Cardiac Biomarkers : Troponins,Creatinine Kinase Myoglobin...

Cardiac biomarkers are substances released into the bloodstream in response to **myocardial injury** , making them essential tools for:

- Diagnosing **acute coronary syndrome (ACS)** including **acute myocardial infarction (AMI)** .
- Risk stratification and prognosis.
- Monitoring recurrence or response to treatment.

? Obsolete Markers

Older enzymes like **AST** , **LDH** , and its isoenzymes are no longer preferred due to:

- **Low specificity** for cardiac tissue.
- **Delayed elevation** , limiting early diagnosis.

? Creatine Kinase (CK) and CK-MB

Total CK

- Found in **skeletal muscle, cardiac muscle, brain** , and other tissues.
- Lacks specificity for cardiac injury.
- Elevated in trauma, seizures, hyperthyroidism, and renal insufficiency.

CK-MB (Creatine Kinase–Myocardial Band)

- More specific for **cardiac muscle** .
- **Time course** :
  - Rises: 4–6 hours post-infarct.
  - Peaks: 12–24 hours.
  - Normalizes: 2–3 days.
- **Used for** :
  - **Early diagnosis** of AMI.
  - **Detection of reinfarction** if troponin remains elevated.
  - Less commonly used today due to troponin superiority.

CK-MB Subforms

- **CK-MB2** (tissue-specific) vs **CK-MB1** (plasma).
- Ratio **CK-MB2/CK-MB1 >1** suggests myocardial infarction.
- Not routinely used due to complex lab processing.

CK-MB/CK Relative Index

- Formula: **(CK-MB / Total CK) × 100**
- Interpretation:
  - **<3** ? Skeletal muscle source.
  - **>5** ? Cardiac source.
  - **3–5** ? Indeterminate zone.
- Only useful if **both CK and CK-MB are elevated** .
- **Do not use alone** to diagnose MI.

? Cardiac Troponins (cTnI, cTnT)

Overview

- Regulatory proteins in cardiac and skeletal muscle; only **TnI and TnT** are cardiac-specific.
- Central to **universal definition of MI** (4th Universal Definition of MI).
- **Preferred biomarkers** for diagnosis of myocardial injury.

Time Course

- Rises: 3–6 hours.
- Peaks: 12–24 hours.
- Persists: up to 7–14 days.

Troponin T vs I

- Both have **high sensitivity and specificity** .
- **Troponin T** may be elevated in **renal failure** , **polymyositis** , and **dermatomyositis** —not always due to MI.

Clinical Uses

- **Elevated troponin only** : Minor myocardial injury.
- **Elevated CK-MB and troponin** : Likely full-blown AMI.
- **Late markers** : Elevated for up to 2 weeks.

Reference Ranges

- Determined by:
  - **99th percentile** of healthy population.
  - **Coefficient of variation (CV)** <10% at decision cutoff point.

? Myoglobin

- **Earliest marker** : Rises in 2–4 hours, peaks at 6–12 hours, normal in 24–36 hours.
- **High negative predictive value** early on.
- **Not specific** for cardiac muscle ? limited diagnostic utility.

? Cardiac Biomarker Testing Strategies

Recommended ACS Testing Approaches :

1. **Single test** (CK-MB or Troponin) **8–12 hours** after symptom onset.
2. **Serial testing** :
    - Baseline and repeat at 90 minutes: Myoglobin + CK-MB or Troponin I.
    - 2-hour delta testing: Compare changes in CK-MB and Troponin I from baseline.
3. **Repeat troponin** at 6–12 hours post-admission for confirmation.

? Other Emerging/Adjunct Cardiac Biomarkers

1. B-type Natriuretic Peptide (BNP)

- Released in response to **ventricular wall stress** .
- Useful in diagnosing **heart failure** , not MI.
- May aid in risk stratification in ACS.

2. C-Reactive Protein (CRP)

- **Inflammatory marker** .
- Elevated levels predict future **cardiac events** .
- Linked to **atherosclerosis progression** and plaque instability.

3. Myeloperoxidase (MPO)

- Released by **activated neutrophils** .
- Promotes **oxidized lipid formation** , **vasoconstriction** , and **plaque rupture** .
- Potential early marker for **vulnerable plaques** before ACS develops.

4. Ischemia-Modified Albumin (IMA)

- Produced when **albumin interacts with ischemic cardiac tissue** .
- Early but **nonspecific marker** .
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