CLINICAL SIGNIFICANCE of Proteins in Blood and urine

Lac.3

By
Dr. Muna M. Yaseen

Objective

1. Type of proteins in blood
2. Clinical Diagnostic & Utility

of Proteins Measurements in blood

3. Causes of Proteinuria

- **Proteins** are Polypeptide group of nutrients in human body. All enzymes, receptors, membrane channels such as those of Na-K, Ca channels, coagulation factors and peptide hormones

(GH, prolactin,...),..., etc. are proteins in nature.

- All proteins are synthesized in the liver, with exception of complement systems

(C1-C9 these are components of immune system synthesized by liver and macrophages), and Immunoglobulin's (Igs) (by plasma cells of immune system).

- Proteins may be linear structural (such as collagen component of connective tissue) or globular functional such as enzymes & peptide hormones.

Amounts of proteins in blood depend on balance:

rate of synthesis ↔ (rate of catabolism + rate of clearance).

However, protein distribution between the Intravascular (IV) and Extra vascular compartments is also important and therefore blood protein concentrations are affected by dehydration & over hydration.

Proteins in blood involved two types:

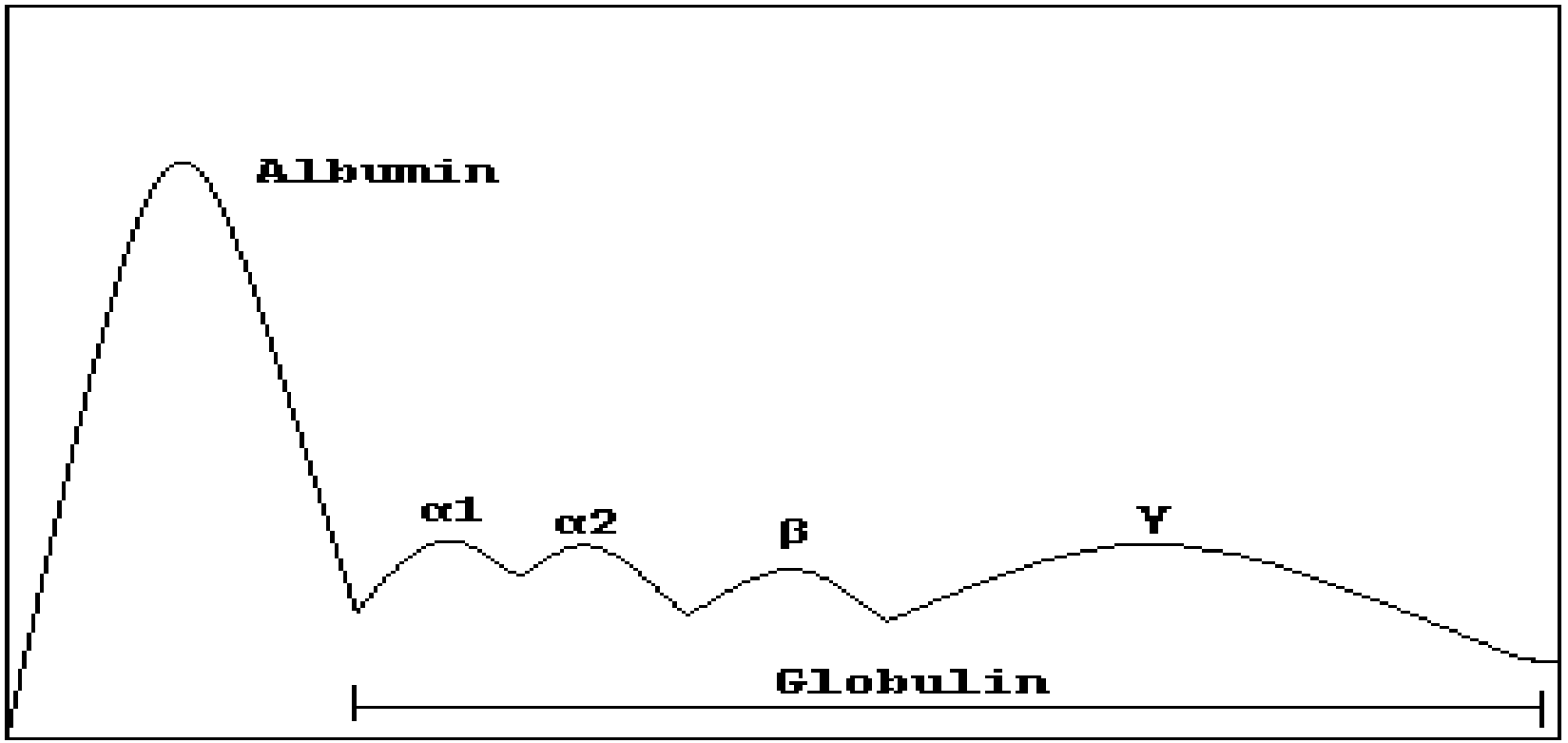
Albumin & total Globulin.

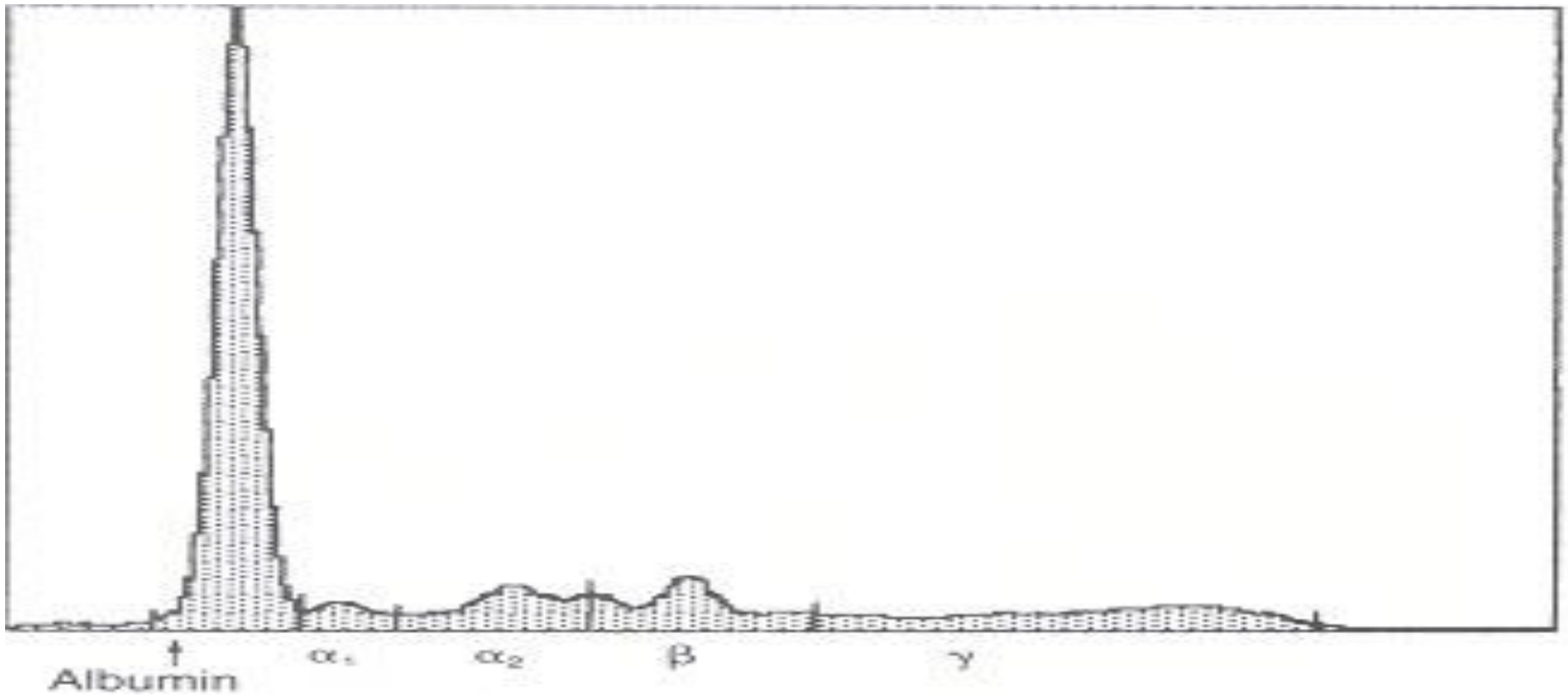
Albumin is the major single protein accounts to 60 % of total serum protein,

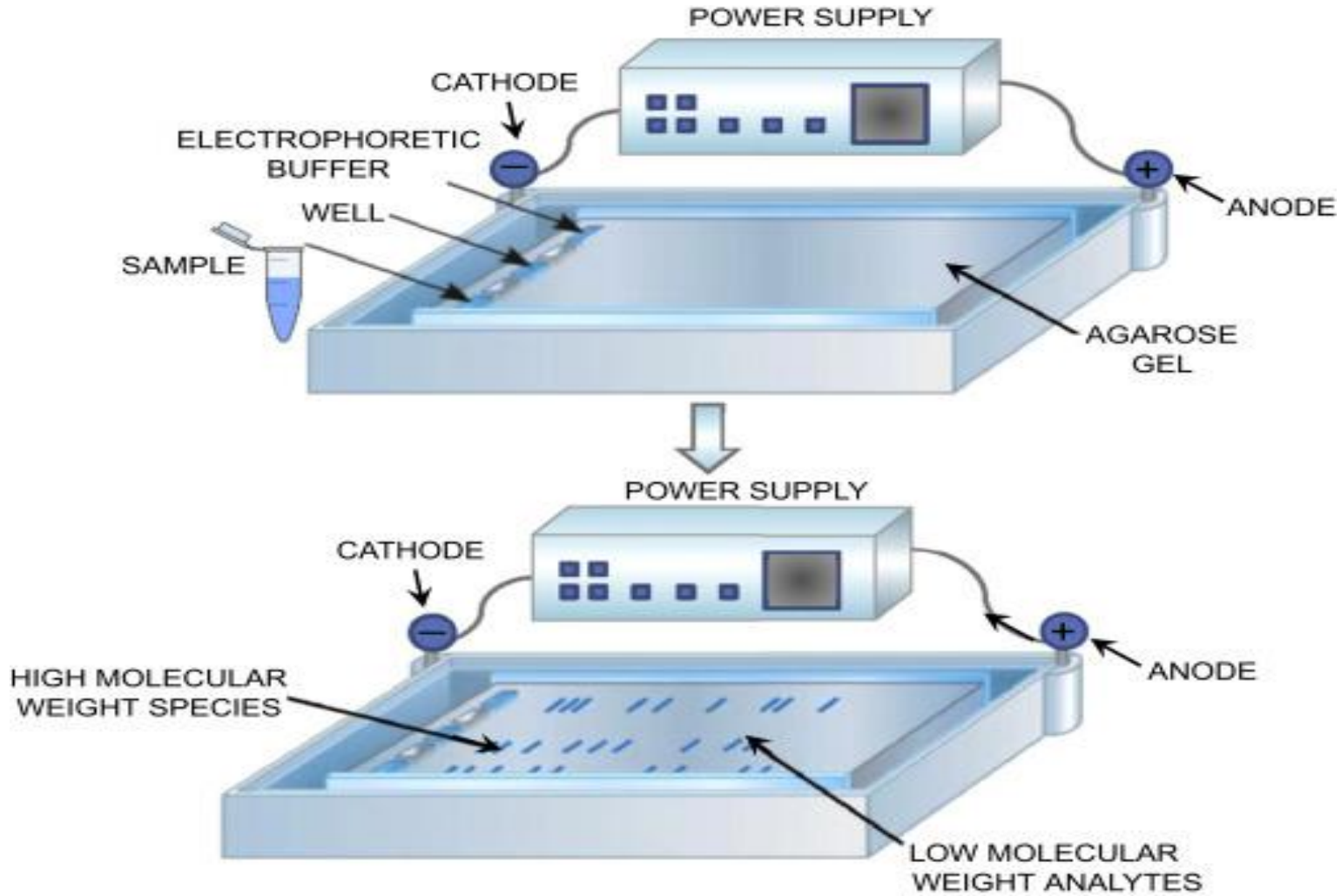
while globulin is consisted of 4-5 fractions**; α 1, α 2, β 1, β 2, and γ globulins**.

These Proteins components are separated by **electrophoresis technique** in which serum is introduced to filter paper in a media of PH 8.6 to make protein which are polar substances negatively charged. Then electrical current is passed into media and the serum proteins are separated **according to their MW and charge intensity** into five–six fractions or bands: **albumin, α1- globulin, α2-globulin, β-globulin (may be β1 & β2), and γ globulin**.

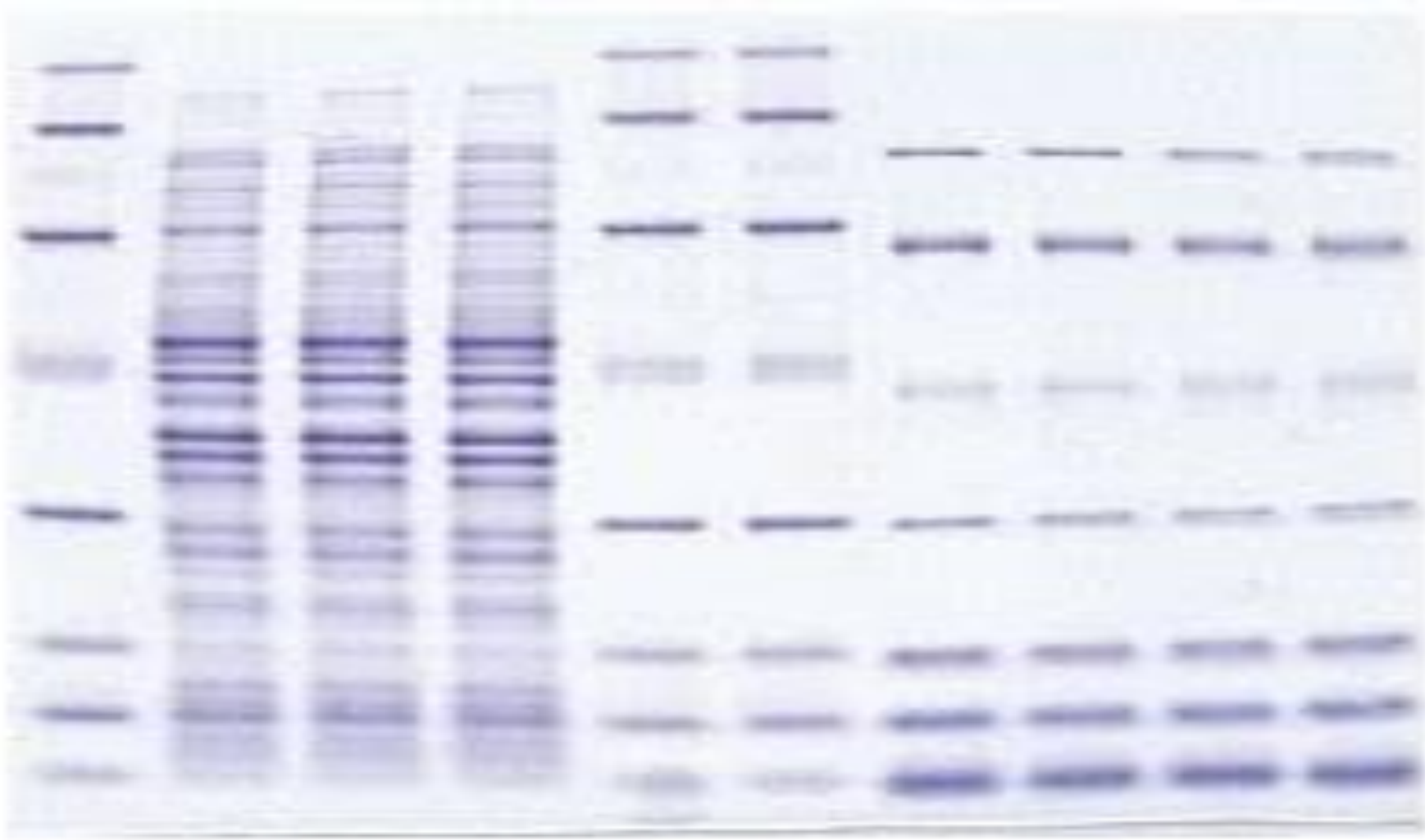
Total Serum Protein=S. albumin + total serum globulin.

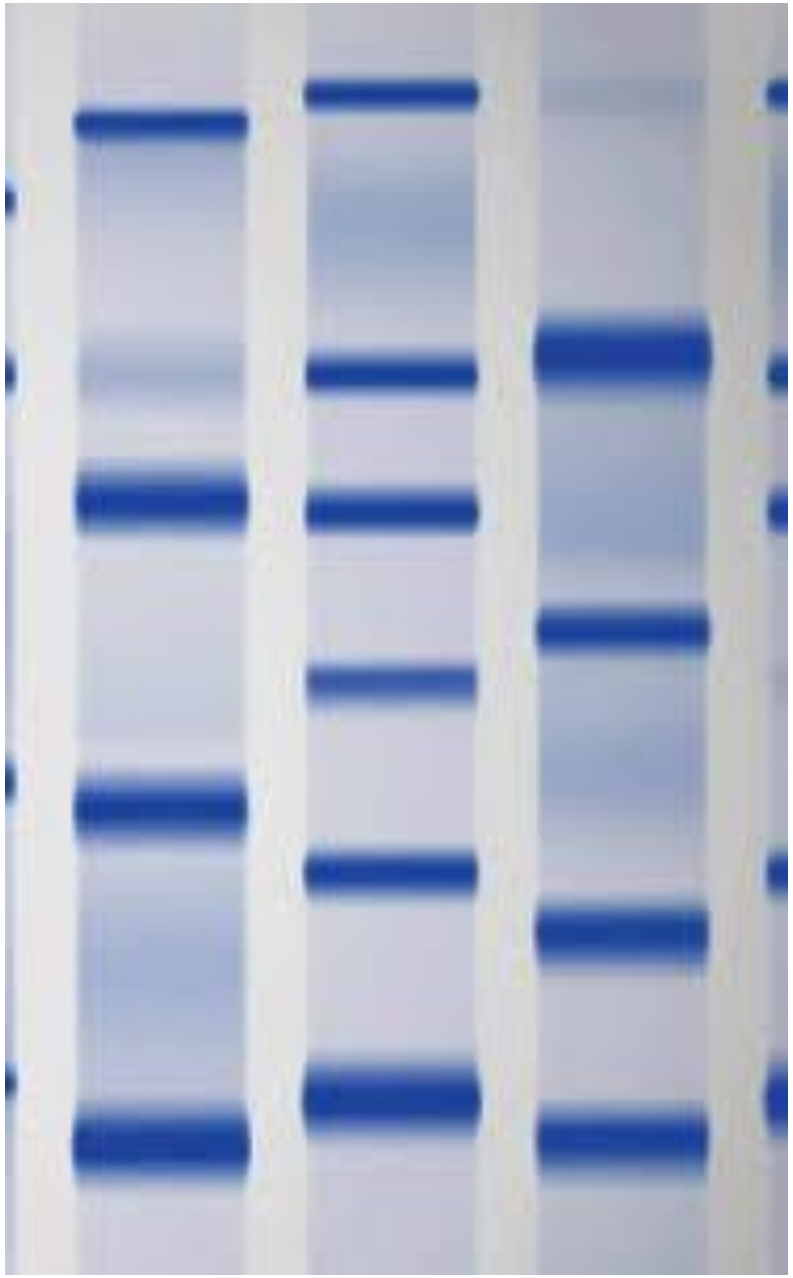

Albumin
α1
α2
β
γ
Globulin

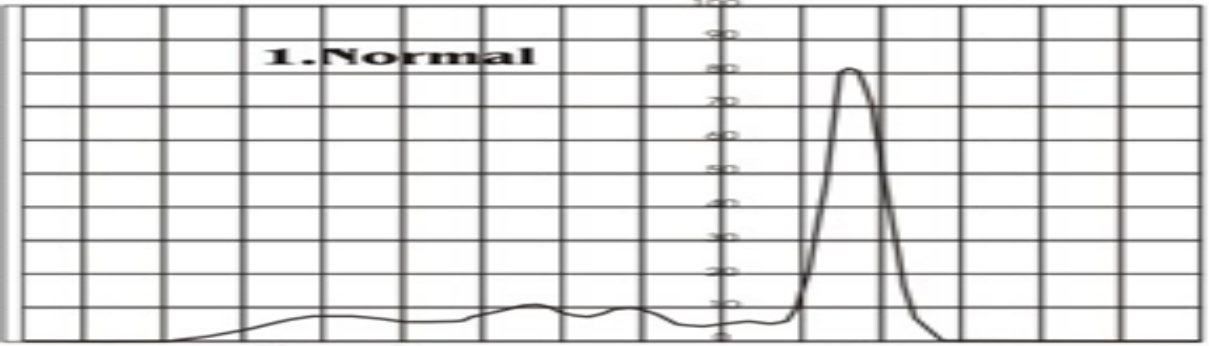

Albumin
α1
α2
β
γ

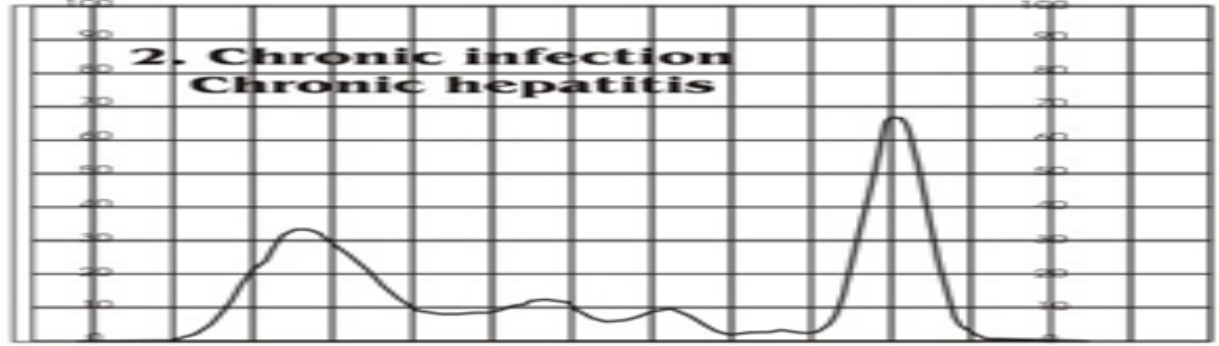

POWER SUPPLY
CATHODE
ELECTROPHORETIC BUFFER
WELL
SAMPLE
ANODE
AGAROSE GEL
POWER SUPPLY
CATHODE
ANODE
HIGH MOLECULAR WEIGHT SPECIES
LOW MOLECULAR WEIGHT ANALYTES

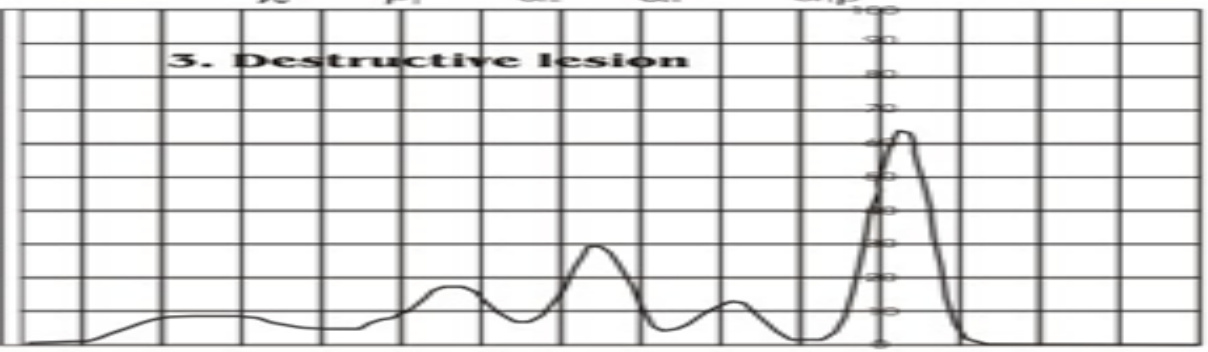

depositphotos

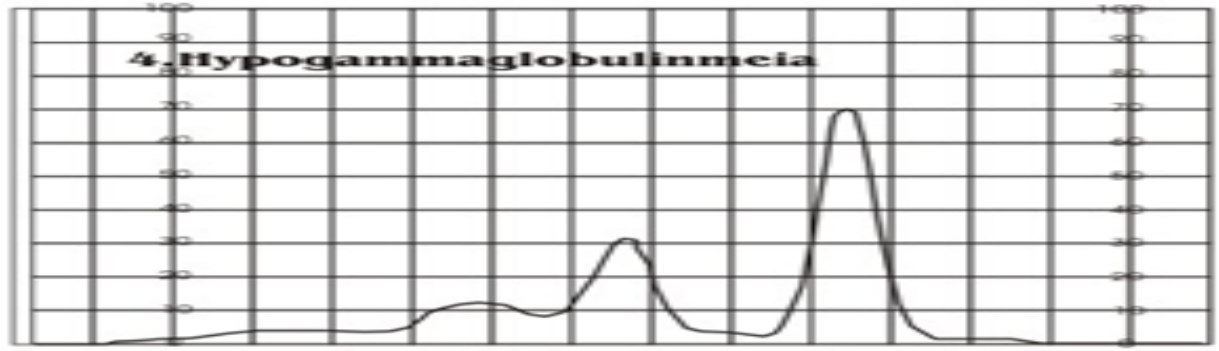


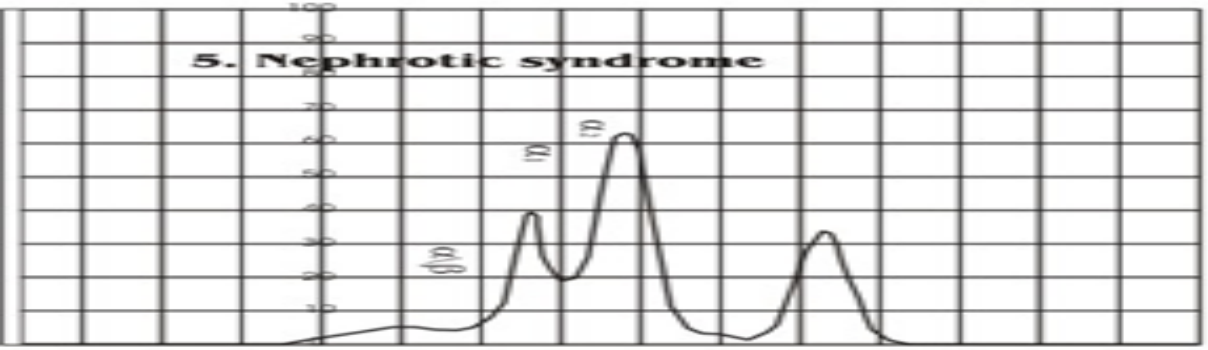


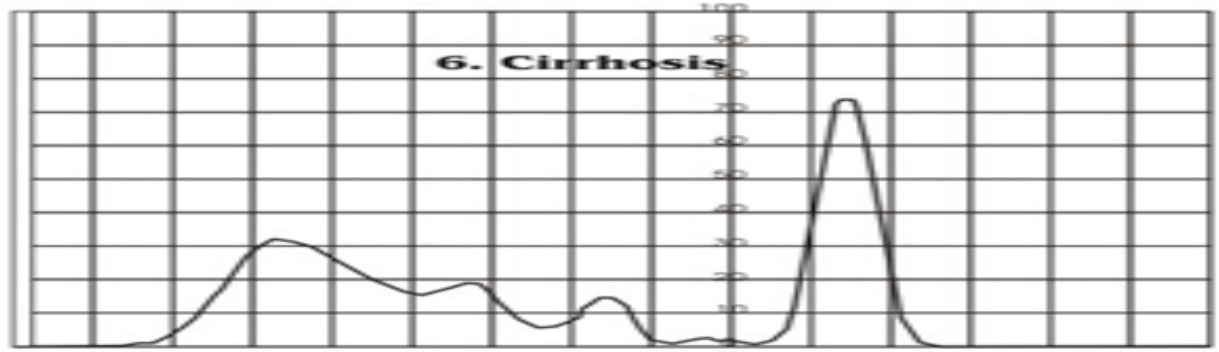

1.Normal
χ
β
α2
α1
α\β

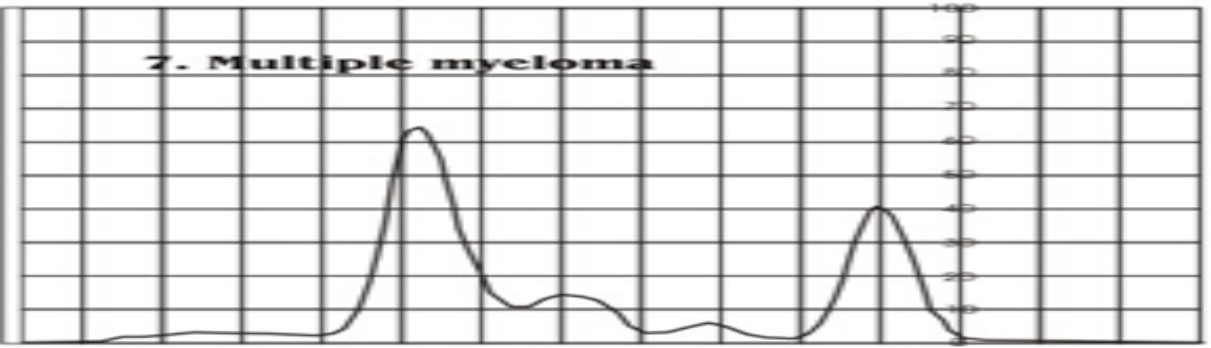

2. Chronic infection
Chronic hepatitis

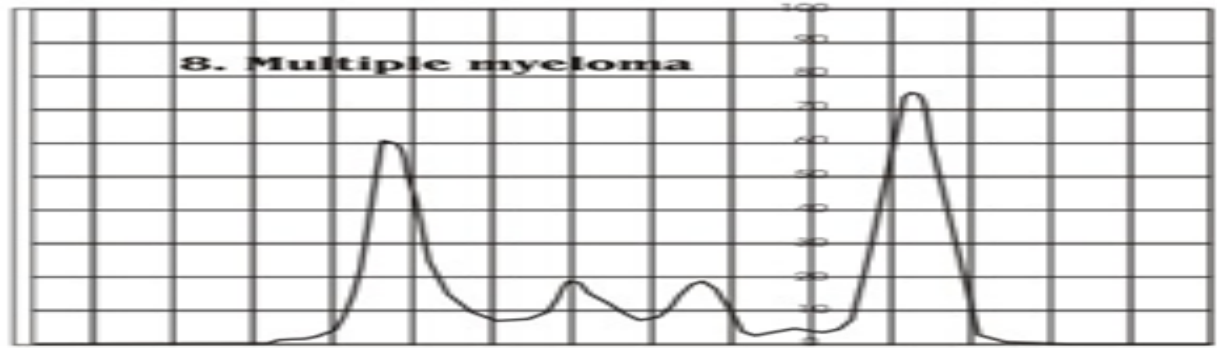

3. Destructive lesion


4.Hypogammaglobulinmeia


5. Nephrotic syndrome
α\β
α1
α2


6. Cirrhosis


7. Multiple myeloma


8. Multiple myeloma

Hyperproteinemia

are rare and are of no clinical significance value and may obtained from prolonged vein stasis during blood collection, posture (due to fluid redistribution) and from excessive dehydration.

Hypoalbuminemia:

It is clinically an important condition because albumin is one of the major components of osmotic colloid pressure of blood vessels and involved in normal fluid distribution between the Intravascular and Extra vascular compartments and in maintenance of normal blood pressure.

Albumin is also the major transporter substance in the blood; transporting bilirubin, fatty acids, steroid drugs, steroid & thyroid hormones,

Hypoalbuminemia

1. Chronic liver disease ; liver cirrhosis

2. Advanced kidney disease; Nephroteic syndrome &Chronic renal failure

3. Malnutrition (Kwashiorkor & Marasmus diseases) and Malabsorption like in Tropical intestinal diseases; Celiac disease

4. Loss through Enteropathy

5. skin lesions; extensive burns.

Clinical consequences Hypoalbuminemia :

1. edema due to migration of fluid from IV to interstitum compartment

2. transporting and binding capacity defects; such as for fatty acids, bilirubin, steroid Hs and drugs which may leads to toxicity with appropriate dose.

Analbuminemia is a rare disorder characterized by low blood albumin (s. albumin 10 gram/l; but of no edema or other symptoms and signs).

Globulin

This include 4-5 fractions (alpha 1, alpha 2, beta, and gamma fractions).

Increased in globulin may be due to increased in one or more of its fractions;α,β, and γ.

The α-1 and -2 include :

α1 -Antitrypsin,

haptoglobin,

ceruloplasmin,

C- reactive protein(CRP),

α2- macroglobulin.... etc.

α1-Antitrypsin(AAT)

- Protease inhibitor that binds to, and inactivates macrophage enzymes like trypsin, limit their actions during infection, and protects the body.
- **Deficiency** is associated with

– Pulmonary emphysema.

– Liver Cirrhosis (direct hyperbilirubinemia; Jaundice is one of tests used in investigation of prolonged neonatal)

•α1 -Fetoprotein(AFP)

– Principal fetal protein, used in screening for fetal abnormalities (neural tube defects) and in adult for liver
carcinoma investigation.

α2 -Macroglobulin

- Largest non-immunoglobulin in blood ~750 KD
- Protease inhibitor
- Increased in Nephrotic syndrome (largest in size)

(α -globulin) Ceruloplasmin (Cp)

- Copper transporting protein
- Participates in plasma redox reactions like Fe+2 Fe+3.
- serum CP measurement is used in investigation of Wilson's disease (Liver cirrhosis-Copper storage disease) in

which serum Cp level is decreased due to genetic defect in incorporation of Cu with apoceruloplasmin in the liver,

leading to precipitation of toxic Cu ion and damage of liver .

(α2) Haptoglobin

- Binds to, and preserves hemoglobin and its content of iron during hemolysis.
- Hemolytic diseases can deplete haptoglobin levels (α2) .

(β) Transferrin

- Iron transporting protein
- Transferrin is increased in iron deficiency anemia.

Apotransferrin + Fe+3=Transferrin

B2 -Microglobulin BMG

- Smallest blood protein (MW=11.8K)

- BMG is filtered through the glomerulus, but is reabsorbed by

renal tubules.

- Urinary BMG levels are a sensitive measure of renal tubular function

γ -Region

- Includes Immunoglobulin's (IgG, IgM, IgA, IgD & IgE).

They are involved in specific immune system.

- CRP is the most sensitive indicator of Acute Phase Reaction (non specific early immune defense system)

– Serum CRP (high sensitive -CRP) increased in Inflammation, trauma, infection, etc.

Protein in urine

normally less than 100 mg/day of proteins appears in urine,

in kidney disease this value increased according to degree of kidney damage which

reflect mainly the glomerular damage.

Normally glomerulus is permeable to

proteins of MW < 60 KD (D Dalton unit of

MW.

In kidney damage(mainly of glomerulus) excess amounts of proteins of large MW>60 KD will pass in the urine and may reach 5-50 gr/day.

Presence of low MW of proteins, like BMG in the urine

indicates the renal tubules damage as these tubules normally catabolize and reabsorbed the low MW proteins. In tubules damage these proteins will escape from the damaged tubules and appear in the urine(Low MW).