

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

# Biochemical Markers of Myocardial Infarction

Cardiovascular Block

Biochemistry Team

hope u find the notes beneficial

Thank u

# Overview

- Myocardial infarction
- Time-course of plasma enzyme changes
- Creatine kinase (CK)
- Lactate dehydrogenase (LDH)
- Aspartate aminotransferase (AST)
- Myoglobin
- Cardiac troponins I and T

# Myocardial Infarction

- Myocardial infarction (heart attack) is due to:
  - Restricted blood supply (oxygen) to heart tissue ( ischemia )
- Causes damage to heart tissue (infarction)
- Infarction causes the release enzymes and other proteins into the blood (markers)

## ❖ Markers of diagnostic value in MI:

- Creatine Kinase (CK)
- Aspartate aminotransferase (AST)
- Lactate dehydrogenase (LDH)
- Myoglobin
- Cardiac troponins I and T

- these biochemical markers of MI have a diagnostic value, and they are elevated in MI case.

# Time-course of enzyme changes

❖ Plasma enzymes follow a pattern of activities after a MI

❖ The initial lag phase lasts for about 3 hours

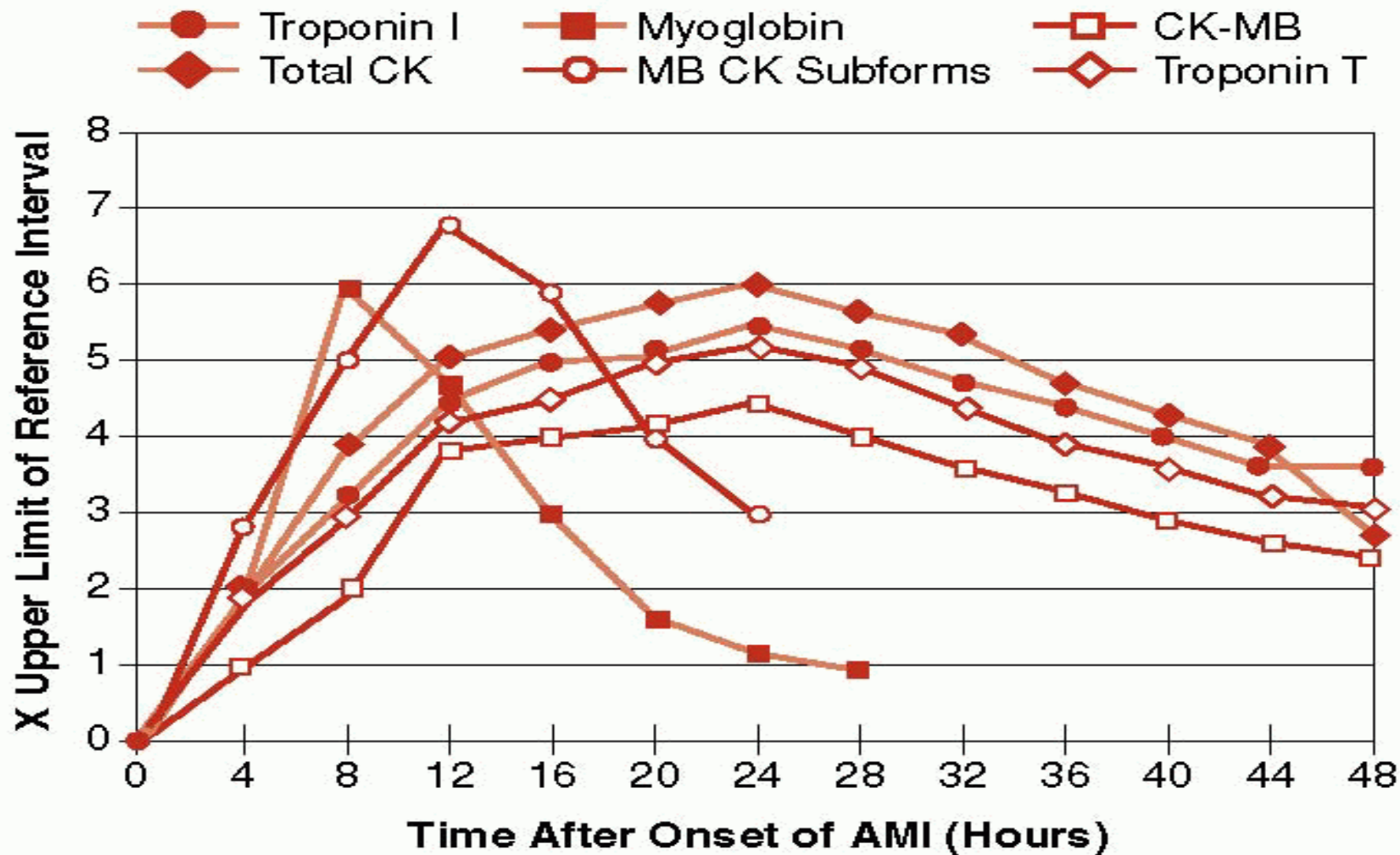
\* the initial lag phase means the time required of the antibodies to be occurred after the angina . ( the period between the onset of MI & the appearance of the markers. during this period, there is minimum of certain markers or no activity).  
i.e. CK-MB needs 3hrs at least to appears.

Enzymes rise rapidly to peak levels in 18-36 hours

❖ The levels return to normal based on enzyme half-life

❖ Rapid rise and fall indicates diagnostic value

- in microbiology, the lag phase refers to "The initial growth phase, during which cell number remains relatively constant prior to rapid growth."



- Blood samples collected at:

- \* Baseline (upon admission)

if the baseline was high, then we have to do further investigation.

- \* Between 12 to 24 hours after the onset of symptoms

Clinically,

- we have to do CK-MB & Troponine in Emergency cases because they start early. Myoglobin sometimes.

- ECG or the markers alone are not accurate, but if combined together, they become a more accurate diagnostic tool.



# Plasma enzyme changes

**\*Very Imp**

Enzyme	Detectable (hours)	Peak value (hours)	Duration (days)
CK-MB	3-10	12-24	1.5-3
Total CK	5-12	18-30	2-5
AST	6-12	20-30	2-6
LDH	8-16	30-48	5-14
(heart specific)			
<b>* it appears at the end, so it wouldn't benefit us to detect the angina early</b>			
Cardiac troponins	3-4	~ 48	Upto 10

# Creatine Kinase (CK)

- Three main CK isoenzymes comprising two polypeptide chains B or M
  - Skeletal Muscle: 98% CK-MM; 2% CK-MB
  - Elevated in muscle disease
  - Cardiac muscle: 70-80% CK-MM; 20-30% CK-MB
  - Cardiac muscle has highest amount of CK-MB
  - Brain: CK-BB
  - Plasma: Mainly CK-MM

# CK-MB

❖ CK-MB is more sensitive and specific for MI than total CK

❖ Not a first-line test for MI:

- It rises and falls transiently after MI
- Methods to detect CK-MB are not reliable
- It appears in high amounts in muscle disease

dr.Rana said the methods to detect CK-MB are reliable

&

CK-MB is the first line after Troponine because it is sensitive to MI

# CK-MB

- ❖ In some situations it is a first-line test if:
  - Very early evidence of infarction is required
  - Post-operative patients suspected for MI
  - Patients suspected of having a second infarct
- ❖ CK-MB is suitable for the late diagnosis of MI (within 48 hours)

# Lactate dehydrogenase (LDH)

- LDH increases within 6-12 h of MI
- Reaches a max. level in 48 h
- Remains elevated for 5-14 days after the MI
- A non-specific marker of tissue injury:
  - \* High levels are found in liver, lung, kidney and other diseases

# Aspartate aminotransferase (AST)

- AST is somewhat heart-specific than ALT
- A non-specific marker of MI
- It appears in liver and other diseases

# Myoglobin

- Myoglobin is a sensitive marker of cardiac damage
- It rises very rapidly after the MI at about the same rate as CK-MB
- It is non-specific because it is also raised after muscle damage

# Troponins (cTn)

(not an enzyme,)

- Troponins are structural proteins in cardiac myocytes and in skeletal muscle
- They are involved in interaction between actin and myosin for contraction
- Troponins are also present in cytosol of cardiac myocytes
- Two main cardiac troponins:
  - cTnI
  - cTnT

Troponins is the global standard to detect MI, because there is a Lap. Method specific to measure the cardiac troponin only without skeletal muscle troponin .



- cTn are structurally different than muscle troponins

it is the best indicator because of :

- Highly specific markers of detecting MI.
- Appears in plasma in 3-4 h after the MI.
- Remains elevated for upto 10 days (long half-life).

Explanation.

Why Troponines remains elevated till the 10<sup>th</sup> day ?

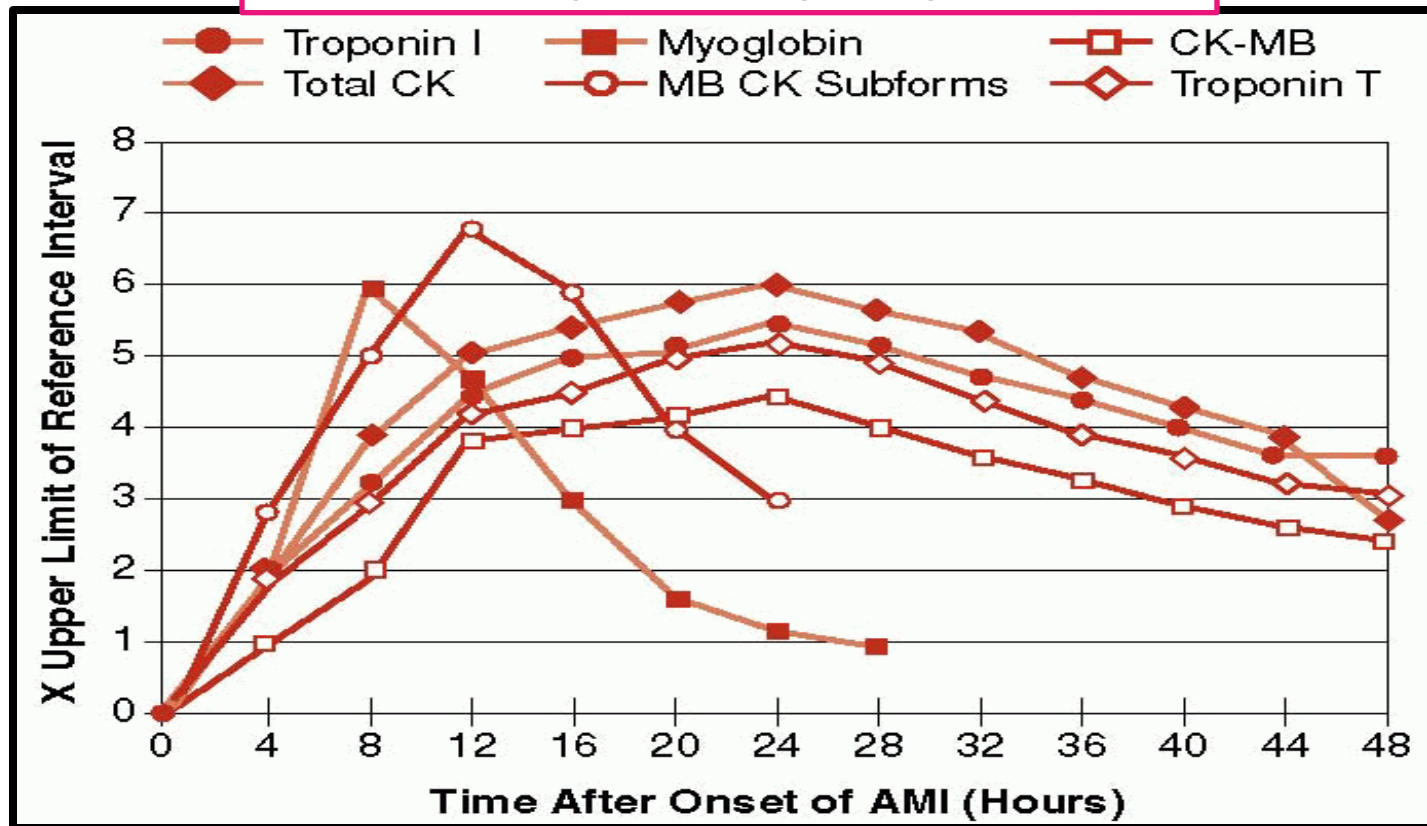
Firstly, there are two types of cardiac troponines,

- structurally bound ( represent 97% of cardiac troponines )
- Free Troponines or cytosolic ( 3% )

after MI, the free troponine starts in the first few hours, then the structurally bound troponines are released for several days .

That's why make Troponines longer than CK-MB.

- all the biochemical markers (in the chart)  
are enzymes except Troponin



- the cytosolic (soluble) troponin appears first in the plasma, then the structurally bound troponin is slowly released.  
in the chart, the rise or the "bulge" in the beginning of the line course represents the cytosolic troponin increased levels in plasma. then the almost straight steady line that comes after, represents the release of the structurally bound troponin

- MI can be diagnosed several days after the onset of chest pain
- CK-MB returns to normal level in 48 h after the onset of chest pain
- cTn are highly specific to heart muscle damage
- They remain elevated in plasma longer than CK-MB
- They have higher sensitivity and specificity than CK-MB
- It is measured in combination with myoglobin and CK-MB

Thank You

😊 Good Luck 😊

Biochemistry Team