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# Medi Quest BRS Hospital

A monthly News letter from BRS Hospital

## MYOCARDIAL INFARCTION

### DIAGNOSIS, COMPLICATIONS & MANAGEMENT - PART (1/3)

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### Definition of Myocardial Infarction:

Previous WHO criteria formulated in 1979 put less emphasis on cardiac biomarkers; according to these, a patient is diagnosed with myocardial infarction if two (probable) or three (definite) of the following criteria are satisfied:

1.Clinical history of ischaemic type chest pain lasting for more than 20 minutes

2.Changes in serial ECG tracings

3.Rise and fall of serum cardiac biomarkers such as creatine kinase-MB fraction and troponin.

However the current current criteria for diagnosis of MI is:

**BRS HOSPITAL** CONGRATULATES

*Dr. Ramanathan Ramkumar*

for successfully becoming a Diplomate in National Board of Examination Cardiology (Dip N.B.Cardiology)

### Definition of myocardial Infarction

Criteria for Acute Myocardial Infarction

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 of cardiac biomarker values[preferably cardiac troponin (cTn)]with at least one value above the 99th percentile upper reference limit (URL) and with at least one of the following :
  - Symptoms of ischemia
  - New or presumed new significant ST - Segment - T wave (ST-T) changes or new left bundle branch block (LBBB).
  - Development of pathological Q waves in the ECG.
  - Imaging evidence of new loss of viable myocardium or new regional wall motion abnormality.
  - Identification of an intracoronary thrombus by angiography or autopsy.
- Cardiac death with symptoms of suggestive myocardial ischemia and presumed new ischemic ECG changes or new LBBB, but death occurred before cardiac biomarkers were obtained ,or before cardiac biomarker values would be increased.
- Percutaneous coronary intervention (PCI) related MI is atbitarily defined by elevation of cTn values (>5 x 99th percentile URL) in patients with normal baseline values (99th percentile URL) or a rise of cTn Values >20% if the baseline values are elevated and are stable or falling. In addition, either (i) symptoms suggestive of myocardial ischemia or (ii) new ischemic ECG changes or (iii) angiographic findings with procedural complication or (iv) imaging demonstation of new loss of viable myocardium or new regional wall motion abnormality are required.
- Stent thrombosis associated with MI when detected by coronary angiography or autopsy in the setting of myocardial ischemia and with a rise and/or fall of cardiac biomarker values with atleast one value above the 99th percentile URL.
- Coronary artery bypass grafting (CABG) related MI is arbitarily defined by elevation of cardiac biomarkers values (>10 x 99th percentile URL) in patients with normal baseline cTn values (99th percentile URL). In addition, either (I) new pathological Q wave or new LBBB,or (ii) angiographic documented new graft or new native coronary artery occlusion or (iii) imaging evidence of new loss of viable myocardium or new regional wall motion abnormality.

Criteria for prior myocardial Infarction

Any one of the following criteria meets the diagnosis for prior MI

- Pathological Q waves with or without symptoms in the absence of non - ischemic cause.
- Imaging evidence of a region of loss of viable myocardium that is thinned and fails to contract, in the absence of a non-ischemic cause.
- Pathological findings of a prior MI

and Based on the above criteria MI is Classified into the following 5 types.

| Type | Clinical Classification of MI |
|---|---|
| Type 1 | Spontaneous MI |
| Type 2 | MI secondary to Ischemic imbalance |
| Type 3 | MI resulting in death without Biomarkers. |
| Type 4a | MI related to PCI |
| Type 4b | MI related to stent thrombosis |
| Type 5 | MI relate to CABG |

The current article will concentrate only on the diagnosis of Spontaneous MI (Type 1) alone with emphasis on ECG and Cardiac Enzymes.

## ECG Criteria for MI are :

According to the 2012 Joint European Society of Cardiology/American College of Cardiology Foundation/American Heart Association/World Health Federation Task Force, the following are the electrocardiogram (ECG) criteria for the two major categories of ECG manifestations of acute myocardial ischemia:

- Findings consistent with ST-elevation myocardial infarction: New ST elevation at the J point in two anatomically contiguous leads using the following diagnostic thresholds:

≥0.1 mV (1 mm) in all leads other than V2 and V3, where the following diagnostic thresholds apply: ≥0.2 mV (2 mm) in men ≥ 40 years, ≥0.25 mV (2.5 mm) in men <40 years, or ≥0.15 mV (1.5 mm) in women.

- Findings consistent with non-ST elevation myocardial infarction or unstable angina: New horizontal or down-sloping ST depression ≥ 0.05 mV (0.5 mm) in two anatomically contiguous leads or T inversion ≥0.1 mV (1 mm) in two anatomically contiguous leads with prominent R wave or R/S ratio >1. Contiguous leads are defined as pairs or groups of leads that reflect the different walls of the heart. These are the inferior (II, III, aVF), lateral (I, aVL), and anterior leads (V1 to V6).

The 12-Lead ECG: Anatomic Locations and Supplying Coronary Arteries

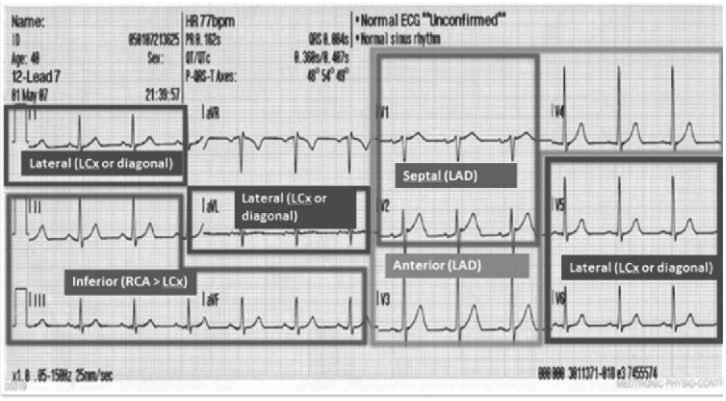


Image adapted by Sumaya Mekkaoui.
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## Criteria for Pathological Q waves. (suggestive of evolved or old MI):

According to the 2012 Joint European Society of Cardiology/American College of Cardiology Foundation/American Heart Association/World Health Task Force, the following are the criteria for ECG changes associated with prior MI (in the absence of left ventricular hypertrophy or left bundle branch block) [1]:

- Any Q wave in leads V2 to V3 ≥ 0.02 sec or QS complex in V2 and V3; or Q wave ≥0.03 sec and ≥0.1 mV deep or QS complex in leads I, II, aVL, aVF; or V4 to V6 in any two leads of a contiguous lead grouping (I, aVL; V1 to V6; II, III, aVF).
- R wave ≥ 0.04 sec in V1 to V2 and R/S ≥ 1 with a

concordant positive T wave in the absence of a conduction defect.

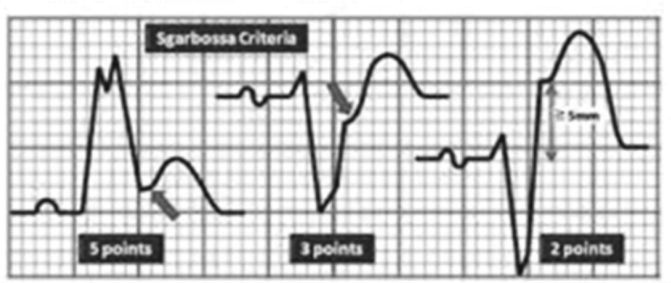
### Diagnosis of MI in the presence of LBBB :

Both LBBB, which is present in approximately 7 percent of patients with an acute MI , and pacing can interfere with the ECG diagnosis of MI or coronary ischemia. Of note, approximately one-half of patients with LBBB and an acute MI do not have chest pain . New right bundle branch block, while generally not interfering with the ECG diagnosis of STEMI, connotes an adverse prognosis similar in degree to LBBB.

In the presence of LBBB the Sgarbossa Criteria is used to diagnose MI,:
The three ECG criteria with an independent value in the diagnosis of acute infarction are,;

- ST segment elevation of 1 mm or more that is in the same direction (concordant) as the QRS complex in any lead – score 5.
- ST segment depression of 1 mm or more in any lead from V1 to V3 – score 3.
- ST segment elevation of 5 mm or more that is discordant with the QRS complex (ie, associated with a QS or rS complex) – score 2.

A Score >3, has 90% specificity for diagnosis of Acute MI. However, prominent J point elevations may occur in V1-V2 solely due to left ventricular hypertrophy or in other settings. Therefore, a ratio (in absolute units) in any relevant lead of the amplitude of the ST elevation to the S wave amplitude exceeding 0.25 has been proposed as having greater accuracy than the original Sgarbossa criterion




| Sgarbossa ECG Criteria for LBBB | |
|---|---|
| Concordant STE ≥1mm | 5 points |
| STD ≥1mm in V1 – V3 | 3 points |
| Discordant STE ≥5mm | 2 points |

### CARDIAC BIOMARKERS

A variety of biomarkers have been used to evaluate patients with a suspected acute myocardial infarction (MI). The cardiac troponins I and T as well as the MB isoenzyme of creatine kinase (CK-MB) are the most frequently used.
Values $\geq$ 99 percentile of the upper reference limit should be considered abnormal. This value for troponin and CK-MB will vary depending on the assay used.
Troponin is the preferred marker for the diagnosis of myocardial injury for all diagnostic categories because of its increased specificity and better sensitivity compared to CK-MB. However, an elevation in cardiac troponins must be interpreted in the context of the clinical history and electrocardiogram (ECG) findings since it can be seen in a variety of clinical settings and is therefore not specific for an acute coronary syndrome (ACS). The new guidelines endorse the concept that if there are elevations of cardiac troponin (cTn) in a situation where ischemia is not present, the term cardiac injury should be used.
Three points should be kept in mind when using troponin to diagnose acute MI:

- With contemporary troponin assays, most patients can be diagnosed within two to three hours of presentation.
- A negative test at the time of presentation, especially if

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the patient presents early after the onset of symptoms, does not exclude myocardial injury.

- Acute MI can be excluded in most patients by six hours, but the guidelines suggest that if there is a high degree of suspicion of an ACS, a 12-hour sample should be obtained. However, very few patients become positive after eight hours.

Other causes of biomarker elevation — Elevations of biochemical markers diagnose cardiac injury, not infarction due to coronary artery obstruction. If an ischemic mechanism of injury is present, for example, as indicated by ischemic ECG changes, then an ACS is diagnosed.

Otherwise, other mechanisms for cardiac injury must be considered (eg, heart failure, rapid atrial fibrillation, myocarditis, anthracycline cardiotoxicity, subendocardial wall stress, myopericarditis, sepsis, etc). As an example, small amounts of cardiac injury can occur in critically ill patients, which may or may not represent an acute MI . Troponin elevations also occur in chronic kidney disease.

In the emergency department setting, life-threatening causes of chest pain with troponin elevation not due to coronary artery disease are acute pulmonary embolism, in which troponin release may result from acute right heart overload, myocarditis, and stress-induced cardiomyopathy.

Absence of biomarker elevation — Using older assays, some patients with STEMI who were rapidly reperfused did not develop a cardiac biomarker elevation. These patients were called "aborted MIs." With contemporary troponin assays, this does not occur or is extremely rare.

Recommended approach — The following general statements apply to the biochemical diagnosis of an acute MI,

Troponins are the markers of choice and should be used in preference to CK-MB. The one remaining area of controversy is in the evaluation of catheter-based periprocedural events

- Measure serum troponin-I or troponin-T at first presentation
- If the troponin is not elevated, repeat at six to nine hours. It is not uncommon to measure a second troponin earlier than six hours in patients who are highly suspected of having ongoing NSTEMI, since 80 percent of patients who rule in will do so in two to three hours. In an occasional patient in whom the index of suspicion for acute MI is high, but the first two troponin measurements are not elevated, a repeat measurement at 12 to 24 hours may be necessary.
- CK-MB is measured when a troponin assay is not available. Previously, CK-MB was advocated to help diagnose reinfarction, but now troponin has subsumed that role. Reinfarction is diagnosed if there is a $\geq$ 20 percent increase of the value in the second sample.
- Troponin elevations persist for one to two weeks after acute MI, but values are usually not rising or falling rapidly at this time, allowing one to distinguish acute from more chronic events.

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