Laboratory diagnosis of plasma proteins and plasma enzymes

Functions of plasma proteins

Function:	**Example:**
● transport	thyroxine-binding globuline, *(and other hormon-binding globulines)* apolipoproteins *(cholesterol, triglyceride)* transferrin *(iron)*
● humoral immunity	immunoglobulins
● enzymes	renin, clotting factors, complement proteins
● protease inhibitors	α1-antitrypsin
● maintenance of oncotic pressure	all proteins, particularly albumin
● buffering	all proteins

Causes of changes in total plasma protein concentration

normal range: 60-80 g/l

Increase:

- Protein synthesis ↑:
  hypergammaglobulinemia, paraproteinemia
- Volume of distribution ↓ :
  dehydration
- Artefactual:
  hemoconcentration due to stasis of blood during venepuncture

Decrease:

- Protein synthesis ↓:
  malnutrition, malabsorption, liver disease
- Volume of distribution ↑:
  overhydration, increased capillary permeability
- Excretion ↑, Catabolism ↑:
  protein-losing states, catabolic states

Pathologic changes of plasma proteins

Dysproteinemia: total plasma protein concentration is normal, but the normal ratio of its components is changed
example: acute inflammation, chronic inflammation.

Defectdysproteinemia: total absence of a certain plasma protein

example: lack of albumin, lack of alfa-1 antitrypsin, lack of ceruloplasmin

Paraproteinemia: There is a protein in the plasma, which can not be detected under normal conditions

example: monoclonal gammopathy

Principal plasma proteins

Class:	Protein:
	prealbumin
	albumin
α_1-globulin	α_1-antitrypsin,
	α_1- acid glycoprotein
α_2-globulin	haptoglobins
	α_2-macroglobulin
	ceruloplasmin
	transferrin
β-globulin	low density lipoprotein
	Complement components
γ-globulins	IgG, IgM, IgD, IgE, IgA

Causes of hypoalbuminemia

Decreased synthesis:

- malnutrition
- malabsorption
- liver disease

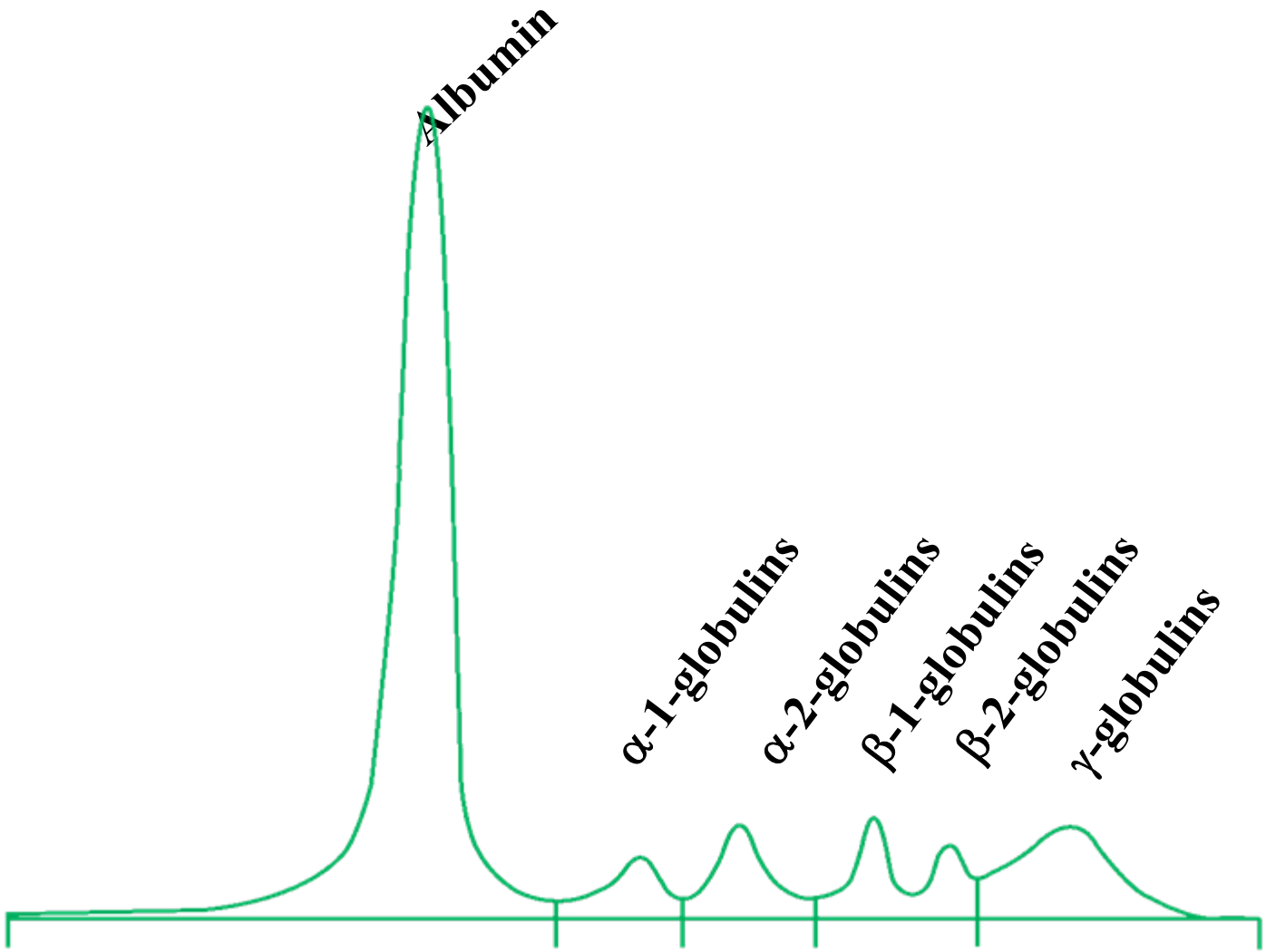
Increased volume of distribution:

- overhydration
- increased capillary permeability: *septicemia, hypoxemia*

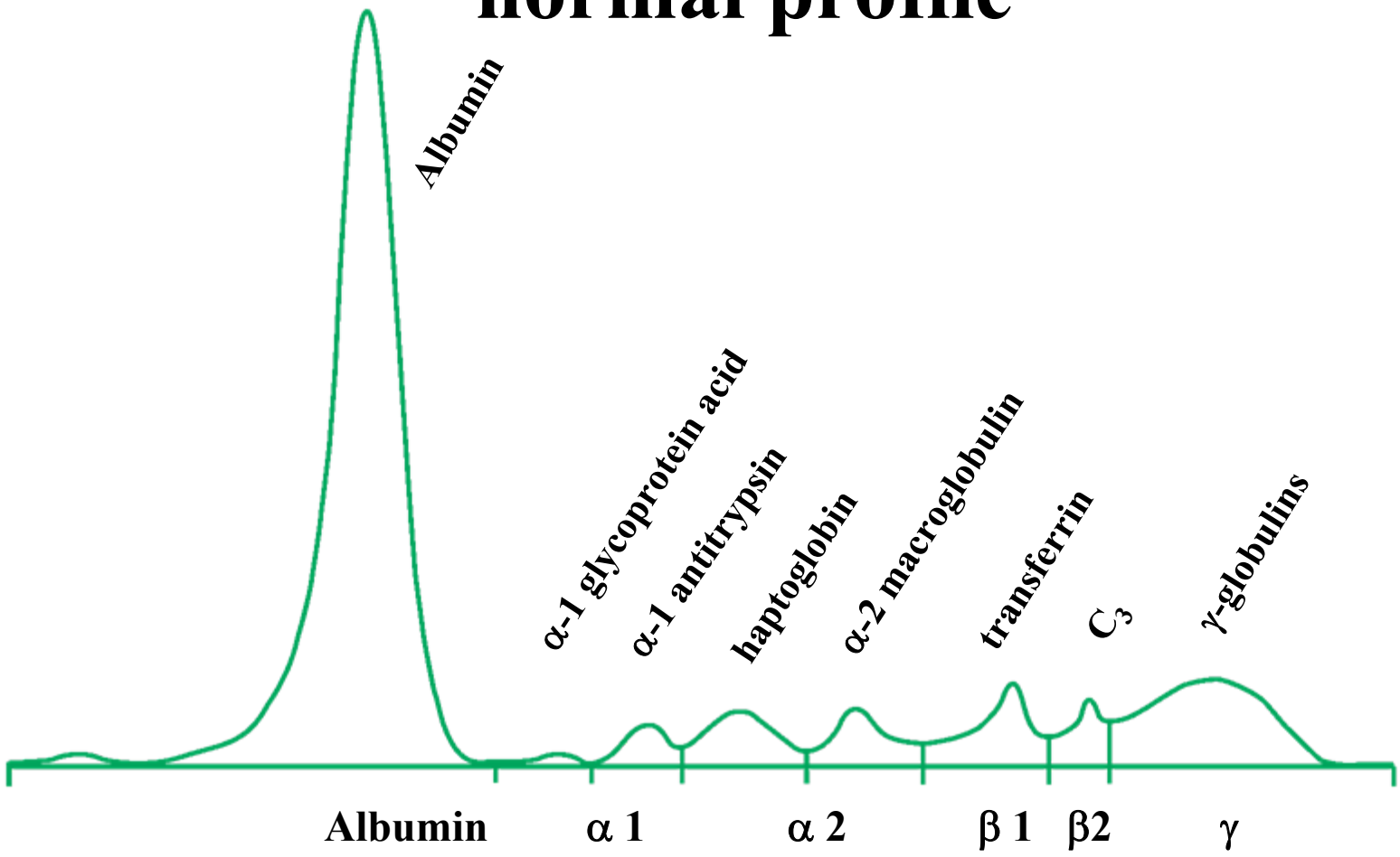
Increased excretion /degradation:

- nephrotic syndrome
- protein-losing enteropathies
- burns
- hemorrhage
- catabolic states: *severe sepsis, fever, trauma, malignant disease*

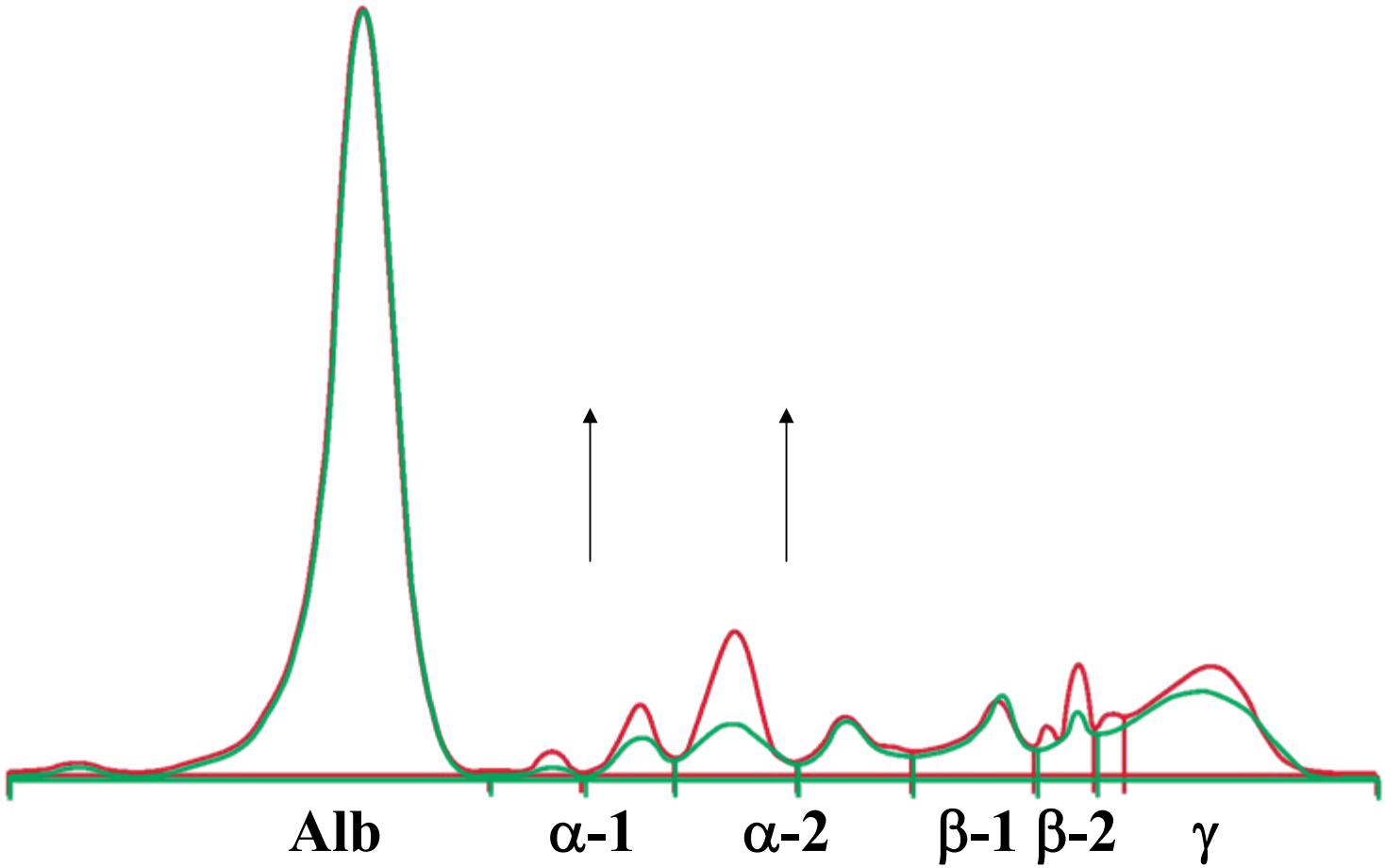
Plasma protein electrophoresis normal profile



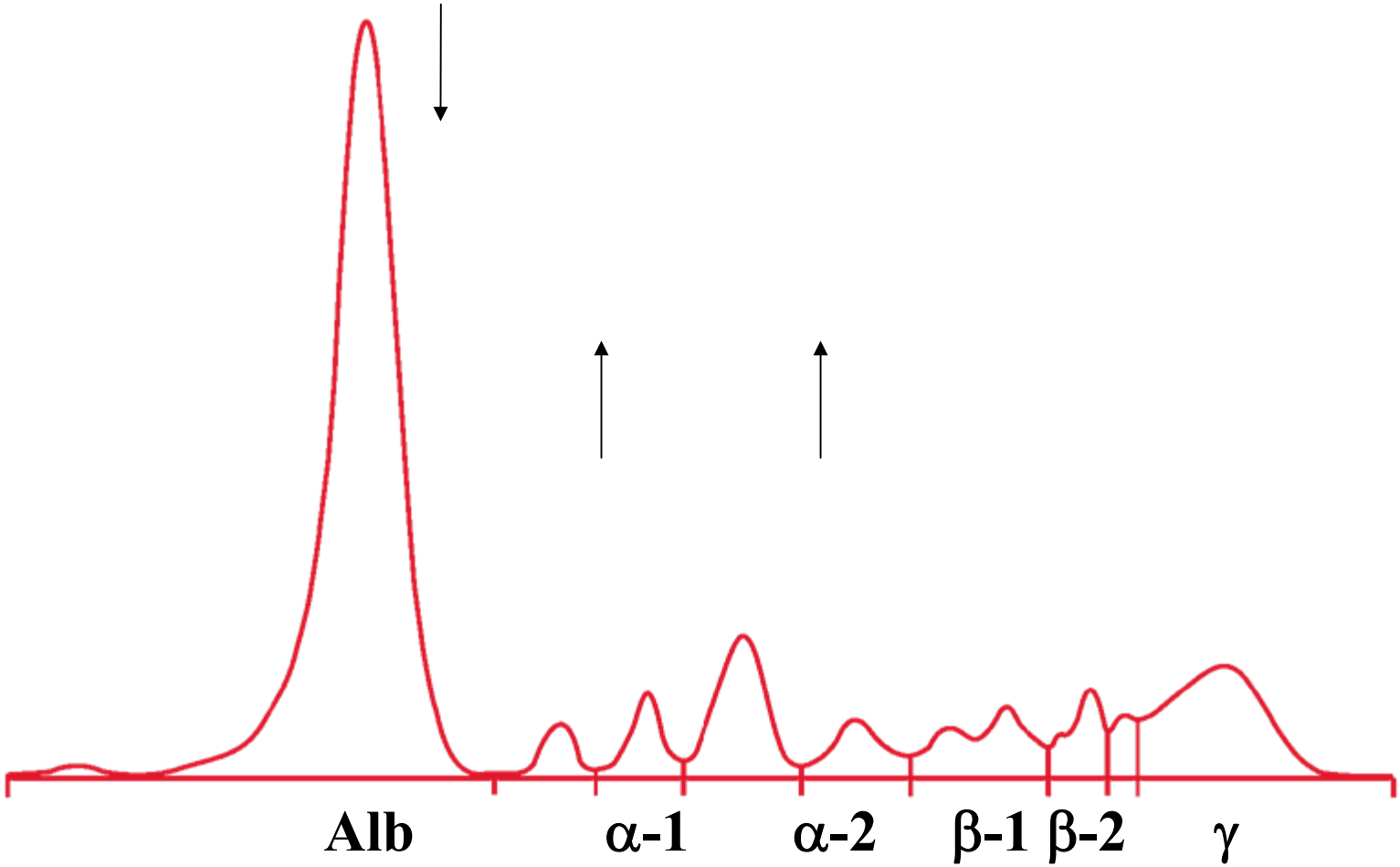
Plasma protein electrophoresis normal profile



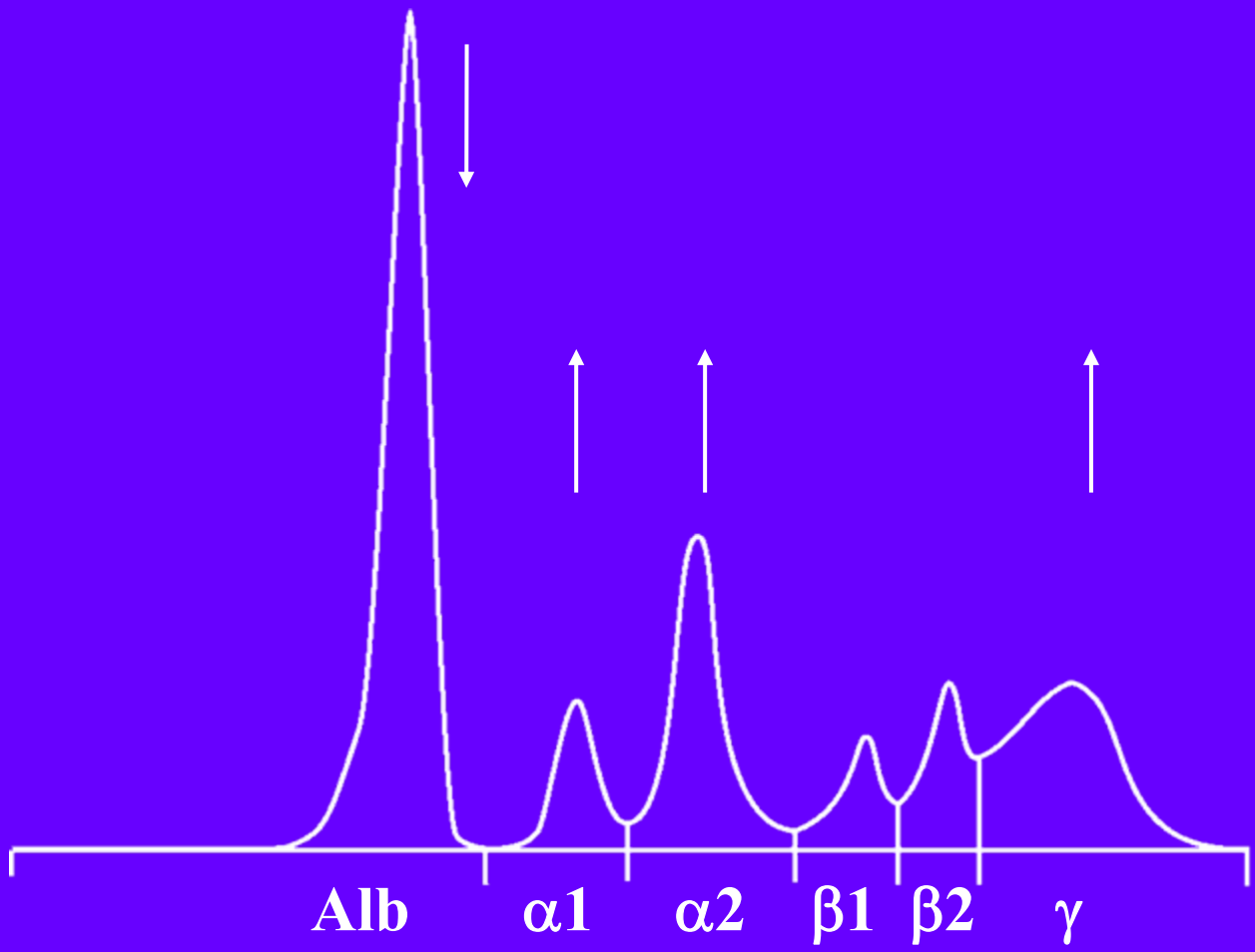
Plasma protein electrophoresis
Acute inflammation



Plasma protein electrophoresis
Acute inflammation



Plasma protein electrophoresis
Chronic inflammation



Laboratory Diagnosis of Inflammattory Diseases

WBC:
qualitativ and quantitativ

Erythrocyte Sedimentation Rate (Westergren):
aspecific

CRP:
rapid and sensitive

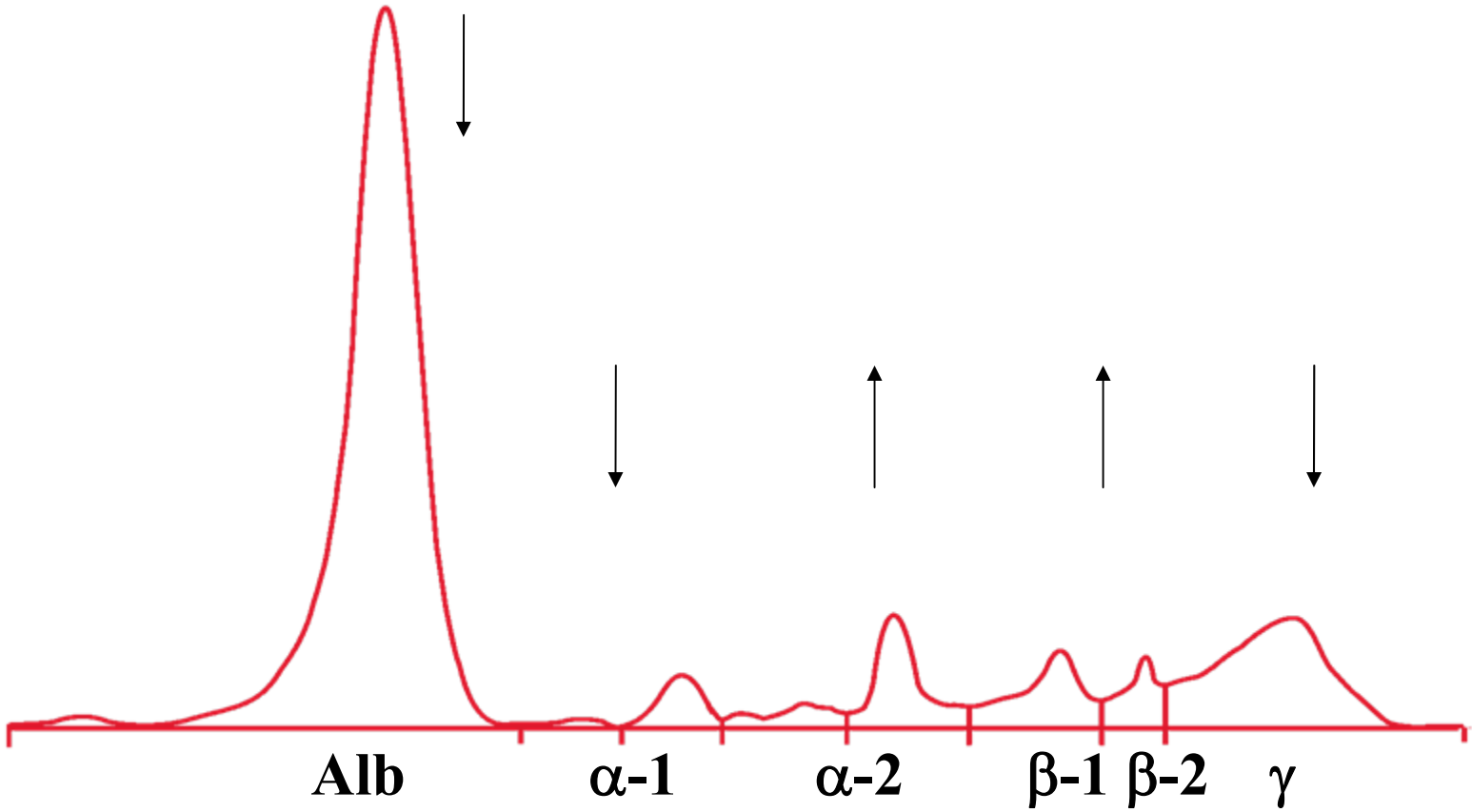
Changes of plasmaproteins:
albumin↓
IgG, IgA, IgM: ↑ A/G ↓
Protein electrophoresis: α_1, α_2 ↑

Acute phase proteins:

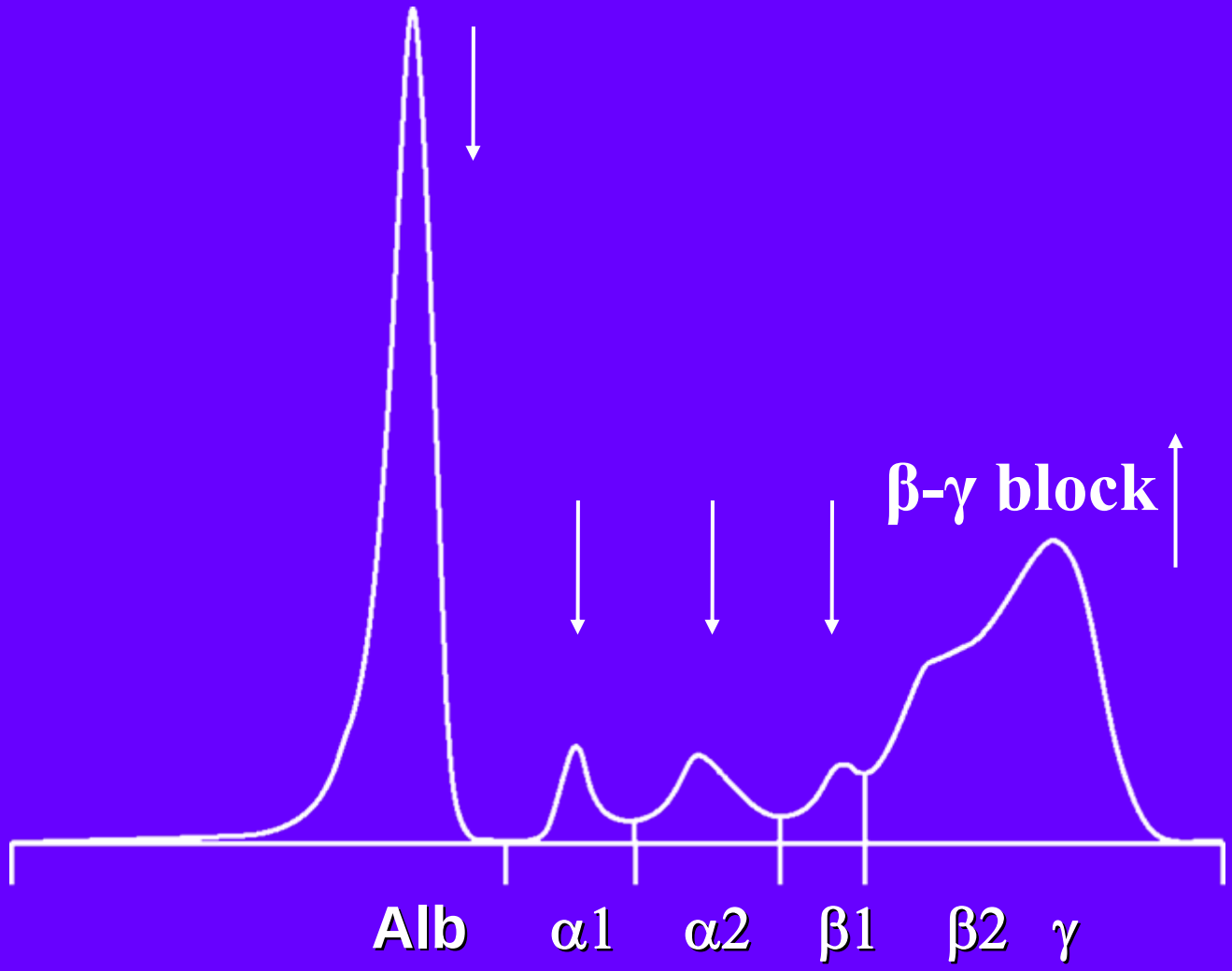
⇧	⇩
α_1-antitrypsin	albumin
fibrinogen	transferrin
haptoglobin	
ceruloplasmin	
CRP	

Procalcitonin: increases in severe bacterial, mycotic and parasitic diseases, also in sepsis

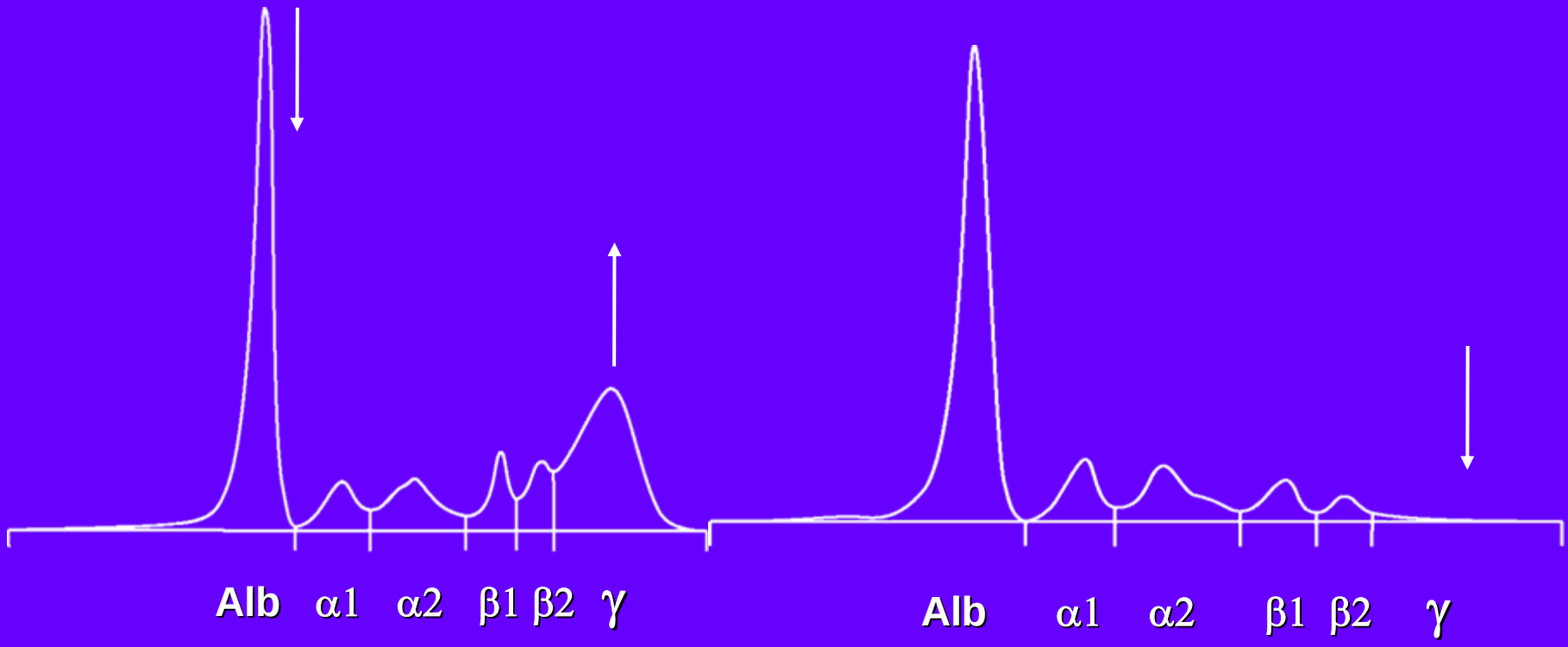
Plasma protein electrophoresis nephrotic syndrome



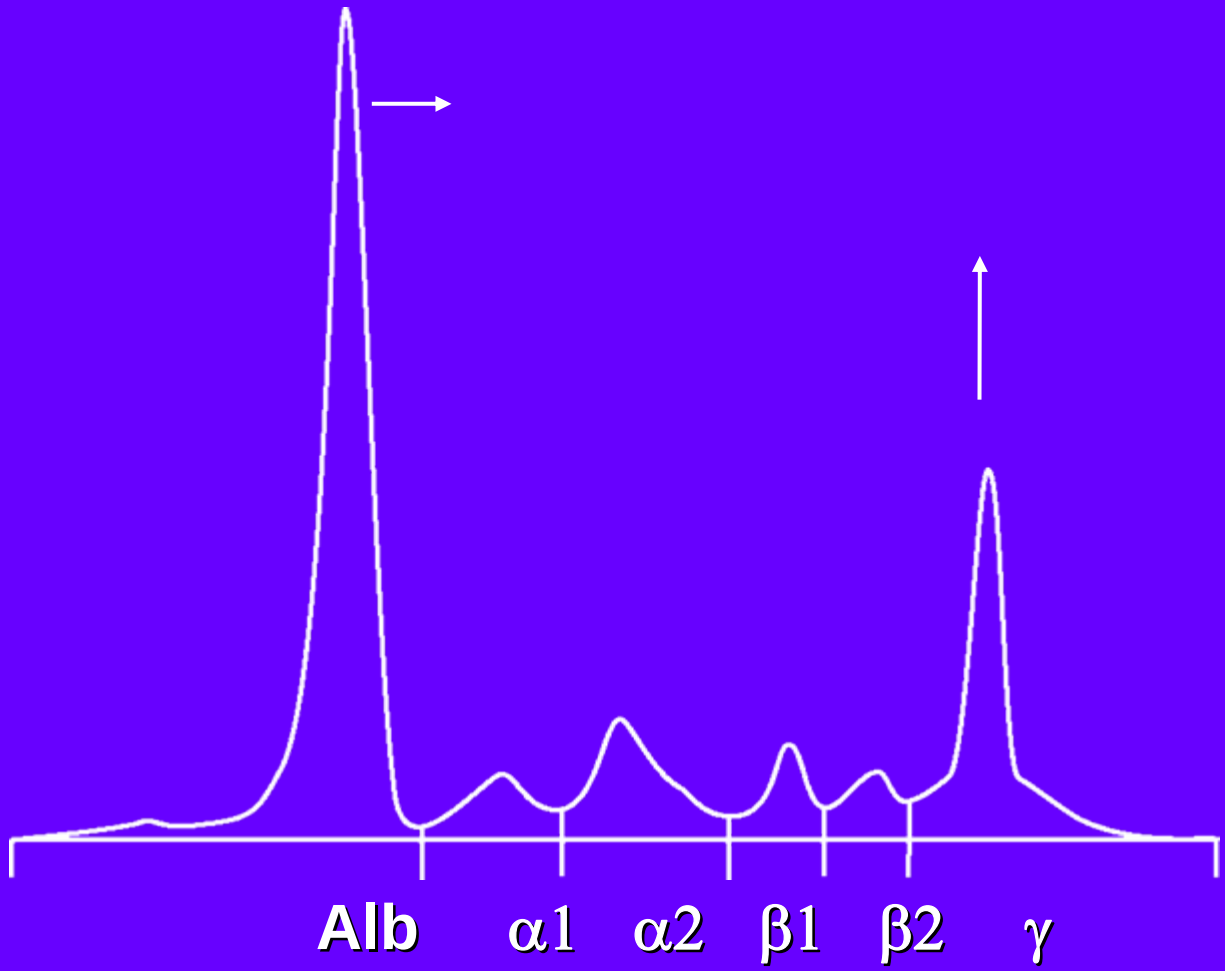
Plasma protein electrophoresis liver cirrhosis



Plasma protein electrophoresis hyper- and hypogammaglobulinemia



Plasma protein electrophoresis monoclonal gammopathy



Laboratory findings in multiple myeloma

Biochemical:

Serum:

- presence of paraprotein
- normal immunoglobulins ↓
- urea ↑
- creatinine ↑
- β_2-microglobulin ↑
- calcium ↑
- urate ↑
- normal alkaline phosphatase activity

Urine:

- presence of Bence-Jones protein

Hematological:

- erythrocyte sedimentation rate ↑
- anemia (usually normochromic, normocytic)
- rouleaux formation

Clinical enzymology
Classification of plasma enzymes

- **Plasma-specific enzymes:**

  clotting factors, elements of complement-system, etc.
- **Exocrin enzymes:**

  amilase, lipase, peptidases etc.
- **Intracellular, non-plasma-specific enzymes:**

  ASAT, ALAT, GGT, ALP, LDH, CK etc.

ISOENZYMES

LDH: 5 isoenzymes:

LDH_1: heart, RBC, renal cortex

LDH_2: heart, RBC, renal cortex

LDH_3: lungs, lymphocytes

LDH_4: liver, skeletal muscle

LDH_5: liver, skeletal muscle

ALP:

intestinal tract

placental origin

non-specific isoforms: bones, liver, kidneys, granulocytes

CK: 3 isoenzymes

CK-BB: central nervous system, intestinal tract
< 1%

CK-MM: skeletal muscle
> 94%

CK-MB: heart
< 6%

Most Important Enzymes in Laboratory Diagnosis I.

AST: mainly from heart, skeletal muscle and liver

ALT: mainly from liver

De Ritis formula:

AST/ALT < 1 injury caused by inflammation

AST/ALT > 1 severe necrotic liver disease

GGT: its clinical importance is monitoring hepatobiliary diseases and alkohol-abuse

ALP: hepatobiliary diseases, bone diseases

Most Important Enzymes in Laboratory Diagnosis II.

Amylase: pancreatic disorders
salivary gland disorders

Lipase: specific for pancreatic disorders