Done by Razan fawwaz
ربي ييسر امركم ويرزقكم
اعلى العلامات ®®

BIOCHEMICAL MARKERS IN MYOCARDIAL ISCHAEMIA / NECROSIS

CLASSIFICATION OF CARDIAC MARKERS

A. Obsolete Markers

- **Aspartate Aminotransferase (AST)**
- **Total Creatine Kinase (Total CK)**
- **Lactate Dehydrogenase (LDH)**

B. Established Markers

- **Troponin T**
- **Troponin I**
- **CK-MB**
- **Myoglobin**

C. Emerging Markers (ميزو بس انو هي النوع الجديد)

- Micro RNA (miRNA)
- Heart Fatty Acid-Binding Protein (H-FABP)
- Ischemia-Modified Albumin (IMA)
- Glycogen Phosphorylase BB (GPBB)
- Copeptin
- B-type Natriuretic Peptide (BNP)
- Growth Differentiation Factor 15
- Pregnancy-Associated Plasma Protein A

	Description	Kinetics	Best Clinical Use (موقعه الأفضل)
Myoglobin	• O_2-binding heme protein. • Released from both **skeletal and cardiac muscle → NOT cardiac-specific.** • **Rapidly** cleared by kidneys → **not long-term marker.** • Varies with gender, age, physical activity. • **More sensitive than CK & CK-MB**. • Elevated in **skeletal muscle diseases & chronic renal failure.**	• **Rises**: 1–4 h • Detectable in almost all AMI cases: 6–9 h • **Returns** to baseline: 18–24 h **• If myoglobin normal at 8 h → AMI ruled out** • **CK-MB preferred** in patients **presenting > 10–12 h**	• **Earliest marker for MI (super early detection).** • Excellent **rule-out marker if negative at 6–8 h**. • Poor specificity → must be combined with troponin. • **Not useful in late presenters.**
CREATINE KINASE (CK) **CK-MB**	• Regulates high-energy phosphate metabolism. • Cytoplasmic CK is a **dimer (M and/or B subunits):** 1. CK-MM 2. CK-MB 3. CK-BB • **Reaction reversible: creatine ↔ phosphocreatine (PCr).** **CK-MB** • **Highly specific** (**more than total CK but less than troponin I**). • **Old gold standard.**	**CK-MB** • **Rises**: 4–6 h • **Peaks**: 12–24 h • **Returns**: 2–3 days • **Useful for early MI diagnosis** • Useful for **diagnosis of reinfarction** **CK-MB MASS** • **Mass > activity for better specificity.** • **Relative Index = CK-MB mass / CK activity** **If >3 → AMI rather than skeletal damage**	• Detection of **reinfarction** (because it **returns to baseline faster than troponin**). • Useful in **early MI diagnosis.** • **Useful if** troponin unavailable. • **Less specific** than troponin but still helpful.
ASPARTATE TRANSAMINASE (AST)	• **Elevated** in **hepatic congestion** due to right-sided heart failure → ***Non-specific*** • **Rises** in **liver disease**, while **LDH1 remains normal** • **Rarely** of practical value **except** in **late presenters** • **LDH may be helpful because it stays elevated longer**	• **Kinetics similar to CK**	• **Rarely useful today**. • Occasionally in **late presenters, combined with LDH.**

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	Description	Kinetics	Best Clinical Use
LACTATE DEHYDROGENASE (LDH)	• Tetramer enzyme: **LD1 (H4) to LD5 (M4)** • LD1 & LD2 **predominant** in ***heart***	• **Rises** later than CK-MB and CK • **Peaks**: 48 h • **Remains elevated**: 5–6 days • **Non-specific: ↑ in liver, lung, kidney diseases** • **MI → anaerobic metabolism → lactic acid accumulation**	• **Late marker of MI** (useful in patients presenting **days after onset**). • Helpful when troponin **unavailable**. • Used historically to detect **"LDH flip" (LD1 > LD2).**
TROPONIN T	**TROPONIN** • Protein in **skeletal & cardiac muscle** • **Regulates contraction** • **3 subunits**: **I, T, C** • **Troponin C** is **NOT** **heart-specific** • **Cardiac-specific**: **Troponin I & Troponin T**	**TROPONIN T** • **Tropomyosin-binding element** • **Rises**: 6 h • **Peaks**: 72 h • **Remains elevated**: 7–10 days • Elevated also in **chronic renal failure**	Diagnosis of **acute MI** **Late presenters** (remains **elevated long**). **Not perfect** in chronic renal failure.
TROPONIN I	• **Not found** in **healthy individuals (unlike CK-MB)** • **More sensitive** and **specific** than **CK-MB** • **Prognostic** (infarct size correlation) • **Indicates success of reperfusion** • **Two negative results 6 h apart → no AMI** • **Positive troponin without ECG changes = high-risk**	• **Rises**: 4–6 h • **Peaks**: 14–24 h • **Remains elevated:** 3–5 days • **Disappears** after 1 week	• **Best overall cardiac marker** • **More specific** than CK-MB. • Useful for **delayed admission (remains elevated days).** • Good for risk stratification (**prognostic**). • Detects **minor infarctions**.
HEART-TYPE FATTY ACID-BINDING PROTEIN (H-FABP)	• Small cytosolic protein in myocardium • Also in **brain, kidney, skeletal muscle** • **Transports** fatty acids to **mitochondria**, **peroxisomes**, **ER** • Released **VERY early** after **myocyte rupture**	• **Rises**: 30 min • **Peaks**: 6–8 h • **Normal** at ~24 h	• **Very early marker** (even earlier than myoglobin). • Useful in **emergency** departments for **rapid rule-out**. • **Combined with troponin improves early sensitivity.**
COPEPTIN	• C-terminal portion of provasopressin • **Released with vasopressin**	• **Rises within minutes in AMI**	**Ultra-early rule-out** when **combined with troponin.** **Excellent** in **first 1–2 hours when troponin still normal.**
ISCHEMIA-MODIFIED ALBUMIN (IMA)	• Elevated during **ischemia** (not necrosis) • Free radicals modify albumin's N-terminus → decreased metal-binding • **Positive** = **ischemia** • **Negative (with negative troponin + ECG) → 99% NPV for MI** • **Rapidly** cleared • **Not cardiac-specific**	• **Detected:** minutes • **Peaks:** 2–4 h • **Disappears:** 6 h	• **Best marker** for **ischemia** (before necrosis) • Helps detect **unstable angina / early ischemia** • **Negative IMA + negative ECG + negative troponin → 99% rule-out** • ***Not specific for heart*** (any ischemia).