both skeletal and cardiac muscle. Because of its low molecular weight, it is rapidly released from the myocardium upon damage, and a typical rise occurs within 2–4 h after the onset of acute myocardial infarction. This is useful for the early diagnosis of acute myocardial infarction, as this rise is generally earlier than that of the other currently used cardiac markers. Unfortunately, myoglobin is not cardiac specific, being also found in skeletal muscle, and thus is less useful in the diagnosis of acute myocardial infarction unless used in conjunction with other markers.