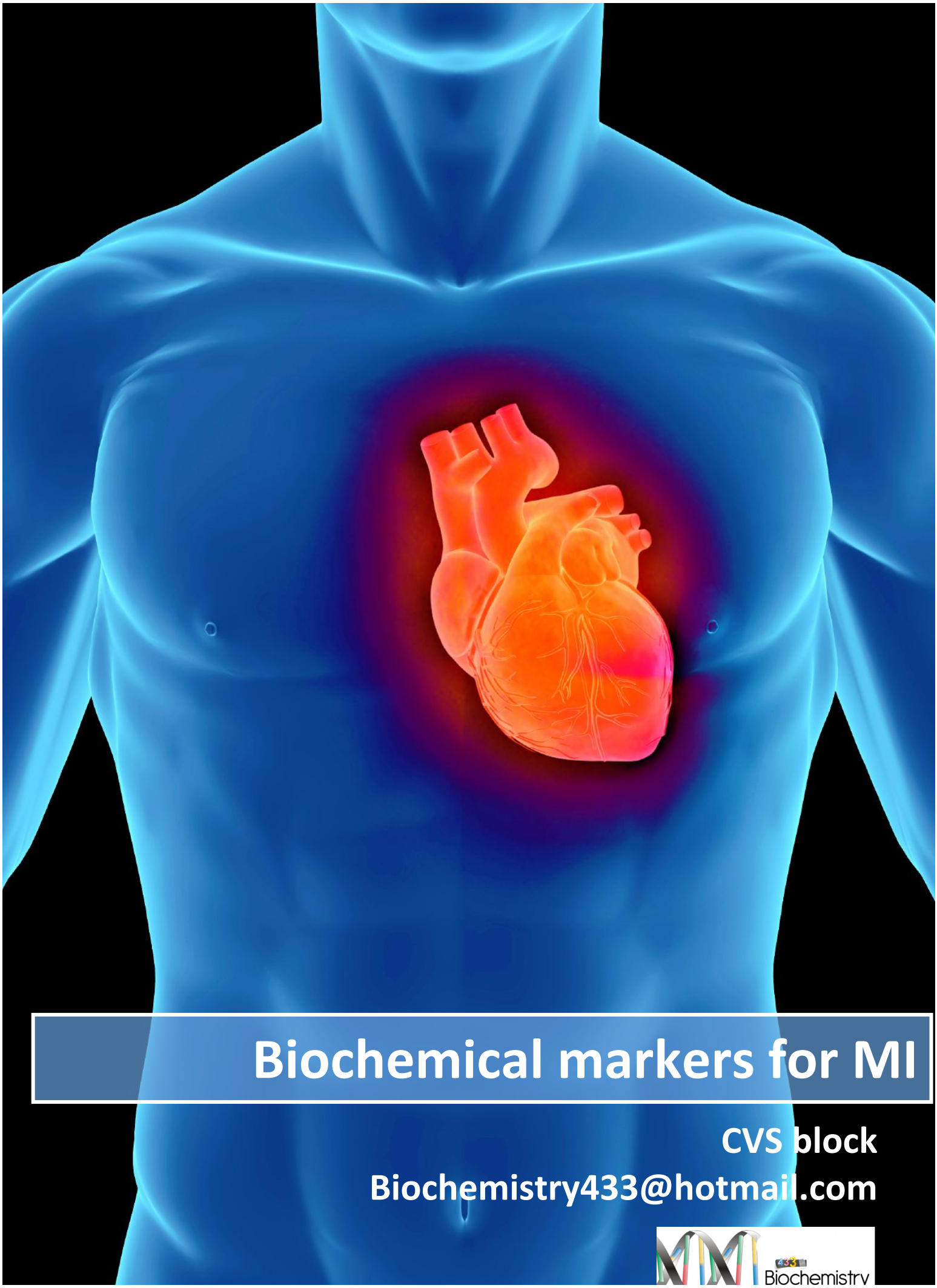

Biochemical markers for MI

CVS block

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Biochemistry

OVERVIEW OF MYOCARDIAL INFARCTION (IM)

Myocardial infarction is due to: Occlusion of coronary arteries → Restricted blood supply (oxygen) to heart tissue (ischemia) → Damage to heart tissue (infarction) → Release of enzymes and other proteins into the blood (markers)

HOW TO DIGNOSE MI ?

- Recommended by the European Society of Cardiology and American College of Cardiology
- Requires presence of at least two of the following characteristics:
  1. Typical heart attack symptoms (Pain in chest, sweating etc.)
  2. Characteristic rise and fall pattern of a cardiac marker in plasma
     - Rise and gradual fall of cardiac troponins
     - More rapid rise and fall of creatine kinase MB
  3. Typical ECG pattern

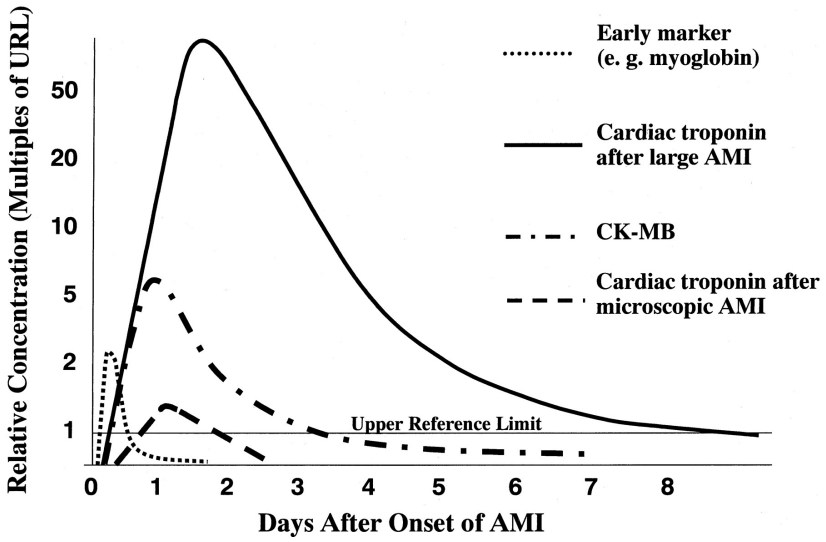
FEATURES OF AN IDEAL CARDIAC MARKER

- High concentration in the myocardium
- Absence from non-myocardial tissue
- High sensitivity (easily to detect + sensitive to MI) and specificity
- Rapid release into plasma following myocardial injury
- Correlation between plasma level and extent of myocardial injury for prognosis
- Detectable by rapid, simple and automated assay methods

PLASMA MI MARKERS

- OBSOLETE MARKERS
  1. Aspartate Transaminase
  2. Lactate dehydrogenase (LDH) and its isoenzymes
- CURRENT MARKERS
  1. Creatine kinase (CK) and CK-MB
  2. Troponin T
  3. Troponin I
  4. Myoglobin
- MARKERS UNDER ASSESSMENT (with potential for clinical use)
  1. CK-MB isoforms
  2. High sensitivity c-reactive protein (CRP)
  3. B-type natriuretic peptide

CK-MB + Troponin + myoglobin + B-type natriuretic peptide are the most used for diagnosis of MI



TIME-COURSE OF PLASMA ENZYME CHANGES

- Plasma enzymes follow a pattern of activities after MI
- The initial lag phase* lasts for about 3 hours
- 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

1- TROPONINS

Troponins are structural proteins in cardiac myocytes and in skeletal muscleInvolved in the interaction between actin and myosin for contraction

cTn are mainly bound to proteins, with small amount soluble in the cytosol

Two main cardiac troponins (cTn):

cTnI: inhibitory protein

cTnT: binds to tropomyosin

cTn are structurally different from muscle troponins

Highly specific markers for detecting MI, Appear in plasma in 3-4 h after MI

& Remain elevated for up to 10 days

After a MI, cytosolic troponins are released rapidly into the blood (first few hours)

Structurally bound troponins are released later for several days

2- CREATINE KINASE (CK)

CK-MB is more sensitive and specific for MI than total CK (will be dicussed)

It rises and falls transiently after MI

Appears in blood within 4-6 hours of heart attack and its peak 12 - 24 hours

Returns to normal within 2-3 days

Relative index = CK-MB mass / Total CK x 100. More than 5 % is indicative for MI

Useful for early diagnosis of MI and in re-infarction condition

Not highly specific (elevated in skeletal muscle damage)

Not significant if measured after 2 days of MI (delayed admission)

Three main CK isoenzymes with two polypeptide chains B or M

Type	Composition	Comment
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	

Enzyme / Protein	Detectable (hours)	Peak value (hours)	Duration (days)
CK-MB	3-10	12-24	1.5-3
Total CK	5-12	18-30	2-5
Cardiac troponins	3-4	~48	Up to 10

3- MYOGLOBIN

- Myoglobin is a sensitive marker of cardiac damage
- Appears in blood earlier than other markers (within 1-4 hours)
- It rises very rapidly after the MI at about the same rate as CK-MB
- It is non-specific because it is elevated in:
    - Muscle disease/injury
    - Acute and chronic renal failure

4- B-TYPE NATRIURETIC PEPTIDE (BNP)

- BNP is a peptide hormone produced by the ventricles of the heart in response to: Myocardial stretching and ventricular dysfunction after MI
- It causes vasodilation, sodium and water excretion and reduces blood pressure
- Half-life is ~ 20 min.

MI MARKER RECOMMENDATIONS

- Use of fast and robust test methods for marker detection
- Blood samples collected after MI:
    - Baseline (upon admission)
    - Between 12 and 24 hours after the onset of symptoms

- Types of markers:
    - Early markers (myoglobin)
    - Highly specific markers (cardiac troponins)
    - CK-MB is the second choice after troponins

MCQS

1- Which marker of the following will be released first in circulation after MI?
   a. Structural troponin
   b. Cytosolic troponin

2- A patient has a suspicion of a second attack of myocardial infarction. And he just had an attack 5 days ago. What is the best method to confirm the second infarction?
   a. CK (MB)
   b. CK (MM)
   c. Troponin

3- Overall what is the most specific biochemical marker for MI?
   a. CK-MB
   b. CK-MM
   c. Troponin I&T
   d. BNP

Ans: 1-B 2-A 3-C

Biochemistry Team

MED 433 Teams