

Notes	Serum Level Behavior	Disease / Condition	Enzyme / Marker
>350 U/L = massive MI; also seen in muscle & liver diseases	Increased	Myocardial infarction, Liver disease	<b>AST (SGOT)</b>
Higher than AST in acute liver diseases; low in alcoholic liver disease	Increased	Liver diseases	<b>ALT (SGPT)</b>
Peaks in 24-30h, normal by 72h; MM in muscle, MB in heart	Increased (early in MI)	MI, muscular dystrophy	<b>CK (CPK)</b>
Specific and sensitive cardiac marker	Increased	Myocardial infarction	<b>CK-MB</b>
TnI: ↑ 3–6h, stays 4–7 days; TnT: ↑ 4–6h, stays up to 24 days	Increased	Myocardial infarction	<b>Troponin I/T</b>
Very sensitive but not specific; ↑ in 1h	Rapidly Increased	MI, muscle injury	<b>Myoglobin</b>
Peaks 2–4 days post-MI, normal in 8–14 days; LDH1↑ in MI	Increased	MI, liver disease, hemolysis, malignancy	<b>LDH</b>
↑ in children, bone growth, pregnancy; liver & bone isoenzymes exist	Increased	Biliary obstruction, bone diseases	<b>ALP</b>
Sensitive for alcohol-induced liver injury	Increased	Liver disease, alcoholism	<b>GGT</b>
Not affected by bone diseases	Increased	Biliary obstruction	<b>5'-Nucleotidase</b>
Also high in semen (used in forensics)	Highly Increased	Prostate cancer	<b>Acid Phosphatase</b>
Early rise in pancreatitis	↑ (>1000 U/L in pancreatitis)	Acute pancreatitis, GI perforation	<b>Amylase</b>
Remains elevated longer than amylase	↑ (up to 2800 U/L)	Acute pancreatitis	<b>Lipase</b>
Highest in Duchenne type	Moderate to High Increase	Muscular dystrophy, dermatomyositis	<b>Aldolase</b>
Tumor marker	Increased	Small cell lung cancer, neuroblastoma	<b>Neuron-specific Enolase</b>
Pseudocholinesterase used in exposure studies	Decreased	Liver dysfunction, organophosphate poisoning	<b>Cholinesterase</b>
Range: 8.6–18.6 U/g Hb	Used for diagnosis	G6PD deficiency, hemolytic anemia	<b>G6PD</b>
Marker of ventricular dysfunction	Increased	Congestive heart failure	<b>BNP</b>
Supplement enzymes	Therapeutic use	Pancreatic insufficiency	<b>Trypsin, Lipase, Amylase</b>
Dissolves clots	Therapeutic use	MI, DVT, pulmonary embolism	<b>Streptokinase / Urokinase</b>
Depletes asparagine in tumor cells	Therapeutic use	Acute lymphoblastic leukemia	<b>Asparaginase</b>
Anti-inflammatory & analgesic agents	Therapeutic use	Inflammation, pain relief	<b>Papain, Chymotrypsin, Serrapeptidase</b>
Proteinase inhibitor	Therapeutic use	Emphysema, deficiency syndromes	<b>Alpha-1 Antitrypsin</b>

## 1. Functional vs. Nonfunctional Plasma Enzymes

Examples	Description	Category
Lipoprotein lipase, pseudocholinesterase, coagulation proenzymes	Enzymes with a physiological role in blood; synthesized and secreted by the liver.	<b>Functional Plasma Enzymes</b>
AST, ALT, LDH (after injury/necrosis)	No known function in blood; released from normal cell turnover or tissue damage.	<b>Nonfunctional Plasma Enzymes</b>

## 2. Enzyme Level Changes in Disease

Mechanisms	Change
- Cell necrosis- Increased membrane permeability- Overproduction- Tumors	<b>Increased Serum Level</b>
- Obstructive jaundice- Renal failure	<b>Impaired Elimination</b>
- Genetic/acquired deficiency- Enzyme inhibition- Cofactor deficiency	<b>Decreased Serum Level</b>

## 3. Enzymes in Myocardial Infarction (MI)

Notes	Return to Normal	Peak	Time of Rise	Enzyme / Marker
Early sensitive indicator	2–4 days	24–30 hours	3–6 hours	<b>CPK (CK)</b>
Levels >350 = massive infarction	3–5 days	24+ hours	~12 hours	<b>AST</b>
Rises later; helps confirm older infarction	8–14 days	48 hours	12–24 hours	<b>LDH</b>
Highly specific & sensitive	4–7 days	1–24 hours	3–6 hours	<b>Troponin I</b>
Very long-lasting	Up to 24 days	10–24 hours	4–6 hours	<b>Troponin T</b>
Sensitive but not specific	Rapid	Early	Within 1 hour	<b>Myoglobin</b>

## 4. CK Isoenzymes

Mobility (Electrophoresis)	% in Blood	Tissue Origin	Composition	Isoenzyme
Least	97–100%	Skeletal & heart muscle	M + M	CK-MM
Intermediate	0–3%	Heart muscle	M + B	CK-MB
Most	0%	Brain	B + B	CK-BB

5. LDH Isoenzymes

Electrophoretic Speed	% in Serum	Tissue Origin	Subunit Composition	LDH Type
Fastest	14–26%	Heart	H4	LDH-1
Faster	29–39%	RBCs	H3M1	LDH-2
Fast	20–26%	Brain	H2M2	LDH-3
Slow	8–16%	Liver	H1M3	LDH-4
Slowest	6–16%	Skeletal muscle	M4	LDH-5

6. Liver Enzymes

a. Hepatocellular Injury

Clinical Notes	Origin	Normal Range	Enzyme
↑ in liver/muscle damage	Liver, muscle, brain	8–33 U/L	AST
ALT > AST in hepatitis	Liver (mainly)	4–36 U/L	ALT

b. Cholestasis Markers

Clinical Use	Normal Range	Enzyme
↑ in bile obstruction, bone growth	44–147 U/L	ALP
Alcoholic liver disease marker	5–27 U/L (age <45), 8–38 (age >45)	GGT
↑ in biliary obstruction (not bone)	–	5'-Nucleotidase

7. Bone Disease Enzymes

Diseases	Enzyme
Rickets, osteomalacia, bone cancers	ALP
Prostate cancer with bone metastases	Acid Phosphatase

8. Muscle Disease Enzymes

Disease	Enzyme
Muscular dystrophies, especially Duchenne	Aldolase
Muscular dystrophies, neurogenic types	CPK

## 9. GI Tract Enzymes

Normal Range	Diseases	Enzyme
40–140 U/L	Acute pancreatitis, perforated ulcer, obstruction	Amylase
0–160 U/L	Acute pancreatitis (↑ up to 2800), stays elevated longer	Lipase

## 10. Enzymes as Tumor Markers

Associated Cancer / Condition	Enzyme
Prostate cancer	Acid Phosphatase (ACP)
Bone metastasis, pancreatic head tumor	ALP
Leukemia, advanced cancers	LDH
Bladder cancer	β-Glucuronidase
Liver carcinoma	LAP
Small cell lung cancer, neuroblastoma, etc.	NSE
Prostate cancer (↑ >10 ng/ml)	PSA

## 11. Enzymes as Therapeutic Agents

Use	Enzyme
MI, DVT, embolism	Streptokinase/Urokinase
Pancreatic insufficiency	Trypsin, Amylase, Lipase
Acute lymphoblastic leukemia	Asparaginase
Local anesthesia enhancement	Hyaluronidase
Anti-inflammatory, pain relief	Papain, Chymotrypsin
Emphysema therapy	Alpha-1 Antitrypsin
Anti-inflammatory, pain relief	Serrapeptidase

